STATE OF CONNECTICUT.

9th

ANNUAL REPORT

OF

The Connecticut Agricultural

EXPERIMENT STATION

For 1885.

PRINTED BY ORDER OF THE GENERAL ASSEMBLY

NEW HAVEN, CONN:
TUTTLE, MOREHOUSE & TAYLOR, PRINTERS.
1886.

The Connecticut Agricultural Experiment Station.

OFFICERS FOR 1885.

STATE BOARD OF CONTROL

Ex-officio.

His Exc. HENRY B. HARRISON, *President.*

	Term expires
Appointed by Connecticut State Agricultural Society:	
Hon. E. H. Hyde, Stafford, *Vice-President.*	July 1, 1888.
Appointed by Board of Trustees of Wesleyan University:	
Prof. W. O. ATWATER, Middletown.	1888.
Appointed by Governor and Senate:	
EDWIN HOYT, New Canaan.	1886.
H. L. DUDLEY, New London.	1887.
Appointed by Board of Agriculture:	
T. S. GOLD, West Cornwall.	1886.
Executive Committee.	
Appointed by Governing Board of Sheffield Scientific School:	
W. H. BREWER, New Haven, *Secretary and Treasurer.*	1887.
Ex-officio.	
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Chemists.

E. H. JENKINS, Ph.D., *Vice-Director.*
E. H. FARRINGTON, B.S.
A. L. WINTON, Jr., Ph.B.

In charge of Buildings and Grounds.
CHARLES J. RICE.

ANNOUNCEMENT.

The Connecticut Agricultural Experiment Station was established in accordance with an Act of the General Assembly, approved March 21, 1877, "for the purpose of promoting Agriculture by scientific investigation and experiment."

The Station is prepared to analyze and test fertilizers, cattle-food, seeds, soils, waters, milks, and other agricultural materials and products, to identify grasses, weeds, and useful or injurious insects, and to give information on the various subjects of Agricultural Science, for the use and advantage of the Citizens of Connecticut.

The Station makes analyses of Fertilizers, Seed-Tests, &c., &c., for the Citizens of Connecticut, without charge, provided—

1. That the results are of use to the public and are free to publish.
2. That the samples are taken by *consumers* from stock now in the market, and in accordance with the Station instructions for sampling.
3. That the samples are fully described on the Station "Forms for Description."

All other work proper to the Experiment Station that can be used for the public benefit will be made without charge. Work done for the use of individuals will be charged for at moderate rates. The Station will undertake no work, the results of which are not at its disposal to use or publish, if deemed advisable for the public good. See p. 52.

Results of analysis or investigation that are of general interest will be published n Bulletins, of which copies are sent to each Post Office in this State, and will be summed up in the Annual Reports made to the Legislature.

The officers of the Station will take pains to obtain for analysis samples of all the commercial fertilizers sold in Connecticut; but the organized coöperation of the farmers is essential for the full and timely protection of their interests. Farmers' Clubs and like Associations can efficiently work with the Station for this purpose, by sending in samples early during each season of trade.

It is the wish of the Board of Control to make the Station as widely useful as its resources will admit. Every Connecticut citizen who is concerned in agriculture, whether farmer, manufacturer, or dealer, has the right to apply to the Station for any assistance that comes within its province to render, and the Station will respond to all applications as far as lies in its power.

☞ Instructions and Forms for taking samples, and Terms for testing Fertilizers, Seeds, etc., for private parties, sent on application.

☞ Parcels by Express, to receive attention, should be prepaid, and all communications should be directed, not to individual officers, but simply to the

AGRICULTURAL EXPERIMENT STATION,
NEW HAVEN, CONN.

☞ Station Grounds, Laboratory and Office are on Suburban St., between Whitney Avenue and Prospect St., 1⅛ miles North of City Hall. Suburban St. may be reached by Whitney Lake Horse Cars, which leave corner of Chapel and Church Sts. each hour and half hour.

