DATE DUE			

MASSACHUSETTS STATE

Agricultural Experiment Station.

AT AMHERST, MASS.

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Supt. of Horticultural Experiments, Microscopist and Draughtsman.

MASSACHUSETTS STATE

AGRICULTURAL EXPERIMENT STATION.

BULLETIN No. 1.

JULY, 1883.

The State Agricultural Experiment Station at the Massachusetts Agricultural College in Amherst, Mass., was established by an act of the Legislature approved on the 12th of May, 1882. The management of the Station is vested in a "Board of Control," which consists of the governor of the state, as president, ex-officio: two members elected by the state board of agriculture; two members from the board of trustees of the Massachusetts Agricultural College; one from the Massachusetts Society for promoting agriculture, and the president of the Massachusetts Agricultural College. (See Chap. 212, Laws and Resolves passed by the Legislature in 1882.) The members of the Board, at their first meeting in July, elected O. B. Hadwen secretary, and Theodore Lyman treasurer. No farther action was taken on account of the lateness of the season, until the following November when a director, a chemist and all necessary assistants, as provided by law, were appointed. The former entered upon his duties on the 15th of November, 1882, the latter on the 1st of January, 1883. By resolution of the Board its members are delegated to visit alternately every month the Station; and the director is instructed to report its condition and its wants at the bi-monthly meeting of the board.

The first report of the director was presented to the board at its annual business meeting at the office of the secretary of the State Board of Agriculture, January 30th, 1883. It contained principally a short outline of a series of experiments proposed for the consideration of the Board as the basis of the first year's work of the Station, besides a detailed statement concerning the chemical work carried on since its establishment. The essential contents of the report are published in the annual report of the secretary of the State Board of Agriculture for 1882. The college buildings selected by the Board for the use of the Station have been repaired under the special direction of Mr. Hadwen, and they are now ready for occupation. The barn and the stables for feeding experiments have been re-fitted under the immediate supervision of Prof. Miles, who has also directed the necessary underdraining of fields and buildings for experiments.

Prof. Maynard has carried out the desired enlargement of experiments in fruit culture and in the cultivation of new forage crops; he has also paid much attention to the investigation of suitable means for the destruction of injurious insects. Most of the experiments assigned to the Station for the present year are fairly under way, and the remainder will be attended to in due time.

At the May meeting of the Board it was voted to authorize the director to publish from time to time in form of bulletins, such results of the work carried on by the Station as in his judgment may prove of immediate benefit to the farmers of the state; and also to make known to them to what extent and in what direction the Station in its present condition can render them assistance in their every-day's agricultural pursuit. As the character of many experiments carried on in their earlier stage of progress renders a detailed discussion quite unprofitable, it seems but natural that the bulletins for sometime hence will contain mainly the results of chemical analyses of fertilizing material, fodder articles, and such other substances as are specified in the legislative Act above referred to. For the sake of completeness, concerning the record of the chemical work of the Station, the chemical analyses previously reported will be reprinted in a proper connection with later work of a similar character.

The bulletins of the Station will be hereafter issued every month as long as the material on hand renders that course advisable. They will be sent to the agricultural press and the various agricultural societies of the state, and also to all parties inside or outside of the latter who will furnish their address to the office of the Station. It is hoped that all who are connected with the publication of agricultural topics will send in return their publications to the latter.

Arrangements have been of late perfected which enable the chemical department of the institution to attend more satisfactorily to the examination of objects of general interest to the farming community. The requests for the analyses of substances coming through officers of agricultural societies or clubs within the state, will receive hereafter first and prompt attention; and in the order as the applications for an examination arrive at the office of the Station. The material for the analysis is to be sent on, transportation prepaid; the results will be returned without charge for the work carried out. Applications for analyses of substances sent on by private parties will receive careful consideration whenever the results promise to be of a more general interest, and as far as the existing special resources admit. The limited financial means of the Station necessitate, however, in the latter case a moderate charge for the services rendered, to cover expenses. For obvious reasons no work can be carried on at the Station of which the results are not at its disposal for publication if deemed advisable in the interest of the citizens of the state. By consent of the secretary of the State Board of Agriculture the analyses of commercial fertilizers collected by the state inspector will be published hereafter in the bulletins in advance of the annual report. All parcels and communications sent to the Experiment Station must have express and postal charges prepaid to receive attention.

July, 1883.

C. A. GOESSMANN,

DIRECTOR

FODDER ANALYSES.

1. WHEAT BRAN.

Collected of Chas. Parsons, Northampton, Mass.

	Percentage Composition.	Constituents in lbs. in a ton of 2000 lbs.	Pounds digestible in a ton of 2000 lbs.	Per cent. of digestibility of constituents.
Moisture at 100° C.,	13.70	271.		
Dry Matter,	86.30			
	100.00			
Analysis of Dry Matter.				
Crude Ash,	5.83	116.6		
" Cellulose,	8.05	161.	32.	20
" Fat,	2.51	50.2	40.2	80
" Protein, (nitrog's matter)	16.88	337.6	297.1	88
Non-nitrogenous extract matter,	53.03	1060.6	848.48	80
	86.30	2000.0	1217.78	

The above stated rate of digestibility of the various constituents of wheat bran was ascertained by feeding the dry material to steers.

A detailed discussion of the various constituents,—stated in the chemical analysis of any article of fodder,—may be found in the 27th Annual Report of the secretary of the Mass. State Board of Agriculture, pages 235—7.

2. RYE BRAN.

Collected of Charles Parsons, Northampton, Mass.

	Percentage Constituents.	Constituents (in lbs.) in a ton of 2000 lbs.	Pounds digestible in a ton of 2000 lbs.	Per cent. of digestibility of constituents.
Moisture at 100° C.,	13.70	274.		
Dry Matter,	86.30			
	100.00			
Analysis of Dry Matter.				
Crude Ash,	4.16	89.2		
" Cellulose,	3.92	78.4	7.06	9.
" Fat,	1.79	35.8	20.60	57.5
" Protein, (nitrog's matter)	16.38	327.6	216.20	66.
Non-nitrogenous extract matter,	59.75	1195.0	890.20	74.5
	86.30	2000.0	1134.06	

The above stated rate of digestibility of the various constituents was ascertained in feeding experiments with pigs.

3. CORN MEAL.

Collected of Charles Parsons, Northampton, Mass.

	Percentage Constituents.	Constituents (in lbs.) in a ton of 2000 lbs.	Pounds digestible in a ton of 2000 lbs.	Per cent. of digestibility of constituents.
Moisture at 100° C.,	17.04	340.8		
Dry Matter,	82.96			
	100.00			
Analysis of Dry Matter.				
Crude Ash,	1.31	26.2		
" Cellulose,	2.99	59.8	20.3	34
" Fat,	4.00	80.	60.8	76
" Protein, (nitrog's matter)	13.94	278.8	237.	85
Non-nitrogeneous extract matter	60.72	1214.4	141.54	94
	82.96	2000.0	1457.64	

ESSENTIAL MINERAL CONSTITUENTS IN 100 PARTS OF CORN MEAL.

Potassium Oxide,	0.419	per cent.
Calcium Oxide,	0.040	"
Magnesium Oxide,	0.176	"
Phosphoric Acid,	0.644	"

The above stated rate of digestibility was found in feeding experiments with pigs.

4. CORN MEAL AND COBS.

Collected of Charles Parsons, Northampton, Mass.

78.63 per cent. passed through mesh of 144 to the inch.

	Percentage constituents.	Constituents (in lbs.) in a ton of 2000 lbs.	Pounds digestible in a ton of 2000 lbs.	Per cent. of digestibility of constituents.
Moisture at 100° C.,	19.07	381.4	Not Determined.	Not Determined.
Dry Matter,	80.93			
	100.00			
Analysis of Dry Matter.				
Crude Ash,	1.30	26.		
" Cellulose,	7.91	158.2		
" Fat,	2.78	55.6		
" Protein, (nitrog's matter)	12.19	243.8		
Non-nitrogenous extract matter,	56.75	1135.		
	80.93	2000.0		

As the rate of digestibility of cobs has not yet been ascertained by actual feeding experiments no statements regarding the digestibility of the above material are given. There is but little doubt, however, that the addition of cobs to meal deserves recognition in regard to their nutritive value as well as to their beneficial mechanical influence upon the digestion of the corn meal. For analysis of corn cobs see report of the Mass. Board of Agriculture for 1879, pages 240—4.

5. HOMINY FEED.

(Chit and soft parts of the kernel of the corn.)

Collected of Mr. J. A. Sullivan, Northampton, Mass.

46.07 per cent. passed through mesh 144 to the inch.

	Percentage Composition.	Constituents (in lbs) in a ton of 2000 lbs.	Pounds digestible in a ton of 2000 lbs.
Moisture at 100° C.,	8.93	178.6	
Dry Matter,	91.07		
	100.00		
Analysis of Dry Matter.			
Crude Ash,	1.89	37.8	Not determined by experiment.
" Cellulose,	3.43	68.6	
" Fat,	4.45	89.	
" Protein, (nitrog's matter)	10.20	204.	
Non-nitrogenous extract matter,	71.10	1422.	
	91.07	2000.	

ESSENTIAL MINERAL CONSTITUENTS IN 100 PARTS HOMINY FEED.

Potassium Oxide,	0.19 per cent.
Calcium Oxide,	0.18 "
Magnesium Oxide,	0.28 "
Phosporic Acid,	0.98 "

The ratio of digestibility is probably similar to that of the corn meal.

6. GLUTEN MEAL.

Refuse from Glucose manufacture.

From Messrs. Sumner Crosby & Son, South Boston, Mass.

	Percentage Constituents.	Constituents (in lbs.) in a ton of 2000 lbs.	Pounds digestible in a ton of 2000 lbs.	Per cent. of digestibility of constituents.
Moisture at 100° C.,	8.43	168.6	Not Determined.	Not Determined.
Dry Matter,	91.57			
	100.00			
Analysis of Dry Matter.				
Crude Ash,	0.59	11.8		
" Cellulose,	3.25	65.		
" Fat,	8.01	160.2		
" Protein, (nitrog's matter)	35.00	700.		
Non-nitrogenous extract matter,	44.72	894.4		
	91.57	2000.0		

ESSENTIAL MINERAL CONSTITUENTS IN 100 PARTS OF GLUTEN MEAL.

Potassium Oxide,	0.0564
Calcium Oxide,	0.0582
Magnesium Oxide,	0.0346
Phosphoric Acid,	0.4512
Sulphuric Acid,	0.0215

The special test for Sulphuric Acid proved the absence of any objectionable amount of that substance. The rich nitrogenous character of the "Gluten meal" places it between the brans of our grains and the oil cakes, and alongside of leguminous seeds, as beans, peas, etc. Its peculiarity as compared with the above fodder articles consists in the low percentage of mineral constituents, a point which requires careful consideration in its application.

7. LINSEED CAKE.

From Indiana.

	Percentage Constituents.	Constituents (in lbs.) in a ton of 2000 lbs.	Pounds digestible in a ton of 2000 lbs.	Per cent of digestibility of constituents.
Moisture at 100° C.,	8.35	167.		
Dry Matter,	91.65			
	100.00			
Analysis of Dry Matter.				
Crude Ash,	6.89	137.8		
" Cellulose,	7.97	159.4	41.4	26
" Fat,	5.22	104.4	95.	91
" Protein, (nitrog's matter)	34.14	682.8	593.8	87
Non-nitrogenous extract matter,	37.43	748.6	681.	91
	91.65	2000.0	1411.2	

ESSENTIAL MINERAL CONSTITUENTS IN 100 PARTS LINSEED CAKE.

Potassium Oxide,	1.43 per cent.
Calcium Oxide,	0.64 "
Magnesium Oxide,	0.77 "
Phosphoric Acid,	1.86 "

The stated ratio of digestibility was ascertained by feeding experiments with steers.

8. COTTON SEED MEAL.

Collected of Charles Parsons, Northampton, Mass.

	Percentage Constituents.	Constituents (in lbs.) in a ton of 2000 lbs.	Pounds digestible in a ton of 2000 lbs.	Per cent. of digestibility of constituents
Moisture at 100° C.,	9.13	182.6		
Dry Matter,	90.87			
	100.00			
Analysis of Dry Matter,				
Crude Ash,	6.92	138.4		
" Cellulose,	5.71	114.2	26.27	23
" Fat,	11.66	233.2	212.20	91
" Protein, (nitrog's matter)	42.75	855.0	632.70	74
Non-nitrogenous extract matter.	23.83	476.6	231.24	46
	90.87	2000.0	1102.41	

The above adopted ratio of digestibility is based on experiments with sheep.

9. COTTON SEED MEAL.

Sent on by E. S. Warner, Hatfield, Mass.

	Percentage Constituents.	Constituents (in lbs.) in a ton of 2000 lbs.	Pounds digestible in a ton of 2000 lbs.	Per cent. of digestibility of constituents.
Moisture at 100° C.,	7.09	141.80		
Dry Matter,	92.91			
	100.00			
Analysis of Dry Matter.				
Crude Ash,	8.50	170.00		
" Cellulose,	9.78	195.60	44.99	23
" Fat (ether abstract)	12.64	252.80	230.05	91
" Protein, (nitrog's matter)	38.69	773.80	572.61	74
Non-nitrogenous extract matter.	23.30	466.00	214.36	46
	92.91	2000.00	1062.01	

This article is of good quality, and was obtained by bolting a coarse cotton seed meal; eighty-one pounds of the above kind was obtained from one hundred pounds of the latter; the coarse portion—nineteen per cent.—has been analyzed to ascertain its fitness as a fertilizer, with the following results:

10. COARSE PORTION OF COTTON SEED MEAL FOR FERTILIZING PURPOSES.

Sent on by E. S. Warner, Hatfield, Mass.

Moisture at 100° C.,	7.09	per cent.
Organic and volatile matter,	93.465	"
Ash Constituents,	6.535	"
	100.000	
Nitrogen in organic compounds,	5.900	per cent.
Potassium Oxide,	1.797	"
Calcium Oxide,	0.263	"
Magnesium Oxide,	0.223	"
Phosphoric Acid,	2.341	"
Insoluble Matter,	1.784	"

VALUATION PER TON OF 2000 POUNDS.

118 lbs. of Nitrogen at 18 c.,	$21.24
46.82 " Phosphoric Acid at 6 c.,	2.69
35.94 " Potassium Oxide, at $4\frac{1}{4}$ c.,	1.53
	$25.46

MASSACHUSETTS STATE

AGRICULTURAL EXPERIMENT STATION.

BULLETIN No. 2.

AUGUST, 1883.

FERTILIZER ANALYSES.

The valuation of COMMERCIAL FERTILIZERS is based on the market value of their essential constituents. The market reports of New York and Boston,—aside from consultations with leading manufacturers of fertilizers, furnish the necessary information. The subsequent statements of trade values adopted in the bulletins are obtained by taking the average New York and Boston wholesale quotations of the six months preceding March 1st, 1883, and increasing them by 20 per cent. to cover expenses for storage, sales, etc. The prices stated in connection with analyses of commercial fertilizers refer therefore to their cost, per ton of 2000 lbs., on board of car or boat.

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. The general physical condition of these substances enters as an important factor in their valuation. 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 thus more or less rapid diffusion of the different articles of plant food throughout the soil.

Trade Values for 1883.

	Cost per lb.
Nitrogen in nitrates, - - - -	20 cts.
" ammonia salts, - - -	26 "
" Peruvian guanos, fine steamed bone, dried and fine ground blood, meat, fish, superphosphates and special manures, - - - -	23 "
Phosphoric acid soluble in water, - -	11 "
" " reverted and in Peruvian guano,	8 "
" " insoluble, in fine bone, fish-guano and superphosphates,	6 "
Potash in high grade sulphate, - - -	7 "
" low grade sulphate and kianite, -	$4\frac{1}{4}$ "
" muriate or potassium chloride, - -	$4\frac{1}{4}$ "

CANADA WOOD ASHES. (11—17).

11. Sent on from Sunderland, Mass.

12. Sent on from Sunderland, Mass.

13. Sent on from North Amherst, Mass.

14. Collected at the R. R. depot in Amherst, by State Inspector.

15. Sent on from North Amherst, Mass.

16. Collected of D. A. Horton, Northampton, Mass., by State Inspector.

17. White Ash, sent on from South Deerfield, Mass.

	11	*12*	*13*	*14*	*15*	*16*	*17*
	Pounds per Hundred.						
Moisture at 100° C.	24.50	16.66	18.70	9.30	8.40	16.70	6.62
Calcium Oxide,	33 13	32.25	30 60	34.91	39.71	35.26	50.89
Potassium Oxide,	4.77	4.97	4.61	6.50	4.96	5.55	5.23
Phosphoric Acid,	1.49	1 66	1.10	.78	.89	2.28	1.29
Insoluble Matter,	8.50	10.45	11.06	9.30	6 70	4.90	4.87

Samples 1, 2, 3, 4, 5, 6, represent the average quality of Canada wood ashes sold in our section of the Connecticut river valley, at from 33 to 35 cents per bushel. Sample 7 was of an exceptional light color and contained a larger per cent. of lime, yet compared well otherwise, in composition with the others.

The increasing importation of Canada ashes into various parts of the state, renders it advisable to insist hereafter upon guaranteed analyses, as the basis of commercial transactions.

The universal high opinion of wood ashes as a fertilizer does not depend merely on a fair percentage of potash, but also on the presence of more or less of *all the various mineral elements essential to the growth of plants.*

Wood ashes, like barnyard manure, on account of their compound character, meet to some extent at least, not only known, but unknown deficiencies in valuable soil constituents. The thorough mixture of their various constituents has no doubt a beneficial influence on their action.

18. TOBACCO STEMS.

Sent on by E. S. Warner, Hatfield, Mass.

Moisture at 100° C.	8.95	per cent.
Dry Matter,	91.05	"
Nitrogen in dry matter,	13.91	"

One hundred part of crude ash contained.

Potassium Oxide,	6.21	per cent.
Sodium Oxide,	0.68	"
Calcium Oxide,	4.76	"
Magnesium Oxide,	1.14	"
Phosphoric Acid,	0.87	"
Silica, Sulphuric Acid, etc., not determined.		

VALUATION PER TON OF 2000 POUNDS.

53.80 lbs.	of Nitrogen at 18c.	$9.68
124.20 "	Potassium Oxide at $4\frac{1}{4}$c.	5.28
17.40 "	Phosphoric Acid at 6c.	1 01
		$16.00

The ash of the tobacco plant, like that of other industrial crops, usually varies less in regard to absolute quantity, than to the relative proportion of its essential elementary constituents. Potash is known to vary as high as fifty per cent. in consequence of modes of cultivation and variety of soil, independent of the variety of plant.

As it is claimed by good authority, that an increase or a decrease of the potash in the ash of tobacco stands in a definite relation to certain qualities of the latter, it is proposed to discuss this question more in detail hereafter in the annual report.

19. EEL-GRASS.

Sent on by the South Bristol Farmers' Club, New Bedford, Mass.

I. Was tested soon after collection, and II. after six months exposure to atmospheric influences.

	I.		II.	
Moisture (as sent on),	45.61	per cent.	25.17	per cent.
Ash constituents,	20.39	"	10.81	"
Nitrogen in organic matter,	.70	"	.96	"
Potassium oxide in ash,	1.61	"	.21	"
Sodium " "	2.51	"	.74	"
Calcium " "	1.56	"	2.70	"
Magnesium " "	.08	"	.12	"
Phosphoric acid "	.41	"	.22	"
Insoluble matter "	.46	"	1.66	"

The composition of the seaweeds in their natural condition is somewhat modified by adhesive sea-shells, sea-water, etc.; no two samples would strictly agree in composition without a previous careful cleaning of the plants. Time and exposure modify organic and inorganic constituents; the alkalies and some of the earthy matters are liable to be washed out in part at least by rain; starchy materials, etc., are decomposed apparently at a higher rate than some of the nitrogenous organic matter.—The entire amount of potash, phosphoric acid and nitrogen contained in the organic vegetable matter is finally available.

Assuming for coarse vegetable organic matter a similar rate of disintegration;—and allowing the same rates of valuation as in Nos. 10 and 18, one ton of I. would be worth \$4.38, and one ton of II. \$3.90.

20. RED LEATHER SHAVINGS.

Sent on from Marlboro', Mass.

Moisture at 100° C.	40.59	per cent.
Nitrogen in Organic matter,	5.12	"
Ash Constituents,	0.27	"

The fertilizing value of this material is practically unknown. The same may be said of another leather refuse, known as "Chemically Prepared Leather Refuse," referred to in some of my previous reports. The latter consists usually of a coarse powder of a more or less dark brown color. Eight to ten samples, which have thus far been tested at the station, show a variation of from 5.0 to 8.8 per cent. of nitrogen. Its use as a constituent of commercial complete fertilizer, without stating the fact on the package,—is quite properly considered an imposition on the consumer.

Whilst it is desirable that all suitable refuse materials from our various industries should be tried by interested parties regarding their manurial value, it is not less important that the incorporation of any kind of material of an unknown rate of disintegration into compound commercial fertilizers ought to be discouraged.

The best interests of the farmers as well as of the trade in commercial fertilizers are most efficiently promoted by that course of action. To meet the varying *periodical* wants of the growing plants necessitates at all times a liberal supply of available plant food of all kinds. To comply *economically* with that essential requirement, for the successful cultivation of any crop renders it necessary to have at least some approximately correct information regarding the behaviour of the various constituents of fertilizers, when brought under the influence of soil and atmosphere. A disregard of this point on the part of a manufacturer, when compounding his articles for the general market, involves not only serious disappointments to the farmers, who chance to use them, but must ultimately ruin his trade.

PEAT. (21—23).

21. Sent on from Harwich, Barnstable Co., Mass.

22. Sent on from Hudson, Worcester Co., Mass.

23. Sent on from Holyoke, Hampden Co., Mass.

	21	22	23
	POUNDS PER HUNDRED.		
Moisture at 100° C.	78.26	33.61	54.28
Dry Matter,	21.74	66.39	45.72
Ash constituents in dry matter,	1.31	4.54	33.72
Nitrogen in wet peat,	.41	1.40	.43
Nitrogen in perfectly dry peat,	1.89	2.11	.94

The difference in the composition of samples 21 and 22, is mainly due to their different state of moisture. Both are fair specimens of their kind. The low percentage of nitrogen in sample 23 is caused by an exceptional large admixture of soil. Wherever the entire deposit shows a similar amount of earthy admixture, a direct cultivation, after draining, suggests itself as worth trying.

FISH. (24—30).

24. Dry Fish, sent on by Franklin Farmers' Club.
Guaranteed composition ; not stated.

25. Dry Fish, sent on by Milo L. Smith, Smith's Ferry, Mass.
Guaranteed composition ; not stated.

26. Dry Fish, of Quinnipiac Fertilizer Co. Collected of E. T. Sabin, East Amherst, Mass., by State Inspector.
Guaranteed composition ; total phosphoric acid, 6 to 8 per cent. ; soluble and reverted phosphoric acid 2 to 4 per cent. ; nitrogen 7 to 9 per cent.

27. Dry Fish of Geo. W. Miles' Co., Milford, Ct. Collected of P. F. Bridges, South Deerfield, Mass., by State Inspector.
Guaranteed composition ; Nitrogen 7 to 10 per cent.

28. Half dry Dog Fish Pomace, sent on from Portsmouth, R. I.

29. Fish Pomace of Geo. W. Miles' Co., Milford, Ct. Collected of P. F. Bridges, So. Deerfield, Mass., by State Inspector.

30. Fish Pomace, collected of H. L. Phelps, Northampton, Mass., by State Inspector.

	24	25	26	27	28	29	30
	POUNDS PER HUNDRED.						
Moisture at 100° C.	6.61	7.50	9.45	7.63	11.35	38.11	44.41
Total phosphoric acid,	6.17	7.67	8.39	6.48	5.85	7.49	5.85
Soluble "	2.40	2.32	2.75	2.16	.66	.82	1.57
Reverted "					2.20	2.87	0.62
Insoluble "	3.77	5.35	5.64	4.32	2.99	3.79	3.62
Nitrogen,	8.47	9.36	8.85	8.65	6.96	5 43	5.27
Valuation per 2000 lbs.,	$47.32	$53.18	$51.88	$48.43	$40.58	$35.92	$33.02

31. CASTOR POMACE.

Collected of D. A. Horton, Northampton, Mass., by State Inspector.

Moisture at 100° C.	10.18	per cent.
Total phosphoric acid,	2.13	"
Nitrogen (18 cts per lb.),	5.69	"
Potassium Oxide,	.92	"
Valuation per 2000 lbs.,	$23.84	"

COMPLETE MANURES.

32. Bowker's Hill and Drill Phosphate. Collected of C. F. Brown, Northampton, Mass., by State Inspector.

Guaranteed composition; total phosphoric acid 10 to 12 per cent.: soluble and reverted phosphoric acid (available) 8 to 10 per cent.; Ammonia 2.5 to 3.5 per cent. (equivalent to Nitrogen 2.0 to 2.8); potassium oxide 2 to 3 per cent. (in form of sulphate).

33. Quinnipiac Phosphate. Collected of E. T. Sabin, East Amherst, Mass., by State Inspector.

Guaranteed composition; soluble and reverted phosphoric acid (available) 8 to 10 per cent.; insoluble phosphoric acid, 1 to 3 per cent.; nitrogen, 2.5 to 3.5 per cent.; potassium oxide, 2 to 3 per cent.

34. X L Superphosphate, Bradley Fertilizer Co. Collected of W. S. Westcott, Amherst, Mass., by State Inspector.

Guaranteed composition; total phosphoric acid, 9 to 11 per cent.; soluble phosphoric acid, 7 to 8 per cent.; reverted phosphoric acid 2 to 3 per cent.; insoluble phosphoric acid, 2 to 3 per cent.; nitrogen, 2.5 to 3 per cent.; potassium oxide, 2 to 3 per cent.

35. L. L. Crocker's Complete Manure. Collected of Fuller & Newton, Springfield, Mass., by State Inspector.

Guaranteed composition; soluble phosphoric acid, 6 to 8 per cent.; reverted phosphoric acid, 2 to 4 per cent.; insoluble phosphoric acid, 1 to 2 per cent.; Ammonia, 2.5 to 3.4 per cent. (nitrogen, 2.06 to 2.89); potassium oxide, 6 to 8 per cent.

	32	33	34	35
	POUNDS PER HUNDRED.			
Moisture at 100° C.,	15.50	22.05	14.08	16.19
Total phosphoric acid,	10.47	12.99	10.45	10.94
Soluble "	8.26	4.86	8.42	6.78
Reverted "	1.00	5 82	0.63	1.53
Insoluble "	1.21	2 31	1.40	2.63
Nitrogen	2.42	2.76	2.87	2.49
Potassium oxide,	1.85	2.80	1.82	4.65
Valuation per 2000 lbs.,	$34 94	$~~37.43~~ 37.85	$35.95	$35.94

C. A. GOESSMANN, *Director*,

AMHERST, MASS.

MASSACHUSETTS STATE

AGRICULTURAL EXPERIMENT STATION.

BULLETIN No. 3.

SEPTEMBER, 1883.

FODDER ANALYSES.

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36. HAY OF BLACK GRASS. (No. One).

Sent on by the Secretary of the Rowley Farmer's Club, Rowley, Essex Co., Mass., in April, 1883.

	Percentage Composition.	Constituents (in lbs.) in a ton of 2000 lbs.	Pounds digestible in a ton of 2000 lbs.	Per cent. of digestibility of constituents.	Nutritive Ratio.
Moisture at 100° C.,	10.22	204 4	Not ascertained by actual feeding experiment.		
Dry Matter,	89.78	1795.6			
	100.00	2000.			
ANALYSIS OF DRY MATTER.					
Crude Ash,	8.63	172.6			
" Cellulose,	24.78	495.6			
" Fat,	1.52	30.4			
" Protein, (nitrogenous matter),	9.39	187.8			
Non-nitrogenous extract matter,	55.68	1113.6			
	100.	2000.			

The grass was cut before blooming on the 24th of June, 1882; it would have matured, according to the letter of the Secretary, by the 10th of July. The hay had been housed as soon as cured.

37. HAY OF BLACK GRASS. (No. Two).

Sent on by the Rowley Farmer's Club, in April, 1883.

	Percentage Composition.	Constituents (in lbs.) in a ton of 2000 lbs.	Pounds digestible in a ton of 2000 lbs.	Per cent. of digestibility of constituents	Nutritive Ration.
Moisture at 100° C.,	13.15	263.0	Not ascertained by actual feeding experiment.		
Dry Matter,	86.85	1737.0			
	100.00	2000.			
ANALYSIS OF DRY MATTER.					
Crude Ash,	6.50	130.0			
" Cellulose,	23.66	573.2			
" Fat,	1.20	24.0			
" Protein, (nitrogenous matter),	7.15	143.0			
Non-nitrogenous extract matter,	61.49	1139.8			
	100.	2000.			

The grass which served for the production of hay No. two was cut when it began to look red, approaching maturity,—on the 24th of July, 1882. The hay had been housed as soon as cured.

38. HAY OF HIGH MARSH GRASS. (No. Three).

Sent on by the Rowley Farmer's Club, in April, 1883.

	Percentage Composition.	Constituents (in lbs.) in a ton of 2000 lbs.	Pounds digestible in a ton of 2000 lbs.	Per cent. of digestibility of constituents	Nutritive Ration.
Moisture at 100° C.,	11.05	221.			
Dry Matter,	88.95	1779.0			
	100.00	2000.			
ANALYSIS OF DRY MATTER.					
Crude Ash,	6.18	123.6			
" Cellulose,	24.81	496.2			
" Fat,	0.98	19.6			
" Protein (nitrogenous matter),	6.14	122.8			
Non-nitrogenous extract matter,	61.89	1237.8			
	~~2000.~~ 100.	2000.			

The grass was cut in July, 1882, and the hay had been stored away in the barn as soon as cured. No statement was made with reference to the particular stage of growth of the grass at the time of cutting.

Three more samples of hay obtained from "Low Marsh Grass," under different circumstances, by members of the Rowley Farmer's Club, are still under investigation. The results of this work, accompanied by a short discussion of several questions, which suggests themselves quite naturally in an investigation like the above, will be published as soon as possible in a subsequent bulletin.

39. NEBRASKA RED CORN.

Sent on from Franklin Co., Mass.

	Percentage Composition.	Constituents (in lbs.) in a ton of 2000 lbs.	Pounds digestible in a ton of 2000 lbs.	Per cent of digestibility of constituents.	Nutritive Ratio.
Moisture at 100° C.,	10.74	214.8			
Dry Matter,	89.26	1785.2			
	100.00	2000.			
ANALYSIS OF DRY MATTER.					
Crude Ash,	1.29	25.8			
" Cellulose,	3.00	60.	20.4	34	1:6.91
" Fat,	5.40	108.	82.08	76	
" Protein (nitrogenous matter),	12.64	252.8	214.88	85	
Non-nitrogenous extract matter,	66.93	1338.6	1258.28	95	
	89.26	2000.0	1575.64		

The detailed results of a chemical examination, regarding the nutritive value, of various prominent varieties of corn raised in Massachusetts, as compared with western and southern corn, may be found in the annual report of the Secretary of the Mass. State Board of Agriculture, for 1879. A comparison of the above stated analytical results, with those referred to,—show a high nutritive value for the red variety. Whether this result is mainly due to a high state of fertilization of the soil, which served for its production, or to an inherent superiority of this variety of corn, further observation only can decide.

FERTILIZER ANALYSES.

40. Ammonium Sulphate. Collected of Geo. P. Smith, Sunderland, Mass., by State Inspector.

Guaranteed composition: ammonia 24 to 25 per cent., (equivalent to nitrogen 19.75 to 20.5 per cent.).

Moisture at 100° C.,	0.23 per cent.
Ammonia (equivalent to nitrogen, 20.4).	24.80 "
Sulphuric acid,	61.60 "
Insoluble matter,	0.05 "
Valuation per 2000 lbs.,	$106.08

41. Nitrate of Soda. Collected of D. A. Horton, Northampton, Mass., by State Inspector.

Moisture at 100° C.,	1.25 per cent.
Nitrogen,	15.57 "
Insoluble matter,	.45 "
Valuation per 2000 lbs.,	$62.28

42. Raw Wool. Fleece from Argentine Republic, sent on for examination from Clinton, Mass.

Moisture at 100° C.,	6.95 per cent.
Organic and Volatile Matter,	92.46 "
Ash constituents,	7.54 "
Fatty matter (ether abstract),	3.92 "
Nitrogen,	12.88 "
Insoluble matter,	3.63 "

One hundred parts of wool washings contained:—

	I. *With Acidulated Water.*	II. *With Hot Water.*
Potassium oxide,	4.20 per cent.	3.92 per cent.
Sodium oxide,	.40 "	.49 "
Calcium oxide,	.61 "	.28 "
Magnesium oxide,	.20 "	None
Ferric oxide,	.13 "	"
Phosphoric acid,	traces "	"

The above stated analytical results of "Raw Wool" do not apply to "wool-waste" from factories; for the latter material is as a rule more or less mixed with foreign substances as sweepings, etc. The nitrogen of wool-waste has varied in my own experience from 6.25 per cent. as the highest, to 3.76 per cent. the lowest result.

The amount of fertilizing material (potash, phosphoric acid and nitrogen) removed from 100 pounds of *raw wool* in consequence of washing, has been found in a series of tests to be worth at present rates of valuation from 46 to 47 cents.

13. Nova Scotia Plaster (Gypsum). Collected of D. A. Horton, Northampton, Mass., by State Inspector.

Moisture at 100° C.,	15.79 per cent.
Calcium oxide,	34.29 "
Magnesium oxide,	0.36 "
Sulphuric acid,	47.14 "
Insoluble matter,	1.42 "
Carbonic acid,	Not determined.

This gypsum contained a few per cent of calcium and magnesium carbonates, which not unfrequently are associated with it.

POTASH COMPOUNDS. (14—17).

14. Muriate of Potash, of Quinnipiac Fertilizer Co., New London, Ct. Collected of E. T. Sabin, East Amherst, Mass., by State Inspector.

15. Muriate of Potash. Collected of G. P. Smith, Sunderland, Mass., by State Inspector.

16. Muriate of Potash, of Bowker Fertilizer Co., Boston, Mass. Collected by State Inspector.

	44	45	46
	POUNDS PER HUNDRED.		
Moisture at 100° C.,	2.89	2.85	2.89
Potassium oxide,	50.05	50.59	50.40
Sodium oxide,	8.30	8.40	8.30
Magnesium oxide,	0.60	trace	0.60
Sulphuric acid,	0.28	trace	0.28
Insoluble matter,	0.15	1.50	0.15
Valuation per 2000 lbs.,	$42.54	$43.00	$42.84

This form of the "German Potash Salts" has thus far proved a very reliable source of potassa for general agricultural purposes; an extensive application has caused of late some advance of its cost, as compared with previous years.

47. Potash Magnesia Sulphate, of Bowker Fertilizer Co. Collected by State Inspector.

Moisture at 100° C.,	4.90	per cent.
Calcium oxide,	1.15	"
Magnesium oxide,	11.30	"
Potassium oxide,	24.94	"
Sodium oxide,	2.09	"
Sulphuric acid,	46.99	"
Insoluble matter,	0.54	"
Valuation per 2000 lbs.,		$34.92

The above compound belongs to a series of salines which some ten years ago, under the name of "German Potash Salts" or "Stassfurt Salines," were introduced into our agricultural industry for manurial purposes. Its peculiarity consists in the combination of a large amount of potassium sulphate, from 46 to 47 per cent., with a remarkable quantity of magnesium sulphate, from 33 to 34 per cent.

The magnesium sulphate stands foremost among substances noted for their quality to counteract the well known great retentive power of most soils for potassa. This circumstance renders the Potash-Magnesia sulphate a very valuable material for the cultivation of deep rooting plants, in case of an exhaustion of potassa in the subsoil.

The Potash-Magnesia Sulphate, as well as the "Douglass Muriate of Potash," occupy a peculiar position among our recently introduced potash resources for manurial purposes. The former has proved the preferable compound where the presence of large quantities of chlorides is known to affect seriously the quality of the vegetable growth, as in the case of tobacco, etc.; whilst the latter recommends itself, on account of from 70 to 75 per cent. of muriate of potash, in presence of from 15 to 20 per cent. of sulphate of magnesia, for deep-rooting forage plants.

A detailed discussion of the character and special fitness of the various brands of German Potash Salts for agricultural purposes, can be found in the annual report of the Secretary of the Mass. State Board of Agriculture for 1874.

BONES. (48—52).

48. Fine Ground Raw Bones, sent on from Worcester, Mass.

49. Holyoke Bone Saw Dust, of Holyoke Manufacturing Co. Collected of D. A. Horton, Northampton, Mass., by State Inspector.

50. Darling's Fine Bones. Collected of Parker & Gannet, Boston, Mass., by State Inspector.

51. Ground Fine Bones, of Bowker Fertilizer Co., Boston, Mass.

52. Bradley's Fine Ground Bones. Collected of Breck & Son, Boston, Mass., by State Inspector.

	48	*49*	*50*	*51*	*52*
	POUNDS PER HUNDRED.				
Moisture at 100° C.,	4.63	9.50	7.10	6.53	7.17
Total phosphoric acid,	22.41	24.96	25.45	23.82	23.28
Nitrogen,	3.69	3.97	2.90	3.83	3.95
Valuation per 2000 lbs.,	$43.86	$48.21	$43.88	$46.20	$46.11

The majority of these samples are fair representatives of refuse bones from rendering establishments. They were well ground, porous and friable, and thus in a favorable condition for speedy action. Sample 49 being the waste material from another industry, consisted of a uniform finely ground mass, yet was compact, gritty and hard. A previous composting or an earlier application will here materially assist to secure an economical return from the investment.

FISH. (53—55).

53. Dry Ground Fish, sent on from South Hadley Falls, Mass.
Guaranteed composition not stated.

54. Bowker's Dry Fish. Collected of C. T. Brown, Northampton, Mass., by State Inspector.

Guaranteed composition; ammonia 10 to 12 per cent. (equivalent to nitrogen 8.25 to 9.9 per cent.).

55. Chittenden's Dry Ground Fish, of National Fertilizer Co., Bridgeport, Ct. Collected of J. A. Sullivan, Northampton, Mass., by State Inspector.

Guaranteed composition; total phosphoric acid 6 to 8 per cent.; ammonia 8 to 10 per cent. (equivalent to nitrogen 6.5 to 8.25 per cent.

	53	54	55
	POUNDS PER HUNDRED.		
Moisture at 100° C.,	10.38	9.02	10.78
Total phosphoric acid.	6.00	8.07	6.58
Soluble phosphoric acid, Reverted, "	2.82	3.68	3.00
Insoluble phosphoric acid,	3.18	4.39	3.58
Nitrogen,	6.13	8.32	7.20
Valuation per 2000 lbs.,	$36.53	$49.43	$42.22

FISH AND POTASH. (56—28).

56. Chittenden's Fish and Potash, of National Fertilizer Co., Bridgeport, Ct. Collected of J. A. Sullivan, Northampton, Mass., by State Inspector.

Guaranteed composition; total phosphoric acid 6 to 8 per cent.; potassium oxide 4 to 6 per cent.; ammonia 3 to 5 per cent. (equivalent to nitrogen 2.5 to 4 per cent.).

57. Fish and Potash, of Geo. W. Miles' Co., Milford, Ct. Collected of P. F. Bridges, So. Deerfield, Mass., by State Inspector.

Guaranteed composition; soluble and reverted phosphoric acid (available) 5 to 8 per cent.; potassium oxide 4 to 6 per cent.; ammonia 4 to 6 per cent. (equivalent to nitrogen 3.25 to 5 per cent.

58. Fish and Potash. No. One, of Quinnipiac Fertilizer Co., New London, Ct. Collected of E. T. Sabin, East Amherst, Mass.

Guaranteed composition; total phosphoic acid 5 to 7 per cent.; soluble and reverted phosphoric acid (available) 3 to 5 per cent.; insoluble phosphoric acid 2; potassium oxide 3 to 5 per cent.; nitrogen 3.25 to 4.25 per cent.

	56	57	58
	POUNDS PER HUNDRED.		
Moisture at 100° C.,	10.60	13.78	19.67
Total phosphoric acid,	6.04	7.57	7.90
Soluble "	0.32	3.44	.50
Reverted "	2.45	1.50	5.50
Insoluble "	3.27	2.63	1.90
Potassium oxide,	4.34	4.59	4.30
Nitrogen,	2.76	3.63	3.73
Valuation per 2000 lbs.,	$24.93	$33.73	$33.00

AMMONIATED SUPERPHOSPHATES AND COMPLETE MANURES. (59—70).

59. Sparrow's Bone and Potash Phosphate, of Judson & Sparrow. Collected of Everett & Gleason, Boston, Mass. By State Inspector.

Guaranteed composition; soluble phosphoric acid 9 to 11 per cent.; potassium oxide 4 to 5 per cent.; ammonia 3 to 4 per cent. (equivalent to nitrogen 2.5 to 3.3 per cent.).

60. Mitchell's Standard Phosphate. Collected of J. & J. A. Rice, Worcester, Mass., by State Inspector.

Guaranteed composition; total phosphoric acid 12.42 per cent.; soluble phosphoric acid 9.85 per cent.; insoluble phosphoric acid 2.57 per cent.; potassium oxide 2.16 per cent.; nitrogen 2.61 per cent.

61. Standard Superphosphate, of Standard Fertilizer Co., Boston, Mass. Collected of Wm. H. Earle, Worcester, Mass., by State Inspector.

Guaranteed composition; total phosphoric acid 13 to 15 per cent.; soluble and reverted phosphoric acid (available) 9 to 13 per cent.; insoluble phosphoric acid 2 to 4 per cent.; potassium oxide 2 to 4 per cent.; magnesium oxide 1.5 to 2 per cent.; ammonia 2 to 4 per cent. (equivalent to nitrogen 1.6 to 3.3 per cent.

62. Bay State Ammoniated Bone Superphosphate. Collected of J. S. Clark & Son, Worcester, Mass., by State Inspector.

Guaranteed composition; soluble and reverted phosphoric acid (available) 9 to 10 per cent.; insoluble phosphoric acid 2 to 3 per cent.; ammonia 3.5 to 4 per cent. (equivalent to nitrogen 2.9 to 3.3 per cent.

	59	*60*	*61*	*62*
	POUNDS PER HUNDRED.			
Moisture at 100° C.,	14.75	16.10	19.38	26.78
Total phosphoric acid,	12.06	11.56	12.14	10.10
Soluble "	11.60	6.10	7.29	7.33
Reverted "	.22	.94	2.09	1.25
Insoluble "	.24	4.52	2.76	1.52
Magnesium oxide,	3.89	4.24	1.51	
Potassium oxide,			1.50	
Nitrogen,	3.39	2.23	1.81	3.30
Valuation per 2000 lbs.,	$45.06	$34.20	$32.30	$35.13

63. Complete Manure. Potatoes and Vegetables, of H. L. Phelps, Northampton, Mass. Collected by State Inspector.

Guaranteed composition; soluble and reverted phosphoric acid (available) 5 to 6 per cent.; potassium oxide (sulphate) 5 to 7 per cent.; ammonia (in form of organic matter and ammonia salts) 4 to 5 per cent. (equivalent to nitrogen 3.3 to 4.1 per cent.

64. Darling's Lawn-Dresser. Collected of Parker & Gannet, Boston, Mass., by State Inspector.

Guaranteed composition; total phosphoric acid 10 to 13 per cent.; potassium oxide 5 to 6 per cent.; ammonia 5 to 6 per cent. (equivalent to nitrogen 4.1 to 4.9 per cent.).

65. Bowker's Lawndressing. Collected of C. T. Brown, Northampton, Mass., by State Inspector.

Guaranteed composition; total phosphoric acid 6 to 8 per cent.; soluble and reverted phosphoric acid (available) 5 to 6 per cent.; potassium oxide 4 to 5 per cent.; nitrogen 4 to 5 per cent.

66. Bradley's X L Ammoniated Bone Superphosphate. Collected of Parker & Gannet, Boston, Mass., by State Inspector.

Guaranteed composition; soluble phosphoric acid 7 to 8 per cent.; reverted phosphoric acid 2 to 3 per cent.; insoluble phosphoric acid 2 to 3 per cent.; potassium oxide 2 to 3 per cent.; nitrogen 2.5 to 3.25 per cent.

	63	64	65	66
	POUNDS PER HUNDRED.			
Moisture at 100° C.	12.08	9.43	10.83	15 80
Total phosphoric acid.	8.20	10.83	7.86	12.31
Soluble "	4.80	0.58	5.09	8.37
Reverted "	2.25	2.40	0.64	1.03
Insoluble, "	1.15	7.85	2.13	2.91
Potassium Oxide,	4.62	6.14	3 71	2.64
Nitrogen (in form of organic matter),	1 87	4.47	5.06	3.10
Nitrogen (in form of ammonia salts),	1.82			
Valuation per 2000 lbs.,	$40.07	$40.32	$41.21	$40.05

67. Dole's Common Sense Fertilizer. No. Three. Collected of J. A. Sullivan, Northampton, Mass., by State Inspector.

Guaranteed composition; total phosphoric acid 4 to 6 per cent.; potassium oxide 3 to 5 per cent.; nitrogen 3 to 6 per cent.

68. Bosworth Bros'. Superphosphate of Lime. Collected of Wilson & Holden, Worcester, Mass., by State Inspector.

Guaranteed composition; soluble phosphoric acid 7 to 8 per cent.; reverted phosphoric acid 4 to 5 per cent.; insoluble phosphoric acid 2 to 5 per cent.; potassium oxide 2 to 3 per cent.; nitrogen 2 to 2.5 per cent.

69. Russell Coe's Ammoniated Bone Superphosphate. Collected of Wm. H. Earle, Worcester, Mass., by State Inspector.

Guaranteed composition; total phosphoric acid 12 to 15 per cent.; soluble and reverted phosphoric acid (available) 10 to 12 per cent.; potassium oxide 2.5 to 4 per cent.; nitrogen 1.75 to 2.5 per cent.

70. Sparrow's Grass Fertilizer of Judson & Sparrow. Collected of Everett & Gleason, Boston, Mass., by State Inspector.

Guaranteed composition; soluble and reverted phosphoric (available) 8 to 9 per cent.; potassium oxide 4 to 5 per cent.; ammonia 5 to 6 per cent. (equivalent to nitrogen 4.1 to 4.9 per cent.

	67	68	69	70
	POUNDS PER HUNDRED.			
Moisture at 100° C., ...	14.20	8.26	16.52	10.40
Total phosphoric acid, ...	5.98	16.60	8.44	9.60
Soluble "	.57	3.60	4.22	7.45
Reverted "	2.35	5.10	1.13	1.09
Insoluble "	3.06	7.90	3.09	1.06
Potassium oxide, ...	3.33	2.06	1.40	4.28
Nitrogen, ...	1.49	2.13	2.95	4.73
Valuation per 2000 lbs., ...	$18.36	$36.21	$29.56	$44.80

C. A. GOESSMANN, *Director*,

AMHERST, MASS.

J. E. Williams, Printer, Amherst, Mass.

MASSACHUSETTS STATE

AGRICULTURAL EXPERIMENT STATION.

BULLETIN No. 4.

OCTOBER, 1883.

FODDER ANALYSES.

71. HAY OF LOW MARSH GRASS. (No. four).

Sent on by the Secretary of the Rowley Farmers' Club, Rowley, Essex Co., Mass., in April, 1883.

	Percentage Composition.	Constituents (in lbs.) in a ton of 2000 lbs.	Pounds digestible in a ton of 2000 lbs.	Per cent. of digestibility of constituents.	Nutritive Ratio.
Moisture at 100° C.,	10.97	219.40	Not ascertained by actual feeding experiment.		
Dry Matter,	89.03	1780.60			
	100.00	2000.00			
ANALYSIS OF DRY MATTER.					
Crude Ash,	8.19	163.80			
" Cellulose.	28.82	576.40			
" Fat,	2.22	44.40			
" Protein, (nitrogenous matter),	6.79	135.80			
Non-nitrogenous extract matter,	53.98	1079.60			
	100.00	2000.00			

The grass was cut in August, 1882, and stacked as soon as cured.

72. HAY OF LOW MARSH GRASS. (No. five).

Sent on by the Rowley Farmers' Club, in April, 1883.

	Percentage Composition.	Constituents (in lbs.) in a ton of 2000 lbs.	Pounds digestible in a ton of 2000 lbs.	Per cent. of digestibility of constituents.	Nutritive Ration.
Moisture at 100° C.,	10.25	205.00	Not ascertained by actual feeding experiment.		
Dry Matter,	89.75	1795 00			
	100.00	2000.00			
ANALYSIS OF DRY MATTER.					
Crude Ash,	5.42	108.40			
" Cellulose,	26.00	520.00			
" Fat,	2.63	52.60			
" Protein, (nitrogenous matter),	7.19	143.80			
Non-nitrogenous extract matter,	58.76	1175.20			
	100.00	2000.00			

The grass was cut in the middle of August, and housed as soon as cured.

73. HAY OF LOW MARSH GRASS. (No. six).

Sent on by the Secretary of the Rowley Farmers' Club, in April, 1883.

	Percentage Composition.	Constituents (in lbs.) in a ton of 2000 lbs.	Pounds digestible in a ton of 2000 lbs.	Per cent of digestibility of constituents.	Nutritive Ratio.
Moisture at 100° C.,	13.30	266.00	Not ascertained by actual feeding experiment.		
Dry Matter,	86 70	1734.00			
	100.00	2000.00			
ANALYSIS OF DRY MATTER.					
Crude Ash,	6.05	121.00			
" Cellulose,	27.19	543.80			
" Fat,	2.90	58.00			
" Protein (nitrogenous matter),	7.17	143.40			
Non-nitrogenous extract matter,	56.69	1133.80			
	100.00	2000.00			

The grass was cut the 9th of September, and stacked when cured. It was injured somewhat by rain, and by the sea water.

Analyses of Dry Matter of the hays sent on by the Rowley Farmers's Club, and of an average quality of a good inland meadow hay.	Hay of Black Grass. No. one.	Hay of Black Grass. No two.	Hay of High Marsh Grass. No. three.	Hay of Low Marsh Grass. No. four.	Hay of Low Marsh Grass. No. five.	Hay of Low Marsh Grass. No. six.	Hay of genuine Grasses in full blossom. (H. Weiske)
Crude Ash.	8.63	6.50	6.18	8.19	5.42	6.05	8.55
" Cellulose, ...	24.78	23.66	24.81	28.82	26.00	27.19	27.61
" Fat, ...	1.52	1.20	0.98	2.22	2.63	2.90	5.02
" Protein (nitr'ous matter),	9.39	7.15	6.14	6.79	7.19	7.17	12.69
Non-nitrogenous extract matter,	55.68	61.49	61.89	53.98	58.76	56.69	46.13
	100.00	100.00	100.00	100.00	100.00	100.00	100.00

The various samples of marsh or "salt hay," which served for the above analyses, were supplied by different members of the club; they arrived in good condition, and had evidently been collected with care. The individual plants were however in a condition, which did not allow a satisfactory determination of their botanical names, and of the relative proportion of the various kinds of plants present, nor of their particular stage of growth. The communications received from the secretary of the club has to furnish for this reason the basis for a few subsequent remarks. A small collection of the upper portion of marsh meadow plants, neatly fastened upon suitable paper, accompanied the hay samples. To each specimen of this collection was attached its local name with some general remarks as follows:—

"No. 1. Sedge grass, grows on low spots.

No. 2. Branch grass.

No. 3. Goose grass, stalks with seeds.

No. 4. Fox or Redgrass, the most common Salt Grass.

No. 5. Marsh Mallows, called by some Rosemary. These varieties of plants are generally found more or less mixed in all Salt Marshes. On marshes, that have been ditched, a grass called Whitetop,—by some called Redtop, comes in and grows together with the above stated Fox Grass. This Whitetop is nearly as early as "Black Grass," which is one of our earliest grasses, and the only one, which grows distinct by itself."

As grass-like "Rushes" and "Sedges" exert a controling influence on the local character, and thus the comparative feeding value of the hay obtained from different places, it has to be conceded, that the absence of a more detailed information regarding the particular character and condition of the vegetation, etc., which served for the production of the above described hay samples, imparts to our analytical results, in the majority of cases, (from 3 to 6), a mere local interest. A comparison of the various samples seems to confirm the prevailing impression, that the Black Grass (Juncus bulbosus) furnishes a valuable fodder; and that carefully secured marsh hay, in many instances, as far as composition is concerned, compares favorably with a large proportion of hay from "inland meadows." There is scarcely another fodder crop on record of which the feeding value depends so much on a judicious management of the farmer, as in the case of hay.

The fact that our opinion regarding the actual and relative feeding value of many of our fodder crops is still largely based on mere chance analyses, instead of on a systematic inquiry regarding our chances of securing the best results, is one of the principal impediments of arriving at a more settled opinion regarding a rational management of feeding our farm live stock.

A chemical examination regarding the feeding value of any of our fodder plants, begins obviously with a determination of the amount of dry vegetable matter it contains; and completes the task by ascertaining the exact quantity of each of the four groups of nutritive compounds of which it is composed. The dry vegetable matter of most of our fodder crops changes comparatively quite rapidly during succeeding stages of growth, in regard to quantity and to quality. The first requirement for an intelligent examination concerning the comparative value of a fodder plant or part of plant, consists in securing specimens of a corresponding stage of growth. Adding to this a due consideration of the various circumstances under which the plants under examination are raised,—results are attainable, which may claim a general interest. I take the liberty of suggesting in this connection,—to communicate rather with the officer in charge of the Station before sending material of a similar character, and of asking an investigation of a subject of similar importance. The best interest of the farmers and of the Station will be served by adopting that course.

FERTILIZER ANALYSES.

CANADA WOOD ASHES. (74—79).

74. Light colored unleached ashes, sent on by Secretary of So. Deerfield Farmer's Club. One bushel weighed 44 lbs., and ½ lb. of coarse material was removed before taking the sample for analysis

75. Dark unleached ashes, sent on by Secretary of So. Deerfield Farmer's Club. One bushel weighed 46 lbs., and 2½ lbs. of coarse material were removed before taking the sample for analysis.

76. Dark unleached ashes, sent on by Secretary of So. Deerfield Farmer's Club. One bushel weighed 41 lbs., and 5 lbs. of coarse material were removed before taking the sample.

77. Collected on board of cars at the R. R. Depot, So. Deerfield, Mass., by State Inspector.

78. Collected on board of cars at the R. R. Depot, So. Deerfield, Mass., by State Inspector.

79. Collected of Mr. Almon Cowles, on board of cars at No. Amherst, Mass., by State Inspector.

	74	75	76	77	78	79
	POUNDS PER HUNDRED.					
Moisture at 100° C.	0.70	16.98	10.28	8.33	1.93	10.01
Calcium Oxide,	50.51	36 11	32.83	45.00	50.02	35.67
Potassium Oxide,	7.38	4.90	6.10	5.91	6.94	7.19
Phosphoric Acid,	0.51	1.41	1.59	.74	.29	1.28
Insoluble Matter,	2.10	8.05	13.65	3.88	2.28	6.27

80. Crude Kieserit, (Crude Sulphate of Magnesia), of Bowker Fertilizer Co., Boston, Mass.

Moisture at 100° C.,	31.90
Calcium Oxide,	2.60
Magnesium Oxide,	13.50
Sulphuric acid,	29.10
Insoluble matter,	5.00
Magnesium in form of chloride,	0.60
Magnesium in form of sulphate,	38.70

Valuation for 2000 lbs. from $8.00 to $10.00

The "Kieserit" occurs among the salines of the saltmines at Stassfurt in Germany, which of late have acquired a particular importance as leading resources of potash compounds for agricultural purposes. Although it forms distinct layers of considerable thickness, it is quite frequently found more or less saturated with a solution of magnesium chloride, when removed from the mines. Well established experimental observations regarding the injurious influence of the latter compound on the healthy growth of roots, renders its presence objectionable, and consequently its removal as far as practicable, desirable whenever Kieserit shall be used for agricultural purposes. The removal of any objectionable percentage of magnesium chloride is usually accomplished by subjecting the crude material to a moderate calcination; the moisture present decomposes at a high temperature largely the magnesium chloride into hydrochloric acid, which escapes, and into magnesium oxide, which remains behind. We find for this reason the calcined and the uncalcined Kieserit in our markets. The former contains for obvious reasons a larger per cent. of magnesia, than the latter; yet is usually less soluble in water. Both kinds ought to be well ground to render a proper distribution possible. The Kieserit, on account of a greater solubility in water, exceeds in efficiency the sulphate of lime or gypsum as an absorber of ammonia in manure cellars, in stables and upon the compost heap. Its well known beneficial influence on a speedy diffusion of potash compounds throughout a deeper layer of soil, as well as its reputed favorable action on leaf and stem growth are of sufficient importance to encourage experiments on the part of farmers engaged in the raising of industrial crops and in particular of gardeners and of fruit growers, to test its influence. The prominence of the magnesia—among the mineral constituents of many of our grain crops and fruits—leaves scarcely a doubt about its importance in the vegetable economy of many of our cultivated plants.

81. "Orchilla" Guano. Collected of D. A. Horton, Northampton, Mass., by State Inspector.

Moisture at 100° C.,	11.05
Magnesium oxide,	4.13
Calcium oxide,	38.24
Phosphoric acid,	21.69
Insoluble matter,	0.17

The "Orchilla Guano" belongs to a class of natural phosphates, which are noted for their deficiency in organic and nitrogenous matter, as well as for their large percentage of carbonate of lime. The above described samples contained 47.39 per cent. bone phosphate and 22.39 per cent. of carbonate of lime. The presence of so large a percentage of the latter compound renders this material—from an economical standpoint—unsuitable for the manufacturers of superphosphate of lime. The natural pulverent condition of the commercial article has favored its introduction into agricultural practice. Very satisfactory results are reported from its application in case of moist pastures and meadows, and of turfy soils. Upon a dry soil and in a dry season its action can be but slow. The safest way to secure an economical return seems to be a direct introduction in the daily produce of stable manure, on account of the beneficial reaction of the fermenting animal excretions on the disintegration of the guano and thus an increased solubility of its bone phosphate. Four cents per pound of phosphoric acid at present rates of valuation might be considered a safe investment; at that rate of valuation the above article would be worth $18.00 per ton of 2000 lbs.

FISH AND POTASH. (82—86).

82. C. Island Fish Guano, of Geo. W. Miles' Co., Milford, Conn. Collected of D. F. Wright, Northampton, by State Inspector.

Guaranteed composition; bone phosphate 10 to 14 per cent., (equivalent to phosphoric acid 4.58 to 6.41 per cent.); ammonia 6 to 8 per cent., (equivalent to nitrogen 4.94 to 6.71 per cent.).

83. Chittenden's Fish and Potash, (No. 2), of National Fertilizer Co., Bridgeport, Conn. Collected of Wilder & Puffer, Springfield, Mass., by State Inspector.

Guaranteed composition; total phosphoric acid 6 to 8 per cent.: potassium oxide 4 to 6 per cent.; ammonia 2 to 4 per cent., (equivalent to nitrogen 1.65 to 3.30 per cent.).

84. Williams, Clark & Co.'s Fish and Potash. Collected of Slate & DeWolf, Greenfield, Mass., by State Inspector.

Guaranteed composition: total phosphoric acid 3 to 4 per cent.; potassium oxide 3 to 4 per cent.; ammonia 4 to 5 per cent., (equivalent to nitrogen 3.30 to 4.13 per cent.).

85. Bowker's Fish and Potash. Collected of Fuller & Newton, Springfield, Mass., by State Inspector.

Guaranteed composition; total phosphoric acid 8 to 10 per cent.; potassium oxide 4 to 6 per cent.; nitrogen $2\frac{1}{4}$ to $3\frac{1}{4}$ per cent.

86. Bradley's Fish and Potash. Collected of Sheldon & Newcomb, Greenfield, Mass., by State Inspector.

Guaranteed compostion; potassium oxide 4 to 5 per cent.: ammonia 4 to 5 per cent., (equivalent to nitrogen 3.30 to 4.13 per cent.

	82	*83*	*84*	*85*	*86*
	POUNDS PER HUNDRED.				
Moisture at 100° C.,	18.96	12 43	10.98	11.90	16.92
Total phosphoric acid,	7.98	6.84	6.08	11.92	4.41
Soluble "	2.18	0.13	0.00	3.32	.96
Reverted "	3.54	2.19	2 75	2.90	1.45
Insoluble "	2.26	4.52	3.33	5.70	2.00
Potassium oxide,	2.36	4.72	3.06	3.86	4.92
Nitrogen,	3.87	1.90	3.22	3.02	3.69
Valuation per 2000 lbs.,	$32.98	$21.96	$25.81	$35.95	$~~27~~.98

27.

BONES.

87. Fine Ground Bones, of C. A. Bellknap & Son, Portland, Me. Collected of J. & J. A. Rice. Worcester, Mass., by State Inspector.

Moisture at 100° C.,	7.66
Total phosphoric acid,	19.37
Soluble " "	00.00
Reverted " "	7.01
Insoluble " "	12.36
Nitrogen,	2.96
Valuation per 2000 lbs.,	$39.67

88. Crushed Raw Bones of Edw. A. Smith. Collected of J. & J. A. Rice, Worcester, Mass., by State Inspector.

Moisture at 100° C.,	8.28
Total phosphoric acid,	22.82
Nitrogen,	3.69

This material was coarse, and according to the dealers statement designed to serve as crude stock for the treatment with sulphuric acid. The composition of this article is very satisfactory—yet as its mechanical condition is unfavorable for speedy action—without a previous treatment with the acid, it cannot claim the customary valuation of fine ground bone. Allowing 4½ cents per pound of phosphoric acid, and from 13 to 14 cents per pound of nitrogen would bring the valuation within market quotations.

AMMONIATED SUPERPHOSPHATES AND COMPLETE MANURES. (89—100).

89. Stearns Ammoniated Bone Superphosphate, of Stearns & Co., New York. Collected of Wilson & Holden, Worcester, Mass., by State Inspector.

Guaranteed composition; soluble and reverted phosphoric acid (available) 8 to 10 per cent.; potassium oxide 2 to 3 per cent.; ammonia 3 to 4 per cent., (equivalent to nitrogen 2.47 to 3.30 per cent.).

90. Bradley's Sea Fowl. Collected of Parker & Gannet, Springfield, Mass., by State Inspector.

Guaranteed composition; soluble and reverted phosphoric acid (available) 8 to 10 per cent.; insoluble phosphoric acid 2 to 3 per cent.; potassium oxide 2 to 3 per cent.; Ammonia 3 to 4 per cent., (equivalent to nitrogen 2.47 to 3.30 per cent.).

91. Williams, Clark & Co.'s "Americus" Ammoniated Bone Superphosphate. Collected of Wilson & Holden, Worcester, Mass., by State Inspector.

Guaranteed composition; soluble phosphoric acid 6 to 8 per cent.; reverted phosphoric acid 3 to 4 per cent.; insoluble phosphoric acid 1 to 3 per cent.; potassium oxide 1 to 2 per cent.; ammonia 2 to 3 per cent., (equivalent to nitrogen 1.65 to 2.47 per cent.

92. Standard Superphosphate, of Standard Fertilizer Co., Boston, Mass. Collected of Whittemore Bros., Boston, Mass., by State Inspector.

Guaranteed composition; soluble and reverted phosphoric acid (available) 9 to 13 per cent.; insoluble phosphoric acid 2 to 4 per cent.; magnesium oxide $1\frac{1}{2}$ to 2 per cent.; potassium oxide 2 to 4 per cent; ammonia 2 to 4 per cent., (equivalent to nitrogen 1.65 to 3.30 per cent.

	89	*90*	*91*	*92*
	POUNDS PER HUNDRED.			
Moisture at 100° C.,	14.48	12.82	16.75	18.35
Total phosphoric acid,	10.30	11.24	11.29	10.22
Soluble "	3.04	8.44	6.68	7.13
Reverted "	6.12	0.66	1.05	.98
Insoluble "	1.14	2.14	3.56	2.11
Potassium oxide,	2.15	2.35	2.12	1.30
Nitrogen	1.99	3.84	2.38	2.20
Magnesium oxide,				1.30
Valuation per 2000 lbs.,	\$28.83	\$41.86	\$33.40	\$31.02

93. Stockbridge Manures. Potato. Collected of Fuller & Newton, Springfield, Mass., by State Inspector.

Guaranteed composition; total phosphoric acid, 8 to 10 per cent.; soluble and reverted phosphoric acid (available) 7 to 8 per cent.; potassium oxide (in form of sulphate) 5 to 6 per cent.; nitrogen $3\frac{1}{4}$ to $4\frac{1}{4}$ per cent.

94. Long Island Ammoniated Superphosphate with Potash, of Atlantic & Virginia Fertilizer Co. Collected of Fuller & Newton, Springfield, Mass., by State Inspector.

Guaranteed composition; soluble and reverted phosphoric acid, (available) 8 to 11 per cent.; insoluble phosphoric acid 2 to 3 per cent.; potassium oxide 5 to 7 per cent.; ammonia 1 to $2\frac{1}{2}$ per cent., (equivalent to nitrogen 0.83 to 2.06 per cent.

95. L. L. Crocker's Potato and Hop Phosphate. Collected of Slate & DeWolf, Greenfield, Mass., by State Inspector.

Guaranteed composition; soluble phosphoric acid 6 to 8 per cent.; reverted phosphoric acid 2 to 4 per cent.; insoluble phosphoric acid, 1 to 2 per cent.; potassium oxide 6 to 8 per cent.; ammonia $2\frac{1}{2}$ to $3\frac{1}{2}$ per cent., (equivalent to nitrogen 2.06 to 2.89 per cent.

96. H. J. Baker & Bros., Potato Fertilizer. Collected of Fuller & Newton, Springfield, Mass., by State Inspector.

Guaranteed composition; soluble and reverted phosphoric acid (available) $5\frac{1}{4}$ per cent.; potassium oxide 10 per cent.; ammonia 4 per cent., (equivalent to nitrogen 3.30 per cent.

	93	94	95	96
	POUNDS PER HUNDRED			
Moisture at 100° C.,	14 15	20.15	17 15	13.65
Total phosphoric acid,	8.62	12.63	10.46	7 31
Soluble "	5.63	6.01	6.39	4.23
Reverted "	.55	1.82	.20	1.61
Insoluble "	2.44	4.80	3.87	1 47
Potassium oxide,	4 26	4.70	4 52	9.68
Nitrogen, (in organic matter),	4.09	1.95	2 65	1.67
Nitrogen, (in ammonia salts),				2 30
Valuation per 2000 lbs ,	$40.97	$34.86	$35.05	$41.52

97. Bradley's Sea Fowl. Collected of Sheldon & Newcomb, Greenfield, Mass., by State Inspector.

Guaranteed composition; soluble phosphoric acid 7 to 8 per cent.; reverted phosphoric acid 2 to 3 per cent.; insoluble phosphoric acid 2 to 3 per cent.; nitrogen $2\frac{1}{2}$ to $3\frac{1}{4}$ per cent.; potassium oxide 2 to 3 per cent.

98. L. L. Crocker's Bone Superphosphate. Collected of C. W. Sears, Worcester, Mass., by State Inspector.

Guaranteed composition; soluble and reverted phosphoric acid (available) 8 to 12 per cent.; insoluble phosphoric acid 1 to 2 per cent.; potassium oxide 1 to 3 per cent.; ammonia $3\frac{1}{2}$ to $4\frac{1}{2}$ per cent., (equivalent to nitrogen 2.9 to 3.74 per cent.

99. Darling's Animal Fertilizer. Collected of Parker & Gannet, Boston, Mass., by State Inspector.

Guaranteed composition; total phosphoric acid 10 to 12 per cent.: potassium oxide 5 to 6 per cent.; nitrogen 4 to 6 per cent.

100. L. L. Crocker's Ammoniated Bone Superphosphate. Collected of Fuller & Newton, Springfield, Mass., by State Inspector.

Guaranteed composition; soluble phosphoric acid 6 to 8 per cent.; reverted phosphoric acid 3 to 4 per cent.; insoluble phosphoric acid 1 to 2 per cent.; potassium oxide 1 to 3 per cent.; ammonia $3\frac{1}{2}$ to $4\frac{1}{2}$ per cent., (equivalent to nitrogen 2.88 to 3.71 per cent.

	97	*98*	*99*	*100*
	POUNDS PER HUNDRED.			
Moisture at 100° C.	12.37	17.10	12.44	12 00
Total phosphoric acid,	11.87	9.95	12.94	12.90
Soluble "	7.77	7.26	.13	5.67
Reverted "	1 87	1.67	4.70	2.61
Insoluble, "	2.23	1.02	8.11	4.62
Potassium Oxide,	3.22	4.00	3.03	1 20
Nitrogen,	2 79	2.13	3.59	3.24
Valuation per 2000 lbs.,	$38.33	$33.06	$36.63	$38.11

C. A. GOESSMANN, *Director*,

AMHERST, MASS.

J. E. Williams, Printer, Amherst, Mass.

MASSACHUSETTS STATE

AGRICULTURAL EXPERIMENT STATION.

BULLETIN No. 5.

NOVEMBER, 1883.

FODDER ANALYSES.

101. HAY OF WINTER RYE.

Sent on by the Secretary of the Mass. State Board of Agriculture, John E. Russell.

	Percentage Composition.	Constituents (in lbs.) in a ton of 2000 lbs.	Pounds digestible in a ton of 2000 lbs.	Per cent. of digestibility of constituents.	Nutritive Ratio.
Moisture at 100° C.,	8.55	171.00			
Dry Matter,	91.45	1829.00			
	100.00	2000.00			
ANALYSIS OF DRY MATTER.					1 : 8.28
Crude Ash,	6.40	128.00			
" Cellulose,	32.97	659.40			
" Fat,	2.57	51.40	23.65	46.00	
" Protein, (nitrogenous matter),	10.66	213.20	121.52	57.00	
Non-nitrogenous extract matter,	47.40	948.00	948.00	100.00	
	100.00	2000.00	1093.17		

The sample was cut May 25, 1883, when in full blossom; it is of a fair quality and compares well with a medium good quality of meadow hay. The rate of digestibility stated in connection with the non-nitrogenous extract matter of the hay includes that of the crude cellulose or raw fibre. Green Winter Rye in blossom may contain from 20 to 26 per cent. of vegetable matter, and from 80 to 74 per cent. of water.

102. HAY OF OATS.

From one of the experimental plots of the Station.

	Percentage Composition.	Constituents (in lbs.) in a ton of 2000 lbs.	Pounds digestible in a ton of 2000 lbs.	Per cent. of digestibility of constituents.	Nutritive Ration.
Moisture at 100° C.,	6.43	128.60			
Dry Matter,	93.57	1871.40			
	100.00	2000.00			
ANALYSIS OF DRY MATTER.					1 : 14.24
Crude Ash,	6.41	128.20			
" Cellulose,	34.06	681.20			
" Fat,	2.92	58.40	26.86	46.00	
" Protein, (nitrogenous matter),	6.58	131.60	75.01	57.00	
Non-nitrogenous extract matter,	50.03	1000.60	1000.60	100 00	
	100.00	2000.00	1102.47		

The sample was collected, when in full blossom; its composition can scarcely be called a fair one. The dry vegetable matter of oats in blossom may vary from 15 to 20 per cent. of the weight of the green plant.

Actual field experiments have shown, that the condition and the quality of the soil, aside of season and of climate, exert a decided influence not only on the quantity, but also on the quality of the crops raised upon it. This fact deserves particular attention in the cultivation of forage crops. Oats raised during the same season upon the same kind of soil, with the aid of manures and without them, has been noticed to contain, in the latter case as low as five and in the former as high as eleven per cent. of nitrogenous constituents in its dry vegetable matter. The existence of similar relations between the particular condition of the soil and the composition of the crops has been proved in regard to most of our prominent grasses, and leguminous plants as clover, as well as of mixed forage crops like meadow hay. A high percentage of nitrogenous constituents in these crops is usually accompanied by a high percentage of phosphoric acid compounds. As both are known to exert a decidedly beneficial influence on the absolute and relative nutritive value of a single article of fodder, may it be an entire plant or a particular part of it, it needs scarcely any farther argument to prove that an economical system of feeding our farm stock ought to begin with an intelligent cultivation of our leading fodder crops. We ought to raise them with a view to promote the special development of their most valuable nutritive constituents; and to select the crops for cultivation with reference to the particular adaptation of soil, climate and location *to favor the production of the best of its kind.* The introduction of a greater variety of fodder crops cannot fail to assist materially in gaining the desirable end. To raise good potatoes for family use, or good sugar-beets for the sugar manufacturer, requires a different condition of the soil as far as the character of its accumulated plant food is concerned, than to raise both crops of a superior quality for feeding purposes. A mealy potato is usually rich in starch and comparatively speaking deficient in nitrogenous matter; and sugar-beets best adapted for the manufacture of sugar are rich in sugar and contain a low percentage of nitrogenous constituents; they yield to the manufacturer the largest amount of sugar at the lowest expense. The garden-farmer and the manufacturer of sugar judge the quality of their respective crops by a standard quite different from that of the farmer, who, engaged in general farming, considers stock feeding an important part of his industry.

To compound an economical and suitable diet for any class of farm animals requires not only a general knowledge of the composition of the fodder on hand, but also a fair acquaintance with the relative proportion of the three groups of essential nutritive constituents they are apt to contain under different conditions of the soil. This kind of information is as essential for the guidance of the experimenter, as the knowledge of the special wants of the animal with reference to its organization, age, and functions. The wide range of variations in composition which has been noticed in our leading fodder crops when raised upon rich or exhausted lands, renders many of our current tabular statements of the chemical composition of the more prominent articles of fodder of *doubtful merit in the hands of the farmer, who considers them an unfailing guide in his special case.* The majority of these fodder tables may be traced to one source (E. Wolff); they state the mean of a smaller or larger number of analyses, quite frequently made without any intention to ascertain the possible variations in the composition of the article under investigation. The analytical statements themselves refer in the majority of cases to plants raised in Germany and in other European countries. Whilst the great value of these tables from an agricultural educational standpoint must be conceded; their analytical statements require a qualification before they may be safely relied on in home practice. The annual report of the Secretary of the Mass. State Board of Agriculture for 1882, pages 104 to 114, contain a tabular statement of the composition of many fodder crops, giving the extremes (highest and lowest percentages found) with reference to each group of the nutritive constituents. This mode of stating the composition of the various farm crops, tends to direct the attention more decidedly towards the advantages arising from a proper cultivation of fodder crops. The experiment station has entered upon a systematic course of investigation to assist in determining the influence of stage of growth and of cultivation on the feeding value of some of our prominent forage plants.

103. COTTON SEED MEAL. (1)

Sent on by J. E. Soper & Co., of Boston.

Eighty-six per cent. passed through mesh of 144 to the square inch.

	Percentage Composition.	Constituents (in lbs.) in a ton of 2000 lbs.	Pounds digestible in a ton of 2000 lbs.	Per cent of digestibility of constituents.	Nutritive Ratio.
Moisture at 100° C.,	7.10				
Dry Matter,	92.90				
	100.00				
ANALYSIS OF DRY MATTER.					1:1.44
Crude Ash,	9.34	186.80			
" Cellulose,	7.53	150.60	34.63	23.00	
" Fat,	13.75	275.00	250.25	91.00	
" Protein (nitrogenous matter),	42.58	851.60	630.18	74.00	
Non-nitrogenous extract matter,	26.80	536.00	246.56	46.00	
	100.00	2000.00	1161.62		

The composition of the above article does not materially differ from that of previously reported analyses; the variations are within the limits noticed in fair samples of cotton seed meal, its mechanical condition was of a superior character. The meal was produced, according to the statement of the dealer by a new process, "Roller-process," and sifted.

104. GLUTEN MEAL.

(Refuse from Glucose Manufacture.)

Sent on by Newton & Fuller, Springfield, Mass.

Eighty-three per cent. passed through mesh 144 to the square inch.

	Percentage Composition.	Constituents (in lbs.) in a ton of 2000 lbs.	Pounds digestible in a ton of 2000 lbs.	Per cent. of digestibility of constituents.	Nutritive Ratio.
Moisture at 100° C.,	10.23	204.60	Not determined by actual experiment.		
Dry Matter.	89.77	1795.40			
	100.00	2000.00			
ANALYSIS OF DRY MATTER.					
Crude Ash,	.65	13.00			
" Cellulose,	1.20	24.00			
" Fat,	5.06	101.20			
" Protein, (nitrogenous matter),	33.56	671.20			
Non-nitrogenous extract matter,	59.53	1190.60			
	100.00	2000.00			

The article was of a good mechanical condition. A comparison of the analysis No 6, in Bulletin No. 1, shows that the above sample contained 3 per cent. of fat and 5 per cent. of nitrogenous matter less than that of No. 6, whilst its soluble non-nitrogenous matter exceeds that of the latter about 10 per cent. No free sulphuric acid was noticed. The discussion of this new article of fodder in connection with analysis No. 6, applies here. Considerable interest has of late been manifested regarding its use for milk production. This analysis as well as the previous one of cotton seed meal, No. 103, was made at the special request of the editor of the *New England Homestead*.

105. EXAMINATIONS OF SKIM MILK FOR FAT.

Samples sent on at different times for examination.

Sample Nos.	*1*	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*
Amt. of Fat in 100 parts.	.26	.31	.38	.30	38	.37	.35	.48	.54	.48

FERTILIZER ANALYSES.

TURF.

106. Sent on by Horace Graves, Amherst, Mass.

I. Turf from upper layer, consisting largely of leaves, roots and mosses; brown, colored and fibrous.

II. Turf from lower layer, consisting of a brown peat-like mass; taken from four feet below the surface and exposed to the air one year.

	I.		II.	
Moisture at 100° C.,	25.58	per cent.	13.00	per cent.
Organic and Volatile Matter,	96.72	"	90.57	"
Ash constituents,	3.28	"	9.43	"
Nitrogen (in wet peat),	1.91	"	1.97	"

The upper layer may be used advantageously as bedding and as an absorber of liquid manure; the lower layer ought to be composted with lime or ashes before it is incorporated in the soil; both samples are of a good quality.

107. Ash of Bogs. Sent on by J. B. Wheeler, Bolton, Mass.

Moisture at 100° C.,	5.05	per cent.
Calcium oxide,	3.09	"
Magnesium oxide,	1.13	"
Potassium Oxide,	.16	"
Phosphoric acid,	.93	"
Insoluble matter,	70.92	"

The ashes were obtained from the burning of the surface growth of a swamp meadow lately in part underdrained. Bogs, hassocks and a few inches thickness of the turf, furnished the ash. The dried-up condition of the vegetable matter explains the presence of but a small quantity of potash. The ash may prove beneficial upon adjoining grass-lands.

108. Ashes from Detroit. Sent on by John Lane, Esq., of East Bridgewater, Mass.

Moisture at 100° C.,	6.39	per cent.
Calcium oxide,	34.15	"
Potassium oxide,	1.00	"
Phosphoric acid,	2.05	"
Magnesium oxide,	3.72	"
Insoluble matter,	22.10	"

The ash had evidently been leached before it entered the market.

109. Green Mountain Odorless Fertilizer, of Geo. W. Maynard, Lawrence, Mass. Sent on from Salem, Mass.

Moisture at 100° C.,	19.40	per cent.
Sulphuric acid,	2.61	"
Chlorine,	7.69	"
Calcium oxide,	33.39	"
Potassium oxide,	·44	"
Phosphoric acid,	1.37	"
Ferric oxide,	1.03	"
Sodium oxide,	7.55	"
Insoluble matter,	5.15	"

FISH AND POTASH. (110–112).

110. Fish and Potash [s], of George W. Miles' Co., Milford, Ct. Collected of D. J. Wright, Northampton, Mass., by State Inspector.

Guaranteed composition ; soluble and reverted phosphoric acid (available), 5 to 8 per cent. ; potassium oxide, 4 to 6 per cent. ; ammonia, 4 to 6 per cent. (equivalent to 3.3 to 5 per cent. nitrogen).

111. Fish and Potash, of Geo. W. Miles' Co., Milford, Ct. Collected of P. F. Bridges, So. Deerfield, Mass., by State Inspector.

Guaranteed composition ; total phosphoric acid, 5 to 8 per cent. ; potassium oxide, 3 to 5 per cent. ; nitrogen, 2.5 to 3.5 per cent.

112. Fish and Potash, of Quinnipiac Fertilizer Co., New London, Ct. Collected of William H. Earle, Worcester, Mass., by State Inspector.

Guaranteed composition; total phosphoric acid, 5 to 7 per cent.; soluble and reverted phosphoric acid (available), 3 to 5 per cent.; potassium oxide, 3 to 5 per cent.; nitrogen, 3.25 to 4.25 per cent.

	110	*111*	*112*
	POUNDS PER HUNDRED.		
Moisture at 100° C.	15.60	27.69	24.08
Total phosphoric acid,	7.51	4.52	5.93
Soluble "	4.88		.93
Reverted "	.07	1.14	1.95
Insoluble, "	2.56	3.38	3.05
Potassium Oxide,	4.52	2.57	3.91
Nitrogen,	2.70	2.77	4.27
Valuation per 2000 lbs.,	$30.18	$20.80	$31.79

CORRECTION. Fertilizer No. 86, Bulletin No. 4, "Bradley's Fish and Potash," the valuation of the article ought to read $27.98 instead of $37.98.

AMMONIATED SUPERPHOSPHATES AND COMPLETE MANURES.

113. Chittenden's Complete Manure, Grain, of National Fertilizer Co., Bridgeport, Conn. Collected of J. A. Sullivan, Northampton, Mass., by State Inspector.

Guaranteed composition; total phosphoric acid 8 to 10 per cent.; soluble and reverted phosphoric acid, (available) 6 to 8 per cent.; potassium oxide 5 to 7 per cent.; ammonia $4\frac{1}{2}$ to $5\frac{1}{2}$ per cent., (equivalent to nitrogen 3.71 to 4.53 per cent.).

114. Bowker's Hill and Drill Phosphate. Collected of Fuller & Newton, Springfield, Mass., by State Inspector.

Guaranteed composition; total phosphoric acid 10 to 12 per cent.; soluble and reverted phosphoric acid (available) 8 to 10 per cent.; potassium oxide (in form of sulphate) 2 to 4 per cent.; ammonia 2 to $3\frac{1}{2}$ per cent., (equivalent to nitrogen 1.65 to 2.88 per cent.

115. Stearns' Ammoniated Bone Superphosphate, of Stearns & Co., New York. Collected of Wilson & Holden, Worcester, Mass., by State Inspector.

Guaranteed composition; soluble and reverted phosphoric acid, (available) 8 to 10 per cent.; potassium oxide 2 to 3 per cent.; ammonia 3 to 4 per cent., (equivalent to nitrogen 2.47 to 3.30 per cent.

116. Dole's Common Sense Fertilizer. (No. two). Collected of Parker & Gannet, Springfield, Mass., by State Inspector.

Guaranteed composition; total phosphoric acid 4 to 8 per cent.; potassium oxide 3 to 5 per cent.; ammonia 3 to 6 per cent., (equivalent to nitrogen 2.59 to 5.18 per cent.

	113	*114*	*115*	*116*
	POUNDS PER HUNDRED.			
Moisture at 100° C.,	14 17	14.22	14 48	23.51
Total phosphoric acid,	8.38	10.31	10.30	4.93
Soluble "	5.14	4.54	3.04	.64
Reverted "	1.50	1.77	6.12	3.30
Insoluble "	1.74	4.00	1.14	1 26
Potassium oxide,	5 38	1.30	2.15	3.34
Nitrogen, (in organic matter),	3.04	2.22	1.99	.84
Nitrogen, (in ammonia salts),				1.06
Nitrogen, (in nitrates),	.14			
Valuation per 2000 lbs.,	$34.91	$29.65	$28.83	$20.41

117. Bone Superphosphate, of Lowell Bone Fertilizer Co., Lowell, Mass. Collected of R. C. Lord, Lowell, Mass., by State Inspector.

Guaranteed composition; moisture 5.9 per cent.; soluble phosphoric acid 14.68 per cent.; reverted phosphoric acid .32 per cent.; insoluble phosphoric acid, .86 per cent.; nitrogen 3.37 per cent.

118. Bay State Bone Superphosphate, of J. J. Tucker, Boston, Mass. Collected of Geo. B. Knowlton, Fitchburg, Mass., by State Inspector.

Guaranteed composition; soluble and reverted phosphoric acid (available) 9 to 10.5 per cent.; insoluble phosphoric acid 1.5 to 3 per cent.; ammonia 3 to 4 per cent., (equivalent to nitrogen 2.5 to 3.3 per cent.

119. Stockbridge Manures. Grass Top Dressing. Collected of J. Breck & Son, Boston, Mass., by State Inspector.

Guaranteed composition; total phosphoric acid 6 to 8 per cent.; soluble and reverted phosphoric acid (available) 5 to 6 per cent.; potassium oxide 4 to 5 per cent.; nitrogen 4.25 to 5 per cent. (equivalent to ammonia 5 to 6 per cent.)

120. Bradley's XL Ammoniated Bone Superphosphate. Collected of J. & J. A. Rice, Worcester, Mass., by State Inspector.

Guaranteed composition; soluble phosphoric 7 to 8 per cent.; reverted phosphoric acid 2 to 3 per cent.; insoluble phosphoric acid 2 to 3 per cent.; potassium oxide 2 to 3 per cent.; nitrogen 2.5 to 3.5 per cent.

	117	*118*	*119*	*120*
	Pounds per Hundred.			
Moisture at 100° C.,	10.45	22.45	18.25	17.50
Total phosphoric acid,	16.03	10.95	8.32	12.40
Soluble "	11.69	8.80	5.56	6 81
Reverted "	3 97	71	.97	3.04
Insoluble "	.37	1.44	1.79	2.55
Potassium oxide,			5 65	1 92
Nitrogen, (in organic matter),	2.82	3.12	4.16	2.65
Nitrogen, (in nitrates),			1.90	
Valuation per 2000 lbs.,	$45.48	$36.58	$47.47	$36.72

121. E. Frank Coe's Bone Superphosphate of Lime. Manufactued by Enoch Coe, Hunter's Point, N. Y. Collected of J. S. Clark & Son, Worcester, Mass., by State Inspector.

Guaranteed composition; soluble and reverted phosphoric acid (available), 11.96 per cent.; insoluble phosphoric acid, 1.28 per cent.; nitrogen, 2.64 per cent.

122. Quinnipiac Co's. Phosphate. Collected of Wm. H. Earle, Worcester, Mass., by State Inspector.

Guaranteed composition; soluble and reverted phosphoric acid (available), 8 to 10 per cent.; insoluble phosphoric acid, 1 to 3 per cent.; potassium oxide, 2 to 3 per cent.; nitrogen, 2.5 to 3.5 per cent.

123. IXL Ammoniated Bone Superphosphate, of Geo. W. Miles' Co., Milford, Ct. Collected of D. J. Wright, Northampton, Mass., by State Inspector.

Guaranteed composition ; soluble and reverted phosphoric acid (available), 8 to 12 per cent. ; potassium oxide, 1 to 3 per cent. ; ammonia, 2.5 to 4 per cent. (equivalent to nitrogen 1.65 to 3.30 per cent.

124. Bay State Ammoniated Bone Superphosphate, of J. J. Tucker, Boston, Mass. Collected of H. A. Emerson, Winchester, Mass., by Chemist of the Station.

Guaranteed composition ; total phosphoric acid, 12.20 per cent. ; soluble and reverted phosphoric acid (available), 9.20 per cent. ; insoluble phosphoric acid, 3.00 per cent. ; ammonia, 3.29 per cent. (equivalent to nitrogen 2.71 per cent.).

	121	*122*	*123*	*124*
	POUNDS PER HUNDRED.			
Moisture at 100° C.,	22.90	19 10	19.04	27.67
Total phosphoric acid,	9.97	11.03	11.95	9.58
Soluble "	7.84	7.96	6.94	7.34
Reverted "	.43	1.45	1.49	.66
Insoluble "	1.70	1.62	3.52	1.58
Potassium oxide,		2.04	1.83	.75
Nitrogen, (in organic matter),	2.54	2.08	2.25	3.20
Nitrogen, (in nitrates),		.79		
Valuation per 2000 lbs.,	$31.66	$36.23	$33.78	$34.47

125. Dole's Common Sense Fertilizer (D). Collected of Parker & Gannet, Springfield, Mass., by State Inspector.

Guaranteed composition ; total phosphoric acid, 1 to 3 per cent. ; potassium oxide, 1 to 3 per cent. ; nitrogen, 2 to 4 per cent.

126. Bradley's Complete Manure ; Potato and Roots. Collected of J. Breck & Son, Boston, Mass.

Guaranteed composition ; soluble phosphoric acid, 8 to 10 per cent. ; potassium oxide, 4.5 to 5.5 per cent. ; ammonia, 4 to 5 per cent. (equivalent to nitrogen 3.3 to 4.1 per cent.).

127. Bowker's Hill and Drill Phosphate. Collected of J. & J. A. Rice, Worcester, Mass., by State Inspector.

Guaranteed composition ; soluble phosphoric acid, 8 to 10 per cent. ; potassium oxide, 2 to 3 per cent. ; ammonia, 2 to 3 per cent. (equivalent to nitrogen 1.6 to 2.5 per cent.

128. Standard Lawn Dressing, of Standard Fertilizer Co., Boston, Mass. Collected of Whittemore Bros., Boston, Mass.

No guarantee obtained.

	125	*126*	*127*	*128*
	POUNDS PER HUNDRED.			
Moisture at 100° C.,	9.72	10.15	16.95	16.00
Total phosphoric acid,	1.47	12.19	8.91	13.60
Soluble "	.12	4.80	7.39	9.88
Reverted "	.96	3 19	1.05	06
Insoluble "	.39	4.20	.47	3.66
Potassium oxide,	1.11	4.48	1.29	2.66
Nitrogen,	1.35	3.78	2.32	2.34
Valuation per 2000 lbs.,	$9.42	$41.90	$30.27	$39.25

C. A. GOESSMANN, *Director*,

AMHERST, MASS.

J. E. Williams, Printer, Amherst, Mass.

MASSACHUSETTS STATE

AGRICULTURAL EXPERIMENT STATION.

BULLETIN No. 6.

DECEMBER, 1883.

FODDER ANALYSES.

129. CORN MEAL.

From John L. Holley, South Amherst, Mass. Ninety-two per cent. passed through mesh 144 to the square inch.

	Percentage Composition.	Constituents (in lbs.) in a ton of 2000 lbs.	Pounds digestible in a ton of 2000 lbs.	Per cent. of digestibility of constituents.	Nutritive Ratio.
Moisture at 100° C., ...	13.55	271 00			
Dry Matter, ...	86.45	1729.00			
	100.00	2000.00			
ANALYSIS OF DRY MATTER.					1:9.66
Crude Ash, ...	1.42	28.40			
" Cellulose.	2.64	52.80	17.95	34.00	
" Fat, ...	4.24	84.80	64.45	76.00	
" Protein, (nitrogenous matter),	10.40	208.00	176.80	85.00	
Non-nitrogenous extract matter, . .	81.30	1626.00	1528.44	94.00	
	100.00	2000.00	1787.64		

The article is a fair specimen of its kind. As a more detailed discussion of the composition of corn may not be without some interest in this connection, I refer to the results of an examination of eleven prominent Eastern, Western and Southern varieties, which have been published in the annual report of the Mass. State Board of Agriculture for 1879. The samples of corn, which served for my investigation, were furnished by well-known parties; the mode of cultivation and of manuring was stated, and the material had been collected with care. The analytical work was carried on with a view of securing results of a strictly comparative value; they were stated with reference to a corresponding amount of moisture,—to render differences in composition prominent at sight. The actual demonstration of the influence of the particular condition of the soil on the feeding value of the same variety of corn raised upon it, (independent of varying quantity), deserves a serious consideration.

130. FODDER CORN. (1).

Sent on by Thomas J. Field, Northfield, Mass.

	Percentage Composition.	Constituents (in lbs.) in a ton of 2000 lbs.	Pounds digestible in a ton of 2000 lbs.	Per cent. of digestibility of constituents	Nutritive Ratio.
Moisture at 100° C.,	6.65	133.00		Not ascertained by actual experiment.	
Dry Matter.	93.35	1867.00			
	100.00	2000.00			
ANALYSIS OF DRY MATTER.					
Crude Ash,	4.68	93.60			
" Cellulose,	31.39	627.80			
" Fat,	1.42	28.40			
" Protein, (nitrogerous matter),	6.83	136.60			
Non-nitrogenous extract matter,	55.68	1113.60			
	100.00	2000.00			

131. FODDER CORN. (2).

(Frost bitten).

Sent on by Thomas J. Field, Northfield, Mass.

	Percentage Composition.	Constituents (in lbs.) in a ton of 2000 lbs.	Pounds digestible in a ton of 2000 lbs.	Per cent. of digestibility of constituents.	Nutritive Ratio.
Moisture at 100° C.,	6.67	133.40		Not ascertained by actual feeding experiments.	
Dry Matter,	93.33	1866.60			
	100.00	2000.00			
ANALYSIS OF DRY MATTER.					
Crude Ash,	5.11	102.20			
" Cellulose,	33.75	675.00			
" Fat,	1.11	22.20			
" Protein, (nitrogenous matter),	6.17	123.40			
Non-nitrogenous extract matter,	53.86	1077.20			
	100.00	2000.00			

The history of the above samples of fodder corn, (130 and 131), as far as their respective stages of growth and their mode of cultivation, etc., is concerned. has not been reported.

The analytical results show some differences in composition in favor of No. 1, yet hardly enough under existing circumstances to encourage a discussion of the effects of frost in this particular case. The sample of frost bitten corn, after careful drying, proves still of a fair composition. The particular stage of growth and the character of the weather which follows the frost, exert a controling influence on the degree of changes in composition. The effects of frost are usually more serious in the earlier periods of the life of plants, than in their more matured state. Dry, cool weather after a frost causes less alteration in composition, than sultry, warm weather. Frost bitten green fodder corn is best preserved in silos.

132. WHEAT BRAN.

From John L. Holley, South Amherst, Mass.

Thirty-three per cent. passed through mesh 144 to square inch.

	Percentage Composition.	Constituents (in lbs.) in a ton of 2000 lbs.	Pounds digestible in a ton of 2000 lbs.	Per cent. of digestibility of constituents	Nutritive Ratio.
Moisture at 100° C.,	12.08	241.60			
Dry Matter,	87.92	1758.40			
	100.00	2000.00			
ANALYSIS OF DRY MATTER.					1 : 4.16
Crude Ash,	7.92	158.40			
" Cellulose,	13.72	274.40	54.88	20.00	
" Fat,	3.81	76.20	60.96	80.00	
" Protein, (nitrogenous matter),	15.67	313.40	275.79	88.00	
Non-nitrogenous extract matter,	58.88	1177.60	942.08	80.00	
	100.00	2000.00	1333.71		

The article is of a good average quality.

133. COTTON SEED MEAL. (2).

Sent on by J. E. Soper & Co., of Boston.

Eighty-one per cent. passed through mesh 144 to square inch.

	Percentage Composition.	Constituents (in lbs.) in a ton of 2000 lbs.	Pounds digestible in a ton of 2000 lbs.	Per cent of digestibility of constituents	Nutritive Ration.
Moisture at 100° C.,	8.15	163.00			
Dry Matter,	91.85	1837.00			
	100.00	2000.00			
ANALYSIS OF DRY MATTER.					1 : 1.88
Crude Ash,	7.46	149.20			
" Cellulose,	7.41	148.20	34.09	23.00	
" Fat,	14.72	294.40	267.90	91.00	
" Protein, (nitrogenous matter).	36.54	730.80	540.79	74.00	
Non-nitrogenous extract matter,	33.87	677.40	311.60	46 00	
	100.00	2000.00	1154.38		

This article has been obtained by the old (press) process. The sample, which served for analysis, No. 103, was of a better mechanical condition than No. 133.

A comparison of the composition of samples, No. 103 and No. 133, shows their differences to be due rather to the fact, that different lots of cotton seeds served for the production of the articles tested, than to a different process of grinding. The two modes of producing cotton seed meal ought to be tried on the same lot of seeds to render their respective merits conspicuous.

134. COTTON SEED MEAL.

From John L. Holley, South Amherst, Mass.

Eighty-nine per cent. passed through mesh 144 to square inch.

	Percentage Composition.	Constituents (in lbs.) in a ton of 2000 lbs.	Pounds digestible in a ton of 2000 lbs.	Per cent. of digestibility of constituents.	Nutritive Ratio.
Moisture at 100° C.,	8.38	167.60			
Dry Matter,	91 62	1832.40			
	100.00	2000.00			
ANALYSIS OF DRY MATTER.					1 : 1.41
Crude Ash,	8.51	170.20			
" Cellulose,	6.73	134.60	30.82	23.00	
" Fat,	12.94	258.80	235.51	91.00	
" Protein (nitrogenous matter),	42.47	849.40	628.56	74.00	
Non-nitrogenous extract matter,	29.35	587.00	270.02	46 00	
	100.00	2000.00	1164.91		

A very good article as far as composition and mechanical condition are concerned.

135. COCOA DUST.

Refuse from Cocoa Manufacture, sent on from Boston, Mass.

	Percentage Composition.	Constituents (in lbs.) in a ton of 2000 lbs.	Pounds digestible in a ton of 2000 lbs.	Per cent. of digestibility of constituents.	Nutritive Ratio.
Moisture at 100° C.,	7.10	142.00		Not ascertained by actual feeding experiment.	
Dry Matter,	92.90	1858.00			
	100.00	2000.00			
ANALYSIS OF DRY MATTER.					
Crude Ash.	6.83	136.60			
" Cellulose,	5.86	117.20			
" Fat,	25.85	517.00			
" Protein, (nitrogenous matter),	15.47	309.40			
Non-nitrogenous extract matter,	45.99	919.80			
	100.00	2000.00			

Essential mineral constituents in 100 parts of Cocoa dust.

Potassium oxide,	2.11
Calcium "	.63
Magnesium "	traces.
Phosphoric acid,	1.34

The material consisted of inside and outside parts of the cocoa bean with some foreign matter. It was obtained in the process of cracking and sifting the bean. The examination was made by request to ascertain its fitness for manuring. Although its nitrogen percentage (2.3 per cent.) compares well with many fertilizers in our market, it would be for economical consideration more advisable to try the cocoa dust as a fodder in place of oil bearing seeds. The reputation of the cocoa as a highly nutritive food for man is too well established to doubt the efficiency of the above described article as a fodder for some kind of farm stock.

FERTILIZER ANALYSES.

136. Sponge Refuse. Sent on from Albany, N. Y.

Moisture at 100° C.,	7.25 per cent.
Nitrogen,	2.43 "
Ferric oxide,	.17 "
Calcium oxide,	3.94 "
Magnesium oxide,	1.27 "
Phosphoric acid,	3.19 "
Insoluble matter,	39.05 "

137. Florida Marl. Sent on from Boston, Mass.

Moisture at 100° C.,	.60 per cent.
Calcium oxide,	41.75 "
Magnesium oxide,	1.03 "
Ferric oxide,	.36 "
Phosphoric acid,	2.72 "
Insoluble matter,	21.95 "

BONES.

138. Pure Dissolved Raw Bones. Sent on from Amherst, Mass.

Moisture at 100° C.,	10.23 per cent.
Total phosphoric acid,	16.03 "
Soluble " "	7.76 "
Reverted " "	3.83 "
Insoluble " "	4.44 "
Nitrogen " "	2.64 "
Valuation per 2000 lbs.	$40.67

139. Dissolved Boneblack, of Bowker Fertilizer Co., Boston, Mass. Collected by State Inspector.

Guaranted composition; soluble phosphoric acid 12 to 13 per cent.

Moisture at 100° C.,	20.78 per cent.
Total phosphoric acid,	15.66 "
Soluble " "	12.76 "
Insoluble " "	2.90 "
Valuation per 2000 lbs.,	$31.55

140. Bone Fertilizer. Sent on by John Sanborn, Lawrence, Mass.

141. Pure Fine Ground Bones. Sent on from Amherst, Mass.

	140	*141*
	POUNDS PER HUNDRED.	
Moisture at 100° C.	4.25	5.27
Total Phosphoric Acid,	24.06	23.13
Soluble "	.76	.46
Reverted "	3.66	3.62
Insoluble "	19.64	19.05
Nitrogen,	2.88	3.73
Valuation per 2000 lbs.	$44.35	$46.82

142. Peruvian Guano. Collected of D. A. Horton, Northampton, Mass., by State Inspector.

Guaranteed composition; total phosphoric acid 16 to 18 per cent.; potassium oxide 3 to 6 per cent.; ammonia 5 to 6 per cent. (equivalent to nitrogen 4.1 to 5 per cent.).

Moisture at 100° C.,	14.00 per cent.
Total phosphoric acid,	20.60 "
Soluble "	3.10 "
Reverted "	1.55 "
Insoluble "	15.95 "
Potassium oxide,	1.14 "
Nitrogen (in organic matter),	1.40 "
Nitrogen (in ammonia salts),	3.04 "
Valuation per 2000 lbs.	$51.66

AMMONIATED SUPERPHOSPHATES AND COMPLETE MANURES.

143. Mapes Tobacco Fertilizer. Collected of Fuller & Newton, Springfield, Mass., by State Inspector.

Guaranteed composition; total phosphoric acid 7 to 7.5 per cent.; potassium oxide (in form of sulphate) 7 to 7.50 per cent.; ammonia 5.75 per cent. (equivalent to nitrogen 4.73 per cent.).

144. Stockbridge Manures. Peas and Beans, of Bowker Fertilizer Co., Boston, Mass. Collected of E. N. Wood, Lowell, Mass., by State Inspector.

Guaranteed composition; soluble phosphoric acid 8 to 10 per cent.; potassium oxide 2 to 3 per cent.; ammonia 3 to 4 per cent. (equivalent to nitrogen 2.5 to 3.3 per cent.).

145. Bowker's Grass Top Dressing. Forage Crops. Collected of J. C. Wright, Fitchburg, Mass., by State Inspector.

Guaranteed composition: total phosphoric acid 6 to 8 per cent.; soluble and reverted phosphoric acid (available) 5 to 6 per cent.; potassium oxide 4 to 5 per cent.; nitrogen 4.25 to 5 per cent. (equivalent to ammonia 5 to 6 per cent.).

146. Haynes' Fertilizer, of Mr. Haynes, Bolton, Mass. Sent on by S. C. Damon, Lancaster, Mass.

No guarantee obtained.

	143	*144*	*145*	*146*
	POUNDS PER HUNDRED.			
Moisture at 100° C.,	15 18	17.10	10 38	17.63
Total phosphoric acid,	8.21	9.62	8.75	10.14
Soluble "	1.95	6.08	3.61	5.89
Reverted "	2.50	.84	1.29	.87
Insoluble "	3.76	2.70	3.85	3.38
Potassium oxide,	7 36	4.13	5.64	5.70
Nitrogen, (in organic matter),	.60	1.60	2.30	2.72
Nitrogen, (in ammonia salts),	2.43	.74	.44	.71
Nitrogen, (in nitrates),	1.70	.23	.93	.60
Valuation per 2000 lbs.,	$45.30	$33.60	$38 00	$41.85

147. Standard Superphosphate, of Standard Fertilizer Co., Boston, Mass. Collected of A. B. Lawrence, Fitchburg, Mass., by State Inspector.

Guaranteed composition; total phosphoric acid 9 to 14 per cent.; potassium oxide 1 to 3 per cent.; ammonia 2 to 4 per cent. (equivalent to nitrogen 1.6 to 3.3 per cent.).

148. H. J. Baker & Bros.' A. A. Ammoniated Bone Superphosphate. Collected of Fuller & Newton, Springfield. Mass., by State Inspector.

Guaranteed composition; soluble and reverted phosphoric acid (available) 10 to 12 per cent.; potassium oxide 2 to 3 per cent.; ammonia 3 to 4 per cent. (equivalent to nitrogen 2.5 to 3.3 per cent.).

149. Bowker's Lawn-dressing. Collected of E. A. Thompson, Woburn, Mass., by Chemist of Station.

Guaranteed composition; total phosphoric acid 6 to 8 per cent.; soluble and reverted phosphoric acid (available) 5 to 6 per cent.; potassium oxide 4 to 5 per cent.; nitrogen 4 to 5 per cent. (equivalent to ammonia 4.5 to 5.5 per cent.).

150. Superphosphate, of Earle's Phosphate Co. Sent on from Dennisport, Mass.

No guarantee obtained.

	147	*148*	*149*	*150*
	POUNDS PER HUNDRED.			
Moisture at 100° C.,	18.08	12 11	5.33	9.48
Total phosphoric acid,	13.32	9.69	9.92	15.08
Soluble "	7.07	8.63	5.73	7.88
Reverted "	3.80	.27	1 93	.69
Insoluble "	2.46	.79	2.26	6.51
Potassium oxide,	1.43	2.38	5.52	2.34
Nitrogen, (in organic matter),	1.11	.65	1.19	2.91
Nitrogen, (in amonia salts),		2.23	3.28	
Nitrogen, (in nitrates),	1.49			
Valuation per 2000 lbs.,	$36.87	$36.98	$45.63	$41.64

151. Soluble Pacific Guano, of Pacific Guano Co., Boston, Mass. Collected of J. S. Clark & Son, Worcester, Mass., by State Inspector.

Guaranteed composition; soluble phosphoric acid $6\frac{1}{2}$ to 8 per cent.; reverted phosphoric acid 1.6 to 3 per cent.; insoluble phosphoric acid 2 to 3 per cent.; potassium oxide 2 to 3.5 per cent.; nitrogen 2 to 3 per cent.

152. Stockbridge Manures. Grain. Collected of J. and J. A. Rice, Worcester, Mass., by State Inspector.

Guaranteed composition; total phosphoric acid 7 to 9 per cent.; soluble and reverted phosphoric acid (available) 6 to 7 per cent.; potassium oxide 4 to 5 per cent.; nitrogen 3.25 to 4.25 per cent.

153. Soluble Pacific Guano. Collected of Parker & Gannet, Springfield, Mass., by State Inspector.

Guaranteed composition; soluble phosphoric acid 6.5 to 8 per cent.; reverted phosphoric acid 1.5 to 3 per cent.; insoluble phosphoric acid 2 to 4 per cent.; potassium oxide 2 to 3.5 per cent.; nitrogen 2 to 3 per cent.

154. Chittenden's Root Fertilizer, of National Fertilizer Co., Bridgeport, Conn. Collected of G. P. Smith, Sunderland, Mass., by State Inspector.

Guaranteed composition; total phosphoric acid 8 to 10 per cent.; soluble and reverted phosphoric acid (available) 6 to 8 per cent.: potassium oxide 6 to 8 per cent.; ammonia 4 to 5 per cent. (equivalent to nitrogen 3.32 to 4.15 per cent.).

	151	*152*	*153*	*154*
	POUNDS PER HUNDRED.			
Moisture at 100° C.,	8.38	14 53	13.42	12 38
Total phosphoric acid,	13.07	8.75	11.74	8.57
Soluble "	6.87	2.91	5.11	5 34
Reverted "	1 17	2 14	1.15	1.91
Insoluble "	5.03	3.70	5.47	1.32
Potassium oxide,	1.60	5.33	2 05	6 68
Nitrogen, (in organic matter),	1.70	3.57	2 60	2.45
Nitrogen, (in nitrates),	.17	1.27	.17	.55
Valuation per 2000 lbs.,	$32.88	$40.29	$34 02	$35.66

155. Chittenden's Complete Manure. Grain, of National Fertilizer Co., Bridgeport, Conn. Collected of Geo. P. Smith, Sunderland, Mass., by State Inspector.

Guaranteed composition; total phosphoric acid 8 to 10 per cent.; soluble and reverted phosphoric acid (available) 6 to 8 per cent.; potassium oxide 5 to 7 per cent.; ammonia 4.5 to 5.5 per cent equivalent to nitrogen 3.7 to 4.5 per cent.).

156. Standard Superphosphate, of Standard Fertilizer Co., Boston, Mass. Collected of E. N. Wood, Lowell, Mass., by State Inspector.

Guaranteed composition; total phosphoric acid 9 to 14 per cent.; potassium oxide 1 to 3 per cent.; ammonia 2 to 4 per cent. (equivalent to nitrogen 1.6 to 3.3 per cent.).

157. Bradley's Complete Manure. Corn and Grain. Collected of Breck & Son, Boston, Mass., by State Inspector.

Guaranteed composition; soluble phosphoric acid 6 to 8 per cent.; potassium oxide 4 to 5 per cent.; ammonia 4 to 5 per cent. (equivalent to nitrogen 3.3 to 4.1 per cent.).

158. Bradley's X L Ammoniated Bone Superphosphate. Collected of Garfield & Proctor, Fitchburg, Mass., by State Inspector.

Guaranteed composition; soluble phosphoric acid 7 to 8 per cent; reverted phosphoric acid 2 to 3 per cent.; insoluble phosphoric acid 2 to 3 per cent.; potassium oxide 2 to 3 per cent.; nitrogen 2.5 to 3.5 per cent.

	155	*156*	*157*	*158*
	POUNDS PER HUNDRED.			
Moisture at 100° C.	12.90	20.75	8.60	15.97
Total phosphoric acid,	8.81	11.55	10.65	10.80
Soluble "	6.52	8.13	6.37	7.34
Reverted "	2.00	2.51	.88	.39
Insoluble, "	.29	.91	3.40	3.07
Potassium Oxide,	5.28	1.35	6 45	3.44
Nitrogen, (in organic matter),	2.79	2.17	4.51	2.44
Nitrogen, (in nitrates),	.38			
Valuation per 2000 lbs.,	$36.73	$34.13	$45.73	$34.59

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AMHERST, MASS.

J. E. Williams, Printer, Amherst, Mass.

MASSACHUSETTS STATE

AGRICULTURAL EXPERIMENT STATION.

BULLETIN No. 7.

MARCH, 1884.

Observations in Regard to Insects Injurious to the Apple.

159. In the growth of all kinds of farm or garden crops, the farmer and gardner find themselves forced to wage constant warfare with insects or parasitic plant life. In this paper we give the results of a few observations in regard to the *plum weevil*, or *Curculio* (*Conotrachelus nenuphar*), as affecting the apple crop, compared also with the *Codling Moth* and the *Apple Maggot*.

It has often been noticed early in the summer that apples nearly all fall from the trees when quite small. This was especially the case during the past season, and careful investigation were made to ascertain the cause. A tree of the variety known as the Westfield Seek-no-further, which blossomed very abundantly and set an unusually large crop of fruit, was selected. When from one half to one-inch in diameter, the fruit began to drop in large numbers so that not enough was left on the tree for one-half a crop. A large quantity of these were collected and examined, and out of eight hundred it was found that all but three were punctured by the plum curculio, leaving its peculiar crescent-shaped mark, and in every puncture was found an egg or small larva. The worm commonly found in the apple at this time have generally been supposed to be the larvæ of the *Codling Moth*, (*Carpocapsa pomonella*), yet in the number examined only four or five of the larvæ of the latter were found.

The remedies which have been successfully employed to prevent the injury of the plum crop by this larvæ are two, i. e., (1) that of jarring the trees and catching the insects and affected fruit in a sheet stretched on a frame or spread on the ground and destroying them, and (2) that of planting the trees in the limits of poultry yards. The first remedy cannot be applied to the apple tree on account of its size. The second has proved successful in saving the plum crop, and would undoubtedly be as successful with the apple, but the fowls should be numerous enough to not only catch the insects when they come from the ground, but also to let none of the larvæ escape when they come from the fallen fruit to go into the ground. Perhaps a more sure preventive would be, in addition to the above, to have the fruit destroyed by pasturing swine in the orchard in sufficient numbers to eat all of the fruit as soon as it drops.

The apple crop is also very much injured by the larvæ of the codling moth, mentioned above, which has been common for a long time, and the *Apple Maggot*, (*Tripeta pomonella*), which has only done serious damage within the past five years. The latter injures the fruit by making burrows in the flesh, many larvæ or maggots often working in the same apple.

The eggs are laid by a small fly somewhat resembling the common house fly—but not more than one-half its size—through a small opening in the skin of the apple made with its ovipositor. It shows especial liking for the thin-skinned, mild, sub-acid or sweet summer or autumn varieties, but also attacks some winter varieties.

Its ravages have become so extensive in some localities that prompt measures must be taken for its extermination or it may work the total destruction of the apple crop.

The practice of pasturing swine in the summer is being recommended, and practiced by many of our leading farmers and stock-breeders and the orchardist, must combine to a certain extent this branch of business with his own if he would be successful, for the destruction of the fruit as it falls from the tree is the only *safe* and *sure* remedy now known to prevent injury by these three insects.

S. T. MAYNARD,

Professor of Botany and Horticulture,

Massachusetts Agricultural College.

Experiments with Special Fertilizers in Fruit Culture.

160. CURRANTS AND PEACHES.

The experiments with *Currants*, which are described in the subsequent communication, are but a continuation of an investigation inaugurated upon the college grounds ten years ago. Field experiments with sugar beets, for the purpose of ascertaining the influence of special fertilizers on the saccharine qualities, and the general character of the roots raised by their assistance, suggested the extension of the inquiry to fruit-bearing plants. For the sake of brevity, and of a desirable understanding of the points involved, I reproduce here the introduction of one of the first publications on the subject under discussion: "The question whether a systematic and rational manuring of our fruit-bearing plants is essential for the continued production of good crops, engages more attention from year to year. Judging merely from the results obtained in general farm management, in consequence of the adoption of the rule to restore annually to the soil under cultivation either the entire amount or in part as circumstances may advise those of its constituents which the crops carried off have abstracted, it seems but reasonable to assume that the same principle applied to the cultivation of fruits and garden crops in general, must prove in the end most advantageous as far as quality and quantity of the crops resulting are concerned. A liberal supply in particular of those essential elements of plant food which are found in the fruits in conspicuous quantities, and for obvious reasons must serve important functions in their growth if judiciously provided, cannot otherwise but prove beneficial to the entire plant. To secure that amount in a more definite form, than as a general rule, has been customary, improves most decidedly our chances to ascertain not only the special wants of the plants under cultivation, but to recognize also the particular form in which the various elements of plant food exert their most valuable influence on the quality of the crops. Believing in the correctness of these views, I entered a few years ago upon a series of analytical chemical inquiries to determine the character of the ash constituents of fruits, and to study also the relations which apparently exist between the variations in the composition of the former, and the quality of the latter, for the purpose of furnishing information needed for the *successful* introduction of a *rational system* of *fertilization* of our *fruit-bearing plants.*"

These investigations have been carried on since without serious interruption, as far as the limited resources of past years for experimental work of that character have permitted. The scarcity of previous systematic chemical inquiries into the relations existing between the kind and the amount of available plant food in a productive garden soil or orchard, and the absolute and relative quantity of the various soil constituents contained in the fruits and the garden crops raised upon it, rendered it necessary to grow them under well defined circumstances, to obtain material fit for comparative analyses. The necessity of adopting that course of action became still more apparent, when considering the extraordinary influence—quite generally conceded—of soil, location and season on the quality of these crops. Products raised by the aid of different manurial substances, within the *same season*, upon a *similar soil*, and of a *corresponding stage* of *growth*, had to be secured for the examination, to impart a scientific and practical value to the analytical results.

It is a well-known fact that the *absolute amount* of the mineral constituents of plants of the same variety and of one and the same species even may differ widely, yet as a rule this circumstance does not necessarily alter the general character of the plants. A change, however, in the *relative proportion* of the various mineral constituents, as potassa, lime, etc., rarely has been noticed without having affected the quantity of some of the organic constituents, as sugar, starch, acids, etc. The fact that the essential mineral constituents (potassium, calcium, magnesium, iron and phosphorus), of our farm plants cannot replace each other beyond a certain extent in the vegetable economy without endangering their life, points towards a *specific* function of each of them in the growth of these plants. We have learned by experimental observation what elements are indispensable for a healthy growth, and a successful reproduction of these plants. It remains for us then to ascertain the particular function of each of the above elements in the life of plants. The more we learn of the specific functions of each essential mineral constituent of plants, the better will we be prepared to perfect our system of manuring, to cultivate with a view of developing desirable qualities in the crops, and to counteract the serious influences of an abnormal composition of the sap, on the life of plants.

To secure suitable material for an examination in the above mentioned direction, five experimental plats were set apart for that purpose, in 1875. They were planted under the direction of Prof. Maynard, with strawberries, raspberries, currants, and blackberries, besides cherry, plum, pear and apple trees. Four of these plats received annually, a certain kind and amount of chemical manure, (see currant experiments below), while one plat received no manure. Upon each plat were planted the same kind and variety of fruits. Some interesting observations made on grapevines and strawberries have already been published in the annual reports of the college, in the Report of the Mass. State Board of Agriculture for 1879, and elsewhere. A brief description of experiments with healthy peach trees, and with trees suffering with "the Yellows," has been published in the reports of the Mass. Horticultural Society, and of the State Board of Agriculture for 1882. A more detailed description of these experiments in particular, will be found in the annual report of the Board of Control of the State Experiment Station for 1883. The experiments with currants below described, furnish an interesting addition to previous observations.

EXPERIMENTS WITH CURRANTS.

RED CURRANTS (VERSAILLES).

The plants furnishing the fruits for the examination had been for several years under special treatment upon five different experimental plats. The ground upon which these plats are located has served for years previous to its present use, for the production of grass. The soil consists of a light gravelly loam. Each plat covers an area of 4,200 square feet; four of them have received annually for five to six years past a definite amount and kind of special chemical manure, while one plat received none. The fertilizer was applied broadcast early in the spring, and subsequently incorporated in the soil by means of a cultivator. The plats were otherwise treated alike to secure a good mechanical condition of the soil, and to keep off the weeds.

FERTILIZERS APPLIED.

PLAT I received annually forty-five pounds of dissolved boneblack containing from 10 to 12 per cent. of soluble phosphoric acid, and fifteen pounds of potash nitre (saltpeter).

PLAT II received annually fifteen pounds of potash nitre, and thirty pounds of Kieserit (sulphate of magnesium).

PLAT III received annually forty-five pounds of dissolved boneblack, fifteen pounds of potash nitre, and thirty pounds of Kieserit.

PLAT IV nothing applied.

PLAT V received annually forty-five pounds of dissolved boneblack, eighteen pounds nitrate of soda (Chili saltpeter), and fifteen pounds of muriate of potash.

Nitrogen was applied in form of nitric acid to secure a uniform action of that element.

Well matured fruits were in every instance secured for the tests. They were collected July 18th, 1883, and examined without delay.

One hundred parts by weight of the berries contained:

	I	II	III	IV	V
Dry vegetable matter,	13.76	13.61	15.72	12.95	13.86
Water at 100° C.,	86.24	86.39	84.28	87.05	86.14
Ash in dry matter,	0.45	0.45	0.48	0.41	0.45

An examination of the composition of the berries showed the highest color, the largest amount of vegetable matter, and the largest amount of mineral constituents in the fruits from plat three; the fruits from plat five rank next in regard to these qualities, yet exceed in sugar by more than one per cent. The fruits from plat four (without fertilizer), rank lowest in quality. The examination of the organic constituents of the berries will be repeated during the coming seeson, when more details will be published.

ASH ANALYSIS OF FRUIT WITH STEMS.

PLATS.	I.	II.	III.	IV.	V.
Sesqui oxide of iron,	1.84	.99	.95	1.20	.75
Potassium oxide,	54.35	56.12	54.32	47.68	59.34
Sodium oxide,	5.42	2.35	2.56	4.02	4.04
Magnesium oxide,	4.10	5.08	5.49	6.23	4.61
Calcium oxide,	15.96	17.21	17.68	18.96	14.69
Phosphoric acid,	18.33	18.25	19.00	21.91	16.57
	100.00	100.00	100.00	100.00	100.00

The results of the ash analyses of the currants are calculated and reported with reference only to the several constituents mentioned in the above statement, for the purpose of rendering the variations in their quantitative relations more conspicuous. Other ash constituents as sulphur, chlorine, and silica are for the present for various reasons excluded from the discussion. A careful consideration of the composition of the ash obtained from fruits raised upon the *unfertilized* plat (IV), as compared with any of those obtained from fruits raised upon the *fertilized* plats, cannot fail to lead to the conclusion that the unfertilized soil contained an ample supply of available phosphoric acid, magnesia, soda, and iron; for even an actual addition of these important plant constituents in the form of fertilizer to the soil of plats I, III and V, failed to increase the quantity of these constituents above that found in the ash of fruits raised upon the unfertilized plat. The only ash constituent in which the unfertilized soil seems apparently to have been deficient, is available potassa.

An addition of potash compounds to the soil has in every instance increased the percentage of potassa in the fruits, varying from six to eleven and more per cent. The fruit gathered from plat five showed the most remarkable difference in that direction. Potash fertilizers have decidedly improved desirable qualities in the fruits; those from plat five proved the most saccharine.

Aside from the practical lessons which may be gleaned from the above described experiment, there is another feature of the analytical results deserving a serious consideration,—namely the *increase* of *potassa* in the currants is invariably accompanied by a *corresponding decrease* of phosphoric acid, and of *lime* in particular. This result coincides with my previous observations, concerning the action of potash fertilizers on grapes, strawberries and peaches. The circumstance that the most striking alterations in the mineral constituents of the currants has been produced by muriate of potash, seems to be of particular interest in connection with some of my previous experiments, regarding the effects of that potash compound on *diseased peach trees.*

The examinations of fruits and of young branches from peach trees affected by

"THE YELLOWS"

disclosed the fact that they contained a larger amount of lime and more phosphoric acid than fruits and young branches collected from healthy peach trees of the same variety. This condition of diseased peach trees has since been recognized by Dr. R. C. Kedzie,—on trees raised in Michigan—in a letter to J. P. Leland, published Jan. 29th, 1884, in the Allegan *Gazette.*

It was also found in our experiments that a repeated application of muriate of potash in connection with a judicious pruning, restored the affected trees to a vigorous growth, and the new branches and fruit to a normal amount of potassa, lime and phosphoric acid. The excess of lime disappeared in both fruit and branches, and the trees are reported by Prof. Maynard, as restored to a healthy bearing condition.

The observation on currants (plat V) furnishes an additional illustration of the beneficial effect claimed by me for the muriate of potash. The importance of the interests involved, renders a fair trial desirable elsewhere. The details of the mode of operation are published in the forthcoming annual report of the Board of Control of the Experiment Station for 1883. The Director of the Station asks to be favored with information, regarding the results obtained.

GARDEN CROPS.

161. ASPARAGUS.

	Stems.	*Roots.*
Moisture at 100° C.,	5.53	4.85
Dry matter,	94.47	95.15
Nitrogen in dry matter,	1.98	1.48
Insol. in acids,	0.08	3.67

One hundred parts of crude ash contained:

	Stems.	*Roots.*
Potasssium oxide,	42.94	56.43
Sodium oxide,	3.58	5.42
Calcium oxide,	27.18	15.48
Magnesium oxide,	12.77	7.57
Phosphoric acid,	12.31	15.09
Sesquioxide of iron,	1.22	not determined.

The examination has been carried on at the especial request of several garden farmers in the eastern part of the state. The plants, serving for the analysis, were raised upon the college grounds, upon a light loamy soil, which previously had been occupied by grasses. The comparatively small amount of soda in the ashes of both stems and roots confirms the impression that the beneficial influence of common salt on asparagus beds not unfrequently reported, is due rather to its action on the physical condition of the soil, than to its requirement as plant food. The common salt increases the hydroscopic quality of the soil, assists in the diffusion of potassa, and phosphoric acid, and rarely supplies deficiencies in the soil, as far as its own constituents are concerned. A judicious application of muriate of potash, with sulphate of magnesia (Kieserit) tends to secure available potash throughout the entire body of the soil, penetrated by the extensive root mass of the plants.

162. ONIONS.

Samples collected on the college grounds.

One hundred parts of air dry onions without leaves contained:

Moisture at 100° C.,	89.200
Dry matter,	10.800
Nitrogen in dry matter,	0.212
Sulphur " "	0.048
Crude ash, " "	0.436

One hundred parts of ash contained:

Potassium oxide,	38.51
Sodium oxide,	1.90
Calcium oxide,	8.20
Magnesium oxide,	3.65
Sesquioxide of iron,	0.58
Silicic acid,	3.33
Phosphoric acid,	15.80

The analysis of onions was made some time ago, and is published here to meet inquiries of parties interested in the cultivation of this crop. The entire amount of sulphur present has been stated as sulphuric acid in the subsequent calculation of a crop per acre.

A calculation of the previously specified analytical results shows, that from four hundred and forty-one, to four hundred and forty-two bushels, of fifty-two pounds each, of onions in an air dry fresh state, contained:

Potassium oxide,	38.51	pounds
Sodium oxide,	1.90	"
Magnesium oxide,	3.60	"
Calcium oxide,	8.20	"
Sesquioxide iron,	0.58	"
Silicic acid,	3.33	"
Phosphoric acid,	15.80	"
Sulphuric acid,	29.81	"
Nitrogen,	48.63	"

FERTILIZER ANALYSES.

The fertilizers presented in this bulletin are valued on the basis of the prices of the past year, the samples being collected towards the close of the year. The rates for the valuation of fertilizers for the present year, will be published in the next bulletin. The annual collection of samples begins towards the close of the present month, n order to secure material from new stock.

TOBACCO STEMS.

163. Connecticut Valley tobacco. Sent on by E. S. Warner, Hatfield, Mass.

164. Havanna tobacco. Sent on by S. G. Hubbard, Hatfield, Mass.

	163	*164*
Moisture at 100° C.,	8.95	11.05
Dry matter,	91.05	88.95
Crude ash,	13.91	13.30
Nitrogen in dry matter,	2.69	2.91

One hundred parts of dry matter contained:

Potassium oxide,	6.21	3.76
Sodium oxide,	0.68	0.20
Calcium oxide,	4.76	4.15
Magnesium oxide,	1.14	1.53
Phosphoric acid,	0.87	0.50
Sesqui oxide iron,	not determined.	0.16

Valuation per ton of 2,000 pounds for fertiltzing purposes.

$16.00	$14.28

Analysis 163 is republished from last year's report for the purpose of enabling a comparison of the composition of the refuse stems of the entire tobacco plant of the Connecticut Valley with that of the leaf-stems of Havana tobacco, 164. The valuation is based on the prices of the past year;—it is safe to count one-tenth less, at the prices of the present year.

165. RAW CUBA GUANO.

Sent on from Boston, Mass.

166. DRIED CUBA GUANO.

Sent on from Boston, Mass.

	165		*166*	
Moisture at 100° C.,	36.57	per cent.	22.57	per cent.
Total phosphoric acid,	11.34	"	13.73	"
Soluble phosphoric acid,	.89	"	1.06	"
Reverted phosphoric acid,	3.52	"	4.45	"
Insoluble phosphoric acid,	6.93	"	8.22	"
Potassium oxide,	.94	"	1.20	"
Nitrogen (in organic matter),	.87	"	1.48	"
Nitrogen (in ammonia salts),	.14	"	.26	"
Nitrogen (in nitrates),	.64	"	1.00	"
Valuation per 2000 lbs.,	$24.00		$34.49	

167. AMERICO A 1 PERUVIAN GUANO.

Sent on by J. C. Cozzen, Swansea, Mass.

No guarantee obtained.

Moisture at 100° C.,	8.35	per cent.
Total phosphoric acid,	10.03	"
Soluble "	2.99	"
Reverted "	1.72	"
Insoluble "	5.32	"
Potassium oxide,	3.84	"
Nitrogen,	5.62	"
Valuation per 2000 lbs.,	$44.82	

168. The Economical Fertilizer, of Baugh & Sons, Philadelphia, Pa. Sent on by Sec. of Mass. State Board of Agriculture.

Guaranteed composition ; soluble and reverted phosphoric acid (available) 5 to 6 per cent. ; sulphate of potash, 4 to 5 per cent. ; ammonia, 2 to 2½ per cent., (equivalent to nitrogen 1.6 to 2. per cent.).

169. Baugh's Double Eagle Phosphate. Sent on by Sec. of State Board of Agriculture.

Guaranteed composition ; soluble and reverted phosphoric acid (available) 5 to 6 per cent. ; ammonia, 2 to 2½ per cent., (equivalent to nitrogen 1.6 to 2. per cent.).

170. Clark's Cove Guano, of Clark's Cove Guano Co., New Bedford, Mass. Collected of E. S. Snow, Belchertown, Mass., by Chemist of Station.

No guarantee obtained.

171. Ames Bone Fertilizer, of A. L. Ames, Peabody, Mass. Collected at Danvers, Mass., by Chemist of Station.

No guarantee obtained.

	168	*169*	*170*	*171*
	POUNDS PER HUNDRED.			
Moisture at 100° C.,	8.10	7.23	22.95	12.38
Total phosphoric acid,	8.68	8.86	8.38	16.41
Soluble "	3.13	4.49	6.39	4.60
Reverted "	.88	1.18	.07	7.38
Insoluble "	4.67	3.19	1.92	4.43
Potassium oxide,	2.31		2.30	.75
Nitrogen, (in organic matter),	2.74	2.20	.76	2.75
Nitrogen, (in ammonia salts),			1.14	
Nitrogen, (in nitrates),			.29	
Valuation per 2000 lbs.,	$29.73	$25.72	$29.02	$40.54

C. A. GOESSMANN, *Director*,

AMHERST, MASS.

J. E. Williams, Printer, Amherst, Mass.

MASSACHUSETTS STATE

AGRICULTURAL EXPERIMENT STATION.

BULLETIN No. 8.

APRIL, 1884.

FODDER AND FODDER ANALYSES.

The Experiment Station has entered in its first year of existence, upon a systematic course of experiments to assist in determining the influence of stage of growth and mode of cultivation on the comparative feeding value of some of our prominent farm crops. The results thus far published, although essentially of local interest, deserve more than a passing notice, on account of the scarcity of examinations of a similar character of forage crops raised under quite common circumstances within the limits of the State. The significance of the various analytical results will become more apparent, as the work progresses. As the character of the soil and its state of fertility ought to be better known before a more detailed discussion of the connection between soil, season and composition of the crop can be considered profitable, a mere record of the progress of the analytical work is all that can be consistently published at the present stage of the investigation. Aside from the trials with some of our standard forage crops there have been also inaugurated experiments with the cultivation of reputed forage crops of other localities and countries, to test their adaptability to our soil and climate. The successful introduction of a greater variety of valuable fodder crops, promises to furnish a wider range of fodder-substances, as far as their nutritive value is concerned, a circumstance not less acceptable to our agricultural industry, than it has proved elsewhere. The best interests of the dairy business call for an efficient protection against the serious influences of drought, during past years, on the yield of meadows and pastures. The cultivation of fodder crops, growing upon different kinds of soil, and maturing at different periods of the season, have proved of valuable assistance in that direction. Some of the results of our trials with cow pea, serradella, vetch, etc., will be reported within a few subsequent papers.

172. COW PEA.

Dolichos (sinensis?) ; var. Clay.

From Experimental Plats of Station ; collected August 1, 1883.

	Percentage Composition.	Constituents (in lbs.) in a ton of 2000 lbs.	Pounds digestible in a ton of 2000 lbs.	Per cent. of digestibility of constituents.	Nutritive Ratio.
Moisture at 100° C.,	9.30	186.00			
Dry Matter,	90.70	1814.00			
	100.00	2000.00			
ANALYSIS OF DRY MATTER.					1 : 4.75
Crude Ash,	9.53	190.60			
" Cellulose,	23.58	471.60	221.65	47	
" Fat,	3.81	76.20	44.96	59	
" Protein, (nitrogenous matter),	17.02	340.40	204.24	60	
Non-nitrogenous extract matter,	46.06	921.20	635.63	69	
	100.00	2000.00	1106.48		

The seeds for these experiments were obtained through the kindness of Dr. Dabney, Director of the State Experiment Station of North Carolina. The rates of digestibility of the various constituents of the hay of the cow pea, above stated, are those of clover hay—a fodder substance of a similar character. The "Clay" variety of the cow pea is considered the best of the many varieties raised in the Southern States. The merits of this plant are described by a farmer of North Carolina,* in the following words: "It has no ten-

*See Report of North Carolina Experiment Station for 1879, page 111.

drils, but twines like beans, or runs upon its own foliage. It is of rapid growth, making in three months on ordinary land, an almost impenetrable mass of foliage two feet high, and so very dense that it destroys all other vegetation, even the thistle, ragweed, and other noxious plants. When well cured these vines are simply invaluable for hay, and worth as ascertained by actual experiments, thirty-three to fifty per cent. more than timothy. The only difficulty in making them the leading crop for hay, is that it takes three days to cure them. Cattle and horses prefer such hay to the best of herds-grass, and even to corn. Pea vines are the best fertilizer we can use, decomposing very rapidly. I have frequently cut off the vines before they began to run (July 1), and by August the roots would throw out new vines two feet long. The seed sold in May for seventy-five cents per bushel."

The experimental plats were seeded down towards the latter part of May, and produced a handsome dense foliaceous growth about 18 inches high at the beginning of August, when the samples for analysis were collected. The early frost in September injured the crop. The plant apparently deserves the importance claimed for it in the above stated report. Its cultivation has proved a success in New Jersey. The only objection which might be raised against its introduction consists in the circumstance that matured seeds cannot be relied on in our section of the country. As green fodder it compares well with clover, and most likely would produce a valuable ensilage.

173. COW PEA.

Var.: Whippoorwill.

From Experimental Plats of Station; collected August 1, 1883.

	Percentage Composition.	Constituents (in lbs.) in a ton of 2000 lbs.	Pounds digestible in a ton of 2000 lbs.	Per cent. of digestibility of constituents.	Nutritive Ratio.
Moisture at 100° C., ...	9.65	193.00			
Dry Matter, ...	90.35	1807.00			
	100.00	2000.00			
ANALYSIS OF DRY MATTER.					1:4.74
Crude Ash, ...	10.46	209.20			
" Cellulose, ...	22.36	447.20	210.18	47	
" Fat, ...	3.87	77.40	45.67	59	
" Protein (nitrogenous matter),	16.95	339.00	203.40	60	
Non-nitrogenous extract matter, . .	46.36	927.20	639.77	69	
	100.00	2000.00	1099.02		

This variety is described as making but little vine, and is considered less valuable than the "Clay" variety. It made a dense foliaceous growth fully equal to latter in size. Neither of them produced seeds.

174. COW PEA.

Var.: Whippoorwill.

Raised on plats of Station, as mixed crop, with oats. Collected August 1, 1883.

	Percentage Composition.	Constituents (in lbs.) in a ton of 2000 lbs.	Pounds digestible in a ton of 2000 lbs.	Per cent. of digestibility of constituents.	Nutritive Ration.
Moisture at 100° C.,	9.75	195.00			
Dry Matter,	90.25	1805.00			
	100.00	2000.00			
ANALYSIS OF DRY MATTER.					1 : 4.95
Crude Ash,	7.87	157.40			
" Cellulose,	19.06	381.20	179.16	47	
" Fat,	4.49	89.80	52.98	59	
" Protein, (nitrogenous matter),	17.17	343.40	206.04	60	
Non-nitrogenous extract matter,	51.41	1028.20	709.46	69	
	100.00	2000.00	1147.64		

The analysis was made from the pea vines, raised with the oats; the analysis of the latter has been reported in Bulletin 5, (No. 102). This course of separate analysis was adopted on account of the uneven distribution of both plants. The mixed crop was on the first of August in excellent condition for green fodder or hay. An experiment with rye failed on account of a bad quality of rye. Assuming the mixed crop of peas and oats to consist of three times as much oats as peas, the nutritive ratio of the mixture would be 1 : 12. In case of two parts of oats and one of cow peas, the ratio would be 1 : 10, and in of even quantities of both plants, the ratio would be 1 : 8.7. Raised in connection with rye, the nutritive value of the mixed crop would be still higher. Within three months time a fodder can be raised fully equal if not decidedly superior in nutritive value to our best English grasses.

VALUATION OF FERTILIZERS

—AND—

ANALYSES OF FERTILIZERS.

PRICES OF NITROGEN, PHOSPHORIC ACID, AND POTASH.

The prices to be used in computing values of Commercial Fertilizers for the year 1884, are given in this bulletin. They are approved at the experiment stations of Connecticut, Massachusetts, and New Jersey, and furnish a uniform basis for comparisons of cost and commercial values of different brands offered in market, when their analyses are known.

TRADE VALUES OF FERTILIZING INGREDIENTS IN RAW MATERIALS AND CHEMICALS.

	CENTS PER POUND.			
	1881	1882	1883	1884
Nitrogen in Ammonia Salts,	22½	29	26	22
" Nitrates,	26	26	20	18
" Dried and fine ground fish,	20	24	23	20
Organic nitrogen in guano and fine ground blood and meat,	20	24	23	18
Organic nitrogen in cotton seed, linseed meal, and in castor pomace,	16	18	18	18
Organic nitrogen in fine ground bone,	15	17	17	18
Organic nitrogen in fine medium bone,	14	15	15	16
Organic nitrogen in medium bone,	13	14	14	14
Organic nitrogen in coarse medium bone,	12	13	13	12
Organic nitrogen in coarse bone, horn shavings, hair, and fish scraps,	11	11	11	10
Phosphoric acid soluble in water,	12½	12½	11	10
" " " ammonia citrate,*	9	9	8	9
Phosphoric acid insoluble in dry fine ground fish, and in fine bone,	6	6	6	6
Phosphoric acid insoluble in fine medium bone,	5½	5½	5½	5½
Phosphoric acid insoluble in medium bone,	5	5	5	5
" " " coarse med. "	4½	4½	4½	4½
" " " " "	4	4	4	4
" " " fine ground rock phosphate,	3½	3	2¾	2¼
Potash as high grade sulphate,	7½	7	7	7¼
" Kainite,	5½	5	4¼	4¼
" Muriate,	4½	5	4¼	4¼

*Dissolved from two grams of Phosphate, unground, by 100 C. C. neutral solution of ammonium citrate sp. gr. 1.09 in 30 minutes at 40 deg. C., with agitation once in five minutes; commonly called "reverted" or "backgone" phosphoric acid.

The above trade values are the figures at which on March 1st, the respective ingredients could be bought at retail, for cash in our 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 1st, plus about 20 per cent. in case of goods for which we have wholesale quotations. The calculated values obtained by the use of the above figures, will be found to agree fairly with the reasonable retail price in case of standard raw materials, such as:

Sulphate of Ammonia,
Nitrate of Soda,
Muriate of Potash,
Sulphate of Potash,
Dried Blood,
Azotin,
Dry Ground Fish,
Cotton Seed,
Castor Pomace,
Bone
Plain Superphosphates.

TRADE VALUES IN SUPERPHOSPHATES, SPECIAL MANURES AND MIXED FERTILIZERS OF HIGH GRADE.

The organic nitrogen in these classes of goods will be reckoned at the highest figure laid down in the Trade Values of Fertilizing Ingredients in Raw Materials, namely, twenty cents per pound.