☞ The Station has Telephone connection and may be spoken from the Central Telephone Office, 346 State St., or from Peck & Bishop's Office in Union R. R. Depot.

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REPORT OF THE BOARD OF CONTROL.

To the General Assembly:

The Board of Control of THE CONNECTICUT AGRICULTURAL EXPERIMENT STATION begs leave to present the following Report.

The Experiment Station has been occupied during 1885 as in former years, mostly with the analysis of Commercial Fertilizers and Feeding Stuffs. The State "Law Concerning Fertilizers" in its 9th Section requires the Director of the Station to make and publish annually at least one analysis of each Commercial Fertilizer sold in Connecticut. This work has been going on throughout the entire year, and during the period from April to November has very fully employed the Station chemists. Its records show that the Station has tested 16 samples of seeds and made analyses of 256 fertilizers, 21 feeding stuffs, 14 soils, 2 samples of milk and several drinking waters. It has investigated two cases of suspected cattle poisoning, in one of which arsenic was found, and has published and distributed 4 printed Bulletins, each averaging 10 pages, in editions of 5,000 copies, and has issued 14 "weekly statements" printed by the hektograph process, and supplied to the Agricultural Press and to the Secretaries of Farmers' Club and Agricultural Societies. Much labor has been bestowed on "vegetation experiments" and on the solubility of the nitrogen of fertilizers. The new requirement that Reports to the General Assembly are to be prepared and printed by the first of November cannot for various reasons be carried out in respect to the details of this work, which properly constitute the Report of the Director of this Station. That Report in past years has been especially valuable to Farmers and Gardeners, because it has put in their possession a

very accurate and complete account of the composition and relative values of all the commercial fertilizers and of most of the concentrated cattle foods found in our markets, so explained and tabulated as to make reference to them and their comparison instructive and easy. These analyses furnish a mass of data which, published in winter, has become indispensable to practical agriculturists in planning their operations for the coming summer, and it is of the highest importance to them that the information be as complete as possible and be brought down to the latest date. The Director cannot finish his Annual Report in a satisfactory manner until the work of nearly the entire calendar year is completed. To close the Station work early in October as would be necessary in order to make and print a Report by the first of November, would in our opinion seriously impair the practical usefulness of the Station. Futhermore the printing of the Director's Report is necessarily slow, great care and repeated proof-reading being required to insure correctness of the numerous tables of analyses which it contains.

The Director's Report for 1885 is in preparation, but it cannot be ready for the printer until well into December, and the printing and proof-reading will require several weeks in addition.

We therefore request that the printing of the Director's Report be authorized to proceed as in former years and that provision be made for the future to except it from the operation of the law requiring all Reports to be made and printed the first of November. The Director's Report hitherto has been mostly or entirely in type at the time designated in the Act establishing the Station for the regular Annual Meeting of this Board, viz: "on the third Tuesday in January of each year." We request that as long a time for presenting the Director's printed Report be permitted in future years.

November, 1885.

HENRY B. HARRISON, *President.*

W. H. BREWER, *Secretary.*

REPORT OF THE TREASURER.

WM. H. BREWER, *in account with the Connecticut Agricultural Experiment Station.*

December 1, 1884, to June 30, 1885.

RECEIPTS.

Balance from account of 1884	$833.78	
Annual Appropriation (6 months)	4,000.00	
Analysis Fees	3,635.40	
Sale of Bulletins and Reports	16.25	
		$8,485.43

PAYMENTS.

Salaries	$4,602.69	
Laboratory expenses	1,258.21	
Grounds and Establishment, repairs and improvements	1,343.86	
Printing	205.95	
Stationery	99.71	
Postage	173.90	
Library	212.70	
Collecting Fertilizers	113.91	
Traveling expenses of the Board of Control	48.14	
Telephone	50.00	
Water	66.00	
Gas	218.40	
Insurance	58.15	
Miscellaneous sundries	20.48	
Balance on hand	13.33	
		$8,485.43

WM. H. BREWER, *Treasurer.*

MEMORANDUM.

This report covers the seven months between the old and new fiscal years of the State. The receipts represent half of a year's annual appropriation and practically the analysis fees established by law for a whole year, nearly all falling due in the second quarter of the calendar year.

WM. H. BREWER, *Treasurer.*

REPORT OF THE DIRECTOR.

During the past year the work of this Station has gone on without interruption.

As in former years the analysis of commercial fertilizers, and work connected with the collection, examination and valuation of samples has occupied the larger part of the time of the Station's working force.

The present Fertilizer Law makes this necessary by prescribing that the Station shall analyze each year at least one sample of every brand of fertilizer offered for sale in the State. As the goods of different manufacturers are compared and judged of largely by these analyses it is necessary both for the credit of the Station and the protection of manufacturers and consumers alike that the utmost care should be used in drawing the samples, making the analyses and interpreting the results. These operations require a large outlay of time and work, which does not appear in the brief statement of results that is given in the Report.

The number of brands of fertilizers legally sold in Connecticut the past year has been 139, an increase of 22 over the year 1884 and of 46 over the year 1883.

One hundred and seventeen other analyses have been made of commercial and home-mixed fertilizers, manures and waste products used for compost, etc., making the total number of fertilizer analyses 256.

Twenty-one samples of feeding stuffs have been examined and in this connection all analyses of American feeding stuffs made during the year which were accessible have been tabulated and the results incorporated in tables to be found in this report.

Sixteen samples of seeds have been tested in the laboratory and garden.

Two samples of milk have been examined on behalf of a creamery in the State. One of these samples was found to have been watered.

Several samples of well- and spring-water have been examined.

Two cases of suspected poisoning of animals have been referred to the Station. In one case the stomach of a valuable horse was found to contain arsenic in considerable quantity.

Fourteen soil analyses have been made with the greatest care and accuracy on samples taken at different depths on the land of the Station.

Over seventy vegetation experiments in pots have been carried out but the results are not at present valuable for publication.

An extended series of experiments has been undertaken with a view of determining the solubility and indirectly the availability of different nitrogenous matters which are used in mixed fertilizers.

The Bulletins issued this year have been four in number, making in all 41 pages of printed matter.

The object of these Bulletins is to place in the hands of those concerned the results of the Station work as promptly as possible.

As required by law, a package of each Bulletin is mailed to every post-office in the State. The package is directed to the Postmaster, with a request to distribute to farmers. The number sent will be increased in any case on application.

The distribution of these Bulletins is of course optional with the Postmaster.

The Bulletins are also regularly sent to every newspaper in the State, and to the Secretary of each Agricultural society, Farmers' club and Grange whose address is known to the Station.

The Bulletins are regularly sent, also, on application, to any private address in Connecticut. Such application, as a rule, must be renewed annually.

To citizens of other States remitting fifty cents, the publications of the current year, including Bulletins and Annual Report, are mailed as they appear. Applications should be made early in the year.

The wish has been recently expressed that a copy of every Fertilizer Analysis should be sent, as soon as made by the Station, to each Farmers' club or local society in the State. The Director has used every endeavor to accomplish the prompt publication of the results of Station work, and has tested every method that has come to his knowledge, including the Hektograph, that promised to serve this end. Early in the year, for the first time, he obtained a Hektograph which gave the requisite number of legible copies,

and thenceforth, once a week, or as soon as practicable after Fertilizer Analyses were finished, Hektograph copies were mailed to the Secretaries of all Agricultural societies, Farmers' clubs and Granges, and to the Connecticut Farmer, and were offered to such newspapers of the State as might apply for and would undertake to print them.

This arrangement will be continued in the future, and on application, Hektograph copies will also be sent to agricultural papers in other States so far as the limited supply permits.

Fourteen such "Weekly Statements" have been issued and promptly printed in the Connecticut Farmer and New England Homestead.

For convenience in printing, the subject of Fertilizers in this report follows that of Feeding Stuffs.