Insoluble phosphoric acid will be reckoned at four and one-half ($4\frac{1}{2}$) cents, the cost of phosphoric acid in coarse medium bones. Potash at four and one-quarter cents, if sufficient chlorine is present in the fertilizer to combine with it. If there is more potash present than will combine with chlorine, then this excess of potash will be reckoned as sulphates.

The use of the highest trade values, is but justice to those articles in which the costliest materials are used. In most cases the calculated value of superphosphates and specials will fall considerably below the retail price. The difference between the two will represent the manufacturer's expenses in converting raw materials into the manufactured articles.

These expenses include grinding and mixing, bagging or barreling, storage and transportation, commission to agents or dealers, long credit, interest on investment, bad debts, and finally profits.

Last year the selling price of the superphosphates and specials was on the average fifteen per cent. greater than the Station valuations, or thirty-five per cent. in advance of the wholesale cost of the fertilizing elements in the raw materials.

The average cost of Ammoniated Superphosphates and Guano was about $41.50, the average estimated value was about $35.00, and the difference $6.50.

In case of specials, average cost was $50.00, average valuation $42.50, difference $7.50.

It has been the aim in previous bulletins of the Station to describe briefly in connection with analytical reports regarding their composition, the peculiar character and the special merits of prominent agricultural chemicals, and of refuse materials of various industries which are commonly used for the manufacture of compound fertilizers for farm purposes.

This feature of the bulletins will be retained for the future, wherever an inducement is offered. The information thus far given on these occasions may be improved by studying the official annual reports on Commercial Fertilizers published for ten years past, in the Reports of the Mass. State Board of Agriculture. A knowledge of the sources and of the character of the ingredients which serve largely for the manufacture of our commercial fertilizers, leads quite naturally to a due appreciation of the importance of securing *the proper form* for our circumstances. No mode of supplying our special wants of plant food for a successful and economical cultivation of crops is as safe, as the practice to supplement—if needed—our home-made manures with commercial fertilizing ingredients in the form of suitable raw materials and chemicals to meet our wants; and if obliged to increase our home resources of manure, to compound them from the most suitable stock in the market. Although a first trial of that course of action may not realize all the advantages expected, there can be no doubt about the correctness of the statement, that the best financial success on the part of the farmer can only be secured by the gradual adoption of that system of manuring the farm.

Our leading dealers in fertilizers begin to realize the late tendency in their trade, and are preparing to meet the call. There is every reason to assume that the consumption of commercial manurial matter will increase in the same proportion, as the principles of a rational and economical system of manuring becomes better understood.

175. THE PHŒNIX FRUIT TREE INVIGORATOR.

Manufactured by the Phœnix Fruit Tree Invigorator Co., of Livonia, Livingston Co., N. Y.

"A specific for the Aphis on Fruit Trees and Berry Bushes of all kinds."

"PATENT SECURED."

Sent on for examination by the Editor of the *New England Homestead*, Springfield, Mass.

One hundred parts of the material contained:

Moisture at 100° C.,	21.75
Sulphur free,	41.25
Sulphur combined (with alkalies),	1.66
Sulphuric acid,	0.64
Phosphoric acid,	0.82
Chlorine,	0.20
Carbonic acid,	9.54
Ferric oxide,	0.68
Magnesium oxide,	1.13
Potassium oxide,	3.34
Calcium oxide,	14.08
Small quantities of soda with coal, etc.,	2.07
Ash constituents insoluble in acid,	2.84
	100.00

CLAIMS OF THE MANUFACTURER.

"This compound when applied to plants or trees, is taken up by the circulation of the sap, and carried by it to the leaves, where it is reorganized and distributed to all parts of the tree, giving the tree a healthy leaf, and a vigorous growth. Price per pound box, $1.50."

DIRECTIONS GIVEN BY THE MANUFACTURER FOR USE.

"For Fruit Trees. Bore into the trunk of the tree near the ground with $\frac{5}{8}$ bit till the heart is nearly reached; and fill the opening with the Phœnix Fruit Tree Invigorator, and close tight with a thin cork or grafting wax. A wooden stopper may be used. Apply any time during the winter and spring, till the first of June.

"For Berry, Currant, Rose Bushes and House Plants. Remove the dirt and rough bark from the roots, and apply the invigorator, covering again with dirt."

The mode of applying the offered remedy for the destruction of insect life, and for the promotion of a healthful growth of plants, requires certainly a serious operation, and a first trial if at all contemplated, ought to be carried out on a limited scale. The proposition to introduce the remedy directly into the circulation of the plant, is not without its analogy in the treatment of animals. One point, however, must be cheerfully conceded—the patentee means to get a liberal pecuniary compensation for his [redacted] discovery.

A mixture of an essentially corresponding composition, may be produced at an expense of from 12 to 15 cents per pound, at retail cost, by taking from 40–42 lbs. of flour of sulphur, and 58–60 lbs. of sifted wood ash.

176-177. SALT MUD.

Sent on by L. B. Goodwin, So. Duxbury, Mass.

I. Sample taken from a dock dug in a salt marsh. The sender states that large quantities of kelp have been unloaded at this dock, and a good deal of ell-grass is also deposited.

II. Taken from the flats at low water mark.

	I.	II.
Moisture at 100° C.,	46.36	60.37
Ash constituents,	49.28	33.09
Insoluble in acids,	43.55	26.20
Nitrogen in organic matter,	0.39	0.40

Soluble constituents contained:

	I.	II.
Sesqui oxide of iron,	4.55	3.70
Calcium oxide,	0.66	0.90
Magnesium oxide,	0.31	0.43
Potassium oxide,	0.33	0.32
Sodium oxide,	0.94	1.21
Phosphoric acid,	traces.	traces.

178. BLACK MUD.

From the flats near Weymouth, Mass.

Sent on by Thomas A. Watson, Esq.

Moisture at 100° C.,	56.55
Ash constituents,	39.60
Insoluble in acids,	31.84
Nitrogen in organic matter,	0.30

Soluble constituents contained:

Sesqui oxide of iron,	4.26
Calcium oxide,	0.91
Magnesium oxide,	0.66
Potassium oxide,	0.38
Sodium oxide,	0.86
Phosphoric acid,	traces.

These three deposits of tidal water are of a similar composition. The amount of organic matter present does not exceed seven per cent.; and the soluble mineral substances are mainly those found in the water of the ocean. The commercial value of plant constituents amounts at present rates per ton of the deposits, in none of them to more than $1.75; in the last named sample still less.

For those interested in the composition of the fertilizing material deposited and collected along the seashore, the following references are given:

Kelp and *Rockweed.* See Report of State Board of Agriculture 1878–79; page 347.

Rockweed and *Musselmud.* Rep. 1879–80; page 338—339.

Eelgrass. Rep. 1882–83; page 407.

179. FRESH WATER MUD.

(Little Pond at South Braintree.)

Sent on by A. Drew, Esq., Boston, Mass.

Analysis of a fairly dried samples:

Moisture at 100° C.,	40.37
Calcium oxide,	1.27
Magnesium oxide,	0.29
Potassium oxide,	0.22
Ferric oxide,	1.80
Phosphoric acid,	.26
Nitrogen,	1.37
Insoluble matter,	18.26

The material in its natural state contains 72 per cent. water; in its composition it resembles a fibrous peat; yet it is less humified, and will yield its nitrogen, etc., more readily. One ton of the analyzed material represents a commercial value of from 5 to 6 dollars.

180. WESTERN ASHES.

(Leached.)

Sent on from Hingham, Mass., by Edmund Hersey, for the Hingham Agricultural and Horticultural Society.

Moisture at 100° C.,	24.53
Calcium oxide,	26.53
Magnesium oxide,	3.03
Potassium oxide,	0.79
Phosphoric acid,	1.89
Insol. matter, before Calcination,	21.71

The composition of this sample of leached ashes resembles closely that of a previously reported one from Detroit, Mich. (See Bulletin 5, No. 108).

181. GARDEN FERTILIZER.

Sent on by farmers from Somerset, Mass.

Moisture at 100° C.	6.64
Soluble phosphoric acid,	0.70
Reverted " "	2.12
Insoluble " "	8.26
Total phosphoric acid,	11.08
Potassium oxide,	11.42
Nitrogen,	4.28
Insoluble matter,	0.90

Valuation per 2000 lbs. $39.49

C. A. GOESSMANN, *Director*,

AMHERST, MASS.

☞ *The Bulletins of the Station will be sent free of charge to all parties interested in its work on application.*

J. E. Williams, Printer, Amherst, Mass.

MASSACHUSETTS STATE

Agricultural Experiment Station.

BULLETIN No. 9.

MAY, 1884.

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182. NOTES UPON INSECTS INJURIOUS TO FARM AND GARDEN CROPS.

In the annual report of the Station is to be found a statement of experiments made to ascertain the best means of destroying the many insects that make havoc among the crops of the farm and garden. Some of the experiments gave satisfactory results and extended preparations are being made to learn more of the *more harmless materials* that may be used as insecticides. As the results cannot be presented to the public in time to be of use the early part of this season, we give a brief statement of the remedies thus far found to be the most successful.

Cabbage Flea.—The first insect of importance that appears is the small black flea or jumping beetle that attacks the cabbage, radish, turnip, etc. Dusting with paris green mixed with one hundred times its weight of plaster has proved an effectual remedy. This must be done when the plants are wet and after every rain.

Cut Worm.—The cut worm of which there are several species, including the army worm, work only during the night, and may be destroyed by the same remedy as the above. We would advise a trial of pyrethrum powder mixed with five times its bulk of plaster as being more safe, although we have no positive proof that it will be effectual.

Striped Squash Bug.—The striped squash bug which has been so abundant for the past two seasons, is best kept in check by the use of plaster and paris green. For the family garden the safest and most satisfactory way to overcome them is to make a bottomless box twelve inches square, and six or eight inches deep, and cover it with mosquito netting. One of these boxes placed over each hill until the plants have become tough and hard, is a sure protection.

The Potato Beetle.—The potato beetle has evidently become a permanent resident among us. Paris green extended with plaster, flour or water, is the only cheap and easily applied remedy known at present, but great care must be exercised in its use and especially in the place where the package is kept, that it may not get upon the food of animals.

Cabbage Worm.—The cabbage worm, the larvæ of the common white butterfly, may be easily destroyed in several ways. That of hand picking, if begun before the first brood have passed into its perfect state, is effectual. We have also found that pyrethrum powder mixed with five times its bulk of plaster and dusted into the centre of the leaves with sulphur bellows, is certain destruction to every one of them. The application of insecticides in liquids to the cabbage has not been satisfactory on account of the peculiar structure of the leaf surface which allows the water to roll off in drops and not adhere to any part of it. Paris green is unsafe to use after the leaves have become over four inches in diameter.

Currant Worm.—The currant worm should be destroyed, while small, with the dust of hellebore or pyrethrum. The latter being perfectly harmless is to be more highly recommended.

Plum Weevel.—There are two certain methods of capturing the plum weevil, the first by jarring the tree early in the morning and catching them upon sheets stretched below upon a frame or upon the ground, and the second by placing chicken coops under the trees. The former method must be attended to regularly every morning for three weeks after the plums have set, and in the latter case, if the number of trees is large, a large flock of chickens will be required to make that remedy effectual.

Codling Moth.—No positive remedy against the ravages of this insect has as yet been found. It is claimed that paris green sprayed over the tree in water is effectual, but should it prove so, it is far too dangerous a remedy to apply where grass or other crops are growing under them.

Apple and Peach Borer.—For the destruction of these two insects no sure remedy has been found except the knife. It is probable that covering the trunk of the tree near the ground with the ink or tar used to catch the moths of the canker worm, or wrapping around the trunk bands of tarred paper, would assist in keeping them away.

THE ROSE BUG.—The rose bug has thus far been the most difficult to overcome of the whole tribe of injurious insects, and we can recommend no remedy with a great degree of confidence, but would advise the trial of the fumes of gas tar held under the vines a short time every evening while the grapes are forming. It is certainly offensive to them, and if used carefully need not injure the plant.

ROSE SLUGS.—This insect is easily destroyed by spraying with water and pyrethrum at the rate of one tablespoonful of the latter to a pailful of the former.

LETTERS.—Several letters have been received asking for information in regard to insects and fungus injurious to plants, which have been answered by letter, and for general information we insert the answers of a few of them.

Letter No. 1, containing shoots of the apple tree covered with a coating of black masses containing some fungus growth. These black masses are the result of dust adhering to the shoots made sticky by the exudations of the common apple aphis or plant louse which were unusually abundant the past two seasons and caused great injury to young trees. The remedy is to syringe with strong soap suds or with a tablespoonful of pyrethrum in one pail of water.

Letter No 2, contained twigs of the peach tree in which were found a double row of the eggs of the tree cricket (*Œcanthus niveus*). This insect lays its eggs more commonly in the branches of the raspberry and blackberry, but in some cases in those of the peach and plum. The larvæ, after hatching, leave the twigs and for a time feed upon plant lice, and later in the season upon succulent ripe fruit. The tree cricket is light green in color, and when full grown, is about three-fourths of an inch long, and lays its eggs in autumn in the centor of the shoots in long lines as mentioned above.

S. T. MAYNARD,

Professor of Botany and Horticulture,

Mass. Agricultural College.

FODDER AND FODDER ANALYSES.

183. COMMON MILLET.

Collected from plats of Station, when blooming, Aug. 14, 1883.

I.

	Percentage Composition.	Constituents (in lbs.) in a ton of 2000 lbs.	Pounds digestible in a ton of 2000 lbs.	Per cent. of digestibility of constituents.	Nutritive Ratio.
Moisture at 100° C.,	6.15	123.00			
Dry Matter.	93.85	1877.00			
	100.00	2000.00			
ANALYSIS OF DRY MATTER.					
Crude Ash,	4.67	93.40			1 : 8.32
" Cellulose,	29.80	596.00			
" Fat,	2.04	40.80	17.14	42	
" Protein, (nitrogenous matter),	7.69	153.80	92.28	60	
Non-nitrogenous extract matter,	55.80	1116.00	725.40	65	
	100.00	2000.00	834.82		

184. COMMON MILLET.

From plats of the Station, when fully matured, Sept. 3, 1883.

II.

	Percentage Composition.	Constituents (in lbs). in a ton of 2000 lbs.	Pounds digestible in a ton of 2000 lbs.	Per cent. of digestibility of constituents.	Nutritive Ratio.
Moisture at 100° C.,	6.73	134.60			
Dry Matter,	93.27	1865.40			
	100.00	2000.00			
ANALYSIS OF DRY MATTER.					
Crude Ash,	4.23	84.60			1 : 8.05
" Cellulose,	33.39	667.80			
" Fat,	2.67	53.40	21.36	40	
" Protein, (nitrogenous matter),	7.09	141.80	85.08	60	
Non-nitrogenous extract matter,	52.62	1052.40	631.44	60	
	100.00	2000.00	737.88		

The analyses of both samples point towards an exhausted condition of the soil, on which they were raised.

185. PEARL MILLET. (In bloom).
Collected from plats of Station, Sept. 19, 1884.

	Percentage Composition.	Constituents (in lbs.) in a ton of 2000 lbs.	Pounds digestible in a ton of 2000 lbs.	Per cent. of digestibility of constituents.	Nutritive Ratio.
Moisture at 100° C., - - - - - - -	6.20	124.00			
Dry Matter, - - - - - - - - - - -	93.80	1876.00			
	100.00	2000.00			
ANALYSIS OF DRY MATTER.					
Crude Ash, - - - - - - - - - - -	4.80	96.00			
" Cellulose, - - - - - - - - -	35.91	718.20			
" Fat, - - - - - - - - - - -	1.63	32.60	13.69	42	1 : 8
" Protein, (nitrogenous matter),	7.20	144.00	86.40	60	
Non-nitrogenous extract matter, - -	50.46	1009.20	655.98	65	
	100.00	2000.00	756.07		

The composition of this variety of millet differs but slightly from that of No. 183. I. This result is to some extent most likely more due to the inferior condition of the lands they were raised on, than to a corresponding character of the varieties examined.

186. HUNGARIAN GRASS. (Panicum germanicum).
From the farm of Levi Adams, Hadley, Mass.
Collected in bloom, Sept. 4, 1883.

	Percentage Composition.	Constituents (in lbs.) in a ton of 2000 lbs.	Pounds digestible in a ton of 2000 lbs.	Per cent. of digestibility of constituents.	Nutritive Ratio.
Moisture at 100° C., - - - - - - -	7.45	149.00			
Dry Matter, - - - - - - - - - - -	92.55	1851.00			
	100.00	2000.00			
ANALYSIS OF DRY MATTER.					
Crude Ash, - - - - - - - - - - -	5.73	114.60			
" Cellulose, - - - - - - - - -	31.96	639.20			
" Fat, - - - - - - - - - - -	2.22	44.40	18.65	42	1 : 6.22
" Protein, (nitrogenous matter),	9.45	189.00	113.40	60	
Non-nitrogenous extract matter, . -	50.64	1012.80	658.32	65	
	100.00	2000.00	790.37		

The composition of the above sample is very fair.

187. SERRADELLA.

(Ornithopus sativus. Brot).

I. Obtained from plats of the Station, when blooming, Aug. 14, 1883.

I.

	Percentage Composition.	Constituents (in lbs.) in a ton of 2000 lbs.	Pounds digestible in a ton of 2000 lbs.	Per cent of digestibility of constituents.	Nutritive Ratio.
Moisture at 100° C.,	7.20	144.00			
Dry Matter,	92 80	1856.00			
	100.00	2000.00			
ANALYSIS OF DRY MATTER.					1:4.72
Crude Ash,	5.87	117.40			
" Cellulose,	24.37	487.40			
" Fat,	2.37	47.40	28.44	60	
" Protein (nitrogenous matter),	17.85	357.00	224.91	63	
Non-nitrogenous extract matter,	49.54	990.80	990.80	100	
	100.00	2000.00	1244.15		

188. II. From plats of Station, collected Sept. 3, 1883, when fully matured.

II.

	Percentage Composition.	Constituents (in lbs.) in a ton of 2000 lbs.	Pounds digestible in a ton of 2000 lbs.	Per cent. of digestibility of constituents.	Nutritive Ratio.
Moisture at 100° C.,	8.70	174.00			
Dry Matter,	91.30	1826.00			
	100.00	2000.00			
ANALYSIS OF DRY MATTER.					1:5.47
Crude Ash,	6.46	129.20			
" Cellulose,	25.14	502.80	236.32	47	
" Fat,	2.91	58.20	29.10	50	
" Protein, (nitrogenous matter),	15.26	305.20	183.12	60	
Non-nitrogenous extract matter,	50.23	1004.60	693.17	69	
	100.00	2000.00	1141.71		

The Serradella, like the vetch, is an annual leguminous plant, which has found its way from Portugal into central Europe some fifty years ago. It grows from one foot to one foot and one-half high, and prefers a moist deep sandy soil. Time of seeding and mode of cultivation correspond with those customary in the cultivation of peas. The growth of the plant is slow until the time of blooming, when it rapidly increases in size and nutritive constituents. The close of the blooming period at the end of August, is the best time for cutting the crop. Leading agriculturalists speak very highly of this fodder plant.

189. VETCH.

(Vicia sativa, var. angustifolia).

I. Collected from experimental plats, Aug. 15th, 1883, in bloom.

I.

	Percentage Composition.	Constituents (in lbs.) in a ton of 2000 lbs.	Pounds digestible in a ton of 2000 lbs.	Per cent. of digestibility of constituents.	Nutritive Ration.
Moisture at 100° C.,	8.35	167.00			
Dry Matter,	91.65	1833.00			
	100.00	2000.00			
ANALYSIS OF DRY MATTER.					
Crude Ash,	7.97	159.40			1 : 4.02
" Cellulose,	30.68	613.60	331.34	54	
" Fat,	2.30	46.00	27.60	60	
" Protein, (nitrogenous matter),	15.76	315.20	239.55	76	
Non-nitrogenous extract matter,	43.29	865.80	562.77	65	
	100.00	2000.00	1161.26		

The vetch has received already considerable attention in various sections of the country; reports thus far speak with much satisfaction of the results. The plant resembles in many respects the common garden pea; there are early and late varieties in cultivation. Its period of vegetation is from 18 to 22 weeks, and the time for seeding corresponds with that of the pea. The common vetch is a hardier plant than the latter, and grows well upon an inferior soil. Its reputation as a valuable green fodder, either single or when grown in common with rey, oats, or barley. is well established.

190. II. Collected from experimental plats, Sept. 3, 1883, when fully matured.

II.

	Percentage Composition.	Constituents (in lbs.) in a ton of 2000 lbs.	Pounds digestible in a ton of 2000 lbs.	Per cent. of digestibility of constituents.	Nutritive Ratio.
Moisture at 100° C.,	9.45	189 00			
Dry Matter,	90.55	1811.00			
	100.00	2000.00			
ANALYSIS OF DRY MATTER.					1 : 4.09
Crude Ash,	8.50	170.00			
" Cellulose,	30.05	601.00	270.45	45	
" Fat,	2.69	53.80	32.28	60	
" Protein, (nitrogenous matter),	14.42	288.40	204.76	71	
Non-nitrogenous extract matter,	44.34	886.80	487.74	55	
	100.00	2000.00	995.23		

The seeds of the matured vetch are ground and commonly used as a rich nitrogenous fodder in place of ground peas and beans. In some sections of central Europe the flour of the seeds is used for bread. The straw is a valuable fodder, and ranks among the most nutritious kind obtained from leguminous plants.

191. BARNYARD GRASS. (Panicum crus-galli).
Collected in bloom from College Farm, August 14, 1883.

	Percentage Composition.	Constituents (in lbs.) in a ton of 2000 lbs.	Pounds digestible in a ton of 2000 lbs.	Per cent. of digestibility of constituents.	Nutritive Ratio.
Moisture at 100° C.,	6.65	133.00			
Dry Matter,	93.35	1867.00			
	100.00	2000.00			
ANALYSIS OF DRY MATTER.					
Crude Ash,	10.82	216.40			
" Cellulose,	33.72	674.40			1 : 2.94
" Fat,	1.95	39.00	16.38	42	
" Protein, (nitrogenous matter),	15.27	305.40	183.24	60	
Non-nitrogenous extract matter,	38.24	764.80	497.12	65	
	100.00	2000.00	696 74		

This grass is found quite frequently around barns and compost heaps, as a weed. The analysis of the above sample shows strikingly the influence of a liberal manuring on the composition of the species of plants, of which it is a variety.

FERTILIZER ANALYSES.

192. GROUND HORN.

Of Perkins & Bradstreet, Danvers, Mass.

Sent on for examination by J. J. H. Gregory, Marblehead, Mass.

Moisture at 100° C.,	10 00
Organic and Volatile matter,	95 00
Ash,	5 00
Phosphoric acid,	1 36
Nitrogen in organic matter,	13 53

VALUATION PER 2000 LBS.

170.6 lbs. nitrogen at 10c.,	$27.06
27.2 lbs. phosphoric acid at 4½c.,	1.22
	$28.28

The inferior mechanical condition of the article advises the low valuation of the nitrogen present.

193. LOBSTER SHELLS.

Sent on for examination by J. Shedd, 90 Waltham St., Boston, Mass.

Moisture at 100° C.,	7.27
Calcium oxide,	22.24
Magnesium oxide,	1.30
Phosphoric acid,	3.52
Nitrogen,	4.50
Insoluble matter,	0.27

The material sent on consisted of coarse pieces of the shells with meat mass in a dry condition. The large percentage of carbonate of lime present tends to promote a rapid decomposition of the organic nitrogenous matter, and favors thus a speedy action of the lobster shells, when dried and ground before their application. Counting phosphoric acid in the coarsely ground material 4½ cts. per pound, and nitrogen 20 cts. per pound, its commercial value would be from 22 to 23 dollars per ton.

194. LIME KILN ASHES.

Collected of R. T. Prentiss, Holyoke, Mass.

195. ONONDAGA PLASTER.

Sent on by H. D. Fearing, Amherst. Mass.

	194	*195*
	POUNDS PER	HUNDRED.
Moisture at 100° C.,	30.70	22.55
Calcium oxide,	37.55	29.80
Magnesium oxide,	3.68	4.32
Potassium oxide,	1 70	
Phosphoric acid,	1.27	
Carbonic acid,	17.83	8.80
Sulphuric acid,		31.58
Insoluble matter,	3.30	10.70

Both articles are fair specimens of their kind. The lime kiln ashes sold at 22 cts. per bushel, and the New York gypsum at from 6 to 7 dollars per ton at their respective selling places.

196. CRUDE KIESERITE.

Of Randall Fertilizer Co., Boston, Mass.

Sent on by C. P. Preston, Danvers, Mass.

Moisture at 100° C.,	28.12
Magnesium oxide,	17.45
Calcium oxide,	3.13
Sulphuric acid,	36.87
Insoluble matter,	3.62

The sample contained 48.6 per cent. of sulphate of magnesia, from 7 to 8 per cent. of gypsum, and 2.23 per cent. of chloride of magnesium; it is consequently of fair quality.

197. DRY FISH.

Quinnipiac Co.'s dry ground fish.

Collected of D. A. Horton, Northampton, Mass.

Guaranteed composition; soluble and reverted (available) phosphoric acid, 2 to 4 per cent.; total phosphoric acid, 6 to 8 per cent.; nitrogen, 7 to 9 per cent., (equivalent to ammonia 9 to 11 per cent.).

198. Dry fish, collected of H. L. Phelps, Northampton, Mass.

Guaranteed composition; total phosphoric acid, 6 to 8 per cent.; ammonia, 10 to 12 per cent., (equivalent to nitrogen, 8.24 to 10 per cent.).

	197	198
	POUNDS PER HUNDRED.	
Moisture at 100° C.	10.65	9.10
Total Phosphoric Acid,	7.30	9.08
Soluble "	1.70	1.70
Reverted "	1.83	2.14
Insoluble "	3.77	5.24
Nitrogen in organic matter,	7.51	8.42
Insoluble Matter,	2.05	2.62
Valuation per 2000 lbs.	$40.12	$45.65

199. FISH AND POTASH.

Bowkers' Fish and Potash.

Collected of C. F. Brown, Northampton, Mass.

Guaranteed composition: total phosphoric acid, 8 to 10 per cent.; potassium oxide, 4 to 6 per cent.; nitrogen $2\frac{1}{2}$ to $3\frac{1}{2}$ per cent.

	199
	POUNDS PER HUNDRED.
Moisture at 100° C.,	10.65
Total phosphoric acid,	10.78
Soluble "	2.24
Reverted "	1.52
Insoluble "	7.02
Potassium oxide,	3.73
Nitrogen, (in organic matter),	2.07
Insoluble matter,	7.20
Valuation per 2000 lbs.,	24 99

200. BONES.

Of National Fertilizer Co., Bridgeport, Conn.

Collected of Wilder & Puffer, Springfield, Mass.

Guaranteed composition; total phosphoric acid, 22 to 24 per cent.; ammonia, 2 to 3 per cent., (equivalent to nitrogen, 1.7 to 2.5 per cent.).

201. Fine Ground Bones, of Bowker Fertilizer Co., Boston, Mass. Collected in Amherst, Mass.

Guaranteed composition; total phosphoric acid, 20 to 23 per cent.; ammonia 3 to 4 per cent., (equivalent to nitrogen, 2.5 to 3.3 per cent.

	200.	201.
	POUNDS PER HUNDRED.	
Moisture at 100° C.,	9.40	10.00
Total phosphoric acid	25.37	22.74
Soluble phosphoric acid, / Reverted "	3.92	3.97
Insoluble phosphoric acid,	21.45	18.77
Nitrogen,	2.28	3.85
Insoluble matter,	1.65	
Valuation per 2000 lbs.,	34.57	36.90

AMMONIATED SUPERPHOSPHATES AND COMPLETE MANURES.

202. Ammoniated superphosphate, of Geo. W. Miles' Co., Milford, Conn. Collected of D. J. Wright, Northampton, Mass.

Guaranteed composition: soluble and reverted phosphoric acid, (available), 8 to 12 per cent.; potassium oxide 2 to 3 per cent.; nitrogen $2\frac{1}{4}$ to $3\frac{1}{4}$ per cent.

203. L. L. Crocker's Ammoniated Bone Superphosphate. Collected of R. T. Prentiss, Holyoke, Mass.

Guaranteed composition: soluble phosphoric acid, 6 to 8 per cent.; reverted phosphoric acid, 2 to 4 per cent.; insoluble phosphoric acid, 1 to 2 per cent.; potassium oxide, 1 to 3 per cent.; ammonia, $3\frac{1}{2}$ to $4\frac{1}{2}$ per cent., (equivalent to nitrogen, 2.90 to 3.70 per cent.).

204. Stockbridge Manure. Potato. Bowker Fertilizer Co., Boston, Mass. Collected of R. T. Prentiss, Holyoke, Mass.

Guaranteed composition; total phosphoric acid, 8 to 10 per cent.; soluble and reverted phosphoric acid, (available), 7 to 8 per cent.; potassium oxide, 5 to 6 per cent.; $3\frac{1}{4}$ to $4\frac{1}{4}$ per cent. nitrogen

205. Bradley's X L Ammoniated Bone Superphosphate of Bradley Fertilizer Co., Boston, Mass. Collected of R. T. Prentiss, Holyoke, Mass.

Guaranteed composition; soluble phosphoric acid, 7 to 8 per cent.; reverted phosphoric acid, 2 to 3 per cent.; potassium oxide, 2 to 3 per cent.; nitrogen, 2.50 to $3\frac{1}{4}$ per cent.

	202	203	204	205
	POUNDS PER HUNDRED.			
Moisture at 100° C.,	19.63	12.18	17.60	16.65
Total phosphoric acid,	11.87	11.98	11.19	12.53
Soluble "	6.68	6.65	7.23	8.44
Reverted "	1.14	1.87	1.48	.98
Insoluble "	4.05	3.46	2.48	3.11
Nitrogen, (in organic matter),	2.81	3.43	1.83	3.22
Nitrogen, (in ammonia salts),			1.67	
Nitrogen, (in nitrates),			.46	.29
Potassium oxide,	1.12	.95	4.29	1.60
Insoluble matter,	5.55	4.85	4.40	5.10
Valuation per 2000 lbs.,	$31.24	$34.31	$39.33	$36.72

C. A. GOESSMANN, *Director*,

AMHERST, MASS.

☞ *The Bulletins of the Station will be sent free of charge to all parties interested in its work on application. There are no back numbers of Bulletins from 1 to 6 on hand. The analytical statements of these Bulletins are embodied in the first annual report of the Station.*

MASSACHUSETTS STATE
AGRICULTURAL EXPERIMENT STATION.

BULLETIN No. 10.

JUNE, 1884.

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206. OBSERVATIONS REGARDING THE VITALITY OF THE SEED OF VARIOUS WEEDS, AND THE CAUSES OF CERTAIN DISEASES OF GRASSES.

The several subjects submitted to me for answers by the Board of Control have been carefully investigated and I am able to make the following report:—

1. How is the vitality of the seeds of our most common weeds, such as dock, sorrel, chickweed, shepherd's purse, white daisy, etc., etc., affected by the action of the digestive organs of animals?

Answer. Seeds of the dock, sorrel, daisy and shepherd's purse were fed to a horse and the refuse collected. Upon careful examination it was found that the seeds, unless crushed, were uninjured and germinated readily when placed in soil under proper conditions of heat and moisture. The experiment was repeated several times with the same result.

2. How is the vitality of the common weed seeds, like the above, affected by the action of the compost-heap?

Answer. Having settled the point that weed seeds are not destroyed by the action of the digestive organs of animals, it becomes important to know how their vitality may be destroyed; for while the thorough farmer should never allow weeds to mature their seed on his farm, there are many instances where it becomes necessary to provide some means by which chance seeds may be destroyed. A series of experiments were carried out, the result of which is, that seeds are destroyed if exposed to a température of from 90° to 110° F. for from five to seven days in a moist compost-heap. In a dry compost-heap, where the temperature runs as high as the above, the seeds were found but little injured. The tests were applied only to the above named seeds, but it is probable that the results would be the same upon others as these are among the seeds of the greatest vitality. The efficiency of this mode of destruction depends upon the maintainance of a continued high temperature and moisture, which will cause the seeds to either germinate and then decay, or to decay before germinating. The amount of moisture can be easily regulated and by properly working over any pile of compost containing a large amount of organic matter, the required amount of heat may be obtained. From the above experiments it would seem doubtful if the practice of keeping swine upon manure piles to cause slow decomposition is the best for manure containing weed seeds. It is also doubtful if the seeds of weeds often put into the pens where pigs are kept will be destroyed by the action of the little heat there generated. It would probably be safer in both of the above cases to compost the manure in large piles before using it upon the land.

3. At what stage of blooming are the seeds of the white daisy (*leucanthemum vulgare*) matured enough to germinate?

Answer. This weed has become so abundant in the grass land of some sections of the state that it must be cut with the grass, and it becomes important to know if it can be cut with the grass before the the seeds mature. After a series of careful examinations it has been decided that when the flower first reaches its full expansion few or no seeds are mature enough to germinate, but that it requires only a few days for these seeds to mature to full ripeness. In view of these facts it would not seem safe for the farmer to depend wholly upon the early stage of cutting, but to afterwards compost all manures made from fodder containing weed seeds of any kind.

June Grass and White Top.—To this grass, on account of the many inflorescences that fail to mature and turn white, is often given the name of *white top*, and the question is often asked, "what is the cause of this condition?" Upon careful investigation it has been found that this condition is most prevalent upon land exhausted by long cropping or where the roots have been much injured by the larveae of the *June Bug* or *May Beetle*. The turning of the top to a white color is due to the destruction of the culm or stalk just above the last leaf, by a fungus growth. Upon rich land and where there are few insect larveae working at the roots, there is little or none of this white top, and we are led to reason that the fungus does not attack the stem of the grass until the cells have become weakened in some way.

S. T. MAYNARD,
Professor of Botany and Horticulture,
Mass. Agricultural College.

207. NOTES ON FEEDING EXPERIMENTS WITH CORN ENSILAGE.

The experiments were chiefly carried on for the purpose of testing the feeding value of corn ensilage, as compared with that of hay. A description of the general character of the ensilage as well as of the hay and corn meal used in this connection, will be found upon a few subsequent pages within this Bulletin. Three cows—crosses between native stock and Ayrshires—of a corresponding milking period—were selected from the herd of the Mass. Agricultural College, to serve for the trial. The previous mode of feeding, the amount of each article of fodder actually consumed per day, and the daily yield of milk were carefully noted during the week preceding the removal of the animals to the stalls of the Station (April 7—14). Each cow had received for some time previous to that date, four quarts of clear corn meal per day, together with all the hay they could consume. This mode of feeding was continued at the station from April 14 to 29, by careful application of the scale in all measurements, to secure reliable values for comparison.

HISTORY OF COWS.

I. Name, CLARA. Age, 5 years. Weight, 895 lbs. No. of calves, 3. Last calf, Feb. 25, 1884. Feed, 4 quarts of clear corn meal ($6\frac{1}{2}$ lbs.), and $15\frac{1}{2}$ lbs. of hay. Average yield of milk per day (April 14 until 30th), $15\frac{1}{2}$ lbs.

Composition of Milk.	*April 8.*	*April 11.*	*April 14.*
Water at 100° C.,	88.04	87.32	87.39
Total solids,	11.96	12.68	12.61
Fat (in solids),	3.27	3.48	3.56

Mean of three analyses.

Water,	87.58
Total solids,	12.42
Fat (in solids),	3.44

II. Name, NELLIE MAY. Age, 4 years. Weight, 860 lbs. No. of calves, 2. Last calf, Feb. 15, 1884. Feed, 4 quarts of clear corn meal ($6\frac{1}{2}$ lbs.), and $16\frac{1}{3}$ lbs. of hay per day. Average yield of milk per day, $14\frac{1}{2}$ lbs.

Composition of Milk.	*April 8.*	*April 11.*	*April 14.*
Water at 100° C.,	87.57	87.18	87.09
Total solids,	12.43	12.82	12.91
Fat (in solids),	3.71	3.82	3.87

Mean of three analyses.

Water,	87.28
Total solids,	12.72
Fat (in solids),	3.80

III. Name, Fairy. Age, 5 years. Weight, 862 lbs. No. of calves, 2. Last calf, Feb. 20, 1884. Feed, 4 quarts of clear corn meal (6½ lbs.), and 17 lbs. of hay per day. Average yield of milk per day, 18½ lbs., (April 14—30).

Composition of Milk.	*April 8.*	*April 11.*	*April 14.*
Water at 100° C.,	87.46	87.67	87.54
Total solids,	12.54	12.33	12.46
Fat (in solids),	3.33	3.20	3.34

Mean of three analyses.

Water,	87.56
Total solids,	12.44
Fat (in solids),	3.29

STATEMENT OF DRY VEGETABLE MATTER CONSUMED IN FORM OF HAY AND CORN MEAL BY EACH COW, BEFORE ENSILAGE WAS INTRODUCED.

I. Clara.

April 19—30.		*Dry Matter.* (*lbs.*)	*Milk Produced.* (*lbs.*) *per day.*
Hay consumed, per day (lbs.),	15.46	13.90	15½
Meal " " "	6.50	5.60	
	21.96	19.50	

II. Nellie May.

April 19—30.		*Dry Matter.* (*lbs.*)	*Milk Produced.* (*lbs.*) *per day.*
Hay consumed, per day (lbs.),	16⅓	14.70	14½
Meal " " "	6½	5.60	
	22⅚	20.30	

III. Fairy.

		Dry Matter. (*lbs.*)	*Milk Produced.* (*lbs.*) *per day.*
Hay consumed, per day (lbs.),	17.00	15.30	18½
Meal " " "	6.50	5.60	
	23.50	20.90	

After the previously stated mode of feeding, and the quantity and quality of the milk obtained thereby had been carefully tested during two weeks' observation under the management of the Station,

CORN ENSILAGE

was introduced as an additional article of the daily diet, in the following way. The amount of corn meal, four quarts (6 1-2 lbs.) per day remained the same during the entire trial. The ensilage was gradually substituted for the hay in the daily fodder, as far as the animal felt disposed to consume it. During the first twelve days of the experiment, each was offered forty pounds of ensilage per day, and subsequently sixty pounds, besides all the hay they would consume. They varied widely in their preference, as subsequent detailed statements show. The manner of feeding was as follows: At 5 : 30 A. M. the meal was fed to the animals during milking, and at 6 o'clock the ensilage. At 12 o'clock M. from four to five pounds of hay were offered: and at five P. M. the remainder of the meal was given, and the rest of the ensilage soon after. At 8 o'clock P. M., from four to five pounds of hay were again offered. Any material remaining after each feeding was removed and weighed. As a rule they consumed first the leaves of the corn, and left, if any, more or less of the harder stem parts behind. They received twice per day all the water they would drink.

I. Name, CLARA.

FEEDING.	Food consumed, (lbs.) per day.			Milk Produced, (lbs.) per day.		Amount of dry vegetable matter contained in the daily fodder consumed in pounds.
	Indian Meal.	English Hay.	Ensilage.	Morning.	Evening.	
Periods.						
May 1—6.	$6\frac{1}{2}$	7	$33\frac{1}{2}$	$8\frac{1}{3}$	$7\frac{1}{2}$	16.3
May 6—12.	$6\frac{1}{2}$	7	$29\frac{1}{2}$	8	7	15.8
May 12—18.	$6\frac{1}{2}$	$5\frac{1}{3}$	$34\frac{1}{3}$	$7\frac{2}{3}$	7	14·9
May 18—27.	$6\frac{1}{2}$	$5\frac{1}{3}$	28	7	$6\frac{1}{2}$	14.1

Analyses of Milk.

May,	*3*	*7*	*12*	*20*	*23*	*26*
Water,	87.25	87.39	87.20	87.69	87.88	87.97
Solids,	12.75	12.61	12.80	12.31	12.12	12.03
Fat (in solids),	3.68	3.62	3.66	3.47	3.21	3.47

Mean of three last stated analyses of milk.

Water,	87.85
Total solids,	12.15
Fat (in solids),	3.39

II. Name, Nellie May.

FEEDING.	Food Consumed (lbs.) per day.			Milk Produced (lbs.) per day.		Amount of dry vegetable matter contained in the daily fodder consumed in pounds.
	Indian Meal.	English Hay.	Ensilage.	Morning.	Evening.	
Periods.						
May 1—6.	6½	7½	40	8½	7½	17.6
May 6—12.	6½	7⅓	40	8⅓	7	17.4
May 12—18.	6½	6	54	8	7⅓	18.1
May 18—27.	6½	5⅔	45½	8	7⅓	16.7

ANALYSES OF MILK.

May,	*3*	*7*	*12*	*20*	*23*	*26*
Water,	87.00	87.09	87.43	87.39	87.19	87.37
Solids,	13.00	12.91	12.57	12.61	12.81	12.63
Fat (in solids),	3.81	3.91	3.86	3.80	3.68	3.68

Mean of three last stated analyses of milk.

Water,	87.32
Total solids,	12.68
Fat (in solids),	3-72

III. Name, Fairy.

FEEDING.	Food Consumed (lbs.) per day.			Milk Produced (lbs.) per day.		Amount of dry vegetable matter contained in the daily fodder consumed in pounds.
	Indian Meal.	English Hay.	Ensilage.	Morning.	Evening.	
Periods.						
May 1—6.	6½	8	40	10	9	18
May 6—12.	6½	8	40	10⅓	9	18
May 12—18.	6½	7⅓	59	10	9	19.9
May 18—27.	6½	7⅓	54½	10	9	19.4
May 27. June 10.	6½	7⅔	56	9.9	9	19.8

ANALYSES OF MILK.

May,	*3*	*7*	*12*	*20*	*23*	*26*	*June 10*
Water,	87.16	86.99	86.84	87.33	87.55	87.57	87.10
Solids,	12.84	13.01	13.16	12.67	12.45	12.43	12.90
Fat (in solids),	4.08	3.88	3.93	3.60	3.29	3.37	3.61

Mean of three last stated analyses of Milk.

Water,	87.41
Total solids,	12.59
Fat (in solids),	3.43

The cows, with the exception of No. 1, retained their original weight well.

SUMMARY OF OBSERVATIONS UNDER EXISTING CIRCUMSTANCES.

1. The cows differed widely in their preference for ensilage.

2. Reducing the ensilage to the same state of dryness noticed in the hay, we find that the total quantity of the *dry vegetable matter* previously consumed, has been considerably reduced, in consequence of the introduction of the ensilage. This is more apparent in Nos. I and II, than in No. III.

3. The quantity of milk has in every instance increased, in consequence of the addition of ensilage to *our customary mode of feeding*, counting the amount of dry vegetable matter in each case pound for pound with the milk produced.

4. The increase in quantity of milk, counting on the basis of the total amount of fodder consumed, was most pronounced in case of moderate quantities of ensilage, i. e. from 35 to 40 lbs. per day.

5. The quality of milk was not perceptibly changed, as far as *the density and the amount of fat was concerned.* None of the mean results obtained after feeding ensilage has been below the lowest results, before its introduction in the daily diet.

In stating the composition of the milk only with reference to water, solid matter and fat, it has been by no means assumed,—in following thereby the common usage,—that the information regarding these points suffices under all circumstances to establish the normal character of a sample of milk. The total amount and the relative proportions of the various nitrogenous constituents of the milk,—commonly stated by the collective name—Casein,—are known to vary and to affect at times seriously its character.

Observations in that direction quite naturally suggested themselves in the course of our investigation. The results thus far obtained are, however,—for various reasons beyond our control,—not decisive enough to question at the present stage of our work seriously the good quality of the milk obtained in connection with the feeding of a moderate amount of corn ensilage. The total amount of nitrogenous matter—crude casein—noticed in case of cow No. II (May 11 and 26,) differed but slightly in different samples as far as its absolute quantity, and the relative proportions of casein, albumin and lactoprotein are concerned. The milk of cow No. III,—the largest consumer of ensilage, showed a somewhat larger amount of total nitrogenous matter—as compared with that from cow No. II; and the relative proportion of genuine casein had decreased, whilst that of albumin and lactoprotein showed a marked increase. Whether these results will prove hereafter to be merely of an incidental character, or will have to be ascribed to an excessive consumption of ensilage, farther studies at the earliest suitable occasion are designed to show. The financial side of the ensilage feeding is not discussed in this connection on account of the absence of exact figures regarding the cost of our ensilage.

The various articles of fodder used in the above stated feeding experiments are described under the following numbers in this bulletin: No. 208, Corn Meal; No. 209, Timothy Hay; No. 210, Corn Ensilage.

FODDER AND FODDER ANALYSES.

208. CORN MEAL.

From John L. Holley, South Amherst, Mass.

Ninety-two per cent. passed through mesh, 144 to the square inch.

	Percentage Composition.	Constituents (in lbs.) in a ton of 2000 lbs.	Pounds digestible in a ton of 2000 lbs.	Per cent. of digestibility of constituents.	Nutritive Ratio.
Moisture at 100° C.,	13.55	271.0			
Dry Matter,	86.45	1729.0			
	100.00	2000.00			
ANALYSIS OF DRY MATTER.					1:9.66
Crude Ash,	1.42	28.4			
" Cellulose.	2.64	52.8	17.95	34	
" Fat,	4.24	84.8	64.45	76	
" Protein, (nitrogenous matter),	10.40	208.0	176.80	85	
Non-nitrogenous extract matter,	81.30	1626.0	1528.44	94	
	100.00	2000.00	1787.64		

A fair article of its kind.

209. TIMOTHY HAY.

From the experimental Farm, 1883.

	Percentage Composition.	Constituents (in lbs.) in a ton of 2000 lbs.	Pounds digestible in a ton of 2000 lbs.	Per cent. of digestibility of constituents	Nutritive Ratio.
Moisture at 100° C.,	8.70	174.0			
Dry Matter,	91.30	1826.0			
	100.00	2000.00			
ANALYSIS OF DRY MATTER.					
Crude Ash,	4.04	80.8			
" Cellulose,	36.59	731.8			
" Fat,	2.12	42.4			
" Protein, (nitrogenous matter),	7.24	144.8			
Non nitrogenous extract matter,	50 01	1000.2			
	100.00	2000.00			

The hay was harvested in July, after blooming. The sample was taken from the barn in November. The article can scarcely be called a fair average quality of its kind.

210. ENSILAGE OF CORN IN TASSEL.

Sample taken from Silo when opened, April 29th.

	Percentage Composition.	Constituents (in lbs.) in a ton of 2000 lbs.	Pounds digestible in a ton of 2000 lbs.	Per cent. of digestibility of constituents	Nutritive Ration.
Moisture at 100° C.,	86.88	1737.6			
Dry Matter,	13.12	262.4			
	100.00	2000.00			
ANALYSIS OF DRY MATTER.					
Crude Ash,	6.89	137.8			1:6.57
" Cellulose,	33.66	673.2	484.70	72	
" Fat,	3.88	77.6	58.20	75	
" Protein, (nitrogenous matter),	12.58	251.6	183.67	73	
Non-nitrogenous extract matter,	42.99	859.8	576.06	67	
	100.00	2000.00	1302.63		

The silo which furnished this ensilage has been described in the first annual report of the Station. The fodder corn which filled the silo was well tasselled out, and had a few days previously suffered from a severe frost on the night of Sept. 3d.; it had been cut into pieces from two to three inches in length, before it was well tramped down, covered and subjected to a pressure of sixty pounds to a square foot of surface. The silo was opened for the use of its contents on April 29th. The color of the ensilage was dark yellowish green; it had an acid taste and odor. On the top of the mass and around its sides could be noticed for some inches in thickness some mould. The main bulk of the mass,—judging from the opinion expressed by many visitors to the Station—who claimed to be familiar with the usual appearance of corn ensilage,—corresponded evidently with a large proportion of the ensilage fed during the past.

A comparison of the above stated analysis of the dried ensilage with an analysis of the frost-bitten corn fodder collected at the time when the silo was being filled (No. 211) shows a decrease of non-nitrogenous constituents, except in the case of fat; and a decided increase in nitrogenous matter (crude protein). The nutritive properties of the corn fodder had been greatly modified in consequence of its treatment in the silo; its nutritive ratio (i. e. relation of nitrogen-containing food constituents to non-nitrogen-containing constituents) had been raised to that of our better grasses. This result is not an exceptional one *in character;* it is only marked *in degree,*—judging from well endorsed observations in competent hands elsewhere; and is coöperated in the case of all kinds of ensilage. Yet these changes in quality are accompanied by a considerable destruction of valuable organic matter. The fact that the nitrogenous constituents (crude protein), resist better the destructive influences in the ordinary silo, than the non-nitrogenous plant-constituents,—as starch, sugar, cellulose, etc.—is the real cause of the alteration in the nutritive character of the fodder in consequenee of our present management of the silo. An analysis of the liquid, which under a partial pressure upon our ensilage, accumulated upon the cleaned floor of the silo, admits of no other explanation. The investigation of the production of a good ensilage, together with a determination of cost as compared with hay, will be resumed at an early date.

LIQUID OF ENSILAGE TAKEN FROM THE BOTTOM OF THE SILO.

Specific Gravity at 20° C.,	1.025

102.5 Grams of solution required ½ Gram of carbonate of soda for its neutralization.

Moisture at 100° C.,	81.52
Dry matter,	18.38
	100.00

ANALYSIS OF DRY MATTER.

Sesqui-oxide of iron,	.04
Calcium oxide,	.85
Magnesium oxide,	1.07
Phosphoric acid,	.20
Potassium oxide,	.81
Sodium oxide,	.16
Nitrogen,	.59

0.246 parts of the nitrogen found in the liquid, was present in form of soluble albuminoids; and 0.344 parts in form of ammonia compounds. The liquid contained from three to four per cent. more of solid matter than the original corn fodder.

211. CORN FODDER. (Frost-bitten).

(In tassel).

From experimental plats of the Station.

	Percentage Composition.	Constituents (in lbs.) in a ton of 2000 lbs.	Pounds digestible in a ton of 2000 lbs.	Per cent. of digestibility of constituents'	Nutritive Ratio.
Moisture at 100° C., ...	8.83	176.60			
Dry Matter, ...	91.17	1823.40			
	100.00	2000.00			
ANALYSIS OF DRY MATTER.					1 : 9.83
Crude Ash, ...	4.86	97.20			
" Cellulose, ...	29.05	581.00	418.32	72	
" Fat, ...	2.06	41.20	30.90	75	
" Protein, (nitrogenous matter),	8.63	172.60	126.00	73	
Non-nitrogenous extract matter, . .	55.40	1108.00	742.36	67	
	100.00	2000.00	1317.58		

This cornfodder served for the production of the previously described corn ensilage. Its frost-bitten condition, and *half matured stage of growth*, have, no doubt, seriously affected the quality and quantity of the ensilage.

FISH FERTILIZERS.

Sent on for examination from Danvers, Mass.

212. Claimed to be chemically prepared fish.

213. Claimed to be clear fish waste.

	212. Pounds per hundred.	213. Pounds per hundred.
Moisture at 100° C.,	7.70	9.00
Total phosphoric acid,	8.15	11.72
Soluble "	0.67	
Reverted "	3.19	4.41
Insoluble "	4.29	7.31
Potassium oxide,	0.89	
Nitrogen, (in organic matter),	8.13	8.16
Insoluble matter,	14.65	3.70
Valuation per 2000 lbs.,	45.51	49 35

CORRECTION.—The percentage of nitrogen in No 197, of Bulletin No. 9, "Dry Fish of the Quinnipiac Fertilizer Co," has to be changed from 7.51 to 8 23; the valuation of the article per ton of 2000 lbs., from $40.12 to $43.00.

FISH AND POTASH.

214. Dry Ground Fish, of Stearns & Co., New York. Collected of B. F. Bridges, So. Deerfield, Mass.

Guaranteed composition; bone phosphate 15 to 20 per cent., (equivalent to phosphoric acid 6.86 to 9.16); ammonia 9 to 11 per cent., (equivalent to nitrogen 7.41 to 9 per cent.

215. (XX) Fish and Potash, of Geo. W. Miles' Co., Milford, Conn. Collected of D. J. Wright, Northampton, Mass.

Guaranteed composition; soluble and reverted phosphoric acid 5 to 8 per cent.; potassium oxide 4 to 6 per cent.; ammonia 4 to 6 per cent.; (equivalent to nitrogen 3.30 to 5 per cent.)

	214 Pounds per hundred.	215 Pounds per hundred.
Moisture at 100° C.	12.38	19.50
Total Phosphoric Acid,	7.99	9.74
Soluble "		4.86
Reverted "	1.78	0.04
Insoluble "	6.21	4.84
Potassium oxide,		3.05
Nitrogen,	7.57	3.40
Valuation per 2000 lbs.	$40.93	$30.34

C. A. GOESSMANN, *Director*,

AMHERST, MASS.

MASSACHUSETTS STATE

Agricultural Experiment Station.

BULLETIN No. 11.

SEPTEMBER, 1884.

216. NOTES ON FEEDING EXPERIMENTS WITH CORN ENSILAGE, CONTINUED.

(See No. 207, Bulletin No. 10.)

The previous Bulletin contained a report of observations concerning the effect of feeding corn ensilage, as a mere substitute for English hay, on the yield of milk and on the general conditions of three cows of a corresponding milking period. The observations, as far as reported on that occasion, extended over a period of from six to seven weeks. The daily feed consumed was stated in each case with reference to its *dry vegetable matter*, to prevent misconceptions regarding the actual amount contained in the daily fodder rations at different stages of the experiment. The amount of dry vegetable matter, actually consumed each day, was reported pound for pound, in connection with a statement of the daily yield of milk in pounds. A comparison of these statements showed, that the fodder, in which the corn ensilage had been largely a substitute for meadow hay, had produced a larger yield of milk,—comparing the amount of dry vegetable matter consumed with the yield of milk—pound for pound. A continuation of these experiments, which is reported in a few subsequent pages, has not altered our former conclusions regarding the influence of corn ensilage on the yield of milk. The daily records during the month of June, point strongly in that direction.

The addition of a liberal amount of wheat shorts (bran) to the daily diet, (9th of June), has in most instances but slightly affected the absolute yield of milk for the better; and has at no time changed the relative proportions between dry vegetable matter and the yield of milk, in favor of the former, as compared with the feeding of corn ensilage alone as an essential additional constituent of the original daily diet. The main benefit derived from the addition of wheat shorts to the daily fodder rations, consisted evidently in the improved appearance of the cows, in the improvement of the milk, and in an increased value of the manure resulting.

The important relations which exist between chemical composition and general character of dry vegetable matter, and its nutritive value under various circumstances, will be discussed at a later date of our experiment.

I. RECORD OF MELIA.

Ayrshire: 11 years old; dropped last calf Feb. 15, 1884.

[Melia consumed larger quantities of ensilage, and has taken the place of I. Clara in our previous record.]

1884.	Feed consumed (lbs.) per day. Corn Meal.	Wheat Shorts.	Hay.	Ensilage.	Milk produced (lbs.) per day. Morning.	Evening.	Total.	Amt. of dry vegetable matter contained in the daily fodder consumed in pounds.	Weight of Animal, (pounds.)
June 1 -									
" 2 -									
" 3 -	6½		7	20	14	13½	27½	14.5	692½
" 4 -	"		6	40	15	14½	29½	16.2	
" 5 -	"		5	40	14	14	28	15.3	
" 6 -	"		5	40	15	13½	28½	15.3	
" 7 -	"		6	40	14	13½	27½	16.2	
" 8 -	"		5	40	15½	12	27½	15.3	
" 9 -	"	6½	6	50	14	13	27	23.2	
" 10 -	"	"	5	58	14	12½	26½	23.4	
" 11 -	"	"	5	59	14½	13	27½	23.5	
" 12 -	"	"	5	60	15	12	27	23.6	
" 13 -	"	"	6	60	14½	12	26½	24.5	
" 14 -	"	"	5	60	14	13	27	23.6	
" 15 -	"	"	5	60	14	13	27	23.6	
" 16 -	"	"	5	60	14	14	28	23.6	
" 17 -	"	"	12	Stock of ensilage exhausted. Discontinued.	13½	14	27½	22.1	755
" 18 -	"	"	14		13	14	27	23.9	
" 19 -	"	"	12		13½	13	26½	22.1	
" 20 -	"	"	12		13½	13	26½	22.1	
" 21 -	"	"	12		14	12	26	22.1	
" 22 -	"	"	14		14	13	27	23.9	
" 23 -	"	"	14		13	13	26	23.9	
" 24 -	"	Discontinued.	New Hay 16		14	12	26	20.0	760
" 25 -	"		19		14	12	26	22.7	
" 26 -	"		16		13	11½	24½	20.0	
" 27 -	"		20		13	11	24	23.6	
" 28 -	"		20		12	11	23	23.6	
" 29 -	"		20		12	11	23	23.6	
" 30 -	"		20		12	10½	22½	23.6	

ANALYSES OF MILK.

June	*16*	*30*
Water,	87.84	88.29
Solids,	12.16	11.71
Fat (in solids),	3.21	2.99

II. RECORD OF NELLIE MAY.

1884.		Feed consumed (lbs.) per day. Corn Meal.	Wheat Shorts.	Hay.	Ensilage.	Milk produced (lbs.) per day. Morning.	Evening.	Total.	Amt. of dry vegetable matter contained in the daily fodder consumed in pounds.	Weight of Animal, (pounds.)
June 1	-	6½		7	37	8	7	15	16.7	
" 2	-	"		8	28	8	7	15	16.4	
" 3	-	"		7	35	8½	7	15½	16.7	852½
" 4	-	"		6	40	8½	8	16½	16.2	
" 5	-	"		5	40	8	8	16	15.3	
" 6	-	"		7	40	9	8	17	17.1	
" 7	-	"		7	40	9	8½	17½	17.1	
" 8	-	"		5	40	10½	8	18½	15.3	
" 9	-	"	6½	5	40	10	9	19	21.0	
" 10	-	"	"	7	40	10	8½	18½	22.8	
" 11	-	"	"	7	40	10	9	19	22.8	
" 12	-	"	"	7	40	9½	9	18½	22.8	
" 13	-	"	"	6	40	10	9	19	21.9	
" 14	-	"	"	6	40	10	9	19	21.9	
" 15	-	"	"	7	40	10	9	19	22.8	
" 16	-	"	"	7	40	10	10	20	22.8	
" 17	-	"	"	16		10	10	20	25.7	895
" 18	-	"	"	14	Discontinued. Stock of ensilage exhausted.	9½	9	18½	23.9	
" 19	-	"	"	13		9½	9	18½	23.0	
" 20	-	"	"	13		9½	9	18½	23.0	
" 21	-	"	"	14		9½	9	18½	23.9	
" 22	-	"	"	14		9½	9	18½	23.9	
" 23	-	"	"	15		9	9	18	24.8	
" 24	-	"	Discontinued.	New Hay 16		10	9	19	20.0	902
" 25	-	"		20		9½	9	18½	23.6	
" 26	-	"		16		9½	9	18½	20.0	
" 27	-	"		20		9	9	18	23.6	
" 28	-	"		20		9½	9	18½	23.6	
" 29	-	"		20		9½	9	18½	23.6	
" 30	-	"		20		9	9	18	23.6	

ANALYSES OF MILK.

June	*16*	*30*
Water,	86.89	87.20
Solids,	13.11	12.80
Fat (in solids),	3.81	3.83

III. RECORD OF FAIRY.

1884.	Food consumed (lbs.) per day. Corn Meal.	Wheat Shorts.	Hay.	Ensilage.	Milk produced (lbs.) per day. Morning.	Evening.	Total.	Amt. of dry vegetable matter contained in the daily fodder consumed in pounds.	Weight of Animal, (pounds.)
June 1 -	6½		8	55	9½	8	17½	20.0	
" 2 -	"		8	60	9½	8	17½	20.6	
" 3 -	"		8	60	10	9	19	20.6	885
" 4 -	"		8	60	10	9½	19½	20.6	
" 5 -	"		7	60	10	9½	19½	19.7	
" 6 -	"		8	60	10½	9½	20	20.6	
" 7 -	"		8	60	10	9½	19½	20.6	
" 8 -	"		7	58	11½	9	20½	19.5	
" 9 -	"	6½	7	60	11	9½	20½	25.4	
" 10 -	"	"	7	60	11	9	20	25.4	
" 11 -	"	"	7	60	11	9	20	25.4	
" 12 -	"	"	6	60	11	10	21	24.5	
" 13 -	"	"	6	60	11	10	21	24.5	
" 14 -	"	"	7	55	11	10	21	24.8	
" 15 -	"	"	8	60	11	10	21	26.3	
" 16 -	"	"	8	57	11	10	21	25.9	
" 17 -	"	"	16		11	10	21	25.7	910
" 18 -	"	"	15	Stock of ensilage exhausted. Discontinued.	10½	10	20½	24.8	
" 19 -	"	"	15		11	10	21	24.8	
" 20 -	"	"	14		10½	10	20½	23.9	
" 21 -	"	"	14		10	10	20	23.9	
" 22 -	"	"	14		10½	10	20½	23.9	
" 23 -	"	"	15		10	9½	19½	24.8	
" 24 -	"	Discontinued.	New Hay 16		10½	9	19½	20.0	885
" 25 -	"		20		10½	10	20½	23.6	
" 26 -	"		20		10½	9½	20	23.6	
" 27 -	"		20		10	9½	19½	23.6	
" 28 -	"		20		10	10	20	23.6	
" 29 -	"		20		10	10	20	23.6	
" 30 -	"		20		10	10	20	23.6	

ANALYSES OF MILK.

June	*10*	*16*	*30*
Water,	87.10	86.60	87.36
Solids,	12.90	13.40	12.64
Fat (in solids),	3.61	3.83	3.53

FODDER AND FODDER ANALYSES.

217. WHEAT BRAN.

From John L. Holley, South Amherst, Mass.

Thirty-three per cent. passed through mesh 144 to the square inch.

	Percentage Composition.	Constituents (in lbs.) in a ton of 2000 lbs.	Pounds digestible in a ton of 2000 lbs.	Per cent. of digestibility of constituents.	Nutritive Ratio.
Moisture at 100° C.,	12.08	241.6			
Dry Matter,	87.92	1758.4			
	100.00	2000.00			
ANALYSIS OF DRY MATTER.					
Crude Ash,	7.92	158.4			1 : 4.16
" Cellulose,	13.72	274.4	54.88	20	
" Fat,	3.81	76.2	60.96	80	
" Protein, (nitrogenous matter),	15.67	313.4	275.79	88	
Non-nitrogenous extract matter,	58.88	1177.6	942.08	80	
	100.00	2000.00			

This quality of wheat bran, which is of a fair composition, has been used in the previously described feeding experiments.

218. CORN STOVER.

From plats of the Station.

	Percentage Composition.	Constituents (in lbs.) in a ton of 2000 lbs.	Pounds digestible in a ton of 2000 lbs.	Per cent. of digestibility of constituents.	Nutritive Ratio.
Moisture at 100° C.,	8.73	174 6			
Dry Matter,	91.27	1825.4			
	100.00	2000.00			
ANALYSIS OF DRY MATTER.					1 :21.16
Crude Ash,	3.12	62.4			
" Cellulose.	34.28	685.6			
" Fat,	1.27	25.4	7.62	30	
" Protein, (nitrogenous matter),	6.58	131.6	52.64	40	
Non-nitrogenous extract matter,	54.75	1095.0	1095.00	100	
	100.00	2000.00	1155.26		

219. WHEAT GRAIN.

From plats of the Station.

	Percentage Composition.	Constituents (in lbs.) in a ton of 2000 lbs.	Pounds digestible in a ton of 2000 lbs.	Per cent. of digestibility of constituents.	Nutritive Ratio.
Moisture at 100° C.,	10.58	211.60			
Dry Matter,	89.42	1788.40			
	100.00	2000.00			
ANALYSIS OF DRY MATTER.					1 : 6.42
Crude Ash,	2.18	43.60			
" Cellulose,	2.42	48.40			
" Fat,	1.79	35.80	30.64	80.0	
" Protein, (nitrogenous matter),	13.35	267.00	240.30	90.0	
Non-nitrogenous extract matter,	80.26	1605.20	1484.81	92.5	
	100.00	2000.00	1755 75		

The composition of this article is a very fair one.

220. WHEAT STRAW.

From plats of the Station.

	Percentage Composition.	Constituents (in lbs.) in a ton of 2000 lbs.	Pounds digestible in a ton of 2000 lbs.	Per cent. of digestibility of constituents.	Nutritive Ratio.
Moisture at 100° C.,	6.50	130.00			
Dry Matter,	93.50	1870.00			
	100.00	2000.00			
ANALYSIS OF DRY MATTER.					1 : 29.09
Crude Ash,	7.44	148.80			
" Cellulose,	40.74	814.80	423.70	52	
" Fat,	1.59	31.80	8.59	27	
" Protein, (nitrogenous matter),	5.32	106.40	27.66	26	
Non-nitrogenous extract matter,	44.91	898.20	359.28	40	
	100.00	2000.00	819.23		

The composition of this sample is better than the average article.

FERTILIZER ANALYSES.

221. REFUSE SALT.

Collected of R. T. Prentiss, Holyoke, Mass.

Moisture at 100° C.,	1.70
Calcium oxide,	1.21
Magnesium oxide,	0.14
Sulphuric acid,	1.57
Sodium chloride,	95.38

The article is a fair specimen of its kind. A detailed discourse of the various kinds of salt used for agricultural purposes, etc., may be found in the annual report of the Mass. State Board of Agriculture for 1869, page 18.

AMMONIUM SULPHATE.

222. Collected of D. A. Horton, Northampton, Mass. Guaranteed 25 per cent. of ammonia.

223. Sent on for examination by M. W. Jefts, for the Ashly Farmer's Club, Ashly, Mass.

	222	223
	Pounds per hundred.	
Moisture at 100° C.,	1.88	0.42
Ammonia,	25.07	24.00
Valuation per 2000 lbs.,	$90.64	$87.12

The cost of this article has varied widely at times; the valuation is based on our annual rate, 22 cts. per pound of nitrogen in ammonia salts.

MURIATE OF POTASH.

224. Sent on by M. W. Jefts, for Ashly Farmer's Club, Ashly, Mass.

225. Collected of Boston Fertilizer Co., by C. P. Preston, Danvers, Mass.

226. Collected of Bowker Fertilizer Co., at Amherst, Mass.

	224	225	226
	Pounds per hundred.		
Moisture at 100° C.,	1.00	0.05	0.90
Potassium oxide,	51.94	49.60	50.80
Valuation per 2000 lbs.,	$44.15	$42.16	$43.18

WOOD ASHES.

Sent on for examination by G. B. Hall, Pres. of Ipswich Farmer's Club, Ipswich, Essex County, Mass.

227. Canada Ashes; sold at 34 cts. per bushel, weight 48 lbs.

228. Maine Ashes; sold at 30 cts. per bushel, weighing 42 lbs.

	227	228
	Pounds per hundred.	
Moisture at 100° C.,	5.46	18.00
Calcium oxide,	35.58	34.34
Potassium oxide,	5.83	4.17
Sodium oxide,	0.61	0.84
Phosphoric acid,	2.55	2.56
Insoluble matter,	11.95	8.70

The difference in the composition of these samples of wood ashes is largely due to a different state of moisture. The retail prices stated do not vary materially from those in our section of the State.

229. KAINITE.

Collected of D. A. Horton, Northampton, Mass.

Moisture at 100° C.,	2.15
Calcium oxide,	0.82
Magnesium oxide,	11.30
Potassium oxide,	16.48
Sulphuric acid,	21.91
Valuation per 2000 lbs.,	$14.08

230. LIME KILN ASHES.

Collected of J. A. Sullivan, Northampton, Mass.

Moisture at 100° C.,	20.55
Calcium oxide,	45.53
Magnesium oxide,	1.80
Potassium oxide,	1.35
Phosphoric acid,	2.92
Carbonic acid,	21.10
Insoluble matter,	8.23

Sold at 18 cts. per bushel in retail, and $12\frac{1}{2}$ cts. per bushel in car loads.

231. PENGUIN ISLAND GUANO.

Sent on for examination.

Guaranteed composition ; bone phosphate, 51.76 per cent. (equal to 23.07 phosphoric acid) ; ammonia 1.43 per cent., (equivalent to nitrogen 1.18 per cent.)

Moisture at 100° C.,	12.10
Total phosphoric acid,	24.35
Soluble " "	0.35
Reverted " "	6.97
Insoluble " "	17.03
Potassium oxide,	0.14
Nitrogen in organic matter,	0.23
Nitrogen in ammonia salts,	0.26
Nitrogen in nitrates,	0.24
Total nitrogen,	0.73
Valuation per 2000 lbs.,	$31.62

This article deserves a careful trial upon lands rich in organic matter ; in particular upon moist grass lands.

232. DISSOLVED BONEBLACK.

Sent on by M. W. Jefts, for Ipswich Farmer's Club, Ipswich, Essex County, Mass.

Moisture at 100° C.,	11.05
Total phosphoric acid,	18.87
Soluble " "	17.83
Reverted " "	.53
Insoluble " "	.51
Insoluble matter,	.83
Valuation per 2000 lbs.,	$37.26

BONES.

233. Darling's Fine Bones. Collected of Parker & Gannet, Boston, Mass.

Guaranteed composition; phosphoric acid, 25 per cent.; nitrogen, 3 to 4 per cent.

Moisture at 100° C.,	4.70
Total phosphoric acid,	26.62
Soluble } " "	{ 6.77
Reverted } " "	
Insoluble " "	19.85
Nitrogen,	3.56
Valuation per 2000 lbs.,	$50.25

AMMONIATED SUPERPHOSPHATES AND COMPLETE MANURES.

Moisture in Fertilizers. The quantity of moisture contained in a compound fertilizer exerts a controlling influence on the results of its analysis; and yet, comparatively speaking, but few manufacturers mention in their printed guaranty of composition, the approximate amount of that constituent in their articles, upon which their guaranteed composition is based.

An article, for instance, which, with 10 per cent. of moisture, analyzes 10 per cent. of soluble phosphoric acid, 2.5 per cent. of nitrogen, and 5. per cent. of potassium oxide, will analyze 9. per cent. of phosphoric acid, 2.25 per cent. of nitrogen, and 4.5 per cent. of potassium oxide, in case of containing 19 per cent. of moisture.

Statements of comparative tests regarding the *exact composition* of two fertilizers, are, for this reason, always made with a definite reference to a corresponding state of their moisture. Manufacturers who state the composition of the articles they offer for sale, without mentioning, at least approximately, the amount of moisture they contain, deprive the inspector of the chance to recognize exceptional conditions in their goods.

The manufacturer of fertilizers is expected to state, in the interest of his customers, the total weight of the article contained in each package;—besides—within certain limits—the amount of phosphoric acid, nitrogen and potassium oxide he offers for sale in each hundred weight. As long as the fertilizer is carefully stored, no serious alterations, either in total weight or in original composition, are expected within one season of keeping. Quite different, however, will be the result when it is stored in ill-constructed sheds, and damp storehouses, or meets with some accidental exposure to rain; for in that case the total weight of the package increases and the composition of its contents is reduced in strength in the same proportion as its percentage of water has increased. The chemical analysis refers to one hundred weight of the fertilizer; the customer who secures the entire package does not necessarily suffer; yet the manufacturer may suffer by a lower analysis of his goods, in consequence of neglecting to furnish all the information needed to recognize the results of exceptional conditions.

During past years I have noticed several instances where circumstances similar to those pointed out above, had caused the deterioration of a fertilizer tested and reported by me. During the past season my attention has again been called to a case of a similar character, which may be considered as the immediate cause of inserting here the previous discussion.

Bulletin No. 7, the first one of this season, contains an analysis (No. 170), of a fertilizer, manufactured by the Clark's Cove Guano Co., New Bedford, Mass., called the "Bay State Fertilizer," and offered for sale by E. S. Snow, of Belchertown, Mass. The sample was collected by one of my assistants. Careful inquiry since at the agent's storehouse, in connection with information from other sources, tends to show that the moisture (22 per cent.,) noticed in the article was largely due to a deficiency in the storeroom. Bags of fertilizer which were subsequently weighed, showed from 10 to 15 lbs. more than the bill of sale stated. I believe now, for above stated reason, that the article originally furnished by the company, was a fair specimen of its kind and within the customary guaranty of composition.

In making this statement, in justice to the manufacturer, I do not intend to convey the idea that the addition of a larger percentage of water exerts no other serious influence on a complete fertilizer than diluting the article, i. e., reducing its original strength; for changes of a more serious character are apt to occur; for instance in case nitrates are forming a source of nitrogen in a fertilizer, containing superphosphates, more or less of nitric acid will be rendered free, and thus directly and indirectly the amount of that costly ingredient reduced. The frequent occurrence of rotten bags in the fertilizer trade, finds a satisfactory explanation in circumstances similar to those pointed out.

234. Fertilizer sent on by the Sec. of the Hampshire, Franklin, and Hampden Agricultural Society. (Potassa mainly present as carbonate).

235. William Clark & Co.'s "Americus" Ammoniated Bone Superphosphate. Collected of B. L. Bragg & Co., Springfield, Mass.

Guaranteed composition; total phosphoric acid 10 to 13 per cent.; soluble phosphoric acid 6 to 8 per cent, reverted phosphoric acid 3 to 4 per cent.; insoluble phosphoric acid 1 to 2 per cent.; potassium oxide 1 to 2 per cent.; ammonia 2 to 3 per cent., (eqvivalent to nitrogen 1.65 to 2.50 per cent.)

236. Quinnipiac Extra Superphosphate. Collected of B. L. Bragg & Co., Springfield, Mass.

Guaranteed composition; total phosphoric acid 10 to 12 per cent.; soluble and reverted phosphoric acid (available) 8 to 10 per cent.; potassium oxide (in form of sulphate) 2 to 4 per cent.; nitrogen $1\frac{3}{4}$ to $2\frac{1}{2}$ per cent.

237. Sparrow's Grass Fertilizer, of Judson & Sparrow, Boston, Mass. Collected of Everett & Gleason, Boston, Mass.

Guaranteed composition; soluble and reverted phosphoric acid, 8 to 9 per cent.; potassium oxide, 4 to 5 per cent.; ammonia, 5 to 6 per cent., (equivalent to nitrogen 4.12 to 5 per cent.)

	234	235	236	237
	POUNDS PER HUNDRED.			
Moisture at 100° C.,	14.65	17.37	19.88	12.57
Total phosphoric acid,	12.76	11.79	11.61	10.46
Soluble "	2.97	6.62	3.87	7.68
Reverted "	5.29	3.00	4.42	2.10
Insoluble "	4.50	2.17	3.32	.68
Potassium oxide,	23.81	1.85	2.06	4.52
Nitrogen, (in organic matter),	0.31	2.73	2.33	1.56
Nitrogen, (in ammonia salts),	0.16		0.81	3.15
Nitrogen, (in nitrates),	.24	.23		
Insoluble matter,	6.55	5.77	6.98	.50
Valuation per 2000 lbs,	$50.88	$33.91	$34.56	$43.69

C. A. GOESSMANN, *Director*,

AMHERST, MASS.

MASSACHUSETTS STATE AGRICULTURAL EXPERIMENT STATION.

BULLETIN No. 12.

OCTOBER, 1884.

238. NOTES ON FEEDING EXPERIMENTS WITH GLUTEN MEAL AS A CONSTITUENT OF THE DAILY DIET OF MILCH COWS.

The experiment was carried on for the purpose of studying the effect of gluten meal as a constitnent of the daily diet of milch cows on the quantity and the quality of milk obtained, as well as on the cost of its production, under several specified circumstances. The same cows, which served in the trial with corn ensilage, hay, Indian meal, and wheat bran, (see Bulletins 10 and 11), were used in the late trial with gluten meal. The observations extended over a period of three months. The third period of feeding was not extended beyond two weeks on account of the bad influence of a too liberal supply of nitrogenous constituents in the daily diet during very warm weather on the general condition of the cows. The mode of feeding was essentially the same as reported on previous occasions. The gluten meal was fed with an equal weight of wheat bran to compensate its deficiency in phosphates of lime and magnesia, and to render it more palatable. The designed amount of both substances was in each instance mixed and moistened, and fed in two meals during milking; the hay followed, mornings, noons, and after milking, evenings; care being taken to ascertain by weight, before and after meals, the exact amount consumed.

The composition and the general character of the Gluten meal, is described in a few subsequent pages. The cost of the daily fodder rations used in these experiments are based on our local market prices; gluten meal, $22.50, wheat bran, $23.00, and hay, $15.00 per ton; corn meal has cost during our trials $28.00, per ton. It has been the aim in our subsequent statement of results to render prominent the controlling influence of the daily yield of milk. on its cost under a corresponding system of feeding. It will be noticed in our trials, that under nearly identical conditions, as far as kind of fodder and period of milking are concerned, the milk of one cow as compared with that of an other one may cost the owner of the animals from 10 to 90 per cent. more in one case than in the other. A careful comparison of the subsequent detailed statement of our late experiment with those of previous Bulletins, (Nos. 10 and 11), tends to show that a good gluten meal at the stated cost, ought to be considered a valuable addition to our commercial concentrated fodder articles. The rations fed during the first feeding period and at the close of the experiment, (IV Period), deserve from an economical standpoint a trial on the part of dairymen. Our results were satisfactory as far as the yield of milk of a good quality is concerned.

I. RECORD OF MELIA.

FEEDING 1.	Feed consumed (lbs.) per day.			Milk produced (lbs.) per day.			Amt. of dry vegetable matter contained in the daily fodder consumed, in pounds.	Weight of Animal. (pounds.)
	Gluten Meal.	Shorts.	English Hay.	Morning.	Evening.	Total.		
Periods.								
July 1—8,	$3\frac{1}{4}$	$3\frac{1}{4}$	20	13	$12\frac{4}{7}$	$25\frac{4}{7}$	23.97	$782\frac{1}{2}$
" 8—15,	"	"	"	$14\frac{2}{7}$	13	$27\frac{2}{7}$	"	"
" 15—22,	"	"	"	$13\frac{5}{7}$	$12\frac{5}{7}$	$26\frac{3}{7}$	"	"
" 22—29,	"	"	"	$14\frac{1}{7}$	13	$27\frac{1}{7}$	"	$762\frac{1}{2}$
" 29, Aug. 5,	"	"	"	$14\frac{3}{7}$	$13\frac{6}{7}$	$27\frac{2}{7}$	"	795

Nutritive Ratio, 1 : 6.32.

ANALYSES OF MILK.

July	*12th,*	*22d,*	*28th,*	*Aug. 4th.*
Water,	88.15	87.30	87.40	87.92
Solids,	11.85	12.70	12.60	12.08
Fat (in solids),	3.28	3.14	3.48	3.20

Amount of fodder consumed during the entire feeding period, and cost of same.

	$113\frac{3}{4}$ lbs. Gluten meal.	\$1.27
	$113\frac{3}{4}$ lbs. Shorts.	1.31
	700 lbs. Hay,	5.25
Total.	$927\frac{1}{2}$ lbs.	\$7.83

Daily produce of milk.	$26\frac{7}{10}$ lbs., 13.36 qts.
Cost of daily fodder,	22.4 cts.
Cost of fodder per quart of milk,	1.68 cts.

RECORD OF MELIA.

FEEDING. 2.	Feed consumed (lbs.) per day.			Milk produced (lbs.) per day.			Amt. of dry vegetable matter contained in the daily fodder consumed, in pounds.	Weight of Animal. (pounds.)
	Gluten Meal.	Shorts.	English Hay.	Morning.	Evening.	Total.		
Periods.								
Aug. 5—12, - -	$6\frac{1}{2}$	$3\frac{1}{4}$	$18\frac{4}{7}$	$14\frac{1}{7}$	$13\frac{3}{7}$	28	25.5	777
" 12—19, - -	"	"	$19\frac{3}{7}$	15	13	28	26.33	782
" 19—26, - -	"	"	$15\frac{6}{7}$	$13\frac{3}{7}$	$13\frac{5}{7}$	$27\frac{1}{7}$	23.10	795
" 26, Sept. 2, -	"	"	$19\frac{3}{7}$	14	$12\frac{2}{7}$	$26\frac{2}{7}$	26.33	$827\frac{1}{2}$

Nutritive Ratio, 1 : 5.32.

ANALYSIS OF MILK.

Aug. 11th.

Water,	87.15
Solids,	12.85
Fat (in solids),	3.49

Amount of fodder consumed during the entire feeding period, and cost of same.

	182 lbs. Gluten meal,	\$2.04
	91 lbs. Shorts,	1.05
	517 lbs. Hay,	3.88
Total,	790 lbs.	\$6.97.

Cost of fodder per day,	24.9 cents.
Average produce of milk per day,	27.36 lbs., 13.68 qts.
Cost of fodder per quart of milk,	1.82 cents.

RECORD OF MELIA.

FEEDING. 3.	Feed consumed (lbs.) per day.			Milk produced (lbs.) per day.			Amt. of dry vegetable matter contained in the daily fodder consumed, in pounds.	Weight of Animal, (pounds.)
	Gluten Meal.	Shorts.	English Hay.	Morning.	Evening.	Total.		
Periods.								
Sept. 2—9, - -	$6\frac{1}{2}$	$6\frac{1}{2}$	$14\frac{2}{7}$	$14\frac{1}{7}$	12	$26\frac{1}{7}$	24.50	784
" 9—16, - -	"	"	$13\frac{5}{7}$	12	$10\frac{3}{7}$	$22\frac{3}{7}$	23.97	815

Nutritive Ratio, 1 : 4.42.

ANALYSIS OF MILK.

Sept. 10th.

Water,	87.60
Solids,	12.40
Fat (in solids),	3.55

Amount of fodder consumed during the entire feeding period, and cost of same.

	91 lbs. Gluten meal,	\$1.02
	91 lbs. Shorts,	1.05
	196 lbs. Hay,	1.47
Total,	378 lbs.	\$3.54

Cost of fodder per day,	25.3 cents.
Average produce of milk per day,	24.3 lbs., 12.15 qts.
Cost of fodder per quart of milk,	2.08 cents.

RECORD OF MELIA.

FEEDING. 4.	Feed consumed (lbs.) per day.			Milk produced (lbs.) per day.			Amt. of dry vegetable matter contained in the daily fodder consumed, in pounds.	Weight of Animal, (pounds.)
	Gluten Meal.	Shorts.	English Hay.	Morning.	Evening.	Total.		
Periods.								
Sept. 16—23, -	$3\frac{1}{4}$	$3\frac{1}{4}$	19.4	12.86	11.00	23.86	23.42	845
" 23, Oct. 1, -	"	"	20	13.36	12.00	25.36	23.97	790

Nutritive Ratio, 1 : 6.25.

ANALYSES OF MILK.

Sept.	*17th,*	*30th.*
Water,	87.48	87.56
Solids,	12.52	12.44
Fat (in solids),	3.26	3.14

Amount of fodder consumed during the entire feeding period, and cost of same.

	45.5 lbs. Gluten meal,	$0.51
	45.5 lbs. Shorts,	.52
	276. lbs. Hay,	2.07
Total,	367. lbs.	$3.10

Cost of fodder per day,	22.14 cents.
Average production of milk per day,	21.6 lbs., 12.32 qts.
Cost of fodder per quart of milk,	1.8

II. RECORD OF NELLIE MAY.

FEEDING. 1.	Feed consumed (lbs.) per day.			Milk produced (lbs.) per day.			Amt. of dry vegetable matter contained in the daily fodder consumed, in pounds.	Weight of Animal, (pounds.)
	Gluten Meal.	Shorts.	English Hay.	Morning.	Evening.	Total.		
Periods.								
July 1—8, - -	$3\frac{1}{4}$	$3\frac{1}{4}$	20	$9\frac{5}{7}$	$9\frac{2}{7}$	19	23.97	925
" 8—15, - -	"	"	"	10	$9\frac{1}{7}$	$19\frac{1}{7}$	"	917
" 15—22, - -	"	"	"	10	$9\frac{1}{7}$	"	"	900
" 22—29, - -	"	"	"	$9\frac{6}{7}$	$8\frac{3}{7}$	$18\frac{2}{7}$	"	892
" 29, Aug. 5, -	"	"	"	$9\frac{4}{7}$	$8\frac{1}{7}$	$17\frac{5}{7}$	"	937

Nutritive Ratio, 1 : 6.32.

ANALYSES OF MILK.

July	*12th,*	*22d,*	*28th,*
Water,	87.11	86.73	86.49
Solids,	12.89	13.27	13.51
Fat (in solids),	3.86	3.61	4.01

Amount of fodder consumed during the entire feeding period, and cost of same.

	$113\frac{3}{4}$ lbs. Gluten meal;	$1.27
	$113\frac{3}{4}$ lbs. Shorts,	1.31
	700 lbs. Hay,	5.25
Total,	$927\frac{1}{2}$ lbs.	$7.83

Daily produce of milk,	18.63 lbs., 9.31 qts.
Cost of fodder per day,	22.4 cts.
Cost of fodder per quart of milk,	2.41 cts.

RECORD OF NELLIE MAY.

FEEDING. 2.	Feed consumed (lbs.) per day. Gluten Meal.	Shorts.	English Hay.	Milk produced (lbs.) per day. Morning.	Evening.	Total.	Amt. of dry vegetable matter contained in the daily fodder consumed, in pounds.	Weight of Animal, (pounds.)
Periods.								
Aug. 5—12, - -	$6\frac{1}{2}$	$3\frac{1}{4}$	20	$8\frac{4}{7}$	8	$16\frac{4}{7}$	26.86	945
" 12—19, - -	"	"	20	$8\frac{5}{7}$	8	$16\frac{5}{7}$	26.86	945
" 19—26, - -	"	"	$19\frac{3}{7}$	8	7	15	26.26	960
" 26, Sept. 1, -	"	"	20	$8\frac{1}{7}$	$7\frac{1}{7}$	$15\frac{2}{7}$	20.86	977

Nutritive Ratio, 1 : 5.45.

ANALYSES OF MILK.

Aug.	*5th.*	*11th.*
Water,	86.77	86.75
Solids,	13.23	13.25
Fat (in solids),	4.01	4.06

Amount of fodder consumed during the entire feeding period, and cost of same.

	182 lbs. Gluten meal,	$2.04
	91 lbs. Shorts,	1.05
	556 lbs. Hay,	4.17
Total,	829 lbs. Hay,	7.26

Cost of fodder per day,	25.93 cts.
Average produce of milk per day,	15.9 lbs., 7.95 qts.
Cost of fodder per quart of milk,	3.38 cts.

RECORD OF NELLIE MAY.

FEEDING. 3.	Feed consumed (lbs.) per day.			Milk produced (lbs.) per day.			Amt. of dry vegetable matter contained in the daily fodder consumed, in pounds.	Weight of Animal, (pounds.)
	Gluten Meal.	Shorts.	English Hay.	Morning.	Evening.	Total.		
Periods.								
Sept. 2—8, - -	$6\frac{1}{2}$	$6\frac{1}{2}$	$19\frac{1}{7}$	$8\frac{1}{7}$	$7\frac{5}{7}$	$15\frac{6}{7}$	28.95	955
" 8—15, - -	"	"	$18\frac{2}{7}$	$7\frac{3}{7}$	$6\frac{3}{7}$	$13\frac{6}{7}$	28.15	985

Nutritive Ratio, 1 : 5.1.

ANALYSIS OF MILK.

Sept.	*10th.*
Water,	85.18
Solids,	14.82
Fat (in solids),	4.59

Amount of fodder consumed during the entire fedding period, and cost of same.

	91 lbs. Gluten meal,	$1.02
	91 lbs. Shorts,	1.05
	270 lbs. Hay,	2.03
Total,	452 lbs.	$4.10

Average produce of milk per day,	14.18 lbs., 7.09 qts.
Cost of fodder per day,	29.3 cts.
Cost of fodder per quart of milk,	4.13 cts.

RECORD OF NELLIE MAY.

FEEDING. 4.	Feed consumed (lbs.) per day.			Milk produced (lbs.) per day.			Amt. of dry vegetable matter contained in the daily fodder consumed, in pounds.	Weight of Animal, (pounds.)
	Gluten Meal.	Shorts.	English Hay.	Morning.	Evening.	Total.		
Periods.								
Sept. 15—22, -	$3\frac{1}{4}$	$3\frac{1}{4}$	$17\frac{3}{7}$	$6\frac{4}{7}$	$5\frac{4}{7}$	$12\frac{1}{7}$	21.67	$1002\frac{1}{2}$
" 22—29, -	"	"	20	$7\frac{3}{7}$	$6\frac{6}{7}$	$14\frac{2}{7}$	23.97	1005

Nutritive Ratio, 1 : 6.11.

ANALYSES OF MILK.

Sept.	*17th*,	*30th*.
Water,	85.04	85.92
Solids,	14.96	14.08
Fat (in solids),	4.36	4.45

Amount of fodder consumed during the entire feeding period, and cost of same.

	$45\frac{1}{2}$ lbs. Gluten meal,	$0.51
	$45\frac{1}{2}$ lbs. Shorts,	.52
	274 lbs. Hay,	2.06
Total,	365 lbs.	$3.09

Average produce of milk per day,	13.46 lbs., 6.82 qts.
Cost of fodder per day,	22.1 cts.
Cost of fodder per quart of milk,	3.25 cts.

III. RECORD OF FAIRY.

FEEDING. 1.	Feed consumed (lbs.) per day.			Milk produced (lbs.) per day.			Amt. of dry vegetable matter contained in the daily fodder consumed, in pounds.	Weight of Animal, (pounds.)
	Gluten Meal.	Shorts.	English Hay.	Morning.	Evening.	Total.		
Periods.								
July 1—8, - -	$3\frac{1}{4}$	$3\frac{1}{4}$	20	$10\frac{1}{7}$	$9\frac{4}{7}$	$19\frac{5}{7}$	23.97	907
" 8—15, - -	"	"	"	$10\frac{6}{7}$	$10\frac{1}{7}$	21	"	927
" 15—22, -	"	"	"	$10\frac{6}{7}$	10	$20\frac{6}{7}$	"	$912\frac{1}{2}$
" 22—29, -	"	"	"	$10\frac{2}{7}$	$9\frac{2}{7}$	$19\frac{4}{7}$	"	902
" 29, Aug. 4, -	"	"	"	$10\frac{1}{7}$	9	$19\frac{1}{7}$	"	935

Nutritive Ratio, 1 : 6.32.

ANALYSES OF MILK.

July	*12th*,	*22d*,	*28th*,	*Aug. 4th*.
Water,	87.05	86.42	86.82	86.79
Solids,	12.95	13.58	13.18	13.21
Fat (in solids),	3.76	3.73	3.67	3.81

Amount of fodder consumed during the entire feeding period, and cost of same.

	$113\frac{3}{4}$ lbs. Gluten meal,	\$1.27
	$113\frac{3}{4}$ lbs. Shorts,	1.31
	700 lbs. Hay,	5.25
Total,	$927\frac{1}{2}$ lbs.	\$7.83

Average produce of milk per day,	20.1 lbs., 10 qts.
Cost of fodder per day,	22.4 cts.
Cost of fodder per quart of milk,	2.24 cts.

RECORD OF FAIRY.

FEEDING. 2.	Feed consumed (lbs.) per day.			Milk produced (lbs.) per day.			Amt. of dry vegetable matter contained in the daily fodder consumed, in pounds.	Weight of Animal, (pounds.)
	Gluten Meal.	Shorts.	English Hay.	Morning.	Evening.	Total.		
Periods.								
Aug. 4—11, - -	$6\frac{1}{2}$	$3\frac{1}{4}$	20	$10\frac{3}{7}$	$9\frac{4}{7}$	20	26.86	942
" 11—18, -	"	"	20	$10\frac{5}{7}$	$9\frac{5}{7}$	$20\frac{3}{7}$	26.86	952
" 18—25, -	"	"	$19\frac{3}{7}$	$9\frac{6}{7}$	9	$18\frac{6}{7}$	26.26	965
" 25, Sept. 1, -	"	"	$19\frac{5}{7}$	10	$8\frac{5}{7}$	$18\frac{5}{7}$	26.67	$1027\frac{1}{2}$

Nutritive Ratio, 1 : 5.45.

ANALYSIS OF MILK.

Sept. 11th.

Water,	86.39
Solids,	13.61
Fat (in solids,)	3.91

Amount of fodder consumed during the entire feeding period, and cost of same.

	182 lbs. Gluten meal,	\$2.04
	91 lbs. Shorts,	1.05
	554 lbs. Hay,	3.79
Total,	827 lbs.	\$6.88

Average produce of milk per day,	19.5 lbs., 9.75 qts.
Cost of fodder per day,	24.6 cts.
Cost of fodder per quart of milk,	2.52 cts.

RECORD OF FAIRY.

FEEDING. 3.	Feed consumed (lbs.) per day. Gluten Meal.	Shorts.	English Hay.	Milk produced (lbs.) per day. Morning.	Evening.	Total.	Amt. of dry vegetable matter contained in the daily fodder consumed, in pounds.	Weight of Animal, (pounds.)
Periods.								
Sept. 1—8, - -	$6\frac{1}{2}$	$6\frac{1}{2}$	20	$9\frac{3}{7}$	$8\frac{4}{7}$	18	29.71	$1002\frac{1}{2}$
" 8—15, - -	"	"	$16\frac{4}{7}$	$9\frac{1}{7}$	$7\frac{6}{7}$	17	26.65	1000

Nutritive Ratio, 1 : 4.96.

ANALYSIS OF MILK.

Sept. 10th.

Water,	85.60
Solids,	14.40
Fat (in solids,)	4.84

Amount of fodder consumed during the entire feeding period, and cost of same.

	91 lbs. Gluten meal,	$1.02
	91 lbs. Shorts,	1.05
	251 lbs. Hay,	1.88
Total,	433 lbs.	$3.95

Average produce of milk per day,	14.68 lbs., 7.34 qts.
Cost of fodder per day,	28.2 cts.
Cost of fodder per quart of milk,	3.84 cts.

RECORD OF FAIRY.

FEEDING. 4.	Feed consumed (lbs.) per day. Gluten Meal.	Shorts.	English Hay.	Milk produced (lbs.) per day. Morning.	Evening.	Total.	Amt. of dry vegetable matter contained in the daily fodder consumed, in pounds.	Weight of Animal, (pounds.)
Periods.								
Sept. 15—22, -	$3\frac{1}{4}$	$3\frac{1}{4}$	$17\frac{5}{7}$	$9\frac{5}{7}$	$8\frac{5}{7}$	$18\frac{3}{7}$	21.96	$1007\frac{1}{2}$
" 22—29, -	"	"	20	10	9	19	23.97	1035

Nutritive Ratio, 1 : 6.21.

ANALYSES OF MILK.

Sept.	*17th.*	*30th.*
Water,	85.85	85.99
Solids,	14.15	14.01
Fat (in solids,)	4.06	4.11

Amount of fodder consumed during the entire feeding period, and cost of same.

	15½ lbs. Gluten meal,	$0.51
	45½ lbs. Shorts,	0.52
	269 lbs. Hay,	2.02
Total,	360 lbs.	$3.05

Average produce of milk per day,	18.9 lbs., 9.45 qts.
Cost of fodder per day,	21.8 cts.
Cost of fodder per quart of milk,	2.31 cts.

FODDER AND FODDER ANALYSIS.

239. GLUTEN MEAL.

From Chicago Sugar Refining Co.

Eighty-five per cent. passed through mesh 144 to square inch.

	Percentage Composition.	Constituents (in lbs.) in a ton of 2000 lbs.	Pounds digestible in a ton of 2000 lbs.	Per cent. of digestibility of constituents.	Nutritive Ratio.
Moisture at 100° C.,	11.68	233.6			
Dry Matter,	88.32	1766.4			
	100.00	2000.00			
ANALYSIS OF DRY MATTER.					1:2.92
Crude Ash,	0.79	15.8			
" Cellulose,	0.77	15.4	5.24	34	
" Fat,	3.94	78.8	59.89	76	
" Protein, (nitrogenous matter),	28.24	564.8	480.08	85	
Non-nitrogenous extract matter,	66.26	1325.2	1245.69	94	
	100.00	2000.00	1790.90		

The gluten meal is obtained as a by-product in the manufacture of starch and glucose from corn. It consists mainly of the germs of the latter with more or less skin parts and starch. The supply of this substance has acquired considerable proportions in consequence of the recent development of the glucose industry in the country.

Examinations of samples from various sources have demonstrated its highly nitrogenous character. and left but little doubt about its value for feeding purposes under suitable circumstances. For details in this direction I refer, as far as my own observations and statements are concerned, to BULLETIN I, page 11, and BULLETIN V, page 5. The variations noticed in composition are in the main evidently caused by modifications in the manufacturing process,—a circumstance by no means an exceptional one, as far as the gluten-meal is concerned: for all our valuable refuse materials for fodder, as brans, oil-cakes, etc. suffer from the same influence. The sample, which served for our feeding experiments and furnished the material for the above analysis, was obtained by the following process, according to the kind communication of Dr. A. Behr, the superintendent of the Chicago Sugar Refining Company: "The process mostly followed in starch and glucose works for the separation of starch includes the use of caustic-soda for dissolving the gluten—(nitrogenous constituent of the corn). Our process differs in these particulars, that we do not use any caustic-soda at all and that we separate the germs of the corn before it is finally ground up. The consequence is, that gluten-meal contains no caustic-soda or sodium-salts, and is comparatively poor in fat,—this being for the greater part removed with the germs. The way we proceed is shortly, as follows: The water as it comes from the mills and carries the fine starch and gluten in suspension is run over long slightly inclined troughs: the ordinary 'Starch-Tables.' Here the heavy starch settles, while the lighter particles, small starch, gluten, fiber and fat are carried away with the water. This mixture is allowed to settle in large vats, the clear water drawn off, and the residue pumped into filter presses. The press cakes are dried in steam driers, ground up in mills and in this form make the gluten-meal." The calculation of the digestible portion of the gluten-meal is based on that noticed in the corn-meal in actual feeding-tests. The numerical relations between the digestible amount of nitrogenous constituents and of carbohydrates or non-nitrogenous constituents in the above sample of gluten-meal (1 : 2.92) corresponds quite closely with that in a fair sample of peas, its mineral constituents are however but one-fifth of that of the latter.

The article is offered for sale by the carload in bulk at $21.00 per ton, or $22.50 in bags, at Boston R. R. depots; similar charges have been made in Springfield.

C. A. GOESSMANN, *Director*,

AMHERST, MASS.

☞ *P. S. The Bulletins of the Experiment Station will be sent free of charge to all parties interested in its work, on application.*

about two ounces of corn meal were fed for every quart of milk, and subsequently three ounces for every quart. This proportion of corn meal to milk produced better results in the case of butter milk (Lot B), than in the case of skim milk (Lot A), considering the larger amount of solid matter contained in the latter. Nearly one-fourth of the solid matter noticed in the skim milk shows no return of a proportionate increase in live weight, as will be found on comparing the subsequent detailed record. The total live weight and dressed weight of both lots of animals differ only two to four pounds from each other—the butter milk leading. The cost of fodder per pound of dressed pork produced amounts in Lot A (skim milk) to 5.8 cts., and in case of Lot B (butter milk) to 4.6 cts. This difference in cost corresponds quite closely with the difference in cost of the two kinds of milk. The dressed pork was sold at $7\frac{1}{4}$ cts. per pound. The value of manure produced will be reported on some later occasion, when actual values can be presented. The investigation is continued. Two breeds—Berkshire and Chester—are already on trial to turn to account the information received in the first experiment.

A.

SKIM MILK AND CORN MEAL.

I.

PERIODS.	Feed Consumed. Meal, (ozs.)	Skim Milk, (qts.)	Weight of Animal, (lbs.)	Daily increase in live weight.
May 21—31, - -	100	58	$41\frac{1}{2}$	0 lb. 11 oz.
June 1—9, - -	132	54	$60\frac{1}{2}$	1 " 0 "
" 9—17, - -	128	48	67	0 " 15 "
" 17—24, - -	152	50	$79\frac{3}{4}$	1 " 13 "
" 24—30, - -	160	54	$89\frac{3}{4}$	1 " 7 "
July 1—7, - -	210	70	101	1 " 10 "
" 7—14, - -	210	70	$111\frac{1}{2}$	1 " 8 "
" 14—22, - -	288	96	$124\frac{3}{4}$	1 " 14 "
" 22—29, - -	252	84	$140\frac{3}{4}$	2 " 4 "
" 29—Aug. 5, -	228	76	$147\frac{3}{4}$	1 " "
Aug. 5—12, - -	180	60	$156\frac{1}{2}$	1 " 5 "
" 12—19, - -	252	84	170	1 " 15 "
" 19—26, - -	252	84	$183\frac{1}{2}$	1 " 15 "
" 26—Sept. 2, -	258	86	$188\frac{1}{4}$	0 " 11 "
Sept. 2—9, - -	231	77	$202\frac{1}{4}$	2 " "
" 9—16, - -	294	98	$217\frac{1}{4}$	2 " $2\frac{2}{7}$ "
" 16—22, - -	210	70	$228\frac{3}{4}$	1 " 15 "

MASSACHUSETTS STATE

AGRICULTURAL EXPERIMENT STATION.

BULLETIN No. 13.

NOVEMBER, 1884.

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240. NOTES ON FEEDING EXPERIMENTS WITH PIGS.

The experiment described in a few subsequent pages is the first of a series planned for the purpose of studying the comparative feeding value of skim milk and of creamery butter milk, in connection with corn meal, for the production of pork. To secure a suitable basis for the work, it was decided to ascertain, first the facts regarding the results of feeding equal measures of skim milk and of butter milk with a corresponding weight of corn meal in both cases. The skim milk was obtained from the dairy of the college and the station, the butter milk from the factory of the Amherst Co-operative Creamery Association. The skim milk was rated at two cents per gallon, and the creamery butter milk 1.37 cts. per gallon—the contractor's price. Corn meal was bought at $28.00 per ton. Several analyses of both kinds of milk and the mean of three analyses of the corn meal, fed during the experiment, are stated further on, (see Nos. 241, 242 and 243,) in this BULLETIN. The skim milk contained about 2.5 per cent. more solid matter, than the creamery butter milk, a circumstance most likely due to the access of some water from the first washing of the butter. Six pigs from forty to fifty pounds in weight, (Berkshires,) secured from the College farm, were used for the experiment; three of them were fed with skim milk and corn meal, (Lot A), and three with creamery butter milk and corn meal, (Lot B). Each of the two lots consisted of one barrow and two sows; the former (III) gave in both lots the best results. The animals were fed alike in the following way: one-third of the daily ration of milk was fed with one-half of the daily ration of corn meal, at 6 o'clock, A. M.; one-third of the milk at 12 o'clock, M., without any meal; and the remaining third, part of milk with one-half of the meal, at 6 o'clock, P. M. Whenever the previous feed was consumed, some hours before a succeeding feeding time, the amount of daily fodder was gradually increased. This rule of feeding was carried out during the entire trial and suffered only a tempor[illegible] lification in consequence of a few short periods of very hot [illegible]. At the beginning of the experiment

Total amount of feed consumed from May 21 to Sept. 22, 1884:

221 lbs. Corn Meal, equal to dry matter,		189.57 lbs.
1219 qts. Skim Milk,	" " "	255.45 "
Total amount of dry matter,		454.02

Live weight of animal at beginning of experiment,	44.75 lbs.
Live weight at time of killing,	228.75 "
Live weight gained during experiment,	184 "
Dressed weight at the time of killing,	181.75 "
Loss in weight by dressing,	47 lbs., or 20.5 per cent.
Dressed weight gained during experiment,	146 lbs.

Cost of feed consumed during the experiment:

221 lbs. Corn Meal, at 1.4 cts.,	$3.09
305 gals. Skim Milk, at 2 cts. per gal.,	6.10
	$9.19

454 lbs. of dry matter fed, produced 184 lbs. of live weight, and 146 lbs. of dressed weight.

2.47 lbs. of dry matter yielded 1 lb. live weight; and 3.11 lbs. of dry matter yielded 1 lb. dressed weight.

Cost of feed, for production of 1 lb. of dressed pork, 6.3 cts.

A.
SKIM MILK AND CORN MEAL.
II.

PERIODS.	Feed Consumed. Meal, (ozs.)	Feed Consumed. Skim Milk, (qts.)	Weight of Animal, (lbs.)	Daily increase in live weight.
May 21—31, - -	100	58	$54\frac{1}{2}$	0 lb. 12 oz.
June 1—9, - -	132	54	77	1 " 11 "
" 9—17, - -	192	64	$87\frac{1}{4}$	1 " 7 "
" 17—24, - -	152	50	$97\frac{3}{4}$	1 " 8 "
" 24—30, - -	160	54	109	1 " 10 "
July 1—7, - -	210	70	$121\frac{1}{4}$	1 " 12 "
" 7—14, - -	210	70	$130\frac{3}{4}$	1 " 6 "
" 14—22, - -	288	96	$141\frac{3}{4}$	1 " 9 "
" 22—29, - -	252	84	$154\frac{1}{2}$	1 " 13 "
" 29—Aug. 5, -	228	76	$162\frac{3}{4}$	1 " 3 "
Aug. 5—12, - -	180	60	$167\frac{1}{4}$	0 " 10 "
" 12—19, - -	252	84	179	1 " 11 "
" 19—26, - -	252	84	$190\frac{3}{4}$	1 " 11 "
" 26—Sept. 2, -	258	86	$193\frac{1}{3}$	0 " 7 "
Sept. 2—9, - -	294	98	$211\frac{1}{2}$	2 " 8 "
" 9—16, - -	294	98	$221\frac{3}{4}$	1 " 8 "
" 16—22, - -	210	70	$230\frac{1}{4}$	1 " 7 "

2.0

Total amount of feed consumed from May 21 to Sept. 22:

226½ lbs. Corn Meal, equal to dry matter,		197.92 lbs.
1256 qts. Skim Milk, " " "		263.21 "
	Total amount of dry matter,	461.13

Live weight of animal at beginning of experiment,	54.50 lbs.
Live weight at time of killing,	230.25 "
Live weight gained during experiment,	175.75 "
Dressed weight at time of killing,	195 "
Loss in weight by dressing,	35.25 lbs., or 15.3 per cent.
Dressed weight gained during experiment,	148.84 lbs.

Cost of feed consumed during the experiment:

226½ lbs. Corn Meal, at 1.4 cts. per lb.,	$3.17
314 gals. Skim Milk, at 2 cts. per gal.,	6.28
	$9.45

461 lbs. of dry matter fed, produced 175.75 lbs. of live weight, and 148.84 lbs. of dressed weight.

2.63 lbs. of dry matter yielded 1 lb. live weight; and 3.08 lbs. dry matter yielded 1 lb. dressed weight.

Cost of feed, for production of 1 lb. of pork, 6.4 cts.

A.
SKIM MILK AND CORN MEAL.
III.

PERIODS.	Feed Consumed. Meal, (ozs.)	Skim Milk, (qts.)	Weight of Animal, (lbs.)	Daily increase in live weight.
May 21—31, - -	100	58	50½	0 lb. 15 oz.
June 1—9, - -	132	54	74½	1 " 12 "
" 9—17, - -	192	64	85¾	1 " 10 "
" 17—24, - -	195	65	97¾	1 " 11 "
" 24—30, - -	195	65	114	2 " 5 "
July 1—7, - -	210	70	127¼	1 " 14 "
" 7—14, - -	252	84	145¼	2 " 9 "
" 14—22, - -	294	98	163	2 " 8 "
" 22—29, - -	294	98	181	2 " 9 "
" 29—Aug. 5, -	294	98	200¾	2 " 13 "
Aug. 5—12, - -	294	98	214½	1 " 15 "
" 12—19, - -	294	98	236	3 " 1 "
" 19—26, - -	294	98	250½	2 " 1 "
" 26—Sept. 2, -	300	100	257½	1 " 0 "
Sept. 2—9, - -	336	112	281¾	3 " 9 "
" 9—16, - -	336	112	293¾	1 " 12 "
" 16—22, - -	240	80	308½	2 " 7 "

Total amount of feed consumed from May 21 to Sept. 22:

$265\frac{3}{4}$ lbs. Corn Meal, equal to dry matter,	231.78 lbs.
1452 qts. Skim Milk, " " "	304.29 "
Total amount of dry matter,	536.07

Live weight of animal at beginning of experiment,	50.50 lbs.
Live weight at time of killing,	308.50 "
Live weight gained during experiment,	258 "
Dressed weight at time of killing,	257.25 "
Loss in weight by dressing,	51.25 lbs., 16.64 per cent.
Dressed weight gained during experiment,	215.15 lbs.

Cost of feed consumed during the experiment:

$265\frac{3}{4}$ lbs. Corn Meal, at 1.4 cts. per lb.,	\$3.72
363 gals. Skim Milk, at 2 cts. per gal.,	7.26
	\$10.98

536 lbs. of dry matter fed, produced 258 lbs. of live weight, and 215.15 lbs. dressed weight.

2.8 lbs. of dry matter yielded 1 lb. of live weight; and 2.5 lbs. of dry matter yielded 1 lb. of dressed weight.

Cost of feed, for production of 1 lb. of pork, 5.11 cts.

B.

BUTTER MILK AND CORN MEAL.

I.

PERIODS.	Feed Consumed. Meal, (ozs.)	Feed Consumed. Butter Milk, (qts.)	Weight of Animal, (lbs.)	Daily increase in live weight.
May 21—31,	100	58	$48\frac{1}{4}$	0 lb. 11 oz.
June 1—9,	132	54	66	1 " 6 "
" 9—17,	192	64	$77\frac{1}{2}$	1 " 7 "
" 17—24,	152	50	$87\frac{1}{2}$	1 " 7 "
" 24—30,	160	54	$98\frac{1}{2}$	1 " 9 "
July 1—7,	210	70	$107\frac{3}{4}$	1 " 5 "
" 7—14,	210	70	$120\frac{3}{4}$	1 " 14 "
" 14—22,	288	96	$131\frac{1}{2}$	1 " 8 "
" 22—29,	252	84	$143\frac{3}{4}$	1 " 12 "
" 29—Aug. 5,	192	68	$153\frac{3}{4}$	1 " 7 "
Aug. 5—12,	168	56	$160\frac{3}{4}$	1 " 0 "
" 12—19,	252	84	$172\frac{1}{2}$	1 " 11 "
" 19—26,	252	84	$183\frac{1}{4}$	1 " 8 "
" 26—Sept. 2,	258	86	185	0 " 4 "
Sept. 2—9,	294	98	$206\frac{1}{4}$	3 " 0 "
" 9—16,	294	98	$219\frac{1}{4}$	1 " 14 "
" 16—22,	294	70	$230\frac{1}{2}$	1 " 14 "

Total amount of feed consumed from May 21 to Sept. 22:

226 lbs. Corn Meal, equal to dry matter,		197.48 lbs.
1244 qts. Butter Milk. " " "		190.33 "
	Total amount of dry matter,	387.81

Live weight of animal at beginning of experiment,	48.25 lbs.
Live weight at time of killing,	230.50 "
Live weight gained during the experiment,	182.25 "
Dressed weight at time of killing,	190.75 "
Loss in weight by dressing, 39.75 lbs., or	17.3 per cent.
Dressed weight gained during experiment,	150.85 lbs.

Cost of feed consumed during the experiment:

226 lbs. Corn Meal, at 1.4 cts. per lb.,	$3.16
311 gals. Butter Milk, at 1.37 cts. per gal.,	4.26
	$7.42

387.8 lbs. of dry matter fed, produced 182.25 lbs. of live weight, and 150.85 lbs. of dressed weight.

2.12 lbs. of dry matter yielded 1 lb. of live weight; and 2.57 lbs. of dry matter yielded 1 lb. of dressed weight.

Cost of feed, for production of 1 lb. of pork, 4.92 cts.

B.
BUTTER MILK AND CORN MEAL.
II.

PERIODS.	Feed Consumed. Meal, (ozs.)	Feed Consumed. Butter Milk, (qts.)	Weight of Animal, (lbs.)	Daily increase in live weight.
May 21—31, - -	100	58	45½	0 lb. 12 oz.
June 1—9, - -	132	54	67½	1 " 7 "
" 9—17, - -	192	64	79½	1 " 11 "
" 17—24, - -	152	50	89¾	1 " 6 "
" 24—30, - -	160	54	100	1 " 7 "
July 1—7, - -	210	70	111	1 " 9 "
" 7—14, - -	210	70	123¾	1 " 3 "
" 14—22, - -	288	96	135½	1 " 11 "
" 22—29, - -	252	84	147¼	1 " 11 "
" 29—Aug. 5, -	192	68	158	1 " 8 "
Aug. 5—12, - -	168	56	163¾	0 " 13 "
" 12—19, - -	252	84	177	1 " 14 "
" 19—26, - -	252	84	189½	1 " 12 "
" 26—Sept. 2, -	258	86	189	—1$\frac{1}{7}$ "
Sept. 2—9, - -	294	98	211¾	3 " 4 "
" 9—16, - -	294	98	226¼	2 " 1 "
" 16—22, - -	210	70	238	1 " 15 "

Total amount of feed consumed from May 21 to Sept. 22:

226 lbs. Corn Meal, equal to dry matter,		197.48 lbs.
1241 qts. Butter Milk, " " "		190.33 "
Total amount of dry matter,		387.81

Live weight of animal at beginning of experiment,		45.50 lbs.
Live weight at time of killing,		238 "
Live weight gained during experiment,		192.50 "
Dressed weight at time of killing,		199.25 "
Loss in weight by dressing,	38.75 lbs.,	or 16.3 per cent.
Dressed weight gained during the experiment,		161.2 lbs.

Cost of feed consumed during the experiment:

226 lbs. Corn Meal, at 1.4 cts. per lb.,	$3.16
311 gals. Butter Milk, at 1.37 cts. per gal.,	4.26
	$7.42

387.8 lbs. of dry matter fed, produced 192.50 lbs. live weight, and 161.2 lbs. dressed weight.

2.01 lbs. of dry matter yielded 1 lb. of live weight; and 2.4 lbs. of dry matter yielded 1 lb. of dressed weight.

Cost of feed, for production of 1 lb. of pork, 4.64 cts.

B.
BUTTER MILK AND CORN MEAL.
III.

PERIODS.	Feed Consumed. Meal, (ozs.)	Feed Consumed. Butter Milk, (qts.)	Weight of Animal, (lbs.)	Daily increase in live weight.
May 21—31, - -	100	58	49	0 lb. 11 oz.
June 1—9, - -	132	54	72	1 " 10 "
" 9—17, - -	192	64	85¼	1 " 14 "
" 17—24, - -	195	65	98	1 " 13 "
" 24—30. - -	195	65	109¼	1 " 10 "
July 1—7, - -	210	70	121¾	1 " 12 "
" 7—14, - -	252	84	133¼	1 " 10 "
" 14—22, - -	294	98	151½	2 " 10 "
" 22—29, - -	294	98	167	2 " 3 "
" 29—Aug. 5, -	294	98	186¼	2 " 12 "
Aug. 5—12, - -	294	98	199¾	1 " 15 "
" 12—19, - -	294	98	218½	2 " 11 "
" 19—26, - -	294	98	227¾	1 " 5 "
" 26—Sept. 2, -	300	100	233½	0 " 13 "
Sept. 2—9, - -	336	112	259	3 " 11 "
" 9—16, - -	336	112	281	3 " 2 "
" 16—22, - -	240	80	293¼	2 " 1 "

Total amount of feed consumed from May 21 to Sept. 22:

$265\frac{3}{4}$ lbs. Corn Meal,	equal to dry matter,	232.21 lbs.
1452 qts. Butter Milk,	" " "	222.16 "
Total amount of dry matter,		454.37

Live weight of animal at beginning of experiment,	49 lbs.
Live weight at time of killing,	$293\frac{1}{4}$ "
Live weight gained during experiment,	$244\frac{1}{4}$ "
Dressed weight at time of killing,	243 "
Loss in weight by dressing,	50 lbs., or 17 per cent.
Dressed weight gained during experiment,	202.3 lbs.

Cost of feed consumed during the experiment:

$265\frac{3}{4}$ lbs. Corn Meal, at 1.4 cts. per lb.,	\$3.72
363 gals. Butter Milk, at 1.37 cts. per gal.,	4.98
	\$8.70

454.37 lbs. of dry matter fed, produced $244\frac{1}{4}$ lbs. of live weight, and 202.3 lbs. dressed weight.

1.86 lbs. of dry matter yielded 1 lb. of live weight; and 2.23 lbs of dry matter yielded 1 lb. of dressed weight.

Cost of feed, for production of 1 lb. of pork, 4.3 cts.

SUMMARY OF RESULTS OF EXPERIMENTS.

A. Pigs fed with Skim Milk and Corn Meal.

	Corn Meal, in pounds.	*Skim Milk, in gallons.*	*Live weight gained during experiment.*	*Dressed weight gained during experiment.*
I.	221	305	184	146
II.	$226\frac{1}{2}$	314	$175\frac{3}{4}$	$148\frac{4}{5}$
III.	$265\frac{3}{4}$	363	258	$215\frac{1}{5}$
	$713\frac{1}{4}$	982	$617\frac{3}{4}$	510

B. Pigs fed with Creamery Butter Milk and Corn Meal.

	Corn Meal, in pounds.	*Butter Milk, in gallons.*	*Live weight gained during experiment.*	*Dressed weight gained during experiment.*
I.	226	311	$182\frac{1}{4}$	$150\frac{9}{10}$
II.	226	311	$192\frac{1}{2}$	$161\frac{3}{10}$
III.	$265\frac{3}{4}$	363	$244\frac{1}{4}$	$202\frac{3}{10}$
	$717\frac{3}{4}$	985	619	$514\frac{4}{10}$

Total cost of feed consumed during the experiment.

A.	$713\frac{1}{4}$ lbs. Corn Meal,	$9.98
	982 gals. Skim Milk.	19.64
		$29.62
B.	$717\frac{3}{4}$ lbs. Corn Meal,	$10.04
	985 gals. Butter Milk,	13.50
		$23.54

Cost of feed per pound of dressed pork produced.

A.	Skim Milk and Meal.	5.8 cts.
B.	Butter Milk and Meal,	4.6 cts.

The difference in cost is approximately equal to the difference in cost of the Butter Milk and Skim Milk.

241. Analyses of Skim Milk, from the Experiment Station Farm.

	I.	II.	III.	Mean.
Water.	~~90.20~~	90.12	90.64	90.42
Solids,	9.80	9.58	9.36	9.58
Fat (in solids),	.68	.32	.18	.39
Casein (nitrogenous matter, in solids,)		3.23		3.23

Nutritive Ratio, 1 : 2.15.

These analyses represent the kind of skim milk fed during the previously described feeding experiment. One quart weighed, 35 ounces; and contained 3.35 ounces of solid (dried) matter.

242. Analyses of Butter Milk, from the Amherst Co-operative Creamery Association.

	I.	II.	III.	Mean.
Water,	92.79	92.76	93.17	90.90
Solids,	7.21	7.24	6.83	7.09
Fat (in solids),	.20	.22		.21
Casein (nitrogenous matter, in solids),		2.9		2.90

Nutritive Ratio, 1 : 1.63.

These analyses were made at the same date, when the skim milk tests were carried out—and represent as far as practicable the quality of butter milk fed during above described feeding trial. One quart of butter milk weighed 34 ounces, and contained 2.41 ounces of solid matter (dried).

243. CORN MEAL.

92.34 per cent. passed through mesh 144 to the square inch.

	Percentage Composition.	Constituents (in lbs.) in a ton of 2000 lbs.	Pounds digestible in a ton of 2000 lbs.	Per cent. of digestibility of constituents.	Nutritive Ratio.
Moisture at 100° C.,	12.62	252.4			
Dry Matter,	87.38	1747.6			
	100.00	2000.00			
ANALYSIS OF DRY MATTER.					
Crude Ash,	1.56	31.2			1:8.68
" Cellulose,	2.65	53.0	18.06	34	
" Fat,	4.27	85.4	64.90	76	
" Protein, (nitrogenous matter),	11.43	228.6	194.31	85	
Non-nitrogenous extract matter,	80.09	1601.8	1505.69	94	
	100.00	2000.00	1782.96		

This article represents the average composition of the corn meal fed in connection with skim milk and butter milk in the feeding experiments, with pigs, described in the previous pages, BULLETIN 13.

244. WHEAT BRAN.

From John L. Holley, South Amherst, Mass.

13.71 per cent. passed through mesh 144 to the square inch.

	Percentage Composition.	Constituents (in lbs.) in a ton of 2000 lbs.	Pounds digestible in a ton of 2000 lbs.	Per cent. of digestibility of constituents.	Nutritive Ratio.
Moisture at 100° C.,	10.48	209.6			
Dry Matter,	89.52	1790.4			
	100.00	2000.00			
ANALYSIS OF DRY MATTER.					1:3.25
Crude Ash,	6.98	139.6			
" Cellulose,	10.20	204.0	40.80	20	
" Fat,	4.77	95.4	76.32	80	
" Protein, (nitrogenous matter),	20.24	404.8	356.22	88	
Non-nitrogenous extract matter,	57.81	1156.2	924.96	80	
	100.00	2000.00	1398.30		

The article sold at $23.00 at the mill. This quality of wheat bran has been fed during the feeding experiments with milch cows reported in BULLETIN 12.

245. TIMOTHY HAY.

From the grounds of the Experiment Station, June 20, 1884.

	Percentage Composition.	Constituents (in lbs.) in a ton of 2000 lbs.	Pounds digestible in a ton of 2000 lbs.	Per cent. of digestibility of constituents.	Nutritive Ratio.
Moisture at 100° C.,	10.55	211.0			
Dry Matter,	89.45	1789.0			
	100.00	2000.00			
ANALYSIS OF DRY MATTER.					
Crude Ash,	4.69	93.8			1 : 10.6
" Cellulose,	29.21	584.2	338.84	58	
" Fat,	2.65	53.0	24.38	46	
" Protein, (nitrogenous matter),	9.02	180.4	102.83	57	
Non-nitrogenous extract matter,	54.43	1088.6	685.82	63	
	100.00	2000.00	1151 87		

The grass was cut at the close of the blooming period, and the hay is a fair article of its kind. It served during the feeding experiment with milch cows described in the previous BULLETIN No. 12.

FERTILIZER ANALYSES.

246. NOVA SCOTIA PLASTER.

(Gypsum.)

Collected of R. T. Prentiss, Holyoke, Mass.

247. ONONDAGA PLASTER.

(Gypsum.)

Collected of Sheldon & Newcomb, Greenfield, Mass.

	246.	247.
	Pounds per hundred.	
Calcium oxide,	32.17	29.15
Magnesium oxide,	1.40	3.89
Sulphuric acid,	44.00	31.82
Insoluble matter,	.70	9.25

The sample (246) contains 94.8 per cent. of gypsum, and is a fair article. The customary market price in our vicinity is $9.00 per ton.

This second article (247) sells at $6.00 per ton; its cost corresponds well with its percentage of gypsum,—67. to 68. per cent.

WOOD ASHES.

248. Canada Ashes, collected of Mr. Roche, South Deerfield, Mass.

249. Canada Ashes, collected of A. Montague, Sunderland, Mass.

250. Ashes, sent on for examination, by H. C. Haskell, Deerfield, Mass.

251. Ashes, sent on for examination, from Northfield, Mass.

	248.	249.	250.	251.
		Pounds per hundred.		
Moisture at 100° C.,	10.72	15.00	15.37	27.47
Calcium oxide,	40.88	35.22	35.65	30.50
Magnesium oxide,	3.33	3.24	2.38	2 81
Potassium oxide,	4.95	5.50	3.64	1.25
Phosphoric acid,	2.02	2.53	2.11	1.98
Insoluble matter,	6.30	9.05	7.95	10.55

Samples 248 and 249, are of a fair composition; 250 contains less potash, and may consist in part of leached ashes; 251 is a leached ash. Wood ash ought to be bought and sold on guaranty of composition; inferior wood ashes are liable to come from all sections of the country.

C. A. GOESSMANN, *Director*,

AMHERST, MASS.

☞*P. S. The Bulletins of the Experiment Station will be sent free of charge to all parties interested in its work, on application.*

MASSACHUSETTS STATE

AGRICULTURAL EXPERIMENT STATION.

BULLETIN No. 14.

MARCH, 1885.

The publication of bulletins, which for economical reasons was discontinued in November, is herewith resumed, to assist in the farm work of the coming season. The results of investigations carried on at the Station towards the close of the past, and at the beginning of the present year, are incorporated in the second annual report of the institution which is contained in the last annual report of the Secretary of the State Board of Agriculture; those of a later date, including some feeding experiments and chemical inquiries of various description, will be published as speedily as circumstances permit.

Arrangements are made 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 farmer's 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 material for examination ought to be sent on, transportation prepaid. 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, and so far as the present quite limited pecuniary means admit. 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.

The bulletins to be issued from time to time will be sent in the future, as they have been in the past, free of charge to the agricultural press, the various agricultural associations in the state, and all parties interested in its work whose names are on our list of regular recipients. New applications will receive, as far as practicable, prompt attention. Parties connected with the publication of agricultural topics, will confer a favor on the institution by sending on a copy.

All parcels and communications sent on to the "The Experiment Station" must have express and postal charges prepaid, to receive attention.

Meteorological Summary for the month ending February 28th.

	December.	*January.*	*February.*
Mean temperature,	28.21°	22.73°	15.17°
Highest temperature,	57.00°	57 00°	39.00°
Lowest temperature,	—20.00°	—18.00°	—15.00°
Mean Relative Humidity,	——	81.70 per ct.	81.65 per ct.
Total Rainfall or melted snow, (in.),	4.85	3.78	3.88
Total Snow fall, (in.),	14.75	13.80	7.88
Prevailing Winds,	Northerly;	Northwesterly;	Northwesterly.
No. of days on which 0.01 in. or more of rain or melted snow fell,	7.	10.	7.
No. of days on which cloudiness averaged 8 or more on scale of 10,	11.	8.	2.

During the three months the "cold wave" flag has been displayed ten times, in accordance with notice received from the Signal Service, and only once has the warning failed to be justified by a marked fall of temperature during the succeeding twenty-four hours.

FODDER AND FODDER ANALYSES.

On a previous occasion, attention has been called to the circumstance that experiments have been instituted at an early date at the Station, to study the adaptability, to our soil and climate, of some reputed forage crops of the valuable family of plants, Leguminosae, of which the clover, the peas, and the beans are so conspicuous representatives. Some observations during 1883, with Cow Peas, Vetches, and Serradella have been reported during the past year in BULLETINS 8 and 9; others of a more recent date, with Common Lucern, (Alfalfa), Horse Bean and Lupine, will be briefly described within these pages. The early stage of our experiments obliges us, however, to confine ourselves for the present, to a mere introduction of the subject, by describing the quality of the crops we raised.

A successful introduction of a greater variety of valuable farm crops tends to improve our chances for economical rotations of crops. The cultivation of valuable fodder crops maturing at different periods of the growing season, assist in the compounding of economical fodder rations. The best interests of the dairy business and of stock feeding in general, call for a more efficient protection against the serious influence of dry seasons. To meet the shortcomings of hill pastures and dry meadows, by feeding a half-matured fodder corn, is decidedly wasteful. The nutritive value of one and the same variety of fodder corn may be impaired, ton for ton, from fifty to seventy and more per cent. in consequence of a too early cutting for green fodder or for ensilage.

A more liberal choice of fodder crops growing successfully upon different kinds of soil, and maturing at different periods of the season, will prove, as it has proved elsewhere, most beneficial in the interest of an economical farm management.

252. WHITE LUPINE. (Lupinus Albus).

Collected when in bloom from Experimental Plats of the Station, 1884.

	Percentage Composition.	Constituents (in lbs.) in a ton of 2000 lbs.	Pounds digestible in a ton of 2000 lbs.	Per cent. of digestibility of constituents.	Nutritive Ratio.
Moisture at 100° C.,	8.60	172.00			
Dry Matter,	91.40	1828 00			
	100.00	2000.00			
ANALYSIS OF DRY MATTER.					1 : 4.27
Crude Ash,	5.03	100.60			
" Cellulose,	31.18	623.60	455.23	73	
" Fat,	2.41	48.20	14 46	30	
" Protein, (nitrogenous matter),	18.71	374.20	276.91	74	
Non-nitrogenous extract matter,	42.67	853.40	512.04	60	
	100.00	2000.00	1258.64		

The cultivation of this variety of Lupine has been undertaken for the purpose of testing its fitness for green manuring upon exhausted farm-lands. The frequent occurrence of a natural dense growth of a blue variety of wild Lupine, on sandy unproductive lands along the Connecticut river, suggested the idea of trying the above described improved variety, as a green manure, for the reclamation of abandoned farm-lands in neighboring districts. The white Lupine enjoys a high reputation as a green manure upon a light, dry, sandy soil. The first season has been used for raising seed.

253. LUCERN. (Alfalfa). (Medicago sativa).

Collected when just beginning to bloom, from Plats of the Station—July 2d, 1884.

	Percentage Composition.	Constituents (in lbs.) in a ton of 2000 lbs.	Pounds digestible in a ton of 2000 lbs.	Per cent. of digestibility of constituents.	Nutritive Ratio.
Moistnre at 100° C..	16.00	320.00			
Dry Motter,	84.00	1680.00			
	100.00	2000.00			
ANALYSIS OF DRY MATTER.					1 : 4.71
Crude Ash,	10 45	209.00			
" Cellulose,	25.42	508.40	203.36	40	
" Fat.	2.50	50.00	19.50	39	
" Protein, (nitrogenous matter),	16.34	326.80	251.64	77	
Non-nitrogenous extract matter,	45 29	905.80	588.77	65	
	100.00	2000.00	1063.27		

The green material contained 77 parts of moisture and 23 parts of vegetable matter. The sample for analysis was taken from the first growth, when in blossom. The composition of the Lucern hay compares favorably with that of a first class hay of red clover in blossom. The past winter will have tested severely the adaption of this valuable fodder plant to our climate. The plant is noted for its resistance to drought wherever its extensive root system freely develops.

254. HORSE BEAN. (Horse Bean). Straw.

	Percentage Composition.	Constituents (in lbs.) in a ton of 2000 lbs.	Pounds digestible in a ton of 2000 lbs.	Per cent. of digestibility of constituents.	Nutritive Ratio.
Moisture at 100° C.,	9.15	183.00			
Dry Matter,	90.85	1817.00			
	100.00	2000.00		In case of cows.	
ANALYSIS OF DRY MATTER.					1 : 8.56
Crude Ash,	9 59	191.80			
" Cellulose,	41.44	828.80	298.37	36	
" Fat,	1.51	30.20	16.61	55	
" Protein, (nitrogenous matter),	9.69	193.80	98.84	51	
Non-nitrogenous extract matter.	37.77	755.40	460.79	61	
	100.00	2000.00	874.61		

(Horse Bean). Beans.

	Percentage Composition.	Constituents (in lbs.) in a ton of 2000 lbs.	Pounds digestible in a ton of 2000 lbs.	Per cent. of digestibility of constituents.	Nutritive Ratio.
Moisture at 100° C.,	10.28	205.60			
Dry Matter,	89.72	1794.40		In case of cows.	
	100.00	2000.00			
ANALYSIS OF DRY MATTER.					1 : 2.24
Crude Ash,	4.27	85.40			
" Cellulose,	8 11	162.20	102.19	63	
" Fat,	1.11	22.20	21.53	97	
" Protein, (nitrogenous matter),	30.03	600.60	540.54	90	
Non-nitrogenous extract matter,	56.48	1129.60	1061.82	94	
	100.00	2000.00	1726.08		

This plant is extensively cultivated throughout Europe either alone or as a mixed crop with oats, barley or rye, for green fodder. The tender parts of the stems and the beans are noted for their high nutritive value. The best results are obtained upon clayish soils and on good marsh-lands. The first year's results with Horsebean, Lupine and Lucern, have been quite encouraging.

255. HAMPDEN PROLIFIC CORN.

(Sent on for examination from Springfield, Mass).

The ears contained from eighteen to twenty rows of kernels; were of a whitish color; and had an average length of from 9 3-4 to 10 inches. They consisted in weight of from 86.5 to 88.2 per cent. of kernels, and from 21.8 to 23.5 per cent. of cobs. The average weight of the ears sent on, varied from 473.4 to 491.4 grammes (about one pound); that of a single kernel, from .39 to .43 grammes. The moisture amounted to from 8.02 to 11.43 per cent.

No. 1 was raised upon a sandy loam, in good condition.

No. 2 was raised upon a heavy soil, in good condition, according to statements made.

	No. 1.	No. 2.
Moisture of kernels,	11.43	8.02
Dry Matter,	88.57	91.98
	100.00	100.00

ANALYSIS OF DRY MATTER.

Crude Ash,	1.72	1.69
" Cellulose,	2.17	1.98
" Fat,	4.52	5.29
Protein (nitrogenous matter),	11.36	13.73
Non-nitrog. extract matter,	80.23	77.31
	100.00	100.00

The analysis of this variety of corn furnishes an additional illustration of the influence of fitness and condition of soil on the composition of one and the same kind of crop, under similar climatical conditions. The corn No. 2 contains nearly one-fifth or 20 per cent. more fat and nitrogenous compounds—the most costly constituents—than sample No. 1. A comparison of the above stated analytical results, with the analyses of prominent varieties of corn raised within the state, shows that as far as composition is concerned, the Hampden Prolific Corn may be counted of equal value with our home standard articles. For details I refer to an article "On Relative Value of Several Prominent Varieties of Eastern, Western and Southern Corn," published in the annual report of the Secretary of the Massachusetts State Board of Agriculture for 1879, page 221—250.

To manure our farm crops well, pays, as a rule, not less in regard to the improvement in quality than in the increase of quantity.

256. MIDDLINGS.

Sent on by Bolton Farmers' and Mechanics' Association, Bolton, Mass.

	Percentage Composition.	Constituents (in lbs.) in a ton of 2000 lbs.	Pounds digestible in a ton of 2000 lbs.	Per cent. of digestibility of constituents.	Nutritive Ratio.
Moisture at 100° C.,	9.25	185.00	Not determined by actual feeding tests.	Not determined by actual feeding tests.	1 : 4.74—1 : 5
Dry Matter,	90.75	1815.00			
	100.00	2000.00			
ANALYSIS OF DRY MATTER.					
Crude Ash,	5.34	106.80			
" Cellulose,	8.40	168.00			
" Fat,	6.46	129.20			
" Protein, (nitrogenous matter),	18.18	363.60			
Non-nitrogenous extract matter,	61.62	1232.40			
	100.00	2000.00			

The article is rich in valuable constituents for feeding purposes, and compares favorably with those of its kind. It seems quite safe to assume the rates of digestibility noticed in wheat bran, fed to cattle, which have been repeatedly stated in previous bulletins :— see No. 11, page 5.

VALUATION OF FERTILIZERS

AND

ANALYSES OF FERTILIZERS.

The valuation of a fertilizer is based on the trade value of the fertilizing elements specified by analysis. The commercial, or money value of the higher grades of agricultural chemicals and of the higher priced, more or less 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; and on the market price of these constituents at the time of sale. The valuation which usually accompanies the analyses of these goods shall inform the consumer, as far as practicable, regarding the price at which the several specified essential elements of plant food, in an efficient form, have been offered of late, for sale, in the general market.

The market value of low priced materials used for manurial purposes, as salt, ashes, various kinds of lime, barnyard manure, factory refuse and waste materials of different description, does, quite frequently, not stand in a close relation to their chemical composition. Their cost varies in different localities. Local facilities for cheap transportation and more or less advantageous mechanical condition for direct application and for a speedy action, exert, as a rule, a decided influence on their selling-price.

The modes of analyses generally adopted for the examination of fertilizing ingredients, are practically the same in different parts of the country. The results obtained by ordinary care, wherever the identity of the material for examination has been secured, answer the main purpose,—to assist in an intelligent management of the trade in commercial fertilizers.

The wholesale 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 have, only in exceptional instances, a desirable chance to inform themselves regarding the conditions which control the market price, the assistance rendered in this direction, by Agricultural chemists charged with the examination of commercial fertilizers, cannot otherwise than benefit, ultimately, both farmers and manufacturers.

The market reports of centres of trade in New England, New York and New Jersey, aside from consultations with leading manufacturers of fertilizers, furnish us the necessary information regarding the current trade value of fertilizing ingredients. The subsequent statement of trade values is obtained by taking the average of the wholesale quotations in New York and Boston, during the six months preceding March 1st, 1885, and increasing them by 20 per cent., to cover expenses for sales, credits, etc. They are recognized and accepted by the experiment stations of Connecticut, Massachusetts and New Jersey.

TRADE VALUES OF FERTILIZING INGREDIENTS IN RAW MATERIALS AND CHEMICALS.

	Cents per pound.	
	1884.	*1885.*
Nitrogen in Ammonia Salts.	22	18
" Nitrates,	18	18
" Dried and fine ground fish,	20	18
Organic nitrogen in guano and fine ground blood and meat,	18	18
Organic nitrogen in cotton seed, linseed meal and in castor pomace,	18	18
Organic nitrogen in fine ground bone,	18	18
Organic nitrogen in fine medium bone.	16	16
Organic nitrogen in medium bone,	14	14
Organic nitrogen in coarse medium bone,	12	12
Organic nitrogen in coarse bone, horn shavings, hair, and fish scraps,	10	10
Phosphoric acid soluble in water,	10	9
" " " ammonia citrate,*	9	8
Phosphoric acid insoluble, in dry fine ground fish, and in fine bone,	6	6
Phosphoric acid insoluble, in fine medium bone,	$5\frac{1}{2}$	$5\frac{1}{2}$
Phosphoric acid insoluble, in medium bone,	5	5
" " " coarse medium bone,	$4\frac{1}{2}$	$4\frac{1}{2}$
" " " coarse bone,	4	4
" " " fine ground rock phosphate,	$2\frac{1}{4}$	2
Potash, as high grade sulphate,	$7\frac{1}{4}$	$7\frac{1}{4}$
" Kainite,	$4\frac{1}{4}$	$4\frac{1}{4}$
" Muriate.	$4\frac{1}{4}$	$4\frac{1}{4}$

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

*Dissolved from two grams of Phosphate, unground, by 100 C. C. neutral solution of ammonium citrate sp. gr. 1.09 in 30 minutes at 65° C., with agitation once in five minutes; commonly called "reverted" or "backgone" phosphoric acid.

They also correspond, as has been stated, to the average wholesale prices for the six months ending March 1st, plus 20 per cent. in case of goods for which we have wholesale quotations. The calculated values obtained by the use of the above figures, will be found to agree fairly with the reasonable retail price in case of standard raw materials such as :

Sulphate of Ammonia,	Azotin,
Nitrate of Soda,	Dry Ground Fish,
Muriate of Potash,	Cotton Seed,
Sulphate of Potash,	Castor Pomace,
Dried Blood,	Bone,

Plain Superphosphates.

TRADE VALUES IN SUPERPHOSPHATES, SPECIAL MANURES AND MIXED FERTILIZERS OF HIGH GRADE.

The organic nitrogen in these classes of goods will be reckoned at the highest figure laid down in the Trade Values of Fertilizing Ingredients in Raw Materials, namely eighteen cents per pound.