ANALYSES OF FEEDING STUFFS.

Explanations Concerning the Analysis, Valuation and Economical Use of Feeding Stuffs.

In order to feed animals most rationally and economically it is necessary to know:

1st. The composition of the feeding stuffs which make up their ration.

2nd. What percentage part of the different ingredients of these feeding stuffs can be digested by the animals.

3rd. How many pounds of the digestible materials must be daily supplied to each animal in order to get the maximum production of milk, of flesh, of wool, or of work; or in order to keep the animal, if at rest, simply in good condition.

I.—The Composition of Feeding Stuffs.

This is determined by chemical analysis. On subsequent pages is given in tabular form the average composition of the feeding stuffs commonly used in this country, compiled exclusively from American analyses. In the first column of these tables is stated the total number of analyses from which the average was obtained. The probable accuracy of the average increases with the number of analyses on which it is based.

As it is very desirable to know within what limits the composition of each fodder is likely to vary, the maximum and minimum amounts of each ingredient have also been inserted in the table.

The following explanations may be helpful to the ready understanding of these tables.

Explanations of Analyses of Feeding Stuffs.

The analysis gives the percentage amounts of Total Dry Matter, Protein, Fat, Nitrogen-free Extract, Fiber and Ash.

Total Dry Matter is what remains of a feeding stuff when all the water it contains is removed. However dry feeding stuffs, whether hay or coarse fodder, or grain and meal, may appear to be, they always contain a considerable and variable proportion of water which is invisible and imperceptible to the senses, but which

can be driven out by heat and which the perfectly dried fodder recovers more or less fully when exposed to the air. This amount of water thus present in feeding stuffs is constantly changing with the temperature and dryness of the air to which they are exposed, and accordingly no proper comparison of different foods is possible unless the proportions of water they contain is known and comparison is made on perfectly dry or water-free substance.

In the Station laboratory, water is expelled and the amount of Dry Matter determined by heating a weighed quantity of the feeding stuff at 212° Fahr. in a stream of hydrogen gas until no further loss of weight occurs.

Protein (or *Albuminoids*) is a general term which includes all those nitrogenous materials of a feeding stuff which bear a general resemblance in composition and properties to egg albumen, (white of egg) flesh fibrin, (lean meat) and milk casein, (curd.) The amount of Protein is commonly determined by multiplying the per cent. of nitrogen present by $6\frac{1}{4}$. This method is based on the fact that the protein bodies all contain not far from sixteen per cent. of nitrogen, which figure multiplied by $6\frac{1}{4}$ gives 100 per cent. or the total amount of protein corresponding to the nitrogen. Some of the albuminoids contain indeed less and some more than this per cent. of nitrogen, but, for practical purposes, the assumption of sixteen per cent. is sufficiently exact in most cases.

It is believed that the vegetable albuminoids do not greatly differ in nutritive effect or at least, since each feeding stuff commonly contains a mixture of several distinct albuminoids, the digestible portions of these various mixtures do not widely differ in nutritive value.

Besides albuminoids, certain feeding stuffs, chiefly root crops, and immature parts of plants, such as hay from young grass, contain a portion of their nitrogen in an entirely different form; as amides or amido-acids. These bodies have a different percentage composition from albuminoids, differ from them in their properties and very considerably in their nutritive value. They are closely related to the albuminoids, and may be derived from or assist in producing the latter.

Other nitrogenous substances which are sometimes found in certain feeding stuffs, generally in very small quantity however, are peptones, alkaloids, nitrates and ammonia salts. The last three are without any nutritive effect on animals so far as is known.

Fat includes fat oil, solid fat, wax, chlorophyl, the green color-

ing matter of plants, and other coloring matters, in brief everything which can be extracted from the perfectly dry feeding stuff by absolute ether.

Nitrogen-free Extract, sometimes called *Carbhydrates*, includes starch, gum, sugar and pectin bodies. They are readily extracted from the feeding stuff by water and dilute acid but their amount is always indirectly determined by subtracting the sum of the protein, fiber, fat and ash from the total dry matter.