Insoluble phosphoric acid will be reckoned at four cents, the cost of phosphoric acid in coarse bones. Potash at four and one-quarter cents, if sufficient chlorine is present in the fertilizer to combine with it. If there is more potash present than will combine with chlorine, then this excess of potash will be reckoned as sulphates. To introduce large quantities of chlorides, common salt, etc., into fertilizer, claiming sulphate of potash as a constituent, is a practice, which in our present state of information will be considered of doubtful merits.

The use of the highest trade values is but justice to these articles in which the costliest materials are expected to be used. In most cases the calculated value of ammoniated superphosphates and specials will fall considerably below the retail price. The difference between the two, will represent the manufacturer's charges for converting raw materials into more or less compounded manufactured articles. These charges include grinding and mixing, bagging or barreling, storage and transportation, commission to agents or dealers, long credit, interest on investment, bad debts, and finally profits.

The prices stated in these bulletins in connection with analyses of commercial fertilizers refer to their cost per ton of 2,000 pounds, on board of car or boat near the factory, or place for 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 substance.

Two samples of fish fertilizer, although equally pure, may differ from 50 to 100 per cent. in commercial value, on account of mere difference in moisture.

As existing laws of the State for control of the trade in commercial fertilizers provides for the examination of licensed articles, the attention of the Station has been directed mainly towards the examination of agricultural chemicals. the crude stock for the manufacture of commercial fertilizers, and of prominent refuse materials from manufacturing industries and elsewhere.

Crude stock for the manufacture of fertilizers, and refuse material 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 at the Station for the purpose of aiding the farming community in a clear and intelligent appreciation of these substances for manurial purposes.

General experience in farm practice teaches that it is safer, for economical reasons, to use commercial fertilizers rather as supplements, than as substitutes for barn-yard manures.

The advantages arising from the introduction of chemical and commercial manurial substances, can only be secured to their full extent when applied with reference to actual local wants of the soil, and to special requirements of the crops under cultivation.

It has been the aim in previous bulletins of the Station, to describe briefly,—in connection with analytical reports regarding the composition,—also the peculiar character and the special merits of prominent agricultural chemicals, and of refuse materials of various industries, which are used for the manufacture of fertilizers for farm purposes.

This feature of the bulletins will be retained for the future, wherever an inducement is offered. The information thus far given on these occasions may be improved by studying the official annual reports on Commercial Fertilizers, published since 1873, in the Report of the Secretary of the State Board of Agriculture; and in the first and second Annual Reports of the Station. A knowledge of the sources and of the character of the ingredients which serve largely for the manufacture of our commercial fertilizers, leads quite naturally to a due appreciation of the importance of securing *the proper form* for our circumstances. No mode of supplying our special wants of plant food for a successful and economical cultivation of crops is as safe, as the practice to supplement—if needed—our home-made manures with commercial fertilizing ingredients, in the form of suitable raw materials and chemicals to meet our wants; and if obliged to increase our home resources of manure, to compound them from the most suitable stock in the market. Although a first trial of that course of action may not realize all the advantages expected, there can be no doubt about the correctness of the statement, that the best financial success on the part of the farmer, can ultimately only be secured by the gradual adoption of that system of manuring the farm.

Our leading dealers in fertilizers begin to realize the late tendency in their trade, and are preparing to meet the call. There is every reason to assume that the consumption of commercial manurial matter will increase in the same proportion, as the principles of a rational and economical system of manuring become better understood.

Consumers of commercial manurial substances do well to buy whenever practicable, on a 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.

257. SUMAC.

Waste material from tanneries in Peabody, Mass. Sent on by the Mass. Society for Promoting Agriculture.

Moisture at 100° C.,	63.06
Organic matter,	36.94
Nitrogen in organic matter,	1.19
Crude Ash in " "	6.80
Calcium oxide in ash,	1.14
Magnesium oxide in ash,	3.25
Potassium oxide " "	.17
Phosphoric acid,	.17
Insoluble matter in ash,	2.25

The nitrogen, potash and phosphoric acid contained in the above article represent a commercial value of $3.50 to $4 per ton of 2000 pounds. The tanning principle was so completely abstracted, that a composting with some air slacked lime, promises to render the material quite valuable as a manurial substance for light soils deficient in organic matter.

258. KENTUCKY TOBACCO STEMS. (Ground).

Sent on for examination.

	Per Cent.
Moisture at 100° C.,	12.18
Dry matter,	87.82
Nitrogen (in organic matter),	2.616

Potassium oxide,	8.816
Magnesium oxide,	1.395
Calcium oxide,	3.720
Phosphoric acid,	.726

This article is valuable for fertilizing purposes,—and deserves the special attention of tobacco-growers; its trade value of fertilizing constituents amounts from $15.50 to $16 per ton of 2000 lbs. at current rates of valuation.

259. Material taken from a Ditch in a Diked Marsh at East Salisbury, Mass. Sent on for examination.

	Per Cent.
Moisture at 100° C.,	33.40
Organic and Volatile Matter,	92.15
Ash,	7.85
Ash soluble,	4.20
Ash insoluble,	3.65
Nitrogen (in organic matter),	1.64
Phosphoric acid,	0.13
Potassium oxide,	0.26
Calcium oxide,	1.24

This material is quite rich in manurial substances, and equal in that respect to the better quality of peat.

260. LIME KILN ASHES.

(Collected at Holyoke, Mass.).

	Per Cent.
Moisture at 100° C.,	30.70
Calcium oxide,	37.55
Magnesium oxide,	3.68
Potassium oxide,	1.70
Phosphoric acid,	1.27
Carbonic acid,	17.83
Insoluble matter,	3.30

Sold at 22 cents per bushel.

The material is a fair sample of its kind.

261. SALTPETER WASTE.

Sent on from Acton, Mass.

	Per Cent.
Moisture at 100° C.,	0.50
Sodium oxide,	44.93
Potassium oxide, (largely chloride)	4.65
Nitrogen (in nitrates),	1.87

The sample represents a trade value from $10 to $11 per ton, and will prove quite effective upon grass lands and in case of forage crops in general.

C. A. GOESSMANN, *Director*,

AMHERST, MASS.

MASSACHUSETTS STATE

AGRICULTURAL EXPERIMENT STATION.

BULLETIN No. 15.

APRIL, 1885.

Meteorological Summary for two months ending April 30th.

	MARCH.	APRIL.
Highest Temperature,	50.0°	83.0°
Lowest Temperature,	11.0°	19.0°
Mean Temperature,	23.29°	45.29°
Mean Relative Humidity,	85.3 per ct.	72.6 per ct.
Total rainfall or melted snow,	0.86 in.	3.38 in.
Prevailing winds,	Northwesterly.	Northwesterly.
No. of days on which 0.01 inch of rain or melted snow fell,	4	6
No. of days on which cloudiness averaged 8 or more on scale of 10,	4	5

The month of March was characterized by unusually low temperature and slight precipitation. The mean temperature for the month was less than the average for forty-eight years, and the precipitation showed a decrease of 2.27 inches from the mean. In April the temperature rose to the opposite extreme, being unusually high towards the close of the month.

262. NOTES ON FEEDING EXPERIMENTS WITH MILCH COWS.

The experiments briefly described in a few subsequent pages were carried on for the purpose of ascertaining, under otherwise fairly corresponding circumstances, the economy of several customary combination of fodder articles—as far as the cost of the feed and the quantity and quality of milk obtained is concerned. The observations began on 1st of November, 1884, and were continued until the 18th of April, 1885; extending thus over a term of nearly six months.

Two cows—Lady Horace (grade Ayrshire), and Bessie (grade Jersey),—both from seven to eight years old, and of a corresponding milking period, served for the trial. The last calf had been dropped between the 16th and 18th of October, 1884.

Hay, corn fodder, corn ensilage, corn meal, wheat bran and gluten meal constituted the ingredients for the compounding of the daily diet; they were fed periodically, in varying proportions and in different combinations. to notice their comparative individual merits, if any should become conspicuous. The same weights of corn meal, gluten meal and wheat bran, whenever used, were retained throughout the entire experiments; whilst the weight of the hay, corn fodder and corn ensilage was altered in consequence of being fed either alone or in some particular combination with each other. The entire amount of these articles consumed under both conditions was limited in every instance by the inclination of the animal. The first feeding took place between six and seven o'clock in the morning, the second at noon, and the third at six o'clock in the evening. Corn meal, wheat bran and gluten meal were usually fed, together with a small amount of the coarser feed, during milking, morning and evenings, whilst the remainder of the coarser feed was offered subsequently three times during the day. The amount left over was weighed and deducted from the previous record. The price which has been adopted in our subsequent valuation of each article of fodder used during the experiments, is based on our local condition of the market, and does not directly apply to more favored localities. The cost of one quart of milk, as stated below, may vary thus in case of the same kind and the same amount of feed and of a corresponding yield of milk, from that in other localities, Whilst our statements of cost of feed for the production of one quart of milk can only claim a direct application for a limited locality, it will be conceded that the statement of relative cost of the milk in case of different combinations of fodder articles for its production, may fairly claim a more general consideration. The following rates of prices have been adopted in our subsequent valuation, per ton of 2000 pounds: Corn meal and wheat bran, $23.00; gluten meal, $22.50; hay, $15.00; dry corn fodder, $5.00; corn ensilage, $2.75. The price of the latter is based on the following circumstances: well dried corn fodder contains 20 per cent. of moisture and 80 per cent. of dry vegetable matter; green corn fodder adapted to the production of ensilage, contains from 18 to 22 per cent of vegetable matter and 82 to 78 per cent. of moisture. Four tons of such green fodder corn will produce one ton of dry corn fodder, as described. Counting one ton of green corn fodder worth $1.25, and the cost of converting it into ensilage equal to $1.50—a rather liberal allowance—one ton of corn ensilage would be worth $2.75. As the relative nutritive value of a fodder article—in case of the same kind and condition of the animal—depends. aside from its general adaption, on its actual percentage of dry vegetable matter, and on the particular relative proportion of its nitrogenous (protein) and non-nitrogenous constituents, the total amount of dry vegetable matter contained in the entire daily diet during each feeding period has been stated, alongside of the daily yield of milk. The relative proportion of digestible nitrogenous and non-nitrogenous constituents of the feed is expressed by "Nutritive Ratio"—taking Nitrogen=1. This mode of reporting our observations has been adopted for the purpose of assisting the reader in the recognition of the amount of dry vegetable matter consumed daily by each cow during each period of feeding; and of rendering more conspicuous the effect of each particular combination of fodder articles on the daily yield of milk, as well as the general condition of the animals on trial.

The weights of the latter were ascertained once each week before milking and feeding in the morning. Lady Horace weighs at present 950 pounds, and Bessie 822 pounds, which is approximately the same as at the beginning of the experiments. The former yields at present from 23 to 24 pounds of milk per day, and the latter from 21 to 22 pounds, with a daily diet consisting of the same amount of hay, corn meal and wheat bran, which constituted the daily feed during the first feeding period (Nov. 1—10). The decline of milk production (independent of kind and amount of feed), in consequence of the progress of the milking period (since Nov. 1st), amounts apparently to nine pounds per day in the case of both cows. The results obtained confirm in several directions those reported in previous bulletins (see Nos. 10–11–12). They show the good services of wheat bran and gluten meal as constituents of the daily diet of milch cows, and also the favorable influence of good corn ensilage on the flow of milk—comparing pound for pound of dry vegetable matter fed, with the yield of milk; yet it is not less apparent that a too exclusive feeding of corn ensilage affects seriously the general condition of the animal. No serious alteration in the composition of the milk obtained under such conditions has thus far been noticed; our samples of milk compared well with the best we have tested from other feed.

I. RECORD OF LADY HORACE.

FEEDING PERIODS.	Feed consumed (lbs.) per day.						Milk produced (lbs.) per day.			Amt. of dry vegetable matter contained in the daily fodder consumed in pounds.	Nutritive Ratio.	Weight of Animal.
	Wheat shorts.	Corn Meal.	Gluten Meal.	Hay.	Corn fodder.	Corn Ensilage cut.	Morning.	Evening.	Total.			
Nov. 1–10,	3.25	3.25		20.			19.3	15.7	35.0	23.63	1:8.11	930
" 11–17,	3.25	3.25		20.			17.1	14.0	31.1	23.63		900
" 18–24,	3.25	3.25		17.4			15.4	13.5	28.9	21.30	1:7.99	905
" 25–Dc 1,	3.25	3.25		18.9			17.2	13.4	30.6	22.65		985
Dec. 4–13,	3.25	3.25	3.25	19 0			18.1	14.4	32.5	25.61	1:6.53	992
" 14–23,	3.25	3.25	3.25	8.3	8.3		17.2	12.4	29.6	23.75	1:5.79	944
" 24–Jn. 2,	3.25	3.25		10.1	10.1		15.4	10.9	26.3	24.17		1015
Jan. 3–12,	3.25	3.25		10.3	10.3		14.2	10.0	24.2	24.53	1:7.01	996
" 13–22,	3.25	3.25		10.7	10.7		13.9	10.2	24.1	25.27		1004
" 27–Fb.3,	3.25	3.25		4.0		30.6	14.5	9.9	24.4	14.86	1:7.47	952
Feb. 4–10,	3.25	3.25				39.1	13.4	9.9	23.3	12.82	1:7.26	905
" 16–22,	3.25					55.0	11.6	7.7	19.3	12 85		895
" 23–Mr.1,	3.25					49.0*	11.3	8.6	19.9	11.12	1:7.0	855
Mar. 2–8,	3.25					46.6	11.0	8.1	19.1	10.72		876
" 13–19,		3.25				36.6	12.0	9.1	21.1	9.02	1:8.7	893
" 24–30,		3.25		20.0			11.1	7.9	19.0	20.75	1:9.75	892
" 31–Ap.6,	3.25			20.0			10.9	7.7	18.6	20.77	1:8.28	935
Apr. 12–18,	3.25	3.25		20.0			12.4	9.7	22.1	23.63	1:8.11	897

*Commenced feeding ensilage of uncut corn Feb. 23.

ANALYSES OF MILK.

	November.		December.				January.		
	18	*24*	*5*	*10*	*17*	*23*	*7*	*15*	*21*
Water,	86.02	87.15	85.12	87.20	87.26	86.22	87.41	87.05	86.54
Solids,	13.98	12.85	14.88	12.80	12.74	13.78	12.59	12.95	13.46
Fat (in solids,)	4.98	3.65	5.10	3 74	3.86	4.70	3.64	3.95	3.97
Solids not fat,	9.00	9.20	9.78	9.06	8.88	9.08	8.95	9.00	9.49

	February.		March.			April.	
	3	*10*	*5*	*16*	*30*	*6*	*13*
Water - - - - -	86.28	86.95	86.52	85.20	86.36	87.53	86.25
Solids, - - - - -	13.72	13 05	13.48	14.08	13.64	12.47	13.75
Fat, (in solids,) - -	4 53	3.30	4.90	3.66	4.51	3 58	4.51
Solids not fat, - -	9.19	9.75	8.58	10.42	9.13	8.89	9,24

II. RECORD OF BESSIE.

FEEDING PERIODS.	Feed consumed (lbs.) per day.						Milk produced (lbs.) per day.			Amt. of dry vegetable matter contained in the daily fodder consumed in pounds.	Nutritive Ratio.	Weight of Animal.
	Wheat shorts.	Corn Meal.	Gluten Meal.	Hay.	Corn fodder.	Corn Ensilage cut.	Morning.	Evening.	Total.			
Nov. 1–10,	3.25	3.25		19.6			17.4	14.4	31.8	23.27	1:8.1	810
" 11–17,	3.25	3.25		20.0			16.1	12.9	29.0	23.63		805
" 18–24,	3.25	3.25		15.0			14.3	11.6	25.9	19.16	1:7.76	786
" 25–Dc.1,	3.25	3.25		15.6			14.9	10.0	24.9	19.69		790
Dec. 4–13,	3.25	3.25	3.25	14.6			16.0	12.7	28.7	21.22	1:6.10	817
" 14–23,	3.25	3.25	3.25	7.4	7.3		15.4	11.9	27.3	22.02	1:5.68	828
" 24–Jn. 2,	3.25	3.25		7.7	7.7		14.8	10.5	25.3	19.80		855
Jan. 3–12,	3.25	3.25		8.5	8.4		14.3	10.0	24.3	21.15	1:6.84	866
" 13–22,	3.25	3.25		8.0	8.0		13.8	9.1	22.9	20.34		867
" 27–Fb.3,	3.25	3.25		4.0		36.3	13.7	9.1	22.8	15.90	1:7.64	821
Feb. 4–10,	3.25	3.25				39.0	13.0	9.0	22.0	12.81	1:7.26	792
" 16–22,	3.25					54 3	11.7	7.0	18.7	12.72		775
" 23–Mr.1,	3.25					50.0*	10.4	7.0	17.4	11.29	1:6.92	790
Mar. 2–8,	3.35					40.0	9.1	7.0	16.1	9.61		755
" 13–19,		3.25				34.3	8.3	7.0	15.3	8.63	1:8.67	730
" 24–30,		3.25		16.3			9.0	7.1	16.1	17.44	1:9.62	750
" 31–Ap.6,	3.25			14.6			9.1	7.0	16.0	15.94	1:7.78	782
Apr. 12–18,	3.25	3.25		16.0			11.6	9.3	20.9	20.05	1:7.81	782

*Commenced feeding ensilage of uncut corn Feb. 23.

ANALYSES OF MILK.

	November.		December.				January.		
	17	24	5	10	17	23	7	15	21
Water,	87.00	86.91	86.18	86 99	87.41	85.36	87.26	87.29	87.89
Solids,	13.00	13.09	13.82	13.01	12.59	14.64	12.74	12.71	12.11
Fat (in solids,)	4.04	3.86	4.02	3.72	3.32	4.75	3.73	3.91	3.02
Solids not fat,	8.96	9.23	9.80	9.29	9.27	9.89	9.01	8.80	9.09

	February.		March.			April.	
	2	10	5	16	30	2	13
Water, - - - - -	86.92	86.54	85.53	87.19	87.15	86.81	87.35
Solids, - - - - -	13.08	13.46	14.47	12.81	12.85	13.19	12.65
Fat (in solids,) - -	4.90	4.11	4.74	3.86	3.54	4.49	3.74
Solids not fat, - -	8.18	9.35	9.73	8.95	9.31	8.70	8.91

COST OF FEED PER QUART OF MILK.

(LADY HORACE.)

FEEDING PERIODS.	Total quantity of milk in period.	Average daily milk for period.	Total amount of shorts consumed for period.	Total amount of corn meal consumed for period.	Total amount of hay consumed for period.	Total amount of dry corn fodder consumed for period.	Total amount of ensilage consumed for period.	Total amount of gluten meal consumed for period.	Total cost of fodder for period.	Av. cost of feed for the production of qt. of milk for period.
	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	$	ct.
Nov. 1–10, - -	350.0	35.0	32.5	32.50	200.0				2.25	1.29
" 11–17, - -	217.7	31.1	22.75	22.75	140.0				1.57	1.44
" 18–24, - -	203.3	28.9	22.75	22.75	121 8				1.44	1.42
" 25–Dec. 1, - -	214.2	30.6	22.75	22.75	132.3				1.52	1.42
Dec. 4–13, - -	325.0	32.5	32.50	32.50	190.0			32.50	2.54	1.56
" 14–23, - -	296.0	29.6	32.50	32.50	83.0	83.0		32.50	1.95	1.32
" 24–Jan. 2, - -	263.0	26 3	32.50	32.50	101.0	101.0			1.76	1.34
Jan. 3–12, - -	242.0	24.2	32.50	32.50	103.0	103.0			1.78	1.47
" 13–22, - -	241.0	24.1	33.50	32.50	107.0	107.0			1.82	1 51
" 27–Feb. 3, - -	195 2	24.4	26.00	26.00	32 0		244.8		1.18	1.21
Feb. 4–10, - -	163.1	23.3	22.75	22.75			273.7		.90	1.11
" 16–22, - -	135.1	19.3	22.75				385.0		.79	1.17
" 23–Mar. 1, - -	139.3	19.9	22.75				343 0		.73	1.05
Mar. 2–8, - -	133.7	19.1	22.75				326.2		.71	1.06
" 13–19, - -	147.7	21.1		22.75			256.2		.61	0.83
" 24–30, - -	133.0	19.0		22.75	140.0				1.31	1.97
" 31–Apr. 6, - -	130.2	18.6	22.75		140.0				1.31	2.01
Apr. 12–18, - -	154.7	22.1	22.75	22.75	140.0				1.57	2.03

COST OF FEED PER QUART OF MILK.

(BESSIE.)

FEEDING PERIODS.	Total quantity of milk produced during the entire period.	Average daily yield of milk for period.	Total amount of shorts consumed for period.	Total amount of corn meal consumed for period.	Total amount of hay consumed for period.	Total amount of dry corn fodder consumed for period.	Total amount of ensilage consumed for period.	Total amount of gluten meal consumed for period.	Total cost of fodder for period.	Av. cost of feed for the production of qt. of milk for period.
	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	$	ct.
Nov. 1–10, - -	318.0	31.8	32.50	32.50	196.0				2.22	1.39
" 11–17, - -	203.0	29.0	22.75	22.75	140.0				1.57	1.55
" 18–24, - -	168.0	24.0	22.75	22.75	105.0				1.31	1.56
" 25–Dec. 1, - -	181.3	25.9	22.75	22.75	109.2				1.34	1.48
Dec. 4–13, - -	287.0	28.7	32.50	32.50	146.0			32.50	2.21	1.55
" 14–23, - -	273.0	27.3	32.50	32.50	74 0	73.0		32.50	1.85	1.36
" 24–Jan. 2. - -	253.0	25.3	32.50	32 50	77.0	77.0			1.52	1.20
Jan. 3–12, - -	243.0	24.3	32.50	32.50	85.0	84.0			1.60	1.32
" 13–22, - -	229.0	22.9	32 50	32.50	80.0	80.0			1.55	1.35
" 27–Feb. 3, - -	182.4	22.8	26 00	26.00	32.0		290.4		1.24	1.36
Feb. 4–10, - -	154 0	22.0	22.75	22 75			273.0		.90	1.17
" 16–22, - -	130.9	18.7	22.75				380.1		.79	1.21
" 23–Mar. 1, - -	121.8	17.4	22.75				350.0		.74	1.22
Mar. 2–8, - -	112.7	16.1	22.75				280.0		.65	1.16
" 13–16, - -	107.1	15.3		22.75			240.1		.59	1.10
" 24–30. - -	112.7	16.1		22.75	114.1				1.12	1.99
" 31–Apr. 6, - -	112.0	16.0	22.75		102.2				1.03	1.84
Apr. 12–18, - -	146 3	20.9	22.75	22.75	112.0				1.36	1.86

SPECIAL ANALYSES OF MILK.

Regarding the quantity and quality of nitrogenous constituents of samples of milk collected before, during and after feeding corn ensilage.

LADY HORACE.

	Jan. 21.		*Feb. 10.*		*March 5.*	
Specific gravity,	1.0346 at 18° C.		1.0341 at 13° C.		1.032 at 13° C.	
Solids,	13.46	per cent.	13.05	per cent.	13.48	per cent.
Fat (in solids)	3.97	"	3.30	"	4.90	"
Solids not fat,	9.49	"	9.75	"	8.58	"
Ash,	0.80	"	——	"	0.80	"
Nitrogen in casein,	0.43	"	0.29	"	0.31	"
" " albumin,	0.04	"	0.06	"	0.04	"
" " lacto-protein,*	0.05	"	0.11	"	0.06	"
Total nitrogen,	0.52	"	0.46	"	0.41	"

BESSIE.

	Jan. 21.		*Feb. 10.*		*March 5.*	
Specific gravity,	1.0338 at 16° C.		1.0338 at 16° C.		1.035 at 1.45° C.	
Solids,	12.12	per cent.	13.49	per cent.	14.47	per cent.
Fat (in solids)	3.02	"	3.72	"	4.74	"
Solids not fat,	9.10	"	9.77	"	9.73	"
Ash,	0.76	"	——	"	0.68	"
Nitrogen in casein,	0.40	"	0.30	"	0.43	"
" " albumin,	0.05	"	0.05	"	0.04	"
" " lacto-protein,*	0.06	"	0.10	"	0.07	"
Total nitrogen,	0.51	"	0.45	"	0.54	"

The results of these analyses are within the variations noticed in milk of recognized good quality.

* Collective name for nitrogenous constituents not casein or albumin

ANALYSES OF FODDER ARTICLES.

263. ENSILAGE OF CUT CORN.

From corn raised upon plats of the Experiment Station.

	Percentage Composition.	Constituents (in lbs.) in a ton of 2000 lbs.	Pounds digestible in a ton of 2000 lbs.	Per cent. of digestibility of constituents.	Nutritive Ratio.
Moisture at 100° C.,	81.88	1637.60			
Dry Matter,	18.12	362.40			
	100.00	2000.00			
ANALYSIS OF DRY MATTER.					1:11.8
Crude Ash,	5.07	101.40	377.71	72	
" Cellulose,	26.23	524.60	52.35	75	
" Fat,	3.49	69.80	114.32	73	
" Protein, (nitrogenous matter),	7.83	156.60	768.89	67	
Non-nitrogenous extract matter.	57.38	1147.60			
	100.00	2000.00	1313.27		

The filling of the silo was carried on during the first and second day of September, 1884; the mass was covered over with boards without weights until the temperature in the mass ceased to increase. In a few places, about eighteen inches below the surface of the mass, the temperature rose to 122° F. or 50° C.; whilst taking the entire silo into consideration, 116° F. or 47° C., represents fairly the highest average temperature attained in our case. The mass showed a slight acid reaction of the second day after cutting the corn, and before putting on the final weight (60 pounds of sand per square foot, in barrels, as in the preceding year). The silo was opened for the use of its contents on the 20th of January, '85. The ensilage was found covered wi]h a mouldy mass several inches in thickness. This being removed, the remainder proved—although acid to customary reagents—a fair article of its kind, and a decided improvement on the ensilage of the first trial. This result is largely due to the fact of using the corn of a more mature stage of growth. For the details of the production of the ensilage, I have to refer to the report of the Secretary of the State Board of Agriculture for 1884.

264. WHOLE CORN ENSILAGE.

From corn raised upon plats of Experiment Station.

	Percentage Composition.	Constituents (in lbs.) in a ton of 2000 lbs.	Pounds digestible in a ton of 2000 lbs.	Per cent. of digestibility of constituents.	Nutritive Ratio.
Moisture at 100° C.,	83.18	1663.60			
Dry Matter,	16.82	336.40			
	100.00	2000.00			
ANALYSIS OF DRY MATTER.					1 : 9.71
Crude Ash,	4.23	84.60			
" Cellulose,	29.44	588.80	423.84	72	
" Fat,	3.69	73.80	55.35	75	
" Protein, (nitrogenous matter),	9.03	180.60	131.84	73	
Non-nitrogenous extract matter,	53.61	1072.20	718.37	67	
	100.00	2000.00	1329.40		

The silo was filled with whole corn, and covered at once, September 1, 1885, as described in detail in the last annual report of the Station; it was opened for feeding purposes on 23d of February, 1885. The odor of fresh ensilage resembled that of the pineapple (Propionic ether), and turned within twenty-four hours of exposure to the air, into that of vinegar; it had a slight acid reaction when first exposed. The color was yellowish green, indicating a good state of preservation; the interior parts of the uncrushed stems showed the presence of saccharine constituents (glucose); and the kernels in the ear contained still an abundance of starch. The ensilage obtained from whole corn plants—at once closed up—was in a better state of preservation than that which had been obtained from the same quality of corn previously cut into pieces of from $1\frac{1}{4}$ to $1\frac{1}{2}$ inches in length, and treated for the production of ensilage as described in the previous statement. The mechanical condition of the whole corn ensilage is less satisfactory for feeding purposes, as far as an economical consumption of the same weight of both are concerned, than that produced from corn previously cut into pieces of from one and one-quarter to one and one-half inch in length.

265. SHREDDED CORN FODDER.

From experimental plats of the Station.

	Percentage Composition.	Constituents (in lbs.) in a ton of 2000 lbs.	Pounds digestible in a ton of 2000 lbs.	Per cent. of digestibility of constituents.	Nutritive Ratio.
Moistnre at 100° C.,	6.95	139.00			
Dry Motter,	93.05	1861.00			
	100.00	2000.00			
ANALYSIS OF DRY MATTER.					1 : 7.23
Crude Ash,	5 16	103.20			
" Cellulose,	33.46	669.20	481.82	72	
" Fat,	1.71	34.20	25.65	75	
" Protein, (nitrogenous matter),	12.15	243.00	163.39	73	
Non-nitrogenous extract matter,	47.52	950.40	636.77	67	
	100.00	2000.00	1307.63		

The corn was cut September 1st, 1885, when the kernels were in the milk. The green fodder contained 21.9 per cent. of dry vegetable matter, and had the appearance of a somewhat prematurely ripened crop, a circumstance confirmed by the results of the analysis, which shows a smaller amount of saccharine and starchy constituents than commonly noticed in this variety of corn ("Clark") at the stated stage of growth.

FERTILIZER ANALYSES.

266. Bradley's Original Coe. Collected of D. J. Wright, Northampton, Mass.

Guaranteed composition; total phosphoric acid, 11 to 14 per cent.; soluble phosphoric acid, 7 to 8 per cent.; reverted phosphoric acid, 2 to 3 per cent.; insoluble phosphoric acid, 2 to 3 per cent.; nitrogen, 2.05 to 2.85 per cent. (equivalent to ammonia 2.5 to 3.5 per cent.)

267. Quinnipiac Co.'s (Cross-brand) Fish and Potash. Collected of D. A. Horton, Northampton, Mass.

Guaranteed composition; nitrogen, $3\frac{1}{4}$ to $4\frac{1}{4}$ per cent.; total phosphoric acid, 5 to 7 per cent.; soluble and reverted phosphoric acid, 3 to 5 per cent.; potassium oxide, 3 to 5 per cent.

268. Bowker's Hill and Drill Phosphate. Collected of J. and J. A. Rice, Worcester, Mass.

Guaranteed composition; nitrogen, $2\frac{1}{2}$ to $3\frac{1}{4}$ per cent., (equivalent to ammonia, 3 to 4 per cent.); total phosphoric acid, 11 to 13 per cent.; soluble phosphoric acid, 8 to 10 per cent.; reverted phosphoric acid, 1 to 2 per cent.; potassium sulphate, 2 to 3 per cent.

269. Mitchell's Standard Superphosphate. Collected of J. and J. A. Rice, Worcester, Mass.

Guaranted composition; ammonia 2 to 3 per cent., (equivalent to nitrogen, 1.6 to 2.47 per cent.); soluble phosphoric acid, 8 to 10 per cent.; insoluble phosphoric acid, 3 to 4 per cent.

	266	267	268	269
		Pounds per hundred.		
Moisture at 100° C.,	12.95	26.45	16.28	15.53
Total phosphoric acid,	12.54	4.98	12.34	10.98
Soluble " "	8.23	1.73	7.90	6 33
Reverted " "	1.90	2.93	2.63	3.30
Insoluble " "	2.41	.32	1.81	1.35
Nitrogen,	3.07	3.63	2.77	1.43
Potassium oxide,	0.30	3.28	1.41	3.84
Insoluble matter,	6.08			6.10
Valuation per 2000 lbs.	$31.09	$23.92	$31.89	$25.96

270. L. L. Crocker's Ammoniated Bone Superphosphate. Collected of Chas. W. Sears, Worcester, Mass.

Guaranteed composition: soluble phosphoric acid, 6 to 8 per cent.; reverted phosphoric acid, 2 to 4 per cent.: insoluble phosphoric acid, 1 to 2 per cent.: ammonia, $3\frac{1}{2}$ to $4\frac{1}{2}$ per cent. (equivalent to nitrogen 2.9 to 3.7 per cent.); potassium oxide, 1 to 3 per cent.

271. Quinnipiac Co. Dry Ground Fish. Collected of D. A. Horton, Northampton, Mass.

Guaranteed composition: nitrogen, 7 to 10 per cent.; soluble and reverted phosphoric acid, 4 to 6 per cent.; total phosphoric acid, 6 to 8 per cent.

272. Quinnipiac Co. Phosphate. Collected of D. A. Horton, Northampton, Mass.

Guaranteed composition: nitrogen, $2\frac{1}{2}$ to $3\frac{1}{2}$ per cent.; soluble and reverted phosphoric acid, 8 to 10 per cent.; insoluble phosphoric acid, 1 to 3 per cent.; potassium oxide, 2 to 3 per cent.

273. Fertilizer sent on for examination by farmers' club near Worcester, Mass.

	270	*271*	*272*	*273*
		Pounds per hundred.		
Moisture at 100° C.,	11.55	8.20	17.60	7.15
Total phosphoric acid,	10.37	7.14	12.13	14.00
Soluble " "	6.30	.67	8.06	11.26
Reverted " "	2.55	2.70	2.18	2.38
Insoluble " "	1.52	3.77	1.89	.36
Potassium oxide,	1.42	——	2.07	1.13
Nitrogen,	3.37	7.96	3.16	2.56
Insoluble matter,	——	3.50	4.23	.83
Valuation per 2000 pounds,	$29.98	$37.21	$32.65	$34.55

274. Bradley's X L Ammoniated Bone Superphosphate. Collected of J. & J. A. Rice, Worcester, Mass.

Guaranteed composition: nitrogen, $2\frac{1}{2}$ to $3\frac{1}{4}$ per cent; (ammonia, 3 to 4); soluble phosphoric acid, 7 to 8 per cent.; reverted phosphoric acid, 2 to 3 per cent. insoluble phosphoric acid, 2 to 3 per cent.; total phosphoric acid, 11 to 14 per cent.; potassium oxide, 2 to 3 per cent.

275. Bosworth Brothers' Superphosphate of Lime. Collected of Wilson & Holden, Worcester, Mass.

Guaranteed composition: nitrogen, 2 to $2\frac{1}{2}$ per cent.; soluble phosphoric acid, 7 to 8 per cent.; reverted phosphoric acid, 4 to 5 per cent.; insoluble phosphoric acid, 2 to 3 per cent.; potassium oxide, 2 to 3 per cent.

276. Mapes' Complete Manure. Collected of W. H. Earle & Co., Worcester, Mass.

Guaranteed composition: ammonia, 6 to 7 per cent. (equivalent to nitrogen 5 to 5.76 per cent.); phosphoric acid, 10 to 12 per cent.; potassium oxide, 3 to 4 per cent.

277. Williams, Clark & Co.'s Ammoniated Bone Superphosphate. Collected of B. L. Bragg & Co., Springfield, Mass.

Guaranteed composition: ammonia, 2 to 3 per cent. (equivalent to nitrogen 1.6 to 2.47 per cent.); total phosphoric acid, 10 to 13 per cent.; soluble phosphoric acid, 6 8 per cent.; reverted phosphoric acid, 3 to 4 per cent.: insoluble phosphoric acid, 1 to 3 per cent.; potassium sulphate, 4 to 6 per cent. (equivalent to potassium oxide, 2 to 3 per cent.); magnesium sulphate, 3 to 4 per cent.

	274	*275*	*276*	*277*
		Pounds per hundred.		
Moisture at 100° C.,	12.30	10.48	16.00	13.03
Total phosphoric acid,	13.12	15.86	14.40	12.73
Soluble " "	7.80	4.54	1.63	9.76
Reverted " "	2.12	5.38	7.89	1.86
Insoluble " "	3.20	5.94	4.88	1.01
Nitrogen,	3.23	2.13	4.58	3.04
Potassium oxide,	1.76	2.45	3.54	2.51
Insoluble matter,	5.28	1.33	1.20	1.20
Valuation per 2000 pounds,	$33.12	$31.28	$38.85	$35.94

C. A. GOESSMAN, *Director*.

AMHERST, MASS.

The Bulletin of the Experiment Station will be sent free of charge to all parties interested in its work, on application. Applications for Annual Reports will receive attention as soon as extra copies are received for distribution.

J. E. Williams, Printer, Amherst, Mass

MASSACHUSETTS STATE

AGRICULTURAL EXPERIMENT STATION.

BULLETIN No. 16.

JULY, 1885.

Meteorological Summary for two months ending June 30th.

	MAY.	JUNE.
Highest temperature,	85.0°	89.0°
Lowest temperature,	21.0°	35.0°
Mean temperature,	54.8°	63.8°
Mean Relative Humidity,	73.0 per ct.	76.2 per ct.
Total rainfall,	3.08 in.	3.49 in.
Prevailing winds,	Westerly.	Southwesterly.
No. of days on which 0.01 inch of rain fell,	6	8
No. of days on which cloudiness averaged 8 or more on scale of 10,	11	5
Dates of frosts,	10th, 11th, 12th.	10th.

The surface of the ground was frozen and ice had formed on the morning of May 4. The frosts of May 10th, 11th, and 12th were moderately severe; that of June 10th was very light, confined to low lands, and did no damage in this locality.

The rainfall has been abundant and favorably distributed.

FODDER ANALYSES.

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278. BLUE JOINT GRASS-HAY.

(CALAMAGROSTIS CANADENSIS.)

From the lands along Ipswich River; for the Essex County Agricultural Society.

	Percentage Composition.	Constituents (in lbs.) in a ton of 2000 lbs.	Pounds digestible in a ton of 2000 lbs.	Per cent. of digestibility of constituents.	Nutritive Ratio.
Moisture at 100° C.,	5.90	118.00			
Dry Matter,	94.10	1882.00			
	100.00	2000.00			1 : 13.08
ANALYSIS OF DRY MATTER.					
Crude Ash,	6.20	124.00			
" Cellulose,	28.91	578.20	335.36	58	
" Fat,	2.54	50.80	23.37	46	
" Protein, (nitrogenous matter),	7.29	145.80	83.11	57	
Non-nitrogenous extract matter,	55.06	1101.20	693.76	63	
	100.00	2000.00	1135.60		

The grass had been cut in the first week in August. The hay sent on consisted, in the main, of Blue Joint grass ; yet contained, besides, a variety of other plants found in similar localities, as Juncus, Cyperus, etc. Its composition is similar to that of several samples of hay obtained from low marsh meadows, sent on by the Rowley Farmers' Club (see I Annual Report, 1883, pages 74 and 75).

279. HOMINY MEAL.

(Sent on for examination from Bolton, Mass.) 70.56 per cent. passed through screen, with mesh 144 to sq. inch.

	Percentage Composition.	Constituents (in lbs.) in a ton of 2000 lbs.	Pounds digestible in a ton of 2000 lbs.	Per cent. of digestibility of constituents.	Nutritive Ratio.
Moisture at 100° C.,	8.11	162.20			
Dry Matter,	91.89	1837.80			
	100.00	2000.00			1 : 9.28
ANALYSIS OF DRY MATTER.					
Crude Ash,	3.24	64.80			
" Cellulose,	4.78	95.60	32.50	34	
" Fat,	12.22	244.40	185.74	76	
" Protein, (nitrogenous matter),	11.76	235.20	199.92	85	
Non-nitrogenous extract matter,	68.00	1360.00	1278.40	94	
	100.00	2000.00	1696.56		

The article was of a good mechanical condition ; and its composition notable on account of the exceptional high percentage of fat. The statement concerning its digestibility is based on that of the corn,—as no actual trials in that direction are known to us.

ANALYSES OF GARDEN CROPS.

280. HORSE-RADISH.

COCHLEARIA ARMORACIA L. ; MUSTARD FAMILY, (CRUCIFERÆ).

The examination of this well-known garden plant was carried on at the request of a farmer in Franklin county, who is engaged in the preparation of horse-radish "with vinegar," for family use. The roots had evidently lost some of their original moisture by storing, at the time of their examination.

One hundred parts of the fresh roots contained :

Moisture at 100° C.,	76.68 per cent.
Dry matter,	23.32 "
Nitrogen in dry matter,	0.36 "
Sulphur in dry matter,	0.06 "
Crude ash in dry matter,	1.87 "

The crude ash—1.87—consisted of 0.71 parts of insoluble silicious matter (including, most likely, some soil), and of 1.16 parts of soluble mineral constituents of plant food.

Relative proportion of essential ash constituents, soluble in acids, sulphur and chlorine excluded :

Magnesium oxide,	8.24 per cent.
Ferric oxide,	2.13 "
Calcium oxide,	13.47 "
Sodium oxide,	10.29 "
Potassium oxide,	62.06 "
Phosphoric acid,	3.81 "
	100 00

The roots contain, besides a notable amount of nitrogenous constituents, a series of valuable non-nitrogenous substances, as starch, sugar, gum, and organic acids,—a circumstance which cannot fail to impart to them a considerable nutritive value, equal, if not superior, to several of our most valued root-crops. Their peculiarity consists, mainly, in the presence of some sulphur-containing organic constituents (myrosin, etc.), which cause, in the fresh and crushed roots, the production of a sulphur-containing, volatile compound. The latter resembles, in odor and taste, the volatile mustard oil (Rhodanallyl). Some investigators assume their identity. The amount of this product, according to the statement of good observers, depends largely either on the general character of the soil, or on the presence of some peculiar constituent in the latter.

It would be not without interest to study the effect of gypsum, or of sulphate of potash, as a special fertilizer, on the character of the roots raised in their presence.

281. RHUBARB.

	Stems and Leaves, Fresh.		Roots, Fresh.	
Moisture,	91.67	per cent.	74.35	per cent.
Dry Matter,	8.33	"	25.65	"
Nitrogen (in dry matter),	0.13	"	0.55	"
Crude Ash (in dry matter),	1.72	"	2.28	"
Insoluble Matter in Ash,	0.22	"	0.25	"
Potassium oxide,	0.36	"	0.53	"
Sodium oxide,	0.03	"	not determined.	
Calcium oxide,	0.34	"	0.50	"
Magnesium oxide,	0.13	"	0.16	"
Phosphoric acid,	0.02	"	0.06	"
Ferric oxide,	0.003	"	0.02	"

Relative proportion of the essential ash constituents, soluble in acids:

Potassium oxide,	41.37	per cent.	37.92	per cent.
Sodium oxide,	3.39	"	8.84	"
Calcium oxide,	38.62	"	35.95	"
Magnesium oxide,	14.50	"	11.40	"
Phosphoric acid,	1.80	"	4.32	"
Ferric oxide,	0.32	"	1.57	"

The analysis has been carried out at the request of garden farmers in the eastern part of the State. The sample was collected from the fields of the College, at the time when the plant was blooming. The results may give some more definite basis for an advantageous mode of manuring.

FERTILIZER ANALYSES.

282. WOOD ASHES.

I, II. Ashes sent on from Beverley, Mass.

III. Canada ashes, sent on by the secretary of the Greenfield Farmers' Club.

IV. Sent on for examination from Chicopee, Mass.

	I	II	III	IV
Moisture at 100° C.,	8.80	14.40	12.93	15.73
Potassium oxide,	2.18	2.25	5.50	5.93
Calcium oxide,	45.90	34.33	33.99	35.45
Magnesium oxide,	3.63	3.13	4.22	3.41
Phosphoric acid,	2.22	1.79	2.05	1.60
Insoluble matter,	8.86	14.40	10.42	10.29

Samples I and II are, apparently, partly leached; samples III and IV are of a fair average composition.

283. POTASH SALTS.

Sent by the secretary of the Dartmouth Farmers' Club.

I. Potash Salts; a fused, hard mass, of a grayish-white color.
II. Black or Blue Ash; a moist, lumpy mass, easily pulverized.

	I	II
	Pounds per hundred.	
Moisture at 100° C.,	1.08	14.60
Potassium oxide,	42.06	13.13
Sodium oxide,	24.51	4.51
Chlorine,	19.30	0.08
Sulphuric Acid,	1.38	7.90
Insoluble matter,	1.00	3.30

These articles are evidently waste materials from some potash industry. No. I represents a value of from $36 to $37 per ton; it contains some potassium sulphide, and ought to be exposed to the air, previous to its application, to prevent injurious influences on the young growth. No. II contains a considerable amount of carbonates, and is better fitted for direct use as a potash source; it is worth from $11 to $12 per ton.

284. KRUGIT.

Bowker Fertilizer Co., Boston, Mass.

	Per Cent.
Moisture at 100° C.,	4.82
Sodium oxide,	5.57
Potassium oxide,	8.42
Calcium oxide,	12.45
Magnesium oxide,	8.79
Sulphuric acid,	31.94
Hydrochloric acid,	6.63
Insoluble matter (in acids),	14.96

This saline belongs to the products of the "German Potash Industry" at Strassfurt. It contains from 15 to 16 per cent. of sulphate of potassa, besides sulphate of lime (gypsum), sulphate of magnesia, and chloride of sodium (common salt), etc. A careful trial of the article upon hill pastures as a top-dressing, in connection with fine-ground bones, deserves attention. It sold at $14 per ton of 2,000 lbs., on board of car, Boston.

285. I. Double Sulphate of Potash and Magnesia, sent on for examination.

II. Double Sulphate of Potash and Magnesia, sent on from Hatfield, Mass.

	I	*II*
	Pounds per hundred.	
Moisture at 100° C.,	1.95	2.73
Potassium oxide,	23.37	18.92
Magnesium oxide,	12.86	13.08
Calcium oxide,	3.38	3.97
Sodium oxide,	not determined	9.61
Sulphuric acid,	45.52	41.89
Chlorine,	1.36	7.80
Insoluble matter,	2.10	2.36

The samples represent, probably, the extremes in composition. Large percentages of chlorides are, in many instances, considered objectionable, in high-priced sulphates. The articles have been offered at from $38 to $40 per ton.

286. BONEBLACK WASTE.

I. Sent on by Bolton Farmers' and Mechanics' Association, Bolton, Mass.

II. Sent on for examination, from Concord, Mass.

	I	*II*
	Pounds per hundred.	
Moisture at 100° C.,	2.30	6.00
Total phosphoric acid,	30.20	27.36
Insoluble matter,	1.53	6.60

Allowing four cents per pound of phosphoric acid, for boneblack of a fine mechanical condition, Sample I represents a value of from $23 to $24 ; and Sample II, of from $21 to $22, per ton of 2,000 lbs. The valuation of these articles depends, somewhat, on their mechanical condition. They furnish a superior material for the manufacture of superphosphate of lime.

287. FISH WASTE.

Sent on by secretary of Hampshire, Franklin, and Hampden Society.

	Per Cent.
Moisture at 100° C.,	41.92
Total phosphoric acid,	5.20
Soluble " "	0.83
Reverted " "	2.02
Insoluble " "	2.35
Nitrogen,	7.60
Insoluble matter,	.28

Valuation, per 2,000 lbs.: $34.37.

288. AMMONITE.

Sent on by secretary of Hatfield Grange.

Guaranteed composition: ammonia, 15 to 16 per cent. (equivalent to nitrogen 12.4 to 13.2 per cent.); phosphoric acid, 4 to 6 per cent.

	Per Cent.
Moisture at 100° C.,	5.88
Total phosphoric acid,	3.43
Nitrogen (= ammonia 13.76 per cent. —),	11.33
Insoluble matter,	1.38

Valuation, per 2,000 lbs.: $44.90.

The article consists, evidently, of fine-ground animal matter, freed from fat. Its general physical character is apparently favorable to a speedy disintegration. The material deserves attention as a source of nitrogen for plant growth.

289. ASH OF SPENT TAN BARK.

Sent on for examination, from North Adams, Mass.

	I	Per Cent.	*II*
Moisture at 100° C.,	7.75		
Calcium oxide,	31.78		31.35
Magnesium oxide,	2.57		5.10
Potassium oxide,	1.14		2.87
Phosphoric acid,	2.77		1.92

The article resembles leached wood-ash, as might be expected from the previous treatment of the hemlock bark.

290. HOME-MADE SUPERPHOSPHATE.

Sent on for examination, from Marblehead, Mass.

	Per Cent.
Moisture at 100° C.,	26.03
Total phosphoric acid,	12.78
Soluble " "	10.87
Reverted " "	0.59
Insoluble " "	1.32
Insoluble matter,	16.04

Valuation, per ton of 2,000 lbs.: $21.04.

The article was obtained, according to a communication received, by treating one thousand pounds of fine-ground South Carolina rock phosphate with six hundred pounds of sulphuric acid of 66° B., specific gravity, diluted previously with an equal volume of water. As the mixture thus produced remains, for some time, more moist than desirable, it is recommended to use equal *weights* of *acid* and *water*.

291. FINE GROUND BONES.

Sent on for examination, from Hingham, Mass.

	I	*II*
	Pounds per hundred.	
Moisture at 100° C.,	4.05	3.65
Total phosphoric acid,	23.77	26.37
Reverted " "	13.65	16.78
Insoluble " "	10.12	9.59
Nitrogen,	3.70	2.90
Insoluble matter,	1.50	2.65
Valuation per 2,000 lbs.:	$43.27	$44.96

The valuation of ground bones varies, somewhat, on account of differences in their mechanical condition. The majority of these articles are at present of a very advantageous form.

292. L. B. Darling's Fine Ground Bones. Collected of J. H. Fairbanks, Fitchburg, Mass.

Guaranteed composition: phosphoric acid, 22 to 25 per cent.; bone phosphate, 52 to 55 per cent.; nitrogen, 3.5 to 4.5 per cent. (equivalent to ammonia, 4 to 5 per cent.).

293. Belknap & Co.'s Pure Ground Bones. Collected of J. & J. A. Rice, Worcester, Mass.

Guaranteed composition: bone phosphate, 56 to 80 per cent.; phosphoric acid, 24 to 38 per cent.; nitrogen, 4.41 per cent. (equivalent to ammonia, 5.35 per cent).

294. Bowker's Fine Ground Bone. Collected of Foskett & Holbrook, Palmer, Mass.

Guaranteed composition: ammonia, 3 to 4 per cent. (equivalent to nitrogen, 2.5 to 3.3 per cent.); phosphoric acid, 20 to 23 per cent.

295. Adams' Fine Ground Bones. Collected of J. B. Raynor & Co., Springfield, Mass.

Guaranteed composition: phosphoric acid, 18 to 20 per cent.; nitrogen, 4 to 5 per cent. (equivalent to ammonia, 4.5 to 5.5 per cent).

	292	*293*	*294*	*295*
		Pounds per hundred.		
Moisture at 100° C.,	5.00	5.00	10.90	4.90
Total phosphoric acid,	26.53	22.11	20.25	16.78
Soluble " "	0.41	——	0.23	0.26
Reverted " "	8.07	2.67	2.51	2.30
Insoluble " "	17.05	19.44	17.51	14.22
Nitrogen,	4.05	4.52	3.47	4.44
Insoluble matter,	——	——	0.55	3.20
Valuation per 2,000 pounds,	$43.59	$39.09	$32.69	$32.93

296. Bowker's Hill and Drill. Collected of Sprague & Williams, South Framingham, Mass.

Guaranteed composition: nitrogen, 2.5 to 3.25 per cent. (equivalent to ammonia, 3 to 4 per cent.); soluble phosphoric acid, 8 to 10 per cent.; reverted phosphoric acid, 1 to 2 per cent.; total phosphoric acid, 11 to 13 per cent.; potassium sulphate, 2 to 3 per cent.

297. Chittenden's Universal Phosphate. Collected of Slate & DeWolf, Greenfield, Mass.

Guaranteed composition: ammonia, 2.5 to 3.5 per cent. (equivalent to nitrogen, 2 to 2.9 per cent.); soluble and available phosphoric acid, 8 to 10 per cent.; total phosphoric acid, 10 to 12 per cent.; bone phosphate, 22 to 26 per cent.; potassium oxide, 2 to 4 per cent.

298. Complete Fertilizer. Sent on for examination, by farmers of Somerset, Mass.

299. H. J. Baker & Bros.' Complete Manure (potato). Collected of J. B. Raynor & Co., Springfield, Mass.

Guaranteed composition: ammonia, 4 per cent. (equivalent to nitrogen, 3.3 per cent.); phosphoric acid, 5.75 per cent.; potassium oxide, 10 per cent.

	296	297	298	299
Moisture at 100° C.,	13.45	14.48	10.03	8.75
Total phosphoric acid,	10.85	9.43	10.35	7.60
Soluble " "	6.51	7.29	3.04	6.17
Reverted " "	2.02	1.14	3.60	1.19
Insoluble " "	2.33	1.00	3.71	0.24
Nitrogen,	3.45	3.07	4.47	3.78
Potassium oxide,	2.81	2.50	11.44	8.20
Insoluble matter,	——	4.60	1.10	0.65
Valuation per 2,000 lbs,	$33.30	$28.93	$40.05	$33.79

300. Chittenden's Complete Tobacco Fertilizer. Collected of Slate & DeWolf, Greenfield, Mass.

Guaranteed composition: ammonia, 4 to 6 per cent. (equivalent to nitrogen, 3.3 to 5 per cent.); total phosphoric acid, 8 to 10 per cent.; soluble and available phosphoric acid, 6 to 8 per cent.; bone phosphate, 18 to 22 per cent.; potassium sulphate, 8 to 10 per cent.

301. Bradley's XL. Superphosphate of Lime. Collected of Garfield & Procter, Fitchburg, Mass.

Guaranteed composition: nitrogen, 2.5 to 3.25 per cent. (equivalent to ammonia, 3 to 4 per cent.); soluble phosphoric acid, 7 to 8 per cent.; reverted phosphoric acid, 2 to 3 per cent.; available phosphoric acid, 9 to 11 per cent.; total phosphoric acid, 11 to 14 per cent.; insoluble phosphoric acid, 2 to 3 per cent.; potassium oxide, 2 to 3 per cent.; potassium sulphate, 3.7 to 5.55 per cent.

302. Davidge's A. A. Ammoniated Bone Superphosphate. Manufactured by Russell Coe's Co., N. Y. Collected of A. B. Lawrence & Co., Fitchburg, Mass.

Guaranteed composition: moisture, 10 to 15 per cent.; ammonia, 2 to 3 per cent. (equivalent to nitrogen 1.65 to 2.5 per cent.); soluble and available phosphoric acid, 9 to 11 per cent.; insoluble phosphoric acid, 1 to 2 per cent.; total phosphoric acid, 10 to 12 per cent.; potassium oxide, 1.5 to 2.5 per cent.

303. Dow's Ground Bone Fertilizer. Collected of T. Cushing & Co., Fitchburg, Mass.

Guaranteed composition: ammonia, 2.5 to 3 per cent. (equivalent to nitrogen 2 to 2.5 per cent.); phosphoric acid, 18 to 22 per cent.; potassium sulphate, 3 to $3\frac{1}{2}$ per cent.

	300	301	302	303
		Pounds per hundred.		
Moisture at 100° C.,	14.88	11.00	15.05	7.97
Total phosphoric acid,	7.37	11.42	11.31	17.55
Soluble " "	5.76	8.22	4.86	1.22
Reverted " "	.92	1.05	1.78	6.94
Insoluble, " "	.69	2.15	4.68	9.39
Nitrogen,	3.53	3.05	2.28	3.04
Potassium oxide,	7.32	3.41	1.66	2.48
Insoluble matter,	1.93	——	——	4.75
Valuation per 2000 pounds,	$35.72	$34.13	$24.97	$35.37

304. Lister Bros.' Ammoniated Bone Superphosphate. Collected of W. S. Westcott, Amherst, Mass.

Guaranteed composition: moisture 10 to 14 per cent.; available phosphoric acid, 8 to 10 per cent.; insoluble phosphoric acid, 2 to 3 per cent.; potassium oxide, 1.5 to 2 per cent.; ammonia, 2 to 2.5 per cent. (equivalent to nitrogen 1.6 to 2 per cent.).

305. Crocker's Ammoniated Bone Superphosphate. Collected of Slate & De Wolf, Greenfield, Mass.

Guaranteed composition: soluble phosphoric acid, 6 to 8 per cent.; precipitated phosphoric acid, 2 to 4 per cent.; insoluble phosphoric acid, 1 to 2 per cent.; bone phosphate, 18 to 26 per cent.; ammonia, 3.5 to 4.5 per cent. (equivalent to nitrogen 2.9 to 3.7 per cent.); potassium sulphate, 1 to 3 per cent.

306. Mapes' Potato Fertilizer. Collected of W. H. Earle & Co., Worcester, Mass.

Guaranteed composition: ammonia, (ready formed), soluble nitrogen, etc., 4.5 to 5 per cent.; soluble and available phosphoric acid, 8 to 10 per cent.; potassium oxide, (as high grade sulphate and chloride of potash), 6 to 8 per cent.

307. Bowker's "Stockbridge's Manure" (potato). Collected of Wilder & Puffer, Springfield, Mass.

Guaranteed composition: nitrogen, 3.25 to 4.25 per cent. (equivalent to ammonia, 4 to 5 per cent.); soluble and reverted phosphoric acid, 7 to 8 per cent.; total phosphoric acid, 8 to 10 per cent.; potassium oxide, 5 to 6 per cent.

	304	305	306	307
		Pounds per hundred.		
Moisture at 100° C.,	11.75	14.48	12.38	10.08
Total phosphoric acid,	11.65	9.43	12.05	10.06
Soluble " "	6.97	7.29	5.05	5.76
Reverted " "	1.83	1.14	3.21	2.18
Insoluble " "	2.85	1.00	3.76	2.12
Potassium oxide,	1.54	1.60	7.62	4.56
Nitrogen,	2.64	3.07	3.63	4.66
Insoluble matter,	1.60	——	——	3.88
Valuation per 2,000 lbs.,	$28.58	$28.15	$39.14	$36.22

308. Quinnipiac Co.'s (Plain Brand) Fish and Potash. Collected of D. A. Horton, Northampton, Mass.

Guaranteed composition: nitrogen, 2 to 3 per cent. (equivalent to ammonia, 2.5 to 3.5 per cent.); soluble and reverted phosphoric acid, 4 to 6 per cent.; total phosphoric acid, 6 to 8 per cent.; potassium oxide, 4 to 6 per cent.

309. Williams, Clark & Co.'s Fish and Potash. Collected of Foskett & Holbrook, Palmer, Mass.

Guaranteed composition: ammonia, 4 to 5 per cent. (equivalent to nitrogen, 3.3 to 4 per cent.); potassium oxide, 3 to 4 per cent.; phosphoric acid, 3 to 4 per cent.

310. Quinnipiac Co.'s (Cross Brand) Fish and Potash. Collected of B. L. Bragg & Co., Springfield, Mass.

Guaranteed composition: total phosphoric acid, 5 to 7 per cent.; soluble and reverted phosphoric acid, 3 to 5 per cent.; potassium sulphate, 3 to 5 per cent.; nitrogen, 3.25 to 4.25 per cent. (equivalent to ammonia 4 to 5 per cent).

311. Chittenden's Fish and Potash. National Fertilizer Co., Bridgeport, Conn.; collected of Wilder & Puffer, Springfield, Mass.

Guaranteed composition: ammonia, 3 to 4 per cent. (equivalent to nitrogen 2.5 to 3.3 per cent.); phosphoric acid, 8 to 10 per cent.; potassium oxide, 4 to 5 per cent.

	308	*309*	*310*	*311*
		Pounds per hundred.		
Moisture at 100° C.,	24.93	9.63	17.30	9.43
Total phosphoric acid,	7.26	7.51	7.67	7.33
Soluble " "	0.96	0.54	0.83	2.02
Reverted, " "	3.96	2.91	4.06	1.82
Insoluble, " "	2.34	4.06	2.78	3.49
Potassium oxide,	4.78	4.30	4.20	5.91
Nitrogen,	2.73	3.00	4.73	3.12
Insoluble matter,	2.65	0.80	0.82	3.18
Valuation per 2,000 pounds	$23.83	$23.34	$33.34	$25.59

C. A. GOESSMAN, *Director*,

AMHERST, MASS.

The Bulletin of the Experiment Station will be sent free of charge to all parties interested in its work, on application. Applications for II. Annual Report will receive attention as soon as extra copies are received for distribution.

J. E. Williams, Printer, Amherst, Mass.

MASSACHUSETTS STATE

AGRICULTURAL EXPERIMENT STATION.

BULLETIN No. 17.

AUGUST, 1885.

Meteorological Summary for month ending July 31st.

Highest temperature,	93.0°
Lowest temperature,	41.0°
Mean temperature,	70.41°
Mean relative humidity,	77.2°
Total rainfall,	2.07 in.
Prevailing winds,	Southwesterly
No. of days on which .01 in. of rain fell,	7
No. of days on which cloudiness averaged 8 or more on scale of 10,	3

Showers of rain were frequent during the first half of the month, but from July 14th to August 1st only .02 of an inch of rain fell, and the drouth became moderately severe.

FODDER ANALYSES.

312. II. BUNKER MEADOW HAY.

Sent on by the Secretary of the Essex County Agricultural Society.

	Percentage Composition.	Constituents (in lbs.) in a ton of 2000 lbs.	Pounds digestible in a ton of 2000 lbs.	Per cent. of digestibility of constituents.	Nutritive Ratio.
Moisture at 100° C.,	11 35	227.00			
Dry Matter,	88.65	1773.00			
	100.00	2000.00			
ANALYSIS OF DRY MATTER.					1 : 9.91
Crude Ash,	6 40	128.00			
" Cellulose,	30.71	614.20	208.83	34	
" Fat,	2.29	45.80	34.81	76	
" Protein, (nitrogenous matter),	7.66	153.20	130 22	85	
Non-nitrogenous extract matter,	52.94	1058.80	995 27	94	
	100.00	2000.00	1369.13		

III. HIGH MEADOW HAY.

	Percentage Composition.	Constituents (in lbs.) in a ton of 2000 lbs.	Pounds digestible in a ton of 2000 lbs.	Per cent. of digestibility of constituents.	Nutritive Ratio.
Moisture at 100° C.,	10.60	212.00			
Dry Matter,	89.40	1788.00			
	100.00	2000.00			
ANALYSIS OF DRY MATTER.					1 : 8.12
Crude Ash,	7.58	151.60			
" Cellulose,	27.23	544.60	185.16	34	
" Fat.	2.77	55.40	42.10	76	
" Protein, (nitrogenous matter),	9.33	186.60	158.61	85	
Non-nitrogenous extract matter,	53.09	1061.80	998.09	94	
	100.00	2000.00	1383.96		

The above described samples of hay, II. and III., and No. 278 of the previous bulletin have been examined by the direction of the Secretary of the Essex Agricultural Society for farmers in Topsfield, Mass. The hay had been obtained from meadows in the vicinity of the Ipswich river. No. III. is the most nutritious material, and sample No. II. has a larger amount of digestible matter than No. I.

313. CORN MEAL.

93.28 per cent. passed through mesh, 144 to square inch. Bought of J. L. Holley, South Amherst, Mass.

	Percentage Composition.	Constituents (in lbs.) in a ton of 2000 lbs.	Pounds digestible in a ton of 2000 lbs.	Per cent. of digestibility of constituents.	Nutritive Ratio.
Moisture at 100° C.,	11.95	239.00			
Dry Matter,	88.05	1761.00			
	100.00	2000.00			
ANALYSIS OF DRY MATTER.					1 : 7.42
Crude Ash,	1.59	31.80			
" Cellulose,	2.59	51.80	17.61	34	
" Fat,	4.43	88.60	67.34	76	
" Protein, (nitrogenous matter),	13.13	262.60	223.21	85	
Non-nitrogenous extract matter,	78.26	1565.20	1471.29	94	
	100.00	2000.00	1779.45		

The analysis represents the average of the composition of the corn meal, fed during our feeding experiments with pigs, November 1st, 1884, to 18th of April, 1885, which will be reported in our next bulletin in detail.

314. MILK.

Average of Analyses of Buttermilk from November 6th, 1884, to February 5th, 1885.

From Amherst Creamery.

Water,	92.00 per cent.
Total solids,	8.00 " "
	100.00

ANALYSIS OF SOLIDS.

Fat,	0.20 per cent.	Nutritive Ratio: 1 : 1.9
Protein (nitrogenous matter),	2.65 " "	
Ash,	0.60 " "	
Non-nitrogenous extract matter,	4.55 " "	
	8.00	

Average of Analyses of Skim Milk from November 6th. 1884, to February 5th, 1885.

From the Experiment Station Farm.

Water,	89.78 per cent.
Total solids,	10.22 " "
	100.00

ANALYSIS OF SOLIDS.

Fat,	0.33 per cent.	Nutritive Ratio: 1 : 1.8
Protein (nitrogenous matter),	3.53 " "	
Ash,	0.80 " "	
Non-nitrogenous extract matter,	5.56 " "	
	10.22	

ANALYSES OF FRUITS.

The fruits which served for the analysis subsequently reported were obtained from one and the same experimental plat. The soil consisted of a sandy loam in a fair state of cultivation, and had received no special manurial substances for several years.

315. CURRANTS.

	Versailles.	*Cherry.*	*White Grape.*
Specific gravity of juice at 27° C.,	1.049	1.030	——
Moisture in fresh fruit,	87.05	88.12	84.82
Dry matter " "	12.95	11.88	15.18
Ash constituents " "	0.41	0.46	0.59
Nitrogen " "	——	0.17	——

316. Relative proportion of some essential Ash Constituents of Fruits:

	Concord Grape.	Currants.	Blackberries.
Potassium oxide,	62.29	49.67	51.42
Magnesium oxide,	1.77	6.49	5.30
Calcium oxide,	15.49	19.76	17.22
Ferric oxide,	1.96	1.26	1.43
Phosphoric acid,	18.49	22.82	24.63
	100.00	100.00	100.00

As these results may be of interest to fruit cultivators, on account of the information they give concerning the special requirements of some prominent fruits in soil constituents, they are published here in advance. A more detailed record of this work, which is steadily progressing, has to be deferred for obvious reasons to the next annual report.

ANALYSIS OF WEEDS.

317. SORREL.

(RUMEX ACETOSELLA.)

The plants for the examination were collected during the month of June, when in blossom. The fresh plant contained in one hundred parts:

Moisture,	87.07
Dry matter	11.93
Mineral constituents,	1.11
(including some earthy matter,	0.158)

The fresh plant contains no free volatile acid—as acetic acid, etc. The strong acid reaction and taste of the juice of the plant is largely, if not exclusively, due to the presence of acid combinations of oxalic acid with the alkalies, potassa and soda.

The soluble portion of the ash constituents contains the subsequent substances in the following relative proportions:

Potassium oxide,	19.35 per cent.
Sodium oxide,	10.79 " "
Calcium oxide,	47.53 " "
Magnesium oxide,	8.99 " "
Ferric oxide,	2.55 " "
Phosphoric acid,	10.79 " "
	100.00

The sudden appearance of this well known plant upon lands which, during the preceding season, had been free from the objectionable weed, suggested the previously described examination into its chemical composition. A more systematic inquiry into the chemical character and the habits of many of our weeds cannot fail to give us here and there useful information regarding an intelligent course to lessen their chances of a luxuriant growth.

Good agricultural authorities in Europe state that this variety of sorrel does not grow upon a calcareous soil, but thrives upon a sandy soil of a medium state of fertility. They recommend a liberal application of lime or marl as an effective remedy to check its growth. Judging from the predominance of lime in the mineral constituents of the sorrel, as shown by the above analysis, it seems that the stated beneficial action of lime and marl, if true, has to be ascribed to their modifying influence on the physical and chemical condition of the soil, and not to a deficiency of lime as a special plant food.

The material serving for our analysis grew upon a light sandy soil.

FERTILIZER ANALYSES.

318. MUCK.

Three samples of muck sent on for examination from Goshen, Mass.

	I.	*II.*	*III.*
	Pounds per Hundred.		
Moisture at 100° C.,	63.75	66.80	43.18
Dry matter,	36.25	33.20	56.82
Ash,	17.30	8.55	26.12
Nitrogen in organic matter,	0.75	1.09	0.97

Sample No. I. consisted of a solid, unbroken, turfy mass, with but little change in the original vegetable structure. It contained some lime, with traces of phosphoric acid as more noteworthy mineral constituents. The nitrogen of the vegetable matter is that of a fair quality of its kind, considering the total amount of earthy material present.

Sample No. II. consisted of a black-brown, somewhat pulverent mass, with rootlets here and there interspersed; it contained more lime and phosphoric acid than No. I., but less earthy matter. The smaller percentage of mineral matter accounts sufficiently for an increased amount of nitrogen as compared with No. I.

Sample No. III. consisted mainly of a material similar to No. II., covered largely with a grayish saline mass, of an acid and astringent taste. Treated with water at an ordinary temperature a very acid solution was obtained, which contained a liberal amount of free sulphuric acid, besides a considerable quantity of the combination of this acid with lime (gypsum), and with oxide of iron (green copperas). The presence of these compounds was evidently due to the action of air and of moisture on iron pyrites—a combination of sulphur and iron—contained in the rocks and the soils through which the water percolated which fills the muck-bed.

Wells located in rocks containing iron pyrites are apt to show a similar alteration in their character during the earlier part of the spring after a dry summer and autumn, when in consequence of a lower level of the water supply a more extensive exposure of adjoining rocks have favored the oxidation of both iron and sulphur. This change may assume such proportions at times that the water of these wells will curdle fresh milk, and produce a more or less inklike abstract of green tea.

A repeated pumping out in most instances removes the cause of these reactions. An actual observation in this direction at Amherst a few years ago, after several years of dry seasons, furnished a striking illustration of the previous statement.

A muck like No. III. is decidedly injurious to vegetation, and needs an exceptionally large addition of lime or ashes, and a longer exposure to the air than the average material of this kind, to prepare it for manurial purposes.

319-320. FERTILIZING MATERIALS.

Sent on from Boston, Mass.

	319	*320*
	Pounds per Hundred.	
Moisture at 100° C.,	4.10	6.24
Phosphoric acid,	1.77	0.48
Potassium oxide,	1.35	0.40
Nitrogen,	1.33	0.57
Calcium oxide,	11.44	18.84
Magnesium oxide,	1.36	1.23
Insoluble matter,	48.35	43.53

The materials are evidently mixtures of refuse from various sources, and contain large quantities of insoluble matter. No. 319 is worth from $7 to $8 per ton, and No. 320 from $2.50 to $3.

321. REFUSE LIME.

Sent on for examination from Lowell, Mass.

Moisture at 100° C.,	33.54	per cent.
Phosphoric acid,	1.62	"
Magnesium oxide,	8.30	"
Calcium oxide,	40.57	"
Insoluble matter,	0.40	"

The lime consists of a mixture of calcium oxide and carbonate of lime, and is equal in pecuniary value to air-slacked lime.

POTASH SALTS.

322. Muriate of potash, sent on from Fall River, Mass.

323. Muriate of potash from H. L. Phelps, Southampton, Mass.

	322	*323*
	Pounds per Hundred.	
Moisture at 100° C.,	2.00	1.50
Potassium oxide,	52.00	51.28
Sodium oxide,	——	8.04
Insoluble matter,	——	2.00

PLASTER.

324. Ground Nova Scotia plaster, collected of B. F. Bridges, South Deerfield, Mass. Sold at $7.50 per ton.

325. Onondaga plaster, collected of B. F. Bridges, South Deerfield, Mass. Sold at $6.00 per ton.

	324	*325*
	Pounds per Hundred.	
Moisture at 100° C.,	4.07	8.95
Calcium oxide,	33.59	29.80
Sulphuric acid,	47.23	32.68
Insoluble matter,	——	8.95

CANADA WOOD ASHES.

326. Munroe Judson & Stroup, Oswego, N. Y., collected of Edward Swan, South Deerfield, Mass.

327. Munroe Judson & Stroup, Oswego, N. Y., collected of Walter Crafts & Son, Whately, Mass.

328. Sent on for examination from Montague, Mass.

	326	*327*	*328*
	Pounds per Hundred.		
Moisture at 100° C.,	16.55	11.95	6.75
Calcium oxide,	34.42	39.60	34.71
Magnesium oxide,	2.52	2.28	2.45
Potassium oxide,	5.36	6.46	6.30
Phosphoric acid,	2.06	1.77	2.21
Insoluble matter,	24.10	10.12	16.10

These samples are of good composition; they are sold at 25 cents per bushel on board of cars. The bushel averages from 15 to 48 pounds.

GROUND BONES.

330. Swift Sure Bone Meal. M. L. Shoemaker & Co., Philadelphia, Pa. Collected of H. L. Phelps, Southampton, Mass.

Guaranteed composition: ammonia, 5 to 6 per cent. (equivalent to nitrogen, 4 to 5 per cent.); bone phosphate, 45 to 50 per cent.

331. Bone Meal. Collected of E. T. Sabin, Amherst, Mass.

No guaranty obtained.

	330	*331*
	Pounds per	*Hundred.*
Moisture at 100° C.,	3.60	5.00
Total phosphoric acid,	20.66	22.64
Soluble " "	——	
Reverted " "	2.24	
Insoluble " "	18.42	
Nitrogen,	6.25	3.01
Insoluble matter,	4.00	
Valuation per 2,000 lbs.:	$44.50	$37.99

332. L. L. Crocker's Hop and Potato Fertilizer. Collected of Merriam & Rolph, Fitchburg, Mass.

Guaranteed composition: soluble phosphoric acid, 6 to 8 per cent.; precipitated phosphoric acid, 2 to 4 per cent.; bone phosphate, 18 to 26 per cent.; insoluble phosphoric acid, 1 to 2 per cent.; ammonia, 2.5 to 3.5 per cent. (equivalent to nitrogen, 2 to 3 per cent.); potassium oxide, 6 to 8 per cent.

333. Adams' Market Bone Fertilizer. Collected of J. B. Raynor & Co., Springfield, Mass.

Guaranteed composition: total phosphoric acid, 10 to 12 per cent.; soluble and available phosphoric acid, 8 to 10 per cent.; nitrogen, 3.5 to 4.5 per cent. (equivalent to ammonia, 4.25 to 5.25 per cent.); potassium oxide, 3 to 4 per cent.

334. Chittenden's Bone Superphosphate; National Fertilizer Co., Bridgeport, Conn. Collected of J. Cushing & Co., Fitchburg, Mass.

Guaranteed composition: ammonia, 2 to 3 per cent. (equivalent to nitrogen, 1.6 to 2.5 per cent.); soluble and available phosphoric acid, 7 to 9 per cent.; total phosphoric acid, 9 to 11 per cent.; bone phosphate, 20 to 24 per cent.; potassium oxide, 2 to 4 per cent.

335. Fertilizer No. 203; Dole Fertilizer Co., Boston. Collected of Frank Sherman, Foxboro', Mass.

Guaranteed composition: nitrogen, 3 to 4 per cent. (equivalent to ammonia, 3.5 to 4.5 per cent.); total phosphoric acid, 10 to 12 per cent.; available phosphoric acid, 8 to 10 per cent.; potassium oxide, 3 to 4 per cent.

	332	*333*	*334*	*335*
		Pounds per hundred.		
Moisture at 100° C.,	12.10	6.55	11.45	8.83
Total phosphoric acid,	9.05	10.68	9.29	10.32
Soluble " "	5.94	3.39	6.16	2.81
Reverted " "	2.10	2.74	1.65	2.18
Insoluble " "	1.01	4.55	1.48	5.33
Potassium oxide,	5.06	3.12	3.28	4.06
Nitrogen,	2.99	4.13	2.51	3.63
Insoluble matter,	——	——	4.50	5.88
Valuation per 2,000 lbs.:	$29.92	$31.65	$26.74	$29.33

336. The Spear Perfect Fertilizer. Collected of B. Spear & Co., Springfield, Mass.

Guaranteed composition: total phosphoric acid, 3.35 per cent.; potassium oxide, 0.65 per cent.; ammonia, 0.93 per cent. (equivalent to nitrogen, 0.77 per cent.).

337. Baker's A. A. Ammoniated Bone Phosphate. Collected of J. B. Raynor & Co., Springfield, Mass.

Guaranteed composition: ammonia, 3 to 4 per cent. (equivalent to nitrogen, 2.5 to 3.3 per cent.); available phosphoric acid, 10 to 12 per cent.; potassium oxide, 2 to 3 per cent.

338. Bradley's X L Ammoniated Bone Superphosphate. Collected of D. A. Wright, Northampton, Mass.

Guaranteed composition: nitrogen, 2.5 to 3.25 per cent. (equivalent to ammonia, 3 to 4 per cent.); soluble phosphoric acid, 7 to 8 per cent.; reverted phosphoric acid, 2 to 3 per cent.; insoluble phosphoric acid, 2 to 3 per cent.; total phosphoric acid, 11 to 14 per cent.; potassium oxide, 2 to 3 per cent. (equivalent to potassium sulphate, 3.7 to 5.55 per cent.).

339. George W. Miles' I X L Ammoniated Bone Superphosphate. Collected of B. F. Bridges, So. Deerfield, Mass.

Guaranteed composition: ammonia, 2.5 to 4 per cent. (equivalent to nitrogen, 2 to 3.3 per cent.); available phosphoric acid, 8 to 12 per cent.; potassium oxide, 1 to 3 per cent.

	336	337	338	339
		Pounds per	*Hundred.*	
Moisture at 100° C.,	20.23	9.78	14.82	17.70
Total phosphoric acid,	7.52	11.63	12.55	12.14
Soluble " "	0.32	10.46	8.32	6.78
Reverted " "	6.09	0.83	2.59	2.53
Insoluble " "	1.11	0.34	1.64	2.93
Potassium oxide,	0.40	2.14	1.85	1.04
Nitrogen,	0.62	3.60	3.43	2.17
Insoluble matter,	33.35	1.25	4.23	5.70
Valuation per 2,000 lbs.:	$13.79	$35.21	$35.46	$27.28

340. Prepared Phosphate of Lime; United States and Canada Co-operative Fertilizer Co., Boston. Collected of W. B. Howe, Marlboro, Mass.

Guaranteed composition: moisture, 12 to 15 per cent.; ammonia, 1.5 to 2.5 per cent. (equivalent to nitrogen, 1.2 to 2 per cent.); available phosphoric acid, 8 to 11 per cent.; potassium sulphate, 4 to 6 per cent. (equivalent to potassium oxide, 2.15 to 3.23 per cent.); insoluble matter, 2 to 6 per cent.

341. Fertilizer No. 203, of Dole Fertilizer Co., Boston. Collected of J. H. Lathrop, Boston.

Guaranteed composition: nitrogen, 3 to 4 per cent. (equivalent to ammonia, 3.5 to 4.5 per cent.); total phosphoric acid, 10 to 12 per cent.; available phosphoric acid, 8 to 10 per cent.; potassium oxide, 3 to 4 per cent.

342. Soluble Pacific Guano; Pacific Guano Co., Glidden & Curtis, Boston. Collected of E. C. Haskell, So. Deerfield, Mass.

Guaranteed composition: moisture 15 to 18 per cent.; ammonia, 2.5 to 3.5 per cent. (equivalent to nitrogen, 2 to 2.9 per cent.); potassium oxide, 2 to 3.5 per cent.; available phosphoric acid, 8 to 10 per cent.; soluble phosphoric acid, 6.5 to 8 per cent.; insoluble phosphoric acid, 2 to 3 per cent.; total phosphoric acid, 12 to 14 per cent.

343. George W. Miles & Co.'s Fish and Potash. Collected of B. F. Bridges, So. Deerfield, Mass.

Guaranteed composition: ammonia, 3 to 5 per cent. (equivalent to nitrogen, 2.5 to 4 per cent.): available phosphoric acid, 5 to 8 per cent.; potassium oxide, 3 to 5 per cent. as sulphate.

	340	341	342	343
		Pounds per Hundred.		
Moisture at 100° C.,	10.63	11.13	14.03	14.45
Total phosphoric acid,	12.54	10.83	12.03	10.09
Soluble " "	6.32	2.62	6.90	5.06
Reverted " "	2.13	3.08	1.83	0.96
Insoluble " "	4.09	5.13	3.30	4.07
Potassium oxide,	3.20	3.98	2.04	4.90
Nitrogen,	2.05	3.27	2.17	3.09
Insoluble matter,	6.50	8.60	5.40	4.75
Valuation per 2.000 lbs.:	$30.08	$28.90	$27.53	$32.13

344. Prepared Phosphate of Lime; United States and Canada Cooperative Fertilizer Co., Boston. Collected of J. N. Brown, North Brookfield, Mass.

No guarantee obtained.

345. Darling's Animal Fertilizer; collected of W. S. Westcott, Amherst, Mass.

Guaranteed composition: Ammonia, 4 to 8 per cent. (equivalent to nitrogen, 3.3 to 6.6 per cent.); phosphoric acid, 10 to 12 per cent.; potassium oxide, 4 to 6 per cent.

346. Bowker's Fish and Potash; collected of W. S. Westcott, Amherst, Mass.

Guaranteed composition: Nitrogen, 2.5 to 3.25 per cent. (equivalent to ammonia, 3 to 4 per cent.); phosphoric acid, 3 to 4 per cent.; bone phosphate, 18 to 22 per cent.; potassium oxide, 4 to 6 per cent.

347. Fertilizing material sent on for examination by Farmers' Club, Lanesboro, Mass.

No guarantee obtained.

	344	345	346	347
		Pounds per Hundred.		
Moisture at 100° C.,	13.00	14.50	8.30	10.59
Total phosphoric acid,	11.02	11.08	10.38	12.06
Soluble phosphoric acid,	5.81	0.34	3.08	6.78
Reverted " "	2.17	2.36	2.86	3.34
Insoluble " "	3.04	8.38	4.44	1.94
Potassium oxide,	5.10	3.94	4.98	0.82
Nitrogen,	2.23	3.30	2.64	3.13
Insoluble matter,	5.00	——	——	4.28
Valuation per 2000 pounds,	$28.72	$26.33	$27.40	$31.06

C. A. GOESSMANN, Director,
Amherst, Mass.

The Bulletin and I. and II. Annual Reports of the Experiment Station will be sent, free of charge, to all parties interested in its work, on application. Address State Agricultural Experiment Station, Amherst, Mass.

MASSACHUSETTS STATE

AGRICULTURAL EXPERIMENT STATION.

BULLETIN No. 18.

OCTOBER, 1885.

Meteorological Summary for two months ending September 30th.

	AUGUST.	SEPTEMBER.
Highest temperature,	87.0°	81.0°
Lowest temperature,	34.0°	27.0°
Mean temperature,	66.05°	58.32°
Mean relative humidity,	79.5° per cent.	82.3° per cent
Total rainfall,	8.31 in.	0.85 in.
Prevailing winds.	Southwesterly.	Southwesterly.
No. of days on which .01 in. of rain fell,	13	5
No. of days on which cloudiness averaged 8 or more on scale of 10,	9	4

The rainfall in August was greater than in the corresponding month for eighteen years past. September presents the opposite extreme for a period of twenty years. A light frost was reported on low lands August 27th, and others occurred September 3d, 6th, 11th, 12th, 21st and 24th, but at the close of this month no serious damage had been done, and only slight effects of frost were visible.

NOTES ON FEEDING EXPERIMENTS WITH PIGS.

348. In BULLETIN NO. 13 has been described the first of a series of feeding experiments with pigs, which were planned for the purpose of studying the comparative feeding value of skim milk from the farm, and of buttermilk from the Amherst Creamery, in connection with corn meal, for the production of pork. Equal *measures* of skim milk and of creamery buttermilk had been fed with an addition of a corresponding *weight* of corn meal, in each case. *Three ounces of corn meal for every quart of each kind of milk consumed* formed the basis for the compounding of the entire diet of the (six) animals on trial. The daily amount of feed required was regulated by the appetite of each animal.

A summary of the results obtained in that connection showed that—taking corn meal pound for pound, and skim milk and creamery buttermilk quart for quart—practically the same quantity of dressed pork had been obtained in both cases when stating the final weight of each lot of animals—three in number—in one sum; 510 pounds where skim milk and meal had been fed, and 514 pounds in the case of buttermilk and meal. Counting in each case the particular feed (milk and meal) with regard to the amount of *dry organic matter*, which it contained, it was noticed that the buttermilk feed had proved—taking pound for pound of dry matter of the mixture—the most nutritious article; for 2.4 pounds of dry organic matter contained in the buttermilk and corn meal feed, had produced, as mean results, one pound of dressed pork, whilst in the case of skim milk and meal, 2.9 pounds of dry organic matter had been spent in the production of one pound.

The lot of animals fed with creamery buttermilk and corn meal had also returned a larger profit, even at the rates of the cost of each constituent of the diet, ruling during the period of feeding—May to September, 1884. These results were in so far of special interest as the *skim milk* from the farm was the more concentrated and richer article of the two kinds of milk fed, according to special chemical analyses made at various times; the skim milk had contained more than 20 per cent. more dry organic matter than the creamery buttermilk. This circumstance seemed to indicate a waste of skim milk, as compared with the results obtained in case of the former. As the skim milk was the most costly article of the feed, a waste of that article cannot otherwise but seriously affect the cost of the dressed pork obtained by its use.

In our first experiment—1884—the corn meal was charged $28 per ton at the mill; creamery buttermilk, 1.37 cts. per gallon, the contractor's price; and farm skim milk, 2 cents asked for at the farm. Cost of feed per pound of dressed pork at these rates amounted in case of the creamery milk feed to 4.6 cts., and in case of the farm skim milk feed to 5.8 cents per pound.

As a charge of 2 cents per gallon for skim milk may be considered somewhat arbitrary, its commercial value for feeding purposes has been based with more propriety, in our subsequent experiments, on the amount of solid matter it contains as compared with that of the creamery buttermilk, taking the contractor's price of the latter as the standard.

	Percentage of Solids. 1884.	1885.	*Cost per Gallon, cts.* 1884.	1885.
Creamery Buttermilk,	7.09	8.00	1.37	1.37
Farm Skim Milk,	9.58	10.22	1.78	1.75

A recalculation of the cost of feed consumed in our *first* experiment (1884) at the rates adopted in our second experiment (1885), described within these pages, does not alter the financial results of that experiment so far as the *relative* cost of *each kind* of feed is concerned.

	Cost of Feed per lb. of Dressed Pork. 1884.	1885.
Creamery Buttermilk and Meal,	4.6 cts.	4.20 cts.
Farm Skim Milk and Meal,	5.8 cts.	4.85 cts.

The previous short discussion of the first feeding experiment, reported in BULLETIN No. 13 (also II. Annual Report), seemed to be necessary in the interest of a desirable understanding of the subsequent description of the second feeding experiment, beginning Nov. 5th, 1884, and ending March 17th, 1885.

Second Feeding Experiment.—Twelve pigs served in this trial; all were barrows. Six of them were crosses of Berkshire sow with Yorkshire boar; their individual weights varied from 38 to 46 lbs.; the remaining six animals were crosses of Chester White sow, with Yorkshire boar, weighing from 15 to 19 lbs. each. They were arranged for the experiment in two lots,—A and B,—each containing three of the former and three of the latter breed. The first three numbers in each lot are the heavier animals (Berkshire).

Lot A (1, 2, 3, 4, 5 and 6,) was fed with *Creamery Buttermilk* and *Corn Meal*, at the rate of *three ounces* of *Corn Meal* for *every quart* of milk consumed, until the quantity of milk required per day, to meet the individual want of each animal, amounted to from twelve to thirteen quarts, when the increase of milk for the daily diet ceased. The subsequent still steadily increasing demand for more feed was supplied by a gradual increase of corn meal, rising from three to four, five, six, and finally to seven and one-half ounces of meal for every quart of butter milk. The experiment terminated with ninety-two ounces of corn meal to twelve quarts of milk.

Lot B (7, 8, 9, 10, 11 and 12,) was fed with *Skim Milk* from the farm, and *Corn Meal*, at the following rates: Nos. 7, 8 and 9, (Berkshire) received from the 5th of November to the 9th of December *two ounces* of *meal* for *every quart of skim milk* consumed; from the 9th of December to the 15th of January, *four ounces* of meal to *every quart* of milk. The meal was subsequently gradually raised to *eight ounces per quart* of milk. The consumption of milk had reached ten quarts per day, when the want of skim milk necessitated (Feb. 7th) a change in the course of feeding adopted for this lot of pigs. *Creamery Buttermilk* and *Meal—six ounces* of meal for *every quart* of the latter—were substituted; at that period seventy-two ounces of meal and twelve quarts of milk were fed. The experiment was continued in the same manner as Nos. 1, 2 and 3, of Lot A, until the 17th of March.

The second half of Lot B (Nos. 10, 11 and 12,) received from November 5th to December 9th *two ounces* of meal for *every quart* of skim milk consumed; from the 9th of December to the 14th of January, *four ounces*; from the 14th of January to the 17th of February, from *five* to *five and one-half ounces* of meal per quart. At this stage of the experiment, when the daily consumption of the milk had reached from *six* to *seven quarts*, the increase of milk ceased; the call for additional feed during the remainder of the experiment was supplied by a gradual increase of meal until March 25th, when the animals were killed. The daily consumption of meal had reached, one week before the close of the experiment, one hundred and eight ounces, or $6\frac{3}{4}$ pounds, in case of every animal of this division of lot B, which proved to be the most profitable one of the entire experiment.

The tabular statement which follows aims at a more concise presentation of numerical relations regarding important points of the entire experiment, as far as every individual animal, as well as each lot is concerned. A summary of results, which closes the detailed statements, shows that Lot B, on the whole, has given the best returns with the second division leading. The superior quality of the *skim milk* (Lot B) is rendered quite conspicuous by a saving of three hundred and sixty gallons of milk, and an increased production of one hundred and one pounds of dressed pork, as compared with the use of the creamery butter milk, (Lot B, with practically a corresponding quantity of corn meal under otherwise corresponding conditions.

The results of our first experiment were reversed, as might have been expected, by a more judicious distribution of an increased proportion of meal at the various stages of growth. The cost of the entire feed consumed by Lot A amounted to $51.00; and that of Lot B to $53.02; whilst the cost of feed for the production of one pound of dressed pork in Lot A amounted to 5.73 cts., and that of Lot B amounted to 5.37 cts. The influence of a severe winter, and thus generally a lower temperature, during the second experiment, (Nov. to March,) has no doubt exerted a depressing influence on the total results, when compared with the results of the first experiment. (May to September).

No. of Pounds of Dry Matter in feed required to Produce one Pound of Dressed Pork.

	I. 1884. Summer.	*II. 1885. Winter.*
Creamery Butter Milk, Feed.	2.4 lbs.	3.67 lbs.
Skim Milk, Feed.	2.9 lbs.	3.33 lbs.

Aside from the stated facts, there are some other points of a more general character deserving of mention in this connection, which are not infrequently underestimated in the feeding of pigs for the market.

First.—A careful preparation of the feed for young pigs, with reference to a *higher nutritious character at the beginning*, and to a gradually *increasing bulk for the proper distention of the digestive organs*, to make them hereafter good eaters. A liberal supply of milk, with a gradual increase of meal, beginning with from one to two ounces of meal per quart, has served us well.

Second.—A *timely closing up* of the fattening process in the *interest* of *profits*, for the best returns of the feed are obtained in the earlier periods of growth; in our case, as a rule, profits were doubtful after the animal reached a weight of from 180 to 200 pounds There may be exceptions to this observation when the cost of feed is low, and the market price of dressed pork very high, a circumstance not often happening.

We sold our dressed pork at $6\frac{3}{4}$ cents per pound.

A good illustration in this direction may be furnished by a detailed record of actual results in the case of pigs No. 10, 11 and 12, of Lot B, (pigs fed with skim milk and meal.)

	Live weight of animal at the close of Feeding Period, in Pounds.	Gain in Live Weight during Period, in Pounds.	One hundred Pounds of dry matter in feed had produced, live weight, in pounds.	Cost of feed for production of one pound of live weight *in cts.*
No. 10. I. Feeding Period,	48.5	30.0	82.0	2.13
II. " "	98.5	50.0	55.1	2.98
III. " "	152.0	53.5	39.1	4.90
IV. " "	209.0	57.0	23.8	6.12
No. 11. I. Feeding Period,	45.5	28.5	77.9	2.25
II. " "	89.5	44.0	48.5	3.38
III. " "	138.0	48.5	35.4	4.52
IV. " "	191.0	53.0	22.1	6.60
No. 12. I. Feeding Period,	48.0	30.0	82.0	2.13
II. " "	97.5	49.5	54.5	3.01
III. " "	147.5	50.0	36.4	4.38
IV. " "	216.0	68.5	28.6	5.10

As the difference of live weight and dressed weight in the case here under discussion amounts on an average to $18\frac{3}{4}$ lbs. per hundred weight, and as we sold our dressed pork at $6\frac{3}{4}$ cts. per pound, we lost money on the feed whenever its cost exceeded 5.49 cts. per pound of *live weight* gained; in other words, in only one case, that of No. 12, did we make money during the IV. feeding period of our trial by converting the feed into live weight. These relations appear most striking in feeding periods of equal length, and of about four weeks duration. Our younger animals showed, in every case, a larger gain in live weight during the first period of feeding than the heavier ones, showing the advantages of beginning well at an early stage of growth.

A. BUTTERMILK AND CORN MEAL.

NUMBER ONE.

PERIODS.	Total amount of Meal consumed during period. (in lbs.)	Total quantity of Milk consumed during period (in quarts.)	Total amount of dry matter in Meal consumed during period.	Total amount of dry matter in Milk consumed during period.	Nutritive Ratio of Food.	Weight of animal at beginning of period.	Weight of animal at end of period	Gain in weight per day during period.	
1884 and 1885.								*Lb.*	*Oz.*
Nov. 5 to Jan. 27.	156 8	796.0	137.0	137.1	1:3.5	43.5	144.5	1	4
Jan. 27 " Feb. 3.	28.0	86.5	24.5	14.9	1:4.	144.5	171.5	3	14
Feb. 3 " Feb. 27.	111.8	288 0	97.7	49.7	1:4.4	171.5	205.5	1	7
Feb. 27 " Mar. 17.	102.4	216.0	89.5	37.3	1:4.8	205.5	231.0	1	7

Total amount of feed consumed from Nov. 5. 1884 to March 17, 1885.

399 lbs. Corn Meal,	equal to dry matter,	349 lbs.
1386 qts. Butter Milk,	" " " "	239 "
	Total amount of Dry Matter,	588 "

Live weight of animal at beginning of experiment,	43.5 lbs.
Live weight at time of killing,	231.0 "
Live weight gained during experiment,	188.5 "
Dressed weight at time of killing,	195.0 "
Loss in weight by dressing, 36 lbs., or 16 per cent.	
Dressed weight gained during experiment,	159.0 "

Cost of feed consumed during the experiment.

399 lbs. Corn Meal, at $22.50 per ton,	$4.49
346 gals. Butter Milk, at 1.37c. per gal.,	4.75
	$9.24

3.13 lbs. of dry matter fed yielded one pound of live weight; and 3.69 lbs. of dry matter yielded one pound of dressed weight.

Cost of feed for production of 1 lb. of dressed pork, 5.81 cents.

A. BUTTERMILK AND CORN MEAL.

NUMBER TWO.

PERIODS.	Total amount of Meal consumed during period, (in lbs.)	Total amount of Milk consumed during period, (in quarts.)	Total amount of dry matter in Meal consumed during period.	Total amount of dry matter in Milk consumed during period.	Nutritive Ratio of Food.	Weight of animal at beginning of period.	Weight of animal at end of period.	Gain in weight per day during period.	
1884 and 1885.								*Lb.*	*Oz.*
Nov. 5 to Jan. 27.	156.8	796.0	137.0	137.1	1:3.5	46.0	156.5	1	5
Jan. 27 " Feb. 3.	28.0	86.5	24.5	14.9	1:4.	156.5	171.0	2	1
Feb. 3 " Feb. 27.	111.8	288.0	97.7	49.7	1:4.4	171.0	220.0	2	1
Feb. 27 " Mar. 17.	102.4	216.0	89.5	37.3	1:4.8	220.0	247.0	1	8

Total amount of feed consumed from Nov. 5, 1884 to March 17, 1885.

399 lbs. of Corn Meal, equal to Dry matter,	349 lbs.	
1386 qts. Butter Milk, " " " "	239 "	
Total amount of Dry Matter.	588 "	
Live weight of animal at beginning of experiment,		46 lbs.
Live weight at time of killing,		247 "
Live weight gained during experiment,		201 "
Dressed weight at time of killing,		204 "
Loss in weight by dressing, 43 lbs., or 17.5 per cent.		
Dressed weight gained during experiment,		168 "

Cost of feed consumed during experiment.

399 lbs. Corn Meal, at $22.50 per ton,	$4.49
346 gals. Butter Milk, at 1.37c. per gal.,	4.75
	$9.24

2.93 lbs. of dry matter yielded one pound of live weight; and 3.54 lbs. of dry matter yielded one lb. of dressed weight.

Cost of feed for production of 1 lb. of dressed pork, 5.56 cents.

A BUTTERMILK AND CORN MEAL.

NUMBER THREE.

PERIODS.	Total amount of Meal consumed during period, (in lbs.)	Total amount of Milk consumed during period, (in quarts.)	Total amount of dry matter in Meal consumed during period.	Total amount of dry matter in Milk consumed during period.	Nutritive Ratio of Food.	Weight of animal at beginning of experiment.	Weight of animal at end of experiment.	Gain in weight per day during period.	
1884 and 1885.								*Lb.*	*Oz.*
Nov. 5 to Jan. 27.	156.8	796.0	137.0	137.1	1:3.5	38	150.0	1	6
Jan. 27 " Feb. 3.	28.0	86.5	24.5	14.9	1:4.	150	153.0	0	7
Feb. 3 " Feb. 27.	111.8	288.0	97.7	49.7	1:4.4	153	198.0	1	14
Feb. 27 " Mar. 17.	102.4	216.0	89.5	37,3	1:4.8	198	218.5	1	2

Total amount of feed consumed from Nov. 5, 1884 to March 17, 1885.

399 lbs. Corn Meal, equal to Dry Matter, 349 lbs.
1386 qts. Butter Milk, " " " " 239 "

Total amount of Dry Matter, 588 "

Live weight of animal at beginning of experiment, 38.0 lbs.
Live weight at time of killing, 218.5 "
Live weight gained during experiment, 180.5 "
Dressed weight at time of killing, 218.5 "
Loss in weight by dressing, 35.5 lbs., or 16.13 per cent.
Dressed weight gained during experiment, 151.0 "

Cost of feed consumed during the experiment.

399 lbs. of Corn Meal, at $22.50 per ton, $4.49
346 gals. Butter Milk, at 1.37c. per gal., 4.75

$9.24

3.25 lbs. of dry matter fed yielded one pound of live weight; and 3.9 lbs. of dry matter yielded one pound of dressed weight.

Cost of feed for production of 1 lb. of dressed pork, 6.1 cents.

A BUTTERMILK AND CORN MEAL.

NUMBER FOUR.

Periods.	Total amount of Meal consumed during period. (in lbs.)	Total amount of Milk consumed during period. (in quarts.)	Total amount of dry matter in Meal consumed during period.	Total amount of dry matter in Milk consumed during period.	Nutritive Ratio of Food.	Weight of animal at beginning of period.	Weight of animal at end of period.	Gain in weight per day during period.	
1884 and 1885.								*Lb.*	*Oz.*
Nov. 5 to Jan. 27.	96	490	84 0	84.5	1:3.5	19.0	101.0	1	0
Jan. 27 " Feb. 25.	101	321	88.0	55.3	1: 4	101.0	135 5	1	5
Feb. 25 " Mar. 17.	88	228	76.7	39 3	1: 4.4	135.5	161.5	1	5
Mar. 17 " Mar. 26.	53	108	46.2	18.6	1: 4.8	161.5	165.0	0	6

Total amount of feed consumed from Nov. 5, 1884 to March 26, 1885.

338 lbs. Corn Meal, equal to Dry Matter, 295.0 lbs.
1147 qts. Butter Milk, " " " " 197.7 "

Total amount of Dry Matter, 492.7 "

Live weight of animal at beginning of experiment, 19 lbs.
Live weight at time of killing, 165 "
Live weight gained during experiment, 146 "
Dressed weight at time of killing, 133 "
Loss in weight by dressing, 32 lbs., or 19.5 per cent.
Dressed weight gained during experiment, 118 "

Cost of feed consumed during the experiment.

338 lbs. Corn Meal, at $22.50 per ton,	$3.80
287 gals. Butter Milk, at 1.37c. per gal..	3.93
	$7.73

3.37 lbs. of dry matter yielded one pound of live weight; and 4.17 lbs. of dry matter yielded one pound of dressed weight.

Cost of feed for production of 1 lb. of dressed pork, 6.55 cents.

A. BUTTERMILK AND CORN MEAL.

NUMBER FIVE.

PERIODS.	Total amount of Meal consumed during period. (in lbs.)	Total amount of Milk consumed during period. (in quarts.)	Total amount of dry matter in Meal consumed during period.	Total amount of dry matter in Milk consumed during period.	Nutritive Ratio of Food.	Weight of animal at beginning of period.	Weight of animal at end of period.	Gain in weight per day during period.	
1884 and 1885.								***Lb.***	***Oz.***
Nov. 5 to Jan. 27.	96	490	84.0	84.5	1:3.5	19	102	1	0
Jan. 27 " Feb. 25	101	321	88.0	55.3	1:4.	102	148	1	9
Feb. 25 " Mar. 17	88	228	76.6	39.3	1:4.4	148	188	2	0
Mar. 17 " Mar. 26.	53	408	46.2	18.6	1:4.8	188	198	1	2

Total amount of feed consumed from Nov. 5, 1884 to March 26, 1885.

338 lbs. Corn Meal, equal to Dry Matter,	295. lbs.
1147 qts. Butter Milk, " " " "	197.7 "
Total amount of Dry Matter,	492.7 "

Live weight of animal at beginning of experiment,	19.0 lbs.
Live weight at time of killing,	198.0 "
Live weight gained during experiment,	179.0 "
Dressed weight at time of killing,	161.5 "
Loss in weight by dressing, 36.5 lbs., or 18.4 per cent.	
Dressed weight gained during experiment,	146.0 "

Cost of feed consumed during the experiment.

338 lbs. Corn Meal, at $22.50 per ton,	$3.80
287 gals. Butter Milk, at 1.37c. per gal.,	3.93
	$7.73

2.75 lbs. of dry matter yielded one pound of live weight; and 3.4 lbs. of dry matter yielded one pound of dressed weight.

Cost of feed for production of 1 lb. of dressed pork, 5.29 cents.

A. BUTTERMILK AND CORN MEAL.

NUMBER SIX.

PERIODS.	Total amount of Meal consumed during period, (in lbs.)	Total amount of Milk consumed during period. (in quarts.)	Total amount of dry matter in Meal consumed during period.	Total amount of dry matter in Milk consumed during period.	Nutritive Ratio of Food.	Weight of animal at beginning of period.	Weight of animal at end of period.	Gain in weight per day during period. Lb.	Oz.
1884 and 1885.									
Nov. 5 to Jan. 27.	96	490	84.0	84.5	1:3.5	15.0	107.5	1	2
Jan. 27 " Feb. 25.	101	321	88.0	55.3	1:4.	107.5	155.0	1	10
Feb. 27 " Mar. 17.	88	228	76.7	39.3	1:4.4	155.0	191.0	1	13
Mar. 17 " Mar. 26.	53	108	46.2	18.6	1:4.8	191.0	198.5	0	13

Total amount of feed consumed from Nov. 5 1884 to March 26, 1885.

338 lbs. Corn Meal, equal to Dry Matter,	295.0 lbs.
1147 qts. Butter Milk, " " " "	197.7 "
Total amount of Dry Matter,	492.7 "

Live weight of animal at beginning of experiment,	15.0 lbs.
Live weight at time of killing,	198.5 "
Live weight gained during experiment,	183.5 "
Dressed weight at time of killing,	159.5 "
Loss in weight by dressing, 39 lbs., or 19.6 per cent.	
Dressed weight gained during experiment,	147.5 "

Cost of feed consumed during experiment.

338 lbs. Corn Meal, at $22.50 per ton,	$3.80
287 gals. Butter Milk, at 1.37c. per gal.,	3.93
	$7.73

2.68 lbs. of dry matter yielded one pound of live weight; and 3.34 lbs. of dry matter yielded one pound of dressed weight.

Cost of feed for producon of 1 lb. of dressed pork, 5.24 cents.

B SKIM MILK AND CORN MEAL.

NUMBER SEVEN.

PERIODS.	Total amount of Meal consumed during period, (in lbs.)	Total amount of Milk consumed during period, (in quarts.)	Total amount of dry matter in Meal consumed during period.	Total amount of dry matter in Milk consumed during period.	Nutritive Ratio of Food.	Weight of animal at beginning of experiment.	Weight of animal at end of experiment.	Gain in weight per day during period. Lb.	Oz.
1884.									
Nov. 5 to Dec. 9.	24.5	197	21.5	44.7	1:2.7	37	69	0	15
1885.									
Dec. 9 " Jan. 27.	121.0	452	105.4	102.6	1:4.	69	160	1	14
Jan. 27 " Feb. 3.	28.0	70	24.5	15.8	1:3.9	160	171	1	9
Feb. 3 " Feb. 7.	19.0	36	16.4	8.1	1:4.3	171	179	2	0
Feb. 7 " Mar. 17.	196.0	B'MILK. 456	171.4	78.7	1:4.7	179	254	2	0

Total amount of feed consumed from Nov. 5, 1884 to March 17, 1885.

388.5 lbs. Corn Meal, equal to Dry Matter,	339.2	lbs.
755 qts. Skim Milk, " " " "	171.2	"
456 " Butter Milk, " " " "	78.7	"
Total amount of Dry Matter,	589.1	"

Live weight at beginning of experiment,	37.0 lbs.
Live weight at time of killing,	254.0 "
Live weight gained during experiment,	217.0 "
Dressed weight at time of killing,	208.5 "
Loss in weight by dressing, 45.5 lbs., or 17.8 per cent.	
Dressed weight gained during experiment,	178.0 "

Cost of feed consumed during experiment.

388.5 lbs. Corn Meal, at $22.50 per ton,	$4.37
189 gals. Skim Milk. at 18c. per gal.,	3.40
114 gals. Butter Milk, at 1.37c. per gal.,	1.56
	$9.33

2.71 lbs. of dry matter yielded one pound of live weight; and 3.31 lbs. of dry matter yielded one pound of dressed weight.

Cost of feed for production of 1 lb. of dressed pork, 5.24 cents.

B. SKIM MILK AND CORN MEAL.

NUMBER EIGHT.

PERIODS.	Total amount of Meal consumed during period, (in lbs.)	Total amount of Milk consumed during period, (in quarts.)	Total amount of dry matter in Meal consumed during period.	Total amount of dry matter in Milk consumed during period.	Nutritive Ratio of Food.	Weight of animal at beginning of period.	Weight of animal at end of period.	Gain in weight per day during period. Lb.	Oz.
1884.									
Nov. 5 to Dec. 9.	24.5	197.0	21.5	44.7	1: 2.7	41.5	74,0	0	15
1885.									
Dec. 9 " Jan. 27.	121.0	452.0	105.4	102.6	1: 4.	74 0	152.5	1	9
Jan. 27 " Feb. 3.	28.0	70.0	24.5	15.8	1: 3.9	152.5	176.0	3	6
Feb. 3 " Feb. 7.	19.0	36.0	16.4	8.1	1: 4 3	176.0	178.0	0	8
Feb. 7 " Mar. 17.	196.0	B'MILK 456.0	171.4	78.7	1: 4.7	178.0	243.0	1	11

Total amount of feed consumed from Nov. 5, 1884 to March 17, 1885.

388.5 lbs. Corn Meal, equal to Dry Matter,	339.2	lbs.
755 qts. Skim Milk, " " " "	171.2	"
456 qts. Butter Milk, " " " "	78.7	"
Total amount of Dry Matter,	589.1	"

Live weight at beginning of experiment,	41.5 lbs.
Live weight at time of killing,	243.0 "
Live weight gained during experiment,	201.5 "
Dressed weight at time of killing,	205.0 "
Loss in weight by dressing, 38 lbs., or 15.6 per cent.	
Dressed weight gained during experiment,	170.0 "

Cost of feed consumed during experiment,

388.5 lbs. Corn Meal, at $22.50 per ton,	$4.37
189 gals. Skim Milk, at 1.8c. per gal.,	3.40
114 gals. Butter Milk, at 1.37c. per gal.,	1.56
	$9.33

2.9 lbs. of dry matter yielded one pound of live weight; and 3.47 lbs. of dry matter yielded one pound of dressed weight.

Cost of feed for production of 1 lb. of dressed pork, 5.48 cents.

B SKIM MILK AND CORN MEAL.

NUMBER NINE.

Periods.	Total amount of Meal consumed during period, (in lbs.)	Total amount of Milk consumed during period, (in quarts.)	Total amount of dry matter in Meal consumed during period.	Total amount of dry matter in Milk consumed during period.	Nutritive Ratio of Food.	Weight of animal at beginning of period.	Weight of animal at end of period.	Gain in weight per day during period. Lb.	Oz.
1884.									
Nov. 5 to Dec. 9.	24.5	197	21.5	44.7	1:2.7	40.0	77.0	1	1
1885.									
Dec. 9 " Jan. 27.	121.0	452	105.4	102.6	1:4	77.0	160.5	1	11
Jan. 27 " Feb. 3.	28.0	70	24.5	15.8	1:3.9	160.5	171.0	1	8
Feb. 3 " Feb. 7.	19.0	36	16.4	8.1	1:4.3	171.0	179.5	2	2
Feb. 7 " Mar. 17.	196.0	B'MILK 456	171.4	78.7	1:4.7	179.5	249.0	1	13

Total amount of feed consumed from Nov. 5, 1884 to March 17, 1885.

388.5 lbs. Corn Meal, equal to Dry Matter,	339.2 lbs.
755 qts. Skim Milk, " " " "	171.2 "
456 qts. Butter Milk, " " " "	78.7 "
Total amount of Dry Matter,	589.1 "

Live weight at beginning of experiment,	40.0 lbs.
Live weight at time of killing,	249.0 "
Live weight gained during experiment,	209.0 "
Dressed weight at time of killing,	209.0 "
Loss in weight by dressing, 40 lbs., or 16 per cent.	
Dressed weight gained during experiment,	174.5 "

Cost of feed consumed during experiment.

385.5 lbs. Corn Meal, at $22.50 per ton,	$4.37
189 gals. Skim Milk, at 1.8c. per gal.,	3.40
114 gals. Butter Milk, at 1.37c. per gal.,	1.56
	$9.33

2.81 lbs. of dry matter yielded one pound of live weight; and 3.37 lbs. of dry matter yielded one pound of dressed weight.

Cost of feed for production of 1 lb. of dressed pork, 5.35 cents.

B SKIM MILK AND CORN MEAL.

NUMBER TEN.

PERIODS.	Total amount of Meal consumed during period. (in lbs.)	Total amount of Milk consumed during period, (in quarts.)	Total amount of dry matter in Meal consumed during period.	Total amount of dry matter in Milk consumed during period.	Nutritive Ratio of Food.	Weight of animal at beginning of period.	Weight of animal at end of period.	Gain in weight per day during period.	
1884.								*Lb.*	*Oz.*
Nov. 5 to Dec. 9.	13.5	109	11.9	24.7	1:2.7	18.5	48.5	0	14
1885.									
Dec. 9 " Jan. 15.	51.0	204	44.5	46.3	1:3.1	48.5	98.5	1	6
Jan. 15 " Feb. 17.	88.0	266	76.6	60.3	1:3.9	98.5	152.0	1	10
Feb. 17 " Mar. 25.	209.0	252	182.5	57.2	1:5.	152.0	209.0	1	9

Total amount of feed consumed from Nov. 5, 1884 to March 25, 1885.

361.5 lbs. Corn Meal, equal to Dry Matter,	315.5 lbs.
831 qts. Skim Milk, " " " "	188.5 "
Total amount of Dry Matter,	504.0 "

Live weight at beginning of experiment,	18.5 lbs.
Live weight at time of killing,	209.0 "
Live weight gained during experiment,	190.5 "
Dressed weight at time of killing,	168.5 "
Loss in weight by dressing, 40.5 lbs., or 19.4 per cent.	
Dressed weight gained during experiment,	154.0 "

Cost of feed consumed during experiment.

361.5 lbs. Corn Meal, at $22.50 per ton,	$4.07
208 gals. Skim Milk, at 1.8c. per gal.,	3.74
	$7.81

2.64 lbs. of dry matter yielded one pound of live weight; and 3.27 lbs. of dry matter yielded one pound of dressed weight.

Cost of feed for production of 1 lb. of dressed pork, 5.07 cents.

B. SKIM MILK AND CORN MEAL.

NUMBER ELEVEN.

Periods.	Total amount of Meal consumed during period. (in lbs.)	Total amount of Milk consumed during period, (in quarts.)	Total amount of dry matter in Meal consumed during period.	Total amount of dry matter in Milk consumed during period.	Nutritive Ratio of Food.	Weight of animal at beginning of period.	Weight of animal at end of period.	Gain in weight per day during period.
1884.								*Lb.* *Oz.*
Nov. 5 to Dec. 9.	13.5	109	11.9	24.7	1:2.7	17.0	45.5	0 13
1885.								
Dec. 9 " Jan. 15.	51.0	204	44.5	46.3	1:3.1	45.5	89.5	1 3
Jan. 15 " Feb. 17.	88.0	266	76.6	60.3	1:3.9	89.5	138.0	1 7
Feb. 17 " Mar. 25.	209.0	252	182 5	27.2	1:5.	138.0	191.0	1 8

Total amount of feed consumed from Nov. 5, 1884 to March 25, 1885.

361.5 lbs. Corn Meal, equal to Dry Matter,	315.5 lbs.
831 qts. Skim Milk, " " " "	188.5 "
Total amount of Dry Matter,	504.0 "

Live weight at beginning of experiment,	17.0 lbs.
Live weight at time of killing,	191.0 "
Live weight gained during experiment,	174.0 "
Dressed weight at time of killing,	158.5 "
Loss in weight by dressing, 32.5 lbs., or 17 per cent.	
Dressed weight gained during experiment,	144.5 "

Cost of feed consumed during experiment.

361.5 lbs. Corn Meal, at $22.50 per ton,	$4.07
208 gals. Skim Milk, at 1.8c. per gal.,	3.74
	$7.81

2.89 lbs. of dry matter yielded one pound of live weight; and 3.48 lbs. of dry matter yielded one pound of dressed weight.

Cost of feed for production of 1 lb. of dressed pork, 5.4 cents.

B SKIM MILK AND CORN MEAL.

NUMBER TWELVE.

Periods.	Total amount of Meal consumed during period, (in lbs.)	Total amount of Milk consumed during period, (in quarts).	Total amount of dry matter in Meal consumed during period.	Total amount of dry matter in Milk consumed during period.	Nutritive Ratio of Food.	Weight of animal at beginning of period.	Weight of animal at end of period.	Gain in weight per day during period. Lb.	Oz.
1884.									
Nov. 5 to Dec. 9.	13.5	109	11.9	24.7	1:2.7	18.0	48.0	0	14
1885.									
Dec. 9 " Jan. 15.	51.0	204	44.5	46.3	1:3.1	48.0	97.5	1	5
Jan. 15 " Feb. 17.	88.0	266	76.6	60.3	1:3.9	97.5	147.5	1	8
Feb. 17 " Mar. 25.	209.0	252	182.5	57.2	1:5	147.5	216.0	1	14

Total amount of feed consumed from Nov. 5, 1884 to March 25, 1885.

361.5 lbs. Corn Meal, equal to Dry Matter,	315.5 lbs.
831 qts. Skim Milk, " " " "	188.5 "
Total amount of Dry Matter,	504.0 "

Live weight at beginning of experiment,	18.0 lbs.
Live weight at time of killing,	216.0 "
Live weight gained during experiment,	198.0 "
Dressed weight at time of killing,	173.0 "
Loss in weight by dressing, 43 lbs., or 19.88 per cent.	
Dressed weight gained during experiment,	169.5 "

Cost of feed consumed during experiment.

361.5 lbs. Corn Meal, at $22.50 per ton,	$4.07
208 gals. Skim Milk, at 1.8c. per gal.,	3.74
	$7.81

2.55 lbs. of dry matter yielded one pound of live weight; and 2.97 lbs. of dry matter yielded one pound of dressed weight.

Cost of feed for production of 1 lb. of dressed pork, 4.61 cents.

SUMMARY OF RESULTS OF EXPERIMENTS.

A. Pigs fed with *Buttermilk* and *Corn Meal.*

	Corn Meal, in lbs.	*Buttermilk, in gallons.*	*Live Weight, gained during Experiment.*	*Dres'd W'ht gained dur'g Experiment.*	*Cost per pound of Dressed Pork, cts.*
I.	399.	346.	188.5	159.0	5.81
II.	399.	346.	201.0	168.0	5.56
III.	399.	346.	180.5	151.0	6.10
IV.	338.	287.	146.0	118.0	6.55
V.	338.	287.	179.0	146.0	5.29
VI.	338.	287.	183.5	147.5	5.24
	2211.	1899	1078.5	889.5	

B. Pigs fed with *Skim Milk* and *Corn Meal.*

	Corn Meal in lbs.	Skim Milk in gallons.	Live Weight gained during Experiment.	Dres'd W'ht gained during Experiment.	Cost per pound of Dressed Pork, cts.
VII.	388.5	303.	217.0	178.0	5.24
VIII.	388.5	303.	201.5	170.0	5.48
IX.	388.5	303.	209.0	174.5	5.35
X.	361.5	208.	190.5	154.0	5.07
XI.	361.5	208.	174.0	144.5	5.40
XII.	361.5	208.	198.0	169.5	4.61
	2250.0	1533.	1190.0	990.5	

Total Cost of Feed Consumed during the Experiment.

A.	2,211 lbs. Corn Meal,	$24.98
	1,899 gallons Buttermilk,	26.02
		$51.00
B.	2,250 lbs. Corn Meal,	$25.42
	1,533 gallons Skim Milk,	27.60
		$53.02

Cost of Feed per Pound of Dressed Pork.

A.	Buttermilk and Meal,	5.73 cts.
B.	Skim Milk and Meal,	5.35 cts.

The pound of dressed pork was sold at $6\frac{3}{4}$ cts. per pound.

The analyses of Buttermilk from the Creamery, as well as of the Skim Milk from the farm, have been published in Bulletin No. 17.

The Buttermilk contained 8 per cent. of solids; one quart of it weighed 34.5 ounces, and contained 2.76 ounces of dry matter; one gallon contained 11.04 ounces of solids. The Skim Milk contained 10.22 per cent of solids; one quart of it weighed 35.5 ounces, and contained 3.63 ounces of solids; one gallon contained 14.52 ounces of dry organic matter.

FODDER ANALYSES.

349. CORN MEAL.

The subsequent analysis represents the average of the composition of the corn meal fed during the previously described feeding experiments with pigs.

	Percentage Composition.	Constituents (in lbs.) in a ton of 2000 lbs.	Pounds digestible in a ton of 2000 lbs.	Per cent. of digestibility of constituents.	Nutritive Ratio.
Moisture at 100° C.,	12.62	252.40			
Dry Matter,	87.38	1747.60			
	100.00	2000.00			
ANALYSIS OF DRY MATTER.					1 : 8.76
Crude Ash,	1.56	31.20			
" Cellulose,	2.66	53.20	18.09	34	
" Fat,	4.27	85.40	64.90	76	
" Protein, (nitrogenous matter),	11.43	228.60	194.31	85	
Non-nitrogenous extract matter,	80.08	1601.60	1505.50	94	
	100.00	2000.00	1782.80		

350. HAY OF OATS.

The crop was cut with the seeds in the milk, July 9th, 1885.

	Percentage Composition.	Constituents (in lbs.) in a ton of 2000 lbs.	Pounds digestible in a ton of 2000 lbs.	Per cent. of digestibility of constituents.	Nutritive Ratio.
Moisture at 100° C.,	9.55	191.00			
Dry Matter,	90.45	1809.00			
	100.00	2000.00			
ANALYSIS OF DRY MATTER.					1 : 7.91
Crude Ash,	6.08	121.60			
" Cellulose,	34.32	686.40			
" Fat,	2.69	53.80	24.75	46	
" Protein, (nitrogenous matter),	10.89	217.80	124.15	57	
Non-nitrogenous extract matter,	46.02	920.40	920.40	100	
	100.00	2000.00	1079.30		

Some of the green crop was used in a feeding experiment with milch cows, previous to the time of cutting for hay.

351. HAY OF BARLEY.

The barley was cut July 9th, 1885, while the seeds were in the milk.

	Percentage Composition.	Constituents (in lbs.) in a ton of 2000 lbs.	Pounds digestible in a ton of 2000 lbs.	Per cent. of digestibility of constituents.	Nutritive Ratio.
Moisture at 100° C.,	10.25	205.00			
Dry Matter,	89.75	1795.00			
	100.00	2000.00			
ANALYSIS OF DRY MATTER.					
Crude Ash,	4.95	99.00			1 : 9.59
" Cellulose,	29 12	582.40			
" Fat,	2.76	55.20	25.39	46	
" Protein, (nitrogenous matter),	10.26	205.20	116.96	57	
Non-nitrogenous extract matter,	52.91	1058.20	1058.20	100	
	100.00	2000.00	1200.55		

Part of the crop was fed green in connection with a feeding experiment with milch cows, which will be described at a later date.

FERTILIZER ANALYSES.

352. DARLING'S ANIMAL FERTILIZER.

(Collected of W. S. Westcott, Amherst, Mass.)

Guaranteed composition: Ammonia, 4 to 6 per cent. (equivalent to nitrogen $3\frac{1}{3}$ to 5 per cent.); phosphoric acid, 10 to 12 per cent.; potassium oxide, 4 to 6 per cent.

	Per Cent.
Moisture at 100° C,	14.93
Total phosphoric acid,	10.52
Soluble " "	0.20
Reverted " "	4.40
Insoluble, " "	5.92
Potassium oxide,	4.91
Nitrogen,	4.36
Insoluble matter,	1.66
Valuation per 2000 lbs.,	$32.01

Correction.—The above results represent the composition of the article No. 345, reported in the previous Bulletin. By some oversight a wrong analysis was published on that occasion.

353. MURIATE OF POTASH.

Sent on for examination by Bolton Farmers and Mechanics Association, Bolton, Mass.

Moisture at 100° C,	0.63 per cent.
Potassium Oxide,	51.33 "
Valuation per ton at current rates,	$43.63

354. DISSOLVED BONEBLACK.

Sent on for examination by Bolton Farmers and Mechanics Association, Bolton, Mass.

Moisture at 100° C,	10.05
Total Phosphoric Acid,	17.56
Soluble, " "	16.84
Reverted, " "	0.44
Insoluble. " "	0.28
Insoluble Matter,	1.08
Valuation at current rates, per ton.	$31.24

355. DRIED BLOOD.

Sent on for examination by Bolton Farmers and Mechanics Association, Bolton, Mass.

Moisture at 100° C,	7.65 per cent.
Nitrogen,	8.10 "
Phosphoric Acid,	6.23 "
Insoluble Matter,	1.08 "
Valuation at current rates, per ton,	$36.64

356. NITRATE OF SODA.

Sent on for examination by Bolton Farmers and Mechanics Association, Bolton, Mass.

Moisture at 100° C,	0.85 per cent.
Nitrogen,	16.26 "
Valuation at current rates, per ton,	$58.54

357. AMMONIUM SULPHATE.

Sent on for examination by Bolton Farmers and Mechanics Association, Bolton, Mass.

Moisture at 100° C,	0.25
Nitrogen,	21.28
Valuation at current rates, per ton,	$76.60

358. CANADA ASHES.

1. Collected of Wm. H. Earle & Co., Worcester, Mass.

2. Munroe, Judson & Stroup; collected of Albert Montague, South Deerfield, Mass.

3. Munroe, Judson & Stroup; collected of E. M. Rouche, South Deerfield, Mass.

	1.	*2.*	*3.*
	Pounds per Hundred.		
Moisture at 100° C,	3.30	11.25	13.33
Total phosphoric acid,	2.30	1.09	1.28
Potassium oxide,	8.51	6.36	5.91
Calcium oxide,	37.49	37.62	39.21
Magnesium oxide,	3.93	7.47	5.11
Insoluble matter,	11.60	6.37	9.36

Sample 1 sold at $14.25 per ton; counting 45 lbs. the weight of a bushel, at 33 cents per bushel. Samples 2 and 3 sold at 25 cents per bushel of from 45 to 48 lbs. each.

C. A. GOESSMANN, Director,
Amherst, Mass.

The Bulletin and I. and II. Annual Reports of the Experiment Station will be sent, free of charge, to all parties interested in its work, on application. Address State Agricultural Experiment Station, Amherst, Mass.

MASSACHUSETTS STATE

AGRICULTURAL EXPERIMENT STATION.

BULLETIN No. 19.

APRIL, 1886.

The publication of BULLETINS for the present year begins with this number. Copies will be sent to all parties already on our distributing list—without awaiting a special notice. Provisions are made to meet new applications. The supply of BULLETINS No. 1 to 15, and of the second annual report is exhausted, while of BULLETINS Nos. 16, 17 and 18, and of the first annual report there are still a limited number on hand for distribution.

Arrangements are made 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 on to "The Experiment Station" must have express and postal charges prepaid, to receive attention.

Meteorological Summary for three months ending March 31, 1886.

	JANUARY.	FEBRUARY.	MARCH.
Highest temperature,	56.0°	52.0°	61.0°
Lowest temperature,	—22.0°	—11.0°	—1.0°
Mean temperature,	21.9°	23.1°	33.5°
Total Precipitation,	5.39 in.	3.94 in.	3.31 in.
Total snow fall,	11.5 in.	3.0 in.	8.5 in.
Prevailing winds,	Northerly.	Northwesterly.	Northwesterly.
No. of days on which cloudiness averaged 8 or more on scale of 10,	11	6	11
No. of days on which .01 inch or more of rain or melted snow fell,	8	8	7

The temperatures of the given months were close to the averages of previous years but the range was unusually great. The precipitation for January was above the average, but the snow fall has been light. At the close of the period the ground is without snow and in many places free of frost: a condition in advance of average years.

VALUATION OF FERTILIZERS

AND

ANALYSES OF FERTILIZERS.

The valuation of a fertilizer is based on the average trade value of the 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. 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, as salt, ashes, various kinds of lime. barnyard manure, factory refuse and waste materials of different description, does, quite frequently, not stand in a close relation to their chemical composition. 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 wholesale market price of manurial substances is liable to serious fluctations; 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 have only in exceptional instances, a desirable chance to inform themselves regarding the conditions which control the market price, the assistance rendered in this direction, by Agricultural chemists charged with the examination of commercial fertilizers, cannot otherwise but benefit, ultimately both farmers and manufacturers.

The market reports of centres of trade in New England, New York and New Jersey, aside from consultations with leading manufacturers of fertilizers furnish us 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, 1886, and increasing them by 20 per cent., to cover expenses for sales, credits, etc.

These trade values, except those for phosphoric acid, soluble in ammonium-citrate, were agreed upon by the Experiment Stations of Massachusetts, Connecticut and New Jersey for use in their several states for the present season.

TRADE VALUES OF FERTILIZING INGREDIENTS IN RAW MATERIALS AND CHEMICALS.

	Cents per Pound. 1886.
Nitrogen in Ammonia salts,	$18\frac{1}{2}$
" " Nitrates,	$18\frac{1}{2}$
" " Dried and fine ground fish,	17
Organic nitrogen in guano and fine ground blood and meat,	17
Organic nitrogen in cotton seed, linseed meal, and in castor pomace,	17

Organic nitrogen in fine ground bone,	17
" " " medium bone,	15
" " in medium bone,	13
" " in coarse medium bone.	11
" " in coarse bone, horn shavings, hair and fish scraps,	9
Phosphoric acid soluble in water,	8
" " " ammonia citrate,*	7½
" " insoluble, in dry fine ground fish, and in fine bone,	7
Phosphoric acid insoluble in fine medium bone,	6
" " " in medium bone,	5
" " " in coarse medium bone,	4
" " " in coarse bone,	3
" " " in fine ground rock phosphate,	2
Potash as high grade sulphate,	5½
" " Kainite,	4¼
" " Muriate,	4¼

The above trade values are the figures at which on March 1st, the respective ingredients could be bought at retail *for cash* per pound in our leading 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 1st, plus 20 per cent. in case of goods for which we have wholesale quotations. The calculated values obtained by the use of the above figures will be found to agree fairly with the reasonable retail price in case of standard raw materials such as:

Sulphate of Ammonia,	Dry Ground Fish,
Nitrate of Soda,	Castor Pomace,
Muriate of Potash,	Cotton Seed,
Sulphate of Potash,	Bone,
Dried Blood,	Azotin,

Plain Superphosphates.

TRADE VALUES IN SUPERPHOSPHATES, SPECIAL MANURES AND MIXED FERTILIZERS OF HIGH GRADE.

The organic nitrogen in these classes of goods will be valued at the highest figure laid down in the Trade Values of Fertilizing Ingredients in Raw Materials, namely seventeen cents per pound, it being

*Dissolved from two grams of Phosphate unground, by 100 C. C. neutral solution of ammonium citrate, sp. gr. 1.09 in 30 minutes at 65 deg. C., with agitation once in five minutes; commonly called "reverted" or "backgone" phosphoric acid.

assumed that the organic nitrogen is derived from the best sources, viz.: bone, blood, animal matter, 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.

Insoluble Phosphoric acid will be valued at 3 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 2 cents per pound. Potash is rated at $4\frac{1}{4}$ cents, if sufficient chlorine is present in the fertilizer to combine with it to make muriate. If there is more Potash present than will combine with the chlorine, then this excess of Potash will be counted as sulphate. To introduce large quantities of chlorides, common salt, etc., into fertilizer, claiming sulphate of potash as a constituent, is a practice, which in our present state of information will be considered of doubtful merit. The use of the highest trade values is but justice to these articles in which the costliest materials are expected to be used.

In most cases the valuation of the ingredients in Superphosphates and Specials falls below the retail price of these goods. The difference between the two figures, represents the manufacturer's charges for converting raw materials into manufactured articles. These charges are for grinding and mixing, bagging or barreling, storage and transportation, commission to agents and dealers, long credits, interest on investment, bad debts, and finally profits.

The prices stated in these bulletins in connection with analyses of commercial fertilizers refer to their cost per ton of 2,000 pounds, on board of car or boat near the factory, or place for general distribution. *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.

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 fertilizer, although equally pure, may differ from 50 to 100 per cent. in commercial value, on account of mere difference in moisture.

Crude stock for the manufacture of fertilizers, and *refuse material* 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 the substances for manurial purposes.

Consumers of commercial manurial substances do well to buy whenever practicable, on a 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.

359. CANADA WOOD ASHES.

I and II sent on from Concord, Mass.
III and IV sent on from South Deerfield, Mass.

	I.	*II.*	*III.*	*IV.*
		Pounds per hundred.		
Moisture at 100° C.,	17.00	18.15	4.90	2.48
Potassium oxide,	4.28	4.80	7.42	6.53
Calcium oxide,	31.31	30.69	42.10	42.98
Magnesium oxide,	2.36	3.71	3.55	3.66
Phosphoric acid,	3.34	3.26	2.00	1.44
Insoluble matter,	15.50	17.35	7.12	4.87

These samples represent the extremes of composition noticed in our section of the state. The use of Canada ashes has of late steadily increased, and the cost gradually declined to 24 to 25 cents per bushel, of forty-five to fifty pounds. These are prices by the carload at Amherst and in its vicinity.

360. ASH OF COTTON SEED HULLS.

Sent on for examination from Northampton, Mass.

		Per Cent.
Moisture at 100° C.,		2.30
Calcium oxide,		11.63
Magnesium oxide,		15.24
Phosphoric acid,	(at 6 cts. per pound),	13.67
Potassium oxide,	(at 5½ cts. per pound),	30.82
Insoluble matter,		21.65

Valuation per 2000 lbs., $50.30.

The percentage of potassa found in the above sample is exceptionally high; the same may be said of the phosphoric acid. On previous occasions potassium oxide was noticed, in this brand of ashes, as low as 23.72 per cent., and the phosphoric acid, 7.88 per cent. From detailed investigations of the cotton plant by Prof. H. C. White of Georgia, "On the Complete Analysis of the Cotton Plant," 1874, we have learned the general character of the ash constituents of the various parts of the cotton plant.

Judging from his analytical statements it becomes apparent that ashes of the cotton plant sold in our section of the country do not represent the mineral constituents of any particular part of the plant, but are obtained from a mixture of different parts, in varying proportions. Taking this feature of their origin into consideration, it becomes most advisable to buy these valuable ashes only on guaranty of composition.

361. GROUND BONE.

Sent on for examination from Concord, Mass.

	Per Cent.
Moisture at 100° C.,	4.78
Total phosphoric acid,	29.83
Reverted, " "	9.22
Insoluble " "	20.61
Nitrogen,	2.03
Insoluble matter,	0.30

Valuation per 2000 lbs., $34.79.

As the principal part of the article was of a coarse medium quality, insoluble phosphoric acid has been valued four cents per pound and nitrogen eleven cents.

362. BONEBLACK WASTE.

Sent on for examination.

	Per Cent.
Moisture at 100° C.,	10.65
Total phosphoric acid,	29.64
Insoluble matter,	2.80
Valuation per 2000 lbs., $23.71.	

This article is best used in the form of a superphosphate, commonly called, dissolved boneblack.

363. FISH WASTE.

Sent on for examination from Boston, Mass.

	Per Cent.
Moisture at 100° C.,	71.11
Nitrogen,	2.21
Phosphoric acid.	0.60
Fat,	0.45
Valuation per 2000 lbs., $4.58	

The article consisted of coarse pieces of fish, and its valuation is based for that reason on the rates of cost adopted for coarse fish-scraps: nine cents per pound of nitrogen and five cents per pound of phosphoric acid.

364. FISH AND POTASH.

Sent on for examination.

	Per Cent.
Moisture at 100° C.,	23.58
Total phosphoric acid,	6.26
Soluble " "	3.58
Reverted " "	1.33
Insoluble " "	1.35
Potassium oxide,	3.24
Nitrogen,	3.07
Insoluble matter,	1.90
Valuation per 2000 lbs., $22.00.	

365. FLAMINGO GUANO.

Sent on for examination from Worcester, Mass.

	Per Cent.
Moisture at 100° C.,	17.20
Total phosphoric acid,	16.16
Soluble " "	0.48
Reverted " "	5.22
Insoluble " "	10.46
Potassium oxide,	0.31
Nitrogen,	0.80
Insoluble matter,	2.95

Valuation per 2000 lbs., $17.86.

366. GLUCOSE REFUSE.

Sent on for examination.

	Per Cent.
Moisture at 100° C.,	8.10
Dry vegetable matter,	91.80
Nitrogen	2.62
Phosphoric acid	0.29
Magnesium oxide	0.02
Calcium oxide	0.18
Sodium oxide	0.12
Potassium oxide	0.15
Insoluble matter	0.07

Valuation per 2000 lbs., $9.33

This material consists mainly of the skins of corn; it is evidently the insoluble residual matter left behind after the conversion of the starch into glucose syrup. The manurial value of the article rests mainly on the amount of nitrogen it contains in form of insoluble nitrogenous matter. To render it an efficient manure requires in the majority of cases a liberal addition of phosphoric acid and potash.

367. ROTTEN BREWER'S GRAIN.

Sent on for examination from Lawrence, Mass.

	Per Cent.
Moisture at 100° C.,	78.77
Dry vegetable matter,	21.23
Nitrogen	0.72
Calcium oxide	0.26
Magnesium oxide	0.15
Phosphoric acid	0.43
Potassium oxide	0.04
Insoluble matter	0.59

Valuation per 2000 lbs., $2.91.

The general character of the above mentioned substance resembles that of barnyard manure. It contains more nitrogen and phosphoric acid, and less potash than the average barnyard manure. By increasing the latter ingredient to one-half a per cent. a fair substitute for barnyard manure may be obtained.

368. HOP REFUSE.

Sent on for examination from Lawrence, Mass.

	Per Cent.
Moisture at 100° C.,	80.98
Dry vegetable matter,	19.02
Nitrogen	0.98
Calcium oxide	0.27
Magnesium oxide	0.10
Phosphoric acid	0.20
Potassium oxide	0.11
Insoluble matter	0.63
Valuation per 2000 lbs.,	$3.62

This refuse from breweries differs from the previously described one merely by a larger percentage of nitrogen, it contains. Supplemented by some phosphoric acid and potash it may serve in place of barnyard manure. The average barnyard manure (partly rotten) is usually stated to contain 0.5 per cent of nitrogen, 0.26 per cent. of phosphoric acid and 0.6 per cent of potassium oxide.

ANALYSES OF VARIOUS ARTICLES OF FEED WITH REFERENCE TO FERTILIZING CONSTITUENTS.

369. 1. *Ground Corn and Oats.*

	Per cent.
Moisture at 100° C.,	10.48
Phosphoric acid,	0.78
Magnesium oxide,	0.05
Calcium oxide,	0.18
Sodium oxide,	0.22
Potassium oxide,	0.37
Nitrogen,	2.10
Insoluble matter,	0.29
Valuation per 2000 lbs.,	$8.23

The mixture consisted of equal weight parts of the grains.

370. 2. *Wheat Bran.*

	Per cent.	
Moisture at 100° C.,	11.45	9.40
Phosphoric acid,	3.05	3.12
Magnesium oxide,	0.90	0.91
Sodium oxide,	0.09	0.16
Potassium oxide,	1.49	1.42
Nitrogen,	2.82	3.08
Insoluble matter,	0.11	0.15
Valuation per 2000 lbs.,	$13.91	$14.80

The above analyses refer to the quality of bran fed of late at the station.

371—372. 3. *Globe Mangold.*

4. *Vilmorin Sugar Beet.*

	3	4
	Pounds per hundred.	
Moisture at 100° C.,	85.99	88.27
Dry matter,	14.01	11.73
Nitrogen,	2.52	2.05
Crude ash,	8.06	4.45
Potassium oxide,	3.79	1.29
Sodium oxide,	2.55	1.26
Calcium oxide,	0.24	0.42
Magnesium oxide,	0.32	0.25
Phosphoric acid,	0.20	0.23
Ferric oxide,	0.03	0.07
Insoluble matter,	0.74	0.68
Valuation per 2000 lbs.,	$12.03	$8.35

RELATIVE PERCENTAGE OF SOLUBLE ESSENTIAL CONSTITUENTS IN ONE HUNDRED PARTS OF THE ASH (3—4).

	3	4
Potassium oxide,	53.156	36.648
Sodium oxide,	35.764	35.795
Calcium oxide,	3.366	11.932
Magnesium oxide,	4.488	7.103
Phosphoric acid,	2.805	6.534
Ferric oxide,	0.421	1.988
	100.000	100.000

373—374. *Whole Apples.*

5. Rhode Island Greening.
6. Sweet Apple.

	5	6
	Pounds per	*hundred.*
Moisture at 100° C.,	84.650	——
Dry matter,	15.350	——
Nitrogen,	0.730	0.630
Crude ash,	2.130	2.020
Potassium oxide,	0.796	1.086
Sodium oxide,	0.086	0.171
Calcium oxide,	0.152	0.180
Magnesium oxide,	0.162	0.116
Ferric oxide,	0.011	0.019
Phosphoric acid,	0.053	0.046
Insoluble matter,	0.015	0.017
Valuation per 2000 lbs.,	$3.22	$3.12

375—376. *Apple Pomaces.*

7. Rhode Island Greening.
8. Baldwin Apple.

	7.	8.
	Pounds per	*hundred.*
Moisture at 100° C.,	78.220	82.780
Dry matter,	21.780	17.220
Nitrogen,	1.110	1.240
Crude ash,	1.090	1.780
Potassium oxide,	0.548	0.875
Sodium oxide,	0.151	0.121
Calcium oxide,	0.194	0.189
Magnesium oxide,	0.128	0.164
Ferric oxide,	0.039	0.049
Phosphoric acid,	0.081	0.107
Insoluble matter,	0.041	0.050
Valuation per 2000 lbs.,	$4.34	$5.09

The composition of the apples, which served for the above analyses, has been described in the third annual report of the institution, recently sent out.

C. A. GOESSMANN, *Director*,

AMHERST, MASS.

The Bulletin of the Experiment Station will be sent free of charge to all parties interested in its work, on application.

J. E. Williams, Printer, Amherst, Mass.

MASSACHUSETTS STATE

AGRICULTURAL EXPERIMENT STATION.

BULLETIN No. 20.

MAY, 1886.

Meteorlogical Summary for two months ending May 31st, 1886.

	APRIL.	MAY.
Highest temperature,	83.0°	82.0°
Lowest temperature,	21.0	29.0
Mean temperature,	50.4	57.3
Total precipitation,	1.73 in.	3.10 in.
Prevailing winds,	S. W. to N. W.	S. E. to S. W.
No. of days on which cloudiness averaged 8 or more on scale of 10,	10	12
No. of days on which .01 inches or more of rain or melted snow fell,	6	7

The season at the close of the month of April, as indicated by the state of vegetation, was fully two weeks in advance of the average. The month of May was cool throughout, and the general farm crops (except grass) were at its close no farther advanced than for the average of years at the same period.

FODDER AND FODDER ANALYSES.

The application of an intelligently devised system of chemical tests for the purpose of ascertaining the amount, and, the relative proportion 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 particular 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. Actual feeding experiments have shown that *three groups* of *plant constituents*, namely, *nitrogenous*, *non-nitrogenous*, and *mineral constituents*, are *needed* to sustain successfully 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.

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, meal refuse, brans, and our steadily increasing supply of refuse material 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 fertilizer in the growth of farm crops, by supplementing our home manurial resources. To feed an excess of fodder materials, as roots, potatoes, etc., which contain a large proportion of *non-nitrogenous* substances, 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, a part of the expense is saved in an increased value of the manure, 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 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 essential groups of food-constituents are contained in the fodder we feed?

Second. How much of each of these essential food-constituents are digestible under existing circumstances, and 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 engaged the attention of skillful 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 intelligent use of what we have learned.

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 determination 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 temperature, 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 craving 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 distention 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, (albumen, fibrin, casein,) 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 the fat,—one of the non-nitrogenous constituents,—2½ times as much, as compared with starch, sugar, and other representatives of that group, its amount is separately recorded. The same course, for similar reasons, has been of late 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 wax, resinous substances, 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.

Wherever the article has been tested by actual feeding experiment under skillful 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.

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 constituents*, 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 indorsed 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 its several constituents to a full extent.

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 1. to from 10. to 12., needs a liberal addition of substances like oil-cakes, wheat bran, gluten meal, etc., which have a nutritive ratio of from 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 the beneficial effects of an addition of these valuable waste products less 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.

The value of an article of fodder may be stated from two different standpoints,—that is, with reference to its cost in the local market, and with reference to its nutritive value or its feeding effect. 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 crop, is as important a question, as that of *raising* them in an economical manner. The great progress which has been made during the past ten or twelve years in regard to the proper mode of feeding plants ought to serve as an encouragement to undertake the task of inquiring more *systematically* into the proper mode of feeding our farm live stock, in the most profitable way.

The importance of the question under discussion, it is hoped, will serve as an excuse for the somewhat lengthy introduction.

ANALYSES OF FODDER.

377. THE CONCENTRATED FEED.

Sent on by South Deerfield Farmers' Club, South Deerfield, Mass.

97.52 per cent. passed through mesh 144 to the square inch.

	PER CENT.
Moisture at 100° C.	10.65
Crude Ash,	14.48
" Cellulose,	9.31
" Fat,	4.30
" Protein (nitrogenous matter),	13.90
Non-nitrogenous extract matter,	47.36
	100.00

ANALYSIS OF DRY MATTER.

Crude Ash,	16.21
" Cellulose,	10.42
" Fat,	4.81
Protein (nitrogenous matter),	15.56
Non-nitrogenous extract matter,	53.00
	100.00

The material was received in a bag marked "The Concentrated Feed Company, Boston, Mass." A circular collected of the agent at South Deerfield, contains a statement of an analysis of the article, which as far as essential points are concerned, does not materially differ from our own, above reported.

The material was of a good mechanical condition and consisted evidently of a mixture of several ingredients; among them was noticeable common salt. An actual test showed the presence of 7.4 per cent. of chlorine, which indicates the presence of from 11 to 12 per cent. of common salt. On inquiry it was learned that "The Concentrated Feed" sold at $8.00 per one hundred weight, a most remarkable price for an article of fodder without any stated guaranty of its various ingredients, nor any statement of its rate of digestibility under some specified condition. The selling price of the article seems to be based largely on the merits of the invention of the compound. It would be no difficult task to compound from our most reputed concentrated feed stuffs, even without a liberal addition of common salt, an article, which would conform to the composition claimed by the manufacturer of "The Concentrated Feed," and at the same time could be sold with a good compensation to the agent, even in remote localities, at a less price per ton, than "The Concentrated Feed" sells for per five hundred pounds.

From my remarks in previous pages it must be apparent, that a mere analysis of a fodder article without any further reliable information concerning its source and its special character, is no safe basis for a decision regarding its particular value for feeding purposes. The practice of buying *compound* feedstuffs in the general market, without a sufficient *actual* knowledge regarding the kind or the character of its various ingredients, ought to be decidedly discouraged; for the farmer, who pursues that course, leaves his best interest to mere chance. To feed commercial *compound* feedstuffs without *some more positive* knowledge of the article which constitutes them, can impart but little useful information for future operation beyond the lesson, to be less credulous hereafter.

378. WHEAT MIDDLINGS.

Sent on from Bolton, Mass.

	Percentage Composition.	Constituents (in lbs.) in a ton of 2000 lbs.	Pounds digestible in a ton of 2000 lbs.	Per cent. of digestibility of constituents.	Nutritive Ratio.
Moisture at 100° C.	10.55	211.00	Not determined by actual feeding tests.	Not determined by actual feeding tests.	
Dry Matter, ...	89.45	1789.00			
	100.00	2000.00			
ANALYSIS OF DRY MATTER.					
Crude Ash, ...	2.49	49.80			
" Cellulose, ...	1.40	28.00			
" Fat, ...	4.26	85.20			
" Protein (nitrogenous matter), .	19.21	384.20			
Non-nitrogenous extract matter, . .	72.64	1452.80			
	100.00	2000.00			

The composition is very fair, and its mechanical condition was not less satisfactory.

379. WHEAT MIDDLINGS.

Sent on from Barre, Mass.

	Percentage Composition.	Constituents (in lbs.) in a ton of 2000 lbs.	Pounds digestible in a ton of 2000 lbs.	Per cent. of digestibility of constituents.	Nutritive Ratio.
Moisture at 100° C., ...	9.85	197.00	Not determined by actual feeding tests.	Not determined by actual feeding tests.	
Dry Matter, ...	90.15	1803.00			
	100.00	2000.00			
ANALYSIS OF DRY MATTER.					
Crude Ash, ...	2.53	50.60			
" Cellulose, ...	2.75	55.00			
" Fat, ...	3.19	63.80			
" Protein, (nitrogenous matter), .	17.23	344.60			
Non-nitrogenous extract matter, . .	74.30	1486.00			
	100.00	2000.00			

This material contains less fat and nitrogenous matter than the previous one, yet not less than samples from the same mill may show at different times.

380. HOMINY MEAL.

Sent on from Berlin, Mass.

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

	Percentage Composition.	Constituents (in lbs.) in a ton of 2000 lbs.	Pounds digestible in a ton of 2000 lbs.	Per cent. of digestibility of constituents.	Nutritive Ratio.
Moisture at 100° C.,	10.70	214.00			
Dry Matter,	89.30	1786.00			
	100.00	2000.00			
ANALYSIS OF DRY MATTER.					1 : 8.75
Crude Ash,	2.82	56.40			
" Cellulose,	3.69	73.80	25.09	34	
" Fat,	10 88	217.60	165.38	76	
" Protein, (nitrogenous matter),	11.88	237.60	201 96	85	
Non-nitrogenous extract matter,	70.73	1414.60	1329.72	94	
	100.00	2000.00	1722 15		

The composition is that of good article of its kind.

Fertilizers and Fertilizer Analyses.

One point, which deserves the careful consideration of farmers when devising an efficient and economical diet for their live-stock, does not always receive a proper attention, namely, the manurial value of the residue left on their hands when the fodder has served its its legitimate purpose. The financial success of a mixed farm management depends quite often largely on the amount, the character, and the cost of the manure obtained in connection with the special industry. The question whether one or the other fodder mixture has to be considered under existing conditions the most economical one, can only be decided intelligently when *both*, the *original cost* and *the value* of the *manurial matter* obtained by its use, are duly considered. The barnyard manure ought to remain, in a rational farm management, the cheapest manurial resource of the farmer. Objections raised against a liberal use of barnyard manure ought not to rest on its original cost of production, as compared with other manurial resources. Well founded objections occasionally raised in regard to its unrestricted use under exceptional circumstances are based on its peculiar mechanical and chemical character and cost of transportation. The analyses of fodder articles with reference to their fertilizing constituents are published for the purpose of assisting in a correct appreciation of the *relative manurial value* of fodder articles under *similar circumstances.*

ANALYSIS OF VARIOUS ARTICLES OF FEED WITH REFERENCE TO FERTILIZING CONSTITUENTS.

381. 1. WHEAT FEED.

Collected at a mill in Amherst, Mass.

Moisture at 100° C.,	9.18	per cent.
Nitrogen,	2.63	"
Crude Ash,	2.30	"
Magnesium oxide,	0.21	"
Calcium oxide,	0.20	"
Potassium oxide,	0.63	"
Sodium oxide,	0.11	"
Phosphoric acid,	0.95	"

Valuation per 2000 lbs., $10.63

382. 2. WHEAT MEAL.

Collected from a mill in Amherst, Mass.

Moisture at 100° C.,	9.83	per cent.
Nitrogen,	2.21	"
Crude Ash,	1.22	"
Magnesium oxide,	0.05	"
Calcium oxide,	0.17	"
Potassium oxide,	0.54	"
Sodium oxide,	1.06	"
Phosphoric acid,	0.57	"

Valuation per 2000 lbs., $8.65.

383. 3. CORN COBS.

Average result of four current varieties of corn raised in Hampden and Hampshire Counties, Mass.

Moisture at 100° C.,	10.00	per cent.
Nitrogen,	0.54	"
Ash,	1.03	"

Silica,	0.20	"
Ferric oxide,	0.01	"
Calcium oxide,	0.03	"
Magnesium oxide,	0.06	"
Potassium oxide,	0.68	"
Sodium oxide,	0.04	"
Phoshoric acid,	0.08	"

Valuation per 2000 lbs., $2.52.

384-385. 4. GLOBE MANGOLD.

5. VILMORIN SUGAR BEET.

	4.	5.
	Pounds per hundred.	
Moisture at 100° C.,	88.27	85.99
Dry Matter,	11.73	14.01
Nitrogen,	0.30	0.29
Crude Ash,	0.96	0.62
Potassium oxide,	0.45	0.18
Sodirm oxide,	0.21	0.18
Calcium oxide,	0.03	0.06
Magnesium oxide,	0.04	0.04
Phosphoric acid,	0.02	0.03
Ferric oxide,	0.04	0.01
Insoluble matter,	0.09	0.10
Valuation per 2000 lbs.,	$1.42	$1.18

CORRECTION. In a few *advanced* copies of Bulletin No. 19 the manurial value of a ton of the above roots was stated with reference to the *dried vegetable matter* of each, instead of, as intended, to that of the average root in its natural condition. To prevent misconstruction, the results of our investigation are here republished in the corrected form.

386. 6. DAMAGED COTTON SEED MEAL.

Sent on from Greenfield, Mass.

Moisture at 100° C.,	9.90	per cent.
Total phosporic acid,	1.26	"
Potassium oxide,	1.21	"
Magnesium oxide,	0.56	"
Calcium oxide,	0.22	"
Nitrogen,	3.73	"
Insoluble matter,	0.20	"

Valuation per 2000 lbs., $14.97.

The article was offered at $19.00 per ton of 2000 lbs.

387. ANALYSIS OF HEN MANURE.

Sent on from Townsend, Mass.

Moisture at 100° C.,	8.35	per cent.
Phosphoric acid,	2.02	"
Calcium oxide,	2.22	"
Magnesium oxide,	0.68	"
Potassium oxide,	0.94	"
Nitrogen in organic matter,	1.85	"
Nitrogen in actual ammonia,	0.28	"
Insoluble matter,	34.65	"

Valuation per 2000 lbs., $10.55.

The material was dry and contained the usual admixture of feathers, short pieces of coarse vegetable matter, earthy substances, etc., yet not in an extraordinary degree. The value of the hen manure depends not less on the care which is bestowed on its keeping, than on the kind of food the fowls consume. The excretion of birds, on account of their peculiar character, undergoes a rapid change; a large amount of ammonia is soon formed, which reduces materially its manurial value, in case it is allowed to escape. A liberal use of plaster, of kieserite, or of good loam is highly recommendable for the absorption of the ammonia. The safest way to secure the full benefit of the droppings is to gather them quite frequently, and to add directly any of the previously mentioned materials. A sandy soil is of little use as an absorbent.

388. ASHES OF CHESTNUT RAILROAD TIES.

Sent on from Waltam, Mass.

Moisture at 100° C.,	6.15	per cent.
Calcium oxide,	4.71	"
Magnesium oxide,	1.80	"
Potassium oxide,	0.19	"
Phosporic acid,	1.54	"
Insoluble mineral matter,	77.83	"

The material was of a dark brown color, and evidently not the pure ash, for it contained 77.83 per cent. of worthless earthy matter. The ash in the *above described state* does not pay carrying any considable distance; it is worth much less than leached ashes.

C. A. GOESSMANN, *Director*,

AMHERST, MASS.

The Bulletin of the Experiment Station will be sent free of charge to all parties interested in its work, on application.

MASSACHUSETTS STATE

AGRICULTURAL EXPERIMENT STATION.

BULLETIN No. 21.

JUNE, 1886.

Meteorological Summary for the month ending June 30th, 1886.

Highest temperature,	82.0°
Lowest temperature,	40.0°
Mean temperature,	63.2°
Total rainfall,	2.33 in.
Prevailing winds,	South to Southwest.
No. of days on which 0.1 inches or more of rain fell,	8
No. of days on which cloudiness averaged 8 or more on scale of 10,	11

The two principal storms of the month were of an unusual long duration; while the rainfall was exceptionally small.

FODDER.

FODDER CORN AND CORN ENSILAGE.

The last annual report on the work of the Experiment Station contains upon pages 52 and 53 a record of observations concerning the gradual increase of vegetable matter in the fodder corn during its successive stages of growth. A series of tests carried out with plants taken from our fields had demonstrated the fact, that the vegetable matter in the variety of corn on trial (Clark) had increased from fifty to one hundred per cent. in actual weight, between the time of the first appearance of the tassel and the beginning of the glazing of the kernels. It was found that the same variety of corn, raised under fairly corresponding circumstances, as far as the general character of the soil and the mode of cultivation are concerned, contained in one hundred weight parts, at the time of the first appearance of the tassel, from twelve to fifteen weight parts of dry vegetable matter and from eighty-two to seventy-five parts of water; whilst at the time of the beginning of the glazing of the kernels the former was noticed to vary from twenty-three to twenty-eight weight parts and the water from seventy-seven to seventy-two. These results of our investigation left no doubt about the fact, that our green fodder corn at the time of the beginning of the glazing of the kernels contained nearly twice as much vegetable matter per ton weight of the crop, as at the time of the appearance of the tassels.

This feature in the change of the composition of the fodder corn during its growth is not an exceptional one; similar changes are noticed in all our farm plants. Our observations in this direction were reported for the purpose of furnishing some more definite numerical values for the consideration of practical farmers. As long as the vital energy of an annual plant is still essentially spent in the increase of its size, as a rule, but a comparatively small amount of valuable organic compounds, as starch, sugar, etc., accumulates within its cellular tissue. The comparative feeding value of the same kind of fodder plants or any particular part of such plants is not to be measured by its size, but by the quantity of valuable organic nitrogenous and non-nitrogenous constituents stored up in its cellular system. The larger or smaller amount of dry vegetable matter left behind from a *given* weight of samples of the same kind of a *fodder plant of a corresponding stage of growth* indicates in the majority of cases their respective higher or lower economical value for feeding purposes. Agricultural chemists for this reason usually begin their examination of fodder plants with a test for the determination of the amount of *dry vegetable matter* left behind, when carefully brought to a constant weight at a temperature not exceeding 110° C.

The taller varieties of corn are not necessarily the more valuable kinds for the production of fodder; on the contrary it would be more judicious, on general principles, to doubt thier superior fitness for that purpose until otherwise proved. This statement applies in particular to some varieties but recently transferred to our section of the country, for they seem to require an exceptionally rich soil to yield the best results they are represented to be capable of producing. Raised in a soil of moderate resources of plant food, but little of the latter can be left over, after the production of their tall stalks and bulky leaves, to assist in the formation of valuable organic compounds, as sugar, starch, fat, nitrogenous matter, etc., to enrich the entire plant. The same mode of reasoning applies to the raising of exceptionally large sized roots, potatoes, etc., they are usually but partly matured, and thus of a watery and indifferent taste.

The general character of the climate and the physical and chemical condition of the soil control the local adaptation of a plant for a successful cultivation. Extremes of seasons and one-sided modes of manuring are apt to modify the growth of a plant and to alter thereby its composition. To learn how to check an inherent tendency of a plant to a rank growth, in the interest of a fairer chance for a complete maturity of the final crop, is most desirable information to secure; for success in that direction insures not unfrequently a superior pecuniary return. A careful study of the special characteristics of the plant on trial under the influence of existing local resources of the soil and of the prevailing local features of the weather during the growing season alone, can furnish a safe guide for the attainment of the desired end.

The determination of the *relative feeding value* of different samples of the *same kind* of plants, raised *under different circumstances*, is always carried out with plants of a *corresponding stage of growth*. Progress in the growth of plants alters not only their composition in regard to the quantity of the vegetable matter which they contain in a given weight, it changes also very materially the absolute and *relative proportion* of their *essential* food constituents, i. e. their nutritive value.

The amount of vegetable matter in a given weight of green fodder corn, cut at the beginning of the glazing of the kernels, is known to be not only nearly twice as large as compared with that contained in an equal weight of green corn fodder cut when just showing the tassels, it is also known to be pound for pound more nutritions, for it contains more starch, more sugar, more of valuable nitrogenous matter, etc.

Considering the previously stated views correct, we filled our silos during last autumn with fodder corn which had just reached the point, when the kernels began to glaze over, expecting to secure an ensilage of superior feeding value. The results of our experiments in that direction have been very satisfactory and may be summed up as follows:

1. The course adopted for the production of corn fodder for the silo, secures the largest amount of valuable vegetable matter, which a given area of land, planted with fodder corn can produce under corresponding circumstances as far as land and season are concerned.

2. The ensilage of a more matured fodder corn has a higher feeding value pound for pound, as compared with that cut at an earlier stage of growth.

3. The more matured fodder corn on account of a harder texture is less crushed by close packing and consequently better resists the peculiar influences, which tend to deteriorate and ultimately destroy the contents of the silo.

As a more detailed description of the products of our silos may not be without some interest to our readers at this period of the season, we publish below the essential part of our results, beginning with an abstract from our late annual report, which relates briefly the course pursued in filling the silo.

The corn fodder, when cut for the silo, September 3 and 4, began to acquire a slightly yellowish tint along the outside of the field, yet was still green and succulent in the interior parts; the kernels were soft, their contents somewhat milky, and their outside just beginning to glaze.

Corn Ensilage. Two silos of the same size, five by fourteen feet, inside measure, and eleven feet deep, were used for the experiment. In both instances the corn was cut into pieces from one and one-quarter to one and one-half inches in size; they were, however, filled in a different way.

Silo *No. 1* was loosely filled September 4, to about two-thirds of its height, and the mass merely levelled without treading it down. It was left in this condition, without covering, until September 7, at 8 o'clock A. M. At this time it had settled from eighteen to twenty-four inches; the odor of acetic acid acid became slightly perceptible, and the pieces of cornstalk, although sweet to the taste, showed an acid reaction to the test-paper (litmus).

Sept. 7, 8 A. M.	Temperature at	12	inches	depth,	147°, 145°, 147° F.
" 8, 8 "	"	" 12	"	"	141°, 145°, 145° F.
" 8, 8 "	"	" 24	"	"	136.5° F.
" 8, 8 "	"	" 30	"	"	114° F.
" 8, 8 "	"	" 36	"	"	107° F.

As the temperature remained practically at a standstill, the filling in of more fresh-cut corn was resumed, and the silo completely, yet loosely filled, September 8. A maximum registering thermometer was buried in the mass at a depth of two feet from the surface, and light boards loosely laid upon the top.

Sept. 10, 8 A. M. Temperature at 12 inches depth, 129°, 127° F.

The mass had now settled eighteen inches.

Sept. 11, 8 A. M.	Temperature at	12	inches	depth,	127°, 129°, 131° F.
" 12, 8 "	"	" 12	"	"	122°, 132°, — F.

The mass had settled from twenty-four to thirty inches. The temperature remained practically the same; the mass was carefully covered with tarred paper and tight-fitting boards, and subsequently, on September 12, pressed down with twenty-five barrels of sand. This silo contained eight tons of green corn fodder.

The temperature observations above recorded were made in different parts of the silo; they show that it is quite difficult to secure a desirable uniform temperature within the mass in all parts of the silo, at the same depth and at the same time.

Silo *No. 2* was filled to a depth of from eight to nine feet, as fast as the cut corn could be supplied and tramped down. As soon as the amount of corn assigned for that silo (9.5 tons) was filled in, the surface was carefully covered with tarred paper and tight-fitting boards, in the same manner as in case of the first silo, and at once pressed down with twenty-five barrels of sand. A maximum registering thermometer was safely buried at a depth of about two feet in the mass, to record the highest temperature which the latter would reach during the time of keeping the silo closed.

389. CORN ENSILAGE.

Taken from Silo No. 1, March 23, 1886.

	Percentage Composition.	Constituents (in lbs.) in a ton of 2000 lbs.	Pounds digestible in a ton of 2000 lbs.	Per cent. of digestibility of constituents.	Nutritive Ratio.
Moisture at 100° C.,	78.05	1561.00			
Dry Matter,	21.95	439.00			
	100.00	2000.00			
ANALYSIS OF DRY MATTER.					1 : 12.2
Crude Ash,	3.16	63.20			
" Cellulose,	20.48	409.60	294.91	72	
" Fat,	3 84	76.80	57.60	75	
" Protein, (nitrogenous matter),	7.37	147.40	107.60	73	
Non-nitrogenous extract matter,	65.15	1303.00	873.01	67	
	100.00	2000.00	1333.12		

The silo had been closed about six months, when opened. The highest temperature recorded by the thermometer buried at a depth of two feet below the surface of the ensilage, after closing the silo, was 116.5° F.

A layer of eighteen inches in thickness on the top and from six to eight inches along the sides of the silo was of a dark color and unfit for fodder. It was removed until no mould could be noticed on the leaves and stem parts; the ears of the corn were best preserved. The main bulk of the ensilage was of a brownish yellow color, and showed a decided acid reaction to the test-paper. The odor was at first, that of organic matter slowly disintegrating under the exclusion of air, but changed, soon after the opening of the silo into that of acetic acid (vinegar). The free organic acids contained in one hundred weight parts of the fresh ensilage (directly after the opening of the silo), required 1.309 parts of sodium hydroxide for their neutralization, which is equal to 1.96 per cent. of acetic acid. The same quantity of fresh ensilage contained 0.0374 parts of actual ammonia. No starch could be detected in the stems and leaves, whilst an abundance of it was found in the ears.

390. CORN ENSILAGE.

Taken from Silo No. 2, April 25, 1886.

	Percentage Composition.	Constituents (in lbs.) in a ton of 2000 lbs.	Pounds digestible in a ton of 2000 lbs.	Per cent. of digestibility of constituents.	Nutritive Ratio.
Moisture at 100° C.	76.90	1538.00			
Dry Matter, ...	23.10	462.00			
	100.00	2000.00			
ANALYSIS OF DRY MATTER.					1 : 10.4
Crude Ash, ...	5.22	104.40			
" Cellulose, ...	17.67	353.40	254.45	72	
" Fat, ...	3.15	63.00	47.25	75	
" Protein (nitrogenous matter), .	8.27	165.40	120.74	73	
Non-nitrogenous extract matter, . .	65.69	1313.80	880.25	67	
	100.00	2000.00	1302.69		

The silo, which furnished the above sample of corn ensilage, was opened seven months after being filled. A layer of about six inches in thickness had to be removed from the top, and the sides of the contents of the silo to reach an acceptable fodder for cows. The highest temperature, registered by the thermometer since its introduction into the silo at a depth of two feet at the time of closing, was 97.8° F.

The main body of the ensilage was in a fine condition, of a yellowish green color, somewhat lighter than in silo No. One. It had a slightly acid smell and taste. To neutralize the free organic acids contained in one hundred weight parts of fresh ensilage; collected at the opening of the silo, required 1.130 parts of sodium hydroxide, which is equal to 1.95 per cent. of acetic acid. The amount of ensilage contained 0.027 parts of actual ammonia.

A comparison of these observations with those made in connection with the contents of silo No. One, shows that in our case the direct filling and closing of the silo produced the best results. The contents of the silo filled up at once with cut corn fodder, and subsequently carefully closed up, had suffered less serious alteration in various directions, than those that had passed through a previous heating process, in consequence of a longer exposure to atmospheric agencies. The records of the thermometers, the chemical analyses of the ensilage from both silos, and the general character of both kinds of ensilage confirm our above conclusion. Adding to these statements the circumstance that our cows decidedly preferred the ensilage from silo No. Two, we feel that we can recommend the course pursued in filling that silo. As the free acids, acetic and lactic, in a corn ensilage, however carefully prepared, steadily increase after the opening of the silo, as long as unchanged saccharine and amylaceous constituents (sugar and starch), are present, it is very important that the access of air should be limited as far as practicable. The decision in regard to the *best size* of the silo should be largely controlled by the possible *rate of consumption*. The feeding value of the contents of the most carefully packed silo is apt to be most seriously impaired in consequence of a subsequent prolonged exposure to the air. Three to four weeks exposure altered the character of our ensilage seriously as far as its acidity was concerned. The degree of the change depends under corresponding circumstances, largely, on the surrounding temperature. It is far less during the winter months than in April or May.

The main portion of both kinds of ensilage was fed to milch cows, in connection with an experiment to ascertain the feeding value of corn ensilage as compared with that of noted root crops. The results of this trial, which extend over a period of from five to six months, will be published in full in a succeeding BULLETIN.

391. ENSILAGE MADE FROM APPLE POMACE.

Amherst Mill.

	PER CENT.
Moisture at 100° C.,	85.33
Dry Matter,	14.67
ANALYSIS OF DRY MATTER.	
Crude Ash,	4.21
" Cellulose,	22.18
" Fat,	7.36
" Protein (nitrogenous matter),	8.22
Non-nitrogenous extract matter,	58.03
	100.00

The pomace which served for the preparation of the apple ensilage, was taken from a cider-mill near Amherst towards the close of October, 1885, and consisted of the clear press refuse, of a mixture of different kinds of apples. Two casks of a capacity of from fifty to sixty gallons each, were used for the experiment. They were painted inside with a black tar varnish to render them air and water tight. The pomace was stamped down solid, and subsequently covered with tar paper, which was held down by a layer of sand, several inches in thickness, and some large stones. The casks, thus filled, were kept in a corner on the barn floor until May 17th, '86, when they were opened to examine their contents. The material was found throughout apparently as fresh as when put up; neither mouldy, or rotten, or even discolored on its surface. It had a pleasant fruit-like acid odor and taste, and contained but traces of ammonia compounds. One hundred parts of the fresh apple ensilage required 0.744 parts of sodium hydroxide for the neutralization of its free organic acids, which prove thus to be less than in either kind of corn ensilage. The ensilage of apple pomace is highly relished by cows and swine, and is, if not superior, at least equal, pound for pound, in feeding value to the apple pomace, which served for its production. The nitrogenous constituents had increased, at the expense of the saccharine constituents; the latter had been destroyed at a higher rate by fermentation than the former.

392. CORN COB MEAL. (Corn and Cob).

Collected at a mill near Amherst, Mass., 1886.

	PER CENT.
Moisture at 100° C.,	9.45
Dry Matter,	90.55
	100.00

ANALYSIS OF DRY MATTER.

Crude Ash,	1.64
" Cellulose	6.32
" Fat,	5.19
" Protein (nitrogenous matter),	9.85
Non-nitrogenous extract matter,	77.00
	100.00

The composition of this article depends somewhat on the relative weight of cob and kernels; the former may vary from 14 to 18 per cent. in current varieties. See article "On different varieties of corn, etc." (Secy's Report of Mass. State Board of Agriculture, 1879—80, pages 222 to 254).

393. YELLOW SWEET CORN.

Raised on the fields of the Experiment Station, 1885.

Ears from five to seven inches in length, having eight rows of kernels.

Weight of an average ear,	70.16	grammes.	
" " kernels,	57.40	"	or 81.8 per cent.
" " cob,	12.76	"	or 18.2 " "
Average weight of a kernel,	0.232	"	

	PER CENT.
Moisture at 100° C.,	10.90
Dry Matter,	89.10
	100.00

ANALYSIS OF DRY MATTER.

Crude Ash,	2.16
" Cellulose,	2.58
" Fat,	4.25
" Protein (nitrogenous matter),	12.61
Non-nitrogenous extract matter,	78.40
	100.00

The article is somewhat deficient in fat, as compared with "Blue Mexican" or Crosby's.

394. RYE BRAN.

From Amherst Mill, 1886.

	Percentage Composition.	Constituents (in lbs.) in a ton of 2000 lbs.	Pounds digestible in a ton of 2000 lbs.	Per cent. of digestibility of constituents.	Nutritive Ratio.
Moisture at 100° C.,	8.18	163.60			
Dry Matter,	91.82	1836.40			
	100.00	2000.00			
ANALYSIS OF DRY MATTER.					1:5.45
Crude Ash,	3.43	68.60			
" Cellulose,	3.46	69.20	6.23	9.0	
" Fat,	3.03	60.60	34 85	57.5	
" Protein, (nitrogenous matter),	16.52	330.40	218.06	66.0	
Non-nitrogenous extract matter.	73.56	1471.20	1096.04	74.5	
	100.00	2000.00	1355.18		

The material has a fair composition. Recent observations by careful observers seem to indicate that it ought not to take the place of wheat bran in the dairy.

FERTILIZERS.

395. CONNECTICUT TOBACCO STEMS.

Sent on from South Deerfield, Mass.

		PER CENT.
Moisture at 100° C.		10.65
Phosphoric acid,	5 cts. per pound,	0.51
Potassium oxide,	$4\frac{1}{4}$ " " "	7.22

Calcium oxide,		3.39
Magnesium oxide,		1.12
Nitrogen,	17 cts. per pound,	2.65
Insoluble matter,		0.29
Valuation per 2000 lbs.,		$14.66

The composition of the above sample corresponds well with that noticed on previous occasions, (see I Annual Rep., page 103).

396. HAVANA TOBACCO STEMS.

Sent on from South Deerfield, Mass.

		PER CENT.
Moisture at 100° C.,		11.85
Phosphoric acid,	5 cts. per pound,	0.44
Potassium oxide,	$4\frac{1}{4}$ " " "	6.62
Calcium oxide,		3.45
Magnesium oxide,		1.11
Nitrogen,	17 cts. per pound,	0.90
Insoluble matter,		1.35
Valuation per 2000 lbs.,		$8.83

The amount of nitrogen in this sample of tobacco stems (Havana) is exceptionally low; about one third of that found in other samples offered for sale in our section of the Connecticut River valley (see II Annual Report, page 138). The difference in nitrogen causes the low valuation per ton, as compared with that of the preceding analysis (396). The sample was handed to us with the statement that it had been used for imparting the odor of Havana tobacco to other varieties of tobacco. The odor had been removed apparently by a steaming process; for the mineral constituents, with the exceptiom of the potassium oxide, correspond fairly with those in the material described in our II Annual Report. Farmers will do well to be careful in buying the article without stated guarantee of composition.

ASHES OF COTTON SEED HULLS.

397. Sent on for examination from South Deerfield, Mass.
398. Sent on from North Amherst, Mass.

	397.	*398.*
	Pounds per hundred.	
Moisture at 100° C.,	10.95	6.38
Phosphoric acid, 6 cts.	6.90	10.69
Calcium oxide,	5.76	13.34
Magnesium oxide,	9.15	not determined.
Potassium oxide, $5\frac{1}{2}$ cts.	25.34	24.16
Insoluble matter,	10.45	10.72
Valuation per 2000 lbs.,	$36.15	$39.41

There is evidently a considerable variation in the composition of this article. Direct communication from a well informed southern source accounts for this fact by stating that more or less seeds are not unfrequently mixed with the hulls when burned. An article which represents a high money value like the above material ought to be bought only on analysis.

399. FRESH HEN MANURE.

Sent on from Townshend, Mass.

	PER CENT.
Moisture at 100° C.,	45.73
Phosphoric acid, 6 cts.	0.47
Potassium oxide, $4\frac{1}{4}$ cts.	0.18
Calcium oxide,	0.97
Nitrogen total, 17 cts.	0.79
Insoluble matter, sand, etc.,	39.32

Valuation per 2000 lbs., $3.42

This sample of *fresh* hen manure came from the same party who sent on sample 387, Bulletin No. 20. It was inferior in quality as compared with the first material; for it contained for the same amount of organic matter, about twice as much worthless earthy matter. In a dry state, corresponding with the first sample, 8 per cent. of moisture, it would be worth only one-half the money, i. e. about five dollars per ton.

GERMAN HIGH GRADE SUPERPHOSPHATE.

400. Sent on from New York city, N. Y., by a Boston manufacturer of Fertilizers.

401. Sent on from Boston, Mass.

	400. *Pounds per hundred.*	*401.*
Moisture at 100° C.,	15.24	7.50
Total phosphoric acid,	45.54	43.24
Soluble " "	41.56	36.62
Reverted " "	3.58	5.67
Insoluble " "	0.40	0.95
Insoluble matter,	5.20	2.50
Valuation per 2000 pounds,	$78.47	$67.67

The material serves for the manufacture of high grades of "*Formula Fertilizers.*" The amount of sulphuric acid present in either sample did not exceed 3.5 per cent. This fact shows that the product is obtained by a different process than our ordinary superphosphates; it is most likely the isolated soluble portion of the latter, evaporated after its separation from the insoluble sulphate of lime, etc.

402. DRIED BLOOD.

Sent on for examination.

	PER CENT.
Moisture at 100° C.,	11.99
Nitrogen,	13.55

Valuation per 2000 lbs., $46.07

403. DISSOLVED BONEBLACK.

Sent on from South Deerfield, Mass.

	PER CENT.
Moisture at 100° C.,	20.43
Total Phosphoric acid,	16.14
Soluble " "	15.81
Reverted " "	0.18
Insoluble " "	0.15
Insoluble matter,	0.94
Valuation per 2000 lbs.,	$25.64

The article is a fair representative of its kind, its moisture is rather more than usual.

MURIATE OF POTASH.

404. Sent on from Northampton, Mass.
405. Sent on from Williamsburg, Mass.
406. Sent on from South Deerfield, Mass.

	404.	*405.*	*406.*
	Pounds per hundred.		
Moisture at 100° C.,	1.02	2.00	4.05
Potassium oxide,	50.09	54.45	45.94
Sodium oxide,	9.94	Not determined.	
Magnesium oxide,	0.63	"	"
Valuation per 2000 lbs.,	$42.58	$46.28	$39.05

The large amount of moisture in the last sample explains somewhat the lower percentage of potassium oxide. The principal admixture of salines in this brand of potash compounds consists of common salt, usually from 14 to 18 per cent.

407.—408. WOOD ASHES.

Sent on by So. Deerfield Farmers' Club.

	407.	*408.*
	Pounds per hundred.	
Moisture at 100° C.,	16.75	11.79
Phosphoric acid,	1.79	1.34
Calcium oxide,	32.28	34.62
Magnesium Oxide,	3.48	4.02
Potassium oxide,	1.80	6.68
Insoluble matter,	16.55	9.50

The first article is evidently a partly leached wood ash. The two samples differ mainly in regard to their relative amount of potash. This difference expressed in money value amounts to from 26 to 27 cents per hundred-weight of ashes, allowing 5.5 cents, per pound of potassium oxide in case of wood-ash.

C. A. GOESSMANN, *Director*,

AMHERST, MASS.

The Bulletins of the Experiment Station will be sent free of charge to all parties interested in its work, on application.

J. E. Williams, Printer, Amherst, Mass.

MASSACHUSETTS STATE

AGRICULTURAL EXPERIMENT STATION.

BULLETIN No. 22.

OCTOBER, 1886.

Meteorological Summary for the four months ending October 31, 1886.

	JULY.	AUGUST.	SEPTEMBER.	OCTOBER.
Highest temperature,	93.0°	90.0°	83.8°	77.9°
Lowest temperature,	41.0°	39.0°	31.6°	17.0°
Mean temperature,	68.8°	66.3°	59.5°	48.9°
Total rainfall,	3.82 in.	2.60 in.	5.48 in.	2.97 in.
Prevailing winds,	S.	S. to S.E.	S. to S.E.	N. to N.W.
No. of days on which 0.1 inches or more of rain fell,	8	10	11	8
No. of days on which cloudiness averaged 8 or more on scale of 10,	4	3	6	9

The warmest weather of the season occurred during the first part of July, the drouth at this time becoming moderately severe. Showers were frequent during the latter part of that month, and the rainfall quite copious. August was cool nearly the whole month, and the rainfall well distributed.

The first frost of the season occurred on low grounds, September 2d; the first one to injure farm crops, was on the 21st.

The rainfall during September was nearly double the average for that month during the past fifty years.

The most serious frost of the season occurred October 2d, 17° F.

Feeding Experiment with Milch Cows.

409. The feeding experiments described within a few subsequent pages were chiefly instituted for the purpose of studying the feeding value of dried corn fodder (stover) as a substitute for English hay, and of beet roots as compared with corn ensilage. The observations made in this connection extended over a period of nearly eight months—November, 1885 to July, 1886.

Two cows, crosses of native stock and Ayrshires and both from six to seven years old, served for the trial. They were in the same milking period, four weeks after calving at the beginning of the experiments. The changes in the daily diet, whenever decided upon, were made gradual to prevent any serious disturbance in the general condition of the animal on trial. As a rule from four to five and more days were allowed to pass by, in case of a change of feed, before a record of the daily yield of milk was made for the purpose of comparing the effect of different fodder rations.

The valuation of the various fodder articles consumed is based on our local market prices, per ton, at the time of their use: good English hay \$15, corn meal \$23, wheat bran \$20, dry corn fodder (stover) \$5, corn ensilage \$2.75, Lane's Improved Sugar beet \$5.

The daily diet of both cows consisted *at the beginning* of the experiments of three and one-quarter pounds of corn meal, an equal weight of wheat bran and all the hay they would eat. The actual amount of hay consumed, in each case, was ascertained by weighing out daily a liberal supply of it and deducting subsequently the hay left over. The same fodder mixture, as far as qualitity and quantity are concerned, was also used for some time as daily feed *at the close* of the experiment. This course was adopted for the purpose of ascertaining the natural shrinkage in daily yield of milk during the time engaged by the experiments (from seven to eight months). It amounted as may be noticed in the subsequent detailed record to nearly fifty per cent. of the original yield of milk.

The above stated combination of fodder articles was adopted as the basis of our investigation, mainly for the reason, that it had been used with satisfactory results in some of our earlier feeding experiments, and not on the assumption of being the best possible combination of fodder rations for milch cows.

The value of a fodder for dairy purposes may be stated from two distinctly different standpoints: 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 first cost, i. e., its physiological and its commercial value.

The judicious selection of ingredients for a suitable and remunerative diet for our dairy stock obliges us to study the value of the fodder articles at our disposal from both standpoints. The chemical analyses of the various articles used in the combination of fodder in our case have been stated in some succeeding pages to show the character and respective quality of the latter. 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 effect 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 farther argument to accept it as a matter of fact, that the efficiency of a fodder ration in the dairy does not depend 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 some prominent constituents of plants, which are known to be essential for a successful support of the life and 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, as the BULLETIN can only contain a condensed abstract of our work. 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 together with the analysis of the chemist, the results 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 also proved useful, for comparing different fodder rations, etc., to make known by a distinct record the relative proportion which has been noticed to exist, between the amount of nitrogenous constituents and the non nitrogenous organic constituents. This relation is expressed by the name of "Nutritive Ratio." An examination of the subsequent short description of our feeding experiments will show, for instance, that the corn meal, we fed, contained one part of digestible nitrogenous matter, to 8.76 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 "Nutrative Ration" of the corn meal is consequently stated as follows 1:8.76. Our different combinations of fodder articles to constitute the daily diet during different feeding periods vary as far as their nutritive ratios are concerned from 1:6.7 to 1:10.17. The closer relation (1:6.7) was obtained by an exceptionally large amount of roots, with hay and wheat bran without corn meal, and the wider relation (1:10.17) by feeding a liberal amount of corn ensilage with hay and corn meal without wheat bran. A closer relation of nitrogenous and non nitrogenous digestible constituents of an otherwise suitable fodder mixture is considered more necessary for growing animals and dairy cows than for full grown animals and moderately worked horses and oxen. German investigators recommend for dairy cows a diet, which conforms to a nutritive ration of 1:5.4. Arrangements will be made during the coming winter season to repeat our feeding experiment with essentially the same coarse fodder articles, but modified by a suitable increase and addition of concentrated feedstuffs to secure a daily diet of a closer nutritive ratio, than has been used on the present occasion.

An examination of the subsequent tabulated statement of the results of our experiments shows among other interesting facts, the marked influence of the feeding of dried corn fodder and of corn ensilage as a substitute for a part of the English hay, on the *cost* of the production of milk. Not less striking is the beneficial influence of a moderate amount of roots, as a substitute for a part of the hay, on the *quality* of milk. A numerical expression of the influence of the yield of milk in case of different cows, as well as at different milking periods of the same cow under the same system of feeding, on the cost of its production may not be without some interest, when entering upon a serious discussion of the question, What kind of cows ought to be removed from our dairy stock in the interest of good economy?

RECORD OF DAISY.

FEEDING PERIODS.	Feed consumed (lbs.) per day.						Amount of Dry Vegetable Matter contained in the daily Fodder consumed, in lbs.	Quarts of Milk produced per day.	Pounds of Dry Matter per quart of milk.	Nutritive Ratio.	Weight of Animal.
	Wheat Shorts.	Corn Meal.	Corn Fodder (stover).	Hay.	Corn Ensilage.	Roots.					
1885.											
Nov. 20—Dec. 7,	3.25	3.25		20.00			24.06	16.3	1.48	1:8.2	910
Dec. 19-29,	3.25	3.25	8.00	10.00			21.64	15.4	1.45	1:7.9	895
1886.											
Jan. 3-22,	3.25	3.25	12.00	5.00			20.41	14.2	1.44	1:7.72	850
Feb. 1-17,	3.25	3.25		15.00		27.00	23.91	14.2	1.68	1:7.1	845
" 17-28,	3.25			15.00		27.00	21.06	13.2	1.60	1:6.9	850
March 1-8,	3.25			15.00		40.00	23.18	13.3	1.74	1:6.7	873
" 12-22	3.25	3.25		15.00		27.00	23.89	14.2	1.68	1:7.1	860
" 25—Apr. 13,	3.25	3.25		14.60	20.63		23.73	12.8	1.85	1:8.14	870
April 18—May 6,	3.25	3.25		10.00	29.71		21.51	11.0	1.91	1:8.15	865
May 20-31,		3.25		5.00	41.75		16.83	9.2	1.83	1:10.17	830
June 4-14,	3.25			5.00	41.36		16.76	8.9	1.88	1:8.29	855
" 26—July 4,	3.25	3.25		20.00			24.04	8.4	2.86	1:8.2	840

RECORD OF MOLLIE.

FEEDING PERIODS.	Feed consumed (lbs.) per day.						Amount of Dry Vegetable Matter contained in the daily fodder consumed, in lbs.	Quarts of Milk produced per day.	Pounds of Dry Matter per quart of milk.	Nutritive Ratio.	Weight of Animal.
	Wheat Shorts.	Corn Meal.	Corn Fodder (stover).	Hay.	Corn Ensilage.	Roots.					
1885.											
Nov. 20—Dec. 7,	3.25	3.25		20.00			24.06	12.62	1.93	1:8.2	882
Dec. 19-29,	3.25	3.25	8.00	10.00			21.64	11.86	1.82	1:7.9	885
1886.											
Jan. 3-22,	3.25	3.25	13.55	5.00			21.75	13.87	1.56	1:7.87	845
Feb. 1-17,	3.25	3.25		15.00		27.00	23.91	11.16	2.14	1:7.1	868
" 17-28,	3.25			15.00		27.00	21.06	13.2	1.60	1:6.9	910
March 1-8,	3.25			15.00		40.00	23.18	10.6	2.19	1:6.7	895
" 12-22,	3.25	3.25		15.00		27.00	23.89	11.1	2.15	1:7.1	905
" 25—April 13,	3.25	3.25		14.20	22.27		23.74	11.2	2.12	1:8.17	921
April 18—May 6,	3.25	3.25		10.00	29.82		21.58	10.6	2.04	1:8.15	899
May 20-31,		3.25		5.00	36.83		16.64	8.9	1.87	1:10.9	850
June 4-14,	3.25			5.00	44.63		16.59	9.1	1.82	1:8.25	852
" 26—July 4,	3.25	3.25		20.00			24.04	8.6	2.80	1:8.2	830

COST OF FEED PER QUART OF MILK.

FEEDING PERIODS.	1885. Nov. 20—Dec. 7.	Dec. 19—29.	1886. Jan. 3—22.	Feb. 1—17.	Feb. 17—28.	March 1—8.	March 12—22.	March 25—April 13.	April 18—May 6.	May 20—31.	June 4—14.	June 26—July 4.
Daisy, - -	1.35c	1.07c	.97c	1.76c	1.60c	1.84c	1.76c	1.61c	1.67c	1.37c	1.39c	2.64c
Mollie, - -	1.74	1.39	1.02	2.24	1.99	2.32	2.25	1.84	1.83	1.37	1.33	2.51

ANALYSES OF MILK.

DAISY.

	1885. Nov. 25.	Dec. 15.	1886. Jan. 6.	Feb. 18.	Feb. 25.	March 4.	March 18.	April 19.	May 14.	May 29.	June 15.	June 21.
Water, - - - - - -	87.56	87.65	88.08	86.18	86.62	86.78	85.81	85.97	87.02	87.10	86.75	87.59
Solids, - - - - - -	12.44	12.35	11.92	13.82	13.38	13.22	14.19	14.03	12.98	12.90	13.25	12.41
Fat (in solids), - - -	3.28	3.56	2.29	4.58	4.30	4.30	4.54	4.93	4.05	4.20	4.62	3.79

MOLLIE.

	1885. Nov. 25.	Dec. 15.	1886. Jan. 6.	Feb. 18.	Feb. 25.	March 4.	March 18.	April 19.	May 14.	May 29.	June 15.	June 21.
Water, - - - - - -	87.16	87.35	87.67	86.35	87.04	87.06	86.61	86.33	87.30	87.25	86.50	87.26
Solids, - - - - - -	12.84	12.65	12.33	13.65	12.96	13.94	13.39	13.67	12.70	12.75	13.50	12.74
Fat (in solids), - - -	3.82	3.59	3.73	4.28	3.74	4.75	4.03	4.51	3.96	4.24	4.36	3.68

CORN FODDER (STOVER).

From the Experiment Station, 1885.

	Percentage Composition.	Constituents (in lbs.) in a ton of 2000 lbs.	Pounds digestible in a ton of 2000 lbs.	Per cent. of digestibility of constituents.	Nutritive Ratio.
Moisture at 100° C.,	15.40	308.0			
Dry Matter,	84.60	1692.0			
	100.00	2000.00			
ANALYSIS OF DRY MATTER.					1 : 9.3
Crude Ash,	4.22	84.4			
" Cellulose,	20.93	418.6	301.39	72	
" Fat,	2.63	52.6	39.45	75	
" Protein, (nitrogenous matter),	9.17	183.4	133.88	73	
Non-nitrogenous extract matter,	63.05	1261.0	844.87	67	
	100.00	2000.00	1319.59		

The corn fodder was raised under the same conditions, as far as the soil and the fertilizers used were concerned, as the corn for the silos. The same variety of corn, Clark, was planted in both instances.

CORN ENSILAGE.

From the Silos of the Experiment Station (1885—1886).

	Percentage Composition.	Constituents (in lbs.) in a ton of 2000 lbs.	Pounds digestible in a ton of 2000 lbs.	Per cent. of digestibility of constituents.	Nutritive Ratio.
Moisture at 100° C.,	77.48	1549.60			
Dry Matter,	22.52	450.40			
	100.00	2000.00			
ANALYSIS OF DRY MATTER.					1 : 11.3
Crude Ash,	4.19	83.80			
" Cellulose,	19.08	381.60	274.68	72	
" Fat,	3.49	69.80	52.42	75	
" Protein, (nitrogenous matter),	7.82	156.40	114.17	73	
Non-nitrogenous extract matter,	65.42	1308.40	876.63	67	
	100.00	2000.00	1317.90		

The above analysis represents the mean composition of the ensilage obtained from the silos described in previous BULLETINS. The contents of the different silos were fed in direct succession, beginning with the one which had been filled slowly. The corn was about six months in the silos when the feeding of the ensilage commenced.

LANE'S IMPROVED SUGAR BEET.

From Experiment Station, 1885.

	Percentage Composition.	Constituents (in lbs.) in a ton of 2000 lbs.	Pounds digestible in a ton of 2000 lbs.	Per cent. of digestibility of constituents.	Nutritive Ratio.
Moisture at 100° C.	83.57	1671.40			
Dry Matter,	16.43	328.60			
	100.00	2000.00			
ANALYSIS OF DRY MATTER.					1 : 5.86
Crude Ash,	3.57	71.4			
" Cellulose,	5.27	105.4	105.4	100	
" Fat,	0.83	16.6	16.6	100	
" Protein (nitrogenous matter),	17.44	348.8	261.6	75	
Non-nitrogenous extract matter,	72.89	1457.8	1384.9	95	
	100.00	2000.00	1768.5		

The roots were raised on a soil in good condition, and were of a good quality.

HAY.

Experiment Station, 1885.

	Percentage Composition.	Constituents (in lbs.) in a ton of 2000 lbs.	Pounds digestible in a ton of 2000 lbs.	Per cent. of digestibility of constituents.	Nutritive Ratio.
Moisture at 100° C.,	8.30	166.00			
Dry Matter,	91.70	1834.00			
	100.00	2000.00			
ANALYSIS OF DRY MATTER.					1 : 9.5
Crude Ash,	6.12	122.4			
" Cellulose,	30.19	603.8	350.20	58	
" Fat,	2.55	51.0	23.46	46	
" Protein, (nitrogenous matter),	9.75	195.0	111.15	57	
Non-nitrogenous extract matter,	51.39	1027.8	647.51	63	
	100.00	2000.00	1132.32		

The hay consisted largely of Herds-grass (Timothy), and Red-top, with a fair admixture of clover.

WHEAT BRAN.

Amherst mill, 1885.

81.93 per cent. passed through mesh 111 to square inch.

	Percentage Composition.	Constituents (in lbs.) in a ton of 2000 lbs.	Pounds digestible in a ton of 2000 lbs.	Per cent. of digestibility of constituents.	Nutritive Ratio.
Moisture at 100° C.,	12.05	241.00			
Dry Matter,	87.95	1759.00			
	100.00	2000.00			
ANALYLSIS OF DRY MATTER.					1 : 3.77
Crude Ash,	6.64	132.80			
" Cellulose.	11.49	229.80	45.96	20	
" Fat,	4.75	95.00	76.00	80	
" Protein, (nitrogenous matter),	17.86	357.20	314.34	88	
Non-nitrogenous extract matter,	59.26	1185.20	948.16	80	
	100.00	2000.00	1384.46		

The above analysis represents the average quality of the wheat bran fed during the time of the experiment.

CORN MEAL.

Amherst mill, 1885.

	Percentage Composition.	Constituents (in lbs.) in a ton of 2000 lbs.	Pounds digestible in a ton of 2000 lbs.	Per cent. of digestibility of constituents.	Nutritive Ratio.
Moisture at 100° C.,	12.62	252.40			
Dry Matter,	87.38	1747.60			
	100.00	2000.00			
ANALYSIS OF DRY MATTER.					1 : 8.76
Crude Ash,	1.56	31.20			
" Cellulose,	2.66	53.20	18.09	34	
" Fat,	4.27	85.40	64.90	76	
" Protein, (nitrogenous matter),	11.43	228.60	194.31	85	
Non-nitrogenous extract matter,	80.08	1601.60	1505.50	94	
	100.00	2000.00	1782.80		

Fodder and Fodder Analyses.

410. CORN REFUSE FROM STARCH FACTORY.

Sent on from New Bedford, Mass.

	PER CENT.
Moisture at 100° C.,	57.04
Dry Matter,	42.96
	100.00

ANALYSIS OF DRY MATTER.

Crude Ash,	.90
" Cellulose,	7.54
" Fat,	10.17
" Protein (nitrogenous matter),	22.41
Non-nitrogenous extract matter,	58.98
	100.00

The above named material, which furnished the sample sent on for an examination, had been bought of a corn starch factory at Long Island, N. Y., for feeding cattle. Forty tons had been landed at New Bedford, at $8.00 per ton, of forty bushels. Some doubts had been expressed in regard to its fitness as a feed for milch cows.

The sample we received, was apparently in a fair state of preservation, and consisted mainly of a soft yellowish white mass, interspersed with coarse fragments of the skin of the corn. The entire mass in an air dried state was quite soft and friable, and of a peculiar vegetable, yet not offensive odor.

The composition of the vegetable matter contained in the article, is that of a valuable ingredient for the compounding of a suitable diet for various kinds of farm live stock, and in some respects similar to that of the refuse grain from breweries. The main objectionable feature of the fresh factory refuse consists in the presence of a large amount of moisture, and its liability to suffer a rapid and serious deterioration in consequence of a careless keeping in particular during the warmer seasons of the year. Two modes of treatment for the preservation of fodder articles, like the one here under discussion suggest themselves in this connection,—the silo system or the drying apparatus. The above described corn starch factory refuse, in its dried state, could command a price from $16 to $18 per ton in our fodder market.

The fitness of this class of refuse material from glucose and starch factories, as well as that from brewers' grain, as *an ingredient* of a daily fodder ration for all kinds of farm live stock, the dairy cow included, is quite generally conceded, provided they are in a fair state of preservation. Excessive and exclusive feeding of many fodder articles is an objectionable practice; this applies as much to corn ensilage, roots, apples, as to the waste products of the factories above enumerated.

All fodder articles of a perishable character deserve the serious attention of farmers, for they are apt to become objectionable sooner or later, if carelessly kept. In an advanced state of fermentation they are decidedly objectionable for various reasons; they may become even poisonous in consequence of their liability to turn into hot beds of a dangerous parasitic growth. Musty corn meal, oil cakes, etc., are known to have been the direct cause of the death of cows.

411. "SELF-HUSKING" CORN.

Experiment Station, 1885.

Ears eight inches in circumference; and eight to ten inches long. Kernels of a reddish, or brownish red color.

Weight of an average ear, 142.7 grammes; consisting of 88.08 per cent. kernels; and 11.92 per cent. cob. Average weight of a single kernel, .37 grammes.

	PER CENT.
Moisture at 100° C.,	12.10
Dry Matter,	87.90
	100.00

ANALYSIS OF DRY MATTER.

Crude Ash,	1.74
" Cellulose,	2.52
" Fat,	5.44
" Protein (nitrogenous matter),	12.47
Non-nitrogenous extract matter,	77.83
	100.00

412. SWEET APPLE POMACE.

Sent on for examination from Prescott, Mass, 1885.

	PER CENT.
Moisture at 100° C.,	77.87
Dry Matter,	22.13
	100.80

ANALYSIS OF DRY MATTER.

Crude Ash,	1.96
" Cellulose,	8.82
" Fat,	3.16
" Protein (nitrogenous matter),	6.70
Non-nitrogenous extract matter,	79.36
	100.00

C. A. GOESSMANN, *Director*,
AMHERST, MASS.

The Bulletins of the Experiment Station will be sent free of charge to all parties interested in its work, on application.

J. E. Williams, Printer, Amherst, Mass.

MASSACHUSETTS STATE AGRICULTURAL EXPERIMENT STATION.

BULLETIN No. 23.

MARCH, 1887.

Meteorological Summary for the four months ending February 28, 1887.

	Nov.	Dec.	Jan.	Feb.
Highest temperature,	65.5°	49.0°	47.2°	43.8°
Lowest temperature,	15.9°	0.8°	—22.2°	—3.8°
Mean temperature,	38.3°	23.0°	19.4°	24.2°
Total precipitation,	5.25 in.	3.61 in.	4.57 in.	5.05in.
Total snowfall,	1.00 in.	16.00 in.	29.50 in.	22.50in.
Prevailing winds,	W.	N.	N. W.	N. W.
No. of days on which cloudiness averaged 8 or more on scale of 10,	8	11	8	8
No. of days on which 0.1 of an inch or more of water from rain or melted snow fell,	10	16	14	15

November was mild throughout and the rainfall unusually heavy. The ground was free from snow or frost at the close of the month. The mean temperature for December was 3.6° and that of January 3.9°, lower than the average for the past fifty years. The snow-fall during January was exceptionally great amounting to 29.0 inches between the 12th and 18th. Storms were frequent during February increasing the total snowfall to 69.0 inches for the four months above stated.

The publication of Bulletins for the present year begins with this number. Copies will be sent to all parties already on our distributing list—without awaiting a special notice. Provisions are made to meet new applications. The supply of BULLETINS No. 1 to 16. and No. 20 and of the second and third annual reports is exhausted, while of BULLETINS Nos. 16. 17, 18, 19, 21, and 22, and of the first annual report there are still a limited number on hand for distribution. The fourth annual report is ready for distribution and will be mailed without delay.

Arrangements are made 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 on to "The Experiment Station" must have express and postal charges prepaid, to receive attention.

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 our valuation, are once more stated, within a few subsequent pages.

The valuation of a fertilizer is based on the average trade value of the 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. 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, as salt, wood ashes, various kinds of lime, barnyard manure, factory refuse and waste materials of different description, does, quite frequently, not stand in a close relation to their chemical composition. 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 wholesale market price of manurial substances is liable to serious fluctations: 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 have only in exceptional instances, a desirable chance to inform themselves regarding the conditions which control the market price, the assistance rendered in this direction, by Agricultural chemists charged with the examination of commercial fertilizers, cannot otherwise but benefit, ultimately both farmers and manufacturers.

The market reports of centres of trade in New England, New York and New Jersey, aside from consultations with leading manufacturers of fertilizers furnish us 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, 1887, and increasing them by 20 per cent., to cover expenses for sales, credits, etc.

These trade values, except those for phosphoric acid, soluble in ammonium-citrate, were agreed upon by the Experiment Stations of Massachusetts, Connecticut and New Jersey for use in their several states for the present season.

TRADE VALUES OF FERTILIZING INGREDIENTS IN RAW MATERIALS AND CHEMICALS.

	1887. *Cents per Pound.*
Nitrogen in nitrates,	16
" " ammoniates,	17½
Organic nitrogen in dried and fine ground fish,	17½
" " Peruvian guano, blood, meat, azotin, ammonite and castor pomace,	17½

organic nitrogen in fine ground bone and tankage.	16
" " " medium bone. "	14
" " in medium bone. "	12
" " in coarse medium bone. "	10
" " in coarse bone, horn shavings, hair and fish scraps.	8
Phosphoric acid soluble in water.	8
" " " ammonia citrate,*	7½
" " insoluble, in dry fine ground fish, in fine bone, tankage	7
Phosphoric acid insoluble in fine medium bone and tankage,	6
" " " in medium bone, "	5
" " " in coarse medium bone. "	4
" " " in coarse bone, "	3
" " " in fine ground rock phosphate.	2
Potash as sulphate in compounds free from chlorine.	5½
" " Kainite.	4¼
" " Muriate.	4¼

The above trade values are the figures at which on March 1st, the respective ingredients could be bought at retail *for cash* per pound in our *leading 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 1st, plus 20 per cent. in case of goods for which we have wholesale quotations. The calculated values obtained by the use of the above figures will be found to agree fairly with the reasonable retail price in case of standard raw material such as:

Sulphate of Ammonia.	Dry Ground Fish.
Nitrate of Soda,	Azotin.
Muriate of Potash.	Ammonite,
Sulphate of Potash.	Castor Pomace.
Dried Blood,	Bone,
Dried Ground Meat.	Plain Superphosphates.

*Dissolved from two grams of Phosphate unground, by 100 C. C. neutral solution of ammonium citrate, sp. gr. 1.09 in 30 minutes at 65 deg. C., with agitation once in five minutes: commonly called "reverted" or "backgone" phosphoric acid.

TRADE VALUES IN SUPERPHOSPHATES, SPECIAL MANURES AND MIXED FERTILIZERS OF HIGH GRADE.

The organic nitrogen in these classes of goods will be valued at the highest figure laid down in the Trade Values of Fertilizing Ingredients in Raw Materials, namely 17.5 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.

Insoluble Phosphoric acid will be valued at 3 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 2 cents per pound. Potash is rated at $4\frac{1}{4}$ cents, if sufficient chlorine is present in the fertilizer to combine with it to make muriate. If there is more Potash present than will combine with the chlorine, then this excess of Potash will be counted as sulphate. To introduce large quantities of chlorides, common salt, etc., into fertilizer, claiming sulphate of potash as a constituent, is a practice, which in our present state of information will be considered of doubtful merit. The use of the *highest trade* values is based on the opinion that these articles ought to contain the most efficient forms of fertilizing ingredients.

In most cases the valuation of the ingredients in Surperphosphates and Specials falls below the retail price of these goods. The difference between the two figures, represents the manufacturer's charges for converting raw materials into manufactured articles. These charges are for grinding and mixing, bagging or barreling, storage and transportation, commission to agents and dealers, long credits, interest on investment, bad debts, and finally profits.

Local disadvantages for transportion, exert not unfrequently a serious influence on the cost of one and the same brand of fertilizers. Binding rules cannot be laid down regarding these points. Farmers must judge for themselves whether the differences between our valuation and the prices asked for is a fair one, considering local condition of supply.

The prices stated in these bulletins in connection with analyses of commercial fertilizers refer to their cost per ton of 2,000 pounds, on board of car or boat near the factory, or place for general distribution. *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.

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 fertilizer, although equally pure, may differ from 50 to 100 per cent. in commercial value, on account of mere difference in moisture.

Crude stock for the manufacture of fertilizers, and *refuse material* 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 the 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 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 responsibilty of the dealer ends with furnishing an article, corresponding in its composition with the *lowest* stated quantity, of each specified essential constituent.

413. COTTON SEED HULL ASHES.

Sent on from Northampton, Mass.

	I.	II.	III.	IV.
		Per Cent.		
Moisture,	7.43	7.77	7.30	8.23
Phosphoric acid, (6 cts. per pound).	5.21	9.68	9.59	11.19
Magnesium oxide,	10.11	14.48	14.81	16.71
Calcium oxide.	6.71	18 42	12.23	12.43
Potassium oxide. (5½ cts. per pound).	25.76	17.34	19.15	24.91
Insoluble matter (before calcination).	12.36	11.30	10.88	7.34
Insoluble matter (after calcination),	12.18	6.34	8.86	5.18
Valuation per 2000 lbs.,	$36.78	$30.70	$32.70	$40.83

These samples show the variations which have been noticed toward the close of the past year in the composition of this valuable ash. The results are reported at the *present time* to caution farmers. Cotton Seed Hull Ashes ought to be sold only on the basis of a guaranteed composition. The sale of this article is at present, as far as our supply is concerned, in the hands of a few parties in New York city, a circumstance which renders a greater uniformity of composition possible. A better supervision regarding their general character in that direction, can only benefit dealers and consumers.

414.—415. DOUBLE MANURE SALT.

Sent on from New York. W. A. Peters & Co.

	414.	415.
	Per Cent.	
Moisture,	11.58	6.58
Magnesium oxide.	10.81	11.50
Sodium Oxide,	3.16	4.16
Potassium oxide, (5½ cts. per pound),	22.40	23.28
Sulphuric acid,	39.89	43.43
Chlorine,	0.14	1.08
Insoluble matter,	0.26	1.80
Calcium oxide.	——	2.93
Valuation per 2000 lbs.,	$24.64	$25.61

Number one was in a crystallized form, and number two in a fine pulverized state. The latter has been of late introduced into our markets. The article deserves particular attention, on account of the almost entire absence of chlorine; and of the presence of a liberal amount of sulphate of magnesia (from 33 to 35 per cent. of kieserite), which favors a rapid diffusion of the potash throughout the soil, besides supplying an important additional article of plant food.

416. FELT FACTORY WASTE.

Sent on from Lowell, Mass.

	Per Cent.
Moisture at 100° C.,	39.24
Organic and volatile matter.	66.47
Ash,	33.53
Nitrogen, 8 cts. per pound.	5.26
Insoluble matter,	8.44

Valuation per ton of 2000 lbs., $8.42.

The principal part of the ash consisted of carbonate of lime. The material ought to be composted before being incorporate, into the soil. For use in stables as an absorbent, it deserves commendation.

417. AMMONITE.

Sent on from Southampton, Mass.

	Per cent.
Moisture at 100° C.,	6.17
Ash,	9.56
Nitrogen, 17½ cts. per pound.	12.20
Phosphoric acid, 6 cts. per pound,	3.40
Insoluble matter,	0.22

Valuation per 2000 lbs., $47.50.

The material was in a fine mechanical condition, and thus in a favorable form for speedy disintegration.

418. GROUND ROCK PHOSPHATE.

Sent on from West Springfield, Mass.

	Per cent.
Moisture at 100° C.,	0.10
Total Phosphoric acid.	30.51
Soluble " "	none.
Reverted. " "	0.19
Insoluble. " " 2 cts. per pound,	30.31
Magnesium oxide,	3.03
Calcium oxide,	41.87
Ferric and Aluminum oxide,	4.26
Insoluble siliceous matter,	13.74

The material is of but little value for manurial purposes, without a previous treatment with sulphuric acid to render its phosphoric acid available.

419. MUCK.

Sent on from Peabody, Mass.

	Per cent.
Moisture at 100° C.,	89.89
Dry Matter,	10.11
Ash in fresh muck,	3.05
Nitrogen in fresh muck,	.26

The ash contained a considerable proportion of lime and magnesia compounds. The material is a fair specimen of its kind.

Fodder and Fodder Analyses.

420. ROCK SALT

From the Retsof Salt Mines at Piffard, Livingston Co., New York. Sent on from Springfield, Mass.

	Per cent.
Moisture at 100° C.,	2.60
Calcium Sulphate,	0.42
Calcium Chloride,	0.33
Magnesium Chloride,	0.01
Sodium Chloride,	95.94
Insoluble matter,	0.70
	100.00

This article has been of late introduced into our market in lump form to take the place of the English lump salt for stock feeding. The sample sent on for examination was of a very fair quality and compared very favorably with the former. Its selling price at Springfield, Mass., is stated: from 5 to 10 pounds at 1½ cts. per pound; 100 pounds at 75 cts.; wholesale, per ton of 2000 pounds, at $8.50, and in carloads one dollar less per ton.

421. PEA MEAL.

Sent on from Springfield, Mass.

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

	Percentage Composition.	Constituents (in lbs.) in a ton of 2000 lbs.	Pounds digestible in a ton of 2000 lbs.	Per cent. of digestibility of constituents.	Nutritive Ratio.
Moisture at 100° C.,	8.85	177.00			
Dry Matter,	91.15	1823.00			
	100.00	2000.00			
ANALYSIS OF DRY MATTER.					1 : 2.98
Crude Ash,	2.94	58.80			
" Cellulose,	19.42	388.40			
" Fat,	1.67	33.40	26.72	80	
" Protein, (nitrogenous matter),	20.95	419.00	368.72	88	
Non-nitrogenous extract matter,	55.02	1100.40	1034.38	94	
	100.00	2000.00	1429.82		

The above material comes from parties engaged in the manufacture of split peas. It is evidently a mixture of ground peas with a liberal admixture of ground skins of peas. The article is offered in Springfield at $20 per ton. The well known highly nutritious quality of the peas renders a trial advisable.

Analysis of Pea Meal with reference to its Fertilizing Constituents.

	Per cent.
Moisture at 100° C.,	8.850
Ferric oxide,	0.027
Phosphoric acid, 6 cts. per pound,	0.823
Magnesium oxide,	0.302
Calcium oxide,	0.302
Potassium oxide, $4\frac{1}{4}$ cts. per pound,	0.993
Sodium oxide,	0.618
Nitrogen, 17 cts. per pound,	3.080
Insoluble matter,	0.122
Valuation per 2000 lbs., $12.31	

422. CHICAGO GLUTEN MEAL.

Wilder & Puffer, Springfield, Mass.

96.81 per cent. passed through Mesh 144 to square inch.

	Percentage Composition.	Constituents (in lbs.) in a ton of 2000 lbs.	Pounds digestible in a ton of 2000 lbs.	Per cent. of digestibility of constituents.	Nutritive Ratio.
Moisture at 100° C.,	8.83	176.60			
Dry Matter,	91.17	1823.40			
	100.00	2000.00			
ANALYSIS OF DRY MATTER.					1 : 2.67
Crude Ash,	0.73	14.60			
" Cellulose,	0.79	15.80	5.37	34	
" Fat,	8.46	169.20	128.59	76	
" Protein, (nitrogenous matter),	31.43	628.60	534.31	85	
Non-nitrogenous extract matter,	58.59	1171.80	1101.49	94	
	100.00	2000.00	1739.76		

The material is sold at Springfield, Mass., at $23.20 per ton. The results of feeding experiments with milch cows and pigs will be described in one of our early bulletins.

Analysis of Gluten Meal with reference to Fertilizing Constituents.

		Per Cent.
Moisture at 100° C.,		8.830
Phosphoric acid, 6 cts. per pound,		.295
Ferric oxide,		.048
Magnesium oxide,		.026
Calcium oxide,		.036
Potassium oxide, $4\frac{1}{4}$ cts. per pound,		.034
Sodium oxide,		.018
Nitrogen, 17 cts. per pound,		4.620
Valuation per 2000 lbs.,	$16.15	

423. WHEAT BRAN. 1886.

(Fine ground.)

94.95 per cent. passed through Mesh 144 to square inch.

	Percentage Composition.	Constituents (in lbs.) in a ton of 2000 lbs.	Pounds digestible in a ton of 2000 lbs.	Per cent. of digestibility of constituents.	Nutritive Ratio.
Moisture at 100° C.	12.20	244.00			
Dry Matter,	87.80	1756.00			
	100.00	2000.00			
ANALYSIS OF DRY MATTER.					1:3.16
Crude Ash,	7.33	146.60			
" Cellulose,	10.92	218.40	43.68	20	
" Fat,	2.80	56.00	44.80	80	
" Protein (nitrogenous matter),	19.79	395.80	348.30	88	
Non-nitrogenous extract matter,	59.16	1183.20	946.56	80	
	100.00	2000.00	1383.34		

Analysis of Wheat Bran with reference to its Fertilizing Constituents.

		Per Cent.
Moisture at 100° C.,		9.540
Phosphoric acid, 6 cts. per pound,		1.890
Magnesium oxide,		0.544
Calcium oxide,		0.142
Potassium oxide, $4\frac{1}{4}$ cts. per pound,		1.090
Sodium oxide,		0.064
Nitrogen, 17 cts. per pound,		2.830
Insoluble matter,		0.640
Valuation per 2000 lbs.,	$12.82.	

424. WHEAT BRAN. 1887.

(Fine ground.)

99.51 per cent. passed through Mesh 144 to square inch.

	Percentage Composition.	Constituents (in lbs.) in a ton of 2000 lbs.	Pounds digestible in a ton of 2000 lbs.	Per cent. of digestibility of constituents.	Nutritive Ratio.
Moisture at 100° C.,	9.54	190 80			
Dry Matter,	90.46	1809.20			
	100.00	2000.00			
ANALYSIS OF DRY MATTER.					
Crude Ash,	4.47	89.40			1 : 4.07
" Cellulose,	5.64	112.80	22.56	20	
" Fat,	6 00	120 00	96.00	80	
" Protein, (nitrogenous matter),	19.45	389.00	342 32	88	
Non-nitrogenous extract matter,	64.44	1288.80	1031.04	80	
	100.00	2000.00	1491 92		

Analysis of Wheat Bran with reference to Fertilizing Constituents.

	Per Cent.
Moisture at 100° C.,	12.20
Phosphoric acid, 6 cts. per pound.	2.84
Ferric oxide,	.02
Magnesium oxide,	.91
Calcium oxide,	.14
Potassium oxide, $4\frac{1}{4}$ cts. per pound,	1.62
Sodium oxide,	.09
Nitrogen, 17 cts. per pound,	2.78
Insoluble matter,	.13

Valuation per 2000 lbs., $14.24.

C. A. GOESSMANN, *Director*,
AMHERST, MASS.

The Bulletins of the Experiment Station will be sent free of charge to all parties interested in its work, on application.

J. E. Williams, Printer, Amherst, Mass.

MASSACHUSETTS STATE

AGRICULTURAL EXPERIMENT STATION.

BULLETIN No. 24.

APRIL, 1887.

Meteorological Summary for the month ending March 31, 1887.

Highest temperature,	46°
Lowest temperature,	—2.4°
Mean temperature,	26.4°
Total precipitation,	4.65 in.
Total snowfall,	14.50 in.
Prevailing winds,	N. W.
No. of days on which cloudiness averaged 8 or more on scale of 10,	6
No. of days on which 0.1 of an inch or more of water from rain or melted snow fell,	13

Suggestions upon Planting Trees and Small Fruits.

425. The time for planting trees and small fruits is fast approaching, and a few suggestions on the subject are here offered, hoping that they may aid the inexperienced in the work, and serve as a reminder to those who may understand full well what is required for success, but from pressure of other work, neglect to provide all the necessary conditions of success.

CONDITIONS.

The most important points to be considered in successful planting are :

1st. Selection of trees and plants.
2d. Preparation of the trees and plants.
3d. Soil and its preparation.
4th. Methods of planting.
5th. After care and cultivation.

SELECTION OF TREES AND PLANTING.

Successful planting depends very largely upon the condition of the trees or plants at the time of planting. The best results are generally obtained, *other things being equal*, when the trees or plants are obtained from local nurseries, and planted with little or no exposure to the drying influence of the sun and air. The merits of Massachusetts grown trees as compared with those grown in the extensive nurseries in distant states are often discussed, and the latter condemned for New England planting. While in many of the above mentioned nurseries, owing to long experience, especial skill and a soil naturally suited to the best growth, very fine trees are grown, perhaps better than are generally grown in small local nurseries, yet the danger from injury in transporting so great a distance and the length of time from the digging to transplanting, will make it generally safer to depend upon home grown trees where they can be obtained.

Great care must be exercised in digging, and if large quantities are to be dug at once, as soon as a few are dug the roots should be protected by mats or blankets, or have soil thrown over them until all are to be packed for transporting or taken to the field for planting. In packing for shipping, no material is so good to keep the roots moist and prevent their heating as clean sphagnum moss; for short distances moist straw or hay may answer very well for this purpose.

Vigorous young plants are much better than those that have been a very long time in growing to suitable size. The average age for fruit trees and plants in the best condition for transplanting is about as follows: Apple, 3 years from bud; Pear, 3 years from bud; Peach, 1 year from bud; Plum, 2 years from bud; Cherry, 2 years from bud; Quince, 3 years from cuttings or root graft; Grape, 1 year No. 1, or 2 years No. 1, from cuttings or layers; Currant, 2 years from cuttings; Gooseberries, 2 years from cuttings; Raspberries and Blackberries, 1 year from suckers or root cuttings; Strawberries, only new runners of last season's growth should be used: the old plants having black roots with the feeding surfaces so far from the crown that when they are dug nearly all of them are destroyed.

PREPARATION OF TREES AND PLANTS FOR PLANTING.

It is impossible to remove a tree from the nursery to the orchard without injuring many of the larger roots, while nearly all the rootlets and all of the root hairs will be destroyed by only a slight exposure to the air. As there are no feeding roots on the newly transplanted tree until new ones are formed, if none of the buds or shoots are removed, the supply of moisture being insufficient, all make a very feeble growth or fail to develop at all, especially if a drought comes on early in the summer. To prevent this injury and ensure a vigorous starting of a few buds, the top should be cut back in proportion to the amount of injury to the roots, which will generally be from $\frac{1}{2}$ to $\frac{2}{3}$ of the entire top. In this pruning all shoots should be cut entirely away that are not needed for the formation of a perfect head, and the others cut back $\frac{1}{2}$ or $\frac{2}{3}$ of their length.

If the head is not formed high enough upon the trunk it may often be carried higher by cutting off *all* lateral shoots, leaving the most central one for a leader upon which will be formed the new head several inches higher than the first. This may be still further carried up by pinching the ends of the lowest laterals to force the growth into the higher ones. Thus in a single season the head may be carried from one to two feet higher than it was when received from the nursery. All injured roots should have the ends cut smooth with a sharp knife, and with small fruits like the grape, currant and strawberry it is often desirable to cut back some of the longer ones.

SOIL AND ITS PREPARATION.

Unless suitable soil is selected very poor results will often be obtained. The Apple thrives upon a greater variety of soils than any other fruit, but that best suited to its growth is a rich, moist, well drained loam. The Pear, Plum and Quince require a heavier soil but it should be free from standing water. The Cherry delights in a light sandy loam. The Peach can only be successfully grown in New England upon high well drained land. Upon the tops of our high hills the trees are hardier, live longer and bear more fruit, although, even here, they are not safe from injury, and annual crops cannot be expected until some method of protection has been discovered that can be easily and cheaply applied. Grape vines give the best fruit in quality of fruit when planted upon high gravelly soil, but to insure a vigorous growth of vine to enable a large crop of fruit to mature, some nitrogenous manure must be used, but only early in the season, as a late application would induce a late growth of wood that is very liable to injury by severe cold.

The Raspberry and Blackberry mature their wood much better upon light land than upon heavy moist soil,but like the grape require the addition of nitrogenous manure to secure growth of canes sufficient to mature a large crop of fruit. Spreading mulch upon the surface or constant cultivation will generally prevent the escape of moisture at the time of the ripening of the fruit when it is most needed.

The Currant and Gooseberry require a moist heavy soil for the best results, but are liable to be thrown out by the frosts if the soil is not well underdrained.

The best soil for the Strawberry is a moist sandy loam. Upon light sandy soil there is a tendency to the production of a large number of berries, but there not being moisture enough in the soil very few will mature.

Before planting it is necessary that the soil be made rich enough to ensure a good growth, if it is not already in that condition. For small fruits it is generally best to apply the manure or fertilizers broadcast and harrow in, as it may also be done for the large fruits if the land is to be cultivated with some other crop for a few years.

If trees are to be planted in land not cultivated for other crops, the manure or fertilizer would be more economically applied only about the trees, increasing the area covered as they increase in size. Unfermented manure should never be placed in contact with the roots of any tree or plant, but if decomposed and well mixed with soil no injury will result from the use of a limited quantity. The best way to use coarse manure is to apply it to the surface about the trees slightly covered with soil. The quantity to be used must be varied with the condition of the soil, but should be used sparingly upon the peach until they begin bearing.

Perhaps the best material to use where the soil is not sufficiently rich for the production of fruit, is fine ground bone and potash, four parts of the former to one part of muriate of potash. This at the rate of one lb. to the tree mixed in the fine soil used around the roots and one lb. applied near the surface will ensure a good growth unless the soil is unusually poor. The holes should be dug a little larger than the roots will extend and loosened a little deeper than they are to be planted. For convenience and beauty trees should be set at regular distances.

METHODS OF PLANTING.

Generally, the best time for planting is in the early spring, although it may be successfully done in the fall when the leaves drop early and the shoots mature by Nov. 1st.

In the spring trees should not be planted until the ground will work up fine, and not compact when pressed about the roots. If the soil is light the roots should be planted a little deeper than they grew in the nursery, but if moist the same depth as they stood in the nursery is sufficient. Grape vines should be planted with the crown or collar within a few inches of the surface and the roots extending six to ten inches deep according to the soil. Raspberry, blackberry and strawberry plants should be set as early in the spring as the land will work. Black-cap raspberries must be planted with the large central bud near the surface, as deep covering often destroys it; the roots however must be put obliquely as deep as they will go. It is important that the soil be pressed *very finely* about the roots before all is filled in, and that upon the surface be left light.

It often happens that trees are received from the nursery in a dry shriveled condition which if planted in that state would certainly fail to grow. They may be improved and sometimes saved by burying top and root in moist soil for a few days or a week; then by severe pruning at planting they will be much more certain to grow.

AFTER CARE.

It often happens that trees received in good condition and very carefully planted fail to grow from want of after care. This, for the first season, consists in seeing that a sufficient supply of moisture is present about the roots.

In times of drought watering may be avoided by covering the ground for several feet about the tree with mulch five or six inches deep, or by stirring the surface soil once or twice each week. Trees planted in turf are especially liable to injury from the moisture being taken up by the surrounding grass roots. This can only be prevented by covering the ground with a mulch, of any waste material like corn stover, old hay, straw, shavings, sawdust, fine brush, cider pomace, meadow mud or peat.

The same result may also be obtained by packing the loose stones often found about the trees. Mulching material of any kind should not be in contact with the trunk of the trees from Nov. 1st to May 1st, unless they are protected by banking up or by a tin or tar paper band about them to protect from injury by mice.

S. T. MAYNARD.

Professor of Botany and Horticulture, Mass. Agricultural College.

426—427. COTTON SEED HULL ASHES.

Sent on from North Hadley, Mass.

	Per Cent. I.	II.
Moisture at 100° C.,	7.40	8.08
Potassium oxide, 5½ cts. per pound,	28.55	26.62
Phosphoric acid, 6 cts. per pound,	8.97	11.50
Magnesium oxide,	16.14	17.15
Calcium oxide,	10.58	11.37
Insoluble matter,	11.71	5.38
Valuation per 2000 lbs.,	$42.17	$43.08

428—431. WOOD ASHES. (Canada.

I. and II. Sent on from Boston, Mass.
III. Sent on from Sunderland, Mass.
IV. Sent on from Concord, Mass.

	Per Cent			
	I.	*II.*	*III.*	*IV.*
Moisture at 100° C..	11.12	8.67	1.10	15.98
Phosphoric acid,	2.05	1.59	1.08	1.34
Magnesium oxide,	3.30	3.18	2.93	4.45
Calcium oxide,	39.15	39.75	50.09	30.49
Potassium oxide,	5.30	5.58	2.93	4.76
Insoluble matter (before cal.)	9.80	10.10	9.59	16.91
" " (after cal.)	8.67	9.17	7.38	14.14

Nos. 1, 2 and 4 are unleached Canada ashes; the large amount of moisture and of insoluble matter in No. 4 explains its lower percentage of potash. Sample No. 3, is a partially leached ash.

432. GROUND BONE.

Sent on from Concord, Mass.

		Per Cent.
Moisture at 100° C.,		3.05
Total Phosphoric acid,		17.72
Reverted " "	$7\frac{1}{2}$ cts. per pound,	5.55
Insoluble " "	4 cts. "	12.17
Nitrogen,	15 cts. "	5.15
Insoluble matter,		1.19
Valuation per 2000 lbs.,		$33.52

433. SALTPETER WASTE.

Sent on from South Acton, Mass.

	Per Cent.
Moisture at 100° C.,	2.71
Sodium oxide,	45.92
Potassium oxide, $4\frac{1}{4}$ cts. per pound,	6.11
Calcium oxide,	.71
Sulphuric acid,	.84
Nitrogen in nitric acid, 16 cts. per pound,	.80
Chlorine,	56.00
Valuation per 2000 lbs.,	$7.75

The sample contained less nitric acid and more potash than previous samples.

434. MURIATE OF POTASH.

Sent on from Fitchburg, Mass.

	Per Cent.
Moisture at 100° C.,	0.15
Potassium oxide, 4¼ cts. per pound.	51.87
Valuation per ton of 2000 pounds.	$44.09

435. GERMAN PEAT.

Sent on from Milbury, Mass.

	Per Cent.
Moisture at 100° C.,	11.29
Nitrogen (in organic matter), 8 cts. per pound,	1.23
Ash constituents,	1.23
Insoluble matter (in ash,)	.38
Valuation per ton of 2000 lbs.,	$1.97

The material was well dried and evidently designed to serve as an absorbent in some branch of manufacture.

436—439. COMPOUND FERTILIZERS.

I. Animal fertilizer; sent on from Boston.
II. Sent on from Eastham, Mass.
III. Sent on from Tewksbury, Mass.
IV. Peruvian Guano; sent on from Taunton, Mass.

	Per Cent.			
	I.	II.	III.	IV.
Moisture at 100° C.,	7.20	8.81	14.15	12.17
Total Phosphoric acid.	14.51	3.97	13.69	18.45
Soluble " "	6.34	0.25	7.00	1.54
Reverted " "	6.74	2.96	4.83	5.92
Insoluble " "	1.43	0.76	1.86	10.99
Potassium oxide,	5.11	2.97	2.96	3.46
Calcium oxide,			16.65	
Total Nitrogen,	3.44	1.39	2.40	5.13
Nitrogen in Ammoniates,				3.94
Nitrogen in Nitrates,				0.33
Nitrogen in Organic matter,				0.86
Insoluble matter,	1.23	65.16	5.52	13.64
Valuation per 2000 lbs.,	$37.49	$12.69	$30.49	$38.73

440—443. COMPOUND FERTILIZERS AND FISH.

I. Sent on from Millbury, Mass.

II. Sent on by Swansea Farmers' Club, Swansea, Mass.

III. Dried Fish; sent on by Swansea Farmers' Club, Swansea, Mass.

IV. Fish and Potash: sent on from Medfield, Mass.

	Per Cent. I.	II.	III.	IV.
Moisture at 100° C.,	11.83	7.69	9.17	26.75
Total Phosphoric acid,	13.95	9.91	7.92	5.44
Soluble " "	6.62	2.81	0.64	2.00
Reverted " "	2.69	3.57	4.36	2.57
Insoluble " "	1.64	3.53	2.92	1.08
Potassium oxide,	3.28	10.64	none	2.95
Nitrogen,	2.88	4.62	8.73	3.90
Insoluble matter,	3.82	1.81	2.69	1.59
Valuation per 2000 lbs.,	$30.28	$37.19	$39.87	$23.87

Fodder and Fodder Analyses.

444. RYE BRAN (Middlings).

Amherst Mills.

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

	Percentage Composition.	Constituents (in lbs.) in a ton of 2000 lbs.	Pounds digestible in a ton of 2000 lbs.	Per cent. of digestibility of constituents.	Nutritive Ratio.
Moisture at 100° C.,	12.54	250.80			
Dry Matter,	87.46	1749.20			
	100.00	2000.00			
ANALYSIS OF DRY MATTER.					
Crude Ash,	4.02	80.40			1 : 7.28
" Cellulose,	3.70	74.00	6.66	9.0	
" Fat,	5.61	112.20	64.52	57.5	
" Protein, (nitrogenous matter),	13.15	263 00	173.58	66.0	
Non-nitrogenous extract matter,	73.52	1470.40	1095.45	74.5	
	100.00	2000.00	1340.21		

Analysis of Rye Bran with reference to Fertilizing Constituents.

One hundred parts of air dried bran contained :—

Moisture at 100° C.,	12.54
Phosphoric acid, 6 cts. per pound.	1.26
Magnesium oxide,	.32
Calcium oxide.	.09
Ferric oxide.	.02
Potassium oxide, $4\frac{1}{4}$ cts. per pound,	.81
Sodium oxide,	.03
Nitrogen, 17 cts. per pound,	1.84
Insoluble matter.	.17

Valuation per 2000 lbs., $8.46.

445. SERRADELLA.

Grown at the Experiment Station. Collected when in bloom, Aug. 4th, 1886.

	Percentage Composition.	Constituents (in lbs.) in a ton of 2000 lbs.	Pounds digestible in a ton of 2000 lbs.	Per cent. of digestibility of constituents.	Nutritive Ratio.
Moisture when collected,	84.60	1692.00			
Dry Matter when collected,	15.40	308.00			
	100.00	2000.00			
ANALYSIS OF DRY MATTER.					1 : 4.07
Crude Ash,	11.85	237.00			
" Cellulose,	26.21	524.20			
" Fat,	2.65	53.00	31.80	60	
" Protein, (nitrogenous matter),	17.75	355.00	223.65	63	
Non-nitrogenous extract matter,	41.54	830.80	830.80	100	
	100.00	2000.00	1083.25		

Analysis of Serradella with reference to Fertilizing Constituents.

	Per Cent.
Moisture at 100° C.,	10.54
Phosphoric acid, 6 cts. per pound,	.90
Potassium oxide, $4\frac{1}{4}$ cts. per pound,	2.60
Magnesium oxide,	.39
Calcium oxide,	2.63
Sodium oxide.	.55

Nitrogen, 17 cts. per pound,		2.54
Insoluble matter,		.21
Valuation per 2000 lbs.,	$11.93.	

This plant has been described in previous reports as a valuable fodder plant, adapted to moist sandy lands. Its feeding value has been tested at the Station during the past year. The results will be stated later in connection with the description of some feeding experiments with milch cows.

446. HERDS GRASS.

Grown at the Experiment Station on well manured lands. Collected while in bloom, June 28th, 1886.

	Percentage Composition.	Constituents (in lbs.) in a ton of 2000 lbs.	Pounds digestible in a ton of 2000 lbs.	Per cent. of digestibility of constituents.	Nutritive Ratio.
Moisture when collected,	65.74	1314.80			
Dry Matter when collected,	34.26	685.20			
	100.00	2000.00			
ANALYSIS OF DRY MATTER.					
Crude Ash,	5.29	105.80			1 : 11.52
" Cellulose,	33.23	664.60	285.47	58	
" Fat,	1.95	39.00	17.94	46	
" Protein, (nitrogenous matter),	8.20	164.00	93.48	57	
Non-nitrogenous extract matter,	51.33	1026.60	646.76	63	
	100.00	2000.00	1143.65		

Analysis of Hay with reference to Fertilizing Constituents.

		Per Cent.
Moisture,		7.80
Phosphoric acid, 6 cts. per pound,		.36
Potassium oxide, $4\frac{1}{4}$ cts. per pound,		1.63
Magnesium oxide,		.12
Calcium oxide,		.44
Sodium oxide,		.08
Nitrogen, 17 cts. per pound,		1.21
Insoluble matter,		1.01
Valuation per 2000 lbs.,	$5.93	

447. 1. FODDER OATS.

Grown at the Experiment Station on well manured land. Collected July 5th, 1886. (in bloom).

	Percentage Composition.	Constituents (in lbs.) in a ton of 2000 lbs.	Pounds digestible in a ton of 2000 lbs.	Per cent. of digestibility of constituents.	Nutritive Ratio.
Moisture when collected, ...	78.61	1572.20			
Dry Matter when collected, ...	21.39	427.80			
	100.00	2000.00			
ANALYSIS OF DRY MATTER.					1:13.02
Crude Ash, ...	7.38	147.60			
" Cellulose, ...	33.12	662.40			
" Fat, ...	2.02	40.40	18.58	46	
" Protein (nitrogenous matter), .	7.10	142.00	80.94	57	
Non-nitrogenous extract matter, . .	50.38	1007.60	1007.60	100	
	100.00	2000.00	1107.12		

448. 2. FODDER OATS.

Grown at the Experiment Station on well manured land. Collected July 13th, 1886.

	Percentage Composition.	Constituents (in lbs.) in a ton of 2000 lbs.	Pounds digestible in a ton of 2000 lbs.	Per cent. of digestibility of constituents.	Nutritive Ratio.
Moisture when collected, ...	71.18	1423.60			
Dry Matter when collected, ...	28.82	576.40			
	100.00	2000.00			
ANALYSIS OF DRY MATTER.					1:13.32
Crude Ash, , ...	6.99	139.80			
" Cellulose, ... , . . .	32.83	656.60			
" Fat, ...	2.44	48.80	22 45	46	
" Protein, (nitrogenous matter), .	7.05	141.00	80.38	57	
Non-nitrogenous extract matter, , .	50.69	1013.80	1013.80	100	
	100.00	2000.00	1116.63		

The value of fertilizing ingredients in the above (I—II) samples of fodder oats amounts to from $2.15 to $2.30 per ton of 2000 lbs.

449. "PRIDE OF THE NORTH" CORN.

Raised at the Experiment Station, 1886.

Average length of ear seven inches, containing fourteen rows of kernels. The ear was well filled out at the butt. Average weight of the corn and cob was six ounces, consisting of 84 per cent. of kernels and 16 per cent. of cob. Average weight of kernel .24 gramme.

	Per Cent.
Moisture at 100° C.,	8.75
Dry matter,	91.25
	100.00

ANALYSIS OF DRY MATTER:

Crude Ash,	1.59
" Cellulose,	2.54
" Fat,	4.34
" Protein (nitrogenous matter),	12.05
Non-nitrogenous extract matter,	79.48
	100.00

The seed corn came from the Department of Agriculture at Washington, D. C.; it had been obtained from Minnesota. The corn was raised at the Station on lands in good cultivation with 600 pounds of ground bones and 200 pounds of muriate of potash per acre as fertilizer. The plant belongs to the "Dent" variety and deserves recommendation for trial in our section of the State. The composition of the kernels is above the average. The stalks are, however, somewhat harder, than many of our local varieties.

C. A. GOESSMANN, *Director*,
AMHERST, MASS.

The Bulletins of the Experiment Station will be sent free of charge to all parties interested in its work, on application.

J. E. Williams, Printer, Amherst, Mass.

MASSACHUSETTS STATE

AGRICULTURAL EXPERIMENT STATION.

BULLETIN No. 25.

JULY, 1887.

Meteorological Summary for the three months ending June 30, 1887.

	April.	May.	June.
Highest temperature,	74.4°	86.5°	91.0°
Lowest temperature,	17.1°	33.2°	38.5°
Mean temperature,	46.61°	60.91°	65.67°
Mean humidity,		70.67°	76.43°
Total precipitation,	2.97½ in.	1.13 in.	5.09 in.
Total snowfall,	6.5 in.		
Prevailing winds,	N. W.	S. W.	S. W.
No. of days on which cloudiness averaged 8 or more on scale of 10,	4	4	8
No. of days on which 0.1 of an inch or more of water from rain or melted snow fell,	7	4	8

Notes on Feeding Experiments with Pigs.

450. The observations recorded within a few subsequent pages may be considered the result of a continuation of feeding experiments with pigs, described in our second and third annual reports. The *first of these experiments*, see for details, second annual report, page 68, was instituted for the purpose of comparing the feeding effect of *equal measures* of creamery buttermilk—Amherst creamery—and of skim-milk from the Station, adding in both instances to the daily diet a corresponding amount of corn meal. The daily ration of corn meal was from time to time increased, independent of the amount of milk fed at the time, during the progress of the growth of the animals on trial. The results of this experiment showed practically no difference in regard to the amount of dressed pork produced in either case.

Repeated examinations of the two kinds of milk used in the trial had proved that the skim-milk contained on an average one-fifth, or 20 per cent., more solid matter of a similar character than the creamery buttermilk at our disposal. This excess of solids in the skim-milk, judging from our results, seemed to be wasted in our mode of feeding; for 714 pounds of corn meal and 982 gallons of skim-milk (with ten per cent. of solids) had produced 510 pounds of dressed pork, whilst 718 pounds of corn meal and 985 gallons of creamery buttermilk (with eight per cent. of solids) had yielded, under otherwise corresponding circumstances, 515 pounds of dressed pork, as the total amount from three pigs on each side.

To account if possible for the less satisfactory returns of the skim-milk diet as compared with that of the creamery buttermilk the *second feeding* experiment was planned,—see for details III annual report, page 23. It was decided to calculate the amount of corn meal to be fed in the new experiment with reference to an *equal amount* of *solids* in *both kinds* of *milk* and *not* with reference to any *equal measure* of *both kinds*.

The average results of this trial seemed to account quite satisfactorily for the above stated difference in solids of both kinds of milk; for 2250 pounds of corn meal fed with 1533 gallons of skim-milk had produced 990½ pounds of dressed pork, whilst 2211 pounds of corn meal fed with 1899 gallons of creamery buttermilk had yielded, under otherwise corresponding circumstances, 889½ pounds of dressed pork, as the total returns from six pigs on each side. It was stated on that occasion, that in our opinion a more judicious distribution of an increased proportion of corn meal, in case of the skim-milk diet had evidently rendered the latter, pound for pound, more efficient during the second experiment, as compared with the first.

Having adopted the same *local market prices* of the three articles, which served in the daily diet during both experiments,—corn meal, per ton, $22.50; skim-milk, 1.8 cts. per gallon; buttermilk, 1.37 cts. per gallon,—it was found that the cost of feed consumed, per pound of dressed pork produced, in the *first experiment* amounted in case of the creamery buttermilk diet to 4.6 cts., in case of the skim-milk diet to 5.8 cts.; whilst in the *second experiment* it amounted in case of the former to 4.2 cts., and in case of the latter to 4.85 cts. In calculating the cost of the feed consumed in each case on the above stated *market prices*, the creamery buttermilk had proved the cheaper article; the higher *nutritive* value of the more concentrated skim-milk from our dairy had been more than offset by the *lower market price* of the *creamery buttermilk*. The adoption of an *equal* market price *per gallon* of skim-milk and of creamery buttermilk, 1.37 cts. per gallon, would have caused a reduction in the above stated cost of feed, per pound of dressed pork, of from .65 to .75 cts. *in favor* of *the skim-milk*.

Before proceeding with the description of three succeeding feeding experiments it seems advisable to offer a few explanatory remarks regarding the standpoint assumed in the planning and the management of the work under discussion. In the published detailed record of the second feeding experiment (see III annual report), it may be noticed that the character of the daily diet was changed from time to time by adding a larger proportion of corn meal to a given amount of skim-milk or buttermilk. The quantity of feed offered daily to the animals on trial was controlled by their individual appetite,—beginning with eight and twelve ounces of meal to four quarts of milk,—and closing with a daily ration, consisting in case of one lot of animals of 91 ounces of corn meal and twelve quarts of buttermilk per head, and in case of the other of 108 ounces of corn meal to seven quarts of skim-milk. The changes regarding the *quantity* of the daily supply of feed were for obvious reasons gradual and depending on the appetite of each animal. The alterations regarding the *character* of the daily feed,—*i. e.*, the changes in the relative proportion of meal and of milk,—were made with reference to the stage of growth of the animals on trial. The proportions between meal and milk were changed from four to five times. These changes consisted in a periodical increase of meal for a given amount of milk; they were made for the purpose of increasing the amount of the non-nitrogenous fodder constituent in the daily diet during the later stages of growth. This course of preparing the daily feed was adopted to secure, whenever desired, a definite change in the relative proportion of its digestible nitrogenous and non-nitrogenous food constituents. As both kinds of milk used in the experiment contained the nitrogenous food constituents in a much larger relative proportion (1 : 1.8,—1 : 1.9) than the corn meal fed (1 : 8.76), an increase in the quantity of the latter rendered it possible to regulate within certain limits the character (nutritive ratio) of the daily diet with reference to a desired proportion of both groups of essential food constituents. The experiment (II) began with a daily diet, consisting of skim-milk and corn meal, which contained *one part* of digestible nitrogenous food constituents to 2.7 parts of digestible non-nitrogenous food constituents; this proportion was subsequently altered by an increase in corn meal to 1 : 3.1, later on to 1 : 3.9, and closed with 1 : 5. The animals which served in this particular case, varied in live weight from 17 to 19 pounds at the beginning of the experiment. The first stated ration was fed until the animals had reached a weight of from 45 to 50 pounds; the second until they had reached from 90 to 100 pounds, the third until 135 to 145 pounds, and the fourth subsequently to the end of the trial. The final summing up of the results of that experiment showed, when including the entire number of pigs on trial (twelve), that 3.39 pounds of dry matter contained in the feed consumed had yielded one pound of dressed pork. In two instances (of the buttermilk diet) from 3.47 to 3.48 pounds of dry matter of the feed had been consumed for one pound of dressed pork obtained; whilst in two other instances (of the skim-milk diet) from 2.97 to 3.27 pounds of dry matter of the feed had sufficed for the production of the same weight of dressed pork (one pound).

As it seemed 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 could be improved on, and, if so, in what direction, the three subsequently described new feeding experiments were instituted. The principal aim of these new experiments was to ascertain, whether a daily diet for pigs, of which skim-milk and corn meal formed a material portion, would secure better pecuniary returns, in case an *exceptionally* large *proportion* of *digestible nitrogenous food*-constituent was fed during *the entire experiment*. Gluten meal and wheat bran were chosen for various reasons to serve in the making up of the feed to meet this requirment, as soon as our milk supply became exhausted. A short abstract of the results obtained in this connection may be found upon a few succeeding pages. Although not less than four animals have served in each of these three new experiments our present communication will be confined to a detailed record of but two animals in each case, with the exception of the last experiment, leaving a more detailed record of a similar character of others to the next annual report.

THIRD FEEDING EXPERIMENT.

Four animals of a mixed breed were selected for the work; their respective weights varied at the beginning of the trial from 40 to 59 pounds. The daily diet during the first three months consisted exclusively of skim-milk from the Station and of corn meal; during the remainder of the time (three and a-half months) a mixture of equal weights of wheat bran and gluten meal was added to assist in maintaining the desired close relation between the proportion of *digestible nitrogenous* and *non-nitrogenous food constituents* in the daily feed. The relation between these two important groups of food constituents was materially the same during the entire experiment. It consisted of one part of nitrogenous food constituents to from 3.27 to 3.76 parts of non-nitrogenous constituents. From four and one-half to five ounces of corn meal were added to every quart of skim-milk needed to meet the wants of the animal. This composition of the feed was retained until the quantity called for per head had reached eight quarts of skim-milk and forty ounces of corn meal per day. At this stage of the experiment the mixture of equal weights of wheat bran and gluten meal was added to the daily fodder ration; beginning with sixteen ounces per head, and closing up with twenty-five ounces. The exact amount required per day was governed by the appetite of the animal; the mixture served to meet the increasing demand of the various animals on trial. It is a good rule to increase the daily fodder rations only when called for, and always gradually.

The subsequent detailed record of our results shows that the cost of feed consumed, per pound of dressed weight produced, varied from 6.2 cts. to 6.6 cts; whilst from 1.10 to 1.18 pounds of dry matter contained in the feed consumed, had yielded one pound of dressed pork. The live weights gained during the experiment amounted to 246.5 and 206.5 pounds.

A

PERIODS.	Total amount of Corn Meal consumed during Period (in lbs.)	Total amount of Skim-Milk consumed during Period (in qts.)	Total am't of Wheat Bran consumed during Period (in lbs.)	Total am't of Gluten Meal consumed during Period (in lbs.)	Nutritive Ratio of Food.	Weight of Animal at beginning of Period.	Weight of Animal at end of Period.	Gain in weight per day during Period.
1885.								lb. oz.
April 1 to May 11, ...	73.5	257.0	....	....	1 : 3.29	40.0	84.8	1 1
May 12 to June 3,............	57.5	184.0	....	....	1 : 3.39	84.8	110.5	1 2
June 4 to June 29,............	49.	208.0	8.0	8.0	1 : 3.04	110.5	150.5	1 9
June 30 to August 12,.........	121.	352.0	25.0	25.0	1 : 3.35	150.5	212.0	1 6
August 13 to September 16,....	105.	210.0	22.0	22.0	1 : 3.67	212.0	246.5	1 0

Total amount of feed consumed from Apr. 1 to Sept. 16.

406 lbs. Corn Meal, equal to dry matter,	357.4 lbs.
1211 qts. Skim-Milk, equal to dry matter,	274.7 lbs.
55 lbs. Wheat Bran, equal to dry matter,	48.3 lbs.
55 lbs. Gluten Meal, equal to dry matter,	50.3 lbs.
Total amount of dry matter,	730.7 lbs.

Live weight of animal at beginning of experiment,	40.0 lbs.
Live weight at time of killing,	246.5 lbs.
Live weight gained during experiment,	206.5 lbs.
Dressed weight at time of killing,	210.0 lbs.
Loss in weight by dressing,	36.5 lbs., or 14.8 per cent.
Dressed weight gained during experiment,	174.9 lbs.

Cost of feed consumed during experiment.

406 lbs. of Corn Meal, at $24.00 per ton,	$4.87
303 gals. Skim-Milk, at 1.8 cts. per gallon,	5.46
55 lbs. Wheat Bran, at $22.50 per ton,	.62
55 lbs. Gluten Meal, at $22.50 per ton,	.62
	$11.57

3.54 lbs. of dry matter fed yielded one pound of live weight, and 1.18 lbs. of dry matter yielded one pound of dressed weight.

Cost of feed for production of 1 pound of dressed pork, 6.6 cts.

B

PERIODS.	Total amount of Corn Meal consumed during Period (in lbs.)	Total amount of Skim-Milk consumed during Period (in qts.)	Total am't of Wheat Bran consumed during Period (in lbs.)	Total am't of Gluten Meal consumed during Period (in lbs.)	Nutritive Ratio of Food.	Weight of Animal at beginning of Period.	Weight of Animal at end of Period.	Gain in weight per day during Period.
1885.								lb. oz.
April 1 to May 11, ...	73.5	257.0	....	....	1 : 3.29	59.5	109.3	1 3
May 12 to June 3, ...	57.5	181.0	....	....	1 : 3.39	109.3	133.3	1 1
June 4 to June 29, ...	65.0	208.0	13.0	13.0	1 : 3.27	133.3	188.5	2 2
June 30 to July 22, ...	69.0	181.0	17.0	17.0	1 : 3.39	188.5	223.0	1 8
July 23 to September 16, ...	210.0	378.0	11.0	14.0	1 : 3.76	223.0	306.0	1 8

Total amount of feed consumed from Apr. 1 to Sept. 16.

475 lbs. Corn Meal, equal to dry matter,	418.2 lbs.
1211 qts. Skim-Milk, equal to dry matter,	271.7 lbs.
74 lbs. Wheat Bran, equal to dry matter,	65.1 lbs.
74 lbs. Gluten Meal, equal to dry matter,	67.8 lbs.
Total amount of dry matter,	825.8 lbs.

Live weight of animal at beginning of experiment,	59.5 lbs.
Live weight at time of killing,	306.0 lbs.
Live weight gained during experiment,	246.5 lbs.
Dressed weight at time of killing,	258.0 lbs.
Loss in weight by dressing,	18. lbs., or 12.4 per cent.
Dressed weight gained during experiment,	205.9 lbs.

Cost of feed consumed during experiment.

475 lbs. Corn Meal, at $24.00 per ton,	$5.70
303 gals. Skim-Milk, at 1.8 cts. per gallon,	5.15
74 lbs. Wheat Bran, at $22.50 per ton,	.83
71 lbs. Gluten Meal, at $22.50 per ton,	.83
	$12.81

3.35 lbs. of dry matter fed yielded one pound of live weight, and 4.01 lbs. of dry matter yielded one pound of dressed weight.

Cost of feed for production of 1 lb. of dressed pork, 6.2 cts.

FOURTH FEEDING EXPERIMENT.

Five animals served in the experiment; their live weights varied from thirty to thirty-eight pounds, when entering upon the trial; they were of a similar mixed breed as those selected for the third experiment. The daily diet of the entire lot consisted from December 8th to February 15th of *four quarts* of *skim-milk* and *eight ounces* of *corn meal*, besides a *mixture* consisting of *two weight parts* of *gluten meal* and *one weight part* of *wheat bran*; the increasing demand for feed was supplied by this mixture, which was moistened with water before being fed. The daily quantity needed per head amounted in the beginning of the trial to three ounces, and rose towards the close of that period to twelve ounces. Subsequently—until the 11th of May—another *mixture*, consisting of *equal weights* of *corn meal*, *gluten meal* and *wheat bran*, was *substituted* in its place. After May 11th until the close of the experiment, May 31st, a larger proportion of corn meal was fed. The daily diet consisted during that period of *four quarts* of *skim-milk* and a *mixture* of dry feed consisting of *seven parts* of *corn meal*, *one part* of *gluten meal* and *one part* of *wheat bran*. On the 12th of May the daily feed consisted on an average per head of four quarts of skim-milk, twenty-eight ounces of corn meal, four ounces of gluten meal and four ounces of wheat bran. The consumption of the solid constituents of the daily fodder ration had reached, at the close of the experiment, in some instances, fifty-six ounces of corn meal, eight ounces of gluten meal and eight ounces of wheat bran. The daily quantity of milk fed remained the same during the entire experiment—four quarts per head. Water was used to assist in moistening the dry portion of the feed.

A comparison of the subsequent statement of our results with those in the preceding experiment (III) shows no marked differences; the results are, if anything, inferior—considering the weights of the animals in both instances, when killed. The cost of the feed consumed, per pound of dressed weight produced, varied from 6.1 to 6.6 cts.; whilst from 3.77 to 4.08 pounds of dry matter contained in the feed consumed had yielded one pound of dressed pork. The live weight gained during the experiment amounted to 128 and 111 pounds. The cost of feed consumed for the production of a given quantity of dressed pork increases materially with the advancing growth of the animal. For details concerning this important point see statements in our III annual report. The financial success of feeding pigs for the home market depends in a controling degree on a timely closing up of the operation. To go beyond 160–175 lbs. of live weight is only in exceptional cases a remunerative practice with our average market prices for dressed pork.

The beneficial effect of a more liberal supply of non-nitrogenous feed constituents as starch and fats (in the corn meal) during the last period of this feeding experiment, deserves particular attention.

C

PERIODS.	Total amount of Corn Meal consumed during Period (in lbs.)	Total amount of Skim-Milk consumed during Period (in qts.)	Total am't of Wheat Bran consumed during Period (in lbs.)	Total am't 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.
1885 and 1886.								lb. oz.
December 8 to January 25, ...	24.5	196	5.6	11.2	1 : 2.68	31.8	66.5	0 11
January 26 to February 15, ...	10.5	81	4.8	9.6	1 : 2.81	66.5	82.0	0 12
February 16 to March 23, ...	26.8	144	8.8	8.8	1 : 3.01	82.0	92.5	0 5
March 24 to May 10, ...	28.6	232	5.6	5.6	1 : 2.66	92.5	119.0	0 9
May 11 to May 31, ...	55.1	84	8.2	8.2	1 : 4.33	119.0	112.8	1 2

Total amount of feed consumed from Dec. 8 to May 31.

145.8 lbs. Corn Meal, equal to dry matter,	127.4 lbs.
740.0 qts. Skim-Milk, equal to dry matter,	167.8 lbs.
33.0 lbs. Wheat Bran, equal to dry matter,	28.6 lbs.
43.4 lbs. Gluten Meal, equal to dry matter,	40.5 lbs.
Total amount of dry matter,	364.3 lbs.

Live weight of animal at beginning of experiment,	31.8 lbs.
Live weight at time of killing,	142.8 lbs.
Live weight gained during experiment,	111.0 lbs.
Dressed weight at time of killing,	115.0 lbs.
Loss in weight by dressing,	27.8 lbs. or 19.3 per cent.
Dressed weight gained during experiment,	89.3 lbs.

Cost of feed consumed during experiment.

145.8 lbs. Corn Meal, at $24.00 per ton,	$1.75
185.0 gals. Skim-Milk, at 1.8 cts. per gallon,	3.30
33.1 lbs. Wheat Bran, at $22.50 per ton,	.37
43.4 lbs. Gluten Meal, at $22.50 per ton,	.49
	$5.91

3.28 lbs. of dry matter fed yielded one pound of live weight; 4.08 lbs. of dry matter yielded one pound of dressed weight.

Cost of feed for production of 1 lb. of dressed pork, 6.6 cts.

D

PERIODS	Total amount of Corn Meal consumed during Period (in lbs.)	Total amount of Skim-Milk consumed during Period (in qts.)	Total am't of Wheat Bran consumed during Period (in lbs.)	Total am't 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.
1885 and 1886.								lbs. oz.
December 8 to January 25, ...	21.5	196	4.1	8.8	1 : 2.64	34.0	70.0	0 12
January 26 to February 15,.....	10.5	84	5.2	10.1	1 : 2.78	70.0	90.5	1 0
February 16 to April 3,........	38.7	188	15.2	15.2	1 : 3.06	90.5	118.0	0 9
April 4 to May 10,.............	25.8	188	7.3	7.3	1 : 2.86	118.0	137.5	0 8
May 11 to May 31,............	60.0	81	8.4	8.4	1 : 4.48	137.5	162.0	1 2

Total amount of feed consumed from December 8 to May 31.

159.5 lbs. Corn Meal, equal to dry matter,	138.4 lbs.
737.0 qts. Skim-Milk, equal to dry matter,	167.2 lbs.
40.5 lbs Wheat Bran, equal to dry matter,	35.7 lbs.
50.1 lbs. Gluten Meal, equal to dry matter,	46.0 lbs.
Total amount of dry matter,	387.3 lbs.

Live weight of animal at beginning of experiment,	34. lbs.
Live weight at time of killing,	162.0 lbs.
Live weight gained during experiment,	128.0 lbs.
Dressed weight at time of killing,	130.0 lbs.
Loss in weight by dressing,	32 lbs., or 19.7 per cent.
Dressed weight gained during experiment,	102.7 lbs.

Cost of feed consumed during experiment.

159.5 lbs. Corn Meal, at $24.00 per ton,	$1.91
184.0 gals. Skim-Milk, at 1.8 cts. per gallon,	3.31
40.5 lbs. Wheat Bran, at $22.50 per ton,	.46
50.1 lbs. Gluten Meal, at $22.50 per ton,	.56
	$6.24

3.02 lbs. of dry matter fed, yielded one pound of live weight, and 3.77 lbs. of dry matter yielded one pound of dressed weight.

Cost of feed for production of 1 lb. of dressed pork, 6.1 cts.

FIFTH FEEDING EXPERIMENT.

Six pigs of a mixed breed were secured for the observation; their live weights varied at the beginning of the experiment from 25 to 30 pounds. The course of feeding was similar to that adopted in the two preceding experiments. Skim-milk and corn meal furnished as in the previous trials a liberal proportion of the daily diet; gluten meal and wheat bran were used in a somewhat different proportion than before as food ingredients to compound the desired temporary fodder ration. The feeding began with four quarts of skim-milk and eight ounces of corn meal; the increasing daily demand for feed was supplied by a mixture of equal weights of gluten meal and wheat bran until October 31st, when a mixture of equal weights of gluten meal, corn meal and wheat bran took its place in providing the desired daily fodder ration, until the close of the experiment, January 15, 1887. At that time from 12 to 18 ounces of this mixture were required per head.

The results of this experiment, judging from subsequent more detailed statements, are in some instances more favorable than those previously described; yet they fall behind those obtained, in our earlier experiments (I and II). The cost of feed consumed per pound of dressed pork varied, in three cases from 5.2 cents to 5.8 cents and reached in one case 6.32 cents. The amount of dry matter in the feed consumed for the production of one pound of dressed pork varied, in three cases from 3.56 to 3.99 pounds and rose in one case to 4.34 pounds. The live weight gained during the entire experiment varied from 132. to 158. pounds.

E

PERIODS.	Total amount of Corn Meal consumed during Period (in lbs.)	Total amount of Skim-Milk consumed during Period (in qts.)	Total am't of Wheat Bran consumed during Period (in lbs.)	Total am't of Gluten Meal consumed during Period (in lbs.)	Nutritive Ratio of Food.	Weight of Animal at beginning of Period.	Weight of Animal at end of Period.	Gain in weight per day during Period.
1886 and 1887.								lb. oz.
September 15 to October 4,.....	10.0	80	6.3	6.3	1 : 2.75	30.8	51.5	1 1
October 5 to October 31,........	13.5	108	35.3	35.3	1 : 2.90	51.5	89.0	1 6
November 1 to December 10,....	66.0	160	46.0	46.0	1 : 3.52	89.0	133.0	1 2
December 11 to January 15,....	47.8	144	29.8	29.8	1 : 3.39	133.0	164.3	0 14

Total amount of feed consumed from Sept. 15 to Jan. 15.

137.3 lbs. Corn Meal, equal to dry matter,	119.58 lbs.
192. qts. Skim-Milk, equal to dry matter,	111.58 lbs.
117.4 lbs. Wheat Bran, equal to dry matter,	102.99 lbs.
117.4 lbs. Gluten Meal, equal to dry matter,	106.89 lbs.
Total amount of dry matter,	441.04 lbs.

Live weight of animal at beginning of experiment. 30.8 lbs.
Live weight at time of killing, 164.3 lbs.
Live weight gained during experiment, 133.5 lbs.
Dressed weight at time of killing, 136.0 lbs.
Loss in weight by dressing, 28.5 lbs., or 17.3 per cent.
Dressed weight gained during experiment, 110.5 lbs.

Cost of feed consumed during experiment.

137.3 lbs. Corn Meal, at \$21.00 per ton,	\$1.61
123. gals. Skim-Milk, at 1.8 cents per gallon,	2.21
117.1 lbs. Wheat Bran, at \$22.50 per ton,	1.32
117.1 lbs. Gluten Meal, at \$22.50 per ton,	1.32
	\$6.49

3.30 lbs. of dry matter fed yielded one pound of live weight, and 3.99 lbs. of dry matter yielded one pound of dressed weight.

Cost of feed for production of 1 lb. of dressed pork, 5.8 cents.

F

PERIODS	Total amount of Corn Meal consumed during Period (in lbs.)	Total amount of Skim-Milk consumed during Period (in qts.)	Total am't of Wheat Bran consumed during Period (in lbs.)	Total am't 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.
1886 and 1887.								lb. oz.
September 15 to October 4,......	10.0	80	6.3	6.3	1 : 2.75	34.5	56.3	1 1
October 5 to October 31,........	13.5	108	35.0	35.0	1 : 2.90	56.3	99.5	1 10
November 1 to December 10,....	69.3	160	49.3	49.3	1 : 3.57	99.5	156.3	1 7
December 11 to January 19,....	58.0	160	38.0	38.0	1 : 3.45	156.3	193.3	0 15

Total amount of feed consumed from Sept. 15 to Jan. 19.

150.8 lbs Corn Meal equal to dry matter,	131.77 lbs.
508.0 qts. Skim-Milk equal to dry matter,	115.21 lbs.
128.6 lbs. Wheat Bran, equal to dry matter,	113.10 lbs.
128.6 lbs. Gluten Meal, equal to dry matter,	117.10 lbs.
Total amount of dry matter,	477.18 lbs.

Live weight of animal at beginning of experiment, 34.5 lbs.
Live weight at time of killing, 193.3 lbs.
Live weight gained during experiment, 158.8 lbs.
Dressed weight at time of killing, 163.0 lbs.
Loss in weight by dressing, 30.3 lbs., or 15.7 per cent.
Dressed weight gained during experiment, 133.9 lbs.

Cost of feed consumed during experiment.

150.8 lbs. Corn Meal, at $24.00 per ton,	$1.81
127. gallons Skim Milk, at 1.8 cents per gallon,	2.29
128.6 lbs. Wheat Bran, at $22.50 per ton,	1.45
128.6 lbs. Gluten Meal, at $22.50 per ton,	1.45
	$7.00

3.01 lbs. of dry matter fed yielded one pound of live weight, and 3.56 lbs. of dry matter yielded one pound of dressed weight.

Cost of feed for production of 1 lb. of dressed pork, 5.2 cents.

G

Total amount of feed consumed from Sept. 15 to Jan. 19.

150.0 lbs. Corn Meal, equal to dry matter,	131.07 lbs.
508.0 qts. of Skim-Milk, equal to dry matter,	115.21 lbs.
128.0 lbs. Wheat Bran, equal to dry matter,	112.58 lbs.
128.0 lbs. Gluten Meal, equal to dry matter,	116.51 lbs.
Total amount of dry matter,	475.40 lbs.

Live weight of animal at beginning of experiment,	32.0 lbs.
Live weight at time of killing,	164.0 lbs.
Live weight gained during experiment,	132.0 lbs.
Dressed weight at time of killing,	137.0 lbs.
Loss in weight by dressing,	27.0 lbs., or 16.4 per cent.
Dressed weight gained during experiment,	110.2 lbs.

Cost of feed consumed during experiment.

150.0 lbs. Corn Meal, at $24.00 per ton,	$1.80
127.0 gallons Skim-Milk, at 1.8 cents per gallon,	2.29
128.0 lbs. Wheat Bran, at $22.50 per ton,	1.44
128.0 lbs. Gluten Meal, at $22.50 per ton,	1.44
	$6.97

3.60 lbs. of dry matter fed yielded one pound of live weight, and 4.31 lbs. of dry matter yielded one pound of dressed weight.

Cost of feed for production of 1 lb. of dressed pork, 6.32 cents.

H

Total amount of feed consumed from Sept. 15 to Jan. 19.

149.5 lbs. Corn Meal, equal to dry matter,	130.63 lbs.
508.0 qts. Skim-Milk, equal to dry matter,	115.21 lbs.
127.4 lbs. Wheat Bran, equal to dry matter,	112.05 lbs.
127.4 lbs. Gluten Meal, equal to dry matter,	116.00 lbs.
Total amount of dry matter,	473.89 lbs.

Live weight of animal at beginning of experiment, 33.0 lbs
Live weight at time of killing, 178.3 lbs.
Live weight gained during experiment, 145.3 lbs.
Dressed weight at time of killing, 153.0 lbs.
Loss in weight by dressing, 25.3 lbs. or 14.2 per cent.
Dressed weight gained during experiment, 124.7 lbs.

Cost of feed consumed during experiment.

149.5 lbs. Corn Meal, at $24.00 per ton,	$1.79
127.0 gallons Skim-Milk, at 1.8 cents per gallon,	2.29
127.4 lbs. Wheat Bran, at $22.50 per ton,	1.43
127.4 lbs. Gluten Meal, at $22.50 per ton,	1.43
	$6.94

3.26 lbs. of dry matter fed yielded one pound of live weight, and 3.80 lbs. of dry matter yielded one pound of dressed weight.

Cost of feed for production of 1 lb. of dressed pork, 5.6 cents.

SUMMARY OF EXPERIMENTS III, IV, V.

		Corn Meal (in pounds).	Skim-Milk (in gallons).	Wheat Bran (in pounds).	Gluten Meal (in pounds).	Live weight gained during experiment.	Dressed weight gained during experiment.	Cost per lb. of Dressed Pork (cts.).
III.	A.	406.0	303	55.0	55.0	206.5	174.9	6.6
	B.	475.0	303	74.0	74.0	246.5	205.9	6.2
IV.	C.	145.8	185	33.0	43.4	111.0	89.3	6.6
	D.	159.5	184	40.5	50.1	128.0	102.7	6.1
V.	E.	137.3	123	117.4	117.4	133.5	110.5	5.8
	F.	150.8	127	128.6	128.6	158.8	133.9	5.2
	G.	150.0	127	128.0	128.0	132.0	110.2	6.3
	H.	149.5	127	127.4	127.4	145.3	153.0	5.6
		1773.9	1479	703.9	723.9	1261.6	1080.4	

Total Cost of Feed Consumed during the Experiment.

1773.9 lbs. Corn Meal,	$21.28
1479. gals. Skim-Milk,	26.62
703.9 lbs. Wheat Bran,	7.92
723.9 lbs. Gluten Meal,	8.14
	$63.96

The above statement shows that the cost of the feed consumed for the production of 1080.4 pounds of dressed pork, during our three late experiments, amounted to $63.96; the feed has cost us therefore 5.92 cents per pound of dressed pork sold in that connection.

In comparing this result with that obtained in our second experiment, where nothing but *skim-milk* and *corn meal* had been fed (see for details our third annual report page 35 to 40 B), it will be noticed that the *outlay* incurred *for feed*, as a rule, has been *larger* in our *three late experiments*, where gluten meal and wheat bran have been used as additional feed ingredients. The following short abstract of the results of our second experiment, above referred to, will show the exact difference in the cost of feed per pound of pork produced. For obvious reasons the same market prices have been adopted here for the different fodder articles used on both occasions.

Six Pigs Fed with Skim-Milk and Corn Meal. (*1884-1885.*)

	Corn Meal (in pounds).	Skim-Milk (in gallons).	Live Weight gained during Experiment.	Dressed Wt. gained during Experiment.	Cost per lb. of Dressed Pork (cents).
VII, ...	388.5	303	217.0	178.0	5.24
VIII,......	388.5	303	201.5	170.0	5.48
IX,........	388.5	303	209.0	174.5	5.35
X,........	361.5	208	190.5	154.0	5.07
XI,........	361.5	208	174.0	144.5	5.40
XII, ...	361.5	208	198.0	169.5	4.61
	2250.0	1533	1190.0	990.5	

Total Cost of Feed Consumed during the Experiment.

2,250 lbs. Corn Meal, $24.00 per ton,	$27.00
1,533 gals. Skim-Milk, 1.8 cents per gallon,	27.60
	$54.60

As the cost of the feed consumed in the production of 990.5 pounds of dressed pork was in this case $54.60, it follows that the cost of feed for the production of one pound of dressed pork amounted to 5.51 cents, or 0.41 cents less per pound, than in our three more recent experiments.

Conclusions. Judging from our own experience there remains but little doubt whenever the mere *cost of the feed* consumed is considered, that the diet consisting of skim-milk and corn meal alone, as described in connection with *our second feeding experiment*, has been *the cheaper one.* It is not less clearly proven in connection with the same series of experiments, that the diet of skim-milk and corn meal as carried out on that occasion has furnished us thus far the *most efficient feed* for raising pigs for the home meat market; for in every instance during four independent feeding experiments has a smaller quantity of dry matter contained in that diet, sufficed to yield a given quantity of dressed pork, than in case of our other diets which contained an addition of gluten meal and wheat bran.

Although these two important circumstances, *lower market price* and *higher nutritive value*, are in favor of the skim-milk and corn meal diet for pigs, *its superior claim of good economy* as compared with others used by us cannot be considered as established without a due consideration of the agricultural and the *commercial value* of the *manurial refuse matter* left behind in our various experiments. Taking for granted that in raising the same kind of animals to the same weights practically the same amount of nitrogen, phosphoric acid, potassa, etc., will be retained in the animal system, it follows that the excess of any one of these constituents of one diet, as compared with an other one must count in favor of the higher commercial value of the manurial residue of that particular diet.

The subsequent statement of the present market value of the essential fertilizing constituents contained in the entire feed, used in the second feeding experiment (skim-milk and corn meal), as well as those contained in that consumed in our three later feeding experiments (skim-milk, corn meal, gluten meal and wheat bran), will show the difference in both instances.

MANURIAL VALUE OF FEED CONSUMED.

Experiments.	Corn Meal.	Skim-Milk.	Wheat Bran.	Gluten Meal.	Total.
II.	\$8.97	\$13.80	——	——	\$22.77
III. IV. V.	7.07	13.31	\$4.75	\$6.33	31.46

The difference in the commercial value of the essential fertilizing elements contained in the feed consumed in both instances, as above specified, amounts to \$8.69 in favor of our three recent feeding experiments. Calculating this amount for an *equal* weight of dressed pork produced in both cases it will be found, that this difference consists of \$6.73—or .76 cents per pound of dressed pork sold.

The higher value of the manure obtained in feeding some gluten meal and wheat bran with skim-milk and corn meal, instead of skim-milk and corn meal alone, amounts to .35 cents more per pound of dressed pork than the higher cost of the feed consumed in that connection.

	II. Exper.	*III. IV. V. Exper.*
Cost of f[illegible] pound of dressed pork,	5.51 cts.	5.92 cts.
Gain in higher value of manure per pound of dressed pork obtained,		.76 cts.
Actual cost per pound of dressed pork,	5.51 cts.	5.16 cts.

Our three late feeding experiments have thus proved more remunerative than the two previous ones.

The money value of the essential fertilizing elements contained in the entire feed consumed per 1000 pounds of dressed pork produced has varied in our experiments, as shown above, from \$22.80 to \$29.10. Admitting a loss of one-third of that value in consequence of the growth of the animals, there remains within the reach of the farmer a value, in the manurial refuse obtained, of from \$15 to \$19.5. This sum ought to be credited to the profits; it amounts to from 1.5 cents to 1.95 cents per pound of dressed pork produced. As we sold our dressed pork at from $5\frac{1}{2}$ to $7\frac{1}{2}$ cents per pound we received from 1.5 to3.5 cents per pound for labor, housing, etc.

VALUATION OF ESSENTIAL FERTILIZING CONSTITUENTS CONTAINED IN THE VARIOUS ARTICLES OF FODDER USED.

	Corn Meal.	Wheat Bran.	Gluten Meal.	Skim-Milk.
		(Per Cent.)		
Moisture,	10.00	10.80	8.80	90.00
Nitrogen, 17 cts. per lb.,	1.96	2.80	5.03	0.55
Phosphoric acid, 6 cts. per lb.,	0.77	2.36	.30	0.17
Potassium oxide, 4 1-4 cts. per lb.,	0.45	1.36	.03	0.20
Valuation per 2000 lbs.,	$7.97	$13.51	$17.49	$2.25

451. WHEAT BRAN.

81.93 per cent. passed through Mesh 144 to square inch.

	Percentage Composition.	Constituents (in lbs.) in a ton of 2000 lbs.	Pounds digestible in a ton of 2000 lbs.	Per cent. of digestibility of constituents.	Nutritive Ratio.
Moisture at 100° C.,	12.05	241.00			
Dry Matter,	87.95	1729.00			
	100.00	2000.00			
ANALYSIS OF DRY MATTER.					1:3.77
Crude Ash,	6.64	132.80			
" Cellulose,	11.49	229.80	45.96	20	
" Fat,	4.75	95.00	76.00	80	
" Protein, (nitrogenous matter),	17.86	357.20	314.34	88	
Non-nitrogenous extract matter,	59.26	1185.20	948.16	80	
	100.00	2000.00	1384.46		

Used in all experiments; it represents the average composition of our wheat bran.

C. A. GOESSMANN, *Director*,
AMHERST, MASS.

The Bulletins of the Experiment Station will be sent free of charge to all parties interested in its work, on application.

J. E. Williams, Printer, Amherst, Mass.

MASSACHUSETTS STATE

AGRICULTURAL EXPERIMENT STATION.

BULLETIN No. 26.

AUGUST, 1887.

Meteorological Summary for the month ending July 31, 1887.

Highest temperature,	93.6°
Lowest temperature,	56.0°
Mean temperature,	73.71°
Total precipitation,	8.93 inches.
Prevailing winds,	South.
No. of days on which cloudiness averaged 8 or more on scale of 10,	8
No. of days on which 0.01 of an inch or more of water from rain or melted snow fell,	**11**

The mean temperature for this month (73.71°), is the highest of the same month since 1839, when it was 74.40°; July, 1863, it was 70.87° the nearest approach to it.

Similar relations are true in regard to the total rainfall.—This month fell 8.93 inches, the largest amount during any month of July since 1839, when it was 9.56 inches; in 1863 it was 8.63 inches, the next highest amount.

FOOD AND FODDER ANALYSES.

452—454. ANALYSES OF FINE SALT.

I and II sent on from Florida, Berkshire Co., Mass. III sent on from Springfield, Mass.

	Per Cent. I.	II.	III.
Moisture at 100° C.,	3.280	4.591	4.616
Sodium chloride,	95.091	94.012	94.236
Calcium sulphate,	1.487	1.177	0.999
Calcium chloride,	0.032	0.143	0.071
Magnesium chloride,	0.075	0.049	0.026
Matter insoluble in water (largely carbonates of lime and magnesia),	0.035	0.028	0.052
Salicylic acid,	0.	0.	trace
	100.000	100.000	100.000

The above described samples of salt have been offered of late in our markets as "Dairy Salt" judging from communications received. As the recent introduction into our markets of various brands of salt from new salt works in Western New York imparts a particular interest to the question of what constitutes a *good Dairy Salt*, a short discussion of that question may not be without interest in connection with the above analyses.

There are three sources of supply for the manufacture of salt, namely, sea water, brines and rock salts. None of them yield by any current mode of manufacture a chemically pure article of sodium chloride; all three may be successfully turned to account for the manufacture of the various brands of salt in our market.

Local circumstances control the selection of the particular source of supply; and as the particular fitness of salt for different domestic applications, as meat-packing, family use and dairy, depends not only on a *fairly good chemical composition*, but also to a considerable degree on a *suitable mechanical condition*, it is quite obvious that the selection of the mode of manufacture has to be made with reference to the general character and the quality of the source on hand, and to the kind of salt desired.

Our home manufactured salt, "*coarse*," "*fine*" and "*dairy salts*," has been produced until of late, almost entirely from natural brines, sea-water included. All natural brines contain more or less of foreign, saline admixtures. Most prominent among these are the sulphates of lime and of magnesia and the chlorides of calcium and magnesium.

The general character and the industrial value of different brines, considering concentration equally favorable, depends as a rule not so much on the *total amount* of foreign saline substances present as on the *relative proportion* of the above stated foreign admixtures.

The same circumstances apply with equal force to the salt produced. The less chlorides of calcium and of magnesium a salt contains the better will be considered its quality from a commercial standpoint. The presence of sulphate of lime within certain limits, is far less objectionable.

A salt which contains but one-fourth of one per cent. of the chlorides of magnesium and of calcium might prove highly objectionable to the dairyman on account of their unpleasant bitter saline taste:— while the sulphate of lime rarely amounts to less than one and one-quarter per cent. in the best reputed brands of dairy salts, home and foreign.

A detailed statement of the exact amount of *each* of the above mentioned foreign saline admixtures is for this reason needed te render a decision *possible* regarding the *relative merits* of the *various brands* of salt offered for sale, as far as a desirable composition is concerned.

The most common cause of injuring the composition of salt for dairy purposes in particular is a too liberal use of lime during its manufacture, to secure a desirable white color and a fine granulation of the salt produced.

The natural consequence of that course of operation is an alkaline reaction of the salt, a most objectionable quality of a dairy salt—for it hastens on the decomposition of the butter.

The peculiar nature of the products of the dairy, butter and cheese, as well as the unusual pecuniary risks involved in their successful manufacture, renders it necessary that only first class articles of salt should be applied for dairy purposes. The fitness of any of the various brands of salt in our markets for dairy use is not restricted to those obtained from any particular natural source or locality, but depends entirely upon a suitable good chemical composition and a suitable mechanical condition.

A good dairy salt ought to be of a neutral reaction and of a pure saline taste; free from offensive odor and without any stain of color; of a properly reduced size to favor a speedy solution, and what is scarcely of less importance free from colored specks. As the application of dairy salt in form of saturated solutions enables with but little trouble the removal of insoluble foreign admixtures, this mode of using salt in the dairy industries, whenever admissable, deserves commendation.

To produce an article of the above description requires an extra exertion on the part of the manufacturer, and necessitates thus additional expenses as compared with the average brands of "Common Fine" and the ordinary "coarse or solar salts", neither of which, as a general rule answers to the previous description.

A dairy salt originally good may become objectionable in consequence of a subsequent careless storing amidst strong smelling articles of merchandise, etc., or in barns.

Judging the above samples of "Dairy Salt" by the customary commercial standard of composition previously explained it will be noticed that sample I is preferable to sample II, although its total amount of foreign saline admixture is larger than in samples II and III. The last named sample would rank next if it did not contain some salicylic acid.

None of the above described three samples can claim to rank with the better brands of "Dairy Salt" in our markets.

The presence of an exceptional amount of carbonate of lime in all of them impairs greatly their fitness for dairy purposes. A good salt may not improve materially an otherwise carelessly manufactured butter or cheese, yet a lower grade of fine salt will invariably destroy the keeping quality of a good butter and cheese.

The addition of salicylic acid as a preservative is strongly condemned by good authorities in sanitary matters.

455—457. VINEGARS.

Sent on from Prescott, Mass.

I. Made Oct. 5, 1885 from unripe Baldwin apples. Shrinkage $1\frac{1}{4}$ galls. on 10 or $12\frac{1}{2}$ per cent.

II. Made Oct. 28, 1885 from ripe Baldwin apples. Shrinkage not determined.

III. Made Oct. 28, 1885 from Sweet Apples. Shrinkage 1 gall. on 7 or $14\frac{2}{7}$ per cent.

	Per Cent. I.	II.	III.
Temperature, C.,	11.1	11.1	11.1
Specific Gravity,	1.016	1.019	1.024
Acetic Acid,	6.67	8.41	8.66
Sulphuric acid and chlorine,	trace.	trace.	trace.
Solids at 100° C.,	1.44	1.94	3.02

The tests were made January 24, 1887.

458. GREEN CORN FODDER.

Used for ensilage in 1886. (Clark variety).

	Percentage Composition.	Constituents (in lbs.) in a ton of 2000 lbs.	Pounds digestible in a ton of 2000 lbs.	Per cent. of digestibility of constituents.	Nutritive Ratio.
Moisture at 100° C.,	70 27	1405.40			
Dry Matter,	29.73	594.60			
	100.00	2000.00			
ANALYSIS OF DRY MATTER.					1:10.36
Crude Ash,	5.24	104.80			
" Cellulose,	24.50	490.00	352.80	72	
" Fat,	3.38	67.60	50 70	75	
" Protein, (nitrogenous matter),	8.36	167.20	122.05	73	
Non-nitrogenous extract matter,	58 52	1170.40	784.16	67	
	100.00	2000.00	1309.71		

The corn was raised upon land for several years fertilized by ground bone and muriate of potash. 600 pounds of ground bone and 200 pounds of muriate potash. It was cut Sept. 4th, when the kernels were glazed, yet soft.

Analysis of Green Corn Fodder with reference to Fertilizing Constituents.

	Per Cent.
Moisture at 100° C.,	70.27
Phosphoric acid, 6 cts.,	.13
Calcium oxide,	.18
Magnesium oxide,	.05
Potassium " $4\frac{1}{4}$ cts.,	.36
Sodium "	.05
Nitrogen, 17 cts.,	.41
Insoluble matter,	.45

Valuation per 2000 pounds, $1.86.

159. CORN ENSILAGE.

Experiment Station, 1886.