Fiber or *Cellulose* is the essential constituent of the walls of vegetable cells and is seen in a nearly pure state in cotton fiber or paper pulp. It is the most insoluble part of the vegetable substance and its quantity is determined by boiling the feeding stuff successively with a weak acid and a weak alkali, and after copious washing with water, extracting the residue with alcohol and ether. This treatment leaves undissolved what is properly called Crude Fiber which is Cellulose in a state of comparative purity.

Ash is what is left when the combustible part of a feeding stuff is burned away by heating to faint redness in a current of air and besides a little charcoal and sand, which are accidental impurities, consists chiefly of lime, magnesia, potash and soda, combined with chlorine and carbonic, sulphuric and phosphoric acids.

The methods of fodder analysis are, in some respects, still very imperfect, as will be inferred by what has been said with regard to protein. The results, however, have proven themselves of great advantage in farm practice which is the best gauge of value and will be used until more satisfactory methods can be devised.

Use of the Tables of Composition of Feeding Stuffs.

These tables are designed to be a help in forming a judgment of the composition of feeding stuffs which for any reason cannot be specially submitted to chemical analysis. It follows that judgment is necessary in their use. All feed and particularly all coarse feed varies considerably in quality. The first thing to decide is whether the feed in question is in fair condition. If coarse fodder, was it raised on poor land or not, was it cut early or late, was it harvested in good order, is it clean and sweet or not? The answers to these questions will decide whether the average composition of that kind of feed can be fairly attributed to the article in hand. If it cannot be, the maximum and minimum figures will indicate how much allowance is to be made in extreme cases for specially good or unusually poor condition of the feed.

A determination of protein or of protein and crude fiber will greatly assist in the judgment, and there are few times when such determinations cannot be made within a few days if the sample is sent to the Station with notice that results are wanted for immediate use. Concentrated foods, grain, bran, etc., it will be noticed, vary much less in composition than coarse fodder. In any case the quality of the feed should be underestimated rather than overestimated.

II. The Digestibility of Feeding Stuffs.

When food is received into the stomach a portion of it is dissolved and otherwise altered by the juices of the mouth, stomach and intestines, is then taken up from the alimentary canal and in the form of chyle passes into the blood and finally becomes a part of the tissues of the body. This portion is said to be digested and assimilated and from it alone the animal is nourished. The other portions pass through the body and are excreted as dung. The urine removes from the body only certain waste products which are formed from the digested or assimilated food.

The analysis of a feeding stuff, as has been said, divides its constituents into several groups, protein, fat, etc., each of which may contain a number of substances, similar in general, yet differing in this: that some of them or portions of them are soluble in the juices of the digestive organs, i. e. are digestible, while others are not soluble, or are indigestible.

As only the soluble or digestible portion of the feeding stuff is of any nutritive use to the animal, it is essential, in order to feed rationally that it should be known of each feeding stuff what part of its protein, fat, and other ingredients—the total quantity of which is given by the analysis—is actually digested by the animal. This is learned by a feeding trial upon two or more animals. In the case of coarse fodders which can make up the entire ration during the period of experiment, the food consumed and the dung excreted are both very carefully weighed and analyzed and from their quantities and composition it is calculated how much protein, nitrogen-free extract, fiber, etc., was eaten by the animal, and how much of these several materials was voided, the difference being what was digested and served as actual nourishment. The digestibility of concentrated fodders is determined in the same way, the process being somewhat complicated and the results probably made a little less accurate because

Composition of Feeding Stuffs.