	Percentage Composition.	Constituents (in lbs.) in a ton of 2000 lbs.	Pounds digestible in a ton of 2000 lbs.	Per cent. of digestibility of constituents.	Nutritive Ratio.
Moisture at 100° C.,	71.60	1432.00			
Dry Matter,	28.40	568.00			
	100.00	2000.00			
ANALYSIS OF DRY MATTER.					1 : 11.9
Crude Ash,	3.32	66.40			
" Cellulose,	18.52	370.40	266.69	72.0	
" Fat,	6.07	121.40	91.05	75.0	
" Protein, (nitrogenous matter),	7.78	155.60	113.59	73.0	
Non-nitrogenous extract matter,	64.31	1286.20	861.75	67.0	
	100.00	2000.00	1333.08		

The above corn ensilage was obtained from the green corn fodder previously described (No. 158). The silo was filled with the cut corn fodder and closed without any delay, Sept. 4th, 1886 (see details pp. 60–62 in IV Annual Report); it was reopened for feeding, January 4th, 1887. The record of the maximum thermometer buried in the centre of the silo showed 97° F., indicating but a slight increase in temperature as compared with the temperature on the day when filled. The ensilage was of a very good quality. A comparison with the composition of the green corn fodder which served for its manufacture shows the usual changes noticed in a silo, which has been filled at once and closed carefully without any material delay to prevent a more serious heating up of its contents,—namely a decrease in nitrogenous matter and crude cellulose, and an increase in fatty acids and in soluble non-nitrogenous extract matter. The nutritive ratio of the corn fodder was but slightly altered. A sample of the corn ensilage taken from two feet below the surface near the centre of the silo contained 32.46 parts of dry matter, 0.0185 parts of actual ammonia, and required 0.659 milligrammes of sodium oxide for the neutralization of its acids (acetic and lactic acid).

Analysis of Corn Ensilage with reference to Fertilizing Constituents

	Per Cent.
Moisture,	71.60
Phosphoric acid, 6 cts. per pound,	.14
Ferric oxide,	.02
Magnesium oxide,	.09
Calcium "	.10
Potassium " $4\frac{1}{4}$ cts. per pound,	.33
Sodium "	.05
Nitrogen, 17 cts. per pound,	.36
Insoluble matter,	.04

Valuation per 2000 pounds, $1.68.

460. ENSILAGE OF SWEET CORN.

Sent on from Marblehead, Mass.

ANALYSIS OF DRY MATTER.

	Per Cent.
Crude Ash,	5.66
" Cellulose,	24.21
" Fat,	5.19
" Protein (nitrogenous matter),	10.10
Non-nitrogenous extract matter,	54.84
	100.00

The general appearance of the ensilage was good. The small amount of soluble non-nitrogenous matter in presence of a comparatively large amount of crude nitrogenous matter and of crude cellulose seems to indicate a considerable destruction of non-nitrogenous matter (sugar, starch, etc.) during the keeping of the corn in the silo. The composition of this sample of ensilage of sweet corn resembles that obtained from corn in the tassel.

A comparison of the above analysis with some of the analyses of the dry vegetable matter of corn ensilage produced at the Experiment Station during previous years suggests that conclusion.

461. "WESTERN DENT" CORN.

Sent on from Sunderland, Mass.

	Per Cent.	
	EARS.	STOVER.
Moisture at 100° C.,	10.20	16.67
Dry Matter,	89,80	83.33
	100.00	100.00

ANALYSIS OF DRY MATTER.

	EARS.	STOVER.
Crude Ash,	1.47	4.17
" Cellulose,	1.86	35.44
" Fat,	4.72	1.71
" Protein (nitrogenous matter),	9.31	6.63
Non-nitrogenous extract matter,	82.64	52.05
	100.00	100.00

The above stated corn was raised, according to reports received, on excellent soil in "Sunderland Meadows"; four cords of barnyard manure and 150 lbs. of a Phosphatic fertilizer per acre had been applied.

6 stalks well air-dried weighed	2 lbs. 0 oz.
6 ears " " "	2 " 8 "

The average length of ear was seven and one-half inches. It contained twelve rows of kernels, and its average weight amounted to six and one-half ounces; 85.6 per cent. kernels and 14.4 per cent. cob.

The variety of Western Corn—*Pride of the North*—described in a previous BULLETIN was of a better composition than the above-named one. Whether this difference is due to an inherent quality or to a superior condition of the soil which served for the production cannot well be decided without an actual test under corresponding conditions. The difference in quality is large enough to deserve the serious attention of those who desire to raise the best in the market.

462. CORN MEAL.

Amherst Mill.

	Percentage Composition.	Constituents (in lbs.) in a ton of 2000 lbs.	Pounds digestible in a ton of 2000 lbs.	Per cent. of digestibility of constituents.	Nutritive Ratio.
Moisture at 100° C.,	12.62	252.40			
Dry Matter,	87.38	1747.60			
	100.00	2000.00			
ANALYSIS OF DRY MATTER.					
Crude Ash,	1.56	31.20			1 : 8.76
" Cellulose,	2.66	53.20	18.09	34	
" Fat,	4 27	85.40	64.90	76	
" Protein, (nitrogenous matter),	11.43	228.60	194.31	85	
Non-nitrogenous extract matter,	80.08	1601.60	1505.50	94	
	100.00	2000.00	1782 80		

Used in third, fourth and fifth experiments in feeding pigs—see Bulletin 25.

463. CHICAGO GLUTEN MEAL.

(Bought at Springfield, Mass.)

	Percentage Composition.	Constituents (in lbs.) in a ton of 2000 lbs.	Pounds digestible in a ton of 2000 lbs.	Per cent. of digestibility of constituents.	Nutritive Ratio.
Moisture at 100° C.,	8.95	179.00			
Dry Matter,	91.05	1821.00			
	100.00	2000.00			
ANALYSIS OF DRY MATTER.					1 : 3.00
Crude Ash,	.76	15.20			
" Cellulose,	1.58	31.60	10.74	34	
" Fat,	7.51	150.20	114.15	76	
" Protein, (nitrogenous matter),	30.81	616.30	523.77	85	
Non-nitrogenous extract matter,	59.34	1186.80	1115.59	94	
	100.00	2000.00	1764.25		

Used in third, fourth and fifth experiments in feeding pigs—see Bulletin 25.

464. HERDS GRASS.

Grown at the Experiment Station. Collected while in bloom June 28, 1886.

	Percentage Composition.	Constituents (in lbs.) in a ton of 2000 lbs.	Pounds digestible in a ton of 2000 lbs.	Per cent. of digestibility of constituents.	Nutritive Ratio.
Moisture when collected,	65.00	1300.00			
Dry Matter when collected,	35.00	700.00			
	100.00	2000.00			
ANALYSIS OF DRY MATTER.					1 : 11.86
Crude Ash,	5.37	107.40			
" Cellulose,	32.50	650.00	377.00	58	
" Fat,	2.07	41.40	19.04	46	
" Protein, (nitrogenous matter),	8.83	176.60	100.66	57	
Non-nitrogenous extract matter,	61.23	1224.60	771.50	63	
	100.00	2000.00	1268.20		

Analysis of Hay with reference to Fertilizing Constituents.

	Per Cent.
Moisture,	7.24
Phosphoric acid, 6 cts. per lb.	.56
Potassium oxide, 4¼ cts. "	1.44
Magnesium oxide,	0.09
Calcium oxide,	0.99
Sodium oxide,	0.37
Nitrogen, 17 cts. per lb.	1.31
Insoluble Matter,	1.33
Valuation per 2000 lbs.,	$6.35

465. CARROTS.

Raised at the Experiment Station, 1886.

	Percentage Composition.	Constituents (in lbs.) in a ton of 2000 lbs.	Pounds digestible in a ton of 2000 lbs.	Per cent. of digestibility of constituents.	Nutritive Ratio.
Moisture at 100° C.,	90.02	1800.40			
Dry Matter,	9.98	199.60			
	100.00	2000.00			
ANALYSIS OF DRY MATTER.				100	1:9.24
Crude Ash,	11.21	224.20			
" Cellulose,	10.76	215.20	215.20		
" Fat,	1.89	37.80	37.80		
" Protein (nitrogenous matter),	8.90	178.00	178.00		
Non-nitrogenous extract matter,	67.24	1344.80	1344.80		
	100.00	2000.00	1775.80		

The average amount of dry matter in well grown carrots is usually stated (E. Wolff) to be 15 per cent. of the weight of the fresh root; in *our* case it varied from *9 to 12* per cent. according to the size of the root tested. Large specimens of roots contain frequently a smaller amount of dry vegetable matter, than smaller ones, equally matured. Cultivation, manuring, season and time of seeding, aside from fitness of the soil, affect seriously the general character of the root crops. In our case, soil and state of fertilization were favorable,—frequent rains towards the close of the summer season had favored apparently in an exceptional degree the growth of the leaves at the expense of a timely maturing of the roots.

Analysis of Carrots with reference to Fertilizing Constituents.

	Per Cent.
Moisture at 100° C.,	90.02
Ferric oxide,	0.01
Phosphoric acid, 6 cts. per pound,	0.10
Magnesium oxide,	0.02
Calcium oxide,	0.07
Potassium oxide, $4\frac{1}{4}$ cts. per pound,	0.51
Sodium oxide,	0.11
Nitrogen, 17 cts. per pound,	0.14
Insoluble matter,	0.01

Valuation per 2000 pounds, $1.06.

Fertilizer and Fertilizer Analyses.

466—470. WOOD ASHES (Canada).

I. Sent on from Methuen, Mass.
II. Sent on from Eastham, Mass.
III. Sent on from Boston, Mass.
IV. Sent on from So. Deerfield, Mass.
V. Sent on from Sunderland, Mass.

	Per Cent.				
	I.	II.	III.	IV.	V.
Moisture,	17.33	13.59	17.38	14.09	11.39
Phosphoric acid,	——	1.46	1.17	1.38	1.71
Magnesium oxide,	——	3.16	3.77	3.35	3.32
Calcium oxide,	——	35.90	31.50	36.90	37.25
Potassium oxide,	7.22	5.74	6.24	6.72	6.14
Insoluble matter (before cal.),	7.05	10.64	18.05	8.20	10.83
" " (after cal.),		7.55	13.49	6.42	7.71

The percentage of phosphoric acid and magnesium and calcium oxides in sample I was not determined as requested.

471—475. WOOD ASHES.

VI. Collected at So. Deerfield (car 0111), Mass.
VII. Collected at So. Deerfield, Mass.
VIII. Sent on from Northampton, Mass.
IX. Collected at So. Deerfield (car 1791), Mass.
X. Sent on from Sunderland, Mass.

	Per Cent.				
	VI.	VII.	VIII.	IX.	X.
Moisture,	13.31	14.71	9.70	12.37	10.97
Phosphoric acid,	1.38	1.17	.89	.98	1.19
Magnesium oxide,	3.48	3.57	3.64	3.58	3.20
Calcium oxide,	37.74	36.32	37.23	36.26	36.46
Potassium oxide,	4.86	6.85	7.55	6.77	6.28
Insoluble matter (before cal.),	7.46	14.65	23.80	17.78	17.45
" " (after cal.),	5.80	9.14	12.62	10.45	12.01

These samples of Wood Ashes are with one exception—No. VI. —of good quality. Unleached wood ash sells in our vicinity, at 24 to 25 cts. per bushel of from 42 to 45 lbs. in weight.

476—479. POTASH SALTS.

I, II and III, Muriate of Potash.
IV, Sulphate of Potash.

Sent on by the Agent of the Farmers' Coöperative Purchasing Club, Ashby, Mass.

	Per Cent.			
	I.	II.	III.	IV.
Moisture at 100° C.,	0.15	1.16	.75	.34
Potassium oxide, $4\frac{1}{4}$ cts. per pound,	51.87	53.33	52.11	51.28
Sulphuric Acid,	——	——	——	46.41
Insoluble matter,	——	——	——	0.93
Valuation per 2000 pounds,	$44.09	$45.33	$44.30	$56.41

All are of a very good quality. The sulphate of potash is valued at $5\frac{1}{2}$ cts. per pound of potassium oxide, the present basis for its valuation.

480, 481. SUPERPHOSPHATES.

I. Dissolved Bone Black.
II. Acid Phosphate.

Sent on by the Agent of the Farmers' Coöperative Purchasing Club, Ashby, Mass.

	I.	II.
	Per Cent.	
Moisture at 100° C.,	13.83	16.39
Total Phosphoric Acid,	18.21	14.68
Soluble " " (8 cts.)	14.59	10.50
Reverted " " ($7\frac{1}{2}$ cts.)	3.41	3.82
Insoluble " " (3 cts.)	.21	.36
Insoluble Matter,	3.52	7.89
Valuation per 2000 lbs.	$28.59	$22.75

Both are of a good quality.

482. FISH BONE AND POTASH.

Sent on from Concord, Mass.

		Per Cent.
Moisture,		16.93
Total Phosphoric Acid,		4.19
Soluble " "	8 cts. per lb.	.37
Reverted " "	$7\frac{1}{2}$ cts. "	2.00
Insoluble " "	3 cts. "	1.82
Potassum Oxide,	$4\frac{1}{4}$ cts. "	1.24
Nitrogen,	$17\frac{1}{2}$ cts. "	1.66
Insoluble Matter,		30.80
Valuation per 2000 lbs.,		$11.54

This article is evidently a refuse material of some particular kind; the large amount of insoluble matter it contains, points in that direction.

483, 484. GROUND BONES.

Sent on from Westford, Mass.

			I.	II.
			Per Cent.	
Moisture at 100° C.,			3.94	9.74
Total Phosphoric Acid,			27.73	12.85
Sol. and Rev. " "	$7\frac{1}{2}$ cts. per lb.,		6.10	4.72
Insoluble " "	5 cts. "		21.63	8.13
Nitrogen,	15 cts. "		1.83	2.93
Insoluble Matter,			.10	2.61
Valuation per 2000 lbs.,			$36.27	$23.90

The mechanical condition of both samples was much the same; the valuation above given has been for this reason the same. The desirability of having ground bones sold only by a guaranteed composition finds an additional strong illustration in this case.

485. MARL.

Sent on from South Framingham, Mass.

	Per Cent.
Moisture at 100° C.,	12.12
Phosphoric acid,	.35
Magnesium oxide,	.65
Calcium oxide,	47.11
Sulphuric acid,	trace
Chlorine,	trace
Insoluble Matter (Before Cal.),	7.73
" " (after Cal.),	7.51

The above material sent on "as a sample of marl," is essentially a carbonate of lime of fine aggregation and of a soft texture; and for this reason it deserves a recommendation for agricultural purposes whereever an addition of lime will benefit the soil in the interest of the crops raised upon it.

C. A. GOESSMANN, *Director*,
AMHERST, MASS.

The Bulletins of the Experiment Station will be sent free of charge to all parties interested in its work, on application.

J. E. Williams, Printer, Amherst, Mass.

MASSACHUSETTS STATE

AGRICULTURAL EXPERIMENT STATION.

BULLETIN No. 27.

OCTOBER, 1887.

Meteorological Summary for August and September.

	AUGUST.	SEPTEMBER.
Highest temperature,	88.°	80.°
Lowest temperature,	42.5°	29.5°
Mean temperature,	64.92°	55.94°
Mean humidity,	81.24°	80.47°
Total precipitation,	7.75 inches.	1.22 inches.
Prevailing winds,	N. W.	N. W.
No. of days on which cloudiness averaged 8 or more on scale of 10,	5	10
No. of days on which 0.1 of an inch or more of rain fell,	9	4

Very heavy fogs characterized both months. The first frost of the season occurred on Sept. 17th.

Notes on Feeding Experiments with Milch Cows.

486. The feeding experiments briefly described within a few subsequent pages are essentially a continuation of those reported in the last annual report of the Station. The same fodder articles have been used on both occasions, with the exception that in the experiments discussed below, carrots have taken the place of sugar beets, which were used in our preceding trial. Aside from this temporary modification in the diet, a comparatively new fodder article, the gluten meal, has been added as a temporary ingredient of the daily fodder ration. This particular change in the composition of the feed used, was made for the purpose of *securing whenever desired* a *closer relation* between the *digestible nitrogenous* and *non-nitrogenous organic constituents* of the *food consumed*, as compared with that which served in our previous experiments. The gluten meal was chosen for that end from among the various concentrated commercial feed-stuffs, on account of its close relation to corn, of which it constitutes a part, and its higher nitrogenous character, when compared with that of the corn meal and the wheat bran (shorts). One of the principal objects of these more recent investigations has been the same as that of the earlier ones, namely: To study the feeding effect of dried corn fodder (stover), as a substitute, whole or in part, for English hay; and that of corn ensilage as compared with roots under corresponding circumstances; for details in this connection see our IV. Annual Report, page 11.

Three cows, mixed breed, from five to six years old were selected for our work. They were practically in the same milking period, from three to six weeks after calving, at the beginning of the trial. The observation extended over a period of seven months, October 1st, 1886 to April 24th, 1887.

The temporary changes in the diet, wherever 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.

As our feeding experiments with milch cows were originally undertaken with the intention of carrying out a systematic course of inquiry into the economical relations of the production of milk with reference to the dairy industry as well as to a practical general farm management, it was thought best for various reasons to begin our work with cows of moderate milking qualities. The effect of different diets, on the *quantity* and *quality* of the milk produced, as well as *their bearing* on the *net cost* of *production* promised to be of particular interest under the stated circumstances. A beginning of our work at the lower end of the scale of the production of milk offered besides, the particular advantage that the results obtained, by a careful mode of observation might find a direct application to a still quite numerous class of cows on our farms, which are not infrequently assumed to be of *but little* merit from an economical standpoint. It is our intention to publish as soon as practicable a statement concerning the *annual yield* of milk of some of our cows at present on trial, and also the *net cost* of its production as far as the feed is concerned, to show more plainly the annual profits of keeping cows of moderate milking qualities.

The daily diet of the cows consisted at the beginning of the experiments of three and one-quarter pounds of corn meal, an equal weight of wheat bran and all the hay they could eat. The actual amount of hay consumed, in each case, was ascertained by daily weighing out a liberal supply of it and deducting subsequently the hay left over.

The statement in our records below refers to the average consumption of hay per day during the feeding period.

The above-stated combination of fodder articles was adopted as the basis of our investigation, mainly for the reason that it had been used with satisfactory results 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 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 is based on the local market price per ton, when used: Good English hay, $15; corn meal, $23; wheat bran, $20; gluten meal, $23; rye middlings, $24; dry corn fodder (stover) $5; corn ensilage, $2.75; carrots, $7.

The value of a fodder *for dairy purposes* may be stated from *two distinctly different standpoints*,—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 first cost, i. e.*, its physiological and commercial value.

The *market value and the 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 judicious use.

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 the fodder articles at our disposal from both standpoints.

The chemical analyses of the various articles used in the combination of fodder in our case, with the exception of that of carrots which may be found in BULLETIN No. 26, page 9, are stated in some succeeding pages to show their character and their respective quality. 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 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 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. 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 *results 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 proportion 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 subsequent short description of our feeding experiments will show, for instance, that the corn meal fed contained *one part of digestible nitrogenous* to *8.76 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 Ratio" of the corn meal is subsequently stated as follows 1 :8.76 ; that of wheat bran 1 :3.47 ; of gluten meal 1 :2.67 ; of rye middlings 1 :7.28 ; of English hay 1 :9.5 ; of dry corn fodder 1 :9.3 ; of corn ensilage 1 :11.9 ; of carrots 1 :9.24. 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 or oxen. German investigators recommend a combination of fodder articles, in other respects suitable, which contains one part of digestible nitrogenous organic constituents, to 5.4 parts of digestible non-nitrogenous constituents.

From the description of our earlier feeding experiments with milch cows, see IV. 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 (1 :6.7) was obtained by feeding on an average daily 3 1-4 pounds of wheat bran. 15 pounds of hay with forty pounds of Lane's sugar beet, and the wider ratio (1 :10.17) by feeding daily on an average 3 1-4 pounds of corn meal, five pounds of hay and 41 3-4 pounds of corn ensilage (see Daisy). During our more recent feeding experiments, described below, on the whole closer relations are adopted than before; the relation between the two above stated important groups of fodder constituents vary from 1 :5.9 to 1 :7.9 ;

they are also more uniform during the various feeding periods. The closer relation—1 :5.9—is obtained by feeding daily on an average, 3 1-4 pounds each of corn meal, wheat bran and gluten meal, with ten pounds of hay and thirty-five pounds of carrots, and the wider ratio —1 :7.9—by feeding daily on an average, 3 1-4 pounds each, of corn meal and wheat bran, with 25 pounds of hay (see Dora). The entire recent feeding experiment is subdivided in eight distinctly differing 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 exact amount consumed of each fodder article was ascertained by taking their weights before feeding and deduct the amount left, if any. Grain and roots were usually fed during milking, and the coarser fodder between times.

Among other conclusions a careful examination of our subsequently tabulated feeding records of each cow, Susie, Meg and Dora, leads apparently with much propriety to the following:

The nutritive value of our dry corn fodder 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 matter they contain, exceeds that of the corn ensilage, as an ingredient of the daily diet in place of a part (1-2) 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 controling degree on the constitutional characteristics of the animals on trial. The effect is not unfrequently in our case the reverse in different animals.

The yield of the 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 entire 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, Feb. 7th to Feb. 21st, 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 total cost of the feed consumed for the production of milk is lowest wherever 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 cts. to 1.6 cts. in case of the same cow. The net cost of the feed is obtained by deducting 80 per cent. of the value of the fertilizing constituents it contains.

The manurial value of the feed consumed during the *entire* feeding experiment, deducting 20 per cent. for the amount of fertilizing constituents lost in the production of milk, is at current market rates in every instance more than equal to one-third of the original cost of the feed.

Two cows gained from 60 to 66 pounds in live weight during the trial; and one, the best milker, Dora, held practically its own from beginning to end.

For further details see the following pages.

FEEDING RECORD.

SUSIE; age 5 years. Grade Ayrshire. Last calf, July 14, 1886.

FEEDING PERIODS.	Feed consumed (pounds) per day. Wheat Bran.	Corn Meal.	Gluten Meal.	Rye Middlings.	Hay.	Ensilage.	Corn Fodder.	Roots, (Carrots).	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.
1886.													
1 Oct. 1–25	3 25	3.25			24.92				28.59	13.5	2.11	1 :7.9	855
2 Nov. 1–16	3.25	3.25	3.25		19.03				26 15	13.2	1.98	1 :6.1	877
3 Dec. 6–13		3.25	3.25	3.25	20.00				27.65	11.8	2.35	1 :6.8	883
4 Dec. 21–31	3.25	3.25					21.36		23.81	11.9	2.00	1 :7.7	883
1887.													
5 Jan. 18–31	3.25	3.25	3.25		5.00	32.79			22.60	11.0	2.06	1 :6.4	897
6 Feb. 7–21	3.25	3.25	3.25		10.00			35.00	21.36	12.9	1.66	1 :5.9	914
7 Mar. 9–25	3.25	3.25	3.25		20.00				27.00	11.1	2.42	1 :6.2	951
8 Apr. 6–24	3.25	3.25	3.25		18.95				26 07	9.4	2.76	1 :6.1	1019

MEG; age 6 years. Grade Devon. Last calf, Aug. 2, 1886.

FEEDING PERIODS.	Wheat Bran.	Corn Meal.	Gluten Meal.	Rye Middlings.	Hay.	Ensilage.	Corn Fodder.	Roots, (Carrots).	Amount of dry vegetable matter.	Quarts of milk per day.	Pounds of dry matter per quart.	Nutritive ratio.	Average weight.
1886.													
1 Oct. 1–25	3.25	3.25			25.00				28.66	13.9	2.06	1 :7.9	1023
2 Nov. 1–16	3.25	3.25	3.25		19.34				26.44	13 2	2.00	1 :6.1	1049
3 Dec. 6–13		3.25	3.25	3.25	20.00				27.65	12.9	2.15	1 :6.8	1078
4 Dec. 21–31	3.25	3.25					17.59		20.62	12.0	1.72	1 :7.5	1023
1887.													
5 Jan. 18–31	3.25	3.25	3.25		5.00	25.25			20.46	10.3	1.98	1 :6.1	1055
6 Feb. 7–21	3.25	3.25	3.25		10.00			35.00	21.36	11.0	1.94	1 :5.9	1083
7 Mar. 9–25	3.25	3.25	3.25		20.00				27.00	10.9	2.50	1 :6.2	1087
8 Apr. 6–24	3.25	3.25	3.25		18.95				26.07	10.7	2.43	1 :6.1	1149

DORA; age 6 years, Grade Devon. Last calf Sept. 6, 1886.

FEEDING PERIODS.	Wheat Bran.	Corn Meal.	Gluten Meal.	Rye Middlings.	Hay.	Ensilage.	Corn Fodder.	Roots, (Carrots).	Amount of dry vegetable matter.	Quarts of milk per day.	Pounds of dry matter per quart.	Nutritive ratio.	Average weight.
1886.													
1 Oct. 1–25	3.25	3.25			23.00				26.86	16.3	1.65	1 :7.8	882
2 Nov. 1–16	3.25	3.25	3.25		17.70				24.92	15.7	1.59	1 :6.0	859
3 Dec. 6–13		3.25	3.25	3.25	20.00				26.98	14.6	1.85	1 :6.8	889
4 Dec. 21–31	3.25	3.25					19.77		22.46	14.0	1.60	1 :7.7	851
1887.													
5 Jan. 18–31	3.25	3.25	3.25		5.00	28.64			21.42	12.8	1.68	1 :6.2	856
6 Feb. 7–21	3.25	3.25	3.25		10.00			35.00	21.36	13.5	1.58	1 :5.9	855
7 Mar. 9–25	3.25	3.25	3.25		20.00				27.00	12.2	2.21	1 :6.2	836
8 Apr. 6–24	3.25	3.25	3.25		18.95				26.07	11.7	2.23	1 :6.1	877

Manurial Value of Feed.

SUSIE.

	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.
	1886.	$	$	$	$	cts.	lbs.
1	Oct. 1–25	6.41	2.72	2.18	4.23	1.24	861
2	Nov. 1–16	4.00	1.92	1.54	2.46	1.16	896
3	Dec. 6–13	2.18	.92	.74	1.44	1.53	883
4	Dec. 21–31	1.36	1.00	.80	.56	.43	876
	1887.						
5	Jan. 18–31	2.66	1.48	1.18	1.48	.97	905
6	Feb. 7–21	4.58	1.67	1.34	3.24	1.67	921
7	Mar. 9–25	4.38	2.09	1.67	2.71	1.43	967
8	Apr. 6–24	3.84	2.27	1.82	2.02	1.13	1060
	Total,	29.41	14.07	11.27	18.14		

MEG.

	1886.	$	$	$	$	cts.	lbs.
1	Oct. 1-25	6.43	2.72	2.18	4.25	1.22	1030
2	Nov. 1–16	4.04	1.92	1.54	2.50	1.18	1055
3	Dec. 6–13	2.18	.92	.74	1.44	1.40	1056
4	Dec. 21–31	1.25	.89	.71	.54	.41	1020
	1887.						
5	Jan. 18–31	2.51	1.39	1.11	1.41	.98	1070
6	Feb. 7–21	4.58	1.67	1.34	3.24	1.96	1096
7	Mar. 9–25	4.38	2.09	1.67	2.71	1.47	1101
8	Apr. 6-24	3.84	2.27	1.82	2.02	.99	1170
	Total,	29.21	13.87	11.11	18.11		

DORA.

	1886.	$	$	$	$	cts.	lbs.
1	Oct. 1–25	6.05	2.58	2.06	3.99	.98	860
2	Nov. 1–16	3.84	1.85	1.48	2.36	.94	876
3	Dec. 6–13	2.18	.92	.74	1.44	1.24	884
4	Dec. 21–31	1.31	.96	.78	.53	.34	844
	1887.						
5	Jan. 18–31	2.58	1.43	1.14	1.44	.80	860
6	Feb. 7–21	4.58	1.67	1.34	3.24	1.60	852
7	Mar. 9–25	4.38	2.09	1.67	2.71	1.30	831
8	Apr. 6–24	3.84	2.27	1.82	2.02	.91	885
	Total,	28.76	13.77	11.03	17.73		

Total Cost of Feed per Quart of Milk.

SUSIE.

FEEDING PERIODS.	Total quantity of Milk produced during entire period.	Average daily yield of Milk for period.	Total amount of Wheat Bran consumed during period.	Total amount of Corn Meal consumed during period.	Total amount of Gluten Meal consumed during period.	Total amount of Rye Middlings consumed during period.	Total amount of Hay consumed during period.	Total amount of Ensilage consumed during period.	Total amount Corn Fodder consumed during period.	Total amount of Roots (Carrots) consumed during period.	Total cost of Feed consumed during period.	Av. cost of Feed for production of one qt. of Milk for period.
1886.	qts.	qts.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	$	cts.
1 Oct. 1–25	338.6	13.5	81.25	81.25			623.0				6.41	1.89
2 Nov. 1–16	211.3	13.2	52.00	52.00	52.00		304.5				4.00	1.89
3 Dec. 6–13	94.0	11.8		28.00	28.00	28.0	160.0				2.18	2.31
4 Dec. 21–31	130.5	11.9	35.75	35.75					235.0		1.36	1.04
1887.												
5 Jan. 18–31	153.3	11.0	45.50	45.50	45.50		70.0	459.0			2.66	1.74
6 Feb. 7–21	193.5	12.9	48.75	48.75	48.75		150.0			525	4.58	2.37
7 Mar. 9–25	189.8	11.1	55.25	55.25	55.25		340.0				4.38	2.31
8 Apr. 6–24	179.0	9.4	61.75	61.75	61.75		360.0				3.84	2.15

MEG.

1886.	qts.	qts.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	$	cts.
1 Oct. 1–25	347.8	13.9	81.25	81.25			625.0				6.43	1.85
1 Nov. 1–16	211.0	13.2	52.00	52.00	52.00		309.5				4.04	1.91
3 Dec. 6-13	103.0	12.9		28.00	28.00	28.0	160.0				2.18	2.12
4 Dec. 21–31	132.0	12.0	35.75	35.75					193.5		1.25	.95
1887.												
5 Jan. 18–31	144.5	10.3	45.50	45.50	45.50		70.0	353.5			2.51	1.74
6 Feb. 7–21	165.5	11.0	48.75	48.75	48.75		150.0			525	4.57	2.76
7 Mar. 9–25	184.0	10.9	55.25	55.25	55.25		340.0				4.38	2.38
8 Apr. 6–24	203.3	10.7	61.75	61.75	61.75		360.0				3.84	1.90

DORA.

1886.	qts.	qts	lbs.	lbs	lbs	lbs	lbs.	lbs.	lbs.	lbs.	$	cts.
1 Oct. 1–25	408.0	16.3	81.25	81.25			576.0				6.05	1.48
2 Nov. 1–16	251.5	15.7	52.00	52.00	52.00		283.0				3.84	1.53
3 Dec. 6–13	116.5	14.6		28.00	28.00	28.0	160.0				2.18	1.87
4 Dec. 21–31	154.0	14.0	35.75	35.75					217.5		1.31	.85
1887.												
5 Jan. 18–31	179.0	12.8	45.50	45.50	45.50		70.0	401.0			2.58	1.44
6 Feb. 7–21	203.0	13.5	48.75	48.75	48.75		150.0			525	4.58	2.26
7 Mar. 9–25	208.0	12.2	55.25	55.25	55.25		340.0				4.38	2.11
8 Apr. 6–24	222.3	11.7	61.75	61.75	61.75		360.0				3.84	1.73

VALUATION OF ESSENTIAL FERTILIZING CONSTITUENTS CONTAINED IN THE VARIOUS ARTICLES OF FODDER USED.

Nitrogen, 17 cts. per lb.; Phosphoric acid, 6 cts.; Potassium oxide, 4¼ cts.

(Per cent.)

	Wheat Bran.	Corn Meal.	Gluten Meal.	Rye Middlings.	Hay	Ensilage.	Corn Fodder.	Roots (Carrots).
Nitrogen, ...	2.80	1.96	5.03	1.84	1.21	0.36	1.17	0.14
Phosphoric acid, .	2.36	0.77	0.30	1.26	0.36	0.14	0.37	0.10
Potassium oxide, .	1.36	0.45	0.03	0.81	1.63	0.33	1.02	0.54
Valuation per 2000 lbs.	$13.51	$7.97	$17.49	$8.46	$5.93	$1.68	$5 26	$1.06

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 period.	Net Cost of Feed for the production of one quart of milk.	Weight of Animal at close of Period.
		$	$	$	$	cts.	lbs.
1.	Susie, ...	6.41	2.72	2.18	4.23	1.24	861
	Meg, ...	6.43	2.72	2.18	4.25	1.22	1030
	Dora, ...	6.05	2.58	2.06	3.99	.98	860
2.	Susie, ...	4 00	1.92	1.54	2.46	1.16	896
	Meg, ...	4.04	1.92	1.54	2.50	1.18	1055
	Dora, ...	3 84	1.85	1.48	2.36	.94	876
3.	Susie, ...	2.18	.92	.74	1.44	1.53	883
	Meg, ...	2.18	.92	.74	1.44	1.40	1056
	Dora, ...	2.18	.92	.74	1.44	1.24	884
4.	Susie, ...	1.36	1.00	.80	.56	.43	876
	Meg, ...	1.25	.89	.71	.54	.41	1020
	Dora, ...	1.31	.96	.78	.53	.34	844
5.	Susie, ...	2.66	1.48	1.18	1.48	.97	905
	Meg, ...	2.51	1.39	1.11	1.41	.98	1070
	Dora, ...	2.58	1.43	1.14	1.44	.80	860
6.	Susie, ...	4.58	1.67	1.34	3.24	1.67	921
	Meg, ...	4 58	1.67	1.34	3.24	1.96	1096
	Dora, ...	4.58	1.67	1.34	3.24	1.60	852
7.	Susie, ...	4.38	2.09	1.67	2.71	1.43	967
	Meg, ...	4.38	2.09	1.67	2.71	1.47	1101
	Dora, ...	4.38	2.09	1.67	2.71	1.30	831
8.	Susie, ...	3.84	2.27	1.82	2.02	1.13	1060
	Meg, ...	3.84	2.27	1.82	2.02	.99	1170
	Dora, ...	3.84	2.27	1.82	2.02	.91	885

SUMMARY.

SUSIE.

Total amount of milk produced during above records,	1490 qts.
Total cost of feed per quart of milk produced,	1.97 cts.
Manurial value left behind per quart of milk produced,	.75 cts.
Net cost per quart of milk produced,	1.22 cts.

MEG.

Total amount of milk produced during above records,	1491.1 qts.
Total cost of feed per quart of milk produced,	1.96 cts.
Manurial value left behind per quart of milk produced,	.75 cts.
Net cost per quart of milk produced,	1.21 cts.

DORA.

Total amount of milk produced during above records,	1742.3 qts.
Total cost of feed per quart of milk produced,	1.65 cts.
Manurial value left behind per quart of milk produced,	.64 cts.
Net cost per quart of milk produced,	1.01 cts.

Analyses of Milk.

SUSIE.

(PER CENT.)

	1886. Oct. 22.	Nov. 3.	Nov. 30.	Dec. 14.	Dec. 31.	1887. Jan. 19.	Jan. 31.	Mar. 1.	Mar. 22.	Apr. 21.
Water,	88.10	87.66	87.21	87.16	88.23	87.75	87.27	87.50	87.68	88.26
Solids,	11.90	12.34	12.79	12.83	11.77	12.24	12.72	12.50	12.32	11.74
Fat (in solids),	3.79	3.47	4.29	3.92	3.34	3.47	4.08	3.68	3.66	3.45

MEG.

Water,	87.71	87.80	87.80	87.62	88.37	88.29	88.43	87.84	87.49	87.88
Solids,	12.29	12.20	12.20	12.38	11.63	11.71	11.57	12.16	12.51	12.12
Fat (in solids),	3.69	3.36	3.30	3.64	3.16	2.98	3.11	3.45	3.55	3.64

DORA.

Water,	87.75	87.14	87.18	87.45	87.00	86.84	87.10	87.47	86.68	86.70
Solids,	12.25	12.86	12.82	12.55	13.00	13.16	12.90	12.53	13.32	13.30
Fat (in solids),	3.69	3.96	3.89	3.73	3.77	3.77	3.27	3.71	3.91	3.85

The milk produced at the Station is not sold in the market; the cream is sent to the local creamery and the skim-milk is turned to account for stock feeding.

Analyses of Fodder Articles used in the Previous Experiment.

HAY.

From Experiment Station.

	Percentage Composition.	Constituents (in lbs.) in a ton of 2000 lbs.	Pounds digestible in a ton of 2000 lbs.	Per cent. of digestibility of constituents.	Nutritive Ratio.
Moisture at 100° C.,	8.30	166.00			
Dry Matter,	91.70	1834.00			
	100.00	2000.00			
ANALYSIS OF DRY MATTER.					1:9.5
Crude Ash,	6.12	122.40			
" Cellulose,	30.19	603.80	350.20	58	
" Fat,	2.55	51.00	23.46	46	
" Protein, (nitrogenous matter),	9.75	195.00	111.15	57	
Non-nitrogenous extract matter,	51.39	102.78	647.51	63	
	100.00	2000.00	1132.32		

WHEAT BRAN.

Amherst, Mass.

	Percentage Composition.	Constituents (in lbs.) in a ton of 2000 lbs.	Pounds digestible in a ton of 2000 lbs.	Per cent. of digestibility of constituents.	Nutritive Ratio.
Moisture at 100° C.,	10.87	217.40			
Dry Matter,	89.13	1782.60			
	100.00	2000.00			
ANALYSIS OF DRY MATTER.					1:3.47
Crude Ash,	5.90	118.00			
" Cellulose,	8.27	165.40	33.08	20	
" Fat,	4.40	88.00	70.40	80	
" Protein, (nitrogenous matter),	19.63	392.60	345.53	88	
Non-nitrogenous extract matter,	61.80	1236.00	988.80	80	
	100.00	2000.00	1437.81		

CORN MEAL.

Amherst Mill.

	Percentage Composition.	Constituents (in lbs.) in a ton of 2000 lbs.	Pounds digestible in a ton of 2000 lbs.	Per cent. of digestibility of constituents.	Nutritive Ratio.
Moisture at 100° C.,	12.62	252.40			
Dry Matter,	87.38	1747.60			
	100.00	2000.00			
ANALYSIS OF DRY MATTER.					
Crude Ash,	1.56	31.20			1:8.76
" Cellulose,	2.66	53.20	18.09	34	
" Fat,	4.27	85.40	64.90	76	
" Protein, (nitrogenous matter),	11.43	228.60	194.31	85	
Non-nitrogenous extract matter,	80.08	1601.60	1505.50	94	
	100.00	2000.00	1782.80		

CHICAGO GLUTEN MEAL.

Springfield, Mass.

96.81 per cent. passed through Mesh, 144 to square inch.

	Percentage Composition.	Constituents (in lbs.) in a ton of 2000 lbs.	Pounds digestible in a ton of 2000 lbs.	Per cent. of digestibility of constituents.	Nutritive Ratio.
Moisture at 100° C.,	8.83	176.60			
Dry Matter,	91.17	1823.40			
	100.00	2000.00			
ANALYSIS OF DRY MATTER.					
Crude Ash,	0.73	14.60			1:2.67
" Cellulose,	0.79	15.80	5.37	34	
" Fat,	8.46	169.20	128.59	76	
" Protein, (nitrogenous matter),	31.43	628.60	534.31	85	
Non-nitrogenous extract matter,	58.59	1171.80	1101.49	94	
	100.00	2000.00	1769.76		

RYE MIDDLINGS.

From Amherst Mill, 1886.

	Percentage Composition.	Constituents (in lbs.) in a ton of 2000 lbs.	Pounds digestible in a ton of 2000 lbs.	Per cent. of digestibility of constituents.	Nutritive Ratio.
Moisture at 100° C.,	12.54	250.80			
Dry Matter,	87.46	1749.20			
	100.00	2000.00			
ANALYSIS OF DRY MATTER.					1 : 7.28
Crude Ash,	4.02	80.40			
" Cellulose,	3.70	74.00	6 66	9.0	
" Fat,	5.61	112.20	64.52	57.5	
" Protein, (nitrogenous matter),	13.15	263.00	173.58	66.0	
Non-nitrogenous extract matter,	73.52	1470.40	1095.45	74.5	
	100.00	2000.00	1340.21		

DRY CORN FODDER (STOVER).

From the Experiment Station.

	Percentage Composition.	Constituents (in lbs.) in a ton of 2000 lbs.	Pounds digestible in a ton of 2000 lbs.	Per cent. of digestibility of constituents.	Nutritive Ratio.
Moisture at 100° C.,	15.40	308.00			
Dry Matter,	84.60	1692.00			
	100.00	2000.00			
ANALYSIS OF DRY MATTER.					1 : 9.3
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	1261.00	844.87	67	
	100.00	2000.00	1319 59		

CORN ENSILAGE.

From the Silos of the Experiment Station.

	Percentage Composition.	Constituents (in lbs.) in a ton of 2000 lbs.	Pounds digestible in a ton of 2000 lbs.	Per cent. of digestibility of constituents.	Nutritive Ratio.
Moisture at 100° C.,	71.60	1432.00			
Dry Matter,	28.40	568.00			
	100.00	2000.00			
ANALYSIS OF DRY MATTER.					
Crude Ash,	3.32	66.40			1 : 11.9
" Cellulose,	18.52	370.40	266·69	72	
" Fat,	6.07	121·40	91.05	75	
" Protein, (nitrogenous matter).	7.78	155.60	113.59	73	
Non-nitrogenous extract matter,	64.31	1286.20	861.75	67	
	100.00	2000.00	1333.08		

C. A. GOESSMANN, *Director*,

AMHERST, MASS.

The Bulletins of the Experiment Station will be sent free of charge to all parties interested in its work, on application.

J. E. Williams, Printer, Amherst, Mass.

MASSACHUSETTS STATE AGRICULTURAL EXPERIMENT STATION.

BULLETIN No. 28.

MARCH, 1888.

Meteorological Summary for the five months ending Feb. 29, 1888.

	OCT.	NOV.	DEC.	JAN.	FEB.
Highest temperature,	74.4°	64.8°	51.0°	41.0°	46.0°
Lowest temperature,	17.0	11.0	—6.0	—21.5	—19.0
Mean temperature,	47.00	36.49	26.65	13.78	22.05
Total precipitation,	2.10 in.	3.35 in.	4.11 in.	3.87 in.	3.94 in.
Total snowfall,			10 in.	19 in.	9.5 in.
Prevailing winds,	N. W.	N. W.	N. W.	N. W.	N. W.
No. of days on which cloudiness averaged 8 or more on scale of 10,	7	11	16	5	8
No. of days on which 0.1 of an inch or more of water from rain or melted snow fell,	5	7	10	8	7

Very mild weather characterized the months of October and November. The first snow of any consequence was on the 18th and 19th of December. January was the coldest month for fifty-one years, the average temperature being 9.5 degrees lower than that of any preceding January for that time. The first of February continued cold. On the 20th a thaw occurred which materially lessened the amount of snow on the ground.

The publication of BULLETINS for the present year begins with this number. Copies will be sent to all parties already on our distributing list—without awaiting a special notice. Provisions are made to meet new applications. The supply of BULLETINS No. 1 to 21 and 22-23 and of the second annual report is exhausted, while of BULLETINS Nos. 20, 24, 25, 26 and 27, and of the first, third and fourth annual reports, there are still a limited number on hand for distribution. The fifth annual report will be soon ready for distribution.

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 on to "The State Experiment Station" must have express and postal charges prepaid, to receive attention.

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 agricultural chemists as a basis for a commercial valuation, are once more stated, within a few subsequent pages.

The customary valuation of manurial substances is based on the average trade value of the 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., phosporic 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 offiered of late for sale, in our large markets.*

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, does, quite frequently, 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 fertilizer 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 in the condition of the trade during the past six months are embodied in the subsequent tabular statement of cost of fertilizing ingredients for the opening of the season for 1888.

The market reports of centres of trade in New England, New York and New Jersey, aside from consultations 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 20 per cent., to cover expenses for sales, credits, etc.

These trade values, except those for phosphoric acid, soluble in ammonium-citrate, were agreed upon by the Experiment Stations of Massachusetts, Connecticut, New Jersey and Vermont for use in their several states for the present season.

TRADE VALUES OF FERTILIZING INGREDIENTS IN RAW MATERIALS AND CHEMICALS.

	1888. *Cents per pound.*
Nitrogen in ammoniates,	17½
" " nitrates,	16
Organic nitrogen in dry and fine ground fish, meat, blood, cotton-seed meal and castor pomace,	16½
" " " fine ground bone and tankage,	16½
" " " fine ground medium bone and tankage,	13
" " " medium bone and tankage,	10½

" " " coarser bone and tankage,	$8\frac{1}{2}$
" " " hair, horn-shavings and coarse fish scrap,	8
Phosphoric acid soluble in water,	8
" " soluble in ammonium citrate,*	$7\frac{1}{2}$
" " in dry ground fish, fine bone and tankage,	7
" " in fine medium bone and tankage,	6
" " in medium bone and tankage,	5
" " in coarser bone and tankage,	4
" " in fine ground rock phosphate,	2
Potash as High Grade Sulphate, and in forms free from Muriate or Chlorides,	$5\frac{1}{2}$
" " Kainite,	$4\frac{1}{2}$
" " Muriate,	$4\frac{1}{4}$

The above trade values are the figures at which in the six months preceding March 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 1st plus about 20 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,	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.

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

*Dissolved from two grams of Phosphate unground, by 100 C. C. neutral solution of ammonium citrate, sp. gr. 1.09 in 30 minutes at 65 deg. C., with agitation once in five minutes; commonly called " reverted " or " backgone " phosphoric acid.

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 fertilizer, although equally pure, may differ from 50 to 100 per cent. in commercial value, on account of mere difference in moisture.

Crude stock for the manufacture of fertilizers, and *refuse material* 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 the 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 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.

Analyses of Fertilizers.

487–489. WOOD ASHES.

I. Sent on from Ipswich, Mass.

II.—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	44.96	14.83
" " (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 $5\frac{1}{2}$ cts. for every pound of potassium oxide and 6 cts. for every pound of phosphoric acid, which the analysis shows to be less than the guaranty states to be present.

489–492. COTTON SEED HULL ASHES.

I. Sent on from Hatfield, Mass.

II. Sent on from Agawam, Mass.

III. Sent on from So. 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, ($5\frac{1}{2}$ 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
" " (after calcination),	12.22	10.57	12.16
Valuation per 2000 pounds,	$37.14	$40.71	$39.42

The samples are of an exceptionably good quality.

492—497. FISH FERTILIZERS.

Sent on from Eastham, Mass.

I. Salt Fish Waste.
II. Fish Chum.
III. Salt Fish Trimmings.
IV. Whale Bone.
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 " " 8 cts. lb.	.58	.36	.69	.34	.84
Reverted " " $7\frac{1}{2}$ cts. lb.	1.16	1.77	2.15	1.84	.07
Insoluble " " 3 cts. lb.	1.15	1.67	2.66	18.69	.24
Nitrogen, 12 cts lb.	5.26	4.26	7.63	3.40	9.64
Insoluble matter,	.10	.06	.26	3.69	9.10
Valuation per 2000 lbs.,	$15.96	$14.46	$24.24	$22.67	$24.73

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

498. CASTOR POMACE.

Sent on from Hatfield, Mass.

	Per Cent.
Moisture at 100° C.,	8.67
Ash,	5.70
Nitrogen in organic matter, ($16\frac{1}{2}$ cts. per lb.),	5.72
Phosphoric acid in ash, (6 cts. per lb.)	1.57
Potassium oxide " ($4\frac{1}{4}$ cts. per lb.)	.97
Calcium " "	.71
Magnesium " "	.65
Insoluble matter "	1.21

Valuation per 2000 lbs., $21.57.

499—500. SEA WEED.

Sent on from Eastham, Mass. (Two samples.)

	Per Cent.	
	I.	*II.*
Moisture at 100° C.,	12.05	14.96
Nitrogen, ($16\frac{1}{2}$ cts. per lb.)	1.66	1.28
Phosphoric acid, (6 cts. per lb.)	.44	.17
Potassium oxide, ($4\frac{1}{4}$ cts. per lb.)	3.81	.36

Calcium "	2.73	3.86
Magnesium "	1.48	1.30
Sodium "	11.75	8.40
Chlorine,	6.40	5.28
Insoluble matter,	7.73	.78
Valuation per 2000 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.

501. BROOM CORN WASTE.

Sent on from No. Hadley, Mass.

	Per Cent.
Moisture at 100° C.,	8.70
Dry Matter,	91.30
	100.00

ANALYSIS OF DRY MATTER.

Crude Ash,	4.88
" Cellulose,	39.25
" Fat,	1.00
" Protein (Nitrogenous matter),	6.78
Non-nitrogenous extract matter,	48.09
	100.00

FERTILIZING INGREDIENTS OF BROOM CORN WASTE.

Moisture at 100° C.,	8.70
Nitrogen, (12 cts. per lb.)	.87
Phosphoric acid, (5 cts. per lb.)	.46
Potassium oxide, ($4\frac{1}{4}$ cts. per lb.)	1.86
Calcium "	.24
Magnesium "	.17
Sodium "	Not determined.
Ferric "	Not determined.
Insoluble matter,	.99
Valuation per 2000 lbs.,	$4.12.

The material was sent on to ascertain its manurial value.

502. COTTON WASTE.

Sent on from Boston, Mass.

Moisture at 100° C.,		8.24
Nitrogen, (14½ cts. per lb.)		2.09
Phosphoric acid, (5 cts. per lb.)		.83
Calcium oxide,		2.52
Magnesium "		.66
Potassium " (4¼ cts. per lb.)		1.62
Insoluble matter,		20.10
Valuation per 2000 lbs.,	$8.27.	

503—505. MUCK.

I. and II. Sent on from Marlboro', 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 det.

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

506—508. 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 " " (8 cts. per lb.)	10.91	14.60	.27
Reverted " " (7½ cts. per lb.)	.69	1.53	.47
Insoluble " " (2 cts. per lb.)	2.24	.24	25.07
Insoluble matter,	9.54	2.09	11.64
Valuation per 2000 lbs.,	$19.38	$25.80	$11.16

509—510. 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	0.37
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 det.
Insoluble matter,	not det.	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 St., 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 proceding 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 the 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 behaviour 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 Kainit are recommended as potash source.

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 2000 lbs. has been asked in our vicinity for a finely ground material.

FODDER ANALYSES.

511. CORN AND COB MEAL. (PRIDE OF THE NORTH.)

Experiment Station, 1887.

	Per Cent. I.	Per Cent. II.
Passed sieve 144 meshes to sq. in..	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.

Moisture at 100° C.,	26.34
Nitrogen, (16½ cts. per lb.)	1.24
Phosphoric acid, (6 cts. per lb.)	.587
Calcium oxide,	.095
Magnesium "	.131
Potassium " (4¼ cts. per lb.)	.468
Sodium "	.200
Ferric "	.004
Insoluble matter,	.130

Valuation per 2000 lbs., $5.19.

512. CORN COB. (PRIDE OF THE NORTH.)

Experiment Station, 1887.

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

ANALYSIS OF DRY MATTER.

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 "	.008
Potassium " (4¼ cts. per lb.)	.512
Sodium "	.265
Ferric "	.006
Insoluble matter,	.267
Valuation per 2000 lbs.,	$1.71.

513. CORN FODDER. (PRIDE OF THE NORTH.)

Moistnre 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 "	.093
Potassium " (4¼ cts. per lb.)	1.465
Sodium "	.794
Ferric "	.026
Insoluble matter,	1.318
Valuation per 2000 lbs.,	$4.77.
Weight of Stalk and Ear (average),	8 oz.
" Stalk, "	3 oz.
" Ear, "	5 oz.

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

C. A. GOESSMANN, *Director*,

AMHERST, MASS.

The Bulletins of the Experiment Station will be sent free of charge to all parties interested in its work, on application.

J. E. Williams, Printer, Amherst, Mass.

MASSACHUSETTS STATE

AGRICULTURAL EXPERIMENT STATION.

BULLETIN No. 29.

JUNE, 1888.

Meteorological Summary for three months ending May 31st, 1888.

	MARCH.	APRIL.	MAY.
Highest temperature,	49.0°	84.0°	80.0°
Lowest temperature,	—3.0°	15.0°	26.0°
Mean temperature,	26.82°	40.44°	54.70°
Total precipitation,	5.96 in.	3.08 in.	4.29 in.
Total snowfall,	20 in.	1.5 in.	
No. of days on which cloudiness averaged 8 or more on scale of 10,	10	6	11
No. of days on which 0.1 of an inch of water from rain or melted snow fell,	7	8	13

From the 11th to the 14th of March a very severe snow-storm occurred, accompanied by very high winds causing bad drifts. The spring was quite late and cold. The lowest temperature for May was lower than for the last three years for the same month. The last frost occurred on May 16th.

FODDER ANALYSES.

514.—524. ROOTS RAISED UPON THE LANDS OF THE STATION IN 1887.

The seeds used in our experiments were sent on by the U. S. Department of Agriculture, with the exception of No. 7—Saxony sugar beet—which was taken from our own 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 600 pounds of fine-ground bone, and 200 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 (80 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, Sugar Beet, "Saxony."
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 Oct. 31 and Nov. 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; whilst 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 analysis were kept in the cellar, slightly covered over 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 illustration, page 148 to 150 in our late 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

ANALYSES OF ROOTS.

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.

	I.	II.	III.
Crude Ash,	8.35	11.01	8.86
" Cellulose,	9.54	7.21	4.29
" Fat,	0.90	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 of the above Beets.

	Per Cent. I.	II.	III.
Moisture at 100° C.,	86.92	87.66	82.59
Nitrogen,	.171	.206	.282
Phosphoric acid,	.102	.085	.156
Potassium oxide,	.305	.462	.587
Calcium "	.064	.059	.062
Magnesium "	.047	.031	.045
Sodium "	.145	.105	.055
Ferric "	.006	.004	.005
Insoluble matter,	.028	.018	.043
Valuation per 2000 lbs.,	$ .94	$1.17	$1.62

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.

VII. "Saxony." Weight, 1 lb., 11 oz.

	Per Cent. IV.	V.	VI.	VII.
Moisture at 100° C.,	86.95	85.80	85.49	83.32
Dry Matter,	13.05	14.20	14.51	16.68
	100.00	100.00	100.00	100.00
ANALYSIS OF DRY MATTER.				
Crude Ash,	10.57	5.80	8.99	5.09
" Cellulose,	4.52	6.23	5.47	5.81
" Fat,	1.76	.82	.79	.39
" Protein (Nitrogen's matter)	12.17	7.82	11.80	7.32
Non-nitrogenous matter,	70.98	79.33	72.95	81.39
	100.00	100.00	100.00	100.00

Fertilizing Ingredients of the above Beets.

	Per Cent. IV.	V.	VI.	VII.
Moisture at 100° C,	86.95	85.80	85.49	83.32
Nitrogen,	.264	.177	.236	.209
Phosphoric acid,	.079	.070	.087	.136
Potassium oxide,	.525	.303	.377	.383
Calcium "	.044	.049	.040	.052
Magnesium "	.025	.035	.044	.034
Sodium "	.110	.061	.099	.113
Ferric "	.004	.002	.003	.025
Insoluble matter,	.013	.018	.028	.032
Valuation per 2000 lbs.,	$1.42	$ .92	$1.20	$1.18

TURNIPS.

VIII. Ruta Baga. "White Sweet German." Weight, 2 lb. 2 oz.
IX. "Early Yellow or Golden Stone." Weight, 14 oz.
X. Ruta Baga. "Skirving's Purple Top." Weight, 2 lb. 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,	11.03	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 of the above Turnips.

	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 "	.106	.117	.080
Magnesium "	.030	.033	.027
Sodium "	.051	.133	.141
Ferric "	.002	.009	.004
Insoluble Matter,	.001	.072	.017
Valuation per 2000 lbs.,	$1.32	$1.22	$1.21

The closing months of the past summer season 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 later period 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 35 per cent. to 45 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—6), contained from 52 to 70 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 proportion 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.

	Total Nitrogen. PER CENT.	*Albuminoid Nitrogen.* PER CENT.	*Non-Albuminoid Nitrogen.* PER CENT.
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

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 7 to 8 per cent.; ordinary mangolds from 11 to 12 per cent.; improved varieties of beet roots, like Lane's, from 15 to 16 per cent.; good carrots from 14 to 15 per cent.; a good sugar beet from 18 to 20 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-decayed 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.

To raise roots the second year, after a liberal application of coarse barnyard manure, or the turning over of grass lands, with the assistance of some commercial phosphatic fertilizer in the interest 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.

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, if properly manured and cultivated, an exceptionally large quantity 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 conditions of the soil, however favorable they 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 development 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 improved varieties of roots should be the rule.

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, grains, 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 Report.

525. 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 compound commercial fodder articles without feeling well satisfied concerning the character of its various ingredients.

526. 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.

527. COTTON HULLS.

I. & II Sent on from Boston, Mass.

	Per Cent. I.	Per Cent. II.
Moisure at 100° C.,	10.17	11.45
Dry Matter.	89.83	88.55
	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 & 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
Magnesum oxide,	.23	.29	.25
Calcium "	.13	.20	.22
Potassium "	1.12	1.06	1.07
Nitrogen,	.77	.76	.74
Insoluble matter,	.06	.003	.11
Valuation per 2000 lbs.,	\$3.66	\$3.75	\$3.57

It is stated in connection with some of the above samples that the material has been of late used in the south as a food ingredient for cattle, its general character and composition renders its fitness merely of local interest.

528. 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,	43.79
	100.00

Fertilizing Ingredients of the above Rowen.

Moisture at 100° C.,	8.840	
Nitrogen, $16\frac{1}{2}$ cents per pound,	1.930	
Phosphoric acid, 6 cents per pound,	.364	
Potassium oxide, $4\frac{1}{4}$ cents per pound,	2.860	
Calcium "	.853	
Magnesium "	.197	
Sodium "	.122	
Ferric "	.057	
Insoluble matter,	2.178	
Valuation per 2000 pounds,		$9.24

529. 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 Ingredients in Spent Brewer's Grain.

	Per Cent.	
Moisture at 100° C.,	6.98	
Nitrogen, $16\frac{1}{2}$ cents per pound,	3.05	
Phosphoric acid, 6 cents per pound,	1.26	
Potassium oxide, $4\frac{1}{4}$ cents per pound,	1.552	
Calcium, "	.296	
Magnesium "	.286	
Sodium "	.347	
Ferric "	.159	
Insoluble matter,	1.770	
Valuation per ton,		$12.88

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

530.—531. WHEAT BRAN.

Sent on from North Amherst, Mass. 68.97 per cent. passed through mesh 144 to square inch.

	Percentage Composition.	Constituents (in lbs.) in a ton of 2000 lbs.	Pounds digestible in a ton of 2000 lbs.	Per cent. of digestibility of constituents.	Nutritive Ratio.
Moisture at 100° C.,	9.43	188.60			
Dry Matter,	90.57	1811.40			
	100.00	2000.00			
ANALYSIS OF DRY MATTER.					
Crude Ash,	6.27	125.40			1 : 4.00
" 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	1192.60	954.08	80	
	100.00	2000.00	1370.74		

The material is of a fair average composition.

Fertilizing Constituents in Wheat Bran.

	Per Cent.
Moisture at 100° C.,	9.43
Phosphoric acid, 6 cents per pound.	2.67
Magnesium oxide,	.83
Calcium oxide,	.18
Potassium oxide, $4\frac{1}{4}$ cents per pound,	1.51
Sodium oxide,	.15
Nitrogen, $16\frac{1}{2}$ cents per pound,	2.43
Insoluble matter,	.24

Valuation per 2000 lbs., $12.50

532.---533. CORN ENSILAGE.

Sent on from Marblehead, Mass.

	Per Cent. I.	*Per Cent.* 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. 20th to 30th, 1887. No. 1 is from "Stowell's Evergreen Sweet" and No. 2 from common "Southern White" corn.

Ensilage No. One shows a larger percentage of nitrogenous and non-nitrogenous matter than No. Two, 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.

CORRECTION.—In our fifth Annual Report, see page 148, it is stated that the variety of *seed Potato* called "*Polaris*," which had given very good results in our field experiments in 1887, was imported by the U. S. Department of Agriculture directly from Ireland. This circumstance, we are informed, is not correctly reported, for we learn from good authority, that this particular kind of potato was first introduced into our markets by H. F. Smith of Waterbury Centre, Vermont, who claims to be the originator of the "Polaris" potato. The fact that our samples for a trial came with other seeds from the U. S Department of Agriculture, caused the mistake.

C. A. GOESSMANN, *Director*,

AMHERST, MASS.

The Bulletins of the Experiment Station will be sent free of charge to all parties interested in its work, on application.

J. E. Williams, Printer, Amherst, Mass.

MASSACHUSETTS STATE

AGRICULTURAL EXPERIMENT STATION.

BULLETIN No. 30.

AUGUST, 1888.

Meteorological Summary for two months ending July 31st, 1888.

	June.	July.
Highest temperature,	94.5°	85.5°
Lowest temperature,	38.0°	46.°
Mean temperature,	69.1°	67.2°
Total percipitation,	5.40 in.	3.63 in.
Prevailing winds,	Westerly.	N. W.
No. of days on which cloudiness averaged 8 or more on a scale of 10,	4	3
No. of days on which 0.1 of an inch or more of rain fell,	11	8

The mean temperature for the month of July is the lowest of any for the same month since 1874. The month of June shows a higher mean and maximum temperature. The continued cool weather of the past spring has shown a marked effect in retarding the growth of the corn crop.

534. NOTES ON FEEDING EXPERIMENTS WITH PIGS. (EIGHTH EXPERIMENT).

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 experiments, creamery buttermilk and home-made skim milk with corn meal had furnished the sole ingredients of the daily diet of 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 various 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 discusson.

SUMMARY OF EXPERIMENTS II, III, IV, V, VI, VII.

EXPERIMENTS.	Average amount of Dry Matter for production of one pound of dressed Pork (lbs).	Cost of Feed per pound of Dressed Pork (cents).	Manurial Value of Feed per pound of Dressed Pork (cents).	Net Cost of Feed per lb of Dressed Pork after deducting 30 per cent from Manurial Value (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 5½ to 7¼ 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, a. s. f. 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 30 per cent. of the essential fertilizing constituents contained in the feed 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 meat 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 experiments 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 equal 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 principle cause of the difference in our results.

To test the correctness of this conclusion it was decided to institute 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.

The following short abstract, taken from a more detailed description of the seventh feeding experiment in our late 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 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-tenth 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.

	Corn meal (ounces).	Skim milk (quarts).	Wheat bran (ounces).	Gluten meal (ounces).	Feeding periods.	Nutritive Ratio of Food.
June 28 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.	Dressed Weight gained during Experiment.	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. . .	191 43	173 0	58 04	59.66	177.50	138.45	4.89
S, . .	191.43	173.0	58 04	59.66	162.50	128.38	5 26
T, . .	191.43	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
1,220.0 gals. skim milk, at 1.8 cts 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 1 lb. of dressed pork, 5.15 cents.

Manurial Value of the 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 1 lb. 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 lbs.

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 each served in the experiment. The latter began November 8, '87, and lasted until March 12, '88, or 124 days; the average of the individual live weight had reached 185 lbs. 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 eighth 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 hereafter 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.

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 result 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 nitrogenious 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 exceptional 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 the 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 animal at close of Feeding Period (in lbs.)	Gain in Live Weight during Period (in lbs.)	One Hundred Pounds of Dry Matter in Feed had produced Live Weight (in lbs.)	Cost of Feed for Production of One Pound of Live Weight (in cents.)
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	31.5	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 (qts.)	Total amount of Corn meal consumed during period (lbs.)	Total amount of Wheat bran consumed during period (lbs.)	Total amount of Gluten meal consumed during period (lbs.)	Total amount Corn and Cob meal consumed during period (lbs.)	Nutritive ratio of food.	Weight of Animal at beginning of period (lbs.)	Weight of animal at end of period (lbs.)	Gain in weight per day during period.
1887 and 1888.									lb. oz.
Nov. 8—Nov. 29.	123.00	15.38	—	—	—	1:2.92	26.00	48.50	1—1
Nov. 30—Jan. 3.	210.00	25.88	12.41	24.83	—	1:2.30	48.50	96.50	1—6
Jan. 4—Jan. 30.	163.00	9.00	16.00	16.00	55.00	1:3.80	96.50	131.00	1—5
Jan. 31—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.

	Lbs.
741 quarts skim milk, equal to dry matter.	133.38
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

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, 35.00 lbs, or 18.52 per cent.
Dressed weight gained during experiment, 132.82 "

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, 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.

V.

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

Total amount of Feed Consumed during Experiment.

741 quarts 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 "

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, 38.00 lbs. or 19.19 per ct.	
Dressed weight gained during experiment.	141.41 "

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 yielding 1 lb. of live weight, and 3.08 lbs. dry matter yielded 1 lb. of dressed weight. Cost of feeding for production of 1 lb. dressed pork, 5.11.

W.

PERIODS.	Total amount of Skim milk consumed during period (qts.)	Total amount of Corn meal consumed during period (lbs.)	Total amount of Wheat bran consumed during period (lbs.)	Total amount of Gluten meal consumed during period (lbs.)	Total amount Corn and Cob meal consumed during period (lbs.)	Nutritive ratio of food.	Weight of animal at beginning of period (lbs.)	Weight of animal at end of period (lbs.)	Gain in weight per day during period.
1887 and 1888.									lb. oz.
Nov. 8—Nov. 29.	123.00	15.38	—	—	—	1:2.92	22.50	44.00	1—0
Nov. 30.—Jan. 3	210.00	25.88	12.41	24.83	—	1:2.30	44.00	96.00	1—8
Jan. 4—Jan. 30.	162.00	9.00	16.00	16.00	55.00	1:3.80	96.00	130.00	1—2
Jan. 31—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 "

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, 36.00 lbs. or 19.25 per ct.	
Dressed weight gained during experiment,	132.83 "

Cost of Feed Consumed during Experiment.

185.25 gals. skim milk, 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
	$7.72

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.

X.

PERIODS.	Total amount of Skim milk consumed during period (qts.)	Total amount of Corn meal consumed during period (lbs.)	Total amount of Wheat bran consumed during period (lbs.)	Total amount of Gluten meal consumed during period (lbs.)	Total amount Corn and Cob meal consumed during period (lbs.)	Nutritive ratio of food.	Weight of animal at beginning of period (lbs.)	Weight of animal at end of period (lbs.)	Gain in weight per day during period.
1887 and 1888.									lbs. oz.
Nov. 8—Nov. 29.	123.00	15.38	—	—	—	1 :2.92	25.00	46.00	0–15
Nov. 30—Jan. 3.	210.00	25.88	12.41	24.83	—	1 :2.30	46.00	93.00	1—5
Jan. 4—Jan. 30.	162.00	9.00	16.17	16.17	55.68	1 :3.81	93.00	128.00	1—3
Jan. 31—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 "
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 not ascertained.	
Dressed weight gained during experiment,	137.59 "

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

2.84 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 cents.

Y.

PERIODS.	Total amount of Skim milk consumed during period (qts.)	Total amount of Corn meal consumed during period (lbs.)	Total amount of Wheat bran consumed during period (lbs.)	Total amount of Gluten meal consumed during period (lbs.)	Total amount Corn and Cob meal consumed during period (lbs.)	Nutritive ratio of food.	Weight of animal at beginning of period (lbs.)	Weight of animal at end of period (lbs.)	Gain in weight per day during period. lbs. oz.
1887 and 1888.									
Nov. 8—Nov. 29.	123.00	15.38	—	—	—	1:2.92	25.00	46.00	0–15
Nov. 30—Jan. 3.	210.00	25.88	12.41	24.83	—	1:2.30	46.00	93.50	1—5
Jan. 4—Jan. 30.	162.00	9.00	16.17	16.17	55.68	1:3.81	93.50	133.00	1—6
Jan. 31—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 "

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 ct.	
Dressed weight gained during experiment,	129.27 "

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. dry matter yielded 1 lb. of live weight, and 3.37 lbs. dry matter yielded 1 lb. of dressed weight. Cost of feed for production of 1 lb. of dressed pork, 5.59 cents.

Z.

PERIODS.	Total amount of skim milk consumed during period (qts.)	Total amount of Corn meal consumed during period (lbs.)	Total amount of Wheat bran consumed during period (lbs.)	Total amount of Gluten meal consumed during period (lbs.)	Total amount Corn and Cob meal consumed during period (lbs.)	Nutritive ratio of food.	Weight of animal at beginning of period (lbs.)	Weight of animal at end of period (lbs.)	Gain in weight per day during period.
1887 and 1888.									lbs. oz.
Nov. 8—Nov. 29.	123.00	15.38	—	—	—	1:2.92	29.50	52.00	1—0
Nov. 30—Jan. 3.	210.00	25.88	12.41	24.83	—	1:2.30	52.00	97.00	1—5
Jan. 4—Jan. 30.	162.00	9.00	16.17	16.17	55.68	1:3.81	97.00	132.50	1—4
Jan. 31—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. of skim milk, equal to dry matter,	133.38 lbs.
50.26 lbs. corn meal, equal to dry matter,	43.60 "
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 "
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 ct.	
Dressed weight gained during experiment,	126.02 "

Cost of Feed Consumed during Experiment.

185.25 gals. of 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 matter yielded 1 lb. of live weight, and 3.46 lbs. of dry matter yielded 1 lb. of dressed weight. Cost of feed for production of one pound dressed pork, 5.74 cents.

Summary of Eighth Experiment.

	Corn meal (lbs.)	Skim milk (gals.)	Wheat bran (lbs.)	Gluten meal (lbs.)	Corn and Cob meal (lbs.)	Live Weight gained during experiment.	Dressed Weight gained during experiment.	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
	301.56	1,111.50	298.76	373.28	1,098.26	967.50	799.94	

Total Cost of Feed Consumed during Experiment.

1,111.50 gallons 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
1,098.26 lbs. corn and cob meal at $20.70 per ton,	11.42
	$43.38

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

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 cents.

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 ($16\frac{1}{2}$ c. per lb.),	1.80	.47	2.78	4.57	1.45
Phosphoric acid (6 c. per lb)	.74	.22	1.86	.30	.69
Potassium oxide ($4\frac{1}{4}$ c. ")	.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 the feed consumed, for the production of one pound of dressed pork, making a deduction of 30 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 $7\frac{3}{4}$ 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 our 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..

1,111.50 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
1,098.26 lbs. corn and cob meal 20.70 per ton,	11.42
	$42.61

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

Manurial Value of Food 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
	$42.61

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

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.

C. A. GOESSMANN, *Director*,
AMHERST, MASS.

The Bulletins of the Experiment Station will be sent free of charge to all parties interested in its work, on application.

J. E. Williams, Printer, Amherst, Mass.

MASSACHUSETTS STATE

AGRICULTURAL EXPERIMENT STATION.

BULLETIN No. 31.

OCTOBER, 1888.

Meteorological Summary for two months ending Sept. 30th, 1888.

	August.	September.
Highest temperature,	87.0°	76.0°
Lowest temperature,	42.0°	25.0°
Mean temperature,	67.38°	57.10°
Total precipitation,	4.29 in.	10.70 in.
Prevailing winds,	N. W.	N. W.
No. of days on which cloudiness averaged 8 or more on a scale of 10,	9	11
No. of days on which 0.01 of an inch or more of rain fell,	8	9

The first frost of the season occurred Sept. 6, the first killing frost, Sept. 7, thirteen days earlier than the average for this vicinity.

The rainfall for the month of September has not been exceeded by any month since September, 1882, when it amounted to 11.85 inches.

ON COMMERCIAL FERTILIZERS.

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 September 1st, 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:

SECT. 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 of 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 sections 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 not be 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.*

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.

More detailed information in this connection, regarding the duties of the director of the Massachusetts state agricultural experiment station, and the obligation of 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.

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 substance 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 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.

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 ingredients may benefit by a short discussion of that subject at the close of this BULLETIN.

I

535–553.—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
7	Bradley's Extra Fine Ground Bone	Bradley Fertilizer Co., Boston, Mass	Springfield.
16	Stockbridge's Manure for Seeding Down	Bowker Fertilizer Co., Boston, Mass	Worcester.
28	Stockbridge's Mnre for Grass, Tp Drs'ng & Forage Crops	Bowker Fertilizer Co., Boston, Mass	Ware.
29	Stockbridge's Manure for Potatoes	Bowker Fertilizer Co., Boston, Mass	Ware.
37	Seeding Down Fertilizer	Cumberland Bone Co., Portland, Me	Fitchburg.
41	Quinnipiac Dry Ground Fish	Quinnipiac Fertilizer Co., New London, Conn	So. Deerfield.
46	Baker's Complete Grass Manure	H. J. Baker & Bro., New York City	New Bedford.
47	Baker's Special Corn Fertilizer	H. J. Baker & Bro., New York City	New Bedford.
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	Cochesett.
56	Brightman's Fish and Potash	W. J. Brightman & Co., Tiverton, R. I	Cochesett.
58	Dow's Grass Fertilizer	John C. Dow & Co., Boston, Mass	Cochesett.
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	Lee, Blackburn & Co., Lawrence, Mass	Lawrence.
83	Jefferd's 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	Springfield.
123	Economic No. 1	Economic Fertilizer Co., Boston, Mass	Charlestown.

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 lbs. Found.	Potassium oxide in 100 lbs. Guaranteed.
7	Bradley's Extra Fine Ground Bone	8.04	2.05	1.9–2.6	2.98	4.08	6.55	13.61	8–12	7.06		1.72	2–3
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	" " for Grass Top-dressing & ForageCrops	15.23	5.28	5.5–6.5	3.94	1 67	4.61	10.22	6–8	5.61	5–6	2.85	2.5–3.5
29	" " 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	.26	1
41	Quinnipiac Dry Ground Fish..........................	7.63	7.94	7.5–10	.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	.62		5.90		5.90	5	7.68	7.5
47	" Special Corn Fertilizer	10.47	5.81	4.12	1.65	5.23	.10	6.98	7.25–9.25	6.88	6.25	6.55	7.00
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	.38	2 30	6.22	8.90	6.8–9.16	2.68			
56	" 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	.72	2.75	7.52	10.99	12–14	3.47		3.04	2–3
65	Farmer's New Method Fertilizer	14.90	1.32	.82–1.82	8.60	.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	" " "	12.62	1.67	2.06–2.88	9.60	2.66	2.94	15.20	10–12	12.26		.58	2–3
83	Jefferd's Fine Ground Bone...........................	9.03	1.86	2.47–3.3	.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	4.34	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	.35	5.00	5–6	4.65		4.22	3.5–4+
123	Economic No. 1	11.68	1.71	1–2		.61	4.22	4.83	2–4	.61		.19	

*Sulphate of Potash the source of Potash.

II.

ANALYSES OF COMMERCIAL FERTILIZERS AND MANURIAL SUBSTANCES SENT ON FOR EXAMINATION.

554—556. 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.

	I.	II.	III.	IV.
		Per Cent.		
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 "	37.39	26.94	39.06	30.16
Potassium "	7.78	7.95	5.38	4.76
Insoluble matter, (before calcination),	10.93	17.44	17.42	21.72
" " (after "),	6.15	15.66	8.79	13.45

557—559. WOOD ASHES.

VI. Sent on by S. M. Farnsworth, Harvard, Mass.
VII. Sent on by J. J. H. Gregory, Marblehead, Mass.
VIII. Sent on by D. G. Lang, Concord, Mass.

	VI.	VII.	VIII.
		Per Cent.	
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 "	32.54	32.03	29.11
Potassium "	5.07	10.24	5.84
Insoluble matter, (before calcination),	16.13	24.39	19.70
" " (after "),	13.06	17.91	15.13

560—561. DRY GROUND FISH.

I. and II. Sent on by R. P. Smith, Hatfield, Mass.

	I.	II.
	Per Cent.	
Moisture at 100° C.,	8.34	9.92
Ash,	37.76	28.37
Total phosphoric acid,	8.23	7.96
Soluble " "	.10	.61
Reverted " "	3.81	3.79
Insoluble " "	4.32	3.56
Nitrogen,	6.81	6.82
Insoluble matter,	.82	1.34

562—563. 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.

	I.	II.	III.
		Per Cent.	
Moisture at 100° C.,	6.26	8.30	8.30
Ash,	6.16	5.77	5.77
Calcium oxide,	0.31	.31	.31
Magnesium "	0.95	.77	.77
Potassium "	1.80	1.21	.89
Phosphoric acid,	1.32	1.45	1.26
Nitrogen,	7.26	6.69	6.88
Insoluble matter,	0.53	.40	.40

564—567. GROUND BONES.

I. Sent on from Amherst, Mass.

II. Sent on by A. S. Belcher, No. Easton, Mass.

III. Sent on by Ed. Hersey, Hingham, Mass.

IV. Sent on by W. W. Sanderson, So. Deerfield, Mass.

MECHANICAL ANALYSES.

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

CHEMICAL ANALYSES.

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 " "		0.13	0.09	2.73
Reverted " "	3.80	6.20	8.10	9.94
Insoluble " "	15.69	19.34	16.52	5.74
Nitrogen,	4.04	2.68	3.14	3.12
Insoluble matter,	.78	0.42	0.42	5.79

The comparative manurial value of ground bones depends on a corresponding chemical composition, and to a considerable degree on a good fine mechanical condition. The relative commercial value of different samples ought to be judged by a due consideration of both circumstances.

568. 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 " "	0.03
Reverted " "	5.29
Insoluble " "	10.05
Nitrogen,	4.24
Insoluble matter,	1.37

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

569. 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

570. 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,	0.17
Total magnesium oxide,	0.27
Nitrogen,	1.90
Sulphuric acid,	1.02
Total chlorine,	53.50
Calcium chloride,	0.05
Magnesium chloride,	0.63
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.

571. MUCK.

Sent on by A. A. Rice, Mount Hermon, Mass.

	Per Cent.
Moisture at 100° C.,	75.44
Dry matter,	24.56
Mineral matter in dry matter,	12.00
Nitrogen in wet muck,	0.37

A fair sample of its kind.

572. 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:

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 the 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 liquid and 33.23 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 So. 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.

573—576. 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.

	I.	II.	III.	IV.
		Per Cent.		
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 " "	4.03	5.50	7.47	6.81
Reverted " "	8.46	1.29	1.43	2.56
Insoluble " "	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

577—580. COMPOUND FERTILIZERS.

V. Sent on by A. S. Hawley, North Hadley, Mass.
VI. Sent on by Staples & Phillips, Taunton, Mass.
VII. Sent on by C. M. Allen, Franklin, Mass.
VIII. Sent on by F. G. Arnold, Swansea, Mass.

	V.	VI.	VII.	VIII.
			Per Cent.	
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 " "	5.87	5.80	2.86	2.09
Reverted " "	3.60	1.85	5.01	6.10
Insoluble " "	1.60	5.65	.45	4.37
Nitrogen in organic matter.	1.65	2.10	.19	3.73
" " nitrates	—		3.44	
Potassium oxide,	3.19	1.63	8.60	9.87
Insoluble matter,	5.50	6.01	1.52	3.03

TRADE VALUES OF FERTILIZING INGREDIENTS IN RAW MATERIALS AND CHEMICALS.

	1888. Cents per pound.
Nitrogen in ammoniates,	17½
" " nitrates,	16
Organic nitrogen in dry and fine ground fish, meat, blood, cotton-seed meal and castor pomace,	16½
" " " fine ground bone and tankage,	16½
" " " fine ground medium bone and tankage,	13
" " " medium bone and tankage.	10½
" " " coarser bone and tankage,	8½
" " " hair, horn-shavings and coarse fish scrap,	8
Phosphoric acid soluble in water,	8
" " soluble in ammonium citrate,	7½
" " in dry ground fish, fine bone and tankage,	7
" " in fine medium bone and tankage,	6
" " in medium bone and tankage,	5
" " in coarser bone and tankage,	4
" " in fine ground rock phosphate,	2
Potash as High Grade Sulphate, and in forms free from Muriate or Chlorides,	5½
" " Kainite,	4½
" " Muriate,	4¼

The above trade values are the figures at which in the six months preceding March 1888, 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 1st plus about 20 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,
Nitrate of Soda,
Muriate of Potash,
Sulphate of Potash,
Dried Blood,
Dried Ground Meat,
Dry Ground Fish,
Azotin,
Ammonite,
Castor Pomace,
Bone and Tankage,
Plain Superphosphates.

The hitherto customary valuation of manurial substances is based on the average trade value of the 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., phosporic 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 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 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 fertilizer, although equally pure, may differ from 50 to 100 per cent. in commercial value, on account of mere difference in moisture.

Crude stock for the manufacture of fertilizers, and *refuse material* of various descriptions, have to be valued with reference to the market prices of their principal constituents, taking into consideration at the same time *their general fitness for speedy action.* For these, and similar circumstances, it is evident that farmers have to judge largely for themselves, whether the prices asked for the manurial substances offered for their patronage are fair, considering local conditions of supply.

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 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 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.

C. A. GOESSMANN, *Director*,
AMHERST, MASS.

The Bulletins of the Experiment Station will be sent free of charge to all parties interested in its work, on application.

J. E. Williams, Printer, Amherst, Mass.

MASSACHUSETTS STATE

AGRICULTURAL EXPERIMENT STATION.

BULLETIN No. 32.

FEBRUARY, 1889.

Meteorological Summary for four months ending Jan. 31, 1888.

	October.	November.	December.	January.
Highest temperature,	66.0°	71.0°	56.5°	58.0°
Lowest temperature,	26.0°	5.7°	3.5°	0.5
Mean temperature,	43.12°	38.93°	30.40	30.30
Total precipitation,	5.19 in.	3.91 in.	3.78 in.	3.29 in.
Total snowfall,		5.00 in.	2.75 in.	8.00 in.
Prevailing winds,	N. W.	N. E.	N. W.	N. W.
No. of days on which cloudiness averaged 8 or more on a scale of 10,	12	12	8	9
No. of days on which 0.01 of an inch or more of water from rain or melted snow fell,	13	11	9	10

The remarkably cool weather of the summer months continued through October, its mean temperature being lower than since 1841.

The mean temperature for November is about the average for that month, while that for November and January is decidedly higher.

Snowsqualls occurred on the ninth of October, and the first snowstorm on the 25th of November. The snow disappeared quickly. It was the only snow of any amount until the 20th of January. The rainfall has been about the average and was evenly distributed through the four months. Southerly winds were frequent during the month of December.

Record of Twelve Cows,

WHICH SERVED AT THE STATION FOR EXPERIMENTS TO ASCERTAIN THE COST OF FEED FOR THE PRODUCTION OF MILK.

581. When entering upon the task to ascertain the cost of feed for the production of milk—1884—it was decided to begin our 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 apiece — they sold at the close of their trial for from twenty-five to thirty-seven dollars each. The general 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 coarse and bulky fodder ingredients. Meadow 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 meadow 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 meadow 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-quarter pounds of grain feed, usually composed of an equal weight of corn meal or corn and cob meal and wheat bran, with or without gluten meal (3 1-4 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 the essential fertilizing constituents contained in the various fodder articles used, are based on our own analyses, 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 days to 599 days; the average daily yield of milk per head for the whole period of observation varied from 7.7 quarts 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 the financial record of cows.
6. Some conclusions suggested by the financial record.

1. HISTORY OF COWS OF TRIAL.

	1. Bessie.	2. Lady Horace.	3. Daisy (1).	4. Mollie.	5. Susie.	6. Meg.
Breed (grades).	Jersey.	Ayrshire.	Ayrshire.	Ayrshire.	Ayrshire..	Devon.
Age (years).	8	8	7	7	5	6
No. of calves.	4	4	3	3	2	3
Last calf.	Oct. 17, '84.	Oct 15, '84.	Nov. 10, '85.	Nov 6, '85.	July 14, '86.	Aug. 2, '86.
Date of arrival.	Oct. 23, '84.	Oct. 23, '84.	Nov. 17 '85.	Nov. 17, '85.	July 30, '86.	Aug. 16, '86.
Date of departure.	Oct. 31, '85.	Oct 31, '85.	Sept. 16 '86.	Sept 19, '86.	May 3, '87.	May 3, '87.
Number of days milked.	374	374	304	307	278	261
Total yield of milk during period, qts.	3724.3	1063.5	3613.5	3124.6	3446.5	3233.8
Average yield of milk per day at beginning of period, qts.	16.5	16.7	15.3	12 1	15.5	17.2
Average yield of milk per day during 9th month. qts.	9.2	9.8	7.9	8.1	9.8	10.8
Average yield of milk per day at close of period. qts.	6.9	7.9	10.5	8.5	9.8	10.9
Average yield of milk per day for entire period, qts.	10.0	10.9	11.9	10.2	12.4	12.4
Live weight at beginning of observation (lbs.).	809	931	911	891	849	1018
Live weight at close of observation (lbs.).	833	970	838	880	1025	1152

	7. Lizzie.	8. Ida.	9. Minnie.	10. Daisy (2).	11. May.	12. Melia.
Breed (grades).	Native.	Durham.	Ayrshire.	Durham.	Jersey.	Dutch.
Age (years).	5	7	7	5	8	10
No. of calves.	2	4	4	3	3	7
Last calf.	Feb. 1, '87.	Feb. 3, '87.	May 3, '87.	Jan. 5, '88.	June 6, '87.	Aug. 5, '87.
Date of arrival.	Feb. 5, '87.	Feb. 7, '87.	May 17, '87.	Jan. 16, '88.	June 13, '87.	Aug. 11, '87.
Date of departure.	June 22, '88.	Jan. 3, '87.	Dec. 22, '88.	Jan. 19, '89.	Jan. 31, '89.	Jan. 31, '89.
No. of days milked.	503	331	584	369	599	540
Total yield of milk during period, qts.	6023 3	2527.8	6779.0	4557.8	6460 6	6157.0
Average yield of milk per day at beginning of period,qts.	19 7	16 0	17.5	18.9	14.3	14.3
Average yield of milk per day during 9th month. qts.	9.2	3.9	12.8	10.2	12.0	11.8
Average yield of milk per day at close of period, qts.	8 3	1.3	5.1	6.3	9.6	7.6
Average yield of milk per day for entire period, qts.	12.0	7.7	11 6	12 4	10.8	11.4
Live weight at beginning of observation (lbs.).	995	978	885	1132	817	964
Live weight at close of observation (lbs.).	1102	1000	1011	1185	909	1069

2. AMOUNT OF EACH OF THE VARIOUS KINDS OF FEED CONSUMED (IN LBS.) BY THE COWS ON TRIAL.

	1. Bessie.	*2.* Lady Horace.	*3.* Daisy(1).	*4.* Mollie.	*5.* Susie.	*6.* Meg.
Corn meal,	941.25	941.25	877 50	890.50	900.25	848.50
Corn and cob meal,						
Wheat bran,	931.25	931 25	939.25	955.50	825 50	776.75
Rye Middlings,					74.75	71.50
Gluten meal,	74.75	74.75			520.00	523.25
Hay,	4228.75	5122.00	2962.00	2780.00	4073.50	3311.50
Rowen,						500.00
Corn fodder (dry),	324 75	408 00	435.00	473 00	399.50	313.00
Corn stover (dry),					94 00	90.50
Corn ensilage,	2098.00	2188 00	2990.00	2959.00	930 00	826.50
Millet (dry),	156.00	119.00	37.00	32.00		
Vetch & lucerne (dry),	72.00	98.00				
Lucerne & clover (dry),	24 00	30.00				
Oats (dry),			308 00	528 00		
Oats (green),			585.00	585.00	70.00	140.00
Vetch & oats (green),						
Vetch (green),			319 00	251 00	40.00	45.00
Serradella (green),			580 00	725 00	320 00	
Cow pea (green),			656.00	676.00	700.00	711.00
Barley & beans (green),	215 00	245 00				
Potatoes,						
Carrots,						
Roots, (sugar beet),			1592 00	1592 00	1041.50	1052.00
Total cost of feed,	$59.00	$65 65	$56 46	$56 04	$63.25	$59.50

	7. Lizzie.	*8.* Ida.	*9.* Minnie.	*10.* Daisy(2).	*11.* May.	*12.* Melia.
Corn meal,	1126.50	1075.75	1343.50	642 25	1378.00	1197 75
Corn & cob meal,	508.25		557.25	557.25	557.25	557.25
Wheat bran,	1530 75	975.00	1868.75	1199.25	1935.25	1755 00
Rye middlings,	156 00	156 00	65.00			
Gluten meal,	771.50	304 00	1083 00	1134.50	1217.25	1217.25
Hay,	7418.75	4925 25	6886.00	4354.50	6757.25	6437.00
Rowen,	1833.25	1268 00	1836.00	528.00	1743.00	1843.00
Corn fodder (dry),	713 25		824.50	1600.00	1059.00	925.00
Corn stover (dry),	112.00	90.50	86.25	368.00	304.00	242.00
Corn ensilage,	878.00		1017.25	1539.25	1550.00	1340.00
Millet (dry),						
Vetch & lucerne (dry),						
Lucerne & clover (dry),						
Oats (dry),						
Oats (green),						
Vetch & oats (green),			2059.50	1051 00	2181.00	998.00
Vetch (green),						
Serradella (green),			2408.50		2374 00	
Cow pea (green),			3109.00	821.00	3110 00	783.00
Barley & beans (green),						
Potatoes,		1190.00				
Carrots,				859.00	916.00	918 00
Roots (sugar beets),	519.50	567.50	91.00	92.00	92 00	92.00
Total cost of feed,	$118.96	$80 08	$135.05	$88.33	$140.39	$124.77

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	Oats (green),	$3.60
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 HorseBean (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

These prices are the same as are adopted, for reasons stated on that occasion, in our previous reports on feeding experiments with milch cows. See Fifth Annual Report, page 36.

4. VALUATION OF THE ESSENTIAL FERTILIZING CONSTITUENTS CONTAINED IN THE VARIOUS ARTICLES OF FODDER USED.

Nitrogen, $16\frac{1}{2}$ cts. per lb., Phosphoric Acid, 6 cts., Potassium Oxide, $4\frac{1}{4}$ cts.)

(Per cent.)

	NITROGEN.	PHOSPHORIC ACID.	POTASH.	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 & Horse Beans (gr'n)	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.

	Total value of milk at 3 cents per qt.	Total cost of feed consumed.	Manurial value of food less 20 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.
										cts.
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 83	35 67	60.00	37.54	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,	193.82	140 39	58.92	81.47	60 00	25.00	77.35	58.92	18 43	12.91
12. Melia,	184 71	124.77	51 92	72 85	65.00	28.00	74.86	51 92	22 94	13 86

Average cost of cow, $62 29
Average of selling price of cow, 28 80
Average of total cost of feed per day, 21.72 cts.
Average product per day for entire period, per head, 11.14 qts.
Average of net cost of feed per day, 12.94 cts.
Average of value received above net cost of feed and of cow, per day, 12.12 cts.
Average of value received in form of manure per day, 8.78 cts.
Average of value received in form of cash per day, 3.34 cts.

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 the milk produced to the commercial value represented in the manure obtainable.—See

BESSIE.

Value of the milk sold,	$111 73
Value of 80 per cent. of the manurial substances in 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 the sum resulting from the addition of the difference between original cost of cow and its selling price, and of the total cost of feed consumed.—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 consumed,	$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 the 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 cts. per day; its average in eleven cases is 12.91 cts. There is an actual loss of 1.2 cts. 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 controling degree in the manure obtainable. In No. 8 it prevents a serious loss; 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 controling 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 suggestive in this connection when compared with the preceding statements of the 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 this 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 a mixed farm management, as far as an economical disposition of home raised fodder crops and a liberal production of home made manure is concerned, yet when reduced to a mere manure producing medium, this value may be well questioned from a financial standpoint.

6. A cow whose total milk record averages not more than eight quarts per day, judging from our own condition, 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.

Analyses of Fodder Articles.

582. WHITE SOJA BEAN (SEED).

Grown at the Experiment Station.

	Percentage Composition.	Constituents (in lbs.) in a ton of 2000 lbs.	Pounds digestible in a ton of 2000 lbs.	Per cent. of digestibility of constituents.	Nutritive Ratio.
Moisture at 100° C.,	17.38	347.60			
Dry Matter,	82.62	1652.40			
	100.00	2000.00			
ANALYSIS OF DRY MATTER.					
Crude Ash,	5.22	104.40			1 : 2.37
" Cellulose,	5.35	107.00	15.52	14.5	
" Fat,	21.89	437.80	393.74	89.8	
" Protein, (nitrogenous matter),	33.36	667.20	600.48	90	
Non-nitrogenous extract matter,	34.18	683.60	423.83	62	
	100.00	2000.00	1432.97		

FERTILIZING CONSTITUENTS IN WHITE SOJA BEAN.

		Per cent.
Moisture at 100° C.,		17.38
Calcium oxide,		.342
Magnesium oxide,		.869
Potassium oxide,	(4¼ cts.)	2.085
Sodium oxide,		.166
Ferric oxide,		.231
Phosphoric acid,	(6 cts.)	1.851
Nitrogen,	(16½ cts.)	5.308
Insoluble matter,		.090
Valuation per ton of 2,000 pounds,		$21.51

583. WHITE SOJA BEAN (SEED).

Bought in New York.

	Percentage Composition.	Constituents (in lbs.) in a ton of 2000 lbs.	Pounds digestible in a ton of 2000 lbs.	Per cent. of digestibility of constituents.	Nutritive Ratio.
Moisture at 100° C.,	5.85	117.00			
Dry Matter,	94.15	1883.00			
	100.00	2000.00			
ANALYSIS OF DRY MATTER.					1 : 1.97
Crude Ash,	5.57	111.40			
" Cellulose,	5.15	103.00	14.94	14.5	
" Fat,	18.42	368.40	330 82	89.8	
" Protein, (nitrogenous matter),	35.98	719.60	647.64	90	
Non-nitrogenous extract matter,	34.88	697.60	432.51	62	
	100.00	2000.00	1425.91		

584. SOJA BEAN (ENTIRE PLANT, DRY).

Collected Aug. 30, 1888 at the Experiment Station Grounds.

	Percentage Composition.	Constituents (in lbs.) in a ton of 2000 lbs.	Pounds digestible in a ton of 2000 lbs.	Per cent. of digestibility of constituents.	Nutritive Ratio.
Moisture at 100° C.,	6.12	122.40			
Dry Matter,	93.88	1877.60			
	100.00	2000.00			
ANALYSIS OF DRY MATTER.					1 : 5.42
Crude Ash,	6.47	129.40			
" Cellulose,	20.76	415.20	144.28	34.75	
" Fat,	5.62	112.40	73.14	65.07	
" Protein, (nitrogenous matter),	15.87	317.40	182.35	57.45	
Non-nitrogenous extract matter,	51.28	1025.60	661.61	64.51	
	100.00	2000.00	1080.20		

FERTILIZING CONSTITUENTS IN SOJA BEAN (ENTIRE PLANT, DRY).

	Per cent.
Moisture at 100° C.,	6.120
Ash,	6.470
Calcium oxide,	2.770
Magnesium oxide,	1.190
Potassium oxide,	.617
Sodium oxide,	.198
Ferric oxide,	.131
Phosphoric acid,	.753
Nitrogen,	2.380
Insoluble matter,	.967
Valuation per ton of 2,000 pounds,	$9.27

This valuable plant is extensively cultivated in Japan and China, and has been of late successfully cultivated in southern Europe. The beans are used as a highly nutritious food for man, and the entire plants, beans and straw are a valuable feed for cattle. The requirements for a successful cultivation are a light soil in a good state of fertilization, and a climate similar to that suitable for the cultivation of Indian corn. The seeding time and the general treatment of the crop correspond to that of garden beans. Our trials with this crop for green fodder and for ensilage are very encouraging. We secured in a first trial from 8 to 9 tons of green fodder per acre.

C. A. GOESSMANN, *Director*,

AMHERST, MASS.

The Bulletins of the Experiment Station will be sent free of charge to all parties interested in this work, on application.

J. E. Williams, Printer, Amherst, Mass.

MASSACHUSETTS STATE
AGRICULTURAL EXPERIMENT STATION.

BULLETIN No. 33.

MARCH, 1889.

On Commercial Fertilizers

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 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 50 to 100 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
" " nitrates,	17
Organic nitrogen in dry and fine ground fish, meat and blood,	19
" " " cotton seed meal and castor pomace,	15
" " " fine ground bone and tankage,	16½
" " " fine ground medium bone and tankage,	13
" " " medium bone and tankage,	10½
" " " coarser bone and tankage,	8½
" " " hair, horn shavings and coarse fish scraps,	8
Phosphoric acid soluble in water,	8
" " soluble in ammonium citrate,	7½
" " in dry ground fish, fine bone and tankage,	7
" " in fine medium bone and tankage,	6
" " in medium bone and tankage,	5
" " in coarse bone and tankage,	4
" " in fine ground rock phosphate,	2
Potash as High Grade Sulphate, and in forms free from Muriates or Chlorides; Ashes, etc.,	6
" " Kainite,	4½
" " 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, 19 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 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 1st, plus about 20 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.

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 on to "The Massachusetts State Experiment Station" must have express and postal charges prepaid, to receive attention.

ANALYSES OF COMMERCIAL FERTILIZERS AND MANURIAL SUBSTANCES SENT ON FOR EXAMINATION.

585.—589. WOOD ASHES.

I. From Rowley, Mass.
II. From Concord, Mass.
III. From Concord, Mass.
IV. From Boston, Mass.
V. From Boston, Mass.

	Per Cent. I.	II.	III.	IV.	V.
Moisture at 100° C.,	7.03	16.55	15.58	8.03	0.55
Calcium oxide,	32.31	36.59	34.20	22.69	33.58
Magnesium oxide,	4.03	3.01	2.86	6.15	3.74
Potassium oxide,	4.36	4.29	4.82	6.52	1.91
Phosphoric acid,	2.38	2.40	1.76	1.66	1.32
Insoluble matter (before cal.),	19.53	15.15	20.75	27.92	3.64
Insoluble matter (after cal.),	13.99	12.42	18.35	23.75	2.03

The first three samples are rather below a fair average composition of Canada wood ash, as far as their percentage of potash is considered.

Sample V. it is stated, was obtained from a smoke-house and had evidently suffered from an access of salt; it consisted mainly of hard lumps.

590.—592. STEAMED BONES.

I. Sent on from Hingham, Mass.
II. Sent on from Northboro', Mass.
III. Sent on from Eastham, Mass.

MECHANICAL ANALYSIS.

	I.	Per Cent. II.	III.
Fine, smaller, than $\frac{1}{50}$ inch,	34.41	37.90	50.78
Fine medium, smaller than $\frac{1}{25}$ inch,	21.03	38.30	49.22
Medium, smaller than $\frac{1}{12}$ inch,	21.96	19.50	——
Coarser than $\frac{1}{12}$ inch,	22.60	4.30	——
	100.00	100.00	100.00

CHEMICAL ANALYSIS.

	I.	II.	III.
Moisture at 100° C.,	2.65	4.33	5.34
Ash,	53.29	57.05	64.17
Total phosphoric acid,	19.57	22.40	27.22
Soluble " "	0.31	0.43	.54
Reverted " "	8.39	6.17	9.34
Insoluble " "	10.87	15.80	17.34
Nitrogen,	3.18	4.04	5.72
Insoluble matter,	0.56	1.65	0.46

Sample three, consists evidently of bone and meat, and ought to be classed with tankage. The mechanical condition, in which ground bones are offered for sale in our markets, are steadily improving. The finer they are ground, the sooner they act as plant-food. The current valuation recognizes that fact, as will be seen from the previously stated schedule of cost of bones.

593.—596. GROUND BONES.

I. II. and III. Sent on from Boston, Mass.
IV. Sent on from New Bedford, Mass.

MECHANICAL ANALYSIS.

	Per Cent. I.	II.	III.	IV.
Fine, smaller than $\frac{1}{50}$ inch.	28.95	56.50	33.35	46.00
Fine medium, smaller than $\frac{1}{25}$ inch.	59.99	38.18	28.65	36.52
Medium, smaller than $\frac{1}{12}$ inch.	11.06	5.32	21.78	17.48
Coarser than $\frac{1}{12}$ inch.			16.32	
	100.00	100.00	100.00	100.00

CHEMICAL ANALYSIS.

	I.	II.	III.	IV.
Moisture at 100° C.,	5.59	5.85	4.18	4.21
Ash,	59.07	38.79	50.20	74.04
Total phosphoric acid,	20.08	19.90	19.32	29.42
Soluble " "	0.30	0.17	0.37	0.45
Reverted " "	5.46	7.86	9.36	13.17
Insoluble " "	14.32	12.67	9.59	15.80
Nitrogen,	3.88	5.90	4.72	2.08
Insoluble matter,	1.48	0.48	0.40	0.31

Samples three and four consist of meat and bone; all are rendered articles.

597. BONE CHARCOAL.

Sent on from Wellesley, Mass.

	Per Cent.
Moisture at 100° C.,	18.16
Ash,	72.24
Total phosphoric acid,	25.58
Soluble " "	.38
Reverted " "	5.18
Insoluble " "	20.02
Insoluble matter,	.69

The material was coarse, and needs a treatment with sulphuric acid to secure a desirable speedy action of its phosphoric acid. Bone charcoal and Spent Boneblack are in a superior degree fitted for the manufacture of plain superphosphates.

598. MONA ISLAND GUANO.

Sent on from New York City.

	Per Cent.
Moisture at 100° C.,	12.52
Ash,	75.99
Total phosphoric acid,	21.88
Soluble " "	
Reverted " "	7.55
Insoluble " "	14.33
Total calcium oxide,	37.49
Potassium oxide,	Trace.
Nitrogen,	0.76
Insoluble matter,	2.45

The material is represented to be obtained from an island in the West Indies; it contains a considerable amount of carbonate of lime like the majority of phosphates from that locality. Its mechanical condition is favorable for a direct application on grass land.

599. "MUD CRAB."

Sent on from Eastham, Mass.

	Per Cent.
Moisture at 100° C.,	7.67
Ash,	6.71
Total phosphoric acid,	1.25
Soluble " "	0.28
Reverted " "	0.62
Insoluble " "	0.35
Nitrogen,	8.84
Insoluble matter,	0.91

The material sent on is essentially a nitrogen-furnishing source of plant food, and ought to be largely supplemented with phosphoric acid and potash salts to secure its economical application as a manure.

600. CRANBERRY VINES.

Sent on from Eastham, Mass.

	Per Cent.
Moisture at 100° C.,	13.07
Nitrogen,	.77
Ash constituents,	2.45
Ferric oxide,	.087
Calcium oxide,	.404
Phosphoric acid,	.268
Magnesium oxide,	.253
Sodium oxide,	.080
Potassium oxide,	.329
Insoluble matter,	.834

The material was sent on to ascertain its composition with reference to its fertilizing constituents. The large amount of insoluble matter of the ash is due to the presence of soil.

601. OAK LEAVES.

Sent from Forestdale, Mass.

	Per Cent.
Moisture at 100° C.,	9.601
Organic matter,	83.360
Mineral matter,	6.840
Ferric oxide,	0.027
Calcium oxide,	0.548
Magnesium oxide,	0.267
Potassium oxide,	0.549

Phosphoric acid,	0.058
Nitrogen,	0.930
Soluble silica,	0.018
Insoluble silica,	4.333

The composition of the above sample confirms the well known fact that the shed leaves of our forest trees are rich in manurial constituents. They contain nearly twice as much nitrogen as the straw of our cereals, and are only surpassed in that point by the straw of some of our leguminous plants as beans, vetch, etc. In a well managed system of forestry their removal is quite properly restricted.

602. COAL DUST.

Sent on from Boston, Mass.

	Per Cent.
Moisture at 100° C.,	1.73
Ash,	5.04
Phosphoric acid,	0.61
Potassium oxide,	Trace.
Nitrogen,	1.86
Insoluble matter,	2.47

This material is proposed as an absorber in the manufacture of fertilizers; its nitrogen is exceptionally large for an article of this kind. The exact history of the sample is not known to us.

603. CHAFF FROM GRAIN ELEVATOR.

Sent on from Lincoln, Mass.

	Per cent.
Moisture at 100° C.,	9.89
Ash,	10.74
Phosphoric acid, 6½ cts. per pound,	5.00
Potassium oxide, 4½ cts. per pound,	0.76
Nitrogen, 15 cts. per pound,	1.62
Insoluble matter,	6.49

The presence of some grain renders the material quite valuable for manurial purposes.

604. LINSEED REFUSE. (Two samples.)

Sent on from South Framingham, Mass.

	Per cent.	
	Fine.	Coarse.
Moisture at 100° C.,	6.44	6.23
Ash,	7.37	5.33
Phosphoric acid, 6 cts.,	1.525	1.188
Potassium oxide, 4½ cts.,	0.679	0.802
Nitrogen, 15 cts.,	7.08	4.68
Insoluble matter,	0.495	0.112

The value of the fertilizing constituents in case of the fine refuse material amounts to $23.68, and in case of the coarse material to $16.19 per ton at stated rates. The coarse sample contains 5.1 per cent. of fat, while the finer part contains only 3.49 per cent.

605. WOOL WASTE.

Sent on from Methuen, Mass.

	Per cent.
Moisture at 100° C.,	3.46
Ash,	59.41
Nitrogen,	1.18
Phosphoric acid,	.29
Potassium oxide,	3.08
Insoluble matter,	49.57

The material was collected in connection with the washing of wool. It contained, besides a considerable quantity of earthy and vegetable matter, a liberal proportion of a combination of potash with fatty acids, peculiar to raw wool. The nitrogen in different samples of wool-waste varies widely, judging from personal observation (from 5 to 10 per cent.) The above sample shows the lowest amounts yet noticed in an article sent on under that name.

606. PEAT AND SOIL.

Sent on from Amherst, Mass.

	Per cent.
Moisture at 100° C.,	33.489
Organic matter,	22.646
Mineral constituents,	43.685
Oxides of iron and alumina,	10.306
Phosphoric acid,	.045
Calcium oxide,	.056
Magnesium oxide,	.260
Potassium oxide,	.058
Nitrogen,	.320
Insoluble silicious matter,	33.478

The lands consisting of the above materials are very promising for a successful cultivation when properly drained.

607. PEAT.

Sent on from Weston, Mass.

	Per cent.
Moisture at 100° C.,	14.28
Organic matter,	80.60
Mineral constituents,	5.12
Calcium oxide,	2.57
Nitrogen,	1.79
Insoluble matter,	2.44

Traces of phosphoric acid and potassium oxide.

The sample is in an exceptional degree free from soil, which explains its richness in nitrogen.

608. TURF.

Sent on from Forestdale, Mass.

	Per cent.
Moisture at 100° C.,	51.81
Organic matter,	44.51
Mineral constituents,	3.68
Calcium oxide,	.20
Magnesium oxide,	.68
Phosphoric acid,	.98
Potassium oxide,	.02
Nitrogen,	1.06
Insoluble matter,	2.89

The material is rich in phosphoric acid and in nitrogen, a circumstance not often noticed in materials of this kind; its manurial value is for this reason an exceptional one.

609. FERTILIZING CONSTITUENTS IN SALT HAY.

Sent on from Eastham, Mass.

	Per cent.
Moisture at 100° C.,	5.36
Ferric oxide,	.028
Calcium oxide,	.371
Magnesium oxide,	.335
Potassium oxide,	.718
Sodium oxide,	.017
Phosphoric acid,	.218
Nitrogen,	1.180
Insoluble matter,	91.890

The manurial value of the material compares well with that of the average hay from dry meadows. The composition is,in both instances, equally liable to serious changes when exposed to the action of water.

610-614. COMPOUND FERTILIZERS.

I. Sent on by Oscar S. Dow, Sharon, Mass.
II. Sent on by E. C. Smith, Rowley, Mass.
III. Sent on by A. F. Leonard & Co., Springfield, Mass.
IV. Sent on by Wesley B. Barton, Dalton, Mass.
V. Sent on by H. A. Barton, Jr., Dalton, Mass,

	Per cent.				
	I.	II.	III.	IV.	V.
Moisture at 100° C.,	17.92	8.71	11.80	7.31	5.49
Ash,	56.65	39.85	29.37	31.06	24.56

Total phosphoric acid,	7.87	16.71	3.58	4.40	6.06
Soluble " "	3.55	4.53	0.24	None	0.18
Reverted " "	1.99	3.67	2.19	2.35	3.14
Insoluble " "	2.33	8.51	1.15	2.05	2.74
Potassium oxide,	3.78	4.70	1.58	1.26	0.27
Nitrogen,	2.06	3.12	1.46	5.76	6.35
Insoluble matter,	9.93	5.55	5.14	19.45	9.79

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 $10 or more per ton of 2000 pounds.

3. *The certificate must be secured annually on or 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 Mass. State Agricultural Experiment Station.

C. A. GOESSMANN, *Director*,

AMHERST, MASS.

The Bulletins of the Experiment Station will be sent free of charge to all parties interested in this work, on application.

J. E. Williams, Printer, Amherst, Mass.

MASSACHUSETTS STATE AGRICUTLURAL EXPERIMENT STATION.

BULLETIN No. 34.

JUNE, 1889.

Meteorological Summary for the four months ending May 31, 1889.

	FEBRUARY.	MARCH.	APRIL.	MAY.
Highest temperature,	42.0°	63.5°	78.0°	89.5°
Lowest temperature,	—9.0°	11.0°	25.0°	31.0°
Mean temperature,	20.78°	35.93°	47.35°	59.77°
Total precipitation,	1.45 in.	1.46 in.	2.42 in.	4.15 in
Total snowfall,	8.00 in.	4.00 in.	0.50 in.	
Prevailing winds,	N.W.	N.E.	N.W.	N.W.
No. of days on which cloudiness averaged 8 or more on a scale of 10,	4	14	4	7
No. of days on which .01 of an inch or more of water from rain or melted snow fell,	10	8	7	11

The temperature for the four months has been above the average, the rainfall, below. The abundant rains of May—the largest since 1883—have placed the hay crop beyond danger of drought. All crops are farther advanced than usual. A frost occurred on May 29th, heavy enough to touch our more tender crops; but no serious damage was done. The weather throughout the season has been quite favorable with us for farm work.

OUTLINES OF THE WORK CARRIED ON AT THE STATE AGRICULTURAL EXPERIMENT STATION DURING THE PRESENT SEASON.

619. The subsequent short statement is published with a desire of stimulating among our farmers, and all parties concerned in progressive agriculture, an active interest in the work for which the station has been established. As periodical bulletins and annual reports, containing a full description of the character and the results of our investigations, however detailed the latter may be, cannot equal the impressions produced by a personal visit to the field of actual operations, at important periods of observations, a cordial invitation is hereby extended to all parties interested to visit the grounds of the station during the present season.

The cultivation of a variety of farm crops, and in particular of reputed fodder crops, presents at this period of the year, a special feature of interest to visitors.

An intelligent, critical discussion of our plans and methods upon the field of actual observation cannot otherwise but benefit managers and visitors, and tend ultimately to promote the best interest of our farming community. All who favor us with their visit will find by calling at the director's office in the labaratory building of the station a well informed guide to conduct them over the fields and the barn.

The observations with reference to the effect of special articles of plant food on the growth and general character of Indian corn are continued. Inquiries regarding the influence of different forms of nitrogen, as well as of the absence of nitrogen on the quantity and quality of the corn crop, have taken the place of those with potash compounds of previous years. Several reputed varieties of ensilage corn are raised to compare their relative merits under our local conditions.

The study of the growth and of the character of prominent grasses, and of different leguminous plants when raised upon manured and unmanured lands, is carried on as in preceding years. Bokahara clover, (Melilotus alba,) and Sainfoin, (Onobrychis sativa) have been substituted for Lucern, (Medicago sativa.) and Red Mammoth clover, Kentucky Blue grass, (Poa pratensis,) has taken the place of English and Italian Rye grass, (Lolium perenne and Italicum.)

Southern Cow pea, Serradella (Ornithopus sativus,) and a mixed crop of vetch and oats are cultivated upon an area sufficiently large to supply green fodder for from five to six milch cows during the months of July, August and a part of September.

The experiments with potatoes described in previous reports are repeated with some modifications. Of interest in this connection is a series of experiments under the especial direction of Prof. Humphrey, to study the cause of scab on potatoes. Attention is invited to his inquiries on pages 3 and 4 of this bulletin.

Various sugar producing plants are cultivated to ascertain their general characters as well as their economic and industrial relation to our system of farming. Home and imported varieties of sugar beets, and of sorghum are included in the trial.

The effect of green manuring on the production of crops may be seen in several parts of the field.

The merits of raising grain crops by broadcast seeding and in drills are illustrated on barley and oats.

The degree of success which has followed our course of renovating worn out grass lands and swampy meadows may be judged by the present condition of various crops raised upon these lands.

Aside from these more prominent features of our field work, may be noticed a variety of reputed fodder plants, foreign to this section of the country, cultivated on a small scale for the purpose of studying their degree of acclimatization, as well as their special merits, when compared with prominent home fodder plants. Included in this part of our field trials are varieties of oats, barley, sorghum, horse beans, southern cow peas, clovers, and lupines, besides sulla, trefoil, Japanese buckwheat, etc.

Adding to attractions offered by an examination of the field work, the inspection of our arrangements for feeding experiments with various kinds of farm live stock, and of the outfit of the chemical and botanical physiological laboratories of the station, with their industry peculiar to the growing season, to meet the numerous application of farmers in all parts of the state, we confidently leave it to the reports of our visitors whether the time they spent with us has compensated them for the exertion made on their part to visit the State Agricultural Experiment Station, during the summer season, in the beautiful town of Amherst.

DEPARTMENT OF VEGETABLE PHYSIOLOGY.

620. While the Department desires to render all possible service to the people of the state in any branch of Agricultural Botany, especial attention is and will be given to those diseases of plants which are caused by the attacks of parasitic fungi, commonly known as *rusts, smuts, mildews, blights, spots, rots, etc.*

The undersigned especially desires to be informed of the prevalence of any of these troubles in any part of the state, and to receive specimens of infected plants. Such specimens may be pressed and sent between pasteboard, or may be packed, fresh, in a tin box, with a little moist moss or cotton to keep them fresh.

In either form specimens are mailable at the rate of one cent an ounce.

Requests for information or advice concerning plant diseases or other subjects within the scope of this Department will be answered as promptly and as fully as may be possible under the circumstances.

Pending the completion of the laboratories and greenhouses provided for the use of the Department by the present Legislature, temporary quarters have been equipped in the chemical laboratory building.

During the present season a leading subject of inquiry is the *scab* of potatoes. A resumé of our present knowledge of this disease will be found on pages 131-8 of the report of the Station for 1888, and all readers of this bulletin who can contribute towards a more complete knowledge of the subject by answering any of the following questions are earnestly requested to do so. It is desired that no one will attempt to answer any question, except from practical experience and observation.

Questions Concerning Potato Scab.

1. What is the extent of the damage caused by *potato scab* in your vicinity?

2. Is *scab* more or less prevalent
   - (*a*) in a wet season?
   - (*b*) on a naturally wet soil?

3. What is the effect on the development of *scab* of the use of
   - (*a*) barnyard manure?
   - (*b*) commercial fertilizers?
   - (*c*) tobacco stalks or dust?
   - (*d*) other refuse matters?

4. Is *scab* more or less likely to attack potatoes grown on
   - (*a*) newly broken land?
   - (*b*) old land previously in other crops?
   - (*c*) old land previously in potatoes?

5. How do crops raised from *scabby* seed-potatoes compare in scabbiness with those raised from *smooth* potatoes?

6. Have you noted any effect on the development of *scab* caused by deep or shallow planting?

7. Is there any difference in liability to the attacks of *scab* between light and dark skinned varieties of potatoes?

8. How early in the development of a potato tuber have you ever seen it attacked by *scab?*

9. Does *scab* increase on potatoes lying in the earth, after the tops are dead?

10. What remedies for *scab* have you ever tried, or what precautions against its attacks have you ever taken, and with what result?

11. What ideas or opinions, based on experience, do you entertain as to the nature or cause of this trouble, which you think worthy of consideration?

12. What information can you give regarding the disease under consideration which is not called for by the above questions?

Inquiries, specimens, and answers to the above questions should be addressed to

JAS. ELLIS HUMPHREY,
Prof. of Vegetable Physiology,
Amherst, Mass.

CREAMERY RECORD OF THE STATION DURING THE YEARS 1887 AND 1888.

621. In a preceding bulletin, No. 32, has been published a milk record of twelve cows, grades, which had served during past years for feeding exeriments at the station. It was stated on that occasion 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. The fitness of the various animals for our purpose ceased, in turn, whenever the period of time between the day of calving and the day of observation had reached the point where constitutional changes in their life threatened to interfere, more or less seriously with a clear demonstration of the special nutritive effect, as far as the production of milk is concerned, of any particular change in their daily diet. As existing conditions did not advise any increase of our dairy stock, the cows were usually sold on fair terms for our locality. The conclusions arrived at in consequence of our observations were clearly qualified by a detailed statement of the course we felt obliged to adopt in our position. Our financial results, although obtained under somewhat exceptional circumstances, were 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 present 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. 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 which are adopted in our late 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 correspond with those lately published in Bulletin 32.

The value of the 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 AND 1888 (IN LBS.).

	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		2590.0						
February.	523.5		523.5		409.5	1630.0			467.5							4255.0
March,	585.0		585.0		585.0	390.0	2975.0		115.0							663.5
April.	585.0		481.0	101.0	585.0	3550.0										
May,	466.0		81.5	637.0	130.0	2860.0										
June,	549.5		549.0			3380.0										
July,	598.0		552.5			2521.5					3415.0					
August,	572.0		572.0			2494.0							6150.0			
September,	585.0		585.0			2660.5						7185.0	735.0			
October,	604.5		604.5			4368.5										
November,	585.0		585.0			212.5	4194.5							570.0		
December,	590.0		589.5		24.0	1183.0	3023.5							620.0		
1888.																
January,	280.0	282.0	562.5		522.5	3378.0										
February,		565.5	565.5		565.5	1155.0		2064.0		225.0						
March,		604.5	604.5		604.5	1307.5		79.5		5094.0						
April.		585.0	585.0		585.0	1050.0		1319.5		1303.5						
May,		604.5	604.5		510.0	3600.0		27.0								551.0
June,		585.0	585.0		291.0	3600.0										
July,	413.0	117.0	530.0		530.0	2054.0					4730.5					
August,	504.0		504.0		504.0	620.0	2534.0									
September,	510.0		510.0		510.0	2148.5							3970.0			
October,	575.5		575.5		575.5	3431.0										
November,	585.0		585.0		585.0	1845.0		1348.5								
December,	588.5		588.5		588.5	223.0		1183.0	1488.5						461.0	

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					62.00			
				{ 1:6.94	3.25		3.25			5.00								
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 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		3.25		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															

3.—Value of Cream Produced at Creamery Basis of Valuation.

	Total cost of feed consum'd	Total value of fert. constituents of food consumed.	Val. fertiliz'ng constituents lost in cream.	Net cost of feed for production of cream.	Value of cream produced.
1887.	$	$	$	$	$
January	16 21	9.69	.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
1888.					
January	43.53	21.42	.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	39.68	20.30	.62	20.01	34.34

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. (1 qt.,34 spc's)	Quarts of skim-milk.	Value of cream per space. (Cents.)	Value of cream per qt. of m'lk. (Cents.)	Total value of Cream.	Cost of skim milk per qu'rt (Whole milk at 3c. per quart.)	Total cost of skim-milk.
1887.							$	$	$
January	976.2	445	130.9	845.3	3.88	1.76	17 24	1 43	12.05
February	2093.1	1036	304.7	1788.4	3.75	1.86	38.85	1.34	23.94
March	2352.7	1072	315.3	2037.4	3.75	1.71	40 20	1.43	30.38
April	2083.4	859	252.6	1830.8	3 63	1.50	31.14	1.71	31.36
May	1729 0	962	282.9	1446.1	3 38	1.88	32.47	1.34	19.40
June	1818.7	1001	294.4	1524.3	3.00	1.65	30.03	1.61	24 53
July	1749.7	886	260.6	1489.1	3.13	1.58	27.69	1 67	24.80
August	1772 6	1026	301.8	1470.8	3 50	2.03	35.91	1.17	17.27
September	1808.4	1037	305.0	1503.4	3.50	2.01	36 30	1.19	17.95
October	1574.4	968	284.7	1289.7	3.75	2.31	36.30	0.85	10.93
November	1545.6	786	231.2	1314.4	3.75	1.91	29.48	1 28	16.89
December	1522.3	909	267.3	1255.0	3,88	2.31	35.23	0 83	10.44
1888.									
January	1807.5	1144	336.5	1471.0	4.00	2.53	45 76	0.58	8.47
February	1925.8	1100	323.5	1602.3	4 00	2.28	44.00	0.86	13.77
March	1794 5	1049	308.5	1486.0	3.90	2.28	40.91	0.87	12 93
April	1702.5	986	290.0	1412.5	3.65	2.11	35.99	1.07	15.09
May	1638.1	978	287.6	1350.5	3 50	2.10	34 23	1.10	14.91
June	1553.9	882	259.4	1294.5	3.25	1.85	28.67	1.39	17.95
July	1841.5	952	280.0	1561.5	3.25	1.68	30.94	1.56	24.31
August	1696.9	928	272.9	1424.0	3.50	1.91	32 48	1 29	18 43
September	1580.1	854	251.2	1328.9	3.75	2.03	32.02	1.16	15.38
October	1606.8	933	274.4	1332.4	3.85	2.24	35.92	1.00	12.28
November	1576.0	966	284.1	1291.9	4.00	2.39	37.67	0.74	9.61
December	1270.3	889	261.5	1008.8	4.00	2.73	34.67	0.34	3.44
Averages	1709.2	943.7	277.5	1435.3	3.65	2.03	34 34	1.16	16.94

5.—FERTILIZING CONSTITUENTS OF CREAM.

(Average Analysis.)

	Per cent.
Moisture at 100° C., - - - - - - - -	75.22
Nitrogen, (16 1-2 cts. per pound) - - - - - -	.51
Potassium oxide, (4 1-4 cts. per pound) - - -	.123
Phosphoric acid, (6 cts. per pound) - - - - - -	.168

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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 of 1887 than in 1888. During one-half of the year 1887 it ranged above 1:8.5, while 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).

2. The amount of fat in the milk varied during the year of 1887 from 3.45 to 4.50 per cent. with an average of 4.00 per cent., while during the year of 1888 it varied from 3.14 to 4.86 per cent. with an average of 3.97 per cent.

3. The quantity of milk, in quarts, required to produce one space of cream during the year of 1887 varied from 2.42 to 1.63 and amounted on the average, to 1.93 quarts, for the entire year; during the year of 1888 it varied from 1.93 to 1.43 while it averaged for the year 1.72 quarts.

4. The value received for one space of cream during the year of 1887 varied from 3.00 to 3.88 cents with an average of 3.58 cents; during the year of 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.

5. The total cost of feed consumed for the production of one quart of cream amounted for the year 1887 to 15.09 cents and for the year 1888 to 13.55 cents.

6. The value of the fertilizing constituents which are lost to the farm by the sale of cream produced amounted, during both years,

according to analyses of our cream, to from 2.8 per cent. to 4.5 per cent. with an average of 3.05 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 the manure.

7. The net cost of feed consumed per quart of cream, (1 qt.=3.4 spaces,) averaged, for the year of 1887, 8 cents, and for the year of 1888, 6.47 cents. As we obtained 12.17 cents per quart of cream during 1887, and 12.65 cents during 1888, we secured a profit above net cost of feed of 4.17 per quart in 1887, and in the year 1888, 6.18 cents for the same quantity.

8. We produced during the year 1887, 21,026.1 quarts, and during the year 1888, 19,991.9 quarts of whole milk.

It required on an average during 1887 and 1888, 6.17 quarts of whole milk to produce one quart of cream. We secured during the same period of time 34,359.4 quarts of skim milk, and 6,661.0 quarts of cream.

9. Counting the whole milk at three cents per quart, the skim milk has cost us on an average during the year 1887, 1.32 cents per quart, and during the year 1888, 1.00 cent 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 cream; during 1887 the cost of skim milk varied from .83 to 1.71 cents per quart, and in 1888 from .34 to 1.56 cents per quart.

The feeding value of skim milk containing 9.5 per cent. 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 our 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 that basis, a value of 1.75 cents per gallon, or .44 cents per quart.

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
	Compound Fertilizers.		
16	Potato Fertilizer	Davidge Fertilizer Co., New York	Amherst.
20	Animal Fertilizer	Bowker Fertilizer Co , 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	"
108	" "	" "	New Bedford.
53	Potato Manure	" "	Springfield.
59	Chittenden's Complete Fertilizer for Grass	National Fertilizer Co., Bridgeport, Conn	Northampton.
61	Mapes Complete Manure for Light and Sandy Soils	Mapes Formula and Peruvian Guano Co., New York	"
65	Red Brand, Special Fer'zer for Potatoes, Cabbages & Peas	Le Page Co , Boston, Mass	Boston.
76	Randall Market Garden Fertilizer	Benj. Randall, Boston, Mass	"
98	Crocker's New Rival Ammoniated Superphosphate	Crocker Fertilizer and Chemical Co , Buffalo, N. Y	Haverhill
102	Lawrence Fertilizer	Lee, Blackburn & Co., Lawrence, Mass	Lawrence
110	Potato and Root Crop Manure	L. B. Darling Fertilizer Co., Pawtucket, R. I.	Taunton
124	Jennison's Animal Fertilizer	Edward F. Jennison, Lancaster, Mass	So. Lincoln.
129	Lister's Ammoniated Dissolved Bone	Lister's Agricultural Chemical Works, Newark, N. J	Turner's Falls.
132	Sea Fowl Guano	Bradley Fertilizer Co., Boston, Mass	"
134	Orient Complete Manure	Orient Guano Co , Orient, L. I.	Sheffield.
135	Great Eastern Tobacco Fertilizer	Great Eastern Fertilizer Co., 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 Co., Boston, Mass	Haverhill.
118	Hargrave's Fine Ground Bone	Hargrave Manufacturing Co., Fall River	Fall River.

Laboratory Number.	Name of Brand.	Moisture.	Nitrogen in 100 pounds.		Phosphoric Acid in 100 pounds.							Potassium Oxide in 100 lbs.			
			Found.	Guaranteed	Soluble.	Reverted.	Insoluble.	Total. Found.	Total. Guaran-teed.	Available. Found.	Available. Guaran-teed.	Found.	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'td Bone S'phos'te Am'rcus Bd	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 Fert. 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' Comp.Man. for l'gt & sand 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	Rd S'r Bd. 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 Am'td S'phos'te.	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	*		
												Mechanical Analysis.			
	Bones and Tankage											Fine.	Fine med'm	Med.	Coarse Med.
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.

TRADE VALUES OF FERTILIZING INGREDIENTS IN RAW MATERIALS AND CHEMICALS.

	1889. Cents per pound.
Nitrogen in ammoniates,	19
" " nitrates,	17
Organic nitrogen in dry and fine ground fish, meat, blood,	19
" " " cotton-seed meal and castor pomace,	15
" " " fine ground bone and tankage,	16½
" " " fine ground medium bone and tankage,	13
" " " medium bone and tankage,	10½
" " " coarser bone and tankage,	8½
" " " hair, horn-shavings and coarse fish scraps,	8
Phosphoric acid soluble in water,	8
" " soluble in ammonium citrate,	7½
" " in dry ground fish, fine bone and tankage,	7
" " in fine medium bone and tankage,	6
" " in medium bone and tankage,	5
" " in coarse bone and tankage,	4
" " in fine ground rock phosphate,	2
Potash as High Grade Sulphate, and in forms free from Muriate or Chlorides, Ashes, etc,,	6
" " Kainite,	4½
" " Muriate,	4½

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.

Trade Values in Superphosphates, Special Manures and Mixed Fertilizers of High Grade.

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, 19 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 insoluble phosphoric acid is worth but two cents per pound.

C. A. GOESSMANN, *Director*,

AMHERST, MASS.

The publications of the Experiment Station will be sent free of charge to all parties interested in its work, on application.

J. E. Williams, Printer, Amherst, Mass.

MASSACHUSETTS STATE

AGRICULTURAL EXPERIMENT STATION.

BULLETIN No. 35.

NOVEMBER, 1889.

Meteorological Summary for the five months ending Oct. 31, 1889.

	June.	July.	August.	September.	October.
Highest temperature,	88.5°	86.°	84.°	82.5°	69.5°
Lowest temperature,	38.°	46.5°	40.5°	34.5°	21.°
Mean temperature,	66.41°	68.09°	64.43°	60.89°	45.23°
Total precipitation,	3.85 in.	8.35 in.	2.69 in.	2.90 in.	4.10 in.
Prevailing winds,	S.W.	N.W.	N.W.	N.E.	N.E.
No. of days on which cloudiness averaged 8 or more on a scale of 10,	8	8	6	20	13
No. of days on which .01 of an inch or more of water from rain or melted snow fell,	12	15	7	10	14

The distribution of rain has frequently seriously interfered with farm work. A large proportion of the hay and grain crop has been damaged by rain or delay in cutting.

Most crops except on well drained land have suffered considerably. Corn was late during the growing season, but had sufficient time to ripen; for the frost came later than usual in this vicinity. The first killing frost occurred Sept. 23.

FEEDING EXPERIMENTS WITH MILCH COWS.

Fodder Corn, Corn Stover and Corn Ensilage vs. English Hay.

In preceding communications under the stated heading 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 the 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 case of the different fodder combinations used as a daily diet for the support of the 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. A short abstract of more recent observations in the same direction forms part of this bulletin.

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 standpoint taken in our several reports of progress is justifiable by the facts presented.

SUMMARY OF FEEDING EXPERIMENTS,

Nov., 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 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	1 : 6.7						
	Wheat bran	20.00	to						
	English hay	15.00	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		2. Mollie	12.62-8.60	11.00	1.02-2.50	.51-1.61	1.56-2.80
	Corn ensilage	2.75	Mean						
	Sugar beets	5.00	1 : 7.86						
Oct. 1, 1886, to April 24, 1887.	Corn meal	23.00							
	Wheat bran	20.00	1 : 5.99						
	Gluten meal	23.00	to	1. Susie	13.5-9.4	11.92	1.04-2.37	.43-1.67	1.66-2.76
	Rye middlings	24.00	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		3. Dora	16.3-11.7	13.94	.85-2.26	.34-1.60	1.58-2.23
	Corn stover	5.00	Mean						
	Corn ensilage	2.75	1 : 6.60						
	Carrots	7.00							
Jan. 8, 1888 to May 15.	Corn meal	23.00							
	Wheat bran	20.70	1 : 5.20	1. May (1)	12.3-10.1	11.23	1.51-2.51	.77-1.63	1.94-2.50
	Gluten meal	27.00	to	2. Minnie (1)	12.7-10.2	11.49	1.40-2.53	.74-1.65	1.73-2.52
	Corn and cob meal	20.70	1 : 6.10	3. Melia (1)	14.6-10.9	12.62	1.28-2.44	.66-1.59	1.73-2.43
	English hay	15.00		4. Eva (1)	7.2-5.5	6.22	2.58-4.74	1.39-3.09	3.36-4.74
	Corn Stover	5.00	Mean	5. Lizzie	10.6-7.9	9.06	1.68-3.36	.95-2.19	2.17-3.35
	Corn ensilage	2.75	1 : 5.80	6. Daisy (2)	19.2-13.5	16.22	1.01-1.97	.50-1.28	1.38-1.96
	Fodder corn	5.00							
Nov. 1, 1888 to May 21, 1889.	Corn meal	21.90		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	1 : 5.13	3. Eva (2)	14.95-10.73	11.79	1.30-2.71	.63-1.99	1.67-2.49
	English hay	15.00	to	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	1 : 6.79	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	Mean	7. Elsie	13.64-12.25	12.71	2.18-2.29	1.17-1.56	1.78-2.39
	Carrots	7.00	1 : 6.02	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 as well as succeeding tabular statement may assist in a desirable appreciation of the questions involved.

During our first year of observation, Nov., 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 lb.) 17 cts.; phosphoric acid, 6 cts.; and potassium oxide, 4 1-4 cts. Eighty per cent. of the entire amount of fertilizing constituents contained in the fodder consumed are considered obtainable by proper management, while twenty per cent. are assumed to be sold with the milk and thus lost to the farm.

Net cost of the 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 present discussion of *the cost of production of milk.*

Nutritive ratio of a fodder combination refers to the relative proportion of the digestible non-nitrogenous fodder constituents to its digestible nitrogenous food constituents counted as 1.

The quantity of the different fodder rations stated below represents in each case the daily average of the amount actually consumed per head during 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 larger quantities than the figures represent were offered for their consumption. The daily consumption of the grain feed varied in no instance from the amount stated in each case; the same statement applies to the hay when fed in connection with some other coarse fodder article as corn ensilage, etc.

From three to six cows, and at times more, served at different periods of observation.

DAILY FODDER RATIONS.

Nov., 1885—July, 1886.

1.

Corn meal,	3.25 lbs.
Wheat bran,	3.25 "
Hay,	21.75 "
Total cost,	23.43 cts.
Net cost,	15.43 "
Manurial value obtainable,	8.00 "
Nutritive ratio,	1 :8.02

2.

Corn meal,	3.25 lbs.
Wheat bran,	3.25 "
Hay,	10.00 "
Corn stover,	8.00 "
Total cost,	16.62 cts.
Net cost,	10.04 "
Manurial value obtainable,	6.58 "
Nutritive ratio,	1 :7.83

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—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

January—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—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 ration No. 3, 8, 10, 11 and 14 deserve in particular attention for trials. The remainder, although in some instances not without a special interest, is 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. (cts.)	Net cost. (cts.)	Manurial value obtainable. (cts.)
No. 1,	23.43	15.43	8.00
No. 2,	16.62	10.04	6.58
No. 3,	14.06	7.83	6.23
No. 4,	25.12	17.10	8.02
No. 5,	21.41	14.31	7.10
No. 6,	24.66	16.66	8.00
No. 7,	25.14	15.77	9.37
No. 8,	19.60	11.62	7.98
No. 9,	31.89	23.05	8.84
No. 10,	15.75	7.54	7.99
No. 11,	15.40	7.44	7.96
No. 12,	21.64	13.15	8.49
No. 13,	30.40	20.22	10.18
No. 14,	25.72	13.51	12.21

Considering the previously described fodder combinations *from a mere financial standpoint, 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 $\frac{1}{3}$ to $\frac{1}{2}$). It seems scarcely necessary to mention here, that only equally well prepared fodder articles are considered in the discussion.

Sugar beets compared 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 feeding effect 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 price of a given quantity of the various ingredients which constitute the daily fodder rations, but also in a controlling degree on the quantity of some essential articles of plant food, in particular, of nitrogen, phosphoric acid and potassium oxide, 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 various ingredients, the sum expressing the commercial value of the manurial matter 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, (1885 to 1889).

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 $21.00 and gluten meal $24.50; the latter sells to-day at $23.00 per ton, corn meal at $19.00 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 their 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 depending 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, at the same time reducing the net cost of the feed consumed and furnishing 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 substitution under otherwise corresponding circumstances of dry corn fodder, 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 are already on record, in our respective annual reports; they lead to the same conclusions. The net cost of the daily feed during our late experiment has been stated on preceding pages of this bulletin. The quality of the milk and cream obtained on that occasion may be learned from the subsequent tabular record. More details of a similar character are reserved for our next annual report.

TABULAR STATEMENT OF THE COMPOSITION OF MILK DURING DIFFERENT FEEDING PERIODS.

Name of Cow.	Date.	Percentage composition of milk.		AVERAGE DAILY FEED CONSUMED (IN POUNDS).								
		Solids	Fat	Corn Meal.	Wheat Bran.	Gluten Meal.	Hay.	Fodder Corn.	Corn Stover.	Carrots.	Corn Ensilage.	Sugar Beets.
	1888											
ANNIE.	Nov. 14	13.68	3.65	3.25	3.25	3.25	18.67					
	Dec. 4	15.22	5.10	3.25	3.25	3.25		13.27				
	Dec. 24	14.83	4.90	3.25	3.25	3.25			14.36			
	1889											
	Jan. 16	14.10	4.10	3.25	3.25	3.25	10.00			37.05		
	Feb. 11	14.30	4.55	3.25	3.25	3.25	5.00				29.91	
	Apr. 2	14.52	4.72	3.25	3.25	3.25	10.00					43.53
	1888											
MAY.	Nov. 14	14.90	4.13	3.25	3.25	3.25	20.00					
	Dec. 4	14.42	5.30	3.25	3.25	3.25		17.68				
	Dec. 24	15.37	4.74	3.25	3.25	3.25			21.82			
	1889											
	Jan. 16	15.42	4.60	3.25	3.25	3.25	10.00			39.37		
	Feb. 11	15.05	4.65	3.25	3.25	3.25	5.00				38.86	
	Apr. 2	15.02	4.60	3.25	3.25	3.25	10.00					43.33
	1888											
EVA.	Nov. 14	14.40	4.85	3.25	3.25	3.25	20.00					
	Dec. 4	14.45	5.25	3.25	3.25	3.25		18.23				
	Dec. 24	15.11	5.17	3.25	3.25	3.25			19.00			
	1889											
	Jan. 16	14.90	4.82	3.25	3.25	3.25	10.00			39.35		
	Feb. 11	14.95	4.95	3.25	3.25	3.25	5.00				43.00	
	Apr. 2	15.63	5.33	3.25	3.25	3.25	10.00					46.20

QUARTS OF MILK REQUIRED TO MAKE ONE SPACE OF CREAM.

(AVERAGE OF SIX COWS FED UPON THE ABOVE 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

ABSTRACT FROM OUR RECORD OF THE COMPOSITION OF CREAM.

Date.	Percentage Composition of Cream.		AVERAGE DAILY FEED CONSUMED (IN LBS).						
	SOLIDS.	FAT.	Corn Meal.	Wheat Bran.	Gluten Meal.	Hay.	Carrots.	Corn Ensilage.	Sugar Beets.
1889.									
Jan. 22.	27.83	18.10	3.25	3.25	3.25	10	40		
" 29.	28.50	20.90	3.25	3.25	3.25	5		35	
Feb. 5.	27.55	19.41	3.25	3.25	3.25	5		40	
" 12.	26.75	19.21	3.25	3.25	3.25	5		40	
" 19.	27.02	19.75	3.25	3.25	3.25	5		40	
" 26.	26.75	18.93	3.25	3.25	3.25	18			
Mar. 5.	26.62	17.54	3.25	3.25	3.25	20			
" 12.	25.34	16.35	3.25	3.25	3.25	20			
" 19.	24.65	16.45	3.25	3.25	3.25	10			40
" 26.	27.25	18.25	3.25	3.25	3.25	10			45
Apr. 2.	26.00	17.20	3.25	3.25	3.25	10			45
" 9.	25.92	17.25	3.25	3.25	3.25	18			
" 17.	24.92	16.30	3.25	3.25	3.25	20			
June 25.	28.16	18.20	3.25	3.25	2.25	20			

The above partial abstracts from our milk and creamery records show that the fodder corn, corn stover and corn ensilage, when fed pound for pound of dry matter, in place of English hay, compare well, as far as the quality and the quantity of the milk and of the cream obtained, is concerned.

There can be no doubt about the fact in the present condition of our market prices of feed stuffs,—that the care and the expense required to secure a well cured corn fodder and corn stover or a well prepared corn ensilage, as circumstances may advise, and to offer them in an ccceptable form, to milch cows, will prove a well paying investment.

It may not be without interest to state here that the results of feeding experiments of a similar character, of late published by the Ohio and Iowa Experiment Stations, coincide, in the main, with ours, stated in previous reports.

C. A. GOESSMANN, *Director*,

AMHERST, MASS.

The Bulletins of the Experiment Station will be sent free of charge to all parties interested in this work, on application.

J. E. Williams, Printer, Amherst, Mass.

MASSACHUSETTS STATE AGRICULTURAL EXPERIMENT STATION.

BULLETIN No. 36.

MARCH, 1890.

Meteorological Summary for the four months ending Feb. 28, 1890.

	Nov.	Dec.	Jan.	Feb.
Highest temperature,	62.5°	64.°	61.5°	59.5°
Lowest temperature,	14.5°	3.5°	4.5°	3.°
Mean temperature,	40.61°	33.51°	30.51°	30.37°
Total precipitation,	6.21 in.	2.85 in.	2.61 in.	4.01 in.
Total snowfall,	—	8 in.	4 in.	4.5 in.
Prevailing winds,	N.W.	N.W.	N.W.	N.W.
No. of cloudy days,	15	12	14	15
No. of days on which .01 of an inch or more of water from rain or melted snow fell,	13	11	14	12

The mildness of the above stated four months has been without a parallel since the beginning of the weather records at Amherst in 1836. The mean temperature for each of the months is considerably above the average. No ice was cut until February, when it was from six to eight inches in thickness.

The periodical snowfall was light with the exception of the one on the 20th of February which offered a chance for sleighing for a few days.

SOME SUGGESTIONS REGARDING THE QUESTION—HOW CAN WE IMPROVE IN AN ECONOMICAL WAY THE PRODUCTIVENESS OF OUR FARM-LANDS?

The consideration of this important question forces itself for obvious reasons at no period of the year more seriously upon the mind of every tiller of the soil, than at the present one; for every thinking farmer recognizes to-day the fact, that a successful termination of his work during the coming season, as far as human efforts can promote satisfactory results, depends in a controlling degree on a correct appreciation of the extent and the character of his resources of plant-food and on a liberal and intelligent use of the latter.

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 publication. 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 livestock.

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 lands 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 comparative 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 the 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 lay 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 horsebeans 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 cowpea, 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 9 to 10 tons of green vetch and oats; 10 tons of green southern cowpea; and from 12 to 13 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 exhaustion of the 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 annual report for 1889: (VII.) :—

COMPOSITION OF FODDER CROPS

Raised upon the Station Grounds.

NAME OF CROP. (Suitable for feeding.)	Nutritive Ratio.	Fodder Constituents (in lbs.) in 1000 lbs. of Dry Matter. Crude Ash.	Crude Cellulose.	Crude Fat.	Crude Protein (nitrogenous matter.)	Non-nitrogenous extract matter.	Fertilizing Constituents (in lbs.) in 1000 lbs of Dry Matter. Nitrogen.	Phosphoric Acid.	Potassium oxide.	Manurial value per ton of dry matter.
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	324.9	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
Lucern (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	6.24	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
Rutabagas.		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 of 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 on 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 *net cost of feed* is concerned; for it is admissable 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 the feed consumed. A few tabular statements may not be without interest on this occasion; for further illustration I refer to our last annual report.

I. Table showing the relative manurial value of stated fodder. Net cost signifies market cost less manurial value.

II. 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 .9 cents per pound of digestible non-nitrogenous extract matter and $4\frac{1}{3}$ 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 article, 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.

I. 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, (O. P.)	27.00	21.75	5.25
" " (N. P.)	25.00	24.00	1.00
English hay, (mixed)	12.00	5.50	6.50
Corn fodder,	5.00	4.32	.20
Corn stover,	5.00	4.80	.68
Sugar beets,	5.00	1.15	3.85
Mangel-wurzels,	3.00	1.10	1.95
Skim-milk,	4.10	2.25	1.80

II. COST OF DIGESTIBLE NITROGENOUS MATTER OF FODDER ARTICLES (per pound).

(The constituents are given in pounds per 1000 lbs. 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. (lbs.)	Indigestible nitrogenous matter. (lbs.)	Cost of digestible nitrogenous matter per lb., allowing for digestible fat 4⅓ cts. for cellulose and non-nitrogenous extract matter, .9 cts. per lb.	Total nitrogen in article.	Digestible nitrogen.	Indigestible nitrogen.
Corn meal,	$20.00	128.6	871.4	98.47	85	83.70	14.77	3.30 cts.	15.66	13 31	2 35
Wheat bran,	17.00	109 7	890.3	158.36	88	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 (O. P.),	27.00	74 8	925.2	343.70	87	299.02	44.68	2.50	54.99	47.84	7.15
Linseed meal (N. P.),	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

Approximate values.

*The digestible fat, cellulose and non-nitrogenous extract matter at stated prices more than cover the market Cost.

Analyses of Fodder Articles.

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 8-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 500 lbs. ground bone in hill.
2. About thirty loads or 10 cords stable manure broadcast and 200 lbs. phosphate in hill.
3. Forty loads stable manure broadcast.
4. After a crop of rye for fodder with 5 cords stable manure, 400 lbs. E. F. Coe's phosphate in drill.
5. Six cords horse manure with 300 lbs. of Bradley's fish in hill.
6. Two and one-half cords stable manure broadcast on grass sod in the fall and ploughed in with 400 lbs. of phosphate in drill when planting.

c. Mode of planting.

1. Rows 3 ft. apart; hills 26 in. apart; 4 kernels to hill.
2. Rows 3 1-2 ft. apart; hills 20 in. apart.
3. Rows 3 ft. apart; hills 12 in. apart.
4. Rows 3 ft. apart; kernels about three inches apart in drills.
5. Rows 32 in. apart; kernels about 6 in. apart in drills.
6. Rows 3 ft. apart; kernels about 1 ft. apart in drills.

d. Period of harvesting.

1. Somewhat past the milk.
2. Over ripe. Rather dry. Sept. 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. Sept. 25.

e. Yield per acre (approximately).

1. 18 to 20 tons.

2. About eight tons of ensilage and 80 bush. of ears.
3. Estimated 35 to 40 tons; 10 to 15 ft. high.
4. 12 tons.
5. 20 to 22 tons.
6. 12 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 12 inches of old hay or straw; then with inch boards and 10 inches thickness of stones.
5. Cut in pieces 3-4 inch 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. Not so bright looking as No. 1. Odor agreeable, but slightly sour.

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.

On Commercial Fertilizers.

The duties assigned to the director of the station, to act as inspector of commercial fertilizers, 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 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 pruposes, 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 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 50 to 100 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
" " nitrates,	14½
Organic nitrogen in dry and fine ground fish, meat, blood,	17
" " " cotton-seed meal and castor pomace,	15
" " " fine ground bone and tankage,	16½
" " " fine ground medium bone and tankage,	13
" " " medium bone and tankage,	10½
" " " coarser bone and tankage,	8½
" " " hair, horn-shavings and coarse fish scraps,	8
Phosphoric acid soluble in water,	8
" " soluble in ammonium citrate,	7½
" " in dry ground fish, fine bone and tankage,	7
" " in fine medium bone and tankage,	6
" " in medium bone and tankage,	5
" " in coarse bone and tankage,	4
" " in fine ground rock phosphate,	2
Potash as High Grade Sulphate, and in forms free from Muriate or Chlorides, Ashes, etc.	6
" " Kainite,	4½
" " 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, 17 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 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, 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 1st, plus about 20 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.

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.

C. A. GOESSMANN, *Director.*

AMHERST, MASS., March 15th, 1890.

The publications of the Experiment Station will be sent free of charge to all parties interested in its work, on application.

Amherst RECORD Press, Amherst, Mass.

MASSACHUSETTS STATE AGRICULTURAL EXPERIMENT STATION.

BULLETIN No. 37.

JULY, 1890.

Meteorological Summary for the four months ending June 30, 1890.

	MARCH.	APRIL.	MAY.	JUNE.
Highest temperature,	59.5°	77.5°	79.0°	86.5°
Lowest temperature,	—9.5°	22.0°	32.0°	38.0°
Mean temperature,	30.18°	45.45°	56.41°	64.58°
Total precipitation,	4.81 in.	1.64 in.	5.14 in.	1.48 in.
Total snowfall,	17 in.			
Prevailing winds,	N. E.	N. E.	S. E.	S. E.
No. of cloudy days,	14	9	11	8
No. of days on which .01 of an inch or more of water from rain or melted snow fell,	16	7	15	9

A snow storm on the 6th of March gave good sleighing for a few days. Toward the close of the month the weather was mild with more than an average rainfall.

The temperature for April was about the average; the rainfall was considerably less. The last heavy frost of the season occurred April 29th.

The cool and wet weather of May favored the growth of grasses and grain crops. The corn crop was somewhat behind at the end of the month; light frosts were reported on the 17th and 23rd.

The weather during June has been more favorable for corn. Some localities have suffered from drought toward the close of the month.

Feeding Experiments with Lambs.

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.

Six grade lambs—three ewes and three wethers—bought (Sept. 4th, '89) of a farmer in our vicinity served for our observations. They consisted of five Hampshire Down and one Merino,—grades. 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. 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. 1–2–3) received a daily diet much richer in nitrogenous food constituents than the one adopted for Division II. (Nos. 4–5–6). This circumstance was brought about by feeding to the first division as grain-feed a mixture of wheatbran and of gluten meal, and to the second division one consisting of a liberal proportion of cornmeal with some wheatbran 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 three equal parts and fed respectively in the morning, at noon 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. 1–2–3) were continued for 152 successive days—Sept. 5th, '89 to Feb. 4th, '90—while in case of the second division (Nos. 4–5–6) they were extended to March 18th, '90, 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 $107\frac{1}{2}$ pounds, or each individual on an average $35\frac{8}{10}$ pounds; while those of the second division (Nos. 4–5–6) gained during 194 days in the aggregate only 86 pounds or each individual on an average $28\frac{7}{10}$ 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.

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 lbs.	3.50 lbs.	79.00 lbs (wether)
2.	69.50 "	3.50 "	66.00 " (ewe)
3.	75.00 "	4.25 "	70.75 " (ewe)
4.	71.00 "	3.50 "	67.50 " (ewe)
5.	70.00 "	3.75 "	66.25 " (wether)
6.	82.50 "	3.75 "	78.75 " (wether)
	450.50	22.25	428.25

I. Division consisted of lambs Nos. 1–2–3; its aggregate live weight was 215.75 pounds at the beginning of the experiment.

II. Division consisted of lambs Nos. 4–5–6; 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 22 cts. per pound. The sum realized by that transaction was $4.89. Allowing the deduction of $4.89 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 $22.14, or 5.17 cts. per pound of live weight. The live weight without the removed wool was 428.25 pounds.

I. Division.

1.	79.00 pounds of live weight at 5.17 cts. per lb.,	$4.10	=$11.13
2.	66.00 " " " " "	3.41	
3.	70.00 " " " " "	3.62	

II. Division.

4.	67.00 pounds of live weight at 5.17 cts. per lb.,	$3.49	=$11.00
5.	66.25 " " " " "	3.43	
6.	78.75 " " " " "	4.08	

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—Sept. 4th to Sept. 16th. Subsequently a division of animals was made. Three lambs, 1–2–3, were fed with daily rations richer in digestible nitrogenous food constituents than those fed to the remaining number, 4–5–6.

The daily feed of the first division (1–2–3) 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—1 :5.5.

The daily diet of the second division (4–5–6) 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 I. DIVISION, (1–2–3).

The daily quantity of the subsequent stated fodder rations was regulated by the appetite of each animal. Further details in this connection are reserved for the next annual report.

a. Sept. 16th to Sept. 30th.
2 lbs. of rowen.
1 lb. of a mixture consisting of wheat bran, 2 weight parts.
gluten meal, 1 weight part.
Nutritive ratio 1 :4.75.

b. Oct. 1st. to Dec. 31st.
2 lbs. of rowen.
1 lb. of a mixture consisting of wheat bran, } equal
gluten meal, } weights.
Nutritive ratio 1 :4.55.

c. Jan. 1st to Jan. 20th.
1 lb. of rowen.
3½ lbs. of corn ensilage.
1 lb. of the same grain mixture as in ration *b*.
Nutritive ratio 1 :5.09.

d. Jan. 21st to Feb. 3d.
7½ lbs. of corn ensilage.
1 lb. of grain mixture as in ration *b*.
Nutritive ratio 1 :5.5.

COST OF ABOVE FODDER RATIONS FOR WEIGHTS STATED.

	a.	*b.*	*c.*	*d.*
First cost of feed consumed, (cts.)	2.45	2.51	2.24	1.97
Manurial value obtainable, (cts.)	1.13	1.15	1.10	1.01
Net cost of feed, (cts.)	1.32	1.36	1.14	0.93

FODDER COMBINATIONS USED IN II. DIVISION.

a. Sept. 16th to Dec. 31st.
2 lbs. of rowen.
½ lb. of a mixture consisting of corn meal, 10 weight parts.
wheat bran, 2 " "
gluten meal, 1 " "
Nutritive ratio 1 :7.00.

b. Jan. 2nd to Jan. 20th.
1 lb. of rowen.
3½ lbs. corn ensilage.
½ lb. of the same grain mixture as in preceding ration *a.*
Nutritive ratio 1 :7.3.

c. Feb. 4th to Feb. 15th.
7 lbs. of corn ensilage.
1 lb. of a mixture consisting of corn meal, 2 weight parts.
wheat bran, 2 " "
gluten meal, 1 " "
Nutritive ratio 1 :5.7.

COST OF FODDER RATIONS USED IN DIVISION II.

	a.	*b.*	*c.*
Cost of feed consumed, (cts.)	1.98	1.71	1.91
Manurial value obtainable, (cts.)	0.71	0.50	0.88
Net cost of feed, (cts.)	1.27	1.21	1.03

The customary deduction of 20% 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 80% of the market value of its manurial constituents.

COST OF FODDER ARTICLES USED IN THE EXPERIMENT.

Rowen,	per ton,	$15.00
Corn ensilage,	"	2.75
Corn meal,	"	19.00
Wheat bran,	"	17.00
Gluten meal,	"	23.00

4. GAIN IN LIVE WEIGHT DURING THE EXPERIMENT.

I. Division, (1–2–3).

Time of observation extended over 152 days.

	Live weight at the beginning of the experiment. (lbs.)	Live weight at the time of killing, before shearing. (lbs.)	Gain in live weight during the experiment. (lbs.)
1.	79.00	118.25	39.25
2.	66.00	98.50	32.50
3.	70.75	106.50	35.75
	215.75	323.25	107.50

II. Division, (4–5–6).

Time of observation extended over 194 days.

	Live weight at the beginning of the experiment. (lbs.)	Live weight at the time of killing, before shearing. (lbs.)	Gain in live weight during the experiment. (lbs.)
4.	67.50	102.50	35.00
5.	66.25	86.50	20.50
6.	78.75	109.50	30.75
	212.50	298.50	86.25

I. Division, entire lot gained in live weight on an average per day, 0.706 lbs.

II. Division, entire lot gained in live weight on an average per day, 0.445 lbs.

THE AMOUNT OF RAW WOOL SECURED AFTER THE CLOSE OF THE EXPERIMENTS.

I. Division, (1–2–3).

	Live weight with wool. (lbs.)	Live weight after shearing. (lbs.)	Amount of wool obtained. (lbs.)	(oz.)
1.	118.25	114.38	3	14
2.	98.50	94.60	3	15
3.	106.50	102.00	4	8
	323.25	310.98	12	5

II. Division, (4–5–6).

	Live weight with wool. (lbs.)	Live weight after shearing. (lbs.)	Amount of wool obtained. (lbs.)	(oz.)
4.	102.50	99.25	3	4
5.	86.50	82.00	4	8
6.	109.50	105.00	4	8
	298.50	286.25	12	4

I. Division yielded 12 lbs. 5 oz. of wool.

II. Division yielded 12 lbs. 4 oz. 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 22 cts. per pound, the pelts brought 12½ cts. each.

I. Division, (1–2–3).

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 %.

YIELD DRESSED WEIGHTS.

1.	66 pounds, at 11 cts. per pound,	$7.26
2.	54 " " "	5.94
3.	60 " " "	6.60
	180 pounds.	$19.80

II. Division, (4–5–6).

The difference between the live weight of the animals at the close of the experiment, after shearing, and the dressed lambs, when sold, amounted on an average to 46.3 %.

YIELD OF DRESSED WEIGHT.

4.	54 pounds at 11 cts. per pound,	$5.94
5.	46 " " "	5.06
6.	60.50 " " "	6.65
	160.50	$17.65

Division I.

	1.	2.	3.	
Cost of lamb,	$4.10	$3.41	$3.62	$22.85
Cost of feed consumed,	4.53	3.11	4.08	
	$8.63	$6.52	$7.70	
Value received for meat,	$7.26	$5.94	$6.60	$28.55
" " " wool and pelt,	.98	.99	1.11	
" of obtainable manure.	2.19	1.52	1.96	
	$10.43	$8.45	$9.67	

Difference in favor, $5.70.

Division II.

	4.	5.	6.	
Cost of lamb,	$3.49	$3.43	$4.08	$22.09
Cost of feed consumed,	4.24	3.03	3.82	
	$7.73	$7.46	$7.90	
Value received for meat,	$5.94	$5.06	$6.65	$25.17
" " " wool and pelt,	.80	1.11	1.12	
" of obtainable manure,	1.71	1.23	1.55	
	$8.45	$7.40	$9.32	

Difference in favor, $3.08.

6. CONCLUSIONS.

1. The superior feeding effect of a daily diet rich in digestible nitrogenous food constituents when raising lambs for the meat market is well demonstrated 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 constituent 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 careful the matter may be arranged.

Analyses of Fodder Articles.

688. WHEAT MIDDLINGS.

From 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,	15.13
Non-nitrogenous extract matter,	71.50
	100.00

Passed screen 144 mesh, 94.16

FERTILIZING CONSTITUENTS OF WHEAT MIDDLINGS.

		Per cent.
Moisture at 100° C.,		12.43
Calcium oxide,		.193
Magnesium oxide,		.202
Sodium oxide,		.106
Potassium oxide,	4½ cts. per pound,	.607
Phosphoric acid,	6 " " "	.916
Nitrogen,	17 " " "	2.12

Valuation per ton, $8.86.

689—690. OAT FEED.

Sent on by D. K. Reed & Son, Boston, Mass.

	Per cent. I.	II.
Moisture at 100° C.,	6.36	6.85
Dry matter,	93.64	93.15
	100.00	100.00

ANALYSIS OF DRY MATTER.

Crude ash,	3.43	4.49
" cellulose,	3.97	4.66
" fat,	8.32	7.21
" protein,	16.29	17.44
Non-nitrogenous extract matter,	67.99	66.20
	100.00	100.00
Passed screen 144 mesh,	76.63	80.58

FERTILIZING CONSTITUENTS OF OAT FEED.

		Per cent.
Moisture at 100° C.,		6.61
Calcium oxide,		.181
Magnesium oxide,		.042
Ferric oxide,		.037
Sodium oxide,		.373
Potassium oxide,	4½ cts. per pound,	.750
Phosphoric acid,	6 " " "	1.103
Nitrogen,	17 " " "	2.52
Insoluble matter,		1.188

Valuation per ton, $10.57.

691. GLUTEN MEAL.

Sent on by S. N. Fletcher, South Acton, Mass.

	Per cent.
Moisture at 100° C.,	7.30
Dry matter,	92.70
	100.00

ANALYSIS OF DRY MATTER.

Crude ash,	1.32
" cellulose,	1.14
" fat,	17.60
" protein, (nitrogenous matter,)	39.77
Non-nitrogenous extract matter,	40.17
	100.00

84.80% passed sieve.

FERTILIZING CONSTITUENTS OF GLUTEN MEAL.

		Per cent.
Moisture at 100° C.,		7.300
Calcium oxide,		.051
Magnesium oxide,		.035
Ferric oxide,		.070
Sodium oxide,		.018
Potassium oxide,	4½ cts. per pound,	.045
Phosphoric acid,	6 " " "	.429
Nitrogen,	17 " " "	5.900

Valuation per ton, $20.67.

Analyses of Commercial Fertilizers.

I.

ANALYSES OF COMMERCIAL FERTILIZERS AND MANURIAL SUBSTANCES SENT ON FOR EXAMINATION.

692—695. WOOD ASHES.

I. Sent on by F. F. O'Neil, N. Sudbury, Mass.
II. Sent on by Jonathan Ames, So. Lincoln, Mass.
III. Sent on by F. C. Davis, E. 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
" " (after calcination),	11.60	16.20	12.37	17.41

696—697. POTASH SALTS.

I. Muriate of potash, sent on by Anson Wheeler, Concord, Mass.
II. Sulphate of potash, sent on by J. F. Barn, Feeding Hills, Mass.

	Per Cent.	
	I.	II.
Moisture at 100° C.,	.64	2.54
Magnesium oxide,	——	10.88
Potassium oxide,	49.68	24.90
Chlorine,	50.00	——
Sulphuric acid,	——	48.32
Insoluble matter,	Trace	2.67

698. SALTPETRE WASTE.

Sent on by Coolidge Bros., So. Sudbury, Mass.

	Per Cent.
Moisture at 100° C.,	.38
Calcium oxide,	.84

Magnesium oxide,	.05
Sodium oxide,	49.37
Potassium oxide, 4½ cts. per pound,	2.55
Sulphuric acid,	.81
Chlorine,	58.00
Nitrogen, 14½ cts. per pound,	.65
Insoluble matter,	Trace.

699—701. 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
Organic and volatile matter,	77.60	79.60	82.28
Total phosphoric acid,	6.88	7.25	6.97
Soluble " "	.49	.52	.49
Reverted " "	3.06	3.89	2.04
Insoluble " "	3.33	2.84	4.44
Nitrogen,	9.50	6.73	7.56
Insoluble matter,	1.92	4.99	1.17

702—704. GROUND BONES.

I. Sent on by E. H. Smith, Northboro, Mass.
II. Sent on by the Hargrave Manufacturing Co., Fall River, Mass.
III. Sent on by Anson Wheeler, Concord, Mass.

MECHANICAL ANALYSES.

	Per Cent.	
	I.	II.
Fine,	36.83	46.87
Fine medium,	36.86	37.23
Medium,	24.58	11.80
Coarse,	1.73	4.10
	100.00	100.00

CHEMICAL ANALYSES.

	Per Cent.		
	I.	II.	III.
Moisture at 100° C.,	4.51	8.29	6.14
Organic and volatile matter,	43.17	32.79	49.29
Total phosphoric acid	22.69	26.72	18.17

Soluble phosphoric acid,	.14	.34	4.14
Reverted " "	5.70	2.78	8.77
Insoluble " "	16.85	23.60	5.26
Nitrogen,	3.86	2.78	2.78
Insoluble matter,	1.48	.65	1.02

705. BLOOD, MEAT AND BONE.

Sent on by Isaac Madill, Lexington, Mass.

	Per Cent.
Moisture at 100° C.,	7.87
Organic and volatile matter,	79.37
Calcium oxide,	10.33
Phosphoric acid,	8.29
Nitrogen,	5.84
Insoluble matter,	.48

706. JUTE WASTE.

Sent on by J. H. Easterbrook, Dudley, Mass.

	Per Cent.
Moisture at 100° C.,	13.10
Potassium oxide, $4\frac{1}{4}$ cts.,	.08
Phosphoric acid, 6 cts.,	.72
Nitrogen, 10 cts.,	1.50
Valuation per 2000 lbs.,	3.93

707. 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,	.89
Potassium oxide,	.32
Sulphuric acid (SO_3),	1.24
Phosphoric acid,	1.00
Nitrogen,	1.20
Insoluble matter,	17.69

The material, it is stated, was treated with sulphate of lime (Plaster) to prevent the loss of nitrogen in form of ammonia; a very commendable practice.

II.

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
21	Tobacco and Sulphure Lawn Fertilizer,	F. C. Sturtevant, Hartford, Ct.,	Springfield.
30	Ammoniated Dissolved Bone,	Crocker Fertilizer and Chemical Co., Buffalo, N. Y.,	Lee.
32	Potato, Hop and Tobacco Phosphate,	" " " " "	Lee.
35	N. L. Superphosphate of Lime,	Bradley Fertilizer Co., Boston, Mass.,	North Adams.
40	Darling's Animal Fertilizer,	L. B. Darling Fertilizer Co., Pawtucket, R. I.,	N. Framingh'm
42	Ammoniated Wheat and Corn Manure,	Crocker Fertilizer and Chemical Co., Buffalo, N. Y.,	Framingham.
47	The Ames Fertilizer,	Ames Fertilizer Co., Peabody, Mass.,	N. Sudbury.
48	N. Ward & Co.'s High Grade Animal Fertilizer,	N. Ward & Co., Boston, Mass.,	Boston.
49	Red Star Brand 203 Fertilizer for General Crops,	Le Page Co., 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 Co., Portland, Me.,	Jefferson's.
97	Clark's Cove King Phillip 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 Co., Boston, Mass.,	Taunton.
106	Potato Fertilizer,	E. Frank Coe, New York City, N. Y.,	Taunton.
115	Cumberland Superphosphate,	Cumberland Bone Co., Portland, Me.,	Sunderland.
128	Fish and Potash, Anchor Brand,	Bradley Fertilizer Co., Boston, Mass.,	Northampton.
130	Dry Fish Guano,	Bradley Fertilizer Co., Boston, Mass.,	Northampton.
137	Nitrogenous Superphosphate,	J. C. Dow & Co., Boston, Mass.,	Cambr'dgeport
146	Soluble Pacific Guano,	W. D. Stewart & Co., Boston Mass.,	Berlin.
147	Special Favorite,	Davidge Fertilizer Co., New York City, N. Y.,	Barre Plains.

Laboratory Number.	Name of Brand.	Moisture.	Nitrogen in 100 pounds.		Phosphoric Acid in 100 pounds.							Potassium Oxide in 100 lbs.	
			Found.	Guaranteed.	Soluble.	Reverted.	Insoluble.	Total. Found.	Total. Guaranteed.	Available. Found.	Available. Guaranteed.	Found.	Guaranteed.
21	Tobacco and Sulphur Lawn Fertilizer,	22.06	1.96	2.38				.71	.75			7.80	7.66
30	Ammoniated Dissolved Bone,	11.77	3.25	2.88-3.50	6.54	.49	3.42	10.45	11-15	3.91	11-15	1.41	1-2
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	X. L. 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 & Corn Manure,	15.61	2.02	2-3	8.47	2.23	.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	.42	10.00	8-12	9.58	7-10	1.04	.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	Listers 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 Phillip 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,	11.28	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	.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	.03	11.41	11-14	11.38	10-12	1.82	1.5-2.5

TRADE VALUES OF FERTILIZING INGREDIENTS IN RAW MATERIALS AND CHEMICALS.

	1890. Cents per pound.
Nitrogen in ammoniates,	17
" " nitrates,	14½
Organic nitrogen in dry and fine ground fish, meat, blood,	17
" " " cotton-seed meal and castor pomace,	15
" " " fine ground bone and tankage,	16½
" " " fine ground medium bone and tankage,	13
" " " medium bone and tankage.	10½
" " " coarser bone and tankage,	8½
" " " hair, horn-shavings and coarse fish scraps,	8
Phosphoric acid soluble in water,	8
" " soluble in ammonium citrate,	7½
" " in dry ground fish, fine bone and tankage,	7
" " in fine medium bone and tankage,	6
" " in medium bone and tankage,	5
" " in coarse bone and tankage,	4
" " in fine ground rock phosphate,	2
Potash as High Grade Sulphate, and in forms free from Muriate or Chlorides, Ashes, etc.,	6
" " Kainite,	4½
" " Muriate,	4½

The above trade values are the 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.

Trade Values in Superphosphates, Special Manures and Mixed Fertilizers of High Grade.

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, 17 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 insoluble phosphoric acid is worth but two cents per pound.

C. A. GOESSMANN, *Director.*

The publications of the Experiment Station will be sent free of charge to all parties interested in its work, on application.

Press of Carpenter & Morehouse, Amherst, Mass.

MASSACHUSETTS STATE

AGRICULTURAL EXPERIMENT STATION.

BULLETIN NO. 38.

SEPTEMBER, 1890.

Feeding Experiments with Milch Cows.

DECEMBER 1889 TO JULY 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 Oilcake 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 Oilcake Meal is sold, in our local markets at $27.00 per ton of 2000 pounds, and the New Process Linseed Meal of the Cleveland Linseed Oil Co., at $26.00 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 Co. 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 toward 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
Moisture at 100° C.,	5.06%	9.88%
Dry Matter,	94.94 "	90.12 "
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 "

FERTILIZING CONSTITUENTS.

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 2000 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 was 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 to 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 gradual, 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 2000 pounds, at Amherst:

Corn meal per ton,	$19.00	Hay, per ton,	$15.00
Wheat bran,	17.50	Rowen, per ton,	15.00
Old process linseed meal,	27.00	Fodder corn,	5.00
New " " "	26.00	Corn stover,	5.00
Carrots,	7.00	Corn ensilage,	2.75
Sugar beets,	5.00		

A few subsequent pages contain a short abstract of the results of the experiment. Some of the details are reserved for the next annual report.

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

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

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

Valuation of Essential Fertilizing Constituents in the Various Fodder Articles Used.

Nitrogen, 17c. per lb.; Phosphoric acid, 6c.; Potassium oxide, $4\frac{1}{2}$c.

	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
Potass'm oxide,	0.430	1.637	1.162	1.160	1.572	0.301	0.760	1.320	0.540	0.462	1.966
Val. per 2000 lbs	$6.27	13.60	21.15	24.00	6.53	1.56	4.89	5.67	1.12	1.14	8.42

Amount of Dry Vegetable Matter of the Feed Required to Produce One Quart of Milk During the Entire 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

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		
III. Feb. 23 to Mar. 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. Mar. 18 to Apr. 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. Apr. 9 to Apr. 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. Apr. 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

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	10.04	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

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

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, " "	3.89	3.72	5.21		
II	Solids, per cent	12.97	13.86	14.93		
	Fat, " "	3.93	4.33	5.86		
III	Solids, per cent	13.68	15.44	15.61	13.27	14.86
	Fat, " "	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, " "	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, " "	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, " "	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, " "	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, " "	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, " "	4.45	3.52	5.13	3.68	3.93

AMOUNT OF MILK REQUIRED TO PRODUCE ONE SPACE OF CREAM.

FROM AMHERST CREAMERY RECORDS.

	FEEDING PERIODS.								
	I	II	III	IV	V	VI	VII	VIII	IX
Quarts....................	1.42	1.47	1.52	1.60	1.67	1.74	1.73	1.76	1.81

LIVE WEIGHTS OF ANIMALS DURING THE FEEDING PERIODS (LBS.)

NAME.	FEEDING PERIODS.									GAIN AT CLOSE.
	I	II	III	IV	V	VI	VII	VIII	IX	
Juno..............	1070	1030	1018	1025	1042	1095	1095	1142	1125	55
Flora..............	1000	990	960	984	1005	1047	1050	1084	1080	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

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 increase, somewhat, the value of obtainable manure, (see rations 6 and 7, and 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 of Old Process Linseed-meal has been fed. As the old process Linseed-oil cake 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.

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
	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 Co., Boston, Mass.,	No. Sudbury.
12	Ammoniated Bone Fertilizer,	Bowker Fertilizer Co., Boston, Mass.,	No. Sudbury.
13	Stockbridge's Manure for Asparagus,	Bowker Fertilizer Co., Boston, Mass.,	No. Sudbury.
15	Stockbridge's Manure for Vegetables and Potatoes,	Bowker Fertilizer Co., Boston, Mass.,	No. Sudbury.
28	Lion Brand,	Read Fertilizer Co., New York, N. Y.,	Lee.
38	Grass and Grain Fertilizer,	Great Eastern Fertilizer Co., Rutland, Vt.,	Framingham.
50	Mayo's Superphosphate,	C. E. Mayo & Co., Boston, Mass.,	Woburn.
53	Breck's Lawn Dressing,	Bowker Fertilizer Co., Boston, Mass.,	Boston.
63	Chittenden's Universal Phosphate,	National Fertilizer Co., Bridgeport, Conn.,	Lawrence.
66	Mapes' Grass and Grain Spring Top Dressing,	Mapes' Formula and Peruvian Guano Co., 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 Co., New London, Conn.,	Northampton.
79	Bowker's Square Brand Fish and Potash,	Bowker Fertilizer Co., 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 Co., Boston, Mass.,	New Bedford.

Laboratory Number.	Name of 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 lbs. Found.	Potassium Oxide in 100 lbs. Guaranteed.
	Compound Fertilizers.												
9	Lawn Dressing,	18.87	4.16	3.50	4.66	1.75	.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	.82	.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	.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	.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	.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	.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	.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.

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
	Compound Fertilizers.		
107	High Grade Ammoniated Bone Superphosphate	E. Erank 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 Co., New London, Conn.,	So. Deerfield.
117	Pequot Fish and Potash	The Quinnipiac Co., New London, Conn.,	So. Deerfield.
118	Potato Manure,	The Quinnipiac Co., New London, Conn.,	So. 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 Co., Boston, Mass.,	Northampton.
131	Fish and Potash "A" Brand	Bradley Fertilizer Co., Boston, Mass.,	Northampton.
133	Grass and Grain Spring Top Dressing,	Mapes' Formula and Peruvian Guano Co., 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.,	Cambridgepo't
140	Standard Superphosphate	Standard Fertilizer Co., 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 Co., Buffalo, N. Y.,	Clinton.
149	Fish and Potash,	The Miles Fertilizer and Oil Co., Milford, Conn.,	Northampton.

Laboratory Number.	Name of Brand.	Moisture.	Nitrogen in 100 lbs.		Phosphoric Acid in 100 lbs.							Potassium Oxide in 100 lbs.	
								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	.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	.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	.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	.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	.69	.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	.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	.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	.96	7.50		6.54	4-6	3.91	4-6
133	Grass & 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	.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	.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	.46	10.21	9.5-12.5	9.75	8-10	1.90	1.5-2
144	Harvest Queen Phosphate,	6.22	1.04	.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	.42	8.44	7-9	8.02	6-7	6.10	*
149	Fish and Potash,	21.50	3.06	3.30-4.94	5.91	.12	1.13	7.16		6.03	5-8	4.10	4-6

*Sulphate of Potash, the source of Potash.

TRADE VALUES OF FERTILIZING INGREDIENTS IN RAW MATERIALS AND CHEMICALS.

	1890. *Cents per pound.*
Nitrogen in ammoniates,	17
" " nitrates,	14½
Organic nitrogen in dry and fine ground fish, meat, blood,	17
" " " cotton-seed meal and castor pomace,	15
" " " fine ground bone and tankage,	16½
" " " fine ground medium bone and tankage,	13
" " " medium bone and tankage,	10½
" " " coarser bone and tankage,	8½
" " " hair, horn-shavings and coarse fish scraps,	8
Phosphoric acid soluble in water,	8
" " soluble in ammonium citrate,	7½
" " in dry ground fish, fine bone and tankage,	7
" " in fine medium bone and tankage,	6
" " in medium bone and tankage,	5
" " in coarse bone and tankage,	4
" " in fine ground rock phosphate,	2
Potash as High Grade Sulphate, and in forms free from Muriate or Chlorides, Ashes, etc.,	6
" " Kainite,	4½
" " Muriate,	4½

The above trade values are the 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.

Trade Values in Superphosphates, Special Manures and Mixed Fertilizers of High Grade.

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, 17 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 insoluble phosphoric acid is worth but two cents per pound.

C. A. GOESSMANN, *Director*.

The publications of the Experiment Station will be sent free of charge to all parties interested in its work, on application.

Press of Carpenter & Morehouse, Amherst, Mass.

MASSACHUSETTS STATE

AGRICULTURAL EXPERIMENT STATION.

BULLETIN No. 39.

APRIL, 1891.

Meteorological Summary for eight months ending Feb. 28, 1891.

	JULY.	AUG.	SEPT.	OCT.
Highest temperature, . . .	92°	86°	78.5°	76°
Lowest temperature, . . .	41°	41.5°	29.5°	26.5°
Mean temperature, . . .	68.12°	66.34°	59.37°	47.42°
Total precipitation, . . .	5.44 in.	4.60 in.	5.28 in.	6.89 in.
Prevailing wind, . . .	S.	N. E.	N. W.	N. W.
No. of cloudy days, . . .	13	11	14	17
No. of days on which .01 of an inch or more of rain fell,	9	14	11	15

	NOV.	DEC.	JAN.	FEB.
Highest temperature, . . .	60°	42.5°	50.5°	53.5°
Lowest temperature, . . .	13°	—5.5°	—1°	—5.5°
Mean temperature, . . .	36.25°	21.72°	26.29°	27.49°
Total precipitation, . . .	1.24 in.	3.18 in.	6.61 in.	3.84 in.
Total snowfall, . . .		15½ in.	19 in.	16 in.
Prevailing wind, . . .	N. W	N. W.	N. E.	N. E.
No. of cloudy days,	11	13	15	14
No. of days on which .01 of an inch or more of water from rain or melted snow fell,	5	8	13	13

Crops suffered considerably from drought during July, but there was an abundance of rain during the succeeding months.

The first frost occurred Sept. 25.

The sleighing was good most of the time from the last of December till near the close of February.

Ice began to be harvested in good condition during December.

Treatment of Fungous Diseases.

James Ellis Humphrey,
Professor of Vegetable Physiology.

That many of the most destructive diseases of cultivated plants can be and are every year almost completely controlled is a fact perfectly well known to those who are familiar with the subject, but it has as yet come to be realized by very few, relatively, of those to whom it is of the greatest importance, farmers, gardeners, fruit-growers, florists, amateurs, and others.

The practicability and great money value of proper treatment in the case of various plant diseases, which, in the absence of such treatment, would reduce the yield of important crops to almost nothing, has already become apparent to some cultivators' who have been progressive enough to try for themselves, or who live near the experimental fields or orchards of Experiment Stations, or of progressive neighbors. The vast majority, however, of those who should be most interested, have been heretofore too indifferent or too skeptical even to investigate the basis of the very strong and positive statements which have been made concerning the efficacy of preventive treatment for fungous diseases of plants.

This Department has, on all possible occasions, called the attention of those concerned to the facts here stated, and if few have yet availed themselves of its free offers of assistance and of the protection against loss which they can secure, the fault and the loss are wholly their own. It is impossible for those who know what can be done to compel others to take advantage of that knowledge, and equally impracticable for the Station to give object lessons in the various parts of the state. There should be, and it is believed that there are, live, enterprising farmers and fruit-growers enough in any part of the state to take up the subject under the direction of this Department, the coming season, and furnish to their respective neighborhoods evidence which shall appeal both to the eye and to the pocket-book, that the modern, scientific treatment of fungous diseases *pays*. It is one of the special purposes of this Bulletin to induce a number of such persons in each county to communicate early with this Department, with a view to taking prompt measures to check so far as possible any fungous disease which may threaten any crop during the season.

Any person in the state who may be troubled by any disease of plants cultivated either for use or for ornament is strongly urged to send to this Department specimens of the plants attacked, with notes, as full as possible, on the appearance, effects, and spread of the disease. Such notes often have considerable intrinsic value when carefully made and accompanied by specimens showing the affection to which they relate. The Department will give especial attention, during the coming season, to communications relating to the treatment and prevention of plant diseases and will reply promptly, with detailed recommendations for each special case. It is hoped that the responses to this call will be sufficient to show that it is appreciated, and that *inertia* is not the controlling quality of Massachusetts cultivators.

A general account of the Fungi, especially of such as cause diseases of plants, will be found in the Annual Report of this Station for 1889, at pages 195–211. From the nature of parasitic fungi and the fact that they are for the most part, parasites within the tissues of their hosts, it is evident that our efforts must be directed toward preventing their attacks. The present state of our knowledge does not enable us to stop the development of a parasite within its host-plant, without injury to the host, after it has once obtained a foot-hold.

The various forms of preventive treatment for a given disease fall naturally under two heads, field and orchard hygiene and individual protection. The former includes the minimizing of all sources of infection by the removal of rubbish, of remains of diseased plants or fruits, or of wild plants which may serve as propagators of the disease. The latter includes the application to the plants to be protected of substances in liquid or solid form which shall fortify them against the attacks of fungi which cause disease. Such substances are known as *Fungicides*. Since different fungi attack their hosts in very different ways, since their modes of development and the effects which they produce differ widely, it is plain that no all-embracing rule can be laid down for the treatment of fungous diseases. Certain principles of general applicability can, however, be stated, certain general directions can be given, and instructions regarding the preparation and application of those fungicides which have been proved to be most useful and effective can be furnished. These things this Bulletin seeks to supply. The further special information needed for dealing successfully with any special case, this Department will gladly and promptly furnish, on receipt of a request accompanied by a specimen of a diseased plant and an account, as full as possible, of the existing conditions, as already stated.

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 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.

Now, when the general hygienic conditions have been made as unfavorable as possible to the development of disease, we may resort finally to the special protection afforded by the use of

*See the Report of this Station for 1889, p. 204 and 207.

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

6 lbs. sulphate of copper,
4 lbs. quicklime (fresh), and
22 gals. water.

The sulphate of copper, known to the trade also as blue vitriol or blue stone, is dissolved in 2 gallons of water. The solution will be hastened if the water be heated and the sulphate pulverized. After the solution is complete, 14 gallons of water are added to it. The quicklime is slaked in 6 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 25 or 30 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

3 oz. carbonate of copper,
1 lb. carbonate of ammonia, and
50 gals. water.

Mix the carbonate of copper with the carbonate of ammonia, pulverized, and dissolve the mixture in 2 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 3 oz. carbonate of copper in 1 qt. aqua ammonia (22°B.)* and add the solution to 25 gals. of water.

Dr. Thaxter of the Connecticut Experiment Station suggests 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 2 lbs. of sulphate of copper and dissolve it in a large quantity of hot water; in another barrel or tub, dissolve 2½ lbs. 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 bluestone 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.

MATERIALS. For the convenience of persons who may wish to purchase the necessary materials for the preparation of fungicides,

*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.

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 Co., 360 Washington St., Boston.

Messrs. E. & F. King, Boston.

Talbot Dyewood and Chemical Co., 24 & 26 Middle St., Lowell.

Jerome Marble & Co., Worcester.

Messrs. H. & J. Brewster, 463 Main St., Springfield.

The writer wishes to express here his thanks to those leading Agriculturists in several parts of the state who have furnished him the addresses of these and other dealers in chemicals.

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 effected 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:

Copper sulphate,	8	cents	per	pound.
Copper carbonate,	60	"	"	"
Ammonium carbonate,	15	"	"	"
Sodium carbonate,	3	"	"	"
Aqua Ammonia, (24°)	10	"	"	"
Potassium sulphide,	25	"	"	"

Application. The one of the above fungicides chosen as most available under existing conditions is now to be applied to the plants which it is desired to protect against disease. In the special case of the grain *smuts*, the only effectual treatment is that applied to the seed-grain, since these fungi depend for their propagation upon the spores which adhere to the grain and germinate with it. They cannot attack the host-plant after it has fairly passed the seedling stage, and the adhering spores may be killed before planting without injury to the seed. But ordinarily the fungicide must be thoroughly applied to the whole of each growing plant in the form of a fine spray, so that the plant is completely wet, but not flooded. Perhaps a practical measure of the proper amount of a fungicide to be applied to a plant may be obtained by stopping as soon as the plant is wholly wet, and *before* the solution begins to drip from it. In order to insure a fine and even spray and economy of materials, especial care should be used in securing proper

Nozzles. 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 several of the pieces of apparatus to be described later, or may be purchased separately. It is shown in Figs. 2 and 3, following, at the end of the brass rod which is held in the hand of the operator and is known as the spraying lance. 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, shown in Fig. 1.

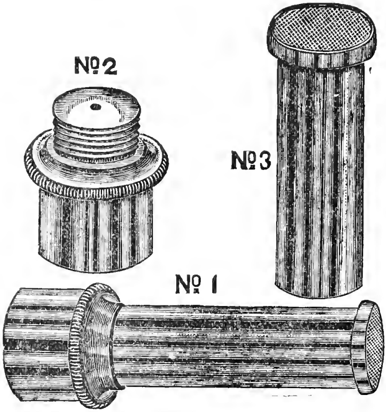

Fig. 1.

Upon the use of these or other equally efficient nozzles, depends very much of the success of treatment with fungicides.

Pumps. 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.

Of this sort is the *Eureka* sprayer, made by Adam Weaber & Son of Vineland, N. J., and costing about $21. Prof. B. T. Galloway, Chief of the Division of Vegetable Pathology of the U. S. Department of Agriculture, has recently devised a similar machine, shown in Fig. 2, and in practical operation in Fig. 3. It is not patented and can be made by any good metal-worker. The writer will be

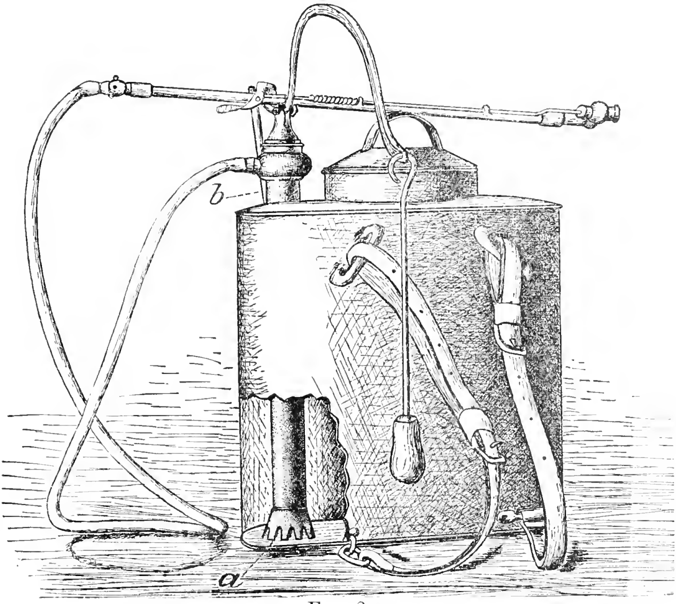

Fig. 2.

glad to furnish detailed specifications for this machine to any one who may desire them. It may be purchased of Albinson & Co., 2026 Fourteenth St., or of Leitch & Sons, 1214 D. St., both of Washington, D. C., for $14. Dr. Thaxter of the Connecticut Experiment Station has devised a combination of a copper wash-boiler, a "Hydronette" force pump, and a Vermorel nozzle which has given him much satisfaction, and may be fitted by any tinsmith. Its cost is a little over $8, he states. The writer will be glad to furnish, on request, details of its construction.

Fig. 3.

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. An excellent example of this form of apparatus is the "Little Giant" machine made by the Nixon Nozzle and Machine Co. of Dayton, Ohio, which costs, with hose and "Climax" nozzle, $35. It is shown in Fig. 4. Machines of this type usually allow the use of two streams at once.

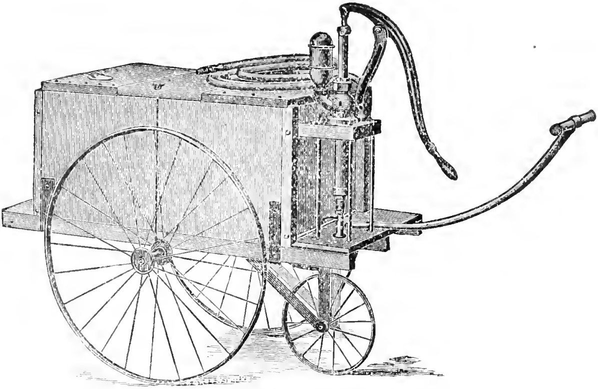

FIG. 4.

The third or *horse-cart* type of apparatus comprises the special "Field and Orchard" machines of the Nixon Nozzle and Machine Co., costing from $55 to $85, or the "Standard" Double Acting Spray Pump of the Goulds Manufacturing Co. of Seneca Falls, N. Y., shown in Fig. 5. This pump is made with brackets for attaching it to the head or bung of a barrel or cask, which serves as the reservoir, and the whole is drawn over the field or through the orchard in a farm wagon or cart, as is shown.

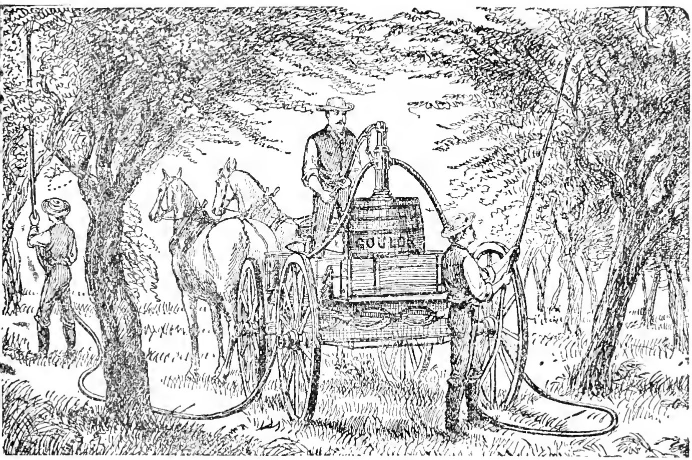

FIG. 5.

This pump, with no hose, nozzles, or accessories of any sort, costs $8.50. Machines of this type are necessary where orchard work on a large scale is to be well and economically done.

Before purchasing either of the pieces of apparatus mentioned above, one should obtain circulars or catalogue from the manufacturers and become thoroughly informed concerning it, so as to order intelligently.

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 in 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 re-appear 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.

We wish to repeat that this Department is ready to supplement the recommendations of this Bulletin in every possible way. It is earnestly hoped that many persons in the state who have suffered in the past from fungous diseases, will this year undertake definite measures to avoid such losses, and will communicate early their intention to do so, to the writer. Full details should be given of the nature of the disease, the extent of its ravages in former years, and the present condition of the orchard or vineyard, if the crop concerned be a fruit crop. In case of a field on which some herbaceous crop is to be planted, which it is desired to protect from disease, state what has been the history of the field for several years, and how badly the crop in question has suffered on this or other neighboring fields during the same time.

Finally, let everyone who makes up his mind to keep up with the times and protect his crops, equip himself thoroughly for the work. Let him have the necessary apparatus on hand and ready for use, and let them be the best things for the purpose. It is useless to expect good work from the use of unsuitable materials or poor tools. But a single season's trial of thorough and suitable treatment will convince the most skeptical man that few investments pay such interest.

C. A. GOESSMANN, *Director*,

AMHERST, MASS.

The Bulletins of the Experiment Station will be sent free of charge to all parties interested in its work, on application.

Carpenter & Morehouse, Printers, Amherst, Mass.

MASSACHUSETTS STATE

AGRICULTURAL EXPERIMENT STATION.

BULLETIN NO. 40.

JULY, 1891.

CONTENTS.

Meteorological Summary for four months, ending June 30, 1891.

	MARCH.	APRIL.	MAY.	JUNE.
Highest temperature,	55.5°	77°	86°	93°
Lowest temperature,	—1.°	18°	25°	34.5°
Mean temperature,	32.04°	46.89°	55.18°	64.94°
Total precipitation,	2.89 in.	2.74 in.	1.82 in.	4.61 in.
Total snow fall,	12 in.	11 in.	—	—
Prevailing wind,	N.E.	N.W.	N.W.	N.E.
No. of cloudy days,	14	11	12	8
No. of days on which .01 of an inch or more of water from rain or melted snow fell,	8	7	8	8

There was enough snow on the ground for fair sleighing until the 10th of March.

A storm on the 2d and 3d of April gave eleven inches of snow, lasting only a few days.

Severe frosts occurred May 6 and May 19 and a light frost June 5.

The comparatively dry weather and occasional cold snaps during April and May have been unfavorable for the grass crop in this vicinity.

The rainfall during June was abundant and well distributed.

SOME DISEASES OF LETTUCE AND CUCUMBERS.

During the past winter and spring the writer has been engaged in the study of certain diseases of lettuce and of cucumbers, cultivated under glass. The investigation of some of these is sufficiently advanced to justify the following preliminary announcement. More detailed accounts, with illustrations, of the diseases will be given in the next annual report of this Station.

The Rotting of Lettuce has been a source of much loss to gardeners who cultivate that plant as a winter crop, but its cause and, therefore, proper preventive measures have not been known. It usually appears first just above the surface of the soil at the attachment of the lower leaves to the stem and then spreads to the center of the head causing the stem and the bases of the lower leaves, and later the whole of the tender inner leaves, to become decomposed into a slimy mass. The larger leaves being thus cut off from the stem by decay at their bases usually dry up; and there appears after a time, on the remains of the plant, if left undisturbed, the erect, spore-bearing threads of one of the imperfect fungus forms known by the name *Botrytis* or *Polyactis*. The vegetative threads of this fungus are to be found in the decaying tissues of the host in the early stages of the trouble, and no other fungus has ever been observed in connection with it. My observations make it practically certain that the disease is due to the fungus-form mentioned, and this view is supported by the fact that similar forms are known to produce similar diseases in some other plants. The discussion of its relations to other forms is reserved for our next Report. This fungus appears to be able to develop also a saprophyte on old lettuce leaves and other vegetable refuse and may thus survive a long interval between two crops of lettuce, resuming its parasitic habits when the opportunity is afforded.

From what has been said, it is evident that careful and thorough treatment is essential to the control of the disease in question; and the nature of the crop limits this treatment to the removal of all sources of infection. All affected lettuce plants should be at once removed *wholly* from the house and destroyed by burning. For this purpose the boiler furnace is conveniently at hand. All dead leaves or other refuse should be often scrupulously cleaned up and burned so that no breeding places may be left for the fungus. A house which has been very badly infested by the disease should be thoroughly cleaned, whitewashed or painted, and supplied with fresh soil before a new season's operations are begun; and one may then expect, with the observance of the above described hygienic precautions, to be able to enjoy comparative freedom from loss from this cause.

The Powdery Mildew of the Cucumber is due to the presence of a fungus which has been long known, but which has not been heretofore reported as occurring in America, so far as I can learn. It has been received during the past season, on leaves of greenhouse cucumbers, from Dr. Jabez Fisher of Fitchburg and from Prof. L. H. Bailey of Cornell University. The fungus, as has been said, attacks the leaves, on whose upper surfaces it forms at first rounded spots which appear like blotches of a white powder. These spots gradually enlarge and become confluent until the leaf is practically covered. Those parts of the leaf which are attacked soon turn yellow and finally become dead and dry. Under favorable conditions the disease spreads quite rapidly and is very destructive.

The fungus which causes the trouble is known as *Oidium erysiphoides* Fries, var. *Cucurbitarum*, and is the *conidial* or summer spore stage of one of the fungi known as Powdery Mildews. It is impossible to say certainly to which of the perfect or winter spore forms of the group it belongs.

It has been found by Prof. Bailey and by Dr. Fisher that the fungus may be kept in check by frequent spraying with a solution of sulphide of potassium (liver of sulphur) in water. The proportion usually given is one ounce of the sulphide to two gallons of water, but both Dr. Fisher and the writer have found this solution injurious to the foliage and the young cucumbers. A preparation containing an ounce to three gallons is certainly strong enough and one with an ounce to four gallons is probably so.

As recommended for the lettuce disease, a house in which this fungus has been troublesome should be thoroughly cleaned and fumigated before the next season's crop is started.

All persons interested are urged to send to this Department specimens of any plants attacked by fungus diseases, in the interest of a better knowledge of these maladies, and that instructions how to avoid or to treat them may be furnished them. Such instructions will be promptly sent on request.

JAS. ELLIS HUMPHREY,
Professor of Veg. Physiology.

ANALYSES OF COMMERCIAL FERTILIZERS COLLECTED DURING 1891, IN THE GENERAL MARKETS BY THE AGENT OF THE MASSACHUSETTS AGRICULTURAL EXPERIMENT STATION.

Laboratory No.	Name of Brand.	Name of Manufacturer.	Sampled at
	Compound Fertilizers.		
48	Bone Superphosphate for Vegetables,	Crocker Fertilizer and Chemical Co., Buffalo, N. Y.	Framingham.
54	Bowker's Bone Black,	Bowker Fertilizer Co., Boston, Mass.,	Amherst.
61	Ammoniated Bone Superphosphate (Americus Brand),	Williams & Clark Fertilizer Co., 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, Ct.,	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 Co., 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 & Chemical Co., Buffalo, N. Y.,	Newburyport.
156	Red Star Brand Special Fert. for Potatoes, Cabbages, &c.	LePage Co., Boston, Mass.,	Boston.
162	Lister's Success Standard Fertilizer,	Lister Agricultural and Chemical Works, Newark, N. J.	Lowell.
177	Huanillos Peruvian Guano,	Mapes Formula & Peruvian Guano Co., New York, N. Y.	Boston.
185	Fish and Potash,	Read Fertilizer Co., 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 M'f'g Co., 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.

Laboratory Number.	Name of Brand.	Moisture.	Nitrogen in 100 lbs. Found.	Nitrogen in 100 lbs. Guaranteed.	Phosphoric Acid in 100 lbs. Soluble.	Reverted.	Insoluble.	Total. Found.	Total. Guaranteed.	Available. Found.	Available. Guaranteed.	Potassium Oxide in 100 lbs. Found.	Potassium Oxide in 100 lbs. Guaranteed.
	Compound Fertilizers.												
48 & 155	Bone Superphos'te 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 Am. Bone Superph.	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 Br. Spec'l Fert. for Pot.&c.	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	.20
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 Ammon. 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.

TRADE VALUES OF FERTILIZING INGREDIENTS IN RAW MATERIALS AND CHEMICALS.

	1891. Cents per pound.
Nitrogen in ammoniates,	18½
" " nitrates,*	14½
Organic nitrogen in dry and fine ground fish, meat, blood,	15½
" " " cotton-seed meal and castor pomace,	15
" " " fine ground bone and tankage,	15
" " " fine ground medium bone and tankage,	12
" " " medium bone and tankage,	9½
" " " coarser bone and tankage,	7½
" " " hair, horn-shavings and coarse fish scraps,	7
Phosphoric acid soluble in water,	8
" " soluble in ammonium citrate,	7½
" " in dry ground fish, fine bone and tankage,	7
" " in fine medium bone and tankage,	5½
" " in medium bone and tankage,	4½
" " in coarse bone and tankage,	3
Potash as High Grade Sulphate, and in forms free from Muriate or Chlorides, Ashes, etc.,	5½
" " Kainite,	4½
" " Muriate,	4½

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.

TRADE VALUES IN SUPERPHOSPHATES, SPECIAL MANURES AND MIXED FERTILIZERS OF HIGH GRADE.

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, 15½ 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 cost stated represents the average of the six months preceding March, 1891;—it is higher at present on account of the civil war in Chili.

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 Mass. 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.

FIRST FEEDING EXPERIMENT.

December, 1889, to May, 1890.

The first experiment, 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 the 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 kind of fodder articles served at the same stage of the experiment to 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 feed 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 are printed in italics.

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 ration I, II below).

2. The increase in live weight per day when feeding the ensilage fodder ration (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 ration 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 ration (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 ration (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 ration (I, II).

COST OF FODDER ARTICLES, (1889–90).

Wheat bran,	$16.50
Gluten meal,	23.00
O. P. 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

VALUE OF FERTILIZING CONSTITUENTS OF FODDER ARTICLES.

	Wheat Bran.	Gluten Meal.	O. P. Lins'ed Meal.	Corn & Cob Meal.	Corn Stover.	Corn Ensl'ge	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	.181
Phosphoric acid, ...	2.900	.392	1.646	.603	.303	1.138	.519	.086
Potassium oxide,....	1.637	.049	1.162	.441	1.320	.301	.760	.462
Valuation per 2000 lbs	$13.60	$16.18	$21.15	$6.02	$4.69	$1.56	$4.89	$1.14

A. ONE YEAR OLD GRADE SHORTHORN STEERS.

Statement of the Average of the Daily Fodder Rations Used.

I.		II.	
Wheat bran, (pounds)	*3.88*	*Wheat bran, (pounds)*	*4.00*
Gluten meal,	*3.88*	*Old Process linseed meal,*	*4.00*
Corn ensilage,	*37.50*	*Corn ensilage,*	*43.38*
Nutritive ratio,	*1 :5.49*	*Nutritive ratio,*	*1 :5.69*
Total cost, (cents)	*12.82*	*Total cost (cents)*	*14.76*
Manurial value obtainable,	*8.01*	*Manurial value obtainable*	*9.50*
Net cost,	*4.81*	*Net cost,*	*5.26*

III.		IV.	
Wheat bran, (pounds)	3.00	Wheat bran, (pounds)	3.00
Old Process linseed meal,	3.00	Old Process linseed meal,	3.00
Corn and cob meal,	3.00	Corn and cob meal,	3.00
Corn fodder,	9.00	Corn stover,	6.00
Nutritive ratio,	1 :4.93	Nutritive ratio,	1 :4.55
Total cost, (cents)	12.45	Total cost, (cents)	10.58
Manurial value obtainable,	7.65	Manurial value obtainable,	6.92
Net cost,	4.80	Net cost,	3.66

V.		VI.	
Wheat bran, (pounds)	3.00	Wheat bran, (pounds)	2.25
Old Process linseed meal,	3.00	Gluten meal,	2.25
Corn and cob meal,	3.00	Corn stover,	12.00
Corn stover,	3.60	Nutritive ratio,	1 :5.51
Sugar beets,	20.00	Total cost, (cents)	7.45
Nutritive ratio,	1 :4.49	Manurial value obtainable,	5.68
Total cost, (cents)	14.98	Net cost,	1.77
Manurial value obtainable,	7.44		
Net cost,	7.54		

Steer 1. (Yearling)

Feeding Periods.	Feed Consumed (pounds) per day.								Total dry matter consum'd per day	Nutritive ratio.	Weight of animal begin'g of period.	Weight of animal at end of period.	Gain in weight per day.
	Wheat Bran.	Gluten Meal.	O.P. L's'd M'l.	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.			42.20			19.30	1 :5.63	725	783	2.90
Feb. 21 to Mar. 11,	3.00		3.	3.00			9.42		15.68	1 :4.98	785	820	1.84
Mar. 14 to Apr. 21,	3.00		3.	3.00	5.91				12.50	1 :4.54	828	880	1.33
Apr. 24 to May 9,	3.00		3.	3.00	3.50			20.	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 lbs.	wheat bran,	422.35	$3.84	$3.17
95.50 "	gluten meal	86.14	1.10	.77
371.00 "	Old Process linseed meal,	334.35	5.10	3.92
239.00 "	corn and cob meal,	219.64	1.97	.72
243.50 "	corn stover,	177.88	.61	.57
1927.00 "	corn ensilage,	521.25	2.65	1.50
205.50 "	corn fodder,	163.54	.77	.50
350.00 "	sugar beets,	34.93	.88	.20
		1960.08	$16.92	$11.35

Live weight of animal at beginning of experiment,	675 lbs.
Live weight of animal at end of feeding,	895 lbs.
Live weight gained during experiment,	220 lbs.
Average gain in weight per day,	1.53 lbs.
Dry matter consumed per pound of live weight gained,	8.91 lbs.
Cost of feed per pound of live weight gained,	7.69 cts.
Net cost of feed per pound of live weight gained, allowing 8% loss of manurial value,	2.95 cts.

Steer 2. (Yearling)

Feeding Periods.	Feed Consumed (pounds) per day.								Total dry matter consum'd per day	Nutritive ratio.	Weight of animal begin'g of period	Weight of animal at end of period.	Gain in weight per day.
	Wheat Bran.	Gluten Meal.	O.P. L's'd M'l.	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.			44.55			19.97	1 :5.75	680	745	3.25
Feb. 21 to Mar. 11,	3.00		3.	3.00			8.53		14.97	1 :4.87	746	770	1.26
Mar. 14 to Apr. 21,	3.00		3.	3.00	6.00				12.56	1 :4.55	776	826	1.28
Apr. 24 to May 9,	3.00		3.	3.00	3.69			20.	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 lbs.	wheat bran,	422.35	$3.84	$3.17
95.50 "	gluten meal,	86.14	1.10	.77
371.00 "	Old Process linseed meal,	331.35	5.10	3.92
239.00 "	corn and cob meal,	219.64	1.97	.72
354.00 "	corn stover,	258.60	.89	.83
1942.00 "	corn ensilage,	525.31	2.67	1.51
285.00 "	corn fodder,	226.80	1.07	.70
350.00 "	sugar beets,	34.93	.88	.20
		2108.12	$17.52	$11.82

Live weight of animal at beginning of experiment,	600 lbs.
Live weight of animal at end of feeding,	840 lbs.
Live weight gained during experiment,	240 lbs.
Average gain in weight per day,	1.67 lbs.
Dry matter consumed per pound of live weight gained,	8.78 lbs.
Cost of feed per pound of live weight gained,	7.30 cts.
Net cost of feed per pound of live weight gained, allowing 8% loss of manurial value,	2.77 cts.

Summary of Record of Steers, No. 1 and No. 2 when left in the Pasture, May 10th, 1889 to September 30th, 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,	1020 lbs.	923 lbs.
Total weight gained during pasturing,	125 lbs.	83 lbs.
Average gain in weight per day,	0.87 lbs.	0.58 lbs.
Cost of feed per day, allowing 40c. per week for use of pasture,	5.71 cts.	5.71 cts.
Cost of feed per pound of live weight gained,	6.58 cts.	9.91 cts.

Summary of Feeding Experiment with Steers One Year Old.

	No. 1.	No. 2.
Beginning of feeding experiment, ...	Dec. 17, 1889	Dec. 17, 1889
Closing of feeding experiment, ...	May 9, 1890	May 9, 1890
Number of days of observation, ...	144	144
Live weight of the animals at the beginning of observation, ...	675 lbs.	600 lbs.
Live weight of the animals at the close of observation, ...	895 lbs.	840 lbs.
Total number of pounds of live weight gained during the experiment, ...	220 lbs.	240 lbs.
Average gain in live weight per day, ...	1.53 lbs.	1.67 lbs.
Amount of dry vegetable matter consumed per pound of live weight gained, ...	8.91 lbs.	8.78 lbs.
Total cost of feed consumed per day, ...	11.75 cts.	12.16 cts.
Manurial value of feed consumed per day, ...	7.87 cts.	8.20 cts.
Manurial value of feed consumed, allowing 8% loss, ...	7.24 cts.	7.54 cts.
Net cost of feed consumed per day, allowing a loss of 8% of manurial value, for live weight gained, ...	4.51 cts.	4.62 cts.
Net cost of feed per pound of live weight gained.	2.95 cts.	2.77 cts.

B. Two Year Old Grade Shorthorn Steers.

The same fodder articles as in the case of the one year old steers (A) served here.

Statement of the average of the daily fodder combinations used during the different successive feeding periods.

I.		II.	
Wheat bran, (pounds)	*3.88*	*Wheat bran, (pounds)*	*4.00*
Gluten Meal,	*3.88*	*Old Process linseed meal,*	*4.00*
Corn ensilage.	*65.50*	*Corn ensilage.*	*76.60*
Nutritive ratio,	*1 : 6.54*	*Nutritive ratio,*	*1 : 6.75*
Total cost, (cents)	*15.67*	*Total cost, (cents)*	*19.33*
Manurial value obtainable,	*10.02*	*Manurial value obtainable,*	*11.89*
Net cost,	*6.65*	*Net cost,*	*7.44*

III.		IV.	
Wheat bran, (pounds)	4.00	Wheat bran, (pounds)	4.00
Old Process linseed meal,	4.00	Old Process linseed meal,	4.00
Corn and cob meal,	4.00	Corn and cob meal,	4.00
Corn fodder,	12.35	Corn stover,	13.00
Nutritive ratio,	1 :4.91	Nutritive ratio,	1 :4.99
Total cost, (cents)	16.73	Total cost, (cents)	15.35
Manurial value obtainable,	10.28	Manurial value obtainable,	10.30
Net cost,	6.45	Net cost,	5.05

V.

Wheat bran, (pounds)	2.65
Gluten meal,	2.65
Corn stover,	18.00
Nutritive ratio,	1 :5.84
Total cost, (cents)	9.74
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.	Nutritive ratio.	Weight of animal at beginni'g of period	Weight of animal at end of period.	Gain in weight per day.
	Wheat Bran.	Gluten Meal.	O.P. L'ns'd M'l.	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	1235	1192	–1.95
Jan. 4 to Jan. 22,	3.88	3.88				68.95		24.60	1 :6.64	1210	1297	4.58
Jan. 28 to Feb. 16,	4.00	4.00				80.10		30.13	1 :6.89	1310	1362	2.60
Feb. 21 to Mar. 11,	4.00		4.	4.00			14.	22.05	1 :5.11	1362	1366	0.21
Mar. 13 to Mar. 25,	4.00		4.	4.00	14.67			21.63	1 :5.09	1367	1370	0.23

Total amount of feed consumed from Dec. 10, 1889, to March 25, 1890.

		Dry matter. Pounds.	Cost.	Fertilizer value.
387.50 lbs.	wheat bran,	351.58	$3.20	$2.64
140.50 "	gluten meal,	126.73	1.62	1.14
248.00 "	Old Process linseed meal,	223.50	3.41	2.62
135.00 "	corn and cob meal,	124.07	1.11	.41
392.00 "	corn stover,	286.36	0.98	.92
3542.00 "	corn ensilage,	958.11	4.87	2.76
315.00 "	corn fodder,	250.68	1.18	.77
		2321.03	$16.37	$11.26

Live weight of animal at beginning of experiment,	1235 lbs.
Live weight at time of killing,	1370 lbs.
Live weight gained during experiment,	135 lbs.
Average gain in weight per day,	1.27 lbs.
Dressed weight of animal,	886 lbs.
Loss in weight by dressing, 484 lbs. or	35.33%
Original cost of animal, 1336 lbs. at 3 1-2c.	$46.76
Selling price of animal, 886 lbs. at 6c.,	$53.16
Net cost of feed after deducting 80% of manurial value,	$6.01

Dry matter required to produce one pound of live weight.	17.19 lbs.
Cost of feed per pound gained,	12.13 cts.
Net cost of feed per pound gained after deducting 8% loss of manurial value,	4.45 cts.

Steer No. 4.

Feeding Periods.	Feed Consumed (pounds) per day.							Total dry matter consumed per day.	Nutritive ratio.	Weight of animal at beginni'g of period	Weight of animal at end of period.	Gain in weight per day.
	Wheat Bran.	Gluten Meal.	O.P.L'ns'd M'l.	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	1180	1138	-1.91
Jan. 4 to Jan. 22,	3.88	3.88				62.21		20.92	1 :6.43	1162	1250	4.63
Jan. 28 to Feb. 16,	4.00	4.00				73.10		28.13	1 :6.70	1246	1317	3.55
Feb. 21 to Mar. 11,	4.00		4.	4.00			10.71	19.43	1 :4.81	1305	1293	-0.63
Mar. 13 to Mar. 25,	4.00		4.	4.00	11.25			19.63	1 :4.89	1297	1300	0.23

Total amount of feed consumed from Dec. 10, 1889 to Mar. 25, 1890.

		Dry matter. Pounds.	Cost.	Fertilizer Value.
387.50 lbs.	wheat bran,	351.58	$3.20	$2.64
140.50 "	gluten meal,	126.73	1.62	1.14
248.00 "	Old Process linseed meal,	223.50	3.41	2.62
135.00 "	corn and cob meal,	124.07	1.11	.41
267.00 "	corn stover,	195.04	0.67	.63
3210.50 "	corn ensilage,	868.44	4.41	2.50
238.00 "	corn fodder,	189.40	0.89	.46
		2078.76	$15.31	$10.40

Live weight of animal at beginning of experiment,	1180 lbs.
Live weight at time of killing,	1300 lbs.
Live weight gained during experiment,	120 lbs.
Average gain in weight per day,	1.13 lbs.
Dressed weight of animal,	859 lbs.
Loss in weight by dressing, 441 lbs., or	33.92%
Original cost of animal, 1332 lbs. at 3 1-2c.,	$46.62
Selling price of steer, 859 lbs. at 6c.,	$51.54
Net cost of feed after deducting 8% of manurial value,	$5.74
Dry matter required to produce one pound of live weight,	17.32 lbs.
Cost of feed per pound gained,	12.76 cts.
Net cost of feed per pound gained, after deducting 8% of manurial value,	4.78 cts.

Summary of Feeding Experiments, Steers Two Years Old, No. 3 and 4.

	No. 3.	No. 4.
Beginning of feeding experiment,	Dec. 10, 1889	Dec. 10, 1889
Closing of observation,	Mar. 25, 1890	Mar. 25, 1890
Number of days of observation,	106	106
Live weight of animals at the beginning of observation,	1235 lbs.	1180 lbs.
Live weight of animals at the close of observation,	1370 lbs.	1300 lbs.
Total number of pounds of live weight gained during the experiment,	135 lbs.	120 lbs.
Average gain in live weight per day,	1.27 lbs.	1.13 lbs.
Amount of dry vegetable matter consumed per pound of live weight gained,	17.19 lbs.	17.32 lbs.
Total cost of feed consumed per day,	15.44 cts.	14.44 cts.
Manurial value of feed consumed per day,	10.62 cts.	9.82 cts.
Manurial value of feed consumed per day, allowing 8% loss,	9.77 cts.	9.03 cts.
Net cost of feed consumed per day allowing a loss of 8% of manurial value,	5.67 cts.	5.41 cts.
Net cost of feed consumed per pound of live weight gained,	4.45 cts.	4.78 cts.
Selling price of dressed weight,	6.00 cts.	6.00 cts.
Per cent. of shrinkage in dressing beef for the market,	35.3	33.9

C. A. GOESSMANN, *Director.*

The publications of the Experiment Station will be sent free of charge to all parties interested in its work, on application.

Press of Carpenter & Morehouse, Amherst, Mass.

MASSACHUSETTS STATE
AGRICULTURAL EXPERIMENT STATION.

BULLETIN NO. 41.

SEPTEMBER, 1891.

CONTENTS.

Meteorological Summary for two months, ending Aug. 31, 1891.

	JULY.	AUGUST.
Highest temperature,	89°	90°
Lowest temperature,	42°	46°
Mean temperature,	66.18°	68.34°
Total precipitation,	5.09 in.	3.67 in.
Prevailing wind,	S.	N. E.
No. of cloudy days,	13	14
No. of days on which .01 of an inch or more of rain fell,	10	13

The rainfall for the two months although somewhat less than during 1890, has been more favorable for growing crops on account of its better distribution.

The rains during the early part of July make this season less favorable for haying than the past.

The mean temperature for the two months varies but little from last year.

ANALYSES OF COMMERCIAL FERTILIZERS COLLECTED DURING 1891, IN THE GENERAL MARKETS BY THE AGENT OF THE MASSACHUSETTS AGRICULTURAL EXPERIMENT STATION.

Laboratory No.	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 Co., Buffalo, N. Y.	Pittsfield.
84	Extra Fine Ground Bone with Potash (circle brand)	Bradley Fertilizer Co., 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, Ct.,	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.,	So. 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 Co., 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 Co., Boston, Mass.,	Woburn.
172	Dow's Ground Bone Fertillzer,	John C. Dow & Co., Boston, Mass.,	Boston.
175	Standard Guano,	Standard Fertilizer Co., Boston. Mass.,	Boston.
186	B. D. Sea Fowl Guano,	Bradley Fertilizer Co., Boston, Mass.,	Greenfield.
	Bones.		
80	Pure Ground Bone,	Crocker Fertilizer & Chemical Co., Buffalo, N. Y.	Lee.
86	Quinnipiac Pure Bone Meal,	The Quinnipiac Co., Boston, Mass.,	Williamstown.
91	Quinnipiac Pure Bone Meal,	The Quinnipiac Co., 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 Co., 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.,	

Laboratory Number.	Name of Brand.	Moisture.	Nitrogen in 100 lbs. Found.	Nitrogen in 100 lbs. Guaranteed.	Phosphoric Acid in 100 lbs. Soluble.	Reverted.	Insoluble.	Total. Found.	Total. Guaranteed.	Available. Found.	Available. Guaranteed.	Potassium Oxide in 100 lbs. Found.	Potassium Oxide in 100 lbs. 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 Amm. 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 Fertlizer	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 & 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.

Feeding Experiments with Milch Cows.

NOVEMBER, 1890, TO MAY, 1891.

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 had 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 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;—namely, corn meal or corn and cob meal, wheat bran and gluten meal (Chicago var.); see VIII annual report, pages 12 to 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 more 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—VIII—pages 15 to 24.

Within a few subsequent pages are briefly recorded the results of more recent observations with cotton seed meal and old process linseed meal when fed as substitutes for gluten meal (Chicago var.) 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 var.) 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, '89	6-7	5-6
2. Pearl	Native	6	Aug. 8, '90	10-11	7
3. Pink	Native	7	Jan. 23, '90	7-8	7
4. Roxy	Grade Ayrshire	7	Feb. 5, '90	6-7	2½
5. Buttercup	Grade Ayrshire	5	Jan. 2, '91	13-14	4
6. Nancy	Native	8	Mar. 16, '90	8-9	4
7. Clarissa	Grade Durham	7	Mar. 18, '91	9-10	2
8. Juno	Grade Ayrshire	7	June 22, '89	7-8	3
9. Favorite	Grade Durham	6	Feb. 20, '91	11-12	3

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 15 to 16 quarts per day at this time. They serve usually in the trials until their daily yield of milk becomes unprofitable, from 5 to 6 quarts, when they are replaced by new milch cows.

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:

FODDER ANALYSES.	Corn Meal.	Wheat Bran.	Cottonseed 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.

Nitrogen 15c. per lb.; phosphoric acid 5½ c.; potassium oxide 4½c.

Manurial Constituents in the Above Stated Samples of Grain Feed.	Corn Meal.	Wheat Bran.	Cottonseed 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 lbs.,	$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 seedpods. In both instances was the entire plant cut a few inches above ground.

The corn,—stalks, leaves and ears,—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 of matched boards. The latter were held in place by barrels filled with sand. The silo was filled at the beginning of September, '90, and opened for use during the succeeding January.

The mixed ensilage thus produced, was of 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. one and No. two.

The clear corn ensilage, No. one, was obtained from the same lot of fodder corn which served for the production of the above described mixed ensilage (No. two). 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 which 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. I. Corn Ensilage.	No. II. Mixed Ensilage. (Corn and Soja bean)
Crude Ash,	6.73	11.04%
" Cellulose,	26.90	27.84%
" Fat,	3.27	5.35%
" Protein, (nitrogen containing organic matter.)	8.97	15.27%
Nitrogen-free extract matter,	54.13	40.50%
	100.00	100.00

The composition of the dry vegetable matter of the mixed ensilage, No. II, compares well with that of a medium quality of red clover hay.

The successful cultivation of the soja bean upon the fields of the Mass. State Agricultural Experiment Station has been repeatedly pointed out in previous annual reports. The superior feeding effect of green soja bean, as coarse fodder constituent in the diet of milch cows has been shown in our summer feeding experiments of 1890, see VIII, annual report, pages 39 to 54. Our this year's experience 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 15c. per lb.; phosphoric acid $5\frac{1}{2}$c.; potassium oxide $4\frac{1}{2}$c.

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 2000 lbs.,	$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 was 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, was 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 below in detail described, 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 Nov., 1890 to June, 1891.

	Corn Meal.	Wheat Bran.	Cottonseed Meal.	Old Proc'ss Linseed Meal.	Gluten Meal.	Rowen.	Corn and Soja Bean Ensilage.	Corn Stover.
Per 2000 lbs.	$28.00	$25.00	$28.00	$26.00	$28.00	$15.00	$3.50	$5.00
Per lb. (cts.)	1.4	1.25	1.4	1.3	1.4	0.75	0.175	0.25
Commercial Value of the Essential Fertilizing Constituents contained in the Above Fodder Articles. Nitrogen, 15c.; Phosphoric acid, 5½c.; Potassium oxide, 4½c. per lb.								
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
Phos. acid,	.707	2.845	2.333	1.780	.425	.464	.420	.259
Potas. oxide	.435	1.625	1.723	1.214	.045	1.966	.444	1.235
Valuation per 2000 lbs.	$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 2000 lbs. (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

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 (Nov., 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, Nov., 1889, to May, 1890; while that of most of the grain feed ingredients 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 2000 pounds at Amherst, Mass.

	November, 1889, to June, 1890.	November, 1890, to June, 1891.
Cornmeal,	$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 cornmeal, 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 cts. 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 cts. higher, and those which contain old process linseed meal (III) are 2.40 cts. 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 cts. 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 cts. to 12.15 cts. a difference of 0.3 cts.* 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 cts.; while that of the old process linseed meal containing daily grain rations (II) is 7.29 cts. and that of gluten meal containing fine feed rations (III) is 8.01 cts.; a difference respectively of 0.22 cts. to 0.94 cts. per head.* This difference in net cost is due to the higher manurial value of cotton seed meal and of the 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 cts. in case rowen alone (18 pounds) serve as coarse feed; it averages 11.5 cts. in case forty-four pounds of mixed ensilage and five pounds of rowen are daily fed; and it amounts to from 4 to 4.5 cts. 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 ration, I, II, III, VIII, IX, containing rowen, averages 25.55 cts.; rations IV, V, containing mixed ensilage with rowen, averages 23.63 cts.; and ration VI, VII, containing corn stover as coarse feed, averages 15.64 cts. *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 cts.* 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.	Total Manurial Value.
Rowen, 18 pounds.	13.5	7.92	5.57 cts.
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 be. 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 will 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 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 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 past season, when a mixed crop of vetch and oats and of soja bean have served as the principle 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 an 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 with rowen, (Period 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 in yield of milk well 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.

		1	2	4	5	3	6	7	8	9
Periods.		Jessie.	Pearl.	Roxy.	Buttercup.	Pink.	Nancy.	Clarissa.	Juno.	Favorite.
I	Solids, % Fat, %	15.62 6.17	12.62 3.92	14.79 5.19		15.37 5.70	13.13 4.41		13.91 4.71	
II	Solids, Fat,	17.85 7.39	12.77 4.00	15.18 5.12		14.73 5.13	13.33 4.31		13.82 4.36	
III	Solids, Fat,	17.69 7.07	13.50 4.06	15.31 5.00			14.47 4.80		14·30 4.88	
IV	Solids, Fat,	17.61 7.09			12.64 3.65	15.90 6.00	14.68 5.00		14.34 4.96	
V	Solids, Fat,	17.36 7.02	13.69 4.27		12.81 3.79	15.53 5.74	14.75 5.00			
VI	Solids, Fat,	17.02 6.47	13.94 4.48		12.64 3.96	15.86 5.67				13.09 4.35
VII	Solids, Fat,	17.63 7.26	14.32 5.04		12.50 4.05	16.56 6.09		14.18 5.01		13.53 4.58
VIII	Solids, Fat,		13.74 4.84		12.98 4.18	15.82 5.65		14.18 5.08		12.78 4.19
IX	Solids, Fat,		13.66 4.04		13.45 4.27	15.54 5.43		13.79 4.60		12.40 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, ...	1010	1016	992	—	—	—	—	—	—	—18
Buttercup, ...	—	—	—	781	797	795	785	766	775	—6
Nancy, ...	946	942	948	963	987	—	—	—	—	41
Clarissa, ...	—	—	—	—	—	—	833	856	848	15
Juno, ...	1142	1124	1135	1114	—	—	—	—	—	—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 cotton seed meal or three pounds of old process linseed meal, at stated market prices, and under otherwise corresponding circumstances, does not materially affect *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 or 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.

C. A. GOESSMANN, *Director.*

The publications of the Experiment Station will be sent free of charge to all parties interested in its work, on application.

Press of Carpenter & Morehouse, Amherst, Mass.

MASSACHUSETTS STATE

AGRICULTURAL EXPERIMENT STATION.

BULLETIN NO. 42.

JUNE, 1892.

FEEDING EXPERIMENTS WITH MILCH COWS,

November, 1891 to March, 1892.

DENT CORN vs. SWEET CORN.

CORN MEAL vs. MAIZE FEED (Chicago Var).

The experiments here under discussion were planned for the purpose of comparing the food-value of a reputed variety of "Dent Corn" with that of a standard variety of "Sweet Corn," when used as the principal coarse fodder constituent in the daily diet of milch cows, either in the form of "ensilage" or, in a more advanced state of growth, in that of "stover." "Pride of the North" was selected as the representative of dent corns and "Stowell's Evergreen" as that of sweet corns; both kinds of corn were used in all cases in corresponding stages of growth.

The exceptionally high market price of the corn meal at the beginning of our experiment, $31 per ton of 2000 lbs., rendered its substitution in the daily diet of milch cows desirable for economical reasons. The Chicago variety of "maize feed" was chosen for that purpose. This comparatively new feed-stuff is one of the waste products of corn obtained in connection with the manufacture of glucose sugar. The "maize feed" sold at the time at $25 per ton of 2000 lbs. The commercial value of its fertilizing constituents, nitrogen, phosphoric acid and potash, exceeded those contained in the corn meal from six to seven dollars per ton, making a difference at the time of twelve dollars in the *net cost* of both kinds of fine or grain feed. A successful attempt at using "maize feed" in place of cornmeal in the daily diet of milch cows could not fail to secure a material reduction in *the net cost* of the grain feed portion of the *daily fodder ration.*

From six to eight cows, grades of various descriptions and of different milking periods, were selected for the trial. Some of these animals served a shorter period than others, on account of a too far advanced stage of lactation. Our record on this occasion is confined to four cows, which took part with but one exception from the beginning of observatios.

1. HISTORY OF COWS.

NAME OF COW.	BREED.	Age (years).	LAST CALF DROPPED	Daily Yield of Milk at beginning of Trial. (Quarts.)	Number of Months on Trial.
Clarissa,	Grade Shorthorn,	8	June 2, 1891,	7-8	4
Cora,	Grade Jersey,	8	Mar. 14, 1891,	9-10	5
Lucy,	Grade Ayrshire,	6	Apr. 16, 1891,	11-12	5
Gem,	Grade Shorthorn,	5	Dec. 6, 1891,	14-15	3½

2. DESCRIPTION OF FODDER ARTICLES.

The *grain feed portion* of the daily diet consisted at different times either of *corn meal*, *wheat bran* and *maize feed* (Chicago), or of *maize feed*, *wheat bran* and *cottonseed meal*.

The mechanical condition of these various feed-stuffs was good; and their chemical composition in every case a fair one, as may be seen from an abstract of the average result of our analyses. The Chicago maize feed was of a somewhat coarser texture than either of the other articles. It represents the dried grain residue of the maize kernels after the principal part of its starchy material has been removed; and contains more or less of the broken up skins of the kernels.

ANALYSES OF FINE FEED USED.

(Grain Feed.)

FOOD ANALYSES.	Corn Meal.	Wheat Bran.	Maize Feed.	Cotton Seed Meal.
Moisture at 100° C.,	13.26	10.01	8.70	7.05
Dry Matter,	86.74	89.99	91.30	92.95
	100.00	100.00	100.00	100.00
Analysis of Dry Matter.				
Crude Ash,	1.72	6.58	.78	5.40
Crude cellulose,	2.28	11.77	7.97	6.15
Crude fat,	4.90	5.04	7.37	13.82
Crude protein,	12.94	18.06	27.55	38.79
Non-nitrogenous matter,	78.16	58.55	56.33	35.84
	100.00	100.00	100.00	100.00

FERTILIZING CONSTITUENTS.

Nitrogen 15c. per lb., phosphoric acid $5\frac{1}{2}$c., potassium oxide $4\frac{1}{3}$c.

FERTILIZER ANALYSES.	Corn Meal.	Wheat Bran.	Maize Feed.	Cotton Seed Meal.
Moisture,	13.26	10.01	8.70	7.05
Nitrogen,	1.79	2.60	4.03	5.77
Phosphoric acid,	0.71	2.85	0.70	2.33
Potassium oxide,	0.44	1.63	0.43	1.72
Valuation per 2000 lbs.,	$6.55	$12.40	$13.25	$21.42

The coarse feed-stuffs used in the daily diet consisted on this occasion either of a good English hay with sugar beets, or of one-fourth of a daily ration of a good English hay with all the ensilage the animal would consume, or of a well cured corn stover. The hay consumed throughout the experiment was of the same fair quality.

The corn ensilage was obtained in part from a dent corn variety, Pride of the North, and in part from a sweet corn variety, Stowell's Evergreen. The same varieties of corn furnished the corn stover. Both kinds of corn were of a corresponding stage of growth when secured for the production of ensilage or of stover. In case of ensilage, the corn was cut in both cases when the kernels began to glaze; the whole plant was reduced to pieces from one to one and one-half inches in length, before being filled into the silo. The latter was filled as rapidly as the supply of material admitted. Both silos were covered in the same way (see previous report). They were of the same size and contained about the same quantity of cut ensilage corn (whole plant).

The corn stover was obtained in both instances from the matured crops, which were cut about ten days later than for ensilage. The ears were separated from the stalks and the latter carefully field-cured, and subsequently cut in a similar way, as the ensilage for the silo, before being fed. The stover from sweet corn retained under otherwise corresponding circumstances more moisture than that from the dent corn; it was for this reason more liable to mould than the former. The ensilage from sweet corn was, however, fully equal in color and flavor to that from the dent corn. Both were highly relished by the animals on trial.

The chemical composition of the several coarse fodder articles used in our experiment is stated in the following tabular record:

ANALYSES OF COARSE FODDER ARTICLES USED.

FOOD ANALYSES.	Hay.	*Sweet Corn Stover.	†Dent Corn Stover.	*Sweet Corn Ensilage.	†Dent Corn Ensilage.	Sugar Beets.
Moisture at 100° C.,	9.72	41.62	20.10	84.30	79.92	85.27
Dry matter,	90.28	58.38	79.90	15.70	20.08	14.73
	100.00	100.00	100.00	100.00	100.00	100.00
Analysis of Dry Matter.						
Crude ash,	6.43	9.76	6.12	6.32	4.99	5.95
Crude cellulose,	32.28	37.79	33.72	29.32	27.19	6.49
Crude fat,	2.49	2.44	2.51	7.36	3.29	0.66
Crude protein,	9.54	6.08	7.75	7.86	8.29	10.97
Non-nitrogenous matter,	49.26	43.93	49.90	49.14	56.24	75.93
	100.00	100.00	100.00	100.00	100.00	100.00

*Stowell's Evergreen. †Pride of the North.

FERTILIZING CONSTITUENTS

Nitrogen 15c. per lb., phosphoric acid 5½c., potassium oxide 4½c.

FERTILIZER ANALYSES.	Hay.	Sweet Corn Stover.	Dent Corn Stover.	Sweet Corn Ensilage.	Dent Corn Ensilage.	Sugar Beets.
Moisture,	9.72	41.62	20.10	84.30	79.92	85.27
Nitrogen,	1.38	0.57	0.99	0.20	0.27	0.26
Phosphoric acid,	0.36	0.20	0.29	0.087	0.14	0.10
Potassium oxide,	1.57	1.00	1.40	0.41	0.33	0.48
Valuation per 2000 lbs.,	$5.95	$2.83	$4.55	$1.06	$1.26	$1.32

3. MODE OF FEEDING.

The time occupied by the experiment is divided into five feeding periods varying from two to five weeks in length. The *total weight* of the *daily grain feed ration remained the same throughout the entire trial*, namely *nine pounds*. This amount consisted during the first feeding period, Nov. 8th to Nov. 23d, of three pounds each of maize feed (Chicago), wheat bran and corn meal, and during the remaining four feeding periods of three pounds each of Chicago maize feed, wheat bran and cottonseed meal. One-half of the daily grain feed ration was fed at the time of milking in the morning with one-half of the coarse feed; and the other half with the remainder of the coarse feed at the milking time toward evening.

The *total* amount of the daily *course feed ration* depended on the individual appetite of the animals, and on the character of the fodder articles fed. During the first feeding period, when English hay and sugar-beets constituted the daily coarse feed ration, the daily consumption of roots was limited per head in all cases to fifteen pounds; while the daily quantity of hay consumed was decided by the appetite of the animal, varying in case of different animals from twelve to sixteen pounds.

During the second and the third feeding periods, nothing but corn stover served as coarse feed in the daily diet. The amount of stover from Stowell's Evergreen sweet corn consumed per day has varied in case of different animals from twelve and one-half to seventeen pounds per head; while the daily consumption of the stover obtained from the dent corn variety, Pride of the North, has varied per head from ten to thirteen and one-half pounds. The difference in the amount of both kinds of stover consumed is evidently mainly due to their different state of moisture, as may be noticed by comparing in both cases the total amount of dry matter contained in the daily diet consumed during the second and third feeding periods.

Corn ensilage and English hay constituted the coarse fodder of the daily diet during the fourth and fifth feeding periods. The amount of English hay fed per day in this connection was limited in all cases to five pounds per head; that of both kinds of the ensilage was governed by the appetite of each animal. Dent corn ensilage was fed in connection with English hay as stated during the fourth feeding period, and the ensilage from the sweet corn during the fifth.

The daily consumption of the ensilage from the sweet corn varied per head in case of different animals from twenty-four to forty-three pounds, and that of the ensilage from the sweet corn from thirty-five to fifty-three pounds. This difference in the weights of both kinds of ensilage consumed in case of the same animal is materially due to the same circumstance as has been pointed out previously with reference to similar facts noticed concerning the consumption of both kinds of corn stover. The ensilage of the dent corn contains 20% of dry vegetable matter and 80% of water, and the ensilage of the sweets 16% of dry vegetable matter and 84% of water. The cows were watered twice a day, about two hours after feeding time.

The daily fodder rations below described represent the *average composition* of the daily diet used per head during the stated five succeeding feeding periods.

AVERAGE COMPOSITION

OF THE DAILY FODDER RATIONS USED, DURING THE FIVE SUCCESSIVE FEEDING PERIODS.

I.

Corn meal,	3.00 lbs.
Wheat bran,	3.00 "
Maize feed,	3.00 "
Hay,	14.35 "
Sugar beets,	15.00 "
Total cost, (cents),	26.18
Manurial value obtainable, cents,	9.48
Net cost ,cents,	16.70
Nutritive ratio, cents,	1 :6.65

II.

Wheat bran,	3.00 lbs.
Maize feed,	3.00 "
Cotton seed meal,	3.00 "
Sweet corn stover (Stowell' Evergreen),	14.56 "
Total cost (cents),	15.04
Manurial value obtainable, cents,	7.29
Net cost, cents,	7.75
Nutritive ratio, cents,	1 :4.61

III.

Wheat bran,	3.00 lbs.
Maize feed,	3.00 "
Cotton seed meal,	3.00 "
Dent corn stover (Pride of the North),	12.06 "
Total cost (cents),	14.42
Manurial value obtainable, cents,	7.84
Net cost, cents,	6.58
Nutritive ratio, cents,	1 :4.63

IV.

Wheat bran,	3.00 lbs.
Maize feed,	3.00 "
Cotton seed meal,	3.00 "
Hay,	5.00 "
Dent corn ensilage,	32.00 "
Total cost (cents),	19.15
Manurial value obtainable, cents,	8.46
Net cost, cents,	10.69
Nutritive ratio, cents	1 :4.64

V.

Wheat bran,	3.00 lbs.
Maize feed,	3.00 "
Cotton seed meal,	3.00 "
Hay,	5.00 "
Sweet corn ensilage,	41.39 "
Total cost (cents),	20.32
Manurial value obtainable, cents,	8.60
Net cost, cents,	11.72
Nutritive ratio, cents,	1 :4.80

4. COST OF FEED.

The commercial valuation of the previously described daily average fodder rations during the five feeding periods of our experiment is based on the below stated contemporary local price of the various fodder articles used in their composition.

	Per ton, 2000 lbs.	Per lb.
Corn meal,	$31.00	1.55 cts.
Wheat bran,	22.00	1.10 "
Maize feed (Chicago),	25.00	1.25 "
Cotton seed meal,	29.00	1.45 "
English hay,	15.00	.75 "
Sweet corn stover,	5.00	.25 "
Dent corn stover,	5.00	.25 "
Sweet corn ensilage,	2.50	.125 "
Dent corn ensilage,	2.50	.125 "
Sugar beets,	5.00	.25 "

COST OF THE AVERAGE DAILY FODDER RATIONS USED.

(Cents.)

	Feeding Periods.				
	I.	II.	III.	IV.	V.
Total cost,	26.18	15.04	14.42	19.15	20.32
Manurial value obtainable,	9.48	7.29	7.84	8.46	8.60
Net cost,*	16.70	7.75	6.58	10.69	11.72

*Allowing 80 per cent. of the manurial value of the feed consumed obtainable.

Total cost of each daily ration represents the sum of the market cost of the quantity of the different fodder articles contained in that particular daily diet.

Net cost of a fodder article represents the cost of the article, less the commercial value of that portion of the various quantities of the different essential fertilizing constituents they contain, which passes into the animal excretions, liquid and solid, and becomes thus available in the manurial refuse resulting from its consumption. The value of the manurial refuse obtainable from one and the same kind and quality of fodder article depends on the function, the kind and the age of animal which consumes it. In case of milch cows it is conceded that an allowance of a loss of 20% covers the amount of nitrogen, phosphoric acid and potash which passes into the milk produced, and is thus lost as a manurial resource of the farm.

As our various fodder articles differ quite frequently widely from each other with reference to the amount of nitrogen, phosphoric acid and potash they contain, it is but natural that the obtainable manurial value of our different fodder articles under otherwise corresponding *circumstances cannot otherwise but differ also more or less seriously.* The more phosphoric acid, potash and in particular nitrogen a given quantity of a fodder article contains, the more valuable, considered from a commercial standpoint, is the obtainable manurial refuse resulting from its use, taking everything else even. The subsequent abstract of our fertilizer analyses of the different fodder articles used on the present occasion may well serve as an illustration of the previous statements.

COMMERCIAL VALUATION

OF ESSENTIAL FERTILIZING CONSTITUENTS CONTAINED IN THE VARIOUS ARTICLES OF FODDER USED.

Nitrogen 15c., phosphoric acid $5\frac{1}{2}$c., potassium oxide $4\frac{1}{2}$c. per lb.

One Hundred Weight.	Corn Meal.	Wheat Bran.	Maize Feed. (Chicago)	Cotton Seed Meal.	English Hay.	Sweet Corn Stover.	Dent Corn Stover.	Sweet Corn Ensilage.	Dent Corn Ensilage.	Sugar Beets.
	%	%	%	%	%	%	%	%	%	%
Moisture,	13.26	10.01	8.70	7.05	9.72	41.62	20.10	84.30	79.92	85.27
Nitrogen,	1.79	2.60	4.03	5.77	1.38	0.57	0.99	0.20	0.27	0.26
Phos. acid,	.71	2.85	.70	2.33	0.36	.20	.29	0.087	0.14	0.10
Potass. oxide	.44	1.63	.43	1.72	1.57	1.00	1.40	0.41	0.33	0.48
Val. 2000 lbs.	$6.55	$12.40	$13 25	$21.42	$5.95	$2.83	$4.55	$1.06	$1.26	$1.32
Obtainable Manurial Value (per ton); allowing a loss of 20 per cent. contained in the milk sold.										
	$5.24	$9.92	$10.60	$17.14	$4.76	$2.26	$3.64	$0.85	$1.01	$1.06

	Market cost, 2000 lbs.	*Obtainable manurial value 80 per cent.*	*Net cost, 2000 lbs.*
Corn meal.	$31.00	$5.24	$25.76
Wheat bran,	22.00	9.92	12.08
Maize feed (Chicago),	25.00	10.60	14.40
Cotton seed meal,	29.00	17.14	11.86
English hay,	15.00	4.76	8.24
Sweet corn stover,	5.00	2.26	2.74
Dent corn stover,	5.00	3.64	1.36
Sweet corn ensilage,	2.50	0.85	1.65
Dent corn ensilage,	2.50	1.01	1.49
Sugar beets,	5.00	1.06	3.94

From previous discussions it will be noticed that the different fodder rations used during the five feeding periods of our last experiment varied seriously in regard to *market cost* as well as to *net cost.* To what particular circumstance this result is due deserves some special attention. Whether it is due to the cost of the grain feed or to that of the coarse feed, and to what extent in either case, is shown in the subsequent tabular statement.

STATEMENT OF THE COST OF FINE AND COARSE FEED

PORTION OF THE DAILY FODDER RATION USED.

FINE FEED.

Feeding periods.	*Total cost, (cents.)*	*Manurial value obtainable, (cents.)*	*Net cost, (cents.)*
I	11.70	3.90	7.80
II	11.40	5.65	5.75
III	11.40	5.65	5.75
IV	11.40	5.65	5.75
V	11.40	5.65	5.75

COARSE FEED.

Feeding periods.	*Total cost, (cents.)*	*Manurial value obtainable, (cents.)*	*Net cost, (cents.)*
I	14.51	5.65	8.86
II	3.64	1.65	1.99
III	3.02	2.20	.82
IV	7.75	3.30	4.45
V	8.92	3.45	5.47

The market cost of our grain feed ration is materially the same in all cases; the high manurial value of maize feed and cotton seed meal (II, III, IV, V), as compared with that of corn meal (I), makes the net cost of the former two cents less than that of the latter. The pecuniary advantages arising from an intelligent use of corn stover and corn ensilage in the dairy industry in place of English hay deserves particular attention. In sight of these results it may not be out of place to repeat a former advice :—

"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 be. 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 will 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 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 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, cow peas, serradella and soja bean has been very encouraging. The satisfactory results obtained in previous years are fully confirmed year after year. We are raising the present season vetch and oats, Canada peas and oats, soja beans and serradella, partly for green fodder and for ensilage and partly for hay.

5. AVERAGE QUANTITY OF MILK PER DAY (Pounds.)

	FEEDING PERIODS.				
	I.	*II.*	*III.*	*IV.*	*V.*
1. Clarissa,	7.18	5.76	4.88	4.52	—
2. Cora,	8.57	7.29	6.68	6.17	5.39
3. Lucy,	9.68	8.00	7.73	7.73	7.79
4. Gem,	—	13.46	—	13.18	12.31

Considering the period of lactation in case of each animal, the decline in yield of milk as the time of observation advances seems to be normal. Cow No. 4, "Gem," was somewhat indisposed during the third feeding period, refusing for a week or two to eat its customary amount of feed; the yield of milk fell off and is for this reason not recorded here. As soon as she began to consume again the regular fodder ration, the yield of milk with reference to quantity was normal; yet its quality had suffered a serious change, in solids, as will be noticed from the following record of analyses of morning's milk:

ANALYSES OF MILK

DURING DIFEERENT FEEDING PERIODS.

1891-92.	CLARISSA. Solids.	CLARISSA. Fat.	CORA. Solids.	CORA. Fat.	LUCY. Solids.	LUCY. Fat.	GEM. Solids.	GEM. Fat.
Period II.	%	%	%	%	%	%	%	%
December 8,	15.12	5.96	14.06	5.17	13.68	4.66	—	—
December 15,	13.96	5.15	13.39	4.34	12.81	4.77	13.93	4.91
December 22,	15.50	5.61	13.65	4.73	13.67	4.67	14.49	5.10
Period III.								
December 29,	14.09	5.02	13.03	4.37	13.63	4.43	13.19	4.16
January 5,	13.95	4.62	13.21	4.21	14.14	5.05	—	—
January 12,	14.55	4.72	14.04	4.66	13.53	4.38	—	—
Period IV.								
January 19,	13.96	4.66	13.77	4.69	14.04	5.42	11.63	3.48
January 26,	13.19	4.11	12.71	4.15	13.63	4.79	11.11	3.38
February 2,	13.93	4.47	13.97	4.72	13.84	4.73	11.94	3.55
February 9,	14.07	5.18	13.06	4.34	14.50	5.32	11.64	3.49
February 16,	13.29	4.57	13.63	4.77	14.16	5.18	12.06	3.58
February 22,	13.89	4.92	14.05	4.84	13.65	4.56	12.06	3.56
Period V.								
March 1,	—	—	13.38	4.45	13.82	4.51	12.23	3.56
March 8,	—	—	14.00	4.80	14.10	5.08	12.15	3.66
March 15,	—	—	14.34	5.41	12.82	4.09	11.99	3.56
March 22,	—	—	13.83	4.67	14.11	4.78	11.60	3.27

LIVE WEIGHT OF ANIMALS

DURING THE FEEDING PERIODS. (POUNDS.)

	Feeding Periods. I	II.	III.	IV.	V.	Gain at Close.
Clarissa,	951	966	957	999	—	48
Cora,	1062	1042	1051	1062	1069	7
Lucy,	850	815	816	808	804	—46
Gem,	—	869	—	856	865	—4

The general condition of the animals at the close of the observation was a satisfactory one.

Conclusions. A careful consideration of the previously recorded results leads us to the following conclusions:

1. The substitution of a ration composed of three pounds each of corn meal, maize feed and wheat bran, by one consisting of three pounds each maize feed, wheat bran and cotton seed meal *has in our case not materially changed the market cost of the grain feed ration,*

but reduced two cents its net cost; in consequence of the more valuable manurial refuse of the latter.

2. The quantity and quality of milk has not been affected in any noticeable degree by the change in the grain feed ration in case of healthy animals.

3. The differences in the cost, *both market and net, of the differ. ent fodder rations are in a controlling degree due to the cost of the different coarse fodder articles used, a fact which has been repeatedly pointed out in previous communications.*

Analyses of Fodder Articles.

GLUTEN FEED (Buffalo).

I. Sent on from Amherst, Mass.

II. From Station Barn.

	Per cent. I.	II.
Moisture at 100° C.	6.81	8.97
Dry Matter,	93.19	91.03
	100.00	100.00
ANALYSIS OF DRY MATTER.		
Crude ash,	1.81	.77
" cellulose,	6.39	5.09
" fat,	11.73	13.46
" protein,	28.43	26.16
Nitrogen free extract matter,	51.64	54.52
	100.00	100.00

GLUTEN MEAL.

Sent on and represented to have been manufactured at Glen Cove, L. I.

	Per cent.
Moisture at 100° C.	8.80
Dry matter,	91.20
	100.00
ANALYSIS OF DRY MATTER.	
Crude ash,	.46
" cellulose,	6.10
" fat,	8.49
" protein,	18.18
Nitrogen free extract matter,	66.77
	100.00

I. CORN GERM FEED.

Sent on from Conway, Mass.

II. MAIZE FEED (Chicago).

From Station Barn.

	Per cent. I.	II.
Moisture at 100° C.,	7.55	8.60
Dry matter,	92.45	91.40
	100.00	100.00
ANALYSIS OF DRY MATTER.		
Crude ash,	.87	.92
" cellulose,	14.05	7.93
" fat,	12.17	7.90
" protein,	10.81	29.40
Nitrogen free extract matter,	62.10	53.85
	100.00	100.00

CORN MEAL.

I. Sent on from Sherborn, Mass.

II. From Station Barn.

	Per cent. I.	Per cent. II.
Moisture at 100° C.,	12.38	13.96
Dry matter,	87.62	86.04
	100.00	100.00
ANALYSIS OF DRY MATTER.		
Crude ash,	1.76	1.26
" cellulose,	1.92	1.49
" fat,	4.69	3.97
" protein,	10.83	11.11
Nitrogen free extract matter,	80.80	82.17
	100.00	100.00

GROUND BARLEY.

From Station Barn.

	Per cent.
Moisture at 100° C.,	10.91
Dry matter,	89.09
	100.00
ANALYSIS OF DRY MATTER.	
Crude ash,	3.19
" cellulose,	4.10
" fat,	2.13
" protein,	13.33
Nitrogen free extract matter,	77.25
	100.00

COTTON SEED MEAL.

I., II. and III. Sent on from Amherst, Mass.
IV. From Station Barn.

	Per cent. I.	II.	III.	IV.
Moisture at 100° C.,	6.17	8.83	8.53	7.05
Dry matter,	93.83	91.17	91.47	92.95
	100.00	100.00	100.00	100.00
ANALYSIS OF DRY MATTER.				
Crude ash,	5.34	4.72	7.54	5.40
" cellulose,	7.68	9.77	5.87	6.15
" fat,	14.19	9.47	11.67	13.82
" protein,	44.89	42.43	48.23	38.79
Nitrogen free extract matter,	27.90	33.61	26.69	35.84
	100.00	100.00	100.00	100.00

CHICKEN FEED. (Ground Meat Scraps).

Sent on from North Hadley, Mass.

	Per cent.
Moisture at 100° C.	3.71
Dry matter,	96.29
	100.00
ANALYSIS OF DRY MATTER.	
Crude ash,	35.61
" fat,	20.31
" protein,	40.08

C. A. GOESSMANN, *Director.*

The publications of the Experiment Station will be sent free of charge to all parties interested in its work, on application.

Press of Carpenter & Morehouse, Amherst, Mass.

MASSACHUSETTS STATE

AGRICULTURAL EXPERIMENT STATION.

AUGUST, 1892.

BULLETIN No. 43.

CONTENTS.

1. WEATHER OBSERVATIONS.
2. WINTER FEEDING EXPERIMENTS WITH LAMBS.
3. MISCELLANEOUS ANALYSES OF MATERIALS USED FOR MANURIAL PURPOSES.
4. ANALYSES OF LICENSED COMMERCIAL FERTILIZERS.

I.

METEOROLOGICAL SUMMARY

for seven months ending July 31st, 1892.

	Jan.	Feb.	Mar.	Apr.	May.	June.	July.
Highest temperature,	55°	46.5°	59.°	76.°	81°	94.5°	92.0°
Lowest temperature,	–10°	–8.°	5.°	22.°	30°	40.5°	42.0°
Mean temperature,	23.55°	25.69°	31.0°	45.5°	55°	68.77°	69.58°
Total precipitation (inches),	5.05	1.59	2.45	0.65	5.49	3.04	3.74
Total snowfall (inches),	13	14	7.	0	0	0	0
Prevailing wind,	N.E.	N.E.	N.W.	N.	S	S	
No. of "*cloudy*" days,	15	9	7	4	16	13	5
No. of days on which .01 of an in. or more of rain fell,	9	4	9	3	16	13	8

The absolute maximum temperature for the above seven months, viz. 94.5° June 14, exceeds that of last year by 1.5°.

The absolute minimum temperature is –10°, Jan. 17th. Another cold wave was experienced in February when the minimum thermometer registered –8.° on the 18th; –5.5° was the lowest recorded temperature of last year.

The last frost of the season occurred on the 8th of May.

A cold wave of about two weeks duration in May was unfavorable to the germination of seeds and was a setback to general farming operations.

The mean temperature for the first five months of the year is below that for 1891 during same months, while for June and July it is considerably above.

The precipitation for the year thus far is below the normal. It will be noticed from the above table that during April only 0.65 inches fell, an exceedingly low figure for the month. The last snow storm occurred March 23d.

WINTER FEEDING EXPERIMENTS WITH LAMBS.

November, 1891 to May, 1892.

The experiment briefly described in a few succeeding pages is the third one of a series designed for the purpose of studying the feeding effect and general economy of different combinations of grain feed-stuffs when fed in connection with the same or similar kinds of coarse fodder articles for the production of meat.

During our *first* experiment—corn meal, wheat bran and gluten meal (Chicago) furnished in varying proportions the grain feed part of the daily diet, see eighth annual report, page 67 to 90. During the *second*, corn meal, wheat bran, old process linseed meal and gluten meal (Chicago) served for that purpose—see ninth annual report, page 128 to 147; while in the *third experiment*, which is here under discussion, *wheat bran*, *Buffalo gluten feed* and *Chicago maize feed*, have been used as the grain feed part of the daily feed.

The coarse feed portion of the daily diet during the first and second experiments consisted exclusively of rowen,—hay of the second cut of upland meadows, and of corn ensilage. In the third experiment during one feeding period corn ensilage was substituted by roots, (globe mangolds). The selection of lambs in all these trials was confined to our local supply. From six to nine animals served in each case for our observations.

Six lambs, wethers, grades of uncertain parentage, were selected for the experiment here under consideration. Each animal occupied a separate pen during the entire time of observation; none of them were shorn before entering upon the trial.

1. Live Weight of Lambs.

No. 1.	74.00 lbs.	No. 3.	67.25 lbs.	No. 5.	65.00 lbs.
No. 2.	68.50 lbs.	No. 4.	73.50 lbs.	No. 6	77.75 lbs.

2. Market Cost of Lambs.

No. 1.	74.00 lbs. at 5.5 cts. per pound,				$4.07
No. 2.	68.50	"	"	"	3.77
No. 3.	67.25	"	"	"	3.70
No. 4.	73.50	"	"	"	4.04
No. 5.	65.00	"	"	"	3.58
No. 6.	77.75	"	"	"	4.28
	426.00 lbs.				$23.44

3. Character and Cost of Fodder Articles.

The grain feed used consisted of wheat bran, Chicago maize feed, and Buffalo gluten feed bought in our local market. These articles were of a fair quality and of a good mechanical condition. *Chicago maize feed* and *Buffalo gluten feed* are waste products obtained from maize in connection with the manufacture of glucose-sugar; they are valuable recent additions to our commercial resources of concentrated feed stuffs. The coarse feed stuffs,—consisting of rowen—hay of second cut of upland meadows,—of corn ensilage and of globe mangold, were produced at the station and were of the same good quality as those described in a previous bulletin (No. 42). The local market value and the chemical composition of the various fodder articles used at different times in the daily diet are recorded in the subsequent tabular statements.

Local Market Cost of the Various Fodder Articles Used.

Per ton.

Wheat bran,	$22.00	Globe mangolds,	$4.00
Maize feed (Chicago)	25.00	Dent corn ensilage,	2.50
Gluten feed (Buffalo)	23.00	Sweet corn ensilage,	2.50
Rowen,	15.00		

Analyses of Grain Feed Used.

	Wheat Bran.	Maize Feed.	Gluten Feed.
Moisture at 100° C.,	10.01	8.70	8.97
Dry matter,	89.99	91.30	91.03
	100.00	100.00	100.00

ANALYSES OF DRY MATTER.

Crude ash,	6.58	.78	.77
Crude cellulose,	11.77	7.97	5.09
Crude fat,	5.04	7.37	13.46
Crude protein,	18.06	27.55	26.16
Non-nitrogenous matter,	58.55	56.33	54.52
	100.00	100.00	100.00

Analyses of Coarse Fodder Articles Used.

	Rowen.	Globe Mangolds.	Dent Corn Ensilage.	Sweet Corn Ensilage.
Moisture at 100° C.,	13.90	87.75	79.92	84.30
Dry matter,	86.10	12.25	20.08	15.70
	100.00	100.00	100.00	100.00
ANALYSES OF DRY MATTER.				
Crude ash,	8.28	9.06	4.99	6.32
Crude cellulose,	28.88	7.94	27.19	29.32
Crude fat,	3.91	.88	3.29	7.36
Crude protein,	13.45	10.37	8.29	7.86
Non-nitrogenous matter,	45.48	71.75	56.24	49.14
	100.00	100.00	100.00	100.00

Commercial Value of the Essential Fertilizing Constituents Contained in the Above Fodder Articles.

Nitrogen, 15c; phosphoric acid, 5½c; potassium oxide, 4½c per lb.

	Wheat Bran.	Maize Feed.	Gluten Feed.	Rowen Hay.	Globe Mangolds.	Dent Corn Ensilage.	Sweet Corn Ensilage.
Moisture,	10.01	8.70	8.97	13.90	87.75	79.92	84.30
Nitrogen,	2.60	4.03	3.81	1.853	.203	0.27	0.20
Phosphoric acid,	2.85	0.70	0.69	.464	.093	0.14	0.089
Potassium oxide,	1.63	0.43	0.42	1.966	.383	0.33	0.41
Valuation per 2,000 lbs.,	$12.40	$13.25	$12.57	$7.84	$1.06	$1.26	$1.06

4. Mode of Feeding.

The grain feed portion of the daily diet consisted in every instance of *equal weights* of either wheat bran and Chicago maize feed or of wheat bran and Buffalo gluten feed. The amount of each used, per head, in the daily fodder ration varied in different feeding periods somewhat; during the earlier stages of the experiment it amounted to five ounces of each, per head, during later periods to six ounces. All animals received the same quantity at the same stage of the observation.

The daily coarse feed rations consisted either of rowen hay or of rowen hay with either corn ensilage or roots, (globe mangolds). Whenever corn ensilage or roots were fed in common with rowen hay, only one-half of the customary daily rowen ration was given, while the consumption of corn ensilage or of the roots was governed by the appetite of each animal. One-half of the daily fodder ration—fine and coarser feed—was fed in the morning and the other half later in the afternoon. Water was given once a day, a few hours after feeding.

The entire experiment extended over a period of 183 days, and was sub-divided into five distinct feeding periods, varying in length from fourteen to thirty-five days, with five days between the periods.

Average Daily Fodder Rations Used.

I.		II.	
Wheat bran,	0.34 lbs.	Wheat bran,	0.33 lbs.
Maize feed,	0.34 "	Maize feed,	0.33 "
Rowen,	1.37 "	Rowen,	0.68 "
Nutritive ratio,	1 :4.84	Globe mangolds,	2.97 "
Total cost,	1.83 cts.	Nutritive ratio,	1 : 5.12
Manur'l value obtain'ble,	0.89 "	Total cost,	1.88 cts.
Net cost,	0.94 "	Manurial value obtain'ble,	.78 "
		Net cost,	1.10 "

III.		IV.	
Wheat bran,	0.35 lbs.	Wheat bran,	0.38 lbs.
Maize feed,	0.35 "	Maize feed,	0.38 "
Rowen,	0.77 "	Rowen,	0.84 "
Dent corn ensilage,	1.97 "	Sweet corn ensilage,	2.68 "
Nutritive ratio,	1 : 5.26	Nutritive ratio,	1 : 5.34
Total cost,	1.65 cts.	Total cost,	1.86 cts.
Manur'l value obtain'ble,	0.80 "	Manur'l value obtain'ble,	0.88 "
Net cost,	0.85 "	Net cost,	0.98 "

V.		VI.	
Wheat bran,	0.40 lbs.	Wheat bran,	0.40 lbs.
Maize feed,	0.40 "	Gluten feed,	0.40 "
Rowen,	1.40 "	Rowen,	1.37 "
Nutritive ratio,	1 : 4.79	Nutritive ratio,	1 : 5.02
Total cost,	1.99 cts.	Total cost,	1.93 cts.
Manur'l value obtain'ble,	0.98 "	Manur'l value obtain'ble,	0.95 "
Net cost,	1.01 "	Net cost,	0.98 "

SUMMARY OF COST OF ABOVE STATED DAILY FODDER RATIONS.

	Cents.					
	I.	II.	III.	IV.	V.	VI.
Total cost,	1.83	1.88	1.65	1.86	1.99	1.93
Manur'l value obtain'ble (92%)	0.89	0.78	0.80	0.88	0.98	0.95
Net cost,	0.94	1.10	0.85	0.98	1.01	0.98

5. GAIN IN LIVE WEIGHT DURING EXPERIMENT.

	Live Weight at Beginning of Experiment. (lbs.)	Live Weight at Close of Experiment. (lbs.)	Gain in Live Weight during Experiment. (lbs.)
Sheep No. 1.	74.00	97.00	23.00
No. 2.	68.50	85.50	17.00
No. 3.	67.25	87.50	20.25
No. 4.	73.50	85.00	11.50
No. 5.	65.00	75.00	10.00
No. 6.	77.75	98.50	20.75
Average,	71.00	88.08	17.08

The live weight of the lambs (six) engaged in our first experiment averaged, at the beginning of our experiments, 71 pounds; of those engaged in the second experiment (six) it averaged 53.5 pounds.

YIELD OF DRESSED WEIGHT.

Sheep No. 1.	52.25 lbs.,	at 11 cents,	$5.75
No. 2.	46.50 "	" "	5.11
No. 3.	44.00 "	" "	4.84
No. 4.	43.00 "	" "	4.73
No. 5.	36.00 "	" "	3.96
No. 6.	53.25 "	" "	5.86
	275.00 lbs.		$30.25

Yield of Wool.

Sheep No. 1.	6.50 lbs.,	at 21 cents,	$1.37
No. 2.	5.25 "	" "	1.10
No. 3.	5.75 "	" "	1.21
No. 4.	5.25 "	" "	1.10
No. 5.	6.25 "	" "	1.31
No. 5.	5.75 "	" "	1.21
Total,	34.75		$7.30

6. Financial Results.

	1	2	3	4	5	6	Total.
Cost of lambs,	$4.11	$3.82	$3.75	$4.18	$3.73	$4.35	
Cost of Feed consumed.	3.67	3.38	3.41	3.53	2.75	3.54	
	$7.78	$7.20	$7.16	$7.71	$6.48	$7.89	$44.22
Value received for meat,	5.75	5.11	4.84	4.73	3.96	5.86	
Value received for wool,	1.37	1.10	1.21	1.10	1.31	1.21	
Value of obtainable Manure (92.%)	1.73	1.59	1.60	1.67	1.28	1.66	
	$8.85	$7.70	$7.65	$7.50	$6.55	$8.73	$47.08

CONCLUSIONS.

1. The average daily increase in live weight as compared with that noticed in the two preceding experiments is not as satisfactory; lambs 4 and 5 fall not less than fifty per cent. behind when compared with the gain obtained in case of the lambs 1, 3 and 6.

2. The feeding effect of corn ensilage, when fed with the same kind and amount of grain feed, compares well with that of globe mangold roots.

3. The market cost of the daily fodder ration above stated, is in the majority of cases lower than those used in our preceding experiments with lambs; it varies from 1.65 cts. to 1.93 cts. in different feeding periods.

4. The manurial value obtainable from the different daily fodder rations varies from 0.78 to 0.98 cents, it amounts to one-half of the market cost of the daily diet.

5. The temporary ruling low market cost of the grain feed during the third experiment as compared with those on preceding occasions and the high commercial value of the obtainable manurial refuse, due to their rich nitrogenous composition, have secured still a small profit over expenses charged where the rate of producing meat was too low to entitle to profit. In considering the stated financial results in all our feeding experiments, thus far published, it ought to be kept in mind that all our home-raised fodder articles are charged at a liberal local market price per ton.

I.

ANALYSES OF COMMERCIAL FERTILIZERS AND MANURIAL SUBSTANCES SENT ON FOR EXAMINATION.

811—814. WOOD ASHES.

I. Sent on from Amherst, Mass.
II. and III. Sent on from Lawrence, Mass.
IV. Sent on from Hudson, Mass.

	I.	*II.*	*III.*	*IV.*
		Per	*Cent.*	
Moisture at 100° C.,	13.18	16.12	8.71	18.00
Calcium oxide,	34.06	30.38	36.95	33.25
Magnesium oxide,	2.88	2.64	2.90	1.84
Ferric oxide,	1.32	1.32	.07	1.42
Potassium oxide,	4.56	3.94	5.77	4.51
Phosphoric acid,	1.66	1.52	1.38	1.18
Insoluble matter, before calcination	13.60	17.52	13.15	12.99
Insoluble matter, after calcination	11.16	13.10	11.88	10.84

815—819. WOOD ASHES.

I. Sent on from Concord, Mass.
II. Sent on from Clifton, Mass.
III. and IV. Sent on from Sunderland, Mass.
V. Sent on from Boston, Mass.

	I.	II.	III.	IV.	V.
			Per Cent.		
Moisture at 100° C.,	10.49	15.94	17.82	12.60	10.46
Calcium oxide,	32.42	31.65	*	31.53	33.83
Magnesium oxide,	3.60	2.59	*	2.31	3.19
Ferric oxide,	.65	1.62	*	1.11	.78
Potassium oxide,	6.02	4.71	4.04	5.19	5.08
Phosphoric acid,	1.55	1.43	1.71	1.59	1.46
Insoluble matter, before calcination	11.37	13.38	10.56	17.15	15.76
Insoluble matter, after calcination	8.37	10.62	8.80	14.42	11.77

* Not determined.

820—823. COTTON HULL ASHES.

I. Sent on from Sunderland, Mass.
II. and III. Sent on from Agawam, Mass.
IV. Sent on from Hatfield, Mass.

	I.	II.	III.	IV.
		Per Cent.		
Moisture at 100° C.,	8.55	4.20	4.58	5.44
Calcium oxide,	6.27	9.46	9.66	6.24
Magnesium oxide,	8.48	11.50	10.95	5.23
Ferric oxide,	.92	4.02	3.29	4.93
Potassium oxide,	26.68	21.95	21.75	12.03
Phosphoric acid,	8.55	10.50	10.56	6.12
Insoluble matter, before calcination	18.93	19.25	19.20	45.82
Insoluble matter, after calcination	15.65	16.62	16.27	34.86

824—827. FLORIDA PHOSPHATE.

I. Sent on from Marlboro, Mass.
II., III. and IV. Sent on from Concord, Mass.

	I.	II.	III.	IV.
		Per Cent.		
Moisture at 100° C.,	2.24	1.38	.36	1.51
Organic and volatile matter,	13.37	5.01	3.80	8.07
Total phosphoric acid,	17.71	36.80	36.26	33.88
Calcium oxide,	14.64	46.21	51.78	45.53
Ferric oxide,	6.72	8.38	5.62	9.80
Insoluble matter,	22.05	1.42	2.20	1.47

II.

ANALYSES OF COMMERCIAL FERTILIZERS COLLECTED DURING 1892, IN THE GENERAL MARKETS BY THE AGENT OF THE MASSACHUSETTS STATE AGRICULTURAL EXPERIMENT STATION.

Laboratory No.	Name of Brand.	Name of Manufacturer.	Sampled at
	Compound Fertilizers.		
8	Ammoniated Bone Superphosphate (Americus Brand),	Williams & Clark Fertilizer Co., Boston, Mass.,	Northampton.
16	Bradley's High Grade Tobacco Manure,	Bradley Fertilizer Co., Boston, Mass.,	Northampton.
23	Bowker's Lawn and Garden Dressing,	Bowker Fertilizer Co.,	Springfield.
28	Tobacco and Sulphur Lawn Fertilizer,	F. C. Sturtevant, 216 State St., Hartford, Ct.,	Springfield.
31	Bowker's Lawn and Garden Dressing,	Bowker Fertilizer Co., Boston, Mass.,	Worcester.
41	High Grade Tobacco Manure,	Bradley Fertilizer Co., Boston, Mass.,	No. Amherst.
43	Dry Ground Fish,	Quinnipiac Fertilizer Co., Boston, Mass.,	No. Amherst.
67	High Grade Fish and Potash,	Leander Wilcox, Mystic, Ct.,	Amherst.
76	Complete Manure for Corn,	Prentiss, Brooks & Co., Holyoke, Mass.,	Holyoke.
83	Ammoniated Bone Superphosphate (Americus Brand),	Williams & Clark Fertilizer Co., Boston, Mass.,	Springfield.
96	Special Potato Manure,	Crocker Fertilizer & Chemical Co., Buffalo, N. Y.,	North Adams.
107	Clark's Cove Fish and Potash,	Clark's Cove Fertilizer Co., Boston, Mass.,	Dighton.
112	Columbus "A" Manure,	J. S. Reese & Co., Baltimore, Md.,	Dighton.
115	Market Garden Manure,	Quinnipiac Fertilizer Co., Boston, Mass.,	Fall River.
117	Potato, Tobacco and Hop Phosphate,	Crocker Fertilizer & Chemical Co., Buffalo, N. Y.,	Fall River.
124	Plymouth Rock Fertilizer,	Ames Fertilizer Co., Peabody, Mass.,	Amherst.
125	Dow's Nitrogenous Superphosphate,	John C. Dow & Co., Boston, Mass.,	Amherst.
133	Special Potato Manure,	Crocker Fertilizer & Chemical Co., Buffalo, N. Y.,	Amherst.
136	Potato, Hop and Tobacco Phosphate,	Crocker Fertilizer & Chemical Co., Buffalo, N. Y.,	Amherst.
166	Lowell Bone Fertilizer,	J. M. Butman, Chelmsford, Mass.,	Chelmsford.
180	Red Brand Excelsior Guano,	E. Frank Coe, New York, N. Y.,	Hadley.
193	Market Garden Manure,	Quinnipiac Fertilizer Co., Boston, Mass.,	Northampton.
195	Columbus "A" Manure,	J. S. Reese & Co., Baltimore, Md.,	Springfield.
198	Complete Manure for Corn,	Prentiss, Brooks & Co., Holyoke, Mass.,	Holyoke.
	Bones.		
52	Fresh Ground Bone,	Bowker Fertilizer Co., Boston, Mass.,	Sunderland.
113	Ground Bone,	Hargraves Manufacturing Co., Fall River, Mass.,	Fall River.
116	Ground Bone,	Hargraves Manufacturing Co., Fall River, Mass.,	Fall River.
121	Pure Ground Bone,	S. Winter, Brockton, Mass.,	Brockton.
138	Pure Ground Bone,	S. Winter, Brockton, Mass.,	Amherst.
169	Fine Ground Bone,	Bryant & Brett, New Bedford, Mass.	New Bedford.

Laboratory Number.	Name of Brand.	Moisture.	Nitrogen in 100 lbs.		Phosphoric Acid in 100 lbs.							Potassium Oxide in 100 lbs.			
								Total.		Available.					
			Found.	Guaranteed.	Soluble.	Reverted.	Insoluble.	Found.	Guaranteed.	Found.	Guaranteed.	Found.	Guaranteed.		
	Compound Fertilizers.														
8 & 83	Ammoniated Bone Superphosphate (Americus Brand), ...	11.44	2.78	2.47-3.80	6.14	2.92	2.35	11.41	10-13	9.06	9-11	1.53	2-3*		
16 & 41	Bradley's H. G. Tobacco Manure,..	7.32	5.92	5.77-6.59	2.25	1.02	3.28	6.55	4-5	3.27	—	10.31	10-80*		
23 & 31	Bowker's Lawn & Garden Dressing,	14.46	4.08	4.12-4.94	5.99	.05	5.22	11.26	6-8	6.04	5-6	5.03	5-6*		
28	Tobacco & Sulphur Lawn Fertilizer,	12.72	1.94	1.96	trace	.25	.26	.51	.75	.25	—	8.34	7.66		
43	Dry Ground Fish,................	6.38	8.72	7.41-9.06	.77	3.48	2.30	6.55	7-9	4.25	—	—	—		
67	High Grade Fish and Potash,......	19.44	3.66	3.25-4.25	2.97	1.43	2.25	6.65	6-7	4.40	5-6	4.93	4-5		
76 & 198	Complete Manure for Corn,........	13.92	3.36	3.30-4.12	4.75	.78	1.25	6.78	8-10	5.53	4-6	5.85	6-7		
96 & 133	Special Potato Manure, ...	11.95	3.90	3.70-4.50	5.68	1.48	2.51	9.67	9-11	7.16	8-9	5.45	5.40-6.40*		
107	Clark's Cove Fish and Potash, ...	16.34	3.44	2.47-4.12	3.38	2.20	1.89	7.47	7-9	5.58	6-8	2.73	3-5*		
112 & 195	Columbus "A" Manure, ...	15.73	3.44	3.29-4.11	2.66	5.12	.77	8.55	8-11	7.78	7-9	9.06	9.50-11		
115 & 193	Market Garden Manure,...........	12.94	3.82	3.30-4.12	6.55	.87	2.66	10.08	9-13	7.42	8-11	6.98	7-8*		
117 & 136	Potato, Tobacco and Hop Phosp'te,	15.01	2.56	2-3	7.42	7.17	1.41	16.00	11-14	14.59	10-12	3.87	3.25-4.30*		
124	Plymouth Rock Fertilizer, ...	19.28	2.52	2.47-3.30	5.31	5.92	.19	11.42	9-13	11.23	8-10	3.52	3-4		
125	Dow's Nitrogenous Superphosph'te,	20.82	2.32	2.03-2.88	3.71	5.46	1.04	10.21	8-10	9.17	—	2.18	1.90-2.53		
166	Lowell Bone Fertilizer, ...	13.97	2.48	2-2.50	5.76	6.01	.13	11.90	9-16.5	11.77	7.-13.5	2.88	2-3.50		
180	Red Brand Excelsior Guano,.......	12.82	3.14	3.50-4	7.16	1.86	1.02	10.04	10-14	9.02	9-12	6.47	6*		
												Mechanical Analysis.			
												Fine.	Fine Medium.	Medium.	Coarse Medium.
	Bones.														
52	Fresh Ground Bone, ...	4.89	3.40	2.47-3.30	1.05	6.62	10.75	18.42	18-22	7.67	5-7	39.96	29.04	24.50	6.50
113 & 116	Ground Bone,.....................	12.05	2.80	2.50-2.80	.32	11.45	13.87	25.66	25-27	11.77	—	21.28	37.86	18.48	22.38
121 & 138	Pure Ground Bone, ...	5.82	3.32	3.66	.20	11.67	10.90	22.77	22.85	11.87	9.55	59.61	20.75	8.70	10.94
169	Pure Fine Ground Bone, ...	6.96	2.50	2.50	.10	7.06	18.40	25.56	25.56	7.16	7.16	17.69	20.74	19.90	41.67

*Sulphate of Potash, the source of Potash.

TRADE VALUES OF FERTILIZING INGREDIENTS IN RAW MATERIALS AND CHEMICALS.

	1892. Cents per pound.
Nitrogen in ammoniates,	17½
" " nitrates,	15
Organic nitrogen in dry and fine ground fish, meat, blood,	16
" " " cotton-seed meal and castor pomace,	15
" " " fine ground bone and tankage,	15
" " " fine ground medium bone and tankage,	12
" " " medium bone and tankage,	9½
" " " coarser bone and tankage,	7½
" " " hair, horn-shavings and coarse fish scraps,	7
Phosphoric acid soluble in water,	7½
" " soluble in ammonium citrate,	7
" " in dry ground fish, fine bone and tankage,	7
" " in fine medium bone and tankage,	5½
" " in medium bone and tankage,	4½
" " in coarse bone and tankage,	3
Potash as High Grade Sulphate, and in forms free from Muriate or Chlorides, Ashes, etc.,	5½
" " Kainite,	4½
" " 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, 16 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, 1892, 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.

The Bulletins of the Experiment Station will be sent free of charge to all parties interested in its work, on application.

C. A. GOESSMANN, *Director.*

Amherst, Mass., Aug. 15, 1892.

Carpenter & Morehouse, Printers, Amherst, Mass.

MASSACHUSETTS STATE
AGRICULTURAL EXPERIMENT STATION.

BULLETIN NO. 44.

OCTOBER, 1892.

CONTENTS.

Meteorological Summary for August and September.

	AUGUST.	SEPTEMBER.
Highest temperature,	90°	79°
Lowest temperature,	51.5°	34°
Mean temperature,	67.78°	59.3°
Total precipitation, (inches)	5.70	1.53
Prevailing wind,	N.	S.
Number of cloudy days,	11	6
Number of days on which .01 of an inch of rain, or more, fell,	10	3

The mean temperature for the month of August ('92), viz., 67.78°, was 0.56° lower than that of August ('91), while the absolute maximum temperature, viz., 90°, was exactly the same, as recorded at this station.

The month was characterized by excessive rain falls, usually accompanied with heavy thunder, and brilliant displays of lightning. The precipitation was much above the normal, being 2.03 inches more than that of last year.

The mean temperature for the month of September ('92), viz., 59.3°, was 5.27° lower than for September ('91), while the absolute maximum temperature was 10° lower, than that for last year.

The month was unusually fair and pleasant, being free from severe storms. The total precipitation was 1.45 inches less than for September ('91).

There was no frost until the morning of the 30th.

The weather was very favorable for the ripening and harvesting of crops.

FEEDING EXPERIMENTS WITH STEERS.

The feeding experiment briefly described within a few subsequent pages may be considered a continuation of a preceding one, reported in full in our ninth annual report, 1891-92, pages 107 to 127. They were planned chiefly for the purpose of ascertaining *the cost of the feed for the production of beef for the meat market in case of growing steers under existing local market conditions of the supply of coarse and fine feed stuffs and of cost of beef.*

During our first experiment in the stated direction, four young steers, grade Shorthorn, two one-year-old and two two-years-old, served for our observation. They were selected at different stages of growth for the *special purpose of observing and comparing the feeding effect of one and the same suitable daily diet on the rate of increase in live weights* and on *the cost of the feed consumed per pound of live weight produced*, under specified conditions.

The *coarse fodder articles used on that occasion* were home raised, and consisted, from the beginning to the end of the trial, of either dry fodder corn, or corn ensilage, or corn stover,—all obtained from the same variety of field corn—Pride of the North. The corn used for the production of dry fodder corn and of corn ensilage was in both cases of a corresponding stage of growth—kernels glazing. The corn stover was obtained from the fully matured crop.

The *fine* or *grain feed* used in that connection in the preparation of the daily fodder rations consisted, as a rule, of equal weights of either wheat bran and Chicago gluten meal, or of wheat bran and old process linseed meal, or of wheat bran, old process linseed meal and corn and cob meal. The total quantity of the grain feed mixture used daily, per head, varied from seven to nine pounds; it never exceeded nine pounds. The amount of coarse feed daily consumed per head was controlled in every case by the appetite of each animal on trial. Both lots of steers were kept in the stall during the entire time occupied by the observation—December '89 to April '90.

The most satisfactory results were noticed in case of both lots, as far as the daily increase in live weight is concerned, when corn ensilage was fed with a mixture of either wheat bran and Chicago gluten meal or of wheat bran and old process linseed meal. During a period of from six to seven weeks, when feeding the stated feed stuffs, the daily gain in live weights in case of the yearlings reached in one instance as high as 2.9 pounds per head, while in case of the two-year-old steers it amounted under corresponding conditions to

3.45 pounds per head. The live weight of the yearlings at that time was from 650 to 700 pounds each, and that of the older steers from 1150 to 1200 pounds each. The *market cost* of the daily fodder rations used at the stated time averaged, per head, in case of the yearlings, 13.79 cents, and *its net* cost was 5.03 cents; while in case of the two older steers the market cost of the daily fodder rations averaged 18 cents per head, and its net cost 7.04 cents. We paid in case of both lots of young steers 3½ cents per pound of live weight, and sold at the close of the experiments the older lot of steers to the butcher at 3¾ cents per pound of live weight. The shrinkage noticed between live weight and dressed weight varied from 34% to 36%. Dressed beef brought at that time from 5¾ to 6 cents per pound.

The financial result of the experiment as far as the highest daily yield of live weight is concerned, at stated market price may be seen from the following summary:

	I. Yearlings.	II. Two-year-olds.
Market cost of daily fodder rations,	13.79 cts.	18.00 cts.
Obtainable manurial value (92% per day),	8.76	10.96
Net cost of daily fodder rations,	5.03	7.04
Live weight produced per day, (pounds)	2.99	3.45
Cash received for live weight produced per day,	11.21	12.97

From these statements it will be noticed that the profit secured by the operation consisted in the value of the obtainable manure and in the disposition of our home-raised fodder articles at fair local, retail selling prices. The yearlings proved more remunerative than the two-year-old steers.

Two facts were apparently fairly demonstrated by our first observation, namely:

1. *Yearlings increase at a higher rate in live weight in case of a corresponding suitable diet, than two-year-old steers, taking the total temporary live weight of the animal on trial as the basis for the comparison. The highest daily increase in the live weight of the yearlings —650 pounds each—amounted in our first feeding experiment to 0.46 pounds per one hundred pounds of live weight; and in that of the two-year-old steers—1150 pounds each—to 0.3 pounds per one hundred pounds of live weight.*

2. *Our local market price of young steers and of dressed beef necessitates not only an exceptional care in the selection of efficient and low priced feed stuffs, but also a careful attention in regard to a judi-*

cious combination of suitable feed stuffs for the preparation of an economical diet, to render with us the production of beef for the meat market remunerative.

To assist in a desirable solution of that problem is the principal motive for continuing our observation in the stated direction.

Some of the leading features in the management of our *first* feeding experiment are retained in the course pursued during our *second* experiment, which is farther on briefly described. The difference between the latter and the first feeding experiment consists in the following circumstances:

1. One set of young steers—yearlings—served from the beginning to the end of the experiment.

2. The observation extended over a period of sixteen months—including two succeeding winter seasons, with summer pasturing between them.

3. The animals were kept in the stall, practically without any outdoor exercise, during the late autumn, the winter, and the earlier part of the spring. During the growing season, from May to the middle of October, they were turned for support into a good pasture; no additional food from any outside source was offered during that period.

4. A greater variety of coarse and fine fodder articles were used in the preparation of the daily diet at different stages of the experiments during the second winter season than on the preceding occasion.

SECOND FEEDING EXPERIMENT.

December, 1889, to March, 1891.

Two one-year-old steers, grade Shorthorns, of fairly corresponding general condition served in the trial. They were bought at 3½ cents per pound of live weight. No. 1 weighed 675 pounds; No. 2 weighed 600 pounds, when bought. The systematic feeding began during the middle of December, 1889, both receiving as far as practicable at all times the same daily fodder rations. The mode of feeding was the same as described in the preceding experiment, twice a day; water was offered two hours after feeding.

The grain-feed part of the daily diet was at all times a definite one and the same in quantity and quality in case of both animals. The amount of the coarse feed consumed daily was governed by the appetite of each animal. The composition of the daily fodder rations used during the first winter season, 1889–1890, differed materially from those used during the second winter season, 1890–1891. This circumstance renders it advisable in the interest of a due appreciation of the feeding results in different stages of the trial, to state our results with reference to its *three distinctly different feeding periods*, namely, feeding record of *first winter season*, of *summer pasturing*, and of *second winter* season.

1. *Feeding Record of First Winter Season.*

December 17th, 1889, to May 9th, 1890.

Coarse fodder articles: Dry fodder corn, corn ensilage, corn stover and sugar beets. Fine fodder articles: Wheat bran, Chicago gluten meal, old process linseed meal, and corn and cob meal.

Local Market Value per Ton of the Various Articles of Fodder used, 1889–1890.

Wheat bran,	$16 50
Gluten meal, Chicago,	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

Analysis of Fodder Articles Used.

	Wheat Bran.	Gluten Meal.	Old-Process Linseed Meal.	Corn & Cob Meal.	CornStover	Corn Ensilage.	Corn Fodder.	Sugar Beets.
Moisture at 100° C.,	9.27	9.80	9 88	8.10	26.95	72.95	20.42	90.02
Dry matter,	90.73	90.20	90.12	91.90	73.05	27.05	79.58	9 98
	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
Analysis of Dry Matter.								
Crude ash,	7.47	1.25	7.39	1.47	5.80	6.48	7.40	11.84
Crude cellulose,	9.75	1.75	8.74	5.63	34.33	26.33	20.11	8.20
Crude fat,	5.48	7.00	7.24	3.73	1.66	5.17	1.65	.71
Crude protein,	17.53	31.25	36.97	9.79	7.90	7.64	8.31	11.53
N. free extract matter	59.77	58.75	39.66	79.38	50.31	54.38	62.53	67.72
	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00

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
Valua'n per 2000 lbs.	$13 60	$16 18	$21 15	$6 02	$4 69	$1 56	$4 89	$1 14

AVERAGE COMPOSITION OF DAILY FODDER RATIONS USED.

First Winter Season, 1889–1890.

I.

Dec. 17th to Dec. 31st.

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 obt'ble,	5.68 "
Net cost,	1.77 "

II.

Jan. 4th to Jan. 22d.

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 obt'ble,	8.01 "
Net cost,	4.81 "

III.

Jan. 28th to Feb. 16th.

Wheat bran,	4.00 lbs.
O. P. linseed meal,	4.00 "
Corn ensilage,	43.38 "
Nutritive ratio,	1 : 5.69
Total cost,	14.76 cts.
Manurial value obt'ble,	9.50 "
Net cost,	5.26 "

IV.

Feb. 21st to March 11th.

Wheat bran,	3.00 lbs
O. P. 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 obt'ble,	7.65 "
Net cost,	4.80 "

V.	
March 14th to April 21st.	
Wheat bran,	3.00 lbs.
O. P. 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 obt'ble,	6.92 "
Net cost,	3.66 "

VI.	
April 24th to May 9th.	
Wheat bran,	3.00 lbs.
O. P. 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 obt'ble,	7.44 "
Net cost,	7.54 "

SUMMARY OF COST OF ABOVE STATED AVERAGE DAILY FODDER RATIONS.

Total cost,	7.45	12.82	14.76	12.45	10.58	14.98 cts.
Obtainable manurial value, 92%,	5.68	8.01	9.50	7.65	6.92	7.44 cts.
Net cost,	1.77	4.81	5.26	4.80	3.66	7.54 cts.

As the selling price of live weight per pound was $3\frac{3}{4}$ cents, it will be found that to cover the daily expenses for feed consumed in form of the six stated average daily fodder rations the following rate of a daily increase, per head, in pounds of live weight becomes necessary.

Gain Required in Pounds, per day, of Live Weights to cover Expenses for Feed.

Fodder Ration.	On Total Cost.	On Net Cost.	Fodder Ration.	On Total Cost.	On Net Cost.
I.	1.99 lbs.	0.47 lbs.	IV.	3.32 lbs.	1.28 lbs.
II.	3.42 lbs.	1.28 lbs.	V.	2.82 lbs.	0.98 lbs.
III.	3.93 lbs.	1.40 lbs.	VI.	3.99 lbs.	2.01 lbs.

To what extent the various fodder rations have secured the above specified increase in live weight may be seen from the subsequent detailed feeding record of each steer on trial.

Steer 1 (Yearling).

FEEDING PERIODS.	FEED CONSUMED (POUNDS) PER DAY.								Total Dry Matter consumed per Day (Pounds).	Nutritive Ratio.	Weight of Animal at Begin'ng 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

	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 (entire experiment),	1.53
Highest average gain in live weight per day, III Period,	2.90
Lowest average gain in weight per day, II Period,	0.81

Steer 2 (Yearling).

FEEDING PERIODS.	Feed consumed (Pounds) per Day.								Total Dry Matter consumed per Day (Pounds).	Nutritive Ratio.	Weight of Animal at Begin'ng 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. 21,	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

	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 (entire experiment),	1.07
Highest average gain in live weight per day, II Period,	3.27
Lowest average gain in live weight per day, VI Period,	0.75

The first feeding period in case of both animals shows a decided loss in live weight; this result is presumably largely due to the influence of an entire change in mode of keeping and feeding, and cannot be charged to the daily diet.

2. Record of keeping the steers in the pasture.

May 10, 1890 to September 30, 1890.

	1.	2.
Date of turning steers into pasture,	May 10, 1890.	May 10, 1890.
Date of closing pasturing,	Sept. 30, 1890.	Sept. 30, 1890.
Number of days of pasturing,	144	144
Live weight of steers when turned into pasture	895 lbs.	840 lbs.
Live weight of steers at 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 "

To meet the expenses for the use of the pasture, per head, 40 cents a week, reqnires a daily increase in live weight of 1.52 pounds, or about twice as much as we actually secured. The daily increase in live weight no doubt varies during the season more or less, in consequence of changes in the weather and in the condition of the pasture. A mere statement of the final results at the close of the season does not show the degree of temporary adverse influence. Aside from these circumstances there is, however, another serious source of loss in live weight; apparently unavoidably connected with a system of changing from stall feeding to pasturing, and from the latter again to stall feeding. The loss in live weight due to these changes amounted in our case to from 20 to 25 pounds, per head, on each occasion and in case of both animals.

3. Feeding Record of Second Winter Season.

October 14th, 1890, to March 3d, 1891.

Coarse fodder articles: Upland meadow hay, barley straw, clover hay, corn ensilage, turnips. Fine fodder articles: Barley meal, wheat bran, cotton seed meal.

The steers upon returning from the pasture, Sept. 30th, were allowed for a week or more, some hours every day, an outdoor exercise to make the change for a subsequent close confinement and a systematic system of feeding a gradual one. The mode of feeding was the same as during the preceding winter season. The daily grain feed rations consisted either of wheat bran and cotton seed meal, 3.5 pounds each per head, or of wheat bran, barley meal and cotton seed meal, varying from 3 to 3.5 pounds each, per head, at different times. The daily coarse feed ration consisted at different times in varying proportions either of English hay, or of English hay and barley straw, or of English hay, clover hay and turnips, or of clover hay and corn ensilage; the amount consumed was controlled by the appetite of each animal on trial. The subsequent detailed statement of fodder rations used represents in each case the average composition of the daily diet during succeeding feeding periods. The change from one daily diet to another is in all cases a gradual one, to avoid as far as practicable serious disturbances in digestion.

Local Market Cost of Fodder Articles Used.

Wheat bran,	$23 50
Barley meal,	30 00
Cotton seed meal,	27 50
Barley straw,	5 00
Hay,	15 00
Clover hay,	12 00
Turnips,	4 00
Corn ensilage,	2 75

Analysis of Fodder Articles Used.

	Wheat Bran.	Barley Meal.	Cotton Seed Meal.	Barley Straw.	Hay.	Clover Hay	Turnips.	Corn Ensilage.
Moisture at 100° C.,	12.11	14.62	10.13	11.44	9.72	17.41	89.32	80.53
Dry matter,	87.89	85.38	89.87	88.56	90.28	82.59	10.68	19.47
	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
Analysis of Dry Matter.								
Crude ash,	7.40	3.18	8.22	5.30	6.43	14.98	9.54	6.73
Crude cellulose,	12.17	5.04	7.26	33.85	32.28	30.37	12.61	26.90
Crude fat,	5.04	2.38	11.64	3.38	2.49	1.75	2.05	3.27
Crude protein,	18.48	14.93	45.99	9.24	9.54	16 64	9.89	8.97
N free extract matter,	56.91	74.47	26.89	48.23	49.26	36.26	65.91	54.13
	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00

Essential Fertilizing Constituents of the various Articles of Fodder Used.

Nitrogen 15c.; phosphoric acid 5½c.; potassium oxide 4½c. per lb.

	Wheat Bran.	Barley Meal	Cotton Seed Meal.	Barley Straw.	Hay.	Clover Hay	Turnips.	Corn Ensilage.
Moisture,	12.11	14.62	10.13	11.44	9.72	17.41	89.32	80.53
Nitrogen,	2.697	2.04	6.613	1.310	1.379	2.20	1.69	.279
Phosphoric acid,	2.870	.660	2.090	.303	.352	0.603	.092	.096
Potassium oxide,	1.620	.341	1.620	2.086	1.541	1.962	.358	.226
Valuation per 2000 lbs.	$12.71	$7.16	$23.60	$6.14	$5.92	$9.03	$0.93	$1.15

AVERAGE DAILY FODDER RATIONS USED.

Second Winter Season, 1890–1891.

I.

Oct. 14. 1890 to Oct. 25, 1891.

Wheat bran,	3.50 lbs.
Cotton seed meal,	3.50 "
Barley straw,	6.42 "
Hay,	8.33 "
Nutritive ratio,	1 : 4.15
Total cost,	16.78 cts.
Manurial value obt'ble,	9.93 "
Net cost,	6.85 "

II.

Oct. 28, 1890 to Nov. 10, 1891.

Wheat bran,	3.50 lbs.
Cotton seed meal,	3.50 "
Hay,	15.68 "
Nutritive ratio,	1 : 4.08
Total cost,	20.68 cts.
Manurial value obt'ble,	10.11 "
Net cost,	10.57 "

III.

Nov. 13, 1890 to Dec. 1, 1891.

Wheat bran,	2.50 lbs.
Cotton seed meal,	3.50 "
Hay,	7.53 "
Clover hay,	7.72 "
Turnips,	30.00 "
Nutritive ratio,	1 : 3.75
Total cost,	25.2 cts.
Manurial value obt'ble,	12.38 "
Net cost,	12.82 "

IV.

Dec. 2, 1890 to Dec. 15, 1891.

Wheat bran,	2.50 lbs.
Barley meal,	2.50 "
Cotton seed meal,	2.50 "
Hay,	7.04 "
Clover hay,	6.15 "
Turnips,	30.00 "
Nutritive ratio,	1 : 4.28
Total cost,	25.10 cts.
Manurial value obt'ble,	10.75 "
Net cost,	14.35 "

V.

Dec. 16, 1890 to Jan. 19, 1891.

Wheat bran,	3.32 lbs.
Barley meal,	3.32 "
Cotton seed meal,	3.32 "
Hay,	6.44 "
Clover hay,	5.34 "
Turnips,	30.00 "
Nutritive ratio,	1 : 4.01
Total cost,	27.48 cts.
Manurial value obt'ble,	11.89 "
Net cost,	15.59 "

VI.

Jan. 27, 1890 to Mar. 2, 1891.

Wheat bran,	3.00 "
Barley meal,	3.00 "
Cotton seed meal,	3.00 "
Clover hay,	5.07 "
Corn ensilage,	42.45 "
Nutritive ratio,	1 : 4.11
Total cost,	21.05 cts.
Manurial value obt'ble,	10.34 "
Net cost,	10.71 "

SUMMARY OF COST OF ABOVE DAILY FODDER RATIONS USED.

Second Winter Season, 1890–1891.

	I.	II.	III.	IV.	V.	VI.
Total cost,	16.78	20.68	25.20	25.10	27.48	21.05
Manurial value obt'ble,	9.93	10.11	12.38	10.75	11.89	10.34
Net cost,	6.85	10.57	12.82	14.35	15.59	10.71

Taking the selling price of dressed beef at $3\frac{3}{4}$ cents per pound, it follows that to cover the daily expenses for feed consumed in the form of the above specified six daily fodder rations, the following rate of daily increase in pounds of live weight becomes necessary.

Gain Required per day in Pounds of Live Weight to Cover Expenses for Feed.

Fodder Ration.	On Total Cost.	On Net Cost.	Fodder Ration.	On Total Cost.	On Net Cost.
I.	4.47	1.83	IV.	6.69	3.83
II.	5.51	2.82	V.	7.33	4.16
III.	6.72	3.42	VI.	5.61	2.86

The subsequent detailed record of each steer on trial shows to what extent each of the previously specified fodder rations have realized the required increase in live weight.

Steer—No. 1.

FEEDING PERIODS.	Feed consumed (pounds) per day. Wheat Bran.	Barley Meal.	Cotton Seed Meal.	Barley Straw.	Hay.	Clover Hay.	Turnips.	Corn Ensilage.	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.
1890-91.													
Oct. 1 to Oct. 25,	3.50	—	3.50	7.00	8.33	—	—	—	19.96	1 : 4.22	1060	1085	2.08
Oct. 28 to Nov. 10,	3.50	—	3.50	—	16.53	—	—	—	21.16	1 : 4.16	1095	1083	-.75
Nov. 13 to Dec. 1,	3.50	—	3.50	—	8.00	8.10	30.00	—	23.35	1 : 3.78	1096	1140	2.32
Dec. 2 to Dec. 15,	2.50	2.50	2.50	—	8.00	7.00	30.00	—	22.79	1 : 4.34	1140	1165	1.79
Dec. 16 to Jan, 19,	3.50	3.50	3.50	—	7.13	6.14	30.00	—	23.94	1 : 3.99	1165	1238	2.09
Jan. 27 to Mar. 2,	3.00	3.00	3.00	—	—	4.91	—	49.40	21.59	1 : 4.28	1240	1320	2.29

Weight of animal at beginning of experiment,	1020 lbs.
Weight of animal at time of killing,	1328 lbs.
Live weight gained during experiment.	308 lbs.
Average gain in weight per day (entire experiment).	1.90 lbs.
Highest average gain in live weight per day, III. Period,	2.32 lbs.
Lowest average gain in live weight per day, II. Period,	—0.75 lb.

Steer—No. 2.

FEEDING PERIODS.	Feed consumed (pounds) per day. Wheat Bran.	Barley Meal.	Cotton Seed Meal.	Barley Straw.	Hay.	Clover Hay.	Turnips.	Corn Ensilage.	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.
1890-91.													
Oct. 14 to Oct. 25,	3.50	—	3.50	5.83	8.33	—	—	—	18.92	1 : 4.07	980	1008	2.33
Oct. 28 to Nov. 10,	3.50	—	3.50	—	14.82	—	—	—	19.62	1 : 4.00	1018	1012	-0.43
Nov. 13 to Dec. 1,	3.50	—	3.50	—	7.05	7.34	30.00	—	21.86	1 : 3.72	1022	1040	0.95
Dec. 2 to Dec. 15,	2.50	2.50	2.50	—	6.07	5.29	30.00	—	19.64	1 : 4.23	1040	1053	0.93
Dec. 16 to Jan. 19,	3.14	3.14	3.14	—	5.74	4.54	30.00	—	20.41	1 : 4.02	1053	1120	1.91
Jan. 27 to Mar. 2,	3.00	3.00	3.00	—	—	5.23	—	35.50	19.14	1 : 3.93	1125	1155	0.85

Weight of animal at beginning of experiment,	923 lbs.
Weight of animal at time of killing,	1154 lbs.
Live weight gained during experiment,	231 lbs.
Average gain in weight per day, entire experiment,	1.43 lbs.
Highest average gain in live weight per day, I. Period.	2.33 lbs.
Lowest average gain in live weight per day, II. Period.	—0.43 lbs.

SUMMARY OF RESULTS.

1. The rate of increase in live weight was highest during the first winter season, 1889-90. The daily increase in live weight averaged in case of steer 1 to 2.5 pounds, and in the case of steer 2 to 3.3 pounds, for a period of six weeks, when fodder rations II. and III. were fed. The market value of the stated daily increase in live weight, at $3\frac{3}{4}$ cents per pound, would amount to 9.4 cents in case of steer 1, and to 12.4 cents in case of steer 2. As the market cost of these two fodder rations averages 13.8 cents and their net cost 5.03 cents, it will be noticed that the value gained by the stated increase in live weight does in neither case pay fully for the food consumed for its production; yet there remains a noticeable margin of profit on the net cost of the daily feed in form of obtainable manure—i. e., 4.37 cents per day in case of steer 1, and 7.37 cents in case of steer 2.

2. The average of the daily increase in the live weight of the steers during the entire period of pasture feeding amounted, in case of steer 1 to .87 pounds, and in the case of steer 2 to 0.58 pounds. This increase in live weight represents on an average a market value of 3.18 cents in case of the former, and in that of the latter of 2.18 cents. Our expenses for the use of the pasture, per head, was 40 cents per week or 5.7 cents per day. We lost, per head, 3 cents per day, or 21 cents per week on each animal; not counting expenses for transportation to and from the pasture, loss of interest on the investment, etc.

3. The financial results of the second winter feeding are less satisfactory than those secured during the first winter feeding. This fact is due to two circumstances; namely, higher market cost of several coarse and fine fodder articles used and less nutritive effect of the fodder rations experimented with. The daily increase in live weight did at no time exceed 2.33 pounds per head. The market cost of the various daily fodder rations used during the time stated varied from 16.8 cents to 27.48 cents per head, while their net cost differed from 6.85 cents to 15.59 cents. The highest temporary increase in live weight noticed, per day, 2.33 pounds, would realize in our market only 12.37 cents, which amount is still 4.5 cents less than the market cost of the cheapest daily fodder ration, I. Period, used.

The results of the second feeding experiment emphasize the statements made in connection with the report of our first experiment; namely, cheaper and more efficient fodder rations than most of our grasslands—meadows and pastures—can furnish have to be devised to render the production of beef for our meat markets remunerative.

Our observations with growing steers have been continued, and feeding experiments carried on without the assistance of summer pasturing are well advanced.

C. A. GOESSMANN, Director.

Amherst, Mass., October 21st, 1892.

MASSACHUSETTS STATE

AGRICULTURAL EXPERIMENT STATION.

BULLETIN No. 45.

NOVEMBER, 1892.

On Fodder Articles and Fodder Supplies.

1. HOME RAISED FODDER ARTICLES.
2. COMMERCIAL FEED STUFFS.

The fodder articles used in the preparation and compounding of the daily diet of all kinds and conditions of farm live stock are, as a rule, obtained from two distinctly different sources. They are either raised upon the farm and are used usually without any material change in composition; or they are bought in the general market, and are in that case usually the by-products or waste materials of various other branches of industry, as oil works, flour mills, starch works, glucose factories, breweries, etc., etc.

The home raised fodder crops furnish in the majority of cases the coarse fodder constituent of the daily diet, while the waste or by-products of other industries, furnish the fine or grain feed portion of the daily fodder rations. A rational and economical system of stock feeding has assigned to each of these two groups of feed stuffs its proper position in the daily diet of all kinds of farm live stock, with special reference to their general character, adaptation and composition, as well as to good economy and particular efficiency.

A liberal and economical supply of *both classes* of *fodder articles* is to-day recognized as an indispensable requirement of an economical system of stock feeding. To meet our present market condition of the products of the dairy and of the meat supply with any reasonable prospect of a satisfactory compensation for capital invested and labor spent calls, if possible, for cheaper and more efficient fodder rations than in the majority of instances are in current use.

The importance of a serious and careful consideration of the present condition of our fodder supplies, from both above stated sources, forces itself from day to day more, not only upon the attention of every farmer, but of all parties interested in the support of our animal industry.

The controlling influence of the temporary local market cost of some of our most prominent current fodder articles on the cost of the production of milk and meat has been for years pointed out in our bulletins and annual reports in connection with a description of numerous feeding experiments with milch cows, growing steers, lambs and pigs. An examination of our previous statements concerning the influence of the particular kind of feed stuffs used in the composition of the daily fodder rations on the *market cost* as well as on the *net cost* of the feed consumed in the operation cannot fail to show some striking instances proving in a marked degree the previously pointed-out circumstance.

As the fodder for our farm live stock comes from two different sources, of equal importance, as far as variety, economy and efficiency is concerned, it seems but proper to consider our chances for the improvement of our fodder supply under two separate headings, namely:

1. Home Raised Fodder Articles.
2. Commercial Feed Stuffs.

1. HOME RAISED FODDER ARTICLES.

On various previous occasions, and in particular in bulletin No. 36, an attempt was made to show that an increase in the production of cultivated annual fodder crops, aside from Indian corn or maize, will tend to increase in an economical way the general productiveness of our farm lands in case of a mixed system of farm industry. The introduction of a greater variety of reputed fodder crops—in particular of the clover family–Leguminosae, it was stated, would prove with us, as it had proved elsewhere, an efficient means to increase not only in an economical way the general productiveness of our farm lands, but tend to *cheapen the cost of feed* for all kinds of farm live stock. A short abstract from the above-stated Bulletin may suffice on this occasion to show the standpoint assumed in the matter.

" A careful inquiry into the history of agriculture 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 lands 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 gradual 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.

Careful investigations carried on during the past fifty years for the particular benefit of agriculture, have not only been instrumental in recognizing and pointing out 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—grasses—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 the 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 meadows, and rich and extensive pastures, are rather an exception than the rule. The benefits derived from indifferently yielding natural pastures are often 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 but few crops 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 reproduction, while a liberal supply of other equally 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.

Personal local 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 horsebeans 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 cowpea, 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 following 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 9 to 10 tons of green vetch and oats; 10 tons of green southern cowpea; and from 12 to 13 tons of green serradella.

The exceptional exhaustion of our lands in potash has also been shown abundantly by detailed description of experiments with fodder corn in previous annual reports.

Our local results 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.

Such lands prove in many instances, ultimately a far better investment when used for the raising of other fodder crops than grasses.

The less the variety of crops raised in succession upon the same lands, the more one-sided is usually the exhaustion of the soil, and the sooner, as a rule, will be noticed a decrease in their 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 of crops, 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 subsequently 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."

Beleiving in the soundness of the above stated views, it has been for years a special task of our work at the station to investigate upon our farm lands the comparative merits, if any, of a variety of fodder plants, new to our locality and of a fair reputation elsewhere, as may have been noticed in our annual report. From among those fodder plants, which showed a fair degree of adaptation to our soil and climate, we have selected for several years past a few for cultivation on a large scale to increase our fodder supply during the summer and winter season, either as green fodder or in the form of ensilage.

The new crops thus far selected for that purpose are all annual leguminous plants (clover family), as summer vetch, Scotch tares, sojabean, serradella, horsebean and southern cow-pea. These crops can claim a higher nutritive value than the grasses, and they yield in the majority of cases a larger return per acre. They are readily and with advantage introduced into most local systems of rotation; they tend to increase materially the nitrogen resource of the soil they are raised on, in an economical way; besides improving the physical and chemical conditions of the soil in various directions.

One of the principal aims in the cultivation of fodder crops of every description ought to be, an increase of their nitrogen containing organic constituents as far as practicable. This result is of special interest in the dairy industry—for milch cows, among full-grown animals, require an exceptionally nutritious diet to do their best.

No class of farm crops show in a more marked degree the influence of a liberal use of manure. Both the quantity and quality of these crops are materially improved, when raised upon lands in a fair state of fertility. Exhausted lands produce invariably an inferior quality of fodder crops of its kind, as far as the amount of their nitrogen containing organic constituents are concerned. *A liberal production of nutritious annual fodder crops of the right kind improves our chances of supporting more farm live stock; tends to increase our supply of home-made manure, and ultimately becomes the chief reliance of a remunerative mixed farm industry.*

Our trials on a small scale with new fodder crops during the past year include the following:

Summer vetch,
Sojabean,
Bokhara clover,
Sanfoin,
Horsebean,
Cow pea,
Yellow Trefoil,
Serradella,
Prickly comfrey,
Flat-pea or Lathyris sylvestris,
Kidney vetch,
Blue lupine,
Yellow lupine,
White lupine,
Silver-hull buckwheat,
Japanese buckwheat,
Common buckwheat,
Summer rape,
Winter rape,
Artichoke (Jerusalem),
Sugar beet.

Several of the above enumerated more or less reputed fodder plants have been for some years past successfully cultivated upon the fields of the station, as may have been noticed from previous communications. Some of them have been raised again during the past season on a becoming scale to increase our fodder supply for milch cows, etc., as green fodder during summer and autumn, and as ensilage during winter and spring. A summary of our results may be noticed in the following tabular statement; further details are reserved for the coming annual report. The estimate in regard to meadow growth is based on the results obtained by us on exceptionally good grass land (two tons of first cut and one ton of second cut hay). The annual average yield of meadows, for the entire state does not much exceed one ton of hay.

CROP.	Yield per acre. (Tons)	Dry Matter Per cent.	Dry Matter per acre. (Pounds)	Per cent of Nitrogen in Dry Matter. (Pounds)	Nitrogen per acre. (Pounds)
Fodder corn, (kernels glazing)	18	31.47	11329	1.02	116
Serradella,	12	17.97	4313	2.42	104
Vetch and Oats,	8.05	17.98	2894	2.68	78
Soja bean,	11.1	26.80	5949–	1.19	71–
Hay,	2	87.72	3509	1.64	58
Rye,	7	37.89	4406	.85	37
Peas and Oats,	5	13.68	1368	2.63	36
Rowen,	1	89.79	1795	2.00	36
Hungarian, (second crop after rye)	2.5	25.69	1285	1.50	18

Rye, vetch and oats, peas and oats, part of soja bean, of corn and of serradella, have been fed as green fodder, and the remainder of green corn and soja bean, serradella and Hungarian, are on hand in silos as mixed ensilage for winter use.

2. COMMERCIAL FEED STUFFS.

The name commercial feedstuff or concentrated commercial feedstuffs is usually applied to a class of substances offered for sale in our markets, which in the majority of cases are the waste or by-products of other branches of industry. Some of these articles as brans, middlings and oilcakes have been for years quite generally used in the daily diet of all kinds of farm livestock; others as the gluten meal, gluten feed, corn germ meal, dried brewer's grain, malt sprouts, etc. are but recently more generally offered for a similar purpose.

Their importance as an additional valuable fodder supply for the support of every branch of animal industry on the farm and elsewhere has become from year to year more conspicuous, on account of a marked increase of the supply of well-known articles as well as of the introduction of many new kinds. Their consumption is apparently daily increasing and seems to keep step with the supply.

The special value claimed for commercial feedstuffs as an important source of fodder supply rests in the main on their fitness to supplement advantageously our coarse home-raised fodder crop in the interest of a higher feeding effect and of a better economy. A frequently good mechanical condition as well as an exceptionally valuable chemical composition adapt many of them in a high degree for that purpose.

As no single farm crop or any part of them has been found to supply economically and efficiently to any considerable extent the particular wants of food of our various kinds of farm livestock to secure the best possible results, it becomes a matter of first importance from a mere financial standpoint to know how to supplement our current farm crops—to meet the wants of each kind of animals under various circumstances in a desirable degree. To secure the highest feeding effect of each fodder article raised upon the farm is most desirable in the interest of good economy.

Practical experience in the dairy has thus far abundantly shown that the efficiency of a daily diet does not so much depend on the mere use of more or less of one or the other reputed fodder article, than on the presence of suitable fodder articles,—which contain the *three essential groups of food constituents*,—i. e. *organic nitrogenous, non nitrogenons and mineral constituents of plants*, in a desirable form, and in such relative proportions and quantities as have been recognized to be necessary to meet efficiently the food supply of the dairy-cow. Similar relations are known to exist in regard to the diet best adapted in case of all kinds of animals. *An econominal system of stock feeding has to select among the suitable fodder articles those which furnish the required quality and proportion of the three recognized essential food constituents in a digestible form—at the lowest cost.*

Actual observations in stock feeding fully confirm the correctness of the above statement, that a judicious selection from among the current commercial feedstuffs for the purpose of serving in connection with one or more of our home-raised fodder plants as a fodder ingredient of the daily diet does, as a rule, tend not only to improve their food value, but also lowers in the majority of cases the net cost of the feed consumed. For more details regarding the determination of the intrinsic value of fodder rations I have to refer on the present occasion for obvious reasons to preceding annual reports.

The majority of commercial feed stuffs occupy in a rational system of stock-feeding a similar position to our home raised fodder crops, as is commonly conceded to the Commercial fertilizer, with reference to the barnyard manure for the production of farm crops; they serve for the preparation of a complete diet under different conditions and for different purposes. The individual merits of each of them becomes in the same degree better appreciated, as the principles, which govern animal nutrition are *more generally* understood, and *find a due recognition* in our modes of compounding the daily diet for different kinds as well as for different conditions of the same kind of animals. *They are, as a class, to-day, considered indispensable for a remunerative management of every branch of animal industry on the farm and elsewhere.*

Many of the commercial feed stuffs contain; aside from a liberal amount of phosphoric acid and potash; an exceptionally large percentage of nitrogen. This circumstance gives them a special claim, independent of their respective food value for animals. A liberal addition of these feed stuffs to the daily diet of any kind of animal imparts to the manurial refuse, resulting from their use, a corresponding higher commercial and agricultural value as a valuable source of plant food. A judicious and liberal introduction of a quite numerous class of commercial feed stuffs into the daily fodder supply of the animals kept on the farm is for this reason *deservedly* recommended as a safe and economical way to increase the home production of plant food in the interest of an increase in the fertility of the farm lands.

As the financial success of a mixed system of farming in particular depends to a considerable degree on the character, the amount and the cost of production of the manurial refuse secured in connection with the special farm industry carried on at the time, it seems to need no farther argument to prove that the relation, which exists between the temporary *market cost* of the particular feed stuff under consideration, and the *market value* of the manurial elements, which it contains, deserves a serious consideration, when devising an efficient and at the same time an economical diet.

The character and commercial value of the manurial refuse obtainable from any kind of feed stuff, under otherwise corresponding conditions, stands in a direct relation to more or less of the different essential fertilizing constituents—phosphoric acid, potash, and in particular, nitrogen—it contains. The commercial value of these three important articles of plant food found frequently in prominent commercial feed stuffs equals in many instances more than one-half of the market cost of the particular fodder ingredient in question.

The subsequent tabular statement may serve as an illustration of these relations between market cost and fertilizing value of some current reputed fodder articles :

Name of Feed Stuff.	Their contemporary Market cost (per ton)	Manurial value (per ton)
Corn meal,	$24.00	$ 7.31
Gluten meal, (Chicago)	28.00	14.72
Chicago maize feed,	25.00	13.25
Buffalo gluten feed,	23.00	12.57
Cotton seed meal,	28.00	23.52
Linseed meal, (old process)	26.00	19.22
Linseed meal, (new process)	27.00(?)	20.37
Wheat middlings,	17.00	9.50
Wheat bran,	17.00	13.23
Dried brewer's grain,	23.00	9.96
English hay, (first cut of meadows)	15.00	5.92
Rowen, (second cut of meadows)	15.00	7.00
Corn fodder,	7.00	4.55

Name of Feed Stuff.	Their contemporary Market cost (per ton)	Manurial value (per ton)
Corn stover,	5.00	3.75
Corn ensilage,	2.50	1.53
Sugar beets,	5.00	1.21
Mangold roots,	4.00	1.01

The above stated market cost is subject to periodical changes; and the commercial value of their fertilizing constituents varies more or less with the quality of each kind. This feature does not affect materially the force of the point made.

A due appreciation of the previously pointed out favorable features regarding the peculiar character of a numerous class of commercial feed stuffs has caused a steady increase in their consumption on the farm and elsewhere. *The money invested by farmers for securing commercial feed stuffs as an additional food supply for home consumption, exceeds to-day many times the amount spent for commercial fertilizers.*

As no single commercial feed stuff can be expected to meet our present demand for these articles, nor can claim to be the most economical one under varying market conditions, and with due appreciation of the varying character of our home raised fodder supply, it is but proper that every new addition in suitable kinds should receive a deserved attention, and subsequently an actual trial to ascertain their individual merits.

A considerable number of these feed stuffs have already been tried at this station during past years in connection with our feeding experiments with milch cows, growing steers, lambs, and pigs, as may have been noticed in our periodical reports; others are at present on trial. The articles used on those occasions were, as a rule, bought in the general market. A still larger number of different kinds have been analyized by us at the request of farmers and dealers in feed stuffs; the samples were usually sent on for that purpose. In regard to the former there can be no reasonable doubt about their identity; as far as the latter are concerned, the responsibility of furnishing fair representative samples rests in some instances with the parties asking for the analyses.

The results of our analyses of commercial feed stuffs are embodied in the subsequent tabular statement. The record of the analyses is here purposely confined to the extremes noticed, as far as the percentage of *fat* and *nitrogen containing* organic matter or crude protein are concerned, to engage a special attention in that direction.

NAME.	Analyses.	Dry Matter. %			Dry Matter contains: Protein, per cent.			Fat, per cent.		
		Max.	Min.		Max.	Min.		Max.	Min.	
*Corn Meal,	29	89.95	82.96	–	15.57	9.73	–	5.08	3.10	-
*Gluten Meal (Chicago)	22	93.50	68.32	–	39.28	25.94	–	12.05	3.92	–
*Gluten Feed (Buffalo)	3	93.19	91.03	–	31.05	26.16	–	18.46	11.73	-
Dick Gluten Flour,	1	–	–	92.93	–	–	33.89	–	–	17.11
Corn Germ Meal,	1	–	–	90.65	–	–	28.26	–	–	11.82
*Maize Feed (Chicago)	3	91.40	90.25	–	29.40	21.33	–	7.90	6.15	–
Dick Gluten Feed,	1	–	–	91.01	–	-	8.51	–	–	2.26
Corn Screenings,	1	–	–	88.98	–	–	8.29	–	–	4.48
Starch Feed,	1	–	–	42.96	–	–	22.41	–	–	10.17
Corn Gluten Meal,	1	–	–	92.13	–	–	25.03	-	–	10.48
Corn Germ Feed,	1	–	–	92.45	–	–	10.81	–	–	12.17
Hominy Meal,	4	91.89	88.68	–	11.88	6.77	–	12.22	4.89	–
*Wheat Kernels,	1	–	–	89.42	–	–	13.35	–	–	1.79
*Wheat Bran,	35	92.58	86.30	–	20.54	15.67	–	6.08	2.80	–
*Wheat Middlings,	6	90.65	87.57	–	19.21	15.13	–	6.46	3.19	
*Rye Bran,	2	91.82	86.30	–	18.98	16.52	–	3.03	2.07	–
*Rye Middlings,	1	–	–	87.46	–	–	13.15	–	–	5.61
*Ground Barley,	4	89.09	82.59	–	14.93	10.42	–	2.38	1.69	–
*Spent Brewer's Grain,	4	93.02	88.00	–	33.16	16.08	–	6.29	1.95	–
Malt Sprouts,	1	–	–	84.63	–	–	27.17	–	–	3.85
Oat Feed,	1	–	–	90.66	–	–	14.06	–	-	8.23
Buckwheat Middlings,	1	–	–	88.49	–	–	25.49	–	–	7.53
*Cottonseed Meal,	19	94.31	88.81	–	51.79	36.54	–	14.72	9.47	–
Cotton Hulls,	2	89.83	88.55	–	5.36	4.99	-	4.27	2.36	–
*Linseed Cake, O. P.,	7	92.52	88.50	–	39.97	30.98	–	9.87	6.24	–
*Linseed Cake, N. P.,	5	94.91	88.17	-	41.02	35.30	–	4.08	2.17	–

Articles marked * have been bought in the market, or were raised on the land of the station, and there can be no reasonable doubt about fair sampling. The remainder was sent on with name recorded above. Complete records of analysis will be published in our next annual report.

A careful examination of the preceding partial analyses of current commercial feed stuffs cannot fail to show *the existence of most serious variation in the amount of the two most costly food constituents —in case of the same kind.* The differences noticed in that direction affect in many instances in a marked degree, both the food value of the particular article, as well as its comparative money value. Some of these variations may be due to differences in the processes at the time employed in the parent industry. *The fact that the majority of this class of feed stuffs are waste or by-products of other industries renders them in an exceptional degree liable to changes in composition. This feature in their production deserves a most careful consideration from a financial point of view, on the part of the buyer.*

Commercial feed stuffs are usually bought for their high percentage of either nitrogen containing organic matter, or fat, or both. They are used to enrich the daily diet of various kinds of farm live stock in both directions. This course is generally adopted on account of a well known deficiency of most of our home raised coarse fodder articles in regard to both food constituents—in particular of nitrogenous matter. 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.

The liability of pecuniary losses on the part of the buyer, in consequence of exceptional variations in the percentage of nitrogenous organic matter, crude protein, or fat, or of both is quite frequently greatly aggravated by most unexpected serious fluctuations in the market cost of leading feed stuffs.

As we buy, in the majority of cases, the concentrated commercial feed stuffs on account of their large proporton of nitrogen-contaming food constituents, it becomes of special interest to know at what cost a *given quantity of 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 and which therefore needs not to be secured from outside resources for cash.

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 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.

Prices are apt to rise and to fall without any reference to the agricultural value of the article in question.

Names may remain the same, and in fact do remain in some instances, while the composition of the article suffers serious changes in consequence of changes in the parent industry.

Sales without due responsibility regarding the particular quality of the goods delivered leaves the pecuniary risk involved in the transaction in an objectionable degree on the side of the buyer.

Unaccounted-for variations in the composition of feed stuffs must prove a serious obstacle in the desirable introduction of a rational and economical system of stock-feeding.

For these and other reasons previously pointed out it cannot be claimed that the prevailing mode of selling and buying commercial feed stuffs rests on a just and fairly equitable basis.

The trade in commercial feed stuffs is to-day in a similar unsatisfactory condition as was the trade in commercial fertilizers before the introduction of a system of state inspection in regard to those articles.

The generally conceded success of the introduction of a well regulated system of state inspection in regard to commercial fertilizers seems to suggest the adoption of a similar course with reference to the trade in commercial feed stuffs.

The best interests of both manufacturers and farmers,—in fact of everyone who keeps livestock for his accommodation, render such changes desirable in the present mode of selling and buying feed stuffs, as will impose mutual and equitable responsibility on all parties interested in the transaction. The limited margins for profit in every branch of animal industry carrried on at our farms necessitates a careful attention to all the details of the business. The money interests involved are of an exceptional magnitude.

A due consideration of the present condition of our trade in commercial feed stuffs has induced the Board of Control of the Mass. State Agricultural Experiment Station to request the writer to present the subject once more to the consideration of all parties interested; and to invite their coöperation in devising suitable means to secure a fair degree of mutual responsibility on the part of all parties interested in the trade and the consumption of commercial feed stuffs.

C. A. Goessmann, Director.

Amherst, Mass.,

November 21st, 1892.

Bulletin no. 46 was never published. This number
has been given to the following publications —
Analyses of commercial fertilizers, Nov. 1892.
Circular on " " , Mar. 1893.

MASSACHUSETTS STATE

Agricultural Experiment Station.

Analyses of Commercial Fertilizers.

NOVEMBER, 1892.

I.

ANALYSES OF COMMERCIAL FERTILIZERS AND MANURIAL SUBSTANCES SENT ON FOR EXAMINATION.

844. HORN SHAVINGS.

Sent on from Leominister, Mass.

	Per Cent.
Moisture at 100° C.,	4.83
Ash,	.67
Phosphoric acid,	.42
Nitrogen,	15.31
Insoluble matter,	Trace

845-846. I. PINE NEEDLES.
II. PINE BARREN GRASS.

Sent on from Springfield, Mass.

	Per Cent.	
	I.	*II.*
Moisture at 100° C.,	9.48	8.48
Ash,	3.42	2.40
Phosphoric acid,	.12	.18
Potassium oxide,	.03	.07
Nitrogen,	.36	.10
Insoluble matter,	1.22	1.07

847. TOBACCO LEAF.

Sent on Whately, Mass.

	Per Cent.
Moisture at 100° C.,	13.05
Ash,	21.01
Potassium oxide,	7.24
Calcium oxide,	4.17
Magnesium oxide,	2.17
Ferric and aluminic oxides,	.32
Phosphoric acid,	.43
Nitrogen,	2.75
Insoluble matter, (before calcination)	4.17

II.

ANALYSES OF COMMERCIAL FERTILIZERS COLLECTED DURING 1892, IN THE GENERAL MARKETS BY THE AGENT OF THE MASSACHUSETTS STATE AGRICULTURAL EXPERIMENT STATION.

LABORATORY NO.	NAME OF BRAND.	NAME OF MANUFACTURER.	SAMPLED AT
	Compound Fertilizers.		
6	A. A. Ammoniated Superphosphate,	H. J. Baker & Bro., New York, N. Y.,	Northampton.
11	Fish and Potash,	Williams & Clark, Boston, Mass.,	Northampton.
14	Mapes' Grass and Grain, Spring Top Dressing,	Mapes Formula & Peruvian Guano Co., New York, N. Y.	Northampton.
20	Chittenden's Complete Fert. for Pot,. Roots and Veg.,	National Fertilizer Co., Bridgeport, Ct.,	Northampton.
22	Stockbridge Special Potato Manure,	Bowker Fertilizer Co., Boston, Mass.,	Springfield.
25	A. A. Ammoniated Superphosphate,	H. J. Baker & Bro., New York, N. Y.,	Springfield.
29	Hill and Drii Phosphate,	Bowker Fertilizer Co., Boston, Mass.,	Worcester.
38	Bradley's Potato Manure,	Bradley Fertilizer Co., Boston, Mass.,	No. Amherst.
53	Stockbridge Manure for Potatoes and Vegetables,	Bowker Fertilizer Co., Boston, Mass.,	Sunderland.
55	Hill and Drill Phosphate,	Bowker Fertilizer Co., Boston, Mass.,	Sunderland.
69	Williams & Clark's Corn Phosphate (Americus Brand),	Williams & Clark, Boston, Mass.,	Amherst.
70	Ammoniated Bone Phosphate (No. 1),	Leander Wilcox, Mystic, Conn.,	Amherst.
77	Ground Scrap,	Ellsworth, Tuthill & Co.,	Holyoke.
95	Chittenden's Comp. Fertilizer for Roots, Pot. and Veg.,	National Fertilizer Co., Bridgeport, Ct.,	Pittsfield.
99	Tobacco Fertilizer,	Quinnipiac Co., Boston, Mass.,	So. Deerfield.
135	Ammoniated Bone Superphosphate,	Crocker Fertilizer & Chemical Co., Buffalo, N. Y.,	Amherst.
137	Vegetable Bone Superphosphate,	Crocker Fertilizer & Chemical Co., Buffalo, N. Y.,	Amherst.
143	Manure for Light Soils,	Mapes Formula & Peruvian Guano Co., New York, N. Y.	So. Deerfield.
145	Gloucester Fish and Potash,	Bowker Fertilizer Co., Boston, Mass.,	Amherst.
149	Fine Wrapper Tobacco Manure,	Williams & Clark, Boston, Mass.,	Greenfield.
152	Complete Manure for Corn and Grain,	Bradley Fertilizer Co., Boston, Mass.,	Greenfield.
155	Samson Fertilizer,	Read Fertilizer Co., Syracuse, N. Y.,	Gardner.
159	Vegetable Bone Superphosphate,	Crocker Fertilizer and Chemical Co., Buffalo, N. Y.,	Fitchburg.
162	English Lawn Dressing,	Bradley Fertilizer Co., Boston, Mass.,	Lowell.
163	Farmer's New Method Fertilizer,	Bradley Fertilizer Co., Boston, Mass.,	Lowell.
165	Cumberland Potato Fertilizer,	Cumberland Bone Phosphate Co., Portland, Me.,	Lowell.
182	Ground Fish,	E. Frank Coe, New York, N. Y.,	Hadley.
185	Chittenden's Comp. for Potatoes, Roots and Vegetables,	National Fertilizer Co., Bridgeport, Ct.,	Hadley.
186	Farm and Garden Phosphate,	Bowker Fertilizer Co., Boston, Mass.,	Northampton.
187	Square Brand Fish and Potash,	Bowker Fertilizer Co., Boston, Mass.,	Northampton.
194	Havana and Seed Le[illegible] Tobacco Fertilizer,	Quinnipiac Fertilizer Co., Boston, Mass.,	Northampton.
201	Extra Bone Phosph[illegible]	L. B. Darling Fertilizer Co., Pawtucket, R. I.,	Amherst.

Laboratory Number.	Name of Brand.	Moisture.	Nitrogen in 100 lbs. Found.	Nitrogen in 100 lbs. Guaranteed.	Phosphoric Acid in 100 lbs. Soluble.	Reverted.	Insoluble.	Total. Found.	Total. Guaranteed.	Available. Found.	Available. Guaranteed.	Potassium Oxide in 100 lbs. Found.	Potassium Oxide in 100 lbs. Guaranteed.
	Compound Fertilizers.												
6-25	A. A. Ammoniated Superphosph'te,	16.42	3.08	2.47-3.30	7.93	3.12	—	11.05	11-15	11.05	10-12	3.66	2-3
11	Fish and Potash, ...	18.92	3.46	3.30-4.12	3.07	2.22	2 51	7.80	6-8	5.29	3-5	3.48	3-5*
14	Mapes' Grass and Grain Spring Top Dressing, ...	11.27	5.00	4.12-5.77	5.88	1.93	1.15	8.96	7-9	7.81	5-7	6.68	5-7
20-95-185	Chittenden's Complete Fertilizer for Potatoes, Roots & Vegetables,	8.52	3.98	3.30-4.12	3.71	5.12	2.56	11.39	8-10	8.83	6-8	6.66	6-8
22	Stockbridge Special Potato Manure,	11.15	3.70	3.25-4.25	4.81	3.74	2.66	11.21	8-10	8.55	7-8	6.68	5-6
29-55	Hill and Drill Phosphate, ...	14.10	2.72	2.50-3.25	5.88	5.12	1.92	12.92	12-14	11.00	8-10	1.95	2-3
38	Bradley's Potato Manure, ...	13.49	3.00	2.50-3.25	2.97	3.32	3.28	9.57	8-11	6.29	6-8	5.41	5-6*
53	Stockbridge Manure for Pot. & Veg.	10.85	3.36	3.25-4.25	5.09	2.82	2.58	10.49	8-10	7.91	7-8	6.93	5-6
69	Williams and Clark Corn Phosph'te,	14.47	2.48	2.06-2.88	6.52	2.95	1.92	11.39	10.50-14	9.47	9-12	2.13	1.50-2.50*
70	Ammoniated Bone Phosphate No. 1,	15.95	3.27	2.50-3.50	3.20	2.55	2.05	7.80	7-8	5.75	6-7	5.25	5-6
77	Ground Scrap, ...	9.45	9.21	8.24	.13	3.58	3.20	6.91	6	3.71	—	—	—
99	Tobacco Fertilizer, ...	7.00	6.53	3.30-4.12	1.66	3.07	1.92	6.65	9-13	4.73	8-11	10.83	7-8*
135	Ammoniated Bone Superphosphate,	14.15	3.71	2.90-3.70	9.59	1.66	.90	12.15	11-14	11.25	10-12	1.93	1-2*
137-159	Vegetable Bone Superphosphate, ..	13.65	5.24	5-6	5.38	1.28	1.02	7.68	7-9	6.66	6-7	8.48	6-8*
143	Manure for Light Soils, ...	9.97	4.90	4.94-6.59	4.96	2.54	[illegible]	9.67	8-10	.50	6-8	6.77	6-8
145	Gloucester Fish and Potash, ...	11.26	.94	.82-1.65	8.98	1.21	[illegible]	15.15	9-11	10.19	6-9	3.71	1-2*
149	Fine Wrapper Tobacco Grower, ...	7.45	5.54	5.77-6.59	1.43	2.48	2.05	5.96	6-9	3.91	5-7	11.97	10-12*
152	Complete Manure for Corn & Grain,	12.82	3.12	2.89-3.91	6.27	3.06	1.54	10.87	9-12	9.33	8-10	4.02	3-4*
155	Samson Fertilizer, ...	15.45	2.42	2.47-3.30	6.66	1.79	.51	8.96	9-12	8.45	8-10	6.20	5.6*
162	English Lawn Dressing, ...	8.72	5.35	4.95-5.70	2.04	3.34	1.02	6.40	6-9	5.38	5-7	4.63	2.50-3.50*
163	Farmers' New Method Fertilizer, ..	14.07	1.30	.82-1.65	5.62	2.96	2.30	10.88	10-12	8.58	8-10	3.80	2.16-3.24*
165	Cumberland Potato Fertilizer, ...	13.05	2.52	2.06-2.88	7.42	2.82	1.15	11.39	11-13	10.24	9-11	4.80	3-4*
182	Ground Fish, ...	10.57	8.32	8.24-9.06	.51	3.20	3.33	7.04	—	3.71	—	—	—
186	Farm and Garden Phosphate, ...	13.42	1.93	2-3	5.01	3.63	1.59	10.23	10-12	8.64	8-10	2.73	2-3
187	Square Brand Fish and Potash, ...	3.85	1.92	2.25-3.25	5.04	1.64	5.68	12.36	8-10	6.68	—	4.83	4-6
194	Havana & Seed Leaf Tobacco Fert.,	7.17	5.98	5.77-6.59	4.86	.64	.77	6.27	6-9	5.50	5-7	11.87	10-12*
201	Extra Bone Phosphate, ...	14.75	2.76	2.47-3.30	4.73	2.94	4.61	12.28	10-12	7.67	7-9	4.46	3-5

*Sulphate of Potash, the source of Potash.

TRADE VALUES
OF FERTILIZING INGREDIENTS IN RAW MATERIALS AND CHEMICALS.

	1892. *Cents per pound.*
Nitrogen in ammoniates,	17½
" " nitrates,	15
Organic nitrogen in dry and fine ground fish, meat, blood,	16
" " " cotton-seed meal and castor pomace,	15
" " " fine ground bone and tankage,	15
" " " fine ground medium bone and tankage,	12
" " " medium bone and tankage,	9½
" " " coarser bone and tankage,	7½
" " " hair, horn-shavings and coarse fish scraps,	7
Phosphoric acid soluble in water,	7½
" " soluble in ammonium citrate,	7
" " in dry ground fish, fine bone and tankage,	7
" " in fine medium bone and tankage,	5½
" " in medium bone and tankage,	4½
" " in coarse bone and tankage,	3
Potash as High Grade Sulphate, and in forms free from Muriate or Chlorides, Ashes, etc.,	5½
" " Kainite,	4½
" " 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, 16 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, 1892, 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.

The Bulletins of the Experiment Station will be sent free of charge to all parties interested in its work, on application.

C. A. GOESSMANN, *Director.*

Amherst, Mass., Nov. 25, 1892.

Carpenter & Morehouse, Printers, Amherst, Mass.

MASSACHUSETTS STATE

AGRICULTURAL EXPERIMENT STATION.

MARCH, 1893.

CIRCULAR

—ON—

COMMERCIAL FERTILIZERS.

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 mode prescribed by the laws of our State for the regulation of the trade in Commercial Fertilizers, 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 the amount of their principal constituents found present, 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 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. nor to the particular form in which the different guaranteed essential articles of plant food are best adapted.

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, 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 50 to 100 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.

	1893. *Cents per Pound.*
Nitrogen in ammonia salts,	17
" " nitrates,	15½
Organic nitrogen in dry and fine ground fish, meat, blood, and in high-grade mixed fertilizers,	17½
" " " cotton-seed meal, linseed meal and castor pomace,	16½
" " " fine bone and tankage,	15

" " " fine medium bone and tankage,	12
" " " medium bone and tankage,	9
" " " coarse bone and tankage,	7
" " " hair, horn-shavings, coarse fish scraps,	7
Phosphoric acid soluble in water,	6½
" " soluble in ammonium citrate,	6
" " in fine bone and tankage,	6
" " in fine medium bone and tankage,	5
" " in medium bone and tankage,	4
" " in coarse bone and tankage,	3
" " in fine ground fish, cotton-seed meal, linseed meal, castor pomace and wood ashes,	5
" " insoluble (in am. cit.) in mixed fertilizers,	2
Potash as high-grade sulphate and in mixtures free from muriate,	5½
" " muriate,	4½

The manurial constituents contained in feedstuffs are valued as follows:

Organic Nitrogen,	17½
Phosphoric acid,	5
Potash,	5½

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, 17½ 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, 1893, 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 1st, plus about 20 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.

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 $10 or more per ton of 2000 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 should be addressed to the Director of the Mass. 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 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 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.

ANALYSES OF COMMERCIAL FERTILIZERS AND MANURIAL SERVICES SENT ON FOR EXAMINATION.

848—851. WOOD ASHES.

I. Sent on from Marblehead, Mass.
II. Sent on from Westminister, Vt.
III. Sent on from South Sudbury, Mass.
IV. Sent on from South Deerfield, Mass.

	Per Cent.			
	I.	*II.*	*III.*	*IV.*
Moisture,	18.06	6.51	4.80	4.67
Potassium oxide,	4.17	5.27	3.42	2.12
Calcium oxide,	24.68	38.92	43.40	49.36
Phosphoric acid,	.79	1.23	1.71	.61
Insoluble matter, (before calcination,)	27.66	21.09	10.51	5.63
Insoluble matter, (after calcination,)	25.08	19.32	9.02	4.04

852—854 WOOD ASHES.

I and II. Sent on from Concord, Mass.
III. Sent on from Concord, Mass.

	Per Cent.		
	I.	*II.*	*III.*
Moisture,	11.39	7.87	15.40
Potassium oxide,	8.39	5.56	7.73
Calcium oxide,	33.05	37.93	34.27
Phosphoric acid,	1.74	.74	1.13
Insoluble matter, (before calcination,)	16.11	19.02	12.45
Insoluble matter, (after calcination,)	14.27	17.64	11.11

855. LOGWOOD ASHES.

Sent on from Boston, Mass.

	Per Cent.
Moisture,	.55
Potassium oxide,	.26
Calcium oxide,	58.28
Magnesium oxide,	1.46
Ferric and aluminic oxides,	1.46
Phosphoric acid,	.70
Carbonic acid,	32.95
Insoluble matter,	3.09

856. ASHES FROM CREMATION OF SWILL.

Sent on from Lowell, Mass.

	Per Cent. I.	II.	III.	IV.
Moisture,	.51	.07	.04	0.11
Calcium oxide,	24.79	28.18	33.74	47.60
Magnesium oxide,	1.87	—	—	—
Ferric and aluminic oxides,	3.57	7.63	6.25	1.06
Potassium oxide,	1.73	8.83	7.03	1.25
Phosphoric acid,	16.61	17.18	26.09	32.26
Insoluble matter, (before calcination,)	39.60	18.49	14.40	15.13
" " (after calcination,)	29.72	16.53	11.41	13.20

857—859.

I. Double Superphosphate.
II. Phosphate of Ammonia.
III. Phosphate of Potash.

Sent on from New York City.

	Per Cent. I.	II.	III.
Moisture,	5.74	6.05	3.76
Potassium oxide,	—	—	32.56
Calcium oxide,	16.00	not det.	not det.
Soluble phosphoric acid,	38.38	—	—
Reverted " "	9.04	—	—
Insoluble " "	.38	—	—
Total " "	47.80	43.86	35.70
Sulphuric acid,	1.19	12.46	13.43
Nitrogen,	—	10.37	—
Insoluble matter,	.60	.82	.92

860—861. GROUND BONE.

I. Sent on from New Bedford, Mass.
II. Sent on from Peabody, Mass.

	Per Cent. I.	II.
Moisture,	5.94	4.62
Soluble phosphoric acid,	.32	.52
Reverted " "	15.16	18.23
Insoluble " "	9.85	6.93
Total, " "	25.33	25.68
Nitrogen,	2.96	2.18
Insoluble matter,	1.02	—

The Bulletins of the Experiment Station will be sent free of charge to all parties interested in its work, on application.

C. A. GOESSMANN, *Director.*

Amherst, Mass., Mar. 31, 1892.

Carpenter & Morehouse, Printers, Amherst, Mass.

MASSACHUSETTS STATE

AGRICULTURAL EXPERIMENT STATION.

BULLETIN NO. 47.

MAY, 1893.

Meteorological Summary.

January, February, March and April, 1892–1893.

	Jan. 1892.	Jan. 1893.	Feb. 1892.	Feb. 1893.	March, 1892.	March, 1893.	April, 1892.	April, 1893.
Mean temperature,	23.55	14.48	25.69	21.57	31.00	29.59	45.50	41.90
Highest temperature.	55.00	50.00	46.50	49.00	59.00	48.00	76.00	66.00
Lowest temperature,	-10.00	-13.00	-8.00	-6.00	5.00	3.00	22.00	20.00
Mean range,	19.45	19.68	14.21	19.00	17.40	18.61	24.30	20.06
Total precipitation,	2.05	2.70	1.59	5.55	2.45	3.62	.65	3.66
Total snow fall (in.)	13.00	13.25	14.00	48.00	7.00	3.00	—	7.00
Depth of snow, 15th	8.50	3.00	15.00	7.00	—	in spots	—	—
Depth of snow at end,	2.00	7.00	2.00	15.00	—	..	—	..
Prevailing wind,	N.N.E	N.W.	N.N.E	N.W.	N.W.	N.	N.W.	N.W.

The total snowfall during the above four months (1893) amounted to 71.25 inches, being 37.25 inches greater than that during the same period last year. The greater part fell in February.

The heaviest snow storm of the season occurred February 22d, giving 17 inches of snow.

The mean temperature for the month of April (1893), was from two to three degrees below the average for that month; the spring season is somewhat backward.

Feeding Experiment with Pigs.

BY J. B. LINDSEY.

The following experiment is a continuation of those described in previous reports of the Station. In our experiments with milch cows we have had considerable quantities of skim milk remaining after the removal of the cream, and the question has ever been as to how this milk shall be disposed of *to the best advantage*. This question is one that confronts many of the farmers of our state, from the fact that the creamery system is so generally introduced. Some farmers living near large towns have opportunity to dispose of this milk at from one to two cents per quart, and it is undoubtedly more profitable to thus dispose of it than to feed it to our farm animals. Still, to by far the larger number of farmers this opportunity does not present itself, and the milk must be utilized upon the farm by feeding it to pigs or other animals.

OBJECT OF THIS EXPERIMENT.

The results of our previous experiments have shown that the various grains such as corn meal, wheat bran, gluten meal and maize feed, when fed in connection with skim milk, have furnished very excellent and profitable rations for growing young pigs for the market.

The object of this experiment has been, among other things, to learn the value of gluten feed and corn meal when fed in connection with skim milk for the economical production of pork for the market.

The skim milk being a very nitrogenous article of food, with a nutritive ratio of 1 to 2.15, the rations furnished the pigs were what might be termed narrow, varying from 1 : 3.3 to 1 : 5. Whether a narrow or a wide ration is better for growing and fattening pigs is still a matter of some dispute among investigators. It is certain, however, that the rations fed in our various experiments with pigs have been productive of most excellent results, and we can commend them to the serious attention of the farmers of the state.

DESCRIPTION OF THE EXPERIMENT.

Six grade Chester white pigs, three sows and three barrows, weighing from 25 to 30 pounds each, served us for the experiment. They were kept in separate pens, and fed three times per day, namely in the morning at six o'clock, at noon, and in the afternoon at five o'clock, with all the food they would eat up clean. It was always our object to supply them plentifully, but at the same time not to glut them, and thus in a measure destroy their appetites.

The liquid food consisted of from three to six quarts of skim milk per day, depending upon the size of the pigs and the quantity of milk at our disposal. It never exceeded six quarts per day. The grain fed was corn meal and gluten feed. The gluten feed being quite rich in protein, served to keep our rations within the limits desired when the supply of skim milk failed, and four ounces of gluten feed was in a general way reckoned equal to one quart of skim milk.

NUMBER OF FEEDING PERIODS.

The experiment was divided into three distinct feeding periods. The first period continued till the pigs reached 80 pounds in weight, and the food consisted of two ounces of corn meal to every quart of milk with a ratio of 1 : 3.3. As our supply of milk at this season was rather limited, four ounces of gluten feed was substituted for each quart of milk, and this gradually increased the ratio to 1 : 4.

The second period began when the pigs reached about 80 pounds in weight and continued till 125 pounds weight was reached. The food consisted of the skim milk at our disposal, which varied somewhat, together with corn meal and gluten feed to give the desired ratio of 1 : 4.5.

The third and last period began when the pigs weighed 125 pounds and ended when 180 pounds was reached, at which time they were slaughtered. The feed consisted of skim milk, and of a mixture of one and one-half parts corn meal and one part gluten feed, fed in sufficient quantities to satisfy the appetite of the animals.

The pigs were sold at $7\frac{1}{4}$ cents per pound of dressed weight, and the total cost for food consumed per pound of dressed pork produced was 4.64 cents, and the net cost, found by deducting the value of the manure produced by each pig from the total cost, was 3.3 cents per pound. The following tables will, we believe, present sufficient data to enable the reader to understand the experiment, and grasp the results obtained.

FEEDING PERIODS.

	Composition of Ration.	Duration of Period.	Nutritive Ratio.
Period I.	2 oz. corn meal to each quart of milk.	20 lbs. to 80 lbs. live weight.	1 : 3.3
Period II.	4 oz. corn meal to each quart milk, and 4 oz. gluten feed as a substitute for quart milk.	80 lbs. to 125 lbs. live weight.	1 : 4.5
Period III.	4 to 6 quarts milk and $1\frac{1}{2}$ parts corn meal to 1 part gluten feed to satisfy animal.	125 lbs. to 180 lbs. live weight.	1 : 4.9

AVERAGE DAILY RATIONS.							
	Feeding Periods.	Skim Milk, qts.	Corn Meal, oz.	Gluten Feed, oz.	Nutritive ratio.	Average weekly weight, lbs.	Average daily gain, lbs.
Aug. 9 to Aug. 16,	I	3	6	—	1:3.3	27–31.2	.59
Aug. 16 to Aug. 23,		4	8	—		36.5	.76
Aug. 23 to Aug. 30,		5	10	—		43.9	1.05
Aug. 30 to Sept. 6,		6	12	—		49.5	.80
Sept. 6 to Sept. 13,		6	12	—		56.1	.94
Sept. 13 to Sept. 20,		5	12	4		63.	.99
Sept. 20 to Sept. 27,		5	14	8		71.6	1.23
Sept. 27 to Oct. 4,		5	16	12		80.3	1.24
Oct. 4 to Oct. 11,	II	5	28	8	1:4.5	89.	1.24
Oct. 11 to Oct. 18,		5	32	12		101.7	1.81
Oct. 18 to Oct. 25.		5	36	16		112.7	1.56
Oct. 25 to Nov. 1,		5	36	24		126.0	1.90
Nov. 1 to Nov. 8,	III	4	48	28	1:4.9	143.	2.40
Nov. 8 to Nov. 15,		4	54	36		151.7	2.40
Nov. 15 to Nov. 22,		4	54	40		175.2	2.20
Nov. 22 to Nov. 28,		4	48	30		182.8	1.08

We now wish to call attention to a summary of the results obtained:

SUMMARY OF RESULTS.

	Average results of six pigs
Live weight,	182.8 lbs.
Dressed weight,	144.9 lbs.
Per cent of loss in dressing,	21.6
Live weight gained during experiment,	155.6 lbs.
Dressed weight gained during experiment,	122.0 lbs.
Dry matter required to produce one lb. live weight,	2.27 lbs.
Dry matter required to produce one lb. dressed weight,	2.91 lbs.

FINANCIAL STATEMENT.

732.15 lbs. dressed pork actually produced during the experiment, at $7\frac{1}{4}$ cents per lb.,	$53.07
Cost of food required,	33.94
Profit from pork actually produced,	$19.13
Value of manure produced,	9.61
Total profit from six pigs,	$28.74
Total profit per pig,	4.79

If we take into consideration the first cost of the pigs and the dressed weight actually sold, we have the following:

$867\frac{1}{4}$ lbs. dressed weight actually sold at $7\frac{1}{4}$ cents,		$62.91
Total cost of food consumed,	$35.19	
Cost of pigs, at $3.00,	18.00	
		53.19
Total profit from pork,		$ 9.72
Value of manure produced,		10.00
Total profit from six pigs,		$19.72
Total profit per pig,		3.29
Cost of food to produce one lb. live weight,		3.64c.
Cost of food to produce one lb. dressed weight,		4.64c.
Net cost of food to produce one lb. dressed weight, (obtained by deducting value of manure produced.)		3.30c.

The cost of the labor required to care for the pigs during their growth, as well as the cost of preparing them for the market has not been deducted.

MARKET COST OF FOODS CONSUMED.

Corn meal,	$24.00 per ton
Gluten feed,	23.00 per ton
Skim milk,	1.8 cents per gallon

Percentage of the essential fertilizer constituents in the above articles of fodder, and the commercial value of the constituents in 2000 lbs. of the foods.

Nitrogen 15c., phosphoric acid 5½c., potassium oxide 4½c. per pound.

	Corn meal	Gluten feed.	Skim milk
Moisture,	11.38%	6.82%	90.50%
Nitrogen,	1.80%	3.81%	.52%
Phosphoric acid,	.70%	.30%	.19%
Potassium oxide,	.40%	.04%	.20%
Value in 2000 lbs.,	$6.53	$11.81	$1.95
*Obtainable manurial value per ton,	$4.57	$8.28	$1.36

*Allowing that 30% of the nitrogen, potash and phosphoric acid is retained in the system of the growing animal.

NINETEENTH FEEDING EXPERIMENT WITH PIGS.

December, 1892 to April, 1893.

Six pigs were used in this experiment. They were divided into two lots of three each, and both lots were fed for the first ten days upon skim milk and corn meal till they became accustomed to their new quarters. Pigs 1 and 4 were barrows, and numbers 2-3-5-6 were sows. The pigs came from a Chester white sow, but as they grew numbers 2, 3 and 6 showed plainly the Yorkshire characteristics. The general mode of treatment was quite similar to that described in the preceding experiment.

OBJECT OF THE EXPERIMENT.

The object of the experiment was first: a continuation of the many preceding experiments in order to firmly establish facts relative to the most economical method of feeding skim milk in combination with various grains and new concentrated fodder articles; in this case the experiment with gluten feed was continued. Second, a step was taken in the direction of comparing the relative value of wide *vs.* narrow rations for economical pork production. In the many experiments heretofore made at this station, the general mode of feeding has been what might be termed narrow, i. e., large quantities of nitrogenous matter in proportion to the non-nitrogenous and starchy matter have been fed. The feeding has generally begun with a ration of one part nitrogenous to three parts non-nitrogenous (1 : 3) and has been twice increased during the later feeding periods till in the last of the three periods (in which the animal has increased in weight from 125 lbs. to 180 lbs.) the ratio has been one part nitrogenous to four and one-half parts non-nitrogenous (1 : 4.5). Only in one or two cases have wider rations been fed. This method of feeding has been productive of most excellent results. The skim milk has been most economically utilized and the animals have possessed uniformly good health and the pork has been produced at a comparatively low cost.

In case of three pigs in the present experiment, wider rations were fed, begining with 1 : 4.25 and ending with 1 : 6.5.

From the results obtained in this one experiment no very accurate conclusions can be drawn. What the experiment indicates can be seen from the figures presented further on, and it will be alluded to in our heading of "What Our Experiments Teach Us."

Experiments of this kind will be repeated, we hope, *in order to illustrate to our farmers* whether it is more economical to feed young growing pigs (from 25 to 180 lbs.) in the beginning, rations containing one part of nitrogenous to three parts non-nitrogenous matter (1 : 3) and ending with one part nitrogenous to four and one-half parts non-nitrogenous (1 : 4.5), or whether they can be fed as well or better with rations beginning with one part nitrogenous to four and one-half non-nitrogenous (1 : 4.5), and ending with one part nitrogenous to six and one-half parts non-nitrogenous (1 : 6.5).

HOW THE SIX PIGS WERE TREATED IN THE PRESENT EXPERIMENT.

The pigs were divided into two lots of three each. Lot I consisting of pigs 1, 2, and 3, were treated in practically the same way as in our previously described experiment. We had during a portion of the time a good supply of skim milk, and each pig in this lot received at one time as high as ten quarts per day, in addition to his grain feed. The grain consisted of corn meal, and four ounces of gluten feed as a substitute for one quart of milk, when the supply of the latter was limited. In case of lot two, the number of feeding periods was the same, namely, three. During the first period the pigs were fed six ounces of corn meal to each quart of milk, and this continued until the pigs had reached a weight of 80 pounds, and were consuming four and one-half quarts of milk and 27 ounces of corn meal per day. In periods II and III, the supply of milk was kept at four quarts daily, plus two quarts of water to give the necessary drink, and as much corn meal was added as the animals would consume.

The following tables will, we believe, present the results concisely and clearly:

FEEDING PERIODS.

LOT I.

	Composition of Ration.	Duration of Period.	Nutritive Ratio.
Period I.	2 oz. corn meal to each quart milk.	27 lbs. to 75 lbs. live weight.	1 : 3
Period II.	4 oz. corn meal to each quart milk, and 4 oz. gluten feed as a substitute for each qt. milk.	75 lbs. to 120 lbs. live weight.	1 : 3.6
Period III.	6 oz. corn meal to each quart milk, and 4 oz. gluten feed as a substitute for each qt. milk.	120 lbs. to 175 lbs. live weight.	1 : 4.5

In period II of Lot. I, we fed as high as ten quarts of skim milk per day in addition to grain, while in period III, the quantity of skim milk, because of the limited supply, was reduced to four or five quarts per day.

LOT II.

	Composition of Ration.	Duration of Period.	Nutritive Ratio.
Period I.	6 oz. corn meal to each quart milk.	27 lbs. to 80 lbs. live weight.	1 : 4.20
Period II.	4 quarts skim milk and 2 quarts water and corn meal *ad libitum.*	80 lbs. to 120 lbs. live weight.	1 : 5.3
Period III.	4 quarts skim milk and 2 quarts water and corn meal *ad libitum.*	125 lbs. to 180 lbs. live weight.	1 : 6.5

SUMMARY OF RESULTS.

The experiment lasted 126 days, and was productive of the following average results:

AVERAGE DAILY GAIN.

	I. Period. lbs.	II. Period. lbs.	III Period. lbs.	Daily Average of 126 Days. lbs.
Lot I.	.84	1.33	1.50	1.22
Lot II.	.92	1.30	1.60	1.27

	LOT I. Average of three pigs.	LOT II. Average of three pigs.
Live weight,	172.71 lbs.	180.75 lbs.
Dressed weight,	140.75 lbs.	148.00 lbs.
Per cent. of loss in dressing,	18.53	18.10
Live weight gained during experiment,	146.17 lbs.	152.00 lbs.
Dressed weight gained during experiment,	119.16 lbs.	122.47 lbs.
Dry matter required to produce 1 lb. live weight,	2.82 lbs.	2.57 lbs.
Dry matter required to produce 1 lb. dressed w't,	3.45 lbs.	3.18 lbs.

No difference in the amount of intestinal fat was observed in either lot.

FINANCIAL STATEMENTS.

NO. I.

	LOT I.	LOT II.
Dressed pork actually produced during exp't, lbs,	357.5	367.4
Value at $7\frac{3}{4}$c. per lb. (market price),	$27.71	$28.47
Cost of food consumed,	19.95	18.02
Profit from pork actually produced,	$7.76	$10.45
Value of manure produced,	6.05	4.41
Total profit from three pigs,	$13.81	$14.86
Profit per pig,	$4.60	$4.95

STATEMENT NO. II.

If we take into consideration the first cost of the pigs, and the dressed weight actually sold, we have the following record for both lots taken together:

866.25 lbs. dressed pork actually sold, at $7\frac{3}{4}$c., $67.13

Total cost of food consumed,	$39.05	
Cost of pigs, at $2.25 each,	13.50	
		52.55
Profit from pork,		$14.58
Value of manure produced,		11.38
Total profit from six pigs,		$25.96
Profit per pig,		4.33

	Lot I.	Lot II.
Cost of food to produce 1 lb. live weight,	4.55c	3.95c
Cost of food to produce 1 lb. dressed weight,	5.58c	4.91c
Net cost of food to produce 1 lb. dressed weight,	3.88c	3.90c

(Obtained by deducting value of manure produced from cost of food.)

MARKET COST OF FOODS CONSUMED.

Corn meal,	$23.00 per ton.
Gluten feed,	21.00 per ton.
Skim milk,	1.8c. per gallon.

The *percentages* of the essential fertilizer constituents in the above articles of fodder, their *commercial value* in 2000 lbs. as well as their approximate *obtainable manurial value* when fed to growing pigs, may be seen from the following:

Moisture,	14.00%	7.55	90.24
Nitrogen,	1.36%	3.55	.51
Phosphoric acid,	.707%	.296	.18
Potash,	.435%	.045	.19
Value per 2000 lbs.,	$5.95	$12.70	$2.17
Obtainable manurial value,	4.17	8.89	1.52

Nitrogen at 17½c., phosphoric acid at 5c., and potassium oxide at 5½c. per pound.

PRACTICAL RATIONS FOR PIG FEEDING.

When skim milk is used as a part of the daily diet in feeding pigs for the market, the Station feels justified, in view of its feeding experiments, in recommending the following practical rations as being valuable in producing pork at a minimum cost:

I.

Weight of Pigs.	Food.	Nutritive Ratio.
20 to 80 lbs.	2 oz. corn meal to each qt. milk.*	1 : 3.30
80 to 125 lbs.	4 oz. corn meal to each qt. milk.	1 : 4.00
125 to 190 lbs.	6 oz. corn meal to each qt. milk.	1 : 4.50

II.

When skim milk is in limited supply; from four to six qts. per pig.

Weight of Pigs.	Food.	Nutritive Ratio.
20 to 80 lbs.	Milk at disposal, and one part by weight wheat bran, two parts by weight gluten meal, to satisfy appetite.	1 : 3.20
80 to 120 lbs.	Milk at disposal and following mixture, one weight part corn meal, one weight part wheat bran, one weight part gluten meal, to satisfy animal.	1 : 4.00
125 to 190 lbs.	Milk at disposal and following mixture, two weight parts corn meal, one weight part wheat bran, one weight part gluten meal.	1 : 4.50

III.

Weight of Pigs.	Food.	Nutritive Ratio.
20 to 80 lbs.	2 oz. corn meal to each qt. of milk and 4 oz. gluten feed as a substitute for each qt. milk.	1 : 3.25 to 4.00
80 to 120 lbs.	6 qts. skim milk and a mixture of one part by weight gluten feed, and one part by weight corn meal.	1 : 4.00 to 4.40
125 to 190 lbs.	6 qts. skim milk, and a mixture of one part by weight gluten feed, and one and one-half part by weight corn meal.	1 : 4.4 to 1 : 4.9

*Creamery buttermilk can be substituted for skim milk as above with good results, if it can be had at a reasonable price, say 1.4c. per gallon.

WHAT OUR EXPERIMENTS TEACH.

Briefly stated, from a practical standpoint, these two experiments and many others made at the Station, teach us the following lessons:

I. Skim milk, together with corn meal, gluten meal, wheat bran, gluten feed, maize feed, etc., combined as above stated have proved healthy and profitable foods for the production of pork for our markets.

II. With skim milk reckoned at 1.8 cents per gallon, gluten feed from $21.00 to $23.00 per ton, and corn meal at $23.00 to $24.00 per ton, we have been enabled in these experiments to produce dressed pork at from 4.6 cents to 5.3 cents per pound. The net cost of the dressed pork produced (obtained by deducting the value of the manure produced) was from 3.3 and 3.8 cents per pound.

III. Farmers having a quantity of skim milk at their disposal, can utilize it profitably by feeding it to growing pigs, as above described. If this milk can be sold, however, at one cent per quart, or more, it would undoubtedly be more profitable to sell it than to use it in the production of pork.

IV. Experiments made at this Station have proved that it is not profitable to feed pigs after they reach a weight of 180 to 190 pounds, excepting perhaps when pork commands an exceptionally high price. Fed beyond this weight, the food consumed increases, and the percentage of gain in live weight steadily decreases, so that the daily cost of food consumed is more than the value of the daily increase in weight. This fact has since been confirmed by other Stations.

V. In the last experiment, Lot II gave slightly more favorable results than Lot I. These results are not decisive enough to enable us to make any deductions. Especially when the results of previous experiments at this Station with narrow rations, and experiments elsewhere with both wide and narrow rations are considered. Repeated trials are necessary to establish facts.

ANALYSIS OF FODDER ARTICLES USED IN OUR PIG FEEDING EXPERIMENTS.

CORN MEAL.

Average Analysis.

	Used in 18th Experiment.		Used in 19th Experiment.		
	Percentage Composition.	Nutritive Ratio.	Percentage Composition.	Nutritive Ratio.	Percent. of digestibility of constituents of Corn Meal.
Moisture at 100° C.,	11.38	—	14.00	—	—
Dry matter,	88.62	—	86.00	—	—
	100.00		100.00	—	—
ANALYSIS OF DRY MATTER.					
Crude ash,	1.63		1.50		
Crude cellulose,	2.13	1 : 10.65	2.58	1 : 10.00	40
Crude fat,	4.63		2.44		76
Crude protein,	10.71		9.87		86
Non-nitrogenous extract matter,	80.90		83.61		95
	100.00		100.00		

GLUTEN FEED.

Average Analysis.

	Used in 18th Experiment.		Used in 19th Experiment.		
	Percentage Composition.	Nutritive Ratio.	Percentage Composition.	Nutritive Ratio.	Percent. of digestibility of constituents of Gluten Feed.
Moisture at 100° C.,	6.82	—	7.55	—	—
Dry matter,	93.18	—	92.45	—	—
	100.00		100.00		
ANALYSIS OF DRY MATTER.					
Crude ash,	0.83		0.85		
Crude cellulose,	4.94	1 : 3.46	10.06	1 : 3.80	40
Crude fat,	13.03		12.48		76
Crude protein,	28.71		23.86		86
Non-nitrogenous extract matter,	52.49		52.75		95
	100.00		100.00		

SKIM MILK.

Average Analysis.

	Used in 18th Experiment. Percentage Composition.	Used in 18th Experiment. Nutritive Ratio.	Used in 19th Experiment. Percentage Composition.	Used in 19th Experiment. Nutritive Ratio.	Percent. of digestibility of constituents of Skim Milk.
Moisture at 100° C.,	90.50	—	90.24	—	—
Dry matter,	9.50	—	9.76	—	—
	100.00	—	100.00	—	
ANALYSIS OF DRY MATTER.					
Crude ash,	6.82		8.09		
Crude fat,	4.00	1 : 2.15	2.66	1 : 1.93	100
Crude protein,	31.50		32.66		100
Non-nitrogenous extract matter,	57.68		56.59		100
	100.00		100.00		

The detailed record of each pig is reserved for our Annual Report.

Miscellaneous Fodder Analyses.

I. Artichokes (Jerusalem). Raised on Station farm, 1892.
II. Mangolds. Raised on Station farm, 1892.
III. Carrots. Raised on Station farm, 1892.

	I.	*II.*	*III.*
Moisture at 100° C.,	77.49	88.51	87.53
Dry matter,	22.51	11.49	12.47
	100.00	100.00	100.00

ANALYSIS OF DRY MATTER.

Crude ash,	4.97	12.88	9.42
Crude cellulose,	4.18	9.98	8.77
Crude fat,	.95	1.14	1.41
Crude protein,	12.82	7.04	9.75
Non-nitrogenous extract matter,	77.08	68.96	70.65
	100.00	100.00	100.00

FERTILIZING CONSTITUENTS.

Moisture at 100° C.,	77.490	88.510	87.530
Phosphoric acid,	.168	.100	.074
Potassium oxide,	.484	.470	.451
Nitrogen,	.460	.131	.194
Insoluble matter,	.039	.118	.084

I. Gluten Feed. Sent on from Sunderland, Mass.
II. Gluten Meal. Sent on from Sunderland, Mass.
III. Gluten Meal. Sent on from South Acton, Mass.

	I.	*II.*	*III.*
Moisture at 100° C.,	9.39	6.85	7.29
Dry matter,	90.61	93.15	92.71
	100.00	100.00	100.00

ANALYSIS OF DRY MATTER.

Crude ash,	*	*	*
Crude cellulose,	*	*	*
Crude fat,	12.43	9.94	6.56
Crude protein,	24.88	23.69	30.19
Non-nitrogenous extract matter,	*	*	*

*Not determined.

I. Excelsior Feed. Sent on from Holden, Mass.
II. Proteina. Sent on from Bolton, Mass.
III. Wheat Bran. Sent on from South Acton, Mass.

	I,	*II.*	*III.*
Moisture at 100° C.,	7.08	8.63	6.67
Dry matter,	92.92	91.37	93.34
	100.00	100.00	100.00

ANALYSIS OF DRY MATTER.

Crude ash,	4.43	1.95	*
Crude cellulose,	14.65	*	*
Crude fat,	5.42	7.80	4.71
Crude protein,	9.75	22.44	16.69
Non-nitrogenous extract matter,	65.75	*	*
	100.00		

*Not determined.

I. Rye Feed. Sent on from North Dartmouth, Mass.
II. Glucose Refuse. Sent on from Boston, Mass.
III. Gluten Feed. Sent on from North Amherst, Mass.
IV. Gluten Meal. Sent on from Agawam, Mass.

	I.	II.	III.	IV.
Moisture at 100° C.,	9.63	6.71	6.93	5.93
Dry matter,	90.37	93.29	93.07	94.07
	100.00	100.00	100.00	100.00

ANALYSIS OF DRY MATTER.

Crude ash,	2.62	1.20	.69	.50
Crude cellulose,	3.52	4.77	9.08	5.80
Crude fat,	2.79	10.55	9.81	12.08
Crude protein,	13.56	21.06	14.51	30.63
Non-nitrogenous extract matter,	77.51	62.42	65.91	50.99
	100.00	100.00	100.00	100.00

FERTILIZING CONSTITUENTS.

Moisture at 100° C.,	9.63	6.71	6.93	5.93
Phosphoric acid,	1.561	.61	*	*
Potassium oxide,	.980	.09	*	*
Nitrogen,	1.95	3.37	2.18	4.60
Insoluble matter,	*	.05	*	*

*Not determined.

The Bulletins of the Experiment Station will be sent free of charge to all parties interested in its work, on application.

C. A. GOESSMANN, *Director.*

Amherst, Mass., May 29, 1893.

Carpenter & Morehouse, Printers, Amherst, Mass.

MASSACHUSETTS STATE

Agricultural Experiment Station.

BULLETIN NO. 48.

JUNE, 1893.

METEOROLOGICAL SUMMARY
MAY AND JUNE, 1892-1893.

	May. 1892.	May. 1893.	June. 1892.	June. 1893.
Mean temperature,	55.00	55.74	68.77	66.53
Highest temperature,	81.00	84.00	95.00	93.00
Lowest temperature,	30.00	31.00	40.00	43.00
Mean range,	20.14	23.36	21.60	22.73
Total precipitation, (inches)	5.49	4.37	3.04	2.86
Prevailing wind,	S.	N.W.	S.	N.

The mean temperature, for the month of May, '93, viz 55.74°, was about the normal, being only .74 of a degree higher than that for May 1892. The precipitation was above the normal, being 1.12 inches greater than that during the same month last year.

The mean temperature for June, 1893, viz 66.53°, was 2.24 degrees higher than that of June, 1892. The precipitation was about the same, being only .18 of a degree less than that of the same month last year.

The mean temperature of the above two months 1893, was 61.14°, being .75 of a degree less than that for the same period last year.

The frequent showers during the last week in June somewhat retarded the work of haying.

I.

ANALYSES OF COMMERCIAL FERTILIZERS COLLECTED DURING 1893, IN THE GENERAL MARKETS BY THE AGENT OF THE MASSACHUSETTS STATE AGRICULTURAL EXPERIMENT STATION.

Laboratory No.	Name of Brand.	Name of Manufacturer.	Sampled at
	Compound Fertilizers.		
1	Potato Special	Walker Stratman & Co., Pittsburg, Pa.,	Amherst.
11	Hampden Lawn Dressing,	Bradley Fertilizer Co., Boston, Mass.,	Springfield.
17	Ammoniated Bone Superphosphate,	Williams & Clark, Boston, Mass.,	Springfield.
18	Fish and Potash, (Crossed Fish Brand),	Quinnipiac Fertilizer Co., Boston, Mass.,	Springfield.
28	Complete Manure for Potatoes, and Root Crops,	Prentiss, Brooks & Co., Holyoke, Mass.,	Holyoke.
32	Stockbridge Comp. Manure for Potatoes and Vegetables,	Bowker Fertilizer Co., Boston, Mass.,	Springfield.
34	Fish and Potash (D. Brand),	Joseph Church & Co., Tiverton, R. I.,	Springfield.
36	Complete Potato Manure,	H. J. Baker & Bro., New York, N. Y.,	Springfield.
42	Animal Fertilizer,	J. G. Jefferds, Worcester, Mass.,	Worcester.
65	Complete Animal Fertilizer,	C. A. Bartlett, Worcester, Mass.,	Boston.
76	English Lawn Dressing,	Bradley Fertilizer Co., Boston, Mass.,	Lowell.
77	Bay State Fertilizer,	Clark Cove Fertilizer Co., Boston, Mass.,	Lawrence.
80	Lawrence Fertilizer,	A. Lee & Co., Boston, Mass.,	Lawrence.
82	Animal Fertilizer,	L. B. Darling Fertilizer Co., Pawtucket, R. I.,	Lowell.
86	Special Potato Manure,	Crocker Fertilizer & Chemical Co., Buffalo, N. Y.,	Fitchburg.
90	Ammoniated Bone Superphosphate,	Crocker Fertilizer & Chemical Co., Buffalo, N. Y.,	Lowell.
98	English Lawn Dressing,	Bradley Fertilizer Co., Boston, Mass.,	Fitchburg.
129	Ammoniated Bone Superphosphate,	Williams & Clark, Boston, Mass.,	Dighton.
141	Bay State Fertilizer,	Clark Cove Fertilizer Co., Boston, Mass.,	Dighton.
147	Fish and Potash (D. Brand),	Joseph Church & Co., Tiverton, R. I.,	Taunton.
153	Special Potato Manure,	Crocker Fertilizer & Chemical Co., Buffalo, N. Y.,	Amherst.
157	Ammoniated Bone Superphosphate,	Crocker Fertilizer & Chemical Co., Buffalo, N. Y.,	Amherst.
199	Special Potato Manure,	Crocker Fertilizer & Chemical Co., Buffalo, N. Y.,	N. Adams.
201	Potato Special,	Walker Stratman & Co., Pittsburg, Pa.,	Leeds.
	Bones.		
24	Fine Ground Bone,	Gilbert E. Holmes, Worcester, Mass.,	Worcester.
83	Ground Bone Meal,	Crocker Fertilizer & Chemical Co., Buffalo, N. Y.,	Fitchburg.
124	Ground Bone,	Hargraves' Manufacturing Co., Fall River, Mass.,	Fall River.
127	Fine Ground Bone,	Bryant & Brett, New Bedford, Mass.,	New Bedford.
128	Pure Bone Meal,	Thomas Hersom & Co., New Bedford, Mass.,	New Bedford.
154	Ground Bone Meal,	Crocker Fertilizer & Chemical Co., Buffalo, N. Y.,	Amherst.
215	Fine Ground Bo[illegible]	Bryant & Brett, New Bedford, Mass.,	Amherst.

Laboratory Number.	Name of Brand.	Moisture.	Nitrogen in 100 lbs. Found.	Nitrogen in 100 lbs. Guaranteed.	Phosphoric Acid in 100 lbs. Soluble.	Reverted.	Insoluble.	Total. Found.	Total. Guaranteed.	Available. Found.	Available. Guaranteed.	Potassium Oxide in 100 lbs. Found.	Potassium Oxide in 100 lbs. Guaranteed.
	Compound Fertilizers.												
1-201	Potato Special,	11.70	1.72	2.47-3.30	5.12	2.54	5.90	13.56	12-13	7.66	10-11	7.01	5-6
11	Hampden Lawn Dressing,	8.16	4.86	3.30-4.12	1.41	3.58	1.92	6.91	7-9	4.99	6-8	3.13	2-3
17-129	Ammoniated Bone Superphosphate,	12.98	2.47	2.47-3.30	7.55	2.94	1.28	11.77	10-13	10.49	9-11	2.11	2-3
18	Fish & Potash (Crossed Fish Brand)	21.05	4.90	3.30-4.12	2.35	2.55	2.26	7.16	5-8	4.90	3-5	5.60	3-5
28	Comp. Manure for Pot. & Root Crops	9.75	3.30	4.12-4.94	3.97	2.05	3.04	9.06	6-8	6.02	5-6	8.76	8-10
32	Stockbridge Complete Manure for Potatoes and Vegetables,	10.34	3.31	3.25-4.25	4.95	3.15	4.08	12.18	8-10	8.10	7-8	6.97	5-6
34-147	Fish and Potash (D Brand)	21.40	2.58	2.47-3.30	2.81	3.43	1.33	7.57	7.5-8.5	6.24	—	1.84	2-3
36	Complete Potato Manure,	8.69	3.70	3.30	3.45	2.10	1.84	7.39		5.55	5.75	9.25	10.
42	Animal Fertilizer,	10.67	2.25	2.47-3.30	6.04	1.76	8.17	15.97	16-18	7.80	11-13	3.69	2.5-3.5
65	Complete Animal Fertilizer,	4.44	5.78	3.30-4.12	.95	6.57	5.17	12.69	16-18	7.52	—	7.12	7-8
76-98	English Lawn Dressing,	8.20	4.78	4.95-5.78	1.28	3.66	2.30	7.24	6-8	4.94	5-7	2.86	2.5-35*
77-141	Bay State Fertilizer,	14.80	2.42	2.47-3.30	6.72	4.16	1.94	12.82	10-14	10.88	9-12	2.28	2-3*
80	Lawrence Fertilizer,	12.94	2.63	2.06-2.26	7.16	2.11	1.48	10.75	10-12	9.27	—	2.70	2-3
82	Animal Fertilizer,	12.92	2.99	3-4.5	3.48	3.73	1.87	9.08	10-12	7.21	6-8	5.83	4-5
86-153-199	Special Potato Manure,	15.12	3.37	3.71-4.57	6.60	1.92	.84	9.36	8-9	8.52	8-9.5	5.51	5.4-6.4*
90-157	Ammoniated Bone Superphosphate,	13.47	2.92	2.8-3.7	6.81	2.60	1.59	11.00	10-12	9.41	10-12	1.08	1-2*

Laboratory Number.	Name of Brand.	Moisture.	Nitrogen Found.	Nitrogen Guaranteed.	Soluble.	Reverted.	Insoluble.	Total Found.	Total Guaranteed.	Available Found.	Available Guaranteed.	Mechanical Analysis. Fine.	Med. Fine.	Med.	Coarse Med.
	Bones.														
24	Fine Ground Bone,	9.15	2.90	2.50-3.50	.20	7.90	12.57	20.67	22-24	8.10	—	16.64	23.43	49.73	10.20
83-154	Ground Bone Meal,	13.15	1.21	2-3	.32	10.49	17.00	27.81	25-28	10.81	—	17.57	47.70	25.47	9.26
124	Ground Bone,	13.80	3.52	2.5-2.8	.51	8.19	12.54	21.24	25-27	8.70	—	17.86	19.86	18.56	43.72
127-215	Fine Ground Bone,	7.61	2.78	2.50	.26	8.44	16.50	25.20	25.56	8.70	—	38.43	32.95	19.17	9.45
128	Pure Bone Meal,	4.84	1.75	2.00	.38	10.11	19.57	30.06	29.21	10.49	9.40	74.15	19.04	6.81	—

*Sulphate of Potash, the source of Potash.

I. ANALYSES OF COMMERCIAL FERTILIZERS COLLECTED DURING 1893, IN THE GENERAL MARKETS BY THE AGENT OF THE MASSACHUSETTS STATE AGRICULTURAL EXPERIMENT STATION.

Laboratory No.	Name of Brand.	Name of Manufacturer.	Sampled at
	Compound Fertilizers.		
91	Quinnipiac Phosphate,	Quinnipiac Fertilizer Co., Boston, Mass.	Fitchburg.
96	Cumberland Superphosphate,	Cumberland Bone Co., Portland, Me.,	Lowell.
105	Manure for Light Soils,	Mapes Formula & Peruvian Guano Co., New York, N. Y.	Fitchburg.
111	Alkaline Bone,	E. Frank Coe., New York, N. Y.	Mansfield.
112	Cleveland Superphosphate,	Cleveland Dryer Co., Boston, Mass.,	S.Framingham
118	Eclipse Phosphate,	Bradley Fertilizer Co., Boston, Mass.	Palmer.
119	Potato Fertilizer,	J. J. H. Gregory & Son, Marblehead, Mass.,	Amherst.
123	Market Garden Manure,	Quinnipiac Fertilizer Co., Boston, Mass.	Fall River.
130	Complete Corn Manure,	H. J. Baker & Bro., New York, N. Y.	Fall River.
131	Good Brand Excelsior Guano,	E. Frank Coe, New York, N. Y.,	Dighton.
136	Potato and Root Crop Manure,	L. B. Darling Fertilizer Co., Pawtucket, R. I.,	Fall River.
138	Fish and Potash,	W. J. Brightman & Co., Tiverton, R. I.,	Fall River.
140	Nitrogenous Superphosphate,	J. C. Dow & Co., Boston, Mass.,	Dighton.
166	High Grade Tobacco Manure,	Bradley Fertilizer Co., Boston, Mass.	Greenfield.
169	Standard Phosphate,	Read Fertilizer Co., Syracuse, N. Y.,	Pittsfield.
173	Ammoniated Bone Superphosphate,	Preston's Fertilizer Co., Greenpoint, L. I.,	Williamstown.
184	Dry Ground Fish,	Bradley Fertilizer Co., Boston, Mass.	Greenfield.
185	Fine Wrapper Tobacco Grower,	Williams & Clark, Boston, Mass.	Greenfield.
190	Standard Potato and Tobacco Fertilizer,	Standard Fertilizer Co., Boston, Mass.,	Greenfield.
193	Tobacco Starter,	Mapes Formula & Peruvian Guano Co., New York, N. Y.	Greenfield.
195	Potato and Tobacco Fertilizer,	Williams & Clark Fertilizer Co., Boston, Mass.	Greenfield.
205	Fish and Potash,	National Fertilizer Co., Bridgeport, Ct.,	Hadley.
214	Tobacco Fertilizer,	National Fertilizer Co., Bridgeport, Ct.,	Hadley.
216	Potato, Onion and Tobacco Fertilizer,	Leander Wilcox, Mystic, Conn.	Amherst.
217	Ammoniated Bone Superphosphate,	Leander Wilcox, Mystic, Conn.,	Amherst.
223	Tobacco Starter,	Mapes Formula & Peruvian Guano Co.,	So. Deerfield.
224	Havana Tobacco Fertilizer,	Quinnipiac Fertilizer Co., Boston, Mass.,	So. Deerfield.
234	Tobacco Fertilizer,	Clark Cove Fertilizer Co., Boston, Mass.,	Agawam.

Laboratory Number.	NAME OF BRAND.	Moisture.	Nitrogen in 100 lbs.		Phosphoric Acid in 100 lbs.							Potassium Oxide in 100 lbs.	
								Total.		Available.			
			Found.	Guaranteed.	Soluble.	Reverted.	Insoluble.	Found.	Guaranteed.	Found.	Guaranteed.	Found.	Guaranteed.
	Compound Fertilizers.												
91	Quinnipiac Phosphote, ...	14.41	2.56	3-4	7.14	2.21	1.45	10.80	10-14	9.35	9-12	2.32	2-3*
96	Cumberland Superphosphate, ...	16,43	2.79	2.06-2.88	6.22	2.91	2.43	11.56	10-12	9.13	8-10	2.01	2-3*
105	Manure for light Soils, ...	10.70	4.90	4.04-6.59	5.19	2.77	2.29	10.25	8-10	7.96	6-8	7.38	6-8
111	Alkaline Bone, ...	11.13	1.03	1.-1.5	7.42	.58	2.84	10.84	9-12	8.00	7-9	2.59	1.62-2.16*
112	Cleveland Superphosphate, ...	17.77	2.09	2.05-2.85	7.16	2.05	1.51	10.72	11-14	9.21	9-11	3.31	2-3*
118	Eclipse Phosphate, ...	13.60	2.54	1-2	3.27	6.40	1.49	11.16	12-15	9.67	10-12	2.84	1.5-2.5*
119	Potato Fertilizer, ...	7.65	4.09	4.12-4.94	2.70	2.42	2.30	7.42	7.	5.12	5-6	12.70	13*
123	Market Garden Manure, ...	12.48	3.08	3.30-4.12	5.28	2.80	.90	8.98	9-13	8.08	8-11	7.13	7-8*
130	Complete Corn Manure, ...	11.31	3.98	3.71	3.43	2.84	1.89	8.16	—	6.27	5.	7.10	7.5
131	Gold Brand Excelcior Guano, ...	8.92	2.23	2.5-3.5	6.60	2.00	2.56	11.16	9-13	8.60	8-11	8.21	6-8*
136	Potato and Root Crop Manure, ...	12.00	2.61	3-4	4.71	3.45	5.12	13.28	10-12	8.16	6-8	6.72	7-8
138	Fish and Potash, ...	28.81	3.64	3.71	2.17	2.66	.90	5.73	5-7	4.83	—	5.26	5-6
140	Nitrogenous Superphosphate, ...	16.69	3.11	2.06-2.88	5.76	3.32	1.28	10.36	—	9.08	8-10	3.35	1.89-2.52
166	Bradley's High Grade Tobacco Man.	6.18	5.81	5.77-6.59	1.84	2.41	1.71	5.96	4-5	4.25	—	14.08	10.80-12.42*
169	Standard Phosphate, ...	14.17	1.06	.82-1.65	3.10	6.65	.23	9.98	10-12	9.75	8-10	4.17	4-6*
173	Ammoniated Bone Superphosphate,	9.20	3.65	2.47-3.30	1.56	4.58	1.89	8.03	8-11	6.14	—	3.09	2-3
184	Dry Ground Fish, ...	15.63	8.33	7.41-9.06	1.28	2.95	2.04	6.27	7-9	4.23	—	—	—
185	Fine Wrapper Tobacco Grower, ...	6.30	5.84	5.77-6.59	1.41	2.82	2.81	7.04	6-9	4.23	5-7	9.96	10-12
190	Standard Potato and Tobacco Fert.	13.86	1.83	2.05-2.88	7.01	1.33	2.42	10.76	9-13	8.34	—	3.69	3-4
193-223	Tobacco Starter, ...	10.35	2.85	2.47-3.30	6.42	2.46	4.22	13.10	12-16	8.88	—	3.90	2.5-3.5
195	Potato and Tobacco Fertilizer, ...	12.45	3.66	4.5-5	7.09	.94	.59	8.62	8-11	8.03	7-9	7.83	7-9
205	Fish and Potash, ...	7.48	2.91	3.30-4.12	2.15	2.00	3.63	7.78	6-8	4.15	—	5.64	5-6
214	Tobacco Fertilizer, ...	11.32	4.53	3.30-4.94	7.65	1.14	.60	9.39	10-12	8.79	8-10	5.07	5.40-6.48*
216	Potato, Onion and Tobacco Manure,	14.44	3.35	3.25-4.25	4.86	2.20	1.79	8.85	8-9	7.06	7-8	6.72	6-7
217	Ammoniated Bone Superphosphate,	15.53	2.87	2.5-3.5	3.74	2.43	1.74	7.91	7-8	6.17	6-7	5.72	5-6
224	Havanna Tobacco Fertilizer, ...	6.10	6.16	5.77-6.59	1.70	2.27	2.49	6.46	6-9	3.97	5-7	6.68	10-12*
234	Tobacco Fertilizer, ...	5.60	6.38	5.77-6.59	1.41	2.94	3.45	7.80	—	4.35	5-7	10.37	10-12

*Sulphate of Potash, the source of Potash.

II.

ANALYSES OF COMMERCIAL FERTILIZERS AND MANURIAL SUBSTANCES SENT ON FOR EXAMINATION.

871—875. I. Boiler soot. Sent on from Hatfield, Mass.
II. Mill sweepings. Sent on from Westboro', Mass.
III. Saltpetre. Sent on from S. Acton, Mass.
IV. Horse manure. Sent on from Westboro', Mass.
V. Sewage. Sent on from Danvers, Mass.

	I.	*II.*	*III.*	*IV.*	*V.*
Moisture at 100° C.,	18.80	9.49	.66	11.25	99.959
Phosphoric acid,	1.60	1.18	—	1.46	.0012
Potassium oxide,	.54	.66	45.74	2.82	.0033
Calcium oxide,	2.31	—	—	—	—
Magnesium oxide,	1.19	—	—	—	—
Nitrogen,	—	3.76	11.88	.74	.0028
Insoluble matter,	58.91	5.01	—	12.60	—

876—880. I and II. Ground bone. Sent on from Concord, Mass.
III. Natural phosphate. Sent on from Ashby, Mass.
IV. Cotton hull ashes. Sent on from Agawam, Mass.
V. Cotton hull ashes. Sent on from Boston, Mass.

	I.	*II.*	*III.*	*IV.*	*V.*
Moisture at 100° C.,	9.23	8.71	3.58	13.92	7.77
Total phosphoric acid,	21.80	20.29	.23	9.21	7.83
Soluble " "	None	None	—	—	—
Reverted " "	12.96	10.20	—	—	—
Insoluble " "	8.84	10.09	—	—	—
Potassium oxide,	—	—	—	24.12	20.40
Nitrogen,	3.54	3.70	—	—	—
Insoluble matter,	—	—	77.04	9.33	11.78

881—885. WOOD ASHES.

I. Sent on from Tewksbury, Mass.
II and III. Sent on from Concord, Mass.
IV and V. Sent on from North Amherst, Mass.

	I.	*II.*	*III.*	*IV.*	*V.*
Moisture at 100° C.,	11.30	15.01	8.49	18.13	14.25
Potassium oxide,	6.80	8.05	7.10	5.05	5.95
Phosphoric acid,	1.69	.67	.31	.92	1.43
Insoluble matter (before calcination),	16.56	18.38	16.97	15.33	15.03
Insoluble matter (after calcination),	13.66	15.84	15.25	13.46	12.75

III.

ANALYSES OF FODDER ARTICLES SENT ON FOR EXAMINATION.

I. Gluten feed. Sent on from Marlboro, Mass.

II. Proteina. Sent on from North Amherst, Mass.

III. Proteina. Sent on from Weston, Mass.

	I.	*II.*	*III.*
Moisture at 100, C.,	7.64	8.04	6.80
Dry matter,	92.36	91.96	93.20
	100.00	100.00	100.00
ANALYSIS OF DRY MATTER.			
Crude ash,	1.14	2.80	3.24
Crude cellulose,	5.78	12.33	10.18
Crude fat,	9.18	7.74	8.24
Crude protein,	21.11	24.47	27.23
Non-nitrogeneous extract matter,	62.79	52.66	51.11
	100.00	100.00	100.00

I. Pea bran. Sent on from Great Barrington, Mass.

II. Corn ensilage. Sent on from Marlboro', Mass.

III. Oat and pea ensilage. Sent on from Marlboro', Mass.

IV. Cotton hulls. Sent on from Boston, Mass.

	I.	*II.*	*III.*	*IV.*
Moisture at 100° C.,	7.14	79.98	38.02	8.15
Dry matter,	92.86	20.02	61.98	91.85
	100.00	100.00	100.00	100.00
ANALYSIS OF DRY MATTER.				
Crude ash,	3.33	5.50	9.19	2.81
Crude cellulose,	46.16	25.24	31.34	46.60
Crude fat,	1.16	4.20	3.94	1.79
Crude protein,	10.31	8.22	13.72	4.10
Non-nitrogenous extract matter,	39.04	57.84	41.81	44.70
	100.00	100.00	100.00	100.00

I. Dried brewers' grain. Sent on from Boston, Mass.

II and III. Gluten feed. Sent on from Amherst, Mass.

IV. Gluten meal. Sent on from Boston, Mass.

V. Old process linseed meal. Sent on from North Amherst.

	I.	*II.*	*III.*	*IV.*	*V.*
Moisture at 100° C.,	7.99	8.99	8.06	6.15	10.19
Crude fat,	5.56	7.01	6.96	15.51	2.60
Crude protein,	17.25	24.88	25.00	27.63	34.88

TRADE VALUES OF FERTILIZING INGREDIENTS IN RAW MATERIALS AND CHEMICALS.

	1893. Cents per pound.
Nitrogen in ammonia salts,	17
" " nitrates,	$15\frac{1}{2}$
Organic nitrogen in dry and fine ground fish, meat, blood, and in high-grade mixed fertilizers,	$17\frac{1}{2}$
" " " cotton-seed meal, linseed meal and castor pomace,	$16\frac{1}{2}$
" " " fine ground bone and tankage,	15
" " " fine ground medium bone and tankage,	12
" " " medium bone and tankage,	9
" " " coarse bone and tankage,	7
" " " hair, horn-shavings and coarse fish scraps,	7
Phosphoric acid soluble in water,	$6\frac{1}{2}$
" " soluble in ammonium citrate,	6
" " in fine bone and tankage,	6
" " in fine medium bone and tankage,	5
" " in medium bone and tankage,	4
" " in coarse bone and tankage,	3
" " in fine ground fish, cotton-seed meal, linseed meal, castor pomace and wood ashes,	5
" " insoluble (in am. cit.) in mixed fertilizers,	2
Potash as High Grade Sulphate, and in mixtures free from Muriate,	$5\frac{1}{2}$
" " Muriate,	$4\frac{1}{2}$
The manurial constituents contained in feedstuffs are valued as follows:	
Organic Nitrogen,	$17\frac{1}{2}$
Phosphoric acid,	5
Potash,	$5\frac{1}{2}$

The Bulletins of the Mass. Experiment Station will be sent free of charge to all parties interested in its work, on application.

C. A. GOESSMANN, *Director*.

Amherst, Mass., June 30, 1893.

Carpenter & Morehouse, Printers, Amherst, Mass.

MASSACHUSETTS STATE

AGRICULTURAL EXPERIMENT STATION.

BULLETIN NO. 49.

AUGUST, 1893.

Meteorological Summary for July, 1892-1893.

	JULY, 1892.	JULY, 1893.
Mean temperature,	69.75° F.	67.50° F.
Maximum temperature	92.00° F.	90.00° F.
Minimum temperature,	42.00° F.	42.00° F.
Mean daily range,	22.50° F.	25.51° F.
Total rainfall (inches),	3.74	2.59
Prevailing wind,	S. W.	N. W.

The mean temperature for July, 1893, was below the normal, and 2.25° below that for the same month last year.

The precipitation for July, 1893, viz.: 2.59 inches was much below the normal, and 1.15 inches less than for July, 1892.

Most farm crops are in need of rain, and some are already seriously injured. The rowen crop will be light in this section, judging from the present condition of grass land.

I. ANALYSES OF COMMERCIAL FERTILIZERS COLLECTED DURING 1893, IN THE GENERAL MARKETS BY THE AGENT OF THE MASSACHUSETTS STATE AGRICULTURAL EXPERIMENT STATION.

Laboratory No.	Name of Brand.	Name of Manufacturer.	Sampled at
	Compound Fertilizers.		
3	Banner Fertilizer	Walker Stratman & Co., Pittsburg, Pa	Amherst.
5	Conn. Wrapper Fertilizer "Pinney Formula"	Cleveland Linseed Oil Co., Cleveland, Ohio	Amherst.
29	Tankage,	Prentiss. Brooks & Co., Holyoke, Mass	Holyoke.
45	Vegetable Manure,	Mapes Formula & Peruvian Guano Co., New York, N.Y.	Worcester.
46	Complete Manure for Potatoes and Vegetables,	Bradley Fertilizer Co., Boston, Mass	Worcester.
48	Potato Manure,	J. G. Jefferds, Worcester, Mass	Worcester.
62	Breck's Lawn and Garden Dressing,	Bradley Fertilizer Co., Boston, Mass	Boston.
72	Fruit and Vine Manure,	Mapes Formula & Peruvian Guano Co., New York, N. Y.	Boston.
75	West Andover Market Bone Phosphate	J. E. McGovern, West Andover, Mass	Lawrence.
85	Tobacco and Potato Fertilizer,	Clark Cove Fertilizer Co., Boston, Mass	Lawrence.
87	Lawn Dressing	Crocker Fertilizer & Chemical Co., Buffalo, N. Y	Fitchburg.
94	Sure Crop Bone Phosphate,	Bowker Fertilizer Co., Boston, Mass	Amesbury.
97	Cumberland Potato Fertilizer,	Cumberland Bone Phosphate Co., Portland, Me.,	Lowell.
101	Corn Manure	Quinnipiac Fertilizer Co., Boston, Mass.,	Fitchburg.
103	Farm and Garden Phosphate,	Bowker Fertilizer Co., Boston, Mass	Fitchburg.
109	Fertilizer for Grass and Grain,	Great Eastern Fertilizer Co., Rutland, Vt	Mansfield.
117	Ammoniated Bone Superphosphate,	E. Frank Coe., New York, N. Y	Palmer.
145	Ammoniated Bone Superphosphate,	E. Frank Coe, N.w York, N. Y.,	Dighton.
152	Lawn Dressing	Crocker Fertilizer & Chemical Co., Buffalo, N. Y	Amherst.
160	West Andover Market Bone Phosphate,	J. E. McGovern, West Andover, Mass	Amherst.
198	Ammoniated Bone Superphosphate,	E. Frank Coe, New York, N. Y	Williamstown.
207	Banner Fertilizer,	Walker, Stratman & Co., Pittsburg, Pa	Leeds.
222	Conn. Wrapper Fertilizer "Pinney Formula"	Cleveland Linseed Oil Co., Cleveland, Ohio	Amherst.
	Bones.		
26	Pure Raw Ground Bone,	H. J. Baker & Bro., New York, N. Y	Springfield.
67	Fine Ground Bone,	Bradley Fertilizer Co., Boston, Mass	Boston.
70	Pure Fine Ground Bone,	C. A. Bartlett, Worcester, Mass	Boston.
88	Fine Ground Bone,	L. B. Darling Fertilizer Co., Pawtucket, R. I	Newburyport.
113	Fine Ground Bone,	Bradley Fertilizer Co., Boston, Mass	Palmer.
126	Meat and Bone,	Thomas Hersom & Co., New Bedford, Mass	New Bedford.
146	White Oak Pure Ground Bone,	Clark Cove Fertilizer Co., Boston, Mass.	Dighton.
170	Quinnipiac Pure Ground Bone,	Quinnipiac Fertilizer Co., Boston, Mass.	Williamstown.

Laboratory Number.	Name of Brand.	Moisture.	Nitrogen in 100 lbs. Found.	Nitrogen in 100 lbs. Guaranteed.	Phosphoric Acid in 100 lbs. Soluble.	Reverted.	Insoluble.	Total. Found.	Total. Guaranteed.	Available. Found.	Available. Guaranteed.	Potassium Oxide in 100 lbs. Found.	Potassium Oxide in 100 lbs. Guaranteed.
	Compound Fertilizers.												
3-207	Banner Fertilizer, ...	11.39	1.62	2.06-2.88	5.88	2.81	4.61	13.30	11-12	8.69	9-10	1.06	1-2
5-222	Ct. Wrap. Fert., "Pinney Formula"	6.53	4.22	4.50-5.25	—	3.84	1.74	5.58	5.70-6.20	3.84	—	11.20	10-11*
29	Tankage, ...	8.78	5.99	6.18-6.59	—	5.64	6.52	12.16	10-11	5.64	—	—	—
45	Vegetable Manure, ...	10.78	4.57	4.94-6.59	5.62	2.56	1.62	9.80	8-10	8.18	6-8	7.40	6-8
46	Complete Manure for Pot. and Veg..	12.17	3.47	3.73-4.52	6.70	2.00	.82	9.52	9-13	8.70	8-11	6.23	6-7
48	Potato Manure, ...	12.70	2.00	2.47-3.30	5.17	3.76	6.32	15.35	15-17	8.93	10-12	4.98	5-6
62	Breck's Lawn and Garden Dressing.	9.55	3.95	4.12-4.94	3.86	2.07	2.05	7.98	—	5.93	5-6	5.47	5-6
72	Fruit and Vine Manure, ...	8.46	2.42	1.65-2.47	5.73	2.46	1.48	9.67	7-9	8.19	5-7	12.02	11-12
75-160	West Andover Market Bone Phos.,	14.92	2.10	1.50-2.50	4.22	9.64	1.74	15.60	13-15	13.86	—	3.92	2-4
85	Tobacco and Potato Fertilizer, ...	14.19	2.01	2.06-2.88	6.60	3.22	1.54	11.36	9-13	9.82	8-11	3.67	3-4*
87-152	Crocker's Lawn Dressing, ...	8.53	3.18	4.12-4.94	.27	9.16	13.87	23.30	18-20	9.43	—	3.45	3.74-4.32*
94	Sure Crop Bone Phosphate, ...	13.55	.95	.82-1.65	7.96	2.76	3.07	13.79	10-12	10.72	5-6	2.09	1-2*
97	Cumberland Potato Fertilizer, ...	15.67	2.34	2.06-2.88	6.91	3.58	1.79	12.28	11-13	10.49	9-11	3.55	3-4*
101	Corn Manure, ...	12.73	2.28	2.06-2.88	6.90	3.46	2.12	12.48	10-14	10.36	9-12	1.64	1.50-2.50*
103	Farm and Garden Phosphate, ...	11.11	2.51	1.65 2.47	6.45	1.74	3.48	11.67	12-14	8.19	8-10	2.39	2-3*
109	Fertilizer for Grass and Grain, ...	15.91	3.48	2.88-3.71	5.98	2.36	1.48	9.82	—	8.34	8-12	2.20	2-4
117-145-198	Ammoniated Bone Superphosphate.	10.40	1.88	2	7.43	1.24	3.07	11.74	11-15	8.67	9-12	1.75	1.85*

Laboratory Number.	Name of Brand.	Moisture.	Nitrogen Found.	Nitrogen Guaranteed.	Soluble.	Reverted.	Insoluble.	Total Found.	Total Guaranteed.	Available Found.	Available Guaranteed.	Mechanical Analysis. Fine.	Med. Fine.	Med.	Coarse Med.
	Bones.														
26	Pure Raw Ground Bone, ...	10.07	3.61	3.30-3.71	—	7.58	15.86	23.44	22-26	7.58	—	13.46	41.23	3.68	1.63
67-113	Fine Ground Bone, ...	9.21	3.79	2.50-3.25	.18	5.86	13.44	19.48	21-23	6.04	—	40.14	37.42	22.44	—
70	Pure Fine Ground Bone, ...	3.55	2.63	3-4	.51	9.98	15.61	26.10	24-26	10.49	—	55.85	27.73	16.00	.42
88	Fine Ground Bone, ...	9.06	2.61	3.50-4.50	.15	9.49	14.05	23.79	22-25	9.64	—	73.02	18.62	8.36	—
126	Meat and Bone, ...	5.48	4.47	4.24	—	6.93	12.96	19.89	19.52	6.93	6.73	—	—	—	—
146	White Oak Pure Ground Bone, ...	9.57	3.19	2.47-4.12	—	6.85	13.02	19.87	20-22	6.43	—	44.22	29.25	25.79	.74
170	Pure Ground Bone, ...	9.31	3.22	2.47-4.12	.26	7.02	12.54	19.82	20-25	7.28	—	51.94	26.49	21.57	—

*Sulphate of Potash, the source of Potash.

ANALYSES OF COMMERCIAL FERTILIZERS COLLECTED DURING 1893, IN THE GENERAL MARKETS BY THE AGENT OF THE MASSACHUSETTS STATE AGRICULTURAL EXPERIMENT STATION.

Laboratory No.	Name of Brand.	Name of Manufacturer.	Sampled at
	Compound Fertilizers.		
2	Tobacco Special,	Walker Stratman & Co., Pittsburg, Pa.,	Amherst.
89	Vegetable Bone Superphosphate,	Crocker Fertilizer & Chemical Co., Buffalo, N. Y.,	Fitchburg.
120	General Combination Fertilizer,	J. J. H. Gregory & Son, Marblehead, Mass.,	Amherst.
133	Special Potato Manure,	Pacific Guano Co., Boston, Mass.,	Fall River.
135	Tobacco and Sulphur Lawn Fertilizer,	F. C. Sturtevant, Hartford, Ct.,	Brockton.
139	Bristol Fish and Potash,	Bowker Fertilizer Co., Boston, Mass.,	Dighton.
142	Great Planet "A" Manure,	Clark Cove Fertilizer Co., Boston, Mass.,	Dighton.
149	Vegetable Bone Superphosphate,	Crocker Fertilizer & Chemical Co., Buffalo, N. Y.,	Amherst.
163	Ground Bone Fertilizer,	John C. Dow & Co., Boston, Mass.,	Amherst.
167	Ammoniated Bone Superphosphate,	National Fertilizer Co., Bridgeport, Ct.,	Pittsfield.
168	Tobacco and Sulphur Lawn Fertilizer,	F. C. Sturtevant, Hartford, Ct.,	Gt. Barrington
172	Complete Grass Fertilizer,	National Fertilizer Co., Bridgeport, Ct.,	Pittsfield.
177	Ammoniated Bone Superphosphate,	National Fertilizer Co., Bridgeport, Ct.,	Gt. Barrington
203	Special Tobacco Manure,	H. J. Baker & Bro., New York, N. Y.,	Northampton.
209	Ground Bone and Potash,	E. Frank Coe, New York, N. Y.	Hadley.
219	Dry Ground Fish Guano,	Leander Wilcox, Mystic, Ct.,	Amherst.
231	Tobacco Special,	Walker Stratman & Co., Pittsburg, Pa.,	Northampton.
10	Dry Ground Fish,	Williams & Clark Fertilizer Co., Boston, Mass.,	Hadley.
91	Quinnipiac Phosphate,	Quinnipiac Fertilizer Co., Boston, Mass.,	Fitchburg.
100	King Phillip Guano,	Clark's Cove Fertilizer Co., Boston, Mass.,	Lawrence.
195	High Grade Special,	Williams & Clark Fertilizer Co., Boston, Mass.,	Greenfield.
	Chemicals.		
8	Sulphate of Potash,	Williams & Clark Fertilizer Co., Boston, Mass.,	Hadley.
41	Muriate of Potash,	Bradley Fertilizer Co., Boston, Mass.,	Worcester.
51	Dissolved Bone Black,	Bowker Fertilizer Co., Boston, Mass.,	Amherst.
54	Sulphate of Potash,	Bowker Fertilizer Co., Boston, Mass.,	Amherst.
134	Muriate of Potash,	Clark's Cove Fertilizer Co., Boston, Mass.,	Dighton.
183	Sulphate of Potash,	Lucien Sanderson, New Haven, Ct.,	Greenfield.
232	Sulphate of Potash,	Clark's Cove Fertilizer Co., Boston, Mass.,	Agawam.

Laboratory Number.	Name of Brand.	Moisture.	Nitrogen in 100 lbs.		Phosphoric Acid in 100 lbs.							Potassium Oxide in 100 lbs.	
								Total.		Available.			
			Found.	Guaranteed.	Soluble.	Reverted.	Insoluble.	Found.	Guaranteed.	Found.	Guaranteed.	Found.	Guaranteed.
	Compound Fertilizers.												
2-231	Tobacco Special,	10.50	3.46	2.47-3.30	5.42	.60	6.26	12.28	10-12	6.02	8-10	3.22	3-4
89-149	Vegetable Bone Superphosphate,	11.90	5.03	5-6	5.08	.88	1.66	7.62	6-7	5.96	6.00-7.00	7.76	6-8*
120	General Combination Fertilizer,	7.51	3.14	3.29-4.12	1.84	3.17	2.97	7.98	8	5.01	6-7	12.17	12-13
133	Special Potato Manure,	18.84	2.78	2.47-3.30	4.91	1.82	2.05	8.78	7-10	6.73	5-7	5.10	5-6
135-168	Tobacco & Sulphur Lawn Fertilizer.	13.23	1.95	1.96	—	—	—	.83	.75	—	—	8.11	7.66
139	Bristol Fish and Potash,	12.55	2.05	1.60-2.50	6.38	1.62	4.12	12.12	8-10	8.00	5-8	2.60	2-3*
142	Great Planet "A" Manure,	11.65	3.88	3.30-4.12	4.61	3.24	1.41	9.26	9-13	7.85	8-11	7.26	7-8*
163	Ground Bone Fertilizer,	7.91	2.32	2.06-2.47	.83	2.44	16.35	19.62	18-22	3.27	—	2.07	1.62-1.89*
167-177	Ammoniated Bone Superphosphate.	7.42	1.90	1.65-2.47	1.75	4.67	5.14	11.56	9-11	6.42	7-9	3.88	2-4
172	Complete Grass Fertilizer,	13.27	4.25	4.12-4.94	7.32	2.15	.61	10.08	6-8	9.47	4-6	6.42	5-7
203	Special Tobacco Manure,	6.71	4.54	4.53-5.36	3.38	1.22	1.23	5.83	—	4.60	—	11.25	10-12*
209	Ground Bone and Potash,	9.71	1.57	2-2.50	.72	6.06	8.57	15.35	10.99-11.91	6.78	—	2.71	2.75*
219	Dry Ground Fish Guano,	8.51	8.52	8-10	.59	3.45	3.51	7.55	—	6.96	4-6	—	—
† 10	Dry Ground Fish,	10.62	8.86	7.41-9.06	1.11	3.68	2.05	6.84	7-9	4.79	—	—	—
† 91	Quinnipiac Phosphate,	14.41	2.56	2.47-3.30	7.14	2.21	1.45	10.80	10-14	9.35	9-12	2.32	2-3*
†100	King Philip Guano,	17.69	1.23	1.03-1.64	6.40	2.30	1.02	9.72	9-12	8.70	8-10	2.13	2-3
†195	High Grade Special,	12.45	3.66	3.71-4.11	7.09	.94	.59	8.62	8-11	8.03	7-9	7.83	7-9
	Chemicals.												
8	Sulphate of Potash,	2.00	—	—	—	—	—	—	—	—	—	29.10	—
41	Muriate of Potash,	1.57	—	—	—	—	—	—	—	—	—	51.40	48-55
51	Dissolved Bone Black,	15.72	—	—	12.95	2.22	.19	15.36	15.35	15.17	15.29	—	—
54	Sulphate of Potash,	6.00	—	—	—	—	—	—	—	—	—	26.52	25.93-28.10
134	Muriate of Potash,	1.75	—	—	—	—	—	—	—	—	—	48.90	—
183	Sulphate of Potash,	6.10	—	—	—	—	—	—	—	—	—	29.30	27.02-29.72
232	Sulphate of Potash,	.14	—	—	—	—	—	—	—	—	—	51.00	48.65-51.35

*Sulphate of Potash, the source of Potash.

† Nos. 10, 91, 100 and 195 are republished from the May and June bulletins in which the guaranteed ammonia was stated as guaranteed nitrogen, making them wrongly appear to be below the guarantees. No. 195 was published as "Potato and Tobacco Fertilizer," but is claimed by the company to represent their "High Grade Special."

II.

ANALYSES OF COMMERCIAL FERTILIZERS AND MANURIAL SUBSTANCES SENT ON FOR EXAMINATION.

886—889.

I. Animal meal and tankage. Sent on from Eastham, Mass.
II. Tankage and potash. Sent on from Eastham, Mass.
III. Cotton-hull ashes. Sent on from Boston, Mass.
IV. Florida rock phosphate. From Station barn.

	I.	*II.*	*III.*	*IV.*
Moisture at 100° C.,	3.20	6.20	9.87	2.52
Oxides of iron and alumina,	—	—	—	14.25
Calcium oxide,	—	—	—	17.87
Phosphoric acid,	19.71	15.35	7.68	21.72
Potassium oxide,	—	6.75	24.06	—
Nitrogen,	4.48	3.93	—	—
Insoluble matter,	—	—	15.38	30.50

890—894. WOOD ASHES.

I. Sent on from Winchendon, Mass.
II. Sent on from North Hadley, Mass.
III. Sent on from Concord, Mass.
IV. Sent on from Framingham, Mass.
V. Sent on from North Sudbury, Mass.

	I.	*II.*	*III.*	*IV.*	*V.*
Moisture at 100° C.,	23.07	4.48	16.16	16.39	17.74
Calcium oxide,	33.04	37.32	32.46	35.52	33.76
Potassium oxide,	2.87	6.75	5.88	4.83	6.45
Phosphoric acid,	1.48	1.82	1.07	1.33	1.00
Insoluble matter (before calcination),	10.96	15.53	15.34	10.07	13.37
Insoluble matter (after calcination),	9.29	13.72	13.09	9.28	12.13

895—899. WOOD ASHES.

I and II. Sent on from Concord, Mass.
III. Sent on from Eastham, Mass.
IV. Sent on from Westboro', Mass.
V. Sent on from Sunderland, Mass.

	I.	*II.*	*III.*	*IV.*	*V.*
Moisture at 100° C.,	8.96	13.00	15.33	20.57	19.52
Calcium oxide,	25.60	36.44	36.14	32.03	29.51
Potassium oxide,	3.00	8.74	5.96	5.93	6.21
Phosphoric acid,	.97	1.79	.26	1.48	1.83
Insoluble matter (before calcination),	36.93	8.44	12.91	10.05	13.47
Insoluble matter (after calcination),	34.89	6.40	10.38	8.09	10.85

III.

ANALYSES OF FODDER ARTICLES.

I. Hay. Grown on Station meadows.
II. Rowen. Grown on Station meadows.

	I.	*II.*
Moisture at 100° C.,	8.94	17.31
Dry matter,	91.06	88.69
	100.00	100.00
ANALYSIS OF DRY MATTER.		
Crude ash,	6.64	6.48
Crude cellulose,	34.82	29.98
Crude fat,	3.18	4.23
Crude protein,	10.41	12.11
Non-nitrogenous extract matter,	44.95	47.20
	100.00	100.00

I. Fodder corn (Pride of North). Station. Used for ensilage.
II. Corn and soja bean ensilage. From Station silo.

	I.	*II.*
Moisture at 100° C.,	68.53	77.78
Dry matter,	31.47	22.22
	100.00	100.00
ANALYSIS OF DRY MATTER.		
Crude ash,	5.68	9.48
Crude cellulose,	22.99	26.62
Crude fat,	2.81	3.75
Crude protein,	6.22	7.91
Non-nitrogenous extract matter,	62.30	52.24
	100.00	100.00

I and II. Cotton-seed meal. From Station barn.
III. Buffalo gluten feed. From Station barn.
IV. Hen food. Sent in from Eastham, Mass.

	I.	*II.*	*III.*	*IV.*
Moisture at 100° C.,	6.81	5.58	7.55	5.23
Dry matter,	93.19	94.42	92.45	94.77
	100.00	100.00	100 00	100.00
ANALYSIS OF DRY MATTER.				
Crude ash,	7.10	7.64	.85	—
Crude cellulose,	6.54	5.08	10.06	—
Crude fat,	12.39	14.40	12.48	15.66
Crude protein,	44.33	45.09	23.86	24.27
Non-nitrogenous extract matter,	29.34	27.79	52.75	—
	100.00	100.00	100.00	

TRADE VALUES OF FERTILIZING INGREDIENTS IN RAW MATERIALS AND CHEMICALS.

	1893. Cents per pound.
Nitrogen in ammonia salts,	17
" " nitrates,	15½
Organic nitrogen in dry and fine ground fish, meat, blood, and in high-grade mixed fertilizers,	17½
" " " cotton-seed meal, linseed meal and castor pomace,	16½
" " " fine ground bone and tankage,	15
" " " fine ground medium bone and tankage,	12
" " " medium bone and tankage,	9
" " " coarse bone and tankage,	7
" " " hair, horn-shavings and coarse fish scraps,	7
Phosphoric acid soluble in water,	6½
" " soluble in ammonium citrate,	6
" " in fine bone and tankage,	6
" " in fine medium bone and tankage,	5
" " in medium bone and tankage,	4
" " in coarse bone and tankage,	3
" " in fine ground fish, cotton-seed meal, linseed meal, castor pomace and wood ashes,	5
" " insoluble (in am. cit.) in mixed fertilizers,	2
Potash as High Grade Sulphate, and in mixtures free from Muriate,	5½
" " Muriate,	4½

The manurial constituents contained in feedstuffs are valued as follows:

Organic Nitrogen,	17½
Phosphoric acid,	5
Potash,	5½

The Bulletins of the Mass. Experiment Station will be sent free of charge to all parties interested in its work, on application.

C. A GOESSMANN, *Director.*

Amherst, Mass., August 5, 1893.

Carpenter & Morehouse, Printers, Amherst, Mass.

MASSACHUSETTS STATE

AGRICULTURAL EXPERIMENT STATION.

BULLETIN NO. 50.

OCTOBER, 1893.

Meteorological Summary, for August and September, 1892-1893.

	AUG. '92.	AUG. '93.	SEPT. '92.	SEPT. '93.
Mean temperature,	67.78°	68.13°	59.30°	55.71°
Highest temperature,	90.00°	94.00°	79.00°	81.00°
Lowest temperature,	51.50°	40.00°	34.00°	31.00°
Mean range,	20.61°	24.87°	25.08°	24.97°
Total precipitation (inches),	5.70	3.49	1.53	2.57
Prevailing wind,	N.	N.	S.	S. W.

The mean temperature for August was .35 of a degree above that for August '92, and the rainfall was 2.21 inches less than that of August last year.

There were unusually heavy storms of wind and rain on the 24th and 29th of August, the wind doing considerable damage to crops, blowing much of the fruit from the trees. Many fruit and shade trees were injured.

The mean temperature for September was below the average, being 3.59 degrees below that of September '92.

The rainfall was 1.04 inches greater than that for the same month last year.

There was a slight frost on the 3d of September which was the first noticed this season.

I. ANALYSES OF COMMERCIAL FERTILIZERS COLLECTED DURING 1893, IN THE GENERAL MARKETS BY THE AGENT OF THE MASSACHUSETTS STATE AGRICULTURAL EXPERIMENT STATION.

Laboratory No.	Name of Brand.	Name of Manufacturer.	Sampled at
	Compound Fertilizers.		
99	Wheat and Corn Phosphate,	Crocker Fertilizer & Chemical Co., Buffalo, N. Y	Fitchburg.
115	Potato Phosphate,	Cleveland Deyer Co., Boston, Mass.	So. Fram'gham
121	Corn Fertilizer,	J. J. H. Gregory & Son, Marblehead, Mass.,	Amherst.
132	Dry Ground Manhaden Fish Guano,	W. J. Brightman & Co., Tiverton, R. I.	Fall River.
143	High Grade Special,	Williams & Clark Fertilizer Co., Boston, Mass.,	Dighton.
144	Fish and Potash,	Clark's Cove Fertilizer Co., Boston, Mass.,	Dighton.
151	Wheat and Corn Phosphate,	Crocker Fertilizer & Chemical Co., Buffalo, N. Y.,	Amherst.
156	Ammoniated Practical Superphosphate,	Crocker Fertilizer & Chemical Co., Buffalo, N. Y.,	Amherst.
158	New Rival Ammoniated Superphosphate,	Crocker Fertilizer & Chemical Co., Buffalo, N. Y	Amherst.
164	Canada Hardwood Unleached Ashes,	Allison Stroup & Co., Boston, Mass.	Williamstown
175	New England Favorite,	J. S. Reese & Co., Baltimore, Md.	Pittsfield.
176	Fish and Potash,	Williams & Clark Fertilizer Co., Boston, Mass.,	Greenfield.
178	Grass Fertilizer,	Quinnipiac Fertilizer Co., Boston, Mass.,	Pittsfield.
179	Complete Fertilizer for Potatoes,	National Fertilizer Co., Bridgeport, Ct.,	Pittsfield.
186	Wheat and Corn Phosphate,	Crocker Fertilizer & Chemical Co., Buffalo, N. Y.	No Adams.
187	Bay State Fertilizer, (G. G. Brand)	Clark's Cove Fertilizer Co., Boston, Mass.,	Greenfield.
189	Grass Fertilizer,	Quinnipiac Fertilizer Co., Boston, Mass.	Williamstown.
191	Standard Fertilizer,	Standard Fertilizer Co., Boston, Mass.	Gt. Barrington
192	Lawn Dressing,	Williams & Clark Fertilizer Co., Boston, Mass.,	No. Adams.
197	Blood, Meat and Bone,	Lucien Sanderson, New Haven, Ct.,	Greenfield.
200	Superphosphate No. 2,	Preston Fertilizer Co., Greenpoint, L. I.	Williamstown.
202	Fine Dry Ground Fish,	Bowker Fertilizer Co., Boston, Mass.,	Northampton.
204	Complete Grass Manure,	H. J. Baker & Bro., New York, N. Y.,	Northampton.
206	Dry Ground Fish,	National Fertilizer Co., Bridgeport, Ct.,	Hadley.
210	Excelsior Tobacco Grower,	E. Frank Coe, New York, N. Y.	Hadley.
212	High Grade Fish Guano and Potash,	E. Frank Coe, New York, N. Y.	Hadley.
213	Dry Ground Fish,	National Fertilizer Co., Bridgeport, Ct.,	Hadley.
220	Fish and Potash	Leander Wilcox, Mystic, Ct.,	Amherst.
221	Corn Phosphate,	Williams & Clark Fertilizer Co., Boston, Mass.	Amherst.
235	Potato Special,	J. S. Reese & Co., Baltimore, Md.	Chicopee.
236	Whittemore's Comp[illegible] Manure,	Whittemore Bros., Wayland, Mass.	Amherst.

Laboratory Number.	NAME OF BRAND.	Moisture.	Nitrogen in 100 lbs.		Phosphoric Acid in 100 lbs.							Potassium Oxide in 100 lbs.	
								Total.		Available.			
			Found.	Guaranteed.	Soluble.	Reverted.	Insoluble.	Found.	Guaranteed.	Found.	Guaranteed.	Found.	Guaranteed.
	Compound Fertilizers.												
99-151-186	Wheat and Bone Phosphate, ...	14.61	1.78	2-3	7.32	2.50	2.05	11.87	10-13	9.82	10-13	1.82	1.6-2.7*
115	Potato Phospate, ...	16.68	2.23	2-2.25	7.22	1.91	1.69	10.82	9-13	9.13	8-10	3.81	3-4*
121	Corn Fertilizer, ...	6.85	3.12	3.09	1.25	4.71	2.41	8.37	7.	5.96	5.5	12.96	15.
132	Dry Ground Manhaden Fish Guano,	9.77	8.86	8.24-9.89	.56	3.23	3.17	6.96	6.87-9-16	3.79	—	—	—
143	High Grade Special, ...	11.26	3.68	3.30-4.12	7.60	1.22	.90	9.72	8-11	8.82	7-9	7.90	8-9
144	Fish and Potash, ...	21.96	2.65	2.47-4.12	2.97	2.58	1.82	7.37	7-9	5.55	6-8	2.61	3-5*
156	Ammoniated Practical Superphos.	12.31	1.14	.82-1.64	5.95	.62	2.38	8.94	8-10	6.57	8-10	1.31	1-2
158	New Rival Ammoniated Superphos.	16.18	1.43	1.20-2.	7.42	2.18	1.66	11.26	10-12	9.60	10-12	1.58	1.60-3
164	Canada Hardwood Unleached Ashes,	8.88	—	—	—	—	—	1.79	1.36-1.83	—	—	8.26	5.84-6.80
175	New England Favorite, ...	18.97	2.45	2.47-3.30	4.78	4.24	1.54	10.56	11-14	9.02	9-12	2.04	2-3
176	Fish and Potash, ...	22.34	2.10	2.5-3.5	2.64	3.27	1.02	6.93	6-9	5.91	4-6	4.61	4-6*
178-189	Grass Fertilizer,..................	9.81	4.26	4.75-5.75	2.25	3.73	2.00	7.98	6-8	5.98	5-7	3.25	2-3*
179	Complete Fertilizer for Potatoes,..	12.93	4.60	3.30-4.12	7.12	2.64	.30	10.06	10-12	9.76	8-10	5.44	6-8
187	Bay State Fertilizer(G. G. Brand),	13.58	2.09	1.85-2.68	6.45	2.05	1.92	10.44	10-13	8.50	8.5-11	2.13	2-3*
191	Standard Fertilizer, ...	15.46	2.00	2-3	6.60	2.99	1.54	11.13	10-15	9.59	8-12	2.27	2-3
192	Lawn Dressing, ...	8.78	4.31	4.95-5.78	1.90	3.60	1.28	6.78	6-8	5.50	5-7	3.36	2.5-3.5
197	Blood, Meat and Bone,............	6.30	5.54	5.77 7.41	.38	3.58	5.12	9.08	10.12	3.96	—	—	—
200	Superphosphate No. 2, ...	15.33	1.71	.82-1.65	7.70	1.80	1.02	10.52	—	9.50	10-12	2.23	1-2
202	Fine Dry Ground Fish, ...	15.96	8.32	8-10	.51	4.09	1.51	6.14	7-8	4.60	—	—	—
204	Complete Grass Manure, ...	11.00	3.60	3.71	2.41	3.99	1.33	7.73	—	6.40	3	7.69	7
206-213	Dry Ground Fish,.................	16.77	8.17	8.24-9.89	.40	5.34	1.76	7.50	6-8	5.74	—	—	—
210	Excelsior Tobacco Grower, ...	7.84	3.10	3-4	8.75	1.53	1.64	11.92	8-11	10.28	8-11	4.93	5-6*
212	High Grade Fish Guano and Potash,	10.78	2.73	3.30-4.10	2.46	4.20	3.08	9.74	7-11	6.66	6-9	2.92	2.75*
220	Fish and Potash, ...	13.15	3.44	3.25-4.25	2.38	2.71	1.46	6.55	6-7	5.09	5-6	4.45	4-5
221	Corn Phosphate,...................	14.52	2.52	2.06.2.88	7.16	4.38	2.22	13.76	10.25-14	11.54	9-12	1.62	1.5-2.5
235	Potato Special, ...	14.11	2.72	2.88-3.71	7.78	1.95	.20	9.93	—	9.73	6-8	7.65	7.5-9.5
236	Whittemore's Complete Manure, ..	11.69	3.30	2.47-3.30	6.24	5.86	1.84	13.94	12-14	12.10	8.12	4.30	3-4

*Sulphate of Potash, the source of Potash.

ANALYSES OF COMMERCIAL FERTILIZERS COLLECTED DURING 1893, IN THE GENERAL MARKETS BY THE AGENT OF THE MASSACHUSETTS STATE AGRICULTURAL EXPERIMENT STATION.

Laboratory No.	Name of Brand.	Name of Manufacturer.	Sampled at
	Compound Fertilizers.		
4	Four Fold Fertilizer,	Walker Stratman & Co., Pittsburg, Pa	Amherst.
15	Potato Manure,	Bradley Fertilizer Co., Boston, Mass.	Springfield.
20	Potato Manure,	Bradley Fertilizer Co., Boston, Mass.	Worcester.
23	Complete Manure for Top Dressing Grass,	Prentiss, Brooks & Co., Holyoke, Mass.	Holyoke.
31	Superphosphate,	Prentiss, Brooks & Co., Holyoke, Mass.	Holyoke.
33	A. A. Ammoniated Superphosphate,	H. J. Baker & Bro., New York, N. Y.	Springfield.
37	Lawn and Garden Dressing,	Bowker Fertilizer Co., Boston, Mass	Springfield.
60	Fish and Potash,	Bradley Fertilizer Co., Boston, Mass.,	No. Amherst.
66	Hill and Drill Phosphate,	Bowker Fertilizer Co., Boston, Mass.	Boston.
78	Royal Bone Phosphate,	Williams & Clark, Fertilizer Co., Boston, Mass.	Lowell.
79	Prolific Crop Producer,	Williams & Clark, Fertilizer Co., Boston, Mass.	Lowell.
84	Lawn and Garden Dressing,	Bowker Fertilizer Co., Boston, Mass.	Lawrence.
95	Farmers New Method Fertilizer,	Bradley Fertilizer Co., Boston, Mass.	Amesbury.
116	Hill and Drill Phosphate,	Bowker Fertilizer Co., Boston, Mass.	So. Fram'gham
208	Four Fold Fertilizer.	Walker, Stratman & Co., Pittsburg, Pa.	Leeds.
	Chemicals.		
6	Nitrate of Soda,	Williams & Clark, Fertilizer Co., Boston, Mass.	Hadley.
7	Dissolved Bone Black,	Williams & Clark, Fertilizer Co., Boston, Mass.	Hadley.
25	Nitrate of Soda,	Bradley Fertilizer & Co., Boston, Mass.	Worcester.
30	Nitrate of Soda,	Prentiss, Brooks & Co., Holyoke, Mass.	Holyoke.
38	Muriate of Potash,	Prentiss, Brooks & Co., Holyoke, Mass.	Holyoke.
39	Dissolved Bone Black,	Prentiss, Brooks & Co., Holyoke, Mass.	Holyoke.
44	Sulphate of Potash,	Bradley Fertilizer Co., Boston, Mass.	Worcester.
58	Nitrate of Soda,	Bowker Fertilizer Co., Boston, Mass.	Amherst.
59	Muriate of Potash,	Bowker Fertilizer Co., Boston, Mass.	Amherst.
137	Nitrate of Soda,	Clark Cove Fertilizer Co., Boston, Mass.,	Dighton.
180	Nitrate of Soda,	Quinnipiac Fertilizer Co., Boston, Mass.,	Williamstown.
181	Dissolved Bone Black,	Lucien Sanderson, New Haven, Conn.	Greenfield.
182	Nitrate of Soda,	Lucien Sanderson, New Haven, Conn.	Greenfield.
194	Sulphate of Potash,	Quinnipiac Fertilizer Co., Boston, Mass.	Williamstown.
196	Muriate of Potash,	Lucien Sanderson, New Haven, Conn.	Greenfield.
211	Sulphate of Potash,	National Fertilizer Co., Bridgeport, Conn.	Hadley.
233	Sulphate of Potash,	Clark Cove Fertilizer Co., Boston, Mass.	Agawam.
	Bones.		
63	Fresh Ground Bone,	Bowker Fertilizer Co., Boston, Mass.	Boston.
104	Pure Ground Bone	Mapes Formula & Peruvian Guano Co., New York, N. Y.	Fitchburg.
107	Pure Ground Bone	John C. Dow & Co., Boston, Mass.	Lowell.

Laboratory Number.	Name of Brand.	Moisture.	Nitrogen in 100 lbs. Found.	Nitrogen in 100 lbs. Guaranteed.	Phosphoric Acid in 100 lbs. Soluble.	Reverted.	Insoluble.	Total. Found.	Total. Guaranteed.	Available. Found.	Available. Guaranteed.	Potassium Oxide in 100 lbs. Found.	Potassium Oxide in 100 lbs. Guaranteed.
	Compound Fertilizers.												
4-208	Four Food Fertilizer,	10.88	1.65	1.65-2.47	4.55	2.98	4.27	11.80	10-11	7.53	8-9	4.32	2-3
15-20	Potato Manure,	13.10	2.55	2.50-3.25	4.06	2.67	1.94	8.67	8-11	6.73	6-8	4.93	5-6
23	Complete Manure top dressing grass	6.60	4.48	4.62-4.94	.76	3.35	1.77	5.88	7-8	4.11	4-5	8.04	8-10
31	Superphosphate,	16.06	2.32	2.47-3.30	4.96	3.81	3.20	11.97	10-12	8.77	8-10	3.01	3-4
33	A. A. Ammoniated Superphosphate,	13.77	2.72	2.47-3.30	7.69	2.13	.84	10.66	10.25-14.5	9.82	10-12	2.79	2-3
37-84	Lawn and Garden Dressing,	9.33	4.10	4.-5.	5-84	1.82	4.46	12.12	6-8	7.66	5-6	7.68	5-6
60	Fish and Potash,	22.04	2.38	2.48-3.50	2.50	3.28	1.51	7.29	7.5-8.5	5.78	6-8	2.67	2-3
66-116	Hill and Drill Phosphate,	12.	2.95	2.5-3.25	6.52	3.96	2.56	13.04	11-15	10.48	10-13	2.65	2-3
78	Royal Bone Phosphate,	19.26	.95	1.03-1.65	5.25	3.12	2.15	10.52	8-11	8.37	7-9	2.48	2-3*
79	Prolific Crop Producer,	18.73	1.02	2.	5.01	3.21	2.17	10.39	7-11	8.22	6-9	2.73	1-2
95	Farmers New Method Fertilizer,	16.85	1.18	1.-2.	5.42	2.61	1.69	9.72	10-13	8.03	8-10	2.29	2.16-2.70*
	Chemicals.												
6	Nitrate of Soda,	1.30	16.17	—	—	—	—	—	—	—	—	—	—
7	Dissolved Bone Black,	15.66	—	—	10.54	1.76	.44	12.74	—	12.30	—	—	—
25	Nitrate of Soda,	1.12	16.04	18.-20.	—	—	—	—	—	—	—	—	—
30	Nitrate of Soda,	.92	16.12	15.81-16.14	—	—	—	—	—	—	—	—	—
38	Muriate of Potash,	.02	—	—	—	—	—	—	—	—	—	54.10	53.70-56.86
39	Dissolved Bone Black,	16.25	—	—	15.42	.68	.18	16.28	17-18	16.10	—	—	—
44	Sulphate of Potash,	.55	—	—	—	—	—	—	—	—	—	49.70	48-52
58	Nitrate of Soda,	1.75	16.05	15.65-16.14	—	—	—	—	—	—	—	—	—
59	Muriate of Potash,	.12	—	—	—	—	—	—	—	—	—	52.20	50.54-53.70
137	Nitrate of Soda,	.85	16.03	15.66	—	—	—	—	—	—	—	—	—
180	Nitrate of Soda,	1.55	15.85	14.87-16.06	—	—	—	—	—	—	—	—	—
181	Dissolved Bone Black,	14.00	—	—	15.86	.43	2.43	18.72	16-18	16.29	—	—	—
182	Nitrate of Soda,	2.37	16.11	14.90-16.48	—	—	—	—	—	—	—	—	—
194	Sulphate of Potash,	1.35	—	—	—	—	—	—	—	—	—	49.40	—
196	Muriate of Potash,	1.19	—	—	—	—	—	—	—	—	—	52.05	50.54-53.70
211	Sulphate of Potash,	1.45	—	—	—	—	—	—	—	—	—	46.30	—
233	Sulphate of Potash,	3.01	—	—	—	—	—	—	—	—	—	25.50	25.93-28.10
	Bones.												
63-114	Fresh Ground Bone,	5.98	3.23	2.47-3.30	2.89	13.07	2.97	18.83	18-22	15.96	5-7		
104	Pure Ground Bone,	8.57	3.87	3.5-4.5	—	3.42	22.08	25.50	24-26	3.42	—		
107-161	Pure Ground Bone,	3.43	1.79	1.65-2.47	.20	16.82	10.69	27.71	24-26	17.02	—		

Mechanical Analysis.

Laboratory Number.	Fine.	Med. Fine.	Med.	Coarse Med.
63-114	33.10	31.39	26.27	9.24
104	.53	29.46	55.37	14.64
107-161	58.24	38.06	3.70	—

*Sulphate of Potash, the source of Potash.

II.

ANALYSES OF COMMERCIAL FERTILIZERS AND MANURIAL SUBSTANCES SENT ON FOR EXAMINATION.

WOOD ASHES.

(I. and II., sent on from North Amherst, Mass.; III. and IV., sent on from Westboro, Mass.; V. sent on from Sunderland, Mass.)

	Per Cent.				
	I.	II.	III.	IV.	V.
Moisture at 100° C.,	8.21	11.28	5.50	15.33	11.15
Calcium oxide,	39.48	40.24	45.20	33.60	—
Potassium oxide,	5.99	6.81	6.93	6.25	5.83
Phosphoric acid,	1.13	1.28	1.41	1.20	1.83
Insoluble matter (before calcination,)	10.33	10.58	10.57	10.70	23.85
Insoluble matter (after calcination,)	9.15	9.33	8.57	9.07	18.17

WOOD ASHES.

(I. and II., sent on from Concord, Mass.; III., sent on from North Amherst, Mass.; IV., sent on from Boston, Mass.; V., sent on from Rock Bottom, Mass.)

	Per Cent.				
	I.	II.	III.	IV.	V.
Moisture at 100° C.,	19.43	14.04	17.35	8.11	19.85
Calcium oxide,	35.48	34.55	35.51	—	—
Potassium oxide,	4.55	6.57	7.07	4.88	3.66
Phosphoric acid,	.81	1.60	1.64	1.31	.95
Insoluble matter (before calcination,)	17.58	13.50	8.60	20.67	16.89
Insoluble matter (after calcination,)	14.79	11.28	6.30	16.18	13.24

WOOD ASHES.

(I. and II., sent on from South Sudbury, Mass.; III., sent on from Hadley, Mass.; IV., sent on from Sunderland, Mass.; V., sent on from South Framingham, Mass.)

	Per Cent.				
	I.	II.	III.	IV.	V.
Moisture at 100° C.,	10.61	20.80	10.44	15.79	6.58
Potassium oxide,	5.24	4.19	6.38	6.86	4.79
Phosphoric acid,	1.20	.67	1.28	.95	1.02
Insoluble matter (after calcination,)	29.60	25.39	23.08	18.17	12.49

III.

MISCELLANEOUS FODDER ANALYSES.

(I., Wheat Bran, Station.; II., Wheat middlings, Station.; III., Louisiana Rice Bran. Sent on from Sudbury, Mass.)

	Per Cent.		
	I.	II.	III.
Moisture at 100° C.,	12.00	11.12	10.25
Dry matter,	88.00	88.88	89.75
	100.00	100.00	100.00

ANALYSIS OF DRY MATTER.

Crude ash,	7.70	3.48	10 59
Crude cellulose,	11.10	3.97	14.86
Crude fat,	5.80	5.92	9.66
Crude protein,	17.83	20.07	9.82
Nitrogen-free extract matter,	57·57	66.56	55.07
	100.00	100.00	100.00

FERTILIZING CONSTITUTENTS.

Moisture at 100° C.,	12.00	11.12	10.25
Potassium oxide,	1.542	.87	.84
Phosphoric acid,	2.699	1.54	1.71
Nitrogen,	2.500	2.86	1.43

(I., Soja-bean hay. ; II., Vetch and Oats. ; III., Vetch and Oats hay. All raised on Station grounds.)

	Per Cent I.	II.	III.
Moisture at 100° C.,	16.21	79.16	16.67
Dry matter,	83.79	20.84	83.33
	100.00	100.00	100.00

ANALYSIS OF DRY MATTER.

Crude ash,	12.62	8.80	11.38
Crude cellulose,	27.73	30.34	30.15
Crude fat,	2.55	3.90	3.45
Crude protein,	14.89	13.27	13.51
Nitrogen-free extract matter,	42.21	43.69	41.51
	100.00	100.00	100.00

I. Spring Wheat Bran, Station.
II. Winter Wheat Bran, Station.
III. Cooked Feed. Sent on from Worcester, Mass.

	Per Cent. I.	II.	III
Moisture at 100° C.,	12.28	12.24	5.55
Dry matter,	87.72	87.76	94.45
	100.00	100.00	100.00

ANALYSIS OF DRY MATTER.

Crude ash,	6.13	6.24	4.04
Crude cellulose,	11.48	9.32	8.73
Crude fat,	5.40	4.57	5.34
Crude protein,	17.60	17.04	14.75
Nitrogen-free extract matter,	59.39	62.83	67.14
	100.00	100.00	100.00

TRADE VALUES
OF FERTILIZING INGREDIENTS IN RAW MATERIALS AND CHEMICALS.*

	1893. Cents per pound.
Nitrogen in ammonia salts,	17
" " nitrates,	15½
Organic nitrogen in dry and fine ground fish, meat, blood, and in high-grade mixed fertilizers,	17½
" " " cotton-seed meal, linseed meal and castor pomace,	16½
" " " fine ground bone and tankage,	15
" " " fine ground medium bone and tankage,	12
" " " medium bone and tankage,	9
" " " coarse bone and tankage,	7
" " " hair, horn-shavings and coarse fish scraps,	7
Phosphoric acid soluble in water,	6½
" " soluble in ammonium citrate,	6
" " in fine bone and tankage,	6
" " in fine medium bone and tankage,	5
" " in medium bone and tankage,	4
" " in coarse bone and tankage,	3
" " in fine ground fish, cotton-seed meal, linseed meal, castor pomace and wood ashes,	5
" " insoluble (in am. cit.) in mixed fertilizers,	2
Potash as High Grade Sulphate, and in mixtures free from Muriate,	5½
" " Muriate,	4½

The manurial constituents contained in feedstuffs are valued as follows:

Organic Nitrogen,	17½
Phosphoric acid,	5
Potash,	5½

The Bulletins of the Mass. Experiment Station will be sent free of charge to all parties interested in its work, on application.

C. A. GOESSMANN, *Director.*

Amherst, Mass., October 21st, 1893.

Carpenter & Morehouse, Printers, Amherst, Mass.

MASSACHUSETTS STATE AGRICULTURAL EXPERIMENT STATION.

BULLETIN NO. 51.

MARCH, 1894.

I. General Discussion on Commercial Fertilizers.

II. Analyses of Fodder Articles.

1. GENERAL DISCUSSION ON COMMERCIAL FERTILIZERS.

As the season for field work on the farm is at hand a few suggestions are offered for the consideration of farmers.

To select judiciously from among the great variety of commercial fertilizers and manurial substances offered for patronage requires a fair knowledge regarding the general physical and chemical condition of the lands to be cultivated, the amount and character of the home manurial resources, and the special requirements of the crops under consideration.

As the physical conditions and chemical resources of soils are known to differ widely even on the same farm no definite rule can be given for manuring farm lands beyond the advice to furnish additional supplies of those plant constituents which the crops raised during past years have abstracted in an exceptionally large proportion, and which will be especially called for by the crops to be raised.

It has been the aim of this institution during past years in its annual reports, to furnish this needed information for the benefit of all parties interested in their cultivation, by publishing repeatedly the composition of the majority if not the entire number of farm crops raised in the state.

The present condition of trade in commercial fertilizers by furnishing not only compound mixtures for special crops, but also single articles of plant food in different forms, enable the intelligent farmer to supply his deficiencies in manurial substances. A judicious discrimination in choosing between them with reference to existing wants becomes a necessity in the interest of good economy.

Supplementing home made manures with special reference to the wants of the crops to be raised has not yet received the serious attention it deserves in the interest of remunerative crops.

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 condition of the soil to be treated and the special wants of the crops to be raised by their assistance, nor to the form in which the different guaranteed essential articles of plant food are best adapted.

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 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 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, 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 50 to 100 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.

	1894. Cents per pound.
Nitrogen in ammonia salts,	19
" " nitrates,	14½
Organic nitrogen in dry and fine ground fish, meat, blood, and in high-grade mixed fertilizers,	18½
" " " cotton-seed meal, linseed meal and castor pomace,	15
" " " fine ground bone and tankage,	16½
" " " fine ground medium bone and tankage,	15
" " " medium bone and tankage,	12
" " " coarse bone and tankage,	7
" " " hair, horn-shavings and coarse fish scraps,	7
Phosphoric acid soluble in water,	6
" " soluble in ammonium citrate,	5½
" " in fine bone and tankage,	5½
" " in fine medium bone and tankage,	4½
" " in medium bone and tankage,	3
" " in coarse bone and tankage,	2
" " in fine ground fish, cotton-seed meal, linseed meal, castor pomace and wood ashes,	5
" " insoluble (in am. cit.) in mixed fertilizers,	2
Potash as High Grade Sulphate, and in mixtures free from Muriate,	5
" " Muriate,	4½
The manurial constituents contained in feedstuffs are valued as follows:	
Organic Nitrogen,	15
Phosphoric acid,	5
Potash,	5

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, 18½ 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, 1894, 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 1st, plus about 20 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.

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 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.

II. ANALYSES OF FODDER ARTICLES.

I., Late soja bean, Station. Cut July 10, 1893, 12 to 13 inches high. Not in bloom. II., Early black soja bean, Station. Cut July 10, 1893, 16 to 17 inches high. On point of blooming. III., Early white soja bean, Station. Cut July 10, 1893, 14 inches high. Just before blooming. IV., Early white soja bean, Station. Cut July 10, 1898, 16 to 17 inches high. Before blooming.

	Per Cent.			
	I.	*II.*	*III.*	*IV.*
Moisture at 100° C.,	77.09	82.21	79.51	74.97
Dry matter,	22.91	17.79	20.49	25.03
	100.00	100.00	100.00	100.00
Analysis of Dry Matter.				
Crude ash,	14.36	12.86	14.36	11.85
Crude cellulose,	16.47	25.06	23.41	23.23
Crude fat,	3.34	3.38	2.97	2.16
Crude protein,	22.16	16.18	14.34	13.81
N-free extract matter,	43.67	42.52	44.92	48.95
	100.00	100.00	100.00	100.00

Total nitrogen,	3.54	2.59	2.29	2.21
Amide nitrogen,	.79	.55	.68	.31

I. Rowen from Station barn.
II. Carrots, raised on Station grounds.
III. Beets, raised on Station grounds.

	Per Cent. I.	II.	III.
Moisture at 100° C.,	18.64	88.01	83.71
Dry matter,	81.36	11.99	16.29
	100.00	100.00	100.00

Analysis of Dry Matter.

Crude ash,	7.62	7.98	6.79
Crude cellulose,	26.09	9.00	5.84
Crude fat,	3.28	2.03	.71
Crude protein,	14.42	7.29	13.27
Nitrogen-free extract matter,	48.59	73.70	73.39
	100.00	100.00	100.00

FERTILIZING INGREDIENTS.

Moisture at 100° C.,	18.64	88.01	83.71
Potassium oxide,	1.682	.441	.463
Phosphoric acid,	.574	.095	.111
Nitrogen,	1.876	.140	.346
Insoluble matter,	1.533	.029	.111

I., Potatoes, Station. Raised on Plat 1, Field C, with muriate of potash. II., Potatoes, Station. Raised on Plat 4, Field C, with sulphate of potash. III., Potatoes from Station barn.

	Per Cent. I.	II.	III.
Moisture at 100° C.,	80.71	81.17	78.67
Dry matter,	19.29	18.83	21.33
	100.00	100.00	100.00

Analysis of Dry Matter.

Crude ash,	4.71	4.64	4.76
Crude fibre,	2.26	2.35	2.30
Crude fat,	.54	.42	.62
Crude protein,	10.98	10.06	9.56
Nitrogen-free extract matter,	81.51	82.53	82.76
	100.00	100.00	100.00

Starch,	13.44	13.15	–*
Starch in dry matter,	69.66	70.31	–*

FERTILIZING INGREDIENTS.

Moisture at 100° C.,	80.71	81.17	78.67
Calcium oxide,	.018	.020	–*
Magnesium oxide,	.044	.041	–*
Potassium oxide,	.607	.553	.589
Sodium oxide,	.029	.024	–*
Phosphoric acid,	.065	.048	.134
Nitrogen,	.338	.303	.326
Insoluble matter,	.026	.048	.036

I., Peoria gluten feed, sent on from North Amherst, Mass. II., King gluten meal, sent on from New York, N. Y. III., Iowa gluten meal, sent on from Beverly, Mass. IV., Rye feed, sent on from Westborough, Mass. V., Oat feed, from Station barn.

Moisture at 100° C.,	7.50	6.65	7.33	8.23	6.50
Dry matter,	92.50	93.35	92.67	91.77	93.50
	100.00	100.00	100.00	100.00	100.00
Analysis of Dry Matter.					
Crude ash,	.90	2.19	–*	3.34	10.02
Crude cellulose,	8.86	1.62	–*	3.62	17.73
Crude fat,	13.62	21.44	16.08	3.04	3.95
Crude protein,	21.35	36.19	31.56	16.62	11.02
N-free extract matter,	55.27	38.56	–*	73.38	57.28
	100.00	100.00	–	100.00	100.00

* Not determined.

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C. A. GOESSMANN, *Director.*

Amherst, Mass., March 21st, 1894.

Carpenter & Morehouse, Printers, Amherst, Mass.

MASSACHUSETTS STATE

AGRICULTURAL EXPERIMENT STATION.

BULLETIN NO. 52.

JUNE, 1894.

Meteorological Summary, for five months, ending May 31st, 1894.

	JAN.	FEB.	MAR.	APR.	MAY.
Highest temp.,	52.00°	42.00°	64.00°	69.00°	84.00°
Lowest temp.,	1.00°	—18.00°	16.00°	14.00°	28.00°
Mean temp.,	25.43°	19.68°	39.00°	45.60°	56.45°
Total snowfall, (ins.)	20.20	18.25	2.00	4.5	
Total precipitation (in.)	2.43	2.17	1.68	1.60	3.80
Prevailing wind	N.W.	N.W.	S.W.	N.W.	S.W.

The mean temperature for January, February and March, viz. 28.03° was about 1.3° above the normal, and 6.15° above that for the first three months of last year.

April was unusually warm and pleasant. The mean temperature viz. 45.6° was 3.7° above that of April, '93, as recorded at this station. The precipitation was much below the normal.

The mean temperature for May was about normal. The mercury reached the freezing point several times, and on the morning of the 15th the minimum reading was 28°.

April being so warm and dry farmers were enabled to get most of their land in condition for planting, and some planted their potatoes, onions, etc., during the month.

On the station farm, potatoes, oats, spinach and mixed forage crops were planted between the 20th and 30th of April, which was about two weeks earlier than they were planted in the season of '93.

The drouth during the first part of May greatly retarded the germination of seeds and growth of the plants.

The severe frost of the 15th of May injured those farm crops that were up and greatly damaged fruit, especially on low lands.

The frequent showers during the latter part of May have made the hay crop look quite promising in this vicinity.

I. ANALYSES OF COMMERCIAL FERTILIZERS COLLECTED DURING 1894, IN THE GENERAL MARKETS BY THE AGENT OF THE MASSACHUSETTS STATE AGRICULTURAL EXPERIMENT STATION.

Laboratory No.	Name of Brand.	Name of Manufacturer.	Sampled at
	Compound Fertilizers.		
7	Lowell Bone Fertilizer	J. W. Butman, Lowell, Mass.	Amherst.
15	Blood, Bone and Meat,	Quinnipiac Fertilizer Co., Boston, Mass.,	Sunderland.
17	Blood, Bone and Meat,	Lucien Sanderson, New Haven, Conn.,	Sunderland.
22	Corn Manure	Quinnipiac Fertilizer Co., Boston, Mass.,	Sunderland.
27	Complete Manure for Corn and Grain,	Bradley Fertilizer Co., Boston, Mass.,	Worcester.
29	Potato Manure,	Mapes Formula & Peruvian Guano Co., New York, N. Y.	Worcester.
30	Complete Manure for General Use	Mapes Formula & Peruvian Guano Co., New York, N.Y.	Worcester.
31	Animal Fertilizer,	C. A. Bartlett, Worcester,	Worcester.
32	Potato Manure,	J. G. Jefferds, Worcester, Mass.,	Worcester.
35	Potato Manure,	Bradley Fertilizer Co., Boston, Mass.,	Worcester.
40	X. L. Superphosphate,	Bradley Fertilizer Co., Boston, Mass.,	Springfield.
41	Corn Manure,	Quinnipiac Fertilizer Co., Boston, Mass.,	Springfield.
42	Potato Manure,	Quinnipiac Fertilizer Co., Boston, Mass.,	Springfield.
43	Crossed Fish and Potash,	Quinnipiac Fertilizer Co., Boston, Mass.,	Springfield.
53	Dry Ground Fish,	Williams & Clark Fertilizer Co., Boston, Mass.,	Sunderland.
55	Vegetable, Vine and Tobacco Fertilizer,	Great Eastern Fertilizer Co., Rutland, Vt.	Sunderland.
60	High Grade Special,	Williams & Clark Fertilizer Co., Boston, Mass.,	Sunderland.
62	Complete Tobacco Fertilizer,	National Fertilizer Co., Bridgeport, Conn.,	Hadley.
63	Chittenden's Fish and Potash,	National Fertilizer Co., Bridgeport, Conn.,	Hadley.
67	Dry Ground Fish,	Williams & Clark Fertilizer Co., Boston, Mass.,	Hadley.
68	Complete Corn Manure,	Prentiss, Brooks & Co., Holyoke, Mass.,	Holyoke.
69	Ground Tankage,	Prentiss, Brooks & Co., Holyoke, Mass.,	Holyoke.
73	Complete Grass Manure,	Prentiss, Brooks & Co., Holyoke, Mass.,	Holyoke.
76	Superphosphate,	Prentiss, Brooks & Co., Holyoke, Mass.,	Holyoke.
79	Blood, Meat and Bone,	Springfield Provision Co., Brightwood, Mass.,	Brightwood.
99	Fish and Potash,	Wm. J. Brightman & Co., Tiverton, R. I.,	Dighton.
120	Complete Manure for Corn and Grass,	Bradley Fertilizer Co., Boston, Mass.,	Boston.
127	Animal Fertilizer,	C. A. Bartlett, Worcester, Mass.,	Boston.
141	Potato Special,	H. F. Tucker, Boston, Mass.,	Taunton.
149	Complete Tobacco Manure,	National Fertilizer Co., Bridgeport, Conn.,	Deerfield.

Laboratory Number.	Name of Brand.	Moisture.	Nitrogen in 100 lbs.		Phosphoric Acid in 100 lbs.							Potassium Oxide in 100 lbs.	
								Total.		Available.			
			Found.	Guaranteed.	Soluble.	Reverted.	Insoluble.	Found.	Guaranteed.	Found.	Guaranteed.	Found.	Guaranteed.
	Compound Fertilizers.												
7	Lowell Bone Fertilizer,	10.32	2.55	2	—	7.84	.67	8.51	8	7.84	—	2.94	2
15	Blood, Bone and Meat,	11.36	8.25	6.59-8.24	.08	6.08	2.92	9.08	10-12	6.16	—	—	—
17	Blood, Bone and Meat,	6.49	4.94	5.77-7.41	.38	11.44	5.40	17.22	10-12	11.82	—	—	—
22-41	Corn Manure,	15.65	2.42	2.06-2.88	6.24	4.87	1.79	12.90	10-14	11.11	9-12	3.18	1.50-2.50*
27-120	Complete Manure for Corn & Grain,	9.38	3.81	3.30-4.12	3.04	8.16	4.81	16.01	13-15	11.20	12-14	2.98	3-4*
29	Potato Manure,	7.99	3.60	3.71-4.12	4.91	4.91	.67	10.49	8-10	9.82	8.	8.20	6-8*
30	Complete Manure for General Use,	11.71	3.33	3.30-4.12	4.98	4.41	.90	10.29	10-12	9.39	—	5.40	4-5
31-127	Animal Fertilizer,	6.08	2.78	3.30-4.12	3.74	8.52	1.66	13.92	13-15	12.26	—	8.26	7-8
32	Potato Manure,	9.35	2.28	2.47-3.30	4.72	6.54	2.82	14.08	15-17	11.26	10-12	5.48	5-6
35	Potato Manure,	12.82	2.82	2.5-3.25	2.81	4.00	2.20	9.01	8-11	6.81	6-8	5.12	5-6
40	X. L. Superphosphate,	14.23	2.77	2.50-3.25	6.52	2.76	1.80	11.08	11-14	9.28	9-11	2.08	2-3*
42	Potato Manure,	13.10	2.50	2.47-3.30	3.33	5.21	.77	9.31	7-11	8.54	6-9	7.26	5-6*
43	Crossed Fish and Potash,	16.10	3.92	3.30-4.12	4.61	1.14	1.41	7.16	5-8	5.75	3-5	5.08	3-5*
53-67	Dry Ground Fish,	11.49	7.58	7.41-9.06	.74	5.78	1.51	8.03	7-9	6.52	—	—	—
55	Vegetable, Vine and Tobacco Fert.,	14.70	2.32	2.06-2.51	6.98	1.01	1.46	9.45	9-15	7.99	8-12	6.35	6-8
60	High Grade Special,	12.41	3.95	3.7-4.12	5.23	2.86	1.20	9.29	8-11	8.09	7-9	7.43	7-9
62-149	Complete Tobacco Manure,	10.28	3.41	3.30-4-94	6.19	5.37	1.23	12.79	10-12	11.56	8-10	5.48	5.40-6.48
63	Chittenden's Fish and Potash,	8.73	2.92	2.88-3.71	3.79	3.83	1.69	9.31	6-8	7.62	—	4.45	5-6
68	Complete Corn Manure,	10.52	3.24	3.30-4.12	5.17	2.71	3.94	11.82	8-10	7.88	6-8	7.33	6-8
69	Ground Tankage,	8.91	7.73	7.41-7.83	.65	5.74	1.16	7.55	8-9	6.39	—	—	—
73	Complete Grass Manure,	5.93	4.89	4.12-4.94	2.20	2.86	3.84	8.90	7-8	5.06	4-5	8.42	7-9
76	Superphosphate,	12.60	2.74	2.06-2.47	9.52	.86	3.74	14.12	10-12	10.38	8-10	2.81	2.5-3
79	Blood, Meat and Bone,	8.08	8.13	7-8	.35	5.98	1.36	7.69	9.5-10.5	6.33	—	—	—
99	Fish and Potash,	18.10	2.91	2.07-2.88	3.48	3.53	1.18	8.19	7.5-10.5	7.01	6-8	2.45	2-3
141	Potato Special,	10.27	2.78	2.40	6.75	1.80	1.79	10.34	9-13	8.55	8-11	5.40	6-7

*Sulphate of Potash, the source of Potash.

ANALYSES OF COMMERCIAL FERTILIZERS COLLECTED DURING 1894, IN THE GENERAL MARKETS BY THE AGENT OF THE MASSACHUSETTS STATE AGRICULTURAL EXPERIMENT STATION.

Laboratory No.	Name of Brand.	Name of Manufacturer.	Sampled at
	Compound Fertilizers.		
152	Fish and Potash,	Clark Cove Fertilizer Co., Boston, Mass.,	Deerfield.
170	Standard Unexcelled Fertilizer,	H. J. Baker & Bro., New York, N. Y.	Pittsfield.
172	Ammoniated Bone Superphosphate,	E. Frank Coe Fertilizer Co., New York, N. Y.,	Westfield.
176	High Grade Fish Guano and Potash,	E. Frank Coe Fertilizer Co., New York, N. Y.,	Westfield.
179	Potato, Hop and Tobacco Fertilizer,	Crocker Fertilizer and Chemical Co., Buffalo, N. Y.,	Westfield.
182	Bay State Fertilizer,	Clark Cove Fertilizer Co., Boston, Mass.	Greenfield.
187	Tobacco Manure,	Mapes Formula & Peruvian Guano Co., New York, N.Y.	Greenfield.
202	Animal Fertilizer,	N. Roy & Son, North Attleboro, Mass.,	Amherst.
	Chemicals.		
12	Electrical Dissolved Bone,	M. E. Wheeler & Co., Rutland, Vt.,	Amherst.
14	Dissolved Bone Black,	Quinnipiac Fertilizer Co., Boston, Mass.,	Sunderland.
18	Sulphate of Potash and Magnesia,	Quinnipiac Fertilizer Co., Boston, Mass.	Sunderland.
19	Dissolved Bone Black,	Lucien Sanderson, New Haven, Conn.	Sunderland.
21	Sulphate of Potash and Magnesia,	Lucien Sanderson, New Haven, Conn.	Sunderland.
36	Sulphate of Potash and Magnesia,	Quinnipiac Fertilizer Co., Boston, Mass.,	Springfield.
46	Sulphate of Ammonia,	Bowker Fertilizer Co., Boston, Mass.	Amherst.
47	Nitrate of Soda,	Bowker Fertilizer Co., Boston, Mass.	Amherst.
58	Muriate of Potash,	Williams & Clark, Fertilizer Co., Boston, Mass.	Sunderland.
61	Sulphate of Potash,	National Fertilizer Co., Bridgeport, Conn.	Hadley.
66	Sulphate of Potash,	Williams & Clark, Fertilizer Co., Boston, Mass.	Hadley.
70	Dissolved Bone Black,	Prentiss, Brooks & Co., Holyoke, Mass.	Holyoke.
92	Nitrate of Soda,	Bowker Fertilizer Co., Boston, Mass	Fall River.
145	Sulphate of Potash and Magnesia,	H. J. Baker & Bro., New York, N. Y.,	So. Deerfield.
146	Dissolved Bone Black,	H. J. Baker & Bro., New York, N. Y.,	So. Deerfield.
208	Muriate of Potash,	Clark Cove Fertilizer Co., Boston, Mass.,	Hudson.
	Bones.		
6	Steamed Fine Bone,	E. H. Smith, Northboro, Mass.,	Amherst.
8	Fine Ground Bone,	McQuade Bros., West Auburn, Mass.,	Amherst.
28	Steamed Fine Bone,	E. H. Smith, Northboro, Mass.,	Worcester.
77	Fine Ground Bone,	McQuade Bros., West Auburn, Mass.,	West Auburn.
90	Ground Bone,	John C. Dow & Co., Boston, Mass.	Amherst.
214	Ground Bone,	Crocker Fertilizer and Chemical Co., Buffalo, N. Y.	Fitchburg.

Laboratory Number.	Name of Brand.	Moisture.	Nitrogen in 100 lbs. Found.	Nitrogen in 100 lbs. Guaranteed.	Phosphoric Acid in 100 lbs. Soluble.	Reverted.	Insoluble.	Total. Found.	Total. Guaranteed.	Available. Found.	Available. Guaranteed.	Potassium Oxide in 100 lbs. Found.	Potassium Oxide in 100 lbs. Guaranteed.
	Compound Fertilizers.												
152	Fish and Potash, ...	15.00	2.81	2.06-2.88	4.35	2.66	1.38	8.39	7-11	7.01	6-8	2.43	2-3
170	Standard Unexcelled Fertilizer, ...	13.93	2.72	2.06-2.26	8.14	.53	1.05	9.72	—	8.67	8-10	2.82	2-3
172	Ammoniated Bone Superphosphate,	10.05	2.73	2.	7.01	2.82	3.17	13.00	11-15	9.83	9-12	2.67	1.85
176	High Grade Fish Guano and Potash,	7.15	2.63	2.47-3.30	2.56	2.45	3.48	8.49	7-11	5.01	6-9	3.39	2.75*
179	Potato, Hop and Tobacco Fertilizer,	14.03	2.07	2.-3.	7.01	3.30	1.33	11.64	11-14	10.31	10-12	3.84	3.25-4.30
182	Bay State Fertilizer, ...	12.83	2.60	2.47-3.30	5.35	3.18	1.91	10.44	10-14	8.53	9-12	2.80	2-3
187	Tobacco Manure, ...	6.09	5.62	6.18	—	5.40	.15	5.55	4-5	5.40	—	12.34	10.5
202	Animal Fertilizer, ...	4.07	4.28	4.28	.13	11.54	.28	11.95	11.95	11.67	—	—	—
	Chemicals.												
12	Electrical Dissolved Bone, ...	13.95	—	—	7.82	5.06	.58	13.46	15-20	12.88	13-17	—	—
14	Dissolved Bone Black, ...	12.63	—	—	12.84	2.51	.77	16.12	16-18	15.35	—	—	—
18-36	Sulphate of Potash and Magnesia,	3.54	—	—	—	—	—	—	—	—	—	27.16	27.02-29.72
19	Dissolved Bone Black, ...	13.36	—	—	16.88	—	—	16.88	16-18	16.88	16.18	—	—
21	Sulphate of Potash and Magnesia, ..	3.95	—	—	—	—	—	—	—	—	—	29.44	27.02-29.72
46	Sulphate of Ammonia, ...	.73	20.55	19.78-20.60	—	—	—	—	—	—	—	—	—
47-92	Nitrate of Soda, ...	1.00	15.79	15.64-15.97	—	—	—	—	—	—	—	—	—
58	Muriate of Potash, ...	1.34	—	—	—	—	—	—	—	—	—	50.44	50.54-53.70
61	Sulphate of Potash, ...	1.10	—	—	—	—	—	—	—	—	—	49.92	—
66	Sulphate of Potash, ...	.75	—	—	—	—	—	—	—	—	—	48.16	48.64-51.34
70	Dissolved Bone Black, ...	12.16	—	—	15.51	—	2.00	17.50	16-17	15.51	16.	—	—
145	Sulphate of Potash and Magnesia, ..	5.89	—	—	—	—	—	—	—	—	—	25.80	25.94-28.10
146	Dissolved Bone Black, ...	15.97	—	—	15.81	.44	.36	16.61	—	16.25	15-16	—	—
208	Muriate of Potash, ...	1.42	—	—	—	—	—	—	—	—	—	50.04	50.54-53.70
	Bones.												
6-28	Steamed Fine Bone, ...	4.91	4.09	4.02	.30	18.63	2.93	21.86	23.	18.93	7.69		
8-77	Fine Ground Bone, ...	3.29	2.73	2.78	.05	22.82	1.64	24.51	24.52	22.87	16.74		
90	Ground Bone, ...	2.14	1.65	1.65-2.47	.20	25.84	2.05	28.09	24-26	26.04	—		
214	Ground Bone, ...	6.08	3.98	2.90-3.70	.26	16.32	8.67	25.25	25.	16.58	—		

Mechanical Analysis.

Laboratory Number.	Fine.	Med. Fine	Med.	Coarse Med.
6-28	23.80	47.32	28.88	—
8-77	47.07	23.63	18.00	11.30
90	60.67	39.33	—	—
214	43.87	25.66	22.60	7.87

*Sulphate of Potash, the source of Potash.

II. ANALYSES OF COMMERCIAL FERTILIZERS AND MANURIAL SUBSTANCES SENT ON FOR EXAMINATION.

915-920. WOOD ASHES.

(I., sent on from Beverly, Mass.; II., sent on from Boston, Mass.; III. and IV., sent on from Concord, Mass.; V. and VI., sent on from Waltham, Mass.)

	Per Cent.					
	I.	II.	III.	IV.	V.	VI.
Moisture at 100° C.,	6.44	2.52	11.61	4.88	.57	10.92
Calcium oxide,	*	34.46	35.05	30.20	28.17	33.13
Potassium oxide,	5.28	4.31	4.59	4.80	6.02	4.46
Phosphoric acid,	1.28	.67	.87	1.41	1·65	1.42
Insoluble matter,	15.40	12.63	15.97	15.61	16.87	23.65

921-926. WOOD ASHES.

(I., sent on from North Andover, Mass.; II., sent on from Hudson, Mass.; III., sent on from Westboro, Mass.; IV., V. and VI. sent on from Concord, Mass.)

	Per Cent.					
	I	II.	III	IV.	V.	VI.
Moisture at 100° C.,	19.11	.19	22.26	7.80	14.52	16.08
Calcium oxide,	38.20	36.70	30.24	33.00	36.50	32.61
Potassium oxide,	5.98	3.96	5.04	4.47	5.13	4.50
Phosphoric acid,	1.28	.90	1.15	1.13	1.68	1.22
Insoluble matter,	13.12	41.61	*	10.28	11.03	13.70

927-931.

(I., Ground bone, sent on from Salisbury, Mass.; II., Tankage, sent on from Concord, Mass.; III., Peruvian Guano, sent on from Boston, Mass.; IV., Florida Phosphate, sent on from South Hadley Falls, Mass.; V., Cotton waste, sent on from Concord, Mass.)

	Per Cent.				
	I.	II.	III.	IV.	V
Moisture at 100° C.,	34.55	10.33	8.56	3.69	10.93
Phosphoric acid,	11.42	4.03	19.47	20.79	1.80
Potassium oxide,	—	—	2.88	—	1.51
Nitrogen,	4.04	9.16	2.12	—	9.33
Insoluble matter,	*	*	32.40	25.48	.92

* Not Determined.

III. ANALYSES OF FODDER ARTICLES.

(I., Combination horse feed sent on from Amherst, Mass.; II., Corn, oats and barley chop, sent on from Springfield, Mass.; III., Ground corn and oats chop, sent on from Springfield, Mass., IV., Iowa gluten meal, sent on from Amherst, Mass.; V., Cotton-seed meal, sent on from Amherst, Mass.)

	Per Cent.				
	I.	II.	III.	IV.	V.
Moisture at 100° C.,	10.84	9.85	7.98	8.31	7.29
Dry matter,	89.16	90.15	92.02	91.69	92.71
	100.00	100.00	100.00	100.00	100.00
ANALYSIS OF DRY MATTER.					
Crude ash,	5.69	4.14	2.35	1.24	7.63
Crude cellulose,	19.92	8.48	14.62	4.52	5.91
Crude fat,	1.74	5.54	3.83	10.97	8.41
Crude protein,	11.22	13.75	9.13	36.40	48.79
Nitrogen free ext. matter,	61.43	68.09	70.07	46.87	29 26
	100.00	100.00	100.00	100.00	100.00

(I., Chicago maize feed, sent on from Boston Mass.; II., Peoria gluten feed, sent on from Peoria, Ill.; III., Buffalo gluten feed from Station barn.; IV., Wheat bran, from Station barn.; V., Barley meal, from Station barn.)

	Per Cent.				
	I.	II.	III.	IV.	V.
Moisture at 100° C.,	7.19	7.07	9.37	9.15	11.17
Dry matter,	92.81	92.93	90.63	90.85	88.83
	100.00	100.00	100.00	100.00	100.00
ANALYSIS OF DRY MATTER.					
Crude ash,	1.06	1.16	.86	6.10	2.79
Crude cellulose,	9.34	8.30	8.17	11.06	8.03
Crude fat,	7.39	14.33	14.71	6.10	2.51
Crude protein,	27.07	22.71	23.16	18.29	9.99
Nitrogen-free ext. matter,	55.14	53 50	53.10	58.45	76.68
	100.00	100.00	100.00	100.00	100.00

(I. and II., Cotton-seed meal, sent on from Longmeadow, Mass.; III., Cotton-seed meal, sent on from Williamsburg, Mass.; IV., Chicago germ feed, sent on from Weston, Mass.; V., Oat feed, sent on from North Amherst, Mass.; VI., Ground oats, sent on from North Amherst, Mass.)

	Per Cent.					
	I.	II.	III.	IV.	V.	VI.
Moisture at 100° C.,	5.87	5.82	6.35	7.35	6.75	8.89
Dry matter,	94.13	94.18	93.65	92.65	93.25	91.11
	100.00	100.00	100.00	100.00	100.00	100.00
DRY MATTER CONTAINS:						
Crude fat,	11.55	10.85	9.30	13.18	14.83	4.52
Crude protein,	50.19	47.78	51.38	11.06	11.93	11.93

TRADE VALUES OF FERTILIZING INGREDIENTS IN RAW MATERIALS AND CHEMICALS.

	1894. *Cents per pound.*
Nitrogen in ammonia salts,	19
" " nitrates,	14½
Organic nitrogen in dry and fine ground fish, meat, blood, and in high-grade mixed fertilizers,	18½
" " " cotton seed meal, linseed meal and castor pomace,	15
" " " fine ground bone and tankage,	16½
" " " fine ground medium bone and tankage,	15
" " " medium bone and tankage,	12
" " " coarse bone and tankage,	7
" " " hair, horn-shavings and coarse fish scraps,	7
Phosphoric acid soluble in water,	6
" " soluble in ammonium citrate,	5½
" " in fine bone and tankage,	5½
" " in fine medium bone and tankage,	4½
" " in medium bone and tankage,	3
" " in coarse bone and tankage,	2
" " in fine ground fish, cotton-seed meal, linseed meal, castor pomace and wood ashes,	5
" " insoluble (in am. cit.) in mixed fertilizers,	2
Potash as High Grade Sulphate, and in mixtures free from Muriate,	5¼
" " Muriate,	4½

The manurial constituents contained in feedstuffs are valued as follows:

Organic Nitrogen,	15
Phosphoric acid,	5
Potash,	5

The Bulletins of the Mass. Experiment Station will be sent free of charge to all parties interested in its work, on application.

C. A. GOESSMANN, *Director.*

Amherst, Mass., June 8, 1894.

Carpenter & Morehouse, Printers, Amherst, Mass.

MASSACHUSETTS STATE

AGRICULTURAL EXPERIMENT STATION.

BULLETIN NO. 53.

JULY, 1894.

Meteorological Summary, for June, 1894.

Highest temperature, - - -	93.00°
Lowest temperature, - - -	37.00°
Mean temperature, - - -	67.53°
Total rain fall (inches), - -	3.43
Prevailing wind, - - - -	S. W.

The mean temperature viz 67.53° was about 3° above the normal, and was 1° above that for June of last year. The rain fall was about .5 inches above that for June 1893, as recorded at this station.

Most of the rain fell during the first and last of the month.

The month was favorable for the growth of all crops.

Haying was quite general in this section by the 15th.

I ANALYSES OF COMMERCIAL FERTILIZERS COLLECTED DURING 1894, IN THE GENERAL MARKETS BY THE AGENT OF THE MASSACHUSETTS STATE AGRICULTURAL EXPERIMENT STATION.

Laboratory No.	Name of Brand.	Name of Manufacturer.	Sampled at
	Compound Fertilizers.		
3	Banner Fertilizer,	Walker, Stratman & Co., Pittsburg, Pa.,	Amherst.
9	Corn Fertilizer,	M. E. Wheeler & Co., Rutland, Vt.,	Amherst.
20	Pulverized Bone and Meat.	Lucien Sanderson, New Haven, Conn.	Sunderland.
37	Ammoniated Bone Superphosphate "Americus,"	Williams & Clark, Fertilizer Co., Boston, Mass.	Springfield.
38	Quinnipiac Phosphate,	Quinnipiac Fertilizer Co., Boston, Mass.,	Springfield.
65	Ammoniated Bone Superphosphate,	National Fertilizer Co., Bridgeport, Conn.,	Hadley.
81	Hill and Drill Phosphate,	Bowker Fertilizer Co., Boston, Mass	Springfield.
82	Lawn and Garden Dressing,	Bowker Fertilizer Co., Boston, Mass.	Springfield.
85	Potato and Vegetable,	Bowker Fertilizer Co., Boston, Mass.	Springfield.
89	Ground Bone Fertilizer,	John C. Dow & Co., Boston, Mass.	Amherst.
93	Corn Fertilizer,	M. E. Wheeler & Co. Rutland, Vt.,	Bridgewater.
94	Wood Ashes,	Forest City Wood Ash Co., London, Ont.,	Boston.
95	Special Potato Fertilizer,	Ames Fertilizer Co., Peabody, Mass.,	Dighton.
97	Potato and Root Crop Manure,	L. B. Darling Fertilizer Co., Pawtucket, R. I.,	Somerset.
98	Potato Manure,	H. J. Baker & Bro., New York, N. Y.,	Fall River.
104	Animal Fertilizer,	L. B. Darling Fertilizer Co., Pawtucket, R. I.,	Bridgewater.
105	Standard Fertilizer,	Standard Fertilizer Co., Boston, Mass.,	Whitman.
106	Vegetable, Vine and Fruit,	Read Fertilizer Co., Syracuse, N. Y.,	Bridgewater.
110	Pure Dry Ground Fish,	Joseph Church & Co., Tiverton, R. I.,	Dighton.
111	English Lawn Dressing,	Bradley Fertilizer Co., Boston, Mass.,	Whitman.
113	Fish and Potash "B Brand,"	Bradley Fertilizer Co., Boston, Mass.,	Bridgewater.
114	Brightman's Phosphate,	Wm. J. Brightman & Co., Tiverton, R. I.,	W. Brid'water.
190	Ammoniated Bone Superphosphate "Americus."	Williams & Clark, Fertilizer Co., Boston, Mass.,	Greenfield.
261	Banner Fertilizer,	Walker Stratman and Co., Pittsburg, Pa.,	Leeds.
	Chemicals.		
45	Dissolved Bone Black,	Bowker Fertilizer Co., Boston, Mass.,	Amherst.
56	Dissolved Bone Black,	Williams & Clark Fertilizer Co., Boston, Mass.,	Sunderland.
107	Dissolved Bone Black,	Bowker Fertilizer Co., Boston, Mass,,	Fall River.
108	Nitrate of Soda,	Ames Fertilizer Co., Peabody, Mass.,	Dighton.
201	Dissolved Bone Black.	Clark Cove Fertilizer Co., Boston, Mass.,	Hudson.
220	Dissolved Bone Black,	Bradley Fertilizer Co., Boston, Mass.,	Amesbury.

Laboratory Number.	Name of Brand.	Moisture.	Nitrogen in 100 lbs.		Phosphoric Acid in 100 lbs.							Potassium Oxide in 100 lbs.	
								Total.		Available.			
			Found.	Guaranteed.	Soluble.	Reverted.	Insoluble.	Found.	Guaranteed.	Found.	Guaranteed.	Found.	Guaranteed.
	Compound Fertilizers.												
3-261	Banner Fertilizer,	9.62	2.65	2.06-2.88	5.32	2.13	2.00	9.45	11-12	7.45	9-10	1.62	1-2*
9-93	Corn Fertilizer,	13.65	2.88	1.65-2.47	4.64	3.22	1.64	9.50	9-14	7.86	8-12	2.45	1.65-2.47*
20	Pulverized Bone and Meat,	7.29	5.21	5.77-6.59	.30	11.99	5.58	17.87	18-20	12.29	—	—	—
37-190	Am. Bone Superphos'te "Americus,"	13.88	2.63	2.47-3.30	6.26	2.82	2.18	11.26	10-13	9.08	9-11	2.70	2-3
38	Quinnipiac Phosphate,	15.13	2.92	2.47-3.30	6.00	3.47	.84	10.31	10-14	9.47	9-12	2.73	2-3*
65	Ammoniated Bone Superphosphate,	14.82	2.48	1.65-2.06	.82	7.60	2.51	10.93	9-11	8.42	7-9	3.25	2-4
81	Hill and Drill Phosphate,	13.53	2.80	2.50-3.50	5.22	4.04	3.28	12.54	12-13	9.26	9-11	2.35	2-3
82	Lawn and Garden Dressing,	9.32	4.86	3.25-4.25	5.63	1.95	3.17	10.75	8-10	7.58	6-8	5.54	5-6
85	Potato and Vegetable,	12.20	3.28	3.25-4.25	6.14	2.82	1.89	10.85	8-10	8.96	6-8	6.92	7-8
89	Gound Bone Fertilizer,	6.66	2.20	2.06-2.47	.87	14.74	4.50	20.11	18-22	15.61	—	3.51	1.62-1.89
94	Wood Ashes,	11.59	—	—	—	—	—	1.13	1.5-2.5	—	—	5.28	4.5-8
95	Special Potato Fertilizer.	9.73	3.00	3-4	4.61	5.13	.79	10.53	9-13	9.74	8-11	9.00	7-9
97	Potato and Root Crop Manure,	9.43	2.76	2.88-4.12	3.48	6.24	1.74	11.46	10-12	9.72	6-8	6.57	7-9
98	Potato Manure,	10.99	4.01	3.30	4.52	1.77	.54	6.83	5.75	6.29	—	10.64	10
104	Animal Fertilizer,	13.21	3.06	3-4.5	3.89	4.25	.92	9.06	10-12	8.14	6-8	3.58	4-6
105	Standard Fertilizer,	15.07	2.20	2-3	5.76	2.56	2.30	10.62	10-15	8.32	8-12	2.18	2-3
106	Vegetable, Vine and Fruit,	12.01	1.84	1.65-2.47	4.55	3.13	.46	8.14	7-9	7.68	6-8	7.54	8-10
110	Pure Dry Ground Fish,	7.89	9.62	9.06-9.89	.10	6.70	1.69	8.49	6.87-9.16	6.80	—	—	—
111	English Lawn Dressing.	9.75	3.87	4.95-5.78	1.28	5.42	1.33	8.03	6-8	6.70	5-7	2.08	2.5-3.5
113	Fish and Potash "B. Brand,"	17.80	2.58	2.06-2.88	4.35	1.12	2.46	7.93	7.5-10.5	5.47	6-8	2.70	2-3
114	Brightman's Phosphate,	12.75	2.50	2.5-3.25	3.99	3.02	.67	7.68	8-11	6.01	6-8	5.72	5-6
	Chemicals.												
45-107	Dissolved Bone Black,	13.75	—	—	14.67	.45	.33	15.45	18	15.12	15-18	—	—
56	Dissolved Bone Black,	12.52	—	—	12.13	3.12	.26	15.51	15-18	15.25	—	—	—
108	Nitrate of Soda,	1.50	15.02	15.5-16.5	—	—	—	—	—	—	—	—	—
201	Dissolved Bone Black,	10.99	—	—	11.90	3.86	.26	16.02	15-18	15.76	—	—	—
220	Dissolved Bone Black,	13.34	—	—	13.15	2.48	.64	16.27	15-18	15.63	—	—	—

*Sulphate of Potash, the source of Potash.

ANALYSES OF COMMERCIAL FERTILIZERS COLLECTED DURING 1894, IN THE GENERAL MARKETS BY THE AGENT OF THE MASSACHUSETTS STATE AGRICULTURAL EXPERIMENT STATION.

Laboratory No.	Name of Brand.	Name of Manufacturer.	Sampled at
	Compound Fertilizers.		
140	Cleveland Superphosphate,	Cleveland Dryer Co., Boston, Mass.,	So. Framing'm
151	Dry Ground Fish,	Quinnipiac Fertilizer Co., Boston, Mass.,	So. Deerfield.
155	Ammoniated Bone Superphosphate,	Preston Fertilizer Co., Greenpoint, L. I.,	Pittsfield.
160	Ammoniated Bone Superphosphate,	Crocker Fertilizer and Chemical Co., Buffalo, N. Y.,	No. Adams.
165	Fine Ground Bone and Potash "Circle Brand."	Bradley Fertilizer Co., Boston, Mass.,	Pittsfield.
171	Special Potato Fertilizer,	Crocker Fertilizer and Chemical Co., Buffalo, N. Y.,	Westfield.
174	Ammoniated Bone Superphosphate,	Preston Fertilizer Co., Greenpoint. L. I.,	Lanesborough.
178	High Grade Tobacco Manure,	Bradley Fertilizer Co., Boston, Mass.	Northampton.
181	Potato Phosphate,	Williams & Clark Fertilizer Co., Boston, Mass.,	Greenfield.
186	Complete Tobacco Fertilizer,	H. J. Baker & Bro., New York, N. Y.,	So. Deerfield.
198	Cumberland Superphosphate,	Cumberland Bone Phosphate Co.,	Hudson.
206	Potato Manure,	Clark Cove Fertilizer Co., Boston, Mass.,	Hudson.
211	Vegetable Bone Superphosphate,	Crocker Fertilizer and Chemical Co., Buffalo, N. Y.,	Newburyport.
215	Special Potato Manure,	Pacific Guano Co., Boston, Mass.,	Newburyport.
226	Cumberland Superphosphate.	Cumberland Bone Phosphate Co., Portland, Me.,	Lawrence.
229	Alkaline Bone Phosphate,	E. Frank Coe, New York, N. Y.,	Framingham.
238	Blood, Bone and Meat,	Williams & Clark Fertilizer Co., Boston. Mass.,	Dalton.
258	Grass and Grain Fertilizer,	Great Eastern Fertilizer Co., Rutland, Vt.,	Westfield.
263	Fish and Potash,	Leander Wilcox, Mystic, Conn.,	Amherst.
	Bones.		
1	Pure Bone Meal,	Thomas Stetson, Randolph, Mass.,	Amherst.
78	Ground Bone,	John L. Bonzey, Auburn, Mass.,	Auburn.
83	Fresh Ground Bone,	Bowker Fertilizer Co., Boston, Mass.,	Springfield.
100	Pure Bone Meal,	Thomas Hersom & Co., New Bedford, Mass.	New Bedford.
121	Pure Bone Meal,	Thomas Stetson, Randolph, Mass.,	Boston.
124	Fine Ground Bone,	Bradley Fertilizer Co., Boston, Mass.,	Boston.
131	Fine Ground Bone,	Hargrave's Manufacturing Co., Fall River, Mass.,	Fall River.
189	Pure Bone Meal,	Quinnipiac Fertilizer Co., Boston, Mass.,	Williamstown.
233	Pure Ground Bone,	Mapes Formula & Peruvian Guano Co., New York, N.Y.	Haverhill.
239	Ground Bone,	John L. Bonzey, Auburn, Mass.,	Amherst.

Laboratory Number.	Name of Brand.	Moisture.	Nitrogen in 100 lbs. Found.	Nitrogen in 100 lbs. Guaranteed.	Phosphoric Acid in 100 lbs. Soluble.	Reverted.	Insoluble.	Total. Found.	Total. Guaranteed.	Available. Found.	Available. Guaranteed.	Potassium Oxide in 100 lbs. Found.	Potassium Oxide in 100 lbs. Guaranteed.
	Compound Fertilizers.												
140	Cleveland Superphosphate, ...	14.13	3.46	2.05-2.95	4.61	4.75	2.10	11.46	11-14	9.36	9-11	2.06	2-3
151	Dry Ground Fish, ...	9.69	8.01	7.41-9.06	.87	4.24	1.59	6.70	7-9	5.11	—	—	—
155-174	Ammoniated Bone Superphosphate.	9.67	2.50	2.47-3.30	6.38	6.40	1.26	14.04	—	12.78	9-11	2.93	2-3
160	Ammoniated Bone Superphosphate,	10.21	3.40	2.90-3.70	7.50	2.68	.73	10.91	11-14	10.18	10-12	1.82	1-2
165	Fine Ground Bone & Potash. "Circle Brand, ...	11.15	2.26	1.85-2.68	1.56	7.06	3.10	11.72	8-12	8.62	—	2.42	2-3
171	Special Potato Manure, ...	13.01	3.79	3.70-4.50	6.40	2.30	.46	9.16	9-11	8.70	8-9	5.67	5.40-6.40
178	High Grade Tobacco Manure, ...	6.26	6.04	5.77-6.59	.61	3.18	1.28	5.07	4-5	3.79	—	12.75	10.81-12.43*
181	Potato Phosphate, ...	17.92	2.78	2.47-3.30	4.25	2.50	1.28	8.03	7-11	6.75	6-9	4.60	5-6*
186	Complete Tobacco Manure, ...	7.59	4.88	4.53-5.36	4.09	.21	.87	5.17	—	4.30	3-5	10.65	10-12
198-226	Cumberland Superphosphate, ...	14.35	2.28	2.06-2.88	5.76	2.88	2.68	11.32	10-12	8.64	8-10	2.40	2-3*
206	Potato Manure....................	10.48	2.44	2.47-3.30	3.48	3.33	2.15	8.96	7-11	6.81	6-9	4.79	5-6*
211	Vegetable Bone Superphosphate, ..	13.55	5.06	5-6	5.12	1.07	.82	7.01	7-9	6.19	6-7	6.34	6-8*
215	Special Potato Manure, ...	12.12	2.80	2.47-3.30	2.61	3.33	1.94	7.88	7-10	5.94	5-7	5.52	5-6*
229	Alkaline Bone Phosphate, ...	9.70	1.50	1-1.5	6.40	1.37	3.74	11.51	10-14	7.77	9-12	2.69	1.62-2.16*
238	Blood, Bone and Meat, ...	7.13	8.31	—	.46	7.42	2.87	10.75	—	7.88	—	—	—
258	Grass and Grain Fertilizer, ...	14.94	2.46	2.88-3.71	6.29	1.74	1.18	9.21	9-15	8.03	8-12	3.49	2-4
263	Fish and Potash, ...	14.37	3.48	3.25-4.25	2.66	3.94	.72	7.32	6-7	6.60	5-6	5.23	4-5

Laboratory Number.	Name of Brand.	Moisture.	Nitrogen Found.	Nitrogen Guaranteed.	Soluble.	Reverted.	Insoluble.	Total Found.	Total Guaranteed.	Available Found.	Available Guaranteed.	Mechanical Analysis. Fine.	Med. Fine.	Med.	Coarse Med.
	Bones.														
1-121	Pure Bone Meal, ...	8.70	3.96	3-4	.38	9.48	12.02	21.88	20-26	9.86	—	14.95	25.30	35.96	23.79
78-239	Ground Bone, ...	8.43	3.87	3.87	.30	16.74	3.68	20.72	20.72	17.04	—	42.30	37.60	15.00	5.10
83	Fresh Ground Bone.	8.94	2.88	2.47-3.30	.31	17.45	3.48	21.24	18-22	17.76	5-7	21.20	38.10	40.70	—
100	Pure Bone Meal, ...	4.95	1.88	2	.12	25.08	5.12	30.32	29.21	25.20	—	74.83	15.49	6.68	3.00
124	Fine Ground Bone, ...	7.10	3.60	2.5-3.25	.05	17.81	1.33	19.19	21-23	17.86	—	51.50	36.80	17.70	—
131	Fine Ground Bone, ...	7.71	3.48	2.5-2.8	.41	21.34	1.33	23.08	25-27	21.75	—	29.20	22.20	17.40	31.20
189	Pure Bone Meal, ...	4.62	2.65	2.47-4.12	.31	12.34	6.01	18.66	20-25	12.65	—	54.80	33.80	11.40	—
233	Pure Ground Bone, ...	7.67	4.80	2.88-3.71	—	14.34	8.44	22.78	24-26	14.34	—	17.64	25.90	25.12	31.34

*Sulphate of Potash, the source of Potash.

II. ANALYSES OF COMMERCIAL FERTILIZERS AND MANURIAL SUBSTANCES SENT ON FOR EXAMINATION.

932-936. FERTILIZERS.

(I. and II. sent on from Granby, Mass.; III. sent on from Dighton, Mass.; IV. sent on from Concord, Mass.; V. Tankage, sent on from Lexington, Mass.)

	Per cent.				
	I.	II.	III.	IV.	V.
Moisture at 100° C.,	12.81	12.46	8.29	19.76	8.89
Total phosphoric acid,	10.62	9.39	11.85	10.59	5.87
Soluble phosphoric acid,	.26	5.99	6.12	1.97	.32
Reverted phosphoric acid,	10.01	2.43	4.61	7.01	4.62
Insoluble phosphoric acid,	.35	.97	1.13	1.64	.93
Potassium oxide,	2.78	10.03	10.11	3.78	—
Nitrogen,	2.28	3.55	3.69	3.13	7.98

937-941. GROUND BONE.

(I. sent on from West Berlin, Mass.; II., III., IV. and V. sent on from Lincoln, Mass.)

	Per cent.				
	I.	II.	III.	IV.	V.
Moisture at 100° C.,	4.97	3.76	4.31	4.04	3.64
Total phosphoric acid,	15.81	28.78	28.66	25.64	20.98
Available phosphoric acid,	15.71	—	—	—	—
Insoluble phosphoric acid,	.10	—	—	—	—
Nitrogen,	2.82	3.50	3.54	4.21	3.23

942-947.

(I., Wool Waste, sent on from Lawrence, Mass.; II., Muck, sent on from Millville, Mass.; III., Goose Manure, sent on from Amherst, Mass.; IV., Henhouse Refuse, sent on from Fitchburg, Mass.; V., Black Soot, VI., Brown Soot, sent on from Lynn, Mass.)

	Per cent.					
	I.	II.	III.	IV.	V.	VI.
Moisture at 100° C.,	2.23	83.68	49.82	3.43	2.09	.13
Phosphoric acid,	.38	—	.957	1.28	.74	2.10
Potassium oxide,	3.50	—	.810	.60	.46	.59
Nitrogen,	.96	.295	.213	.98	1.05	—

948-953. WOOD ASHES.

(I., II. and III. sent on from Concord, Mass.; IV. and V. sent on from Lowell, Mass.; VI. sent on from Amherst, Mass.)

	Per cent.					
	I.	II.	III.	IV.	V.	VI.
Moisture at 100° C.,	6.75	15.38	6.05	23.00	19.10	7.97
Calcium oxide,	42.72	43.00	—	33.88	30.32	18.70
Phosphoric acid,	1.66	1.10	1.43	1.02	1.02	2.94
Potassium oxide,	6.02	5.23	6.54	3.01	5.18	7.48
Insoluble matter,	7.71	8.84	9.74	10.88	13.38	22.03

954-959. WOOD ASHES.

(I. and II., sent on from Concord, Mass.; III., sent on from Concord Junction, Mass.: IV., sent on from Amherst, Mass.; V., sent on from Rock Bottom, Mass.; VI., sent on from Walpole, Mass.)

	Per cent.					
	I.	II.	III.	IV.	V.	VI.
Moisture at 100° C.,	14.96	9.86	5.93	1.29	14.69	16.06
Calcium oxide,	29.52	32.74	40.48	32.26	—	—
Phosphoric Acid,	1.79	1.48	1.77	4.04	1.28	1.33
Potassium oxide,	5.25	6.17	7.84	9.20	5.04	5.20
Insoluble Matter,	13.18	18.96	7.21	11.22	12.29	14.31

960-965. WOOD ASHES.

(I. and II., sent on from Concord, Mass.; III., sent on from Granby, Mass.; IV., sent on from Lakeville, Mass.; V., sent on from Sunderland, Mass.; VI., Lime-kiln ashes, sent on from Sunderland, Mass.)

	Per cent.					
	I.	II.	III.	IV.	V.	VI.
Moisture at 100° C.,	9.67	11.13	20.51	6.45	12.59	.68
Phosphoric Acid,	1.43	1.43	1.36	.51	.82	1.48
Potassium Oxide,	7.32	5.22	5.62	5.96	7.54	5.20
Insoluble matter,	8.94	23.13	17.08	—	—	—

966-971.

(I., II. and III., Wood Ashes, sent on from Concord, Mass.; IV., Cotton-hull Ashes, sent on from North Hadley, Mass.; V., Lime-kiln Ashes, sent on from Amherst, Mass.; VI., Slaked lime, sent on from East Walpole, Mass.)

	Per cent.					
	I.	II.	III.	IV.	V.	VI.
Moisture at 100° C.,	13.60	17.80	15.22	8.72	24.09	7.28
Calcium oxide,	—	—	—	—	36.69	61.48
Phosphoric acid,	1.18	1.36	1.07	9.40	1.57	—
Potassium oxide,	5.39	5.75	5.07	25.50	1.57	—
Insoluble matter,	17.48	10.36	12.46	6.08	11.76	3.95

TRADE VALUES OF FERTILIZING INGREDIENTS IN RAW MATERIALS AND CHEMICALS.

	1894. Cents per pound.
Nitrogen in ammonia salts,	19
" " nitrates,	14½
Organic nitrogen in dry and fine ground fish, meat, blood, and in high-grade mixed fertilizers,	18½
" " " cotton-seed meal, linseed meal and castor pomace,	15
" " " fine ground bone and tankage,	16½
" " " fine ground medium bone and tankage,	15
" " " medium bone and tankage,	12
" " " coarse bone and tankage,	7
" " " hair, horn-shavings and coarse fish scraps,	7
Phosphoric acid soluble in water,	6
" " soluble in ammonium citrate,	5½
" " in fine bone and tankage,	5½
" " in fine medium bone and tankage,	4½
" " in medium bone and tankage,	3
" " in coarse bone and tankage,	2
" " in fine ground fish, cotton-seed meal, linseed meal, castor pomace and wood ashes,	5
" " insoluble (in am. cit.) in mixed fertilizers,	2
Potash as High Grade Sulphate, and in mixtures free from Muriate,	5¼
" " Muriate,	4½

The manurial constituents contained in feedstuffs are valued as follows:

Organic Nitrogen,	15
Phosphoric acid,	5
Potash,	5

The Bulletins of the Mass. Experiment Station will be sent free of charge to all parties interested in its work, on application.

C. A. GOESSMANN, *Director.*

Amherst, Mass., July 16, 1894.

Carpenter & Morehouse, Printers, Amherst, Mass.

MASSACHUSETTS STATE

AGRICULTURAL EXPERIMENT STATION.

BULLETIN NO. 54.

AUGUST, 1894.

Meteorological Summary, for July, 1894.

Highest temperature, - - -	98.00°
Lowest temperature, - - -	48.00°
Mean temperature, - - -	71.90°
Total rain fall (inches), - -	1.60
Prevailing wind, - - - -	S. W.

The month of July was very hot and dry, the mean temperature being 4° above that of July, 1893. The rain fall, viz 1.60 inches, was about 3 inches below the normal and 1 inch below that for the same month last year.

All crops have suffered for want of rain. Potatoes and onions have been greatly injured by the drought, so light crops are expected. The hay crop was about the average in this section, but the rowen crop will be very light.

I ANALYSES OF COMMERCIAL FERTILIZERS COLLECTED DURING 1894, IN THE GENERAL MARKETS BY THE AGENT OF THE MASSACHUSETTS STATE AGRICULTURAL EXPERIMENT STATION.

Laboratory No.	Name of Brand.	Name of Manufacturer.	Sampled at
	Compound Fertilizers.		
2	Potato Special,	Walker, Stratman & Co., Pittsburg, Pa.,	Amherst.
10	Potato Manure,	M. E. Wheeler & Co., Rutland, Vt.,	Amherst.
39	Market Garden Manure,	Quinnipiac Fertilizer Co., Boston, Mass.,	Springfield.
51	Odorless Phosphate,	Allison, Stroup & Co., Boston, Mass.,	Amherst.
84	Complete Topdressing Manure,	Bowker Fertilizer Co., Boston, Mass.,	Springfield.
86	Fish and Potash "D Brand,"	Bowker Fertilizer Co., Boston, Mass,,	Springfield.
87	Special Favorite,	Davidge Fertilizer Co., New York, N. Y.,	Monson.
96	Strawberry Manure,	H. J. Baker & Bro., New York, N. Y.,	Fall River.
102	Bristol Fish and Potash,	Bowker Fertilizer Co., Boston, Mass	Dighton.
103	Potato Manure,	M. E. Wheeler & Co., Rutland, Vt.,	Bridgewater.
109	Farm and Garden Phosphate,	Bowker Fertilizer Co., Boston, Mass.,	Dighton.
112	Standard Fertilizer,	Read Fertilizer Co., Syracuse, N. Y.,	W. Brid'water.
115	Potato and Root Fertilizer,	Wm. J. Brightman & Co., Tiverton, R. I.,	W. Brid'water.
116	High Grade Farmers' Friend,	Read Fertilizer Co., Syracuse, N. Y.,	W. Brid'water.
117	Lawn and Garden Dressing,	Bradley Fertilizer Co., Boston, Mass.,	Boston.
119	Sheep Fertilizer,	John J. Peters, Long Island City, N. Y.,	Boston.
123	Wood Ashes,	Allison, Stroup & Co., Boston, Mass.,	Boston.
129	A. A. Ammoniated Superphosphate,	H. J. Baker & Bro., New York, N. Y.,	Fall River.
133	Fish and Potash "D Brand,"	Daniel T. Church & Co., Providence, R. I.,	Dighton.
137	Meat and Bone,	Thomas Hersom & Co., New Bedford, Mass,	New Bedford.
138	Potato and Root Fertilizer,	W. J. Brightman & Co., Tiverton, R. I.,	Dighton.
139	Potato Phosphate,	Cleveland Dryer Co., Boston, Mass.	So. Framing'm
142	Bay State Bone Superphosphate,	H. F. Tucker, Boston, Mass.,	Taunton.
143	Plymouth Rock Brand,	Ames Fertilizer Co., Peabody, Mass.,	Dighton.
147	Ammoniated Dissolved Bone,	Quinnipiac Fertilizer Co., Boston, Mass.,	Williamstown.
148	Grass and Grain Fertilizer,	E. Frank Coe, New York, N. Y.,	Williamstown.
156	Dry Fish Guano,	Bradley Fertilizer Co., Boston, Mass.,	Northampton.
158	Potato Manure,	E. Frank Coe, New York, N. Y.,	[illegible]
167	Special Favorite,	Davidge Fertilizer Co., New York, N. Y.,	[illegible]tfield.
250	Potato Special,	Walker Stratman and Co., Pittsburg, Pa.,	[illegible]s.

Laboratory Number.	Name of Brand.	Moisture.	Nitrogen in 100 lbs.		Phosphoric Acid in 100 lbs.							…sium Oxide in 100 lbs.	
								Total.		Available.			
			Found.	Guaranteed.	Soluble.	Reverted.	Insoluble.	Found.	Guaranteed.	Found.	Guaranteed.	Found.	Guaranteed.
	Compound Fertilizers.												
2-250	Potato Special,	12.01	1.54	2.47-3.30	6.45	2.20	1.94	10.59	12-13	8.65	10-11	6.12	5-6
10-103	Potato Manure,	12.80	2.12	2.06-2.88	5.07	3.27	1.38	9.72	9-15	8.34	8-12	6.46	3.75-4.50
39	Market Garden Manure,	11.46	3.78	3.30-4.12	3.74	5.83	1.02	10.59	9-13	9.57	8-11	7.02	7-8
51	Odorless Phosphate,	.39	—	—	—	—	—	20.84	18	—	—	—	—
84	Complete Topdressing Manure,	6.40	5.04	5-6	2.05	5.01	2.92	9.98	6-7	7.06	4-6	7.19	6-7
86	Fish and Potash "D Brand,"	6.95	3.14	2.14-3.14	2.15	3.88	5.48	11.51	8-10	6.03	—	4.09	2-3
87-167	Special Favorite,	6.57	1.50	1.24-2.06	5.88	6.25	2.97	15.10	11-14	12.13	10-12	1.63	1.5-2.5*
96	Strawberry Manure,	12.25	2.77	2.88	2.89	4.13	1.30	8.32	6	7.02	—	9.04	8
102	Bristol Fish and Potash,	15.72	2.04	1.6-2.5	2.58	5.31	3.79	11.68	8-10	7.89	5-8	1.94	2-3
109	Farm and Garden Phosphate,	11.98	2.14	1.5-2.5	2.61	5.59	2.70	10.90	10-14	8.20	8-11	2.13	2-3
112	Standard Fertilizer,	14.12	1.17	.8	6.09	2.25	.72	9.06	9-12	8.34	8	4.36	4-6
115-138	Potato and Root Fertilizer,	10.71	3.72	3.73-4.52	4.30	4.68	1.82	10.80	9-12	8.98	8-11	5.83	6-7
116	High Grade Farmers' Friend,	11.20	3.34	3.30-4.12	4.61	1.54	1.07	7.22	6	6.15	5-6	10.86	10-11
117	Lawn and Garden Dressing,	7.22	3.30	4.12-4.94	1.82	4.27	1.59	7.68	—	6.09	5-6	5.54	5-6
119	Sheep Fertilizer,	13.44	2.14	1.65	—	—	—	1.59	1.20	—	—	1.64	1.70
123	Wood Ashes,	19.62	—	—	—	—	—	1.74	1.36-1.83	—	—	4.70	5.84-6.80
129	A. A. Ammoniated Superphosphate,	12.77	3.15	2.47-3.30	5.25	5.22	2.02	12.49	—	10.47	10-12	2.32	2-3
133	Fish and Potash, "D Brand,"	19.94	2.53	2.07-2.90	3.63	3.43	.92	7.98	7.50-10.50	7.06	6-8	2.48	2-3
137	Meat and Bone,	5.73	5.53	4.24	.72	10.36	7.96	19.04	19-25	11.08	—	—	—
139	Potato Phosphate,	13.83	1.96	2.05-2.85	3.17	6.48	1.61	11.26	10-13	9.65	8-10	3.56	3-4*
142	Bay State Bone Superphosphate,	11.85	2.02	2	6.04	2.98	2.70	11.72	11-15	9.02	9-12	2.08	1.85
143	Plymouth Rock Brand,	12.55	3.29	3.30-4.12	4.50	5.91	1.74	12.15	9-13	10.41	8-11	4.59	4-4.5
147	Ammoniated Dissolved Bone,	13.01	1.66	1.65-2.47	4.91	4.92	1.48	11.31	10-13	9.83	9-11	2.18	2-3
148	Grass and Grain Fertilizer,	12.12	1.30	.80-1.65	4.61	7.50	.84	13.05	10-13	12.11	9-11	1.66	1.35-1.90
156	Dry Fish Guano,	12.13	8.50	7.41-9.06	.87	4.30	.77	5.94	7-9	5.17	—	—	—
158	Potato Manure,	14.39	2.24	2-2.50	6.47	2.13	3.07	11.67	10-14	8.60	8-11	5.72	6-7

*Sulphate of Potash, the source of Potash.

ANALYSES OF COMMERCIAL FERTILIZERS COLLECTED DURING 1894, IN THE GENERAL MARKETS BY THE AGENT OF THE MASSACHUSETTS STATE AGRICULTURAL EXPERIMENT STATION.

Laboratory No.	Name of Brand.	Name of Manufacturer.	Sampled at
	Compound Fertilizers.		
168	Potato and Root Crop Manure,	Prentiss, Brooks & Co., Holyoke, Mass.,	Westfield.
169	Excelsior Tobacco Grower,	E. Frank Coe, New York, N. Y.,	Westfield.
173	Fish and Potash "Plain Brand,"	Quinnipiac Fertilizer Co., Boston, Mass.,	Westfield.
175	Ground Bone and Potash,	E. Frank Coe, New York, N. Y.,	Lee.
177	Dry Ground Fish,	Bowker Fertilizer Co., Boston, Mass.	Northampton.
184	Potato, Onion and Tobacco Grower,	Williams & Clark Fertilizer Co., Boston, Mass.,	Greenfield.
185	Fish and Potash "Americus Brand,"	Williams & Clark Fertilizer Co., Boston, Mass.,	Greenfield.
194	West Andover Market Bone Phosphate,	James E. McGovern, West Andover, Mass.,	Lawrence.
195	Tobacco and Sulphur,	F. C. Sturtevant, Hartford, Conn.,	Fitchburg.
205	King Philip Guano,	Clark Cove Fertilizer Co., Boston, Mass.,	Lawrence.
218	Tankage and Bone,	Lowe Brothers & Co., Fitchburg, Mass.,	Fitchburg.
222	Royal Bone Phosphate,	Williams & Clark Fertilizer Co., Boston, Mass.,	Lowell.
228	Eclipse Phosphate,	Bradley Fertilizer Co., Boston, Mass.,	Newburyport.
230	Lawrence Fertilizer,	A. Lee & Co., Lawrence, Mass.,	Lawrence.
234	Potato and Tobacco Fertilizer,	Clark Cove Fertilizer Co., Boston, Mass.,	Lawrence.
235	Soluble Pacific Guano,	Pacific Guano Co., Boston, Mass.,	Newburyport.
237	West Andover Market Bone Phosphate,	James E. McGovern, Lawrence, Mass.,	Amherst.
241	Potato, Onion and Tobacco Fertilizer,	Leander Wilcox, Mystic, Conn.,	S. Hadley Falls.
246	Potato and Tobacco Manure,	Standard Fertilizer Co., Boston, Mass.,	Ludlow.
247	Pride of the Valley,	Kirley Fertilizer Co., South Hadley Falls, Mass.,	S. Hadley Falls.
265	Coarse Linseed Meal,	Cleveland Linseed Oil Co., Cleveland, Ohio,	So. Deerfield.
270	Havana Tobacco Fertilizer,	Quinnipiac Fertilizer Co., Boston, Mass.,	Hatfield.
272	Fish and Potash,	Pacific Guano Co., Boston, Mass.,	Belchertown.
274	Pride of the Valley,	Kirley Fertilizer Co., South Hadley Falls, Mass.,	Amherst.
	Bones.		
33	Pure Ground Bone,	C. A. Bartlett, Worcester, Mass.,	Worcester.
34	Pure Fine Ground Bone,	J. G. Jefferds, Worcester, Mass.,	Worcester.
125	Pure Ground Bone,	C. A. Bartlett, Worcester, Mass.,	Boston.
196	Pure Fine Ground Bone,	J. G. Jefferds, Worcester, Mass.,	Hudson.
199	Bone Meal,	Crocker Fertilizer and Chemical Co., Buffalo, N. Y.,	Fitchburg.
221	Ground Bone,	James E. McGovern, West Andover, Mass.,	Lawrence.

Laboratory Number.	Name of Brand.	Moisture.	Nitrogen in 100 lbs.		Phosphoric Acid in 100 lbs.							Potassium Oxide in 100 lbs.	
								Total.		Available.			
			Found.	Guaranteed.	Soluble.	Reverted.	Insoluble.	Found.	Guaranteed.	Found.	Guaranteed.	Found.	Guaranteed.
	Compound Fertilizers.												
168	Potato and Root Crop Manure,......	7.88	4.35	4.12-4.94	5.07	3.38	1.43	9.88	7-9	8.45	5-6	7.45	7-9*
169	Excelsior Tobacco Grower,........	9.35	4.10	3-4	6.70	2.18	3.07	11.95	8-11	8.88	8-11	5.64	5-6*
173	Fish and Potash "Plain Brand,"....	17.83	2.50	2.06-2.88	3.89	1.44	.61	5.94	6-9	5.33	4-6	4.04	4-6
175	Ground Bone and Potash,..........	4.23	1.27	—	.33	9.99	4.82	14.14	—	10.32	—	12.48	—
177	Dry Ground Fish,.................	13.92	7.70	8-10	1.36	3.22	2.56	7.14	7-8	4.58	—	—	—
184	Potato, Onion and Tobacco Grower,	9.62	3.62	3.71-4.12	2.71	6.19	1.28	10.18	8-11	8.90	7-9	7.44	7-9
185	Fish and Potash "Americus Brand,"	16.68	2.35	2.06-2.88	4.09	2.82	1.07	7.98	6-9	6.91	4-6	2.48	4-6
194-237	West Andover Market Bone Phos'te	12.58	1.56	2-3	4.02	9.62	.36	14.02	13-15	13.64	—	1.96	3-4
195	Tobacco and Sulphur,.............	13.08	2.20	1.96	—	—	—	.87	.75	—	—	7.67	7.66
205	King Philip Guano,...............	16.67	1.16	.91-1.65	5.94	3.53	.92	10.39	9-12	9.47	8-10	2.21	2-3
218	Tankage and Bone,................	4.26	2.84	—	—	—	—	24.38	—	—	—	—	—
222	Royal Bone Phosphate,............	17.38	1.45	1-1.64	3.89	6.09	1.15	11.13	8-12	9.98	7-10	2.66	2-3
228	Eclipse Phosphate,...............	13.93	1.20	1-2	4.71	4.50	2.30	11.51	10-14	9.21	8-11	1.82	1.5-2.5
230	Lawrence Fertilizer, ...	13.54	1.62	2.06-2.88	2.81	6.24	2.23	11.28	10-12	9.05	—	2.10	2-3
234	Potato and Tobacco Fertilizer, ...	11.60	1.92	2.06-2.80	2.56	6.90	1.54	11.00	9-14	9.46	8-11	2.94	3-4*
235	Soluble Pacific Guano.............	13.06	2.06	2.25-3.00	6.88	2.70	.82	10.44	10.50-16	9.58	8.50-11	2.23	2-3.50
241	Potato, Onion & Tobacco Fertilizer,	14.42	3.39	3.25-4.25	4.76	3.66	1.07	9.49	8-9	8.42	6-8	6.17	6-7
246	Potato and Tobacco Manure, ...	12.51	2.94	2.06-2.88	4.20	5.21	2.00	11.41	9-13	9.41	8-11	3.08	3-4*
247-274	Pride of the Valley,..............	13.81	1.54	2.06-2.88	.82	6.34	.49	7.65	7-9	7.16	—	3.16	2.70-3.78*
265	Coarse Linseed Meal, ...	9.27	6.54	5.90-6.00	—	—	—	2.10	5.70-6.20	—	—	1.71	1.40-1.50*
270	Havana Tobacco Fertilizer,........	10.15	6.38	5.77-6.59	1.38	1.59	.97	3.94	6-9	2.97	5-7	10.88	10-12
272	Fish and Potash,..................	18.67	3.48	2.06-2.88	3.04	2.82	.69	6.55	6-10	5.86	4-7	3.77	4-6
	Bones.												
33-125	Pure Ground Bone,................	4.12	2.85	2-3	.49	18.88	7.80	27.17	27-29	19.37	—		
34-196	Pure Fine Ground Bone,...........	3.04	1.36	2.47-4.12	—	25.84	3.17	29.01	25-30	25.84	—		
199	Bone Meal, ...	6.25	3.80	2-3	.03	16.29	7.60	23.92	25-28	16.32	—		
221	Ground Bone,.....................	8.87	1.80	—	.03	16.61	2.94	19.58	—	16.64	—		

Mechanical Analysis.

Laboratory Number.	Fine.	Med. Fine.	Med.	Coarse Med.
33-125	57.08	28.60	13.77	.54
34-196	75.06	22.94	2.00	—
199	38.35	29.25	21.92	10.48
221	51.88	18.94	12.80	16.38

*Sulphate of Potash, the source of Potash.

II. ANALYSES OF COMMERCIAL FERTILIZERS AND MANURIAL SUBSTANCES SENT ON FOR EXAMINATION.

972-974. COMMERCIAL FERTILIZERS.

(I., Potato manure, sent on from Lancaster, Mass.; II., Electrical dissolved bone, sent on from Lancaster, Mass.; III., Tobacco grower, sent on from Hatfield, Mass.)

	Per cent.		
	I.	II.	III.
Moisture at 100° C.,	10.39	8.79	6.54
Total phosphoric acid,	10.64	14.12	12.62
Soluble phosphoric acid,	5.81	7.11	*
Reverted phosphoric acid,	2.96	6.50	*
Insoluble phosphoric acid,	1.87	.51	*
Potassium oxide,	5.86	—	11.82
Nitrogen,	2.29	.59	5.42

975-977. COTTON-SEED MEAL.

(I. and II. sent on from Hatfield, Mass.; III. sent on from Hadley, Mass., [damaged]).

	Per cent.		
	I.	II.	III.
Moisture at 100° C.,	8.75	8.23	12.57
Total phosphoric acid,	2.12	3.08	2.48
Potassium oxide,	1.51	1.94	1.66
Nitrogen,	7.70	7.17	5.68

978-980. REFUSE MATERIALS.

(I., Refuse from calico works, sent on from Seekonk, Mass.; II., Hair waste, sent on from Concord, Mass.: III., Cotton waste, sent on from Concord, Mass.)

	Per cent.		
	I.	II.	III.
Moisture at 100° C.,	4.07	72.81	10.01
Phosphoric acid,	11.95	.61	.31
Potassium oxide,	—	.32	1.20
Nitrogen,	4.28	1.79	3.43

981-984.

(I., Dry ground fish, sent on from Hatfield, Mass.; II., Muriate of potash, sent on from Hudson, Mass.; III., Marl, sent on from Dalton, Mass.; IV., Seaweed, sent on from South Bristol, Mass.)

	Per cent. I.	II.	III.	IV.
Moisture at 100° C.,	9.74	1.05	5.33	8.67
Calcium oxide,	*	—	37.36	*
Ferric oxide,	*	—	1.68	*
Phosphoric acid,	6.69	—	Trace.	*
Potassium oxide,	—	51.16	*	*
Nitrogen,	8.19	—	*	1.54

985-987. WOOD ASHES.

(I. sent on from Concord, Mass.; II. sent on from Beverly, Mass.; III. sent on from Waltham, Mass.)

	Per cent. I.	II.	III.
Moisture at 100° C.,	12.32	10.17	9.25
Phosphoric acid,	1.42	1.61	1.38
Potassium oxide,	6.40	5.21	4.32
Insoluble matter,	10.27	*	23.78

988-990. WOOD ASHES.

(I. sent on from Sunderland, Mass.; II. sent on from Beverly, Mass.; III. sent on from Waltham, Mass.)

	Per cent. I.	II.	III.
Moisture at 100° C.,	20.60	2.05	11.75
Phosphoric acid,	1.56	1.79	1.71
Potassium oxide.	4.78	4.64	5.10

991-994. WOOD ASHES.

(I. sent on from South Hadley, Mass.; II. sent on from South Deerfield, Mass.; III. sent on from Northfield, Mass.)

	Per cent. I.	II.	III.
Moisture at 100° C.,	2.35	2.33	12.20
Phosphoric acid,	1.71	1.54	1.33
Potassium oxide,	3.46	6.09	5.18
Insoluble matter,	*	*	17.16

995-997. WOOD ASHES.

(I. sent on from South Sudbury, Mass.; II. sent on from Northfield, Mass.; III. sent on from Beverly, Mass.)

	Per cent. I.	II.	III.
Moisture at 100° C.,	33.23	6.25	2.62
Phosphoric acid,	.90	1.33	1.28
Potassium oxide,	4.09	4.65	4.73
Insoluble matter,	9.79	24.44	*

*Not determined.

TRADE VALUES OF FERTILIZING INGREDIENTS IN RAW MATERIALS AND CHEMICALS.

	1894. *Cents per pound.*
Nitrogen in ammonia salts,	19
" " nitrates,	14½
Organic nitrogen in dry and fine ground fish, meat, blood, and in high-grade mixed fertilizers,	18½
" " " cotton-seed meal, linseed meal and castor pomace,	15
" " " fine ground bone and tankage,	16½
" " " fine ground medium bone and tankage,	15
" " " medium bone and tankage,	12
" " " coarse bone and tankage,	7
" " " hair, horn-shavings and coarse fish scraps,	7
Phosphoric acid soluble in water,	6
" " soluble in ammonium citrate,	5½
" " in fine bone and tankage,	5½
" " in fine medium bone and tankage,	4½
" " in medium bone and tankage,	3
" " in coarse bone and tankage,	2
" " in fine ground fish, cotton-seed meal, linseed meal, castor pomace and wood ashes,	5
" " insoluble (in am. cit.) in mixed fertilizers,	2
Potash as High Grade Sulphate, and in mixtures free from Muriate,	5¼
" " Muriate,	4½
The manurial constituents contained in feedstuffs are valued as follows:	
Organic Nitrogen,	15
Phosphoric acid,	5
Potash,	5

The Bulletins of the Mass. Experiment Station will be sent free of charge to all parties interested in its work, on application.

C. A. GOESSMANN, *Director.*

Amherst, Mass., August 13, 1894.

Carpenter & Morehouse, Printers, Amherst, Mass.

MASSACHUSETTS STATE

AGRICULTURAL EXPERIMENT STATION.

BULLETIN NO. 55.

OCTOBER, 1894.

Meteorological Summary, for August and September, 1894.

	AUG.	SEPT.
Highest temperature, - -	91.00°	91.00°
Lowest temperature, - - -	36.00°	32.00°
Mean temperature, - -	66.90°	63.73°
Total precipitation (inches), - -	.32	4.11
Prevailing wind, - - -	S.	S. W.

The mean temperature for August, viz. 66.90°, was 1.23° below that of August, 1893. On the night of the 22d there was a light frost, slightly injuring vegetation on low lands.

The rainfall, viz. .32 inches, was about four inches below the normal, the average for the month of August, being 4.34 inches, in this section.

The mean temperature for September, viz. 63.73°, was 8.02° above that, for the same month, last year, as recorded at this station.

The rainfall of 4.11 inches, was 1.54 inches greater than that for Sept., '93.

The continued drouth of July and August caused a scarcity of water in many instances. All crops suffered and the rowen crop in most cases was a total failure.

I ANALYSES OF COMMERCIAL FERTILIZERS COLLECTED DURING 1894, IN THE GENERAL MARKETS BY THE AGENT OF THE MASSACHUSETTS STATE AGRICULTURAL EXPERIMENT STATION.

Laboratory No.	Name of Brand.	Name of Manufacturer.	Sampled at
	Compound Fertilizers.		
4	Tobacco Special.	Walker, Stratman & Co., Pittsburg, Pa.	Amherst.
5	Four Fold.	Walker Stratman & Co., Pittsburg, Pa.,	Amherst.
11	Grass and Oats Fertilizer,	M. E. Wheeler & Co., Rutland, Vt.,	Amherst.
16	Pulverized Bone and Meat,	Quinnipiac Fertilizer Co., Boston, Mass.	Sunderland.
26	Animal Fertilizer,	J. G. Jefferds, Worcester, Mass.	Worcester.
64	Dry Ground Fish Guano,	National Fertilizer Co., Bridgeport, Conn	Hadley.
88	Vegetator.	Davidge Fertilizer Co., New York, N. Y.	Monson.
91	Nitrogenous Superphosphate.	John C. Dow & Co., Boston, Mass.,	Amherst.
101	Harvest Home Phosphate,	H. J. Baker & Bro., New York, N. Y.,	Fall River.
126	Strawberry Fertilizer.	Ames Fertilizer Co., Peabody, Mass.	Dighton.
130	Nitrogenous Superphosphate,	John C. Dow & Co., Boston, Mass.,	Dighton.
132	Manhaden Fish Guano,	W. J. Brightman & Co., Tiverton, R. I.,	Dighton.
134	Potato Manure,	Mapes Formula & Peruvian Guano Co., New York, N.Y.	Dighton.
135	Economical Manure.	Mapes Formula & Peruvian Guano Co., New York, N.Y.	Dighton.
136	Church's B. Special Fertilizer,	Daniel T. Church & Co., Providence, R. I.	Dighton.
154	Sheep Fertilizer	Wm Elliott & Sons, New York, N. Y.	Pittsfield.
162	Wheat and Corn Fertilizer,	Davidge Fertilizer Co., New York, N. Y.	Westfield.
163	Ammoniated Wheat and Corn Phosphate,	Crocker Fertilizer and Chemical Co., Buffalo, N. Y.	North Adams.
183	Ammoniated Wheat and Corn Phosphate,	Crocker Fertilizer and Chemical Co., Buffalo, N. Y.	Greenfield.
188	Sure Crop Phosphate	Bowker Fertilizer Co., Boston, Mass.,	Shelburn' Falls
192	Grass Manure,	Williams & Clark Fertilizer Co., Boston, Mass.,	Greenfield.
193	Grass Fertilizer	Quinnipiac Fertilizer Co., Boston, Mass.,	Williamstown.
200	Superphosphate,	William Lavery, Amesbury, Mass.,	Amesbury.
203	Gold Brand Excelcior Guano,	E. Frank Coe, New York, N. Y.,	Framingham.
204	Potato Fertilizer,	Cumberland Bone Phosphate Co., Boston, Mass.,	Hudson.
209	Great Planet "A",	Clark Cove Fertilizer Co., Boston, Mass.,	Hudson.
219	Superphosphate,	William Lavery, Amesbury, Mass.,	Amesbury.
227	Potato Fertilizer.	Cumberland Bone Phosphate Co., Boston, Mass.,	Lowell.
252	Four Fold,	Walker, Stratman & Co., Pittsburg, Pa.,	Leeds.
257	Great Planet "A",	Clark Cove Fertilizer Co., Boston, Mass.	Westfield.

Laboratory Number.	Name of Brand.	Moisture.	Nitrogen in 100 lbs. Found.	Nitrogen in 100 lbs. Guaranteed.	Phosphoric Acid in 100 lbs. Soluble.	Reverted.	Insoluble.	Total. Found.	Total. Guaranteed.	Available. Found.	Available. Guaranteed.	Potassium Oxide in 100 lbs. Found.	Potassium Oxide in 100 lbs. Guaranteed.
	Compound Fertilizers.												
4	Tobacco Special, ...	8.79	2.37	2.47-3.30	6.75	3.23	.97	10.95	10-12	9.98	8-10	4.	3.24-4.32*
5-252	Four Fold, ...	9.95	1.80	1.65-2.47	5.99	3.68	1.64	11.31	10-11	9.67	8-9	1.66	2-3*
11	Grass and Oats Fertilizer, ...	15.42	—	—	6.26	3.18	.16	9.60	12-18	9.44	10-14	2.33	2-4*
16	Pulverized Bone and Meat.........	6.17	5.6	4.94-5.77	.26	7.72	9.98	17.96	18-20	7.98	—	—	—
26	Animal Fertilizer, ...	10.51	2.5	2.47-3.30	4.76	6.21	6.35	17.32	16-18	10.97	11-13	2.58	2.5-3.5
64	Dry Ground Fish Guano...........	9.64	7.41	—	.64	5.70	.72	7.06	—	6.34	—	—	—
88	Vegetator, ...	12.37	2.10	2.06-3.71	9.22	1.86	1.28	12.36	—	11.08	5-7	1.92	3-5
91-130	Nitrogenous Superphosphate, ...	16.10	2.10	2.06-2.88	2.97	7.63	1.94	12.54	8-10	10.60	—	4.37	1.89-2.53
101	Harvest Home Phosphate..........	12.21	1.46	1.03-1.65	1.64	7.63	1.07	10.34	—	9.27	8-10	3.36	2.-2.5
126	Strawberry Fertilizer, ...	13.00	2.7	2.47-3.30	4.73	3.97	3.15	11.85	10-12	8.70	9-11	6.42	6-7
132	Manhaden Fish Guano, ...	9.81	8.20	8.24 9.89	1.05	3.54	2.46	7.05	6.87-9.16	4.59	—	—	—
134	Potato Manure, ...	6.23	3.8	3.71-4.12	2.12	3.74	2.38	8.24	8-10	5.86	8.	8.36	6-8*
135	Economical Manure, ...	11.42	2.78	2.47-3.30	4.25	3.93	.31	8.49	8-10	8.18	6-8	9.86	8-10
136	Church's B. Special Fertilizer, ...	11.48	3.40	3.73-4.52	1.84	6.30	2.71	10.85	9-13	8.14	8-11	6.16	6-7
154	Sheep Fertilizer, ...	9.40	1.91	—	—	—	—	2.18	—	—	—	3.02	—
162	Wheat and Corn Fertilizer, ...	11.52	1.01	.82-1.65	10.50	2.34	1.66	14.50	8-12	12.84	7-9	1.24	1-2
163-183	Ammon. Wheat and Corn Phosphate	12.64	2.26	2-3	6.70	3.54	1.79	12.03	—	10.24	10-13	1.35	1.60-2.70
188	Sure Crop Phosphate, ...	11.75	.9	.75-1.50	4.35	4.96	3.28	12.59	—	9.31	8-10	1.17	1-2
192	Grass Manure, ...	11.23	3.44	3.91-4.74	2.25	3.43	1.07	6.75	6-8	5.68	5-7	2.39	2-3
193	Grass Fertilizer, ...	10.36	3.10	3.91-4.74	2.48	4.12	1.18	7.78	6-8	6.60	5-7	2.33	2-3
200-219	Superphosphate, ...	16.10	1.75	1.97	1.07	6.70	.72	8.49	—	7.77	10.17	1.28	2.36
203	Gold Brand Excelcior Guano.......	7.70	2.60	2.5-3	6.70	2.41	1.94	11.05	9-13	9.11	8-11	6.25	6-8
204-227	Potato Fertilizer, ...	15.52	1.91	2.06-2.88	6.04	3.25	1.30	10.59	11-13	9.29	9-11	3.40	3-4
209-257	Great Planet "A", ...	10.44	3.16	3.30-4.12	2.56	7.06	2.35	11.97	9-13.50	9.62	8-11.50	7.21	7-8

*Sulphate of Potash, the source of Potash.

ANALYSES OF COMMERCIAL FERTILIZERS COLLECTED DURING 1894, IN THE GENERAL MARKETS BY THE AGENT OF THE MASSACHUSETTS STATE AGRICULTURAL EXPERIMENT STATION.

Laboratory No.	Name of Brand.	Name of Manufacturer.	Sampled at
	Compound Fertilizers.		
210	New Rival Ammoniated Superphosphate,	Crocker Fertilizer and Chemical Co., Buffalo, N. Y.,	Newburyport.
213	New Method Fertilizer,	Bradley Fertilizer Co., Boston, Mass.,	Lowell.
217	Lawn Fertilizer,	Crocker Fertilizer and Chemical Co., Buffalo, N. Y.,	Fitchburg.
223	New Method Fertilizer,	Bradley Fertilizer Co., Boston, Mass.,	Amesbury.
236	Prolific Crop Producer,	Williams & Clark Fertilizer Co., Boston, Mass.,	Lowell.
248	Standard Superphosphate,	Standard Fertilizer Co., Boston, Mass.,	Ludlow.
251	Corn Manure,	H. J. Baker & Bro., New York, N. Y.	E. Longm'dow
253	Ammoniated Bone Superphosphate,	Leander Wilcox, Mystic, Conn.,	S. Hadley Falls.
259	Bay State G. G.,	Clark Cove Fertilizer Co., Boston, Mass.,	E. Longm'dow
260	Corn Manure,	H. J. Baker & Bro., New York, N. Y.,	Northampton.
262	Dry Ground Fish Guano,	Leander Wilcox, Mystic, Conn.,	Amherst.
264	Connecticut Wrapper Fertilizer,	Cleveland Linseed Oil Co., Cleveland, Ohio,	Amherst.
265	Coarse Linseed Meal,	Cleveland Linseed Oil Co., Cleveland, Ohio,	So. Deerfield.
268	Onion Manure,	Quinnipiac Fertilizer Co., Boston, Mass.,	Hatfield.
269	Corn and Grain Phosphate,	Cleveland Dryer Co., Boston, Mass.,	Monson.
271	Lawn and Garden Fertilizer,	L. B. Darling Fertilizer Company, Pawtucket, R. I.,	Worcester.
273	High Grade General Fertilizer,	Pacific Guano Co., Boston, Mass.,	Belchertown
	Chemicals.		
24	Nitrate of Soda,	Lucien Sanderson, New Haven, Conn.,	Sunderland.
25	Nitrate of Soda,	Quinnipiac Fertilizer Co., Boston, Mass.,	Sunderland.
50	Sulphate of Potash and Magnesia,	Bowker Fertilizer Co., Boston, Mass.	Amherst.
59	Sulphate of Potash and Magnesia,	Williams & Clark Fertilizer Co., Boston, Mass.,	Sunderland.
	Bones.		
207	Pure Ground Bone,	Wm. Lavery, Amesbury, Mass.,	Amesbury.
231	Pure Ground Bone,	Wm. Lavery, Amesbury, Mass.,	Amesbury.
240	Ground Bone,	Bryant & Brett, New Bedford, Mass.,	Amherst.
256	Ground Bone,	H. J. Baker & Bro., New York, N. Y.,	E. Longm'dow

Laboratory Number.	Name of Brand.	Moisture.	Nitrogen in 100 lbs. Found.	Nitrogen in 100 lbs. Guaranteed.	Phosphoric Acid in 100 lbs. Soluble.	Reverted.	Insoluble.	Total. Found.	Total. Guaranteed.	Available. Found.	Available. Guaranteed.	Potassium Oxide in 100 lbs. Found.	Potassium Oxide in 100 lbs. Guaranteed.
	Compound Fertilizers.												
210	New Rival Ammoniated Superphos'te	11.25	1.26	1.20-2.00	5.01	3.69	1.79	10.49	11-14	8.70	10-12	2.32	1.60-3.00
213-223	New Method Fertilizer,............	12.83	1.33	.82-1.65	5.12	3.53	1.43	10.08	10-12	8.65	8-10	2.20	2.16-3.24
217	Lawn Fertilizer,..................	3.75	2.49	3.29-4.00	—	8.92	17.92	26.84	19-22	8.92	—	1.30	3.25-4.30
236	Prolific Crop Producer,............	12.97	1.19	.82-1.65	4.86	3.70	2.18	10.74	7-11	8.56	6-9	2.17	1-2
248	Standard Superphosphate,.........	11.78	2.48	2.5-3.5	4.09	5.32	2.10	11.51	11-16	9.41	9-13	2.00	2-3
251-260	Corn Manure.....................	7.54	4.19	4.12	2.92	4.04	1.74	8.70	—	6.96	6-25	7.50	7.
253	Ammoniated Bone Superphosphate.	15.70	2.88	2.50-3.50	3.96	2.68	1.80	8.44	7-8	6.64	6-7	6.02	5-6
259	Bay State "G. G.",...............	12.32	2.41	1.85-2.68	6.02	3.06	3.46	12.54	10-13	9.08	8 50-11	1.88	2-3
262	Dry Ground Fish Guano,..........	8.85	8.60	8-10	.52	4.40	2.82	7.74	6-8	4.92	4-6	—	—
264	Connecticut Wrapper Fertilizer,...	5.90	4.16	4.5-5.25	.52	1.46	2.56	7.54	5.46-6.37	4.98	—	13.18	5.70-6.20
265	Coarse Linseed Meal..............	9.27	6.54	5.90-6.00	—	—	—	2.1[illegible]	†2.	—	—	1.71	1.40-1.50
268	Onion Manure,......	10.12	3.38	3.30-4.12	2.44	4.98	3.58	11.	9-13	7.42	8-11	7.66	7-8*
269	Corn and Grain Phosphate,........	15.88	1.97	2.02-2.88	5.17	4.60	.72	10.49	10.50-14.50	9.77	9.50 12.50	2.44	1.50-2.50
271	Lawn and Garden Fertilizer,.......	10.27	3.58	4.94-6.59	4.78	2.20	3.38	10.36	10-12	6.98	—	5.77	5-6
273	High Grade General Fertilizer,.....	11.18	3.64	2.68-3.50	3.33	4.04	2.30	9.67	9-13	7.37	8-11	6.36	7-8*
	Chemicals.												
24	Nitrate of Soda,..................	.76	15.68	15.66-16.48	—	—	—	—	—	—	—	—	—
25	Nitrate of Soda..................	.97	16.04	15.66-16.48	—	—	—	—	—	—	—	—	—
50	Sulphate of Potash and Magnesia.	2.01	—	—	—	—	—	—	—	—	—	25.08	25.94-28.10
59	Sulphate of Potash and Magnesia.	4.31	—	—	—	—	—	—	—	—	—	28.63	25.94-28.10
	Bones.												
207-231	Pure Ground Bone,................	11.92	3.42	—	—	3.96	5.38	9.34	—	3.96	—		
240	Ground Bone,.....................	3.92	2.90	2.50	.38	7.45	18.54	26.37	25.56	7.83	—		
256	Ground Bone,.....................	7.27	4.36	3.30-3.71	.67	8.64	11.64	20.95	22-25	9.31	—		

Mechanical Analysis.

Laboratory Number.	Fine.	Med. Fine.	Med.	Coarse Med.
207-231	32.54	24.05	36.81	6.60
240	26.53	26.80	31.77	14.90
256	38.58	44.28	17.14	—

*Sulphate of Potash, the source of Potash. †Correction from Bulletin No. 54.

ANALYSES OF COMMERCIAL FERTILIZERS AND MANURIAL SUBSTANCES SENT ON FOR EXAMINATION.

998-1000. COMMERCIAL FERTILIZERS.

(I., Tobacco starter, sent on from Hatfield, Mass.; II., Tobacco formula, sent on from Hatfield, Mass.; III., Complete fertilizer sent on from Pittsfield.

	Per cent.		
	I.	II.	III.
Moisture at 100° C.,	6.20	5.61	11.07
Total phosphoric acid,	2.89	6.75	11.82
Available phosphoric acid,	1.56	*	11.31
Insoluble phosphoric acid,	1.33	*	.51
Potassium oxide,	11.26	9.12	5.26
Nitrogen,	4.05	2.60	3.02

1001-1003. CREMATION PRODUCTS. (Swill ashes).

(Sent on from Amherst, Mass.)

	Per cent.		
	I.	II.	III.
Moisture at 100° C.,	.37	7.57	14.24
Potassium oxide,	4.27	3.96	5.09
Phosphoric acid,	12.97	13.92	6.86
Insoluble matter,	34.91	19.96	37.76

1004-1006. POTASH-MAGNESIA SULPHATE.

(Sent on from Hatfield, Mass.)

	Per cent.		
	I.	II.	III.
Moisture at 100° C.,	5.34	4.73	1.19
Potassium oxide,	26.80	26.32	27.28

1007-1008. MURIATE OF POTASH.

(Sent on from Sunderland, Mass.)

	Per Cent.	
	I.	II.
Moisture at 100° C.,	.91	.13
Potassium oxide,	52.50	49.00

*Not determined.

1009-1014. WOOD ASHES.

(I., sent of from South Framingham, Mass.; II., sent on from South Deerfield, Mass.; III., sent on from Concord, Mass.)

	Per cent. I.	II.	III.
Moisture at 100° C.,	3.23	13.65	10.38
Potassium oxide,	4.12	4.68	5.76
Phosphoric acid,	1.26	1.46	1.28

(I., wood ashes, sent on from Leverett, Mass.; II. and III., cotton-seed hull ashes sent on from Hatfield, Mass.)

	Per cent. I.	II.	III.
Moisture at 100° C.,	16.69	9.45	11.00
Potassium oxide,	5.98	25.48	6.84
Phosphoric acid,	1.59	9.96	15.40

1015-1017. MUCK.

(I., sent on from South Amherst, Mass.; II., sent on from Plymouth, Mass.; III., sent on from Millers Falls, Mass.)

	Per cent. I.	II.	III.
Moisture at 100° C.,	70.02	61.53	76.75
Ash,	11.54	30.05	4.38
Nitrogen,	.69	.43	.40

1018. SOOT.

Sent on from South Lancaster, Mass.

	Per cent.
Moisture at 100° C.,	5.39
Potassium oxide.	.52
Phosphoric acid,	.90

1019. RESIDUE FROM WATER FILTER.

Sent on from East Walpole, Mass.

	Per cent.
Moisture at 100° C.,	94.22
Phosphoric acid,	.05
Nitrogen,	.12

1020. VEGETABLE MOULD.

Sent on from Springfield, Mass.

	Per Cent.
Moisture at 100° C.,	77.64
Nitrogen,	.30

1021. COTTON-SEED MEAL.

	Per Cent.
Moisture at 100° C.,	9.01
Potassium oxide,	2.11
Phosphoric acid,	2.38
Nitrogen,	7.11

TRADE VALUES OF FERTILIZING INGREDIENTS IN RAW MATERIALS AND CHEMICALS.

	1894. Cents per pound.
Nitrogen in ammonia salts,	19
" " nitrates,	14½
Organic nitrogen in dry and fine ground fish, meat, blood, and in high-grade mixed fertilizers,	18½
" " " cotton-seed meal, linseed meal and castor pomace,	15
" " " fine ground bone and tankage,	16½
" " " fine ground medium bone and tankage,	15
" " " medium bone and tankage,	12
" " " coarse bone and tankage,	7
" " " hair, horn-shavings and coarse fish scraps,	7
Phosphoric acid soluble in water,	6
" " soluble in ammonium citrate,	5½
" " in fine bone and tankage,	5½
" " in fine medium bone and tankage,	4½
" " in medium bone and tankage,	3
" " in coarse bone and tankage,	2
" " in fine ground fish, cotton-seed meal, linseed meal, castor pomace and wood ashes,	5
" " insoluble (in am. cit.) in mixed fertilizers,	2
Potash as High Grade Sulphate, and in mixtures free from Muriate,	5¼
" " Muriate,	4½

The manurial constituents contained in feedstuffs are valued as follows:

Organic Nitrogen,	15
Phosphoric acid,	5
Potash,	5

The Bulletins of the Mass. Experiment Station will be sent free of charge to all parties interested in its work, on application.

C. A GOESSMANN, *Director.*

Amherst, Mass., October 3, 1894.

Carpenter & Morehouse, Printers, Amherst, Mass.

MASSACHUSETTS STATE

Agricultural Experiment Station.

BULLETIN NO. 56.

NOVEMBER, 1894.

Meteorological Summary for October, 1894.

Mean temperature, - - -	50.3°
Maximum temperature, - - -	73.0°
Minimum temperature, - - -	29.0°
Precipitation, inches, - - -	4.40
Prevailing wind, - - - -	N.W.

The mean temperature for October, viz., 50.3°, was about 1° above normal, but was 1.76° lower than that of the same month last year.

The precipitation was about normal, and was only .05 inch below that for October, 1893, as recorded at this station.

I ANALYSES OF COMMERCIAL FERTILIZERS COLLECTED DURING 1894, IN THE GENERAL MARKETS BY THE AGENT OF THE MASSACHUSETTS STATE AGRICULTURAL EXPERIMENT STATION.

Laboratory No.	Name of Brand.	Name of Manufacturer.	Sampled at
	Chemicals.		
13	Muriate of Potash,	Quinnipiac Fertilizer Co., Boston, Mass.,	Sunderland.
23	Muriate of Potash,	Lucien Sanderson, New Haven, Conn.,	Sunderland.
44	Dried Blood,	Bowker Fertilizer Co., Boston, Mass.,	Amherst.
48	Muriate of Potash,	Bowker Fertilizer Co., Boston, Mass.,	Amherst.
49	Sulphate of Potash, "High Grade,"	Bowker Fertilizer Co., Boston, Mass.,	Amherst.
52	Sulphate of Ammonia,	Quinnipiac Fertilizer Co., Boston, Mass.,	Sunderland.
54	Sulphate of Ammonia,	Lucien Sanderson, New Haven, Conn.,	Sunderland.
57	Nitrate of Soda,	Williams & Clark Fertilizer Co., Boston, Mass.,	Sunderland.
72	Sulphate of Potash, "High Grade,"	Prentiss Brooks & Co., Holyoke, Mass.,	Holyoke.
75	Muriate of Potash,	Prentiss Brooks & Co., Holyoke, Mass.,	Holyoke.
118	Muriate of Potash,	Bradley Fertilizer Co., Boston, Mass.,	Boston.
128	Nitrate of Soda,	Bradley Fertilizer Co., Boston, Mass.,	Boston.
153	Muriate of Potash,	H. J. Baker & Bro., New York, N. Y.,	So. Deerfield.
191	Nitrate of Soda,	H. J. Baker & Bro., New York, N. Y.,	So. Deerfield.
216	Sulphate of Ammonia,	Bradley Fertilizer Co., Boston, Mass.,	Amesbury.
224	Nitrate of Soda,	Williams & Clark Fertilizer Co., Boston, Mass.,	Hadley.
225	Nitrate of Soda,	Prentiss Brooks & Co., Holyoke, Mass.,	Holyoke.
232	Nitrate of Soda,	Mapes Formula & Peruvian Guano Co., New York, N.Y.	Haverhill.
249	Muriate of Potash,	Leander Wilcox, Mystic, Conn.,	S. Hadley Falls
254	Nitrate of Soda,	Clark Cove Fertilizer Co., Boston, Mass.,	E. Longm'dow

Laboratory No.	Name of Brand.	Moisture.	Nitrogen.		Potassium Oxide.	
			Found.	Guaranteed.	Found.	Guaranteed.
	Chemicals.					
13	Muriate of Potash,	1 03	—	—	51.08	50 54-53.70
23	Muriate of Potash,	1.37	—	—	50.52	50.54-53.70
44	Dried Blood,	5.56	9.70	9.89-11.53	—	—
48	Muriate of Potash,	.75	—	—	52.20	50.54-53.70
49	Sulphate of Potash, "High Grade,"	.33	—	—	50.80	48.64-51.34
52	Sulphate of Ammonia,	.33	20.81	20.60-21.42	—	—
54	Sulphate of Ammonia,	2.20	19.79	19.78 20.60	—	—
57–224	Nitrate of Soda,	1.27	15.87	15.48-15.81	—	—
72	Sulphate of Potash, "High Grade,"	.47	—	—	49.56	48 63-51.33
75	Muriate of Potash,	.14	—	—	52.36	50.54-53.70
118	Muriate of Potash,	.96	—	—	51.48	50.54-53.70
128	Nitrate of Soda,	1.58	16.22	14 83-16.48	—	—
153	Muriate of Potash,	.53	—	—	48.24	50.54-53.70
191	Nitrate of Soda,	1.26	15.32	14.82-15.64	—	—
216	Sulphate of Ammonia,	.25	20 84	20 60-21.42	—	—
225	Nitrate of Soda,	2.35	15.48	15.48-15.81	—	—
232	Nitrate of Soda,	1.27	16.02	—	—	—
249	Muriate of Potash,	2.65	—	—	51.72	50.54-53.70
254	Nitrate of Soda,	1.35	15.45	15.66	—	—

II. ANALYSES OF FODDER ARTICLES.

The names of the articles described below are those given by the parties sending them for analysis. As the food value of concentrated feedstuffs depends materially on the amount of crude protein and crude fat present, the analysis has been confined in several instances to the determination of these two constituents.

(I., Cotton-seed meal sent on from North Amherst, Mass.; II., Cotton-seed meal sent on from Hatfield, Mass.)

	Per Cent. I.	*Per Cent.* II.
Moisture at 100° C.,	8.99	9.45
Dry matter,	91.01	90.55
	100.00	100.00
ANALYSIS OF DRY MATTER.		
Crude ash,	7.10	*
Crude fibre,	5.53	*
Crude fat,	9.66	11.20
Crude protein,	50.34	40.92
Nitrogen-free extract matter,	27.37	*
	100.00	
FERTILIZING CONSTITUENTS.		
Moisture at 100° C.,	8.99	9.45
Phosphoric acid,	*	3.65
Potassium oxide,	*	2.34
Nitrogen,	7.33	5.93

I., Cotton-seed meal (undecorticated)) sent on from Hatfield, Mass.; II., Cotton-seed bran sent on from New York, N. Y.)

	Per Cent. I.	*Per Cent.* II.
Moisture at 100° C.,	10.77	10.10
Dry matter,	89.23	89.90
	100.00	100.00
ANALYSIS OF DRY MATTER.		
Crude ash,	*	3.58
Crude fibre,	*	31.09
Crude fat,	5.41	3.17
Crude protein,	23.69	11.82
Nitrogen-free extract matter,	*	50·34
		100.00
FERTILIZING CONSTITUENTS.		
Moisture at 100° C.,	10.77	10.10
Phosphoric acid,	2.04	*
Potassium oxide,	2.18	*
Nitrogen,	3.38	1.70

*Not determined.

(I., Chicago gluten meal sent on from Amherst, Mass.; II., Chicago gluten sent on from Boston, Mass.; III., King gluten meal from Station barn.)

	Per Cent. I.	II.	III.
Moisture at 100° C.,	9.33	10.22	7.18
Dry matter,	90.67	89.78	92.22
	100.00	100.00	100.00

ANALYSIS OF DRY MATTER.

	I.	II.	III.
Crude ash,	.14	*	1.50
Crude fibre,	1.73	*	1.41
Crude fat,	4.60	8.74	19.68
Crude protein,	37.09	43.86	38.57
Nitrogen-free extract matter,	56.44	*	38.84
	100.00		100.00

I., Buffalo gluten feed from Station barn; II., Golden gluten sent on from Boston, Mass.; III., Chicago maize feed sent on from Boston, Mass.)

	Per Cent. I.	II.	III.
Moisture at 100° C.,	8.34	9.89	7.19
Dry matter,	91.66	90.11	92.81
	100.00	100.00	100.00

ANALYSIS OF DRY MATTER.

	I.	II.	III.
Crude ash,	.91	*	1.06
Crude fibre,	8.61	*	9.34
Crude fat,	14.76	15.78	7.39
Crude protein,	25.09	29.13	27.07
Nitrogen-free extract matter,	50.63	*	55.14
	100.00		100.00

*Not determined.

(I., Gluten feed sent on from Lincoln, Mass.; II., Oil cake sent on from Boston, Mass.; III., Gluten feed sent on from Lincoln, Mass.

	Per Cent. I.	II.	III.
Moisture at 100° C.,	8.52	11.01	8.52
Dry matter,	91.48	88.99	91.48
	100.00	100.00	100.00

ANALYSIS OF DRY MATTER.

	I.	II.	III.
Crude ash,	*	2.35	*
Crude fibre,	*	8.37	*
Crude fat,	15.94	18.32	14.58
Crude protein,	24.21	25.21	22.15
Nitrogen-free extract matter,	*	45.75	*
		100.00	

(I., Peoria gluten feed sent on from Peoria, Ill.; II., Chicago gluten sent on from Lincoln, Mass.; III., Gluten feed sent on from Lincoln, Mass.)

	Per Cent.		
	I.	II.	III.
Moisture at 100° C.,	7.07	9.22	9.79
Dry matter,	92.93	90.78	90.21
	100.00	100.00	100.00
ANALYSIS OF DRY MATTER.			
Crude ash,	1.16	*	*
Crude fibre,	8.30	*	*
Crude fat,	14.33	8.98	9.07
Crude protein,	22.71	22.87	21.00
Nitrogen-free extract matter,	53.50	*	*
	100.00		

*Not determined.

(I., Gluten feed sent on from Lincoln, Mass.; II., Gluten feed sent on from Lincoln, Mass.)

	Per Cent.	
	I.	II.
Moisture at 100° C.,	8.61	8.61
Dry matter,	91.39	91.39
	100.00	100.00
ANALYSIS OF DRY MATTER.		
Crude ash,	*	*
Crude fibre,	*	*
Crude fat,	13.89	12.70
Crude protein,	18.38	16.81
Nitrogen-free extract matter,	*	*

I., Peanut cake, (Germany); II., Peanut Husks from Amherst, Mass.

	Per Cent.	
	I.	II.
Moisture at 100° C.,		12.98
Dry matter,		87.02
		100.00
ANALYSIS OF DRY MATTER.		
Crude ash,		1.36
Crude fibre,		75.91
Crude fat,	8.—12.	1.90
Crude protein,	42.—52.	5.74
Nitrogen-free extract matter,		15.09
FERTILIZING CONSTITUENTS.		
Moisture at 100° C.,		12.98
Phosphoric acid,		.13
Potassium oxide,		.48
Nitrogen,	6.—8.	.80

I., Peanut feed sent on from Granby, Mass.; II., Peanut feed sent on from Boston, Mass.

	Per Cent. I.	Per Cent. II.
Moisture at 100° C.,	9.08	10.92
Dry matter,	90.92	89.08
	100.00	100.00
ANALYSIS OF DRY MATTER.		
Crude ash,	2.25	3.60
Crude fibre,	62.48	62.82
Crude fat,	7.61	4.49
Crude protein,	10.31	9.54
Nitrogen-free extract matter,	17.35	19.55
	100.00	100.00
FERTILIZING CONSTITUENTS.		
Moisture at 100° C.,	9.07	10.92
Phosphoric acid,	.23	*
Potassium oxide,	.79	*
Nitrogen,	1.50	1.36

*Not determined.

I., Meat meal sent on from New York; II., German analysis sent on.

	Per Cent. I.	Per Cent. II.
Moisture at 100° C.,	8.00	
Dry matter,	92.00	
	100.00	
ANALYSIS OF DRY MATTER.		
Crude ash,	*	
Crude fibre,	*	
Crude fat,	20.73	12.70
Crude protein,	76.15	73.50
Nitrogen-free extract matter,	*	
FERTILIZING CONSTITUENTS.		
Moisture at 100° C.,	8.00	
Phosphoric acid,	.73	
Potassium oxide,	.30	
Nitrogen,	11.21	11.70

This meal is a refuse from the manufacture of Liebig's Extract of Meat. In the process of manufacture it has lost its salines and in feeding the meal these are replaced in the form of chemicals.

TRADE VALUES OF FERTILIZING INGREDIENTS IN RAW MATERIALS AND CHEMICALS.

	1894. Cents per pound.
Nitrogen in ammonia salts,	19
" " nitrates,	14½
Organic nitrogen in dry and fine ground fish, meat, blood, and in high-grade mixed fertilizers,	18½
" " " cotton-seed meal, linseed meal and castor pomace,	15
" " " fine ground bone and tankage,	16½
" " " fine ground medium bone and tankage,	15
" " " medium bone and tankage,	12
" " " coarse bone and tankage,	7
" " " hair, horn-shavings and coarse fish scraps,	7
Phosphoric acid soluble in water,	6
" " soluble in ammonium citrate,	5½
" " in fine bone and tankage,	5½
" " in fine medium bone and tankage,	4½
" " in medium bone and tankage,	3
" " in coarse bone and tankage,	2
" " in fine ground fish, cotton-seed meal, linseed meal, castor pomace and wood ashes,	5
" " insoluble (in am. cit.) in mixed fertilizers,	2
Potash as High Grade Sulphate, and in mixtures free from Muriate,	5¼
" " Muriate,	4½

The manurial constituents contained in feedstuffs are valued as follows:

Organic Nitrogen,	15
Pho-phoric acid,	5
Potash,	5

The Bulletins of the Mass. Experiment Station will be sent free of charge to all parties interested in its work, on application.

C. A. GOESSMANN, *Director.*

Amherst, Mass., November 13, 1894.

Carpenter & Morehouse, Printers, Amherst, Mass.

MASSACHUSETTS STATE AGRICULTURAL EXPERIMENT STATION.

BULLETIN NO. 57.

MARCH, 1895.

Meteorological Summary for January and February, 1895.

	January.	February.
Mean temperature, - -	13.56°	16.82°
Highest temperature, - -	45.00°	42.00°
Lowest temperature, - -	–6.00°	–11.00°
Total snowfall, inches, - -	21.50	16.00
Total precipitation, inches, -	3.65	00.56
Prevailing wind, - - -	N.W.	N.W.

The mean temperature for January, viz. 19.56°, was 5.87° below that of January, 1894. The precipitation, viz. 3.66 inches, was 1.23 inches greater.

The mean temperature for February, viz. 16.82°, was 2.86° below that of February, 1894. The precipitation, viz. .56 inch, was 1.71 inches less.

The first two months of the year 1895 were, on the whole, very favorable for winter crops, for although the average temperature, viz. 18.19°, was below the normal, the ground was well covered with snow during the whole time.

II. Human Food Articles (*Oats*).

I., Roasted Oats from American Cereal Roasting Co., New York, N. Y.; II., Roasted Oats from Roasted Cereal Co., New York, N. Y.; III., Hecker's Oat Meal (partly cooked), from Croton Mills, New York, N. Y.

	Per Cent.		
	I.	*II.*	*III.*
Moisture at 100° C.,	4.90	5.18	6.87
Dry matter,	95.10	94.82	93.13
	100.00	100.00	100.00
ANALYSIS OF DRY MATTER.			
Crude ash,	1.93	1.69	2.25
Crude fibre,	1.00	.83	1.66
Crude fat,	8.35	8.92	8.65
Crude protein,	15.58	15.75	15.68
Nitrogen-free extract matter,	73.14	72.81	71.76
	100.00	100.00	100.00

I., Rolled Avena, from American Cereal Co., Akron, Ohio; II., Rival Rolled Oats, sent on from Amherst, Mass.; III., Quaker Rolled Oats, from Quaker Mills, Ravenna, Ohio.

	Per Cent.		
	I.	*II.*	*III.*
Moisture at 100° C.,	6.55	6.39	6.37
Dry matter,	93.45	93.61	93.63
	100.00	100.00	100.00
ANALYSIS OF DRY MATTER.			
Crude ash,	1.94	2.36	1.88
Crude fibre,	1.12	1.16	1.13
Crude fat,	8.13	8.80	9.03
Crude protein,	17.06	15.29	15.48
Nitrogen-free extract matter,	71.75	72.39	72.48
	100.00	100.00	100.00

III. Analyses of Fodder Articles.

I., Linseed Meal, sent on from Boston, Mass.; II., Chicago Maize Feed, sent on from Boston, Mass.

	Per Cent. I.	Per Cent. II.
Moisture at 100° C.,	8.35	6.77
Dry Matter,	91.65	93.23
	100.00	100.00
ANALYSIS OF DRY MATTER.		
Crude ash,	5.67	.42
Crude fibre,	9.28	6.39
Crude fat,	1.45	10.31
Crude protein,	39.27	31.83
Nitrogen-free extract matter,	44.33	51.05
	100.00	100.00

WHEAT BRAN.

I., Winter Wheat Bran, sent on from Boston, Mass.; II., "Rex" Bran, sent on from Boston, Mass.

	Per Cent. I.	Per Cent. II.
Moisture at 100° C.,	7.74	6.95
Dry matter,	92.26	93.05
	100.00	100.00
ANALYSIS OF DRY MATTER.		
Crude ash,	6.34	3.76
Crude fibre,	6.80	21.06
Crude fat,	4.63	3.05
Crude protein,	17.74	10.00
Nitrogen-free extract matter,	64.49	62.13
	100.00	100.00

ATLAS MEAL (Dry Distillery Feed).

I., sent on from Peoria, Ill.; II., Station Barn.

	Per Cent. I.	Per Cent. II.
Moisture at 100° C.,	11.21	7.66
Dry matter,	88.79	92.34
	100.00	100.00

ANALYSIS OF DRY MATTER.

Crude ash,	.41	—
Crude fibre,	11.94	—
Crude fat,	15.28	—
Crude protein,	37.30	35.80
Nitrogen-free extract matter,	35.07	—
	100.00	

FERTILIZING CONSTITUENTS.

Moisture at 100° C.,	11.21	7.66
Potassium oxide,	.16	—
Phosphoric acid,	.23	—
Nitrogen,	5.30	5.29

CORN PRODUCTS.

Sent on from Rowley, Mass.

	Per Cent.		
	I.	II.	III.
Moisture at 100° C.,	10.57	8.63	7.82
Dry matter,	89.43	91.37	92.18
	100.00	100.00	100.00

ANALYSIS OF DRY MATTER.

Crude ash,	1.23	.82	.17
Crude fibre,	2.13	11.07	17.27
Crude fat,	5.38	4.48	1.80
Crude protein,	10.06	8.00	4.47
Nitrogen-free extract matter,	81.20	75.63	76.29
	100.00	100.00	100.00

OAT FEED.

I., sent on from Rowley, Mass.; II., sent on from Westboro, Mass.

	Per Cent.	
	I.	II.
Moisture at 100° C.,	7.51	7.40
Dry matter,	92.49	92.60
	100.00	100.00

ANALYSIS OF DRY MATTER.

Crude ash,	4.97	4.91
Crude fibre,	16.82	19.02
Crude fat,	4.04	4.12
Crude protein,	11.89	11.13
Nitrogen-free extract matter,	62.28	60.82
	100.00	100.00

CANADA HAY.

I. and II., sent on from Proctor, Vt., 1st and 2d quality; III. and IV., sent on from Montreal, Canada, 1st and 2d quality.

	Per Cent.			
	I.	*II.*	*III.*	*IV.*
Moisture at 100° C.,	7.41	6.48	6.56	6.46
Dry matter,	92.59	93.52	93.44	93.54
	100.00	100.00	100.00	100.00
ANALYSIS OF DRY MATTER.				
Crude ash,	6.53	5.02	5.86	4.46
Crude fibre,	32.84	33.95	32.70	31.36
Crude fat,	2.87	2.32	2.34	2.48
Crude protein,	8.25	6.68	7.56	6.06
Nitrogen-free extract matter,	49.51	52.03	51.54	55.64
	100.00	100.00	100.00	100.00

WATER GRASS (Sedge).

Sent on from Weston, Mass.

	Per Cent.
Moisture at 100° C.,	5.63
Dry matter,	94.37
	100.00
ANALYSIS OF DRY MATTER.	
Crude ash,	5.44
Crude fibre,	33.74
Crude fat,	2.10
Crude protein,	8.06
Nitrogen-free extract matter,	50.66
	100.00
FERTILIZING CONSTITUENTS.	
Moisture at 100° C.,	5.63
Ferric and aluminic oxides,	.08
Calcium oxide,	.55
Phosphoric acid,	.21
Potassium oxide,	.74
Nitrogen,	1.21
Insoluble matter,	3.41

IV. Analyses of Manurial Substances.

1022—1025. WOOD ASHES.

I., sent on from Boston, Mass.; II., sent on from South Sudbury, Mass.; III., sent on from Concord, Mass.; IV., sent on from Danvers, Mass.

	Per Cent. I.	II.	III.	IV.
Moisture at 100° C.,	16.75	12.22	18.13	14.13
Calcium oxide,	33.00	34.20	35.00	32.60
Potassium oxide,	5.60	4.84	5.68	3.72
Phosphoric acid,	.26	.26	.12	.52
Insoluble matter,	18.39	25.43	15.43	16.20

1026—1029. WOOD ASHES.

I., sent on from Whitinsville, Mass.; II. and III., sent on from Sunderland, Mass.; IV., sent on from Concord, Mass.

	Per Cent. I.	II.	III.	IV.
Moisture at 100° C.,	8.25	7.89	6.17	18.27
Calcium oxide,	37.60	34.00	44.00	41.12
Potassium oxide,	5.70	4.12	5.36	4.20
Phosphoric acid,	1.34	1.34	1.40	1.28
Insoluble matter,	21.87	20.62	6.60	10.50

1030—1033. WOOD ASHES.

I., sent on from Boston, Mass.; II. and III., sent on from North Amherst, Mass.; IV., Lime-kiln ashes, sent on from Sunderland, Mass.

	Per Cent. I.	II.	III.	IV.
Moisture at 100° C.,	6.27	14.77	11.37	8.09
Calcium oxide,	47.00	36.80	41.68	50.66
Potassium oxide,	6.08	3.52	5.68	2.30
Phosphoric acid,	1.80	1.28	1.28	.68
Insoluble matter,	15.61	12.14	9.99	5.19

1034—1035. COTTON-HULL ASHES.

	Per Cent. I.	II.
Moisture at 100° C.,	4.75	7.89
Calcium oxide,	10.00	*
Potassium oxide,	27.64	26.36
Phosphoric acid,	9.04	5.46
Insoluble matter,	18.57	*

* Not determined.

1036–1037. GROUND BONE.

I., sent on from Lincoln, Mass.; II., sent on from Westford, Mass.

	Per Cent. I.	*Per Cent.* II.
Moisture at 100° C.,	4.55	3.23
Total phosphoric acid,	27.64	22.24
Available phosphoric acid,	8.88	3.54
Insoluble phosphoric acid,	18.76	18.70
Nitrogen,	2.85	2.31

1038–1040. COTTON-SEED MEAL.

I., dark, sent on from North Hadley; II., yellow, sent on from North Hadley; III., Texas, sent on from Hatfield.

	Per Cent. I.	*Per Cent.* II.	*Per Cent.* III.
Moisture at 100° C.,	7.80	6.45	6.10
Potassium oxide,	3.00	2.36	2.68
Phosphoric acid,	3.70	2.30	2.44
Nitrogen,	7.11	7.10	7.61

1041. ODORLESS MINERAL GUANO.

Sent on from Boston, Mass.

	Per Cent.
Moisture at 100° C.,	2.95
Total phosphoric acid,	20.34
Available phosphoric acid,	.52
Insoluble phosphoric acid,	19.82
Potassium oxide,	.50

1042. SHEEP FERTILIZER.

Sent on from South Lincoln, Mass.

	Per Cent.
Moisture at 100° C.,	35.65
Potassium oxide,	.76
Phosphoric acid,	.90
Nitrogen,	1.61
Insoluble matter,	25.43

1043. PEAT.

Sent on from West Acton, Mass.

	Per Cent.
Moisture at 100° C.,	59.93
Ash,	2.30
Calcium oxide,	.81
Potassium oxide,	.14
Phosphoric acid,	.17
Nitrogen,	.89
Insoluble matter,	1.58

TRADE VALUES
OF FERTILIZING INGREDIENTS IN RAW MATERIALS AND CHEMICALS.

	1895. Cents per pound.
Nitrogen in ammonia salts,	18.5
" " nitrates,	15.
Organic nitrogen in dry and fine ground fish, meat, blood, and in high-grade mixed fertilizers,	16.5
" " " cotton-seed meal,	12
" " " fine ground bone and tankage,	16
" " " fine ground medium bone and tankage,	14
" " " medium bone and tankage,	11
" " " coarse bone and tankage,	5
" " " hair, horn-shavings and coarse fish scraps,	5
Phosphoric acid soluble in water,	6
" " soluble in ammonium citrate,	$5\frac{1}{2}$
" " in fine bone and tankage,	$5\frac{1}{2}$
" " in fine medium bone and tankage,	$4\frac{1}{2}$
" " in medium bone and tankage,	3
" " in coarse bone and tankage,	2
" " in fine ground fish, cotton-seed meal, linseed meal, castor pomace and wood ashes,	5
" " insoluble (in am. cit.) in mixed fertilizers,	2
Potash as High Grade Sulphate, and in mixtures free from Muriate,	$5\frac{1}{4}$
" " Muriate,	$4\frac{1}{2}$

The manurial constituents contained in feedstuffs are valued as follows:

Organic Nitrogen,	12
Phosphoric acid,	5
Potash,	5

The Bulletins of the Mass. Experiment Station will be sent free of charge to all parties interested in its work, on application.

C. A GOESSMANN, *Director.*

Amherst, Mass., March 22, 1895.

Carpenter & Morehouse, Printers, Amherst, Mass.