Name.	Analyses.	Total Dry Matter.			Protein.			Fat.			Nitrogen-free Extr.			Fiber.			Ash.
		Min.	Max.	Aver.	Min.	Max.	Aver.	Min.	Max.	Aver.	Min.	Max.	Aver.	Min.	Max.	Aver.	
Green Fodder.																	
Maize fodder	36	7.10	30.89	*18.92*	.56	2.72	*1.48*	.14	.89	*.38*	3.20	19.69	*10.74*	1.90	9.78	*5.24*	1.08
Maize fodder—ensilaged	47	12.32	29.24	*19.41*	.87	2.77	*1.49*	.23	1.80	*.69*	5.12	16.49	*10.05*	4.04	10.02	*5.82*	1.37
Sorghum (amber)	3	13.62	24.96	*17.55*	1.03	1.42	*1.17*	.38	.40	*.39*	5.34	17.03	*9.31*	5.45	6 56	*5.94*	.74
Sorghum—ensilaged	5	21.97	28.08	*24.17*	.56	.94	*.75*	.14	.42	*.28*	13.83	19.02	*15.82*	5.90	6.79	*6.28*	1.04
Clover—ensilaged	2	21.44	27.40	*24.42*	3.00	3.81	*3.40*	.93	1.11	*1.02*	8.12	11.41	*9.76*	6.29	8.57	*7.43*	2.83
Cow pea vines—green and succulent, with pods	3	13.97	27.19	*19.69*	1.85	3.25	*2.70*	.21	.62	*.47*	5.34	8.46	*7.41*	2.87	15.27	*7.22*	1.89
Soja bean—whole plant	3	29.59	30.65	*30.13*	2.20	3.94	*3.34*	.87	1.55	*1.16*	14.24	16.01	*14.88*	7.93	8.91	*8.36*	2.39
Rye fodder	6	21.85	25.29	*24.72*	2.31	3.00	*2.61*	.20	.72	*.56*	4.92	12.37	*6.94*	4.92	14.89	*12.73*	1.88
Rye fodder—ensilaged	1	----	----	*19.25*	----	----	*2.42*	----	----	*.27*	----	----	*9.18*	----	----	*5.76*	1.62
Carrot leaves	1	----	----	*16.70*	----	----	*4.26*	----	----	*.86*	----	----	*5.99*	----	----	*2.25*	3.34
Beet leaves	1	----	----	*11.16*	----	----	*2.74*	----	----	*.60*	----	----	*2.49*	----	----	*2.50*	2.83
Hay and Dry Coarse Fodder.																	
Clover hay	13	78.18	89.80	*85.35*	8.87	13.54	*11.44*	1.47	3.10	*2.02*	35.03	45.47	*39.87*	23.79	30.83	*26.69*	5.33
Hay containing much clover	8	85.43	88.63	*86.06*	6.38	14.42	*10.40*	1.50	3.09	*2.59*	35.84	45.19	*41.59*	19.66	29.53	*25.98*	5.50
High meadow hay	2	88.65	89.40	*89.02*	6.79	8.34	*7.57*	2.03	2.48	*2.25*	46.93	47.46	*47.19*	24.34	25.22	*25.78*	6.23
Timothy hay	32	85.70	93.50	*88.81*	4.27	9.60	*6.02*	1.08	3.30	*2.20*	41.09	58.52	*46.26*	22.70	37.11	*30.35*	3.98
Timothy and red top	8	84.78	91.80	*86.55*	5.14	8.97	*6.66*	1.45	2.70	*2.10*	39.20	48.90	*28.69*	24.72	33.33	*28.69*	4.99
Mixed meadow grasses	2	----	----	*85.7**	----	----	*6.76*	----	----	*1.53*	----	----	*46.16*	----	----	*26.85*	4.39
Hungarian grass hay	8	----	----	*83.3**	----	----	*6.59*	----	---	*1.81*	---	----	*42.49*	----	----	*27.16*	5.24
Low meadow hay	10	85.50	93.60	*89.50*	4.60	10.40	*7.70*	.70	3.60	*2.20*	39.80	55.20	*43.60*	21.40	40.00	*30.20*	5.80
Salt marsh hay	11	81.40	92.80	*89.53*	4.30	7.80	*5.90*	1.63	3.10	*2.32*	34.10	53.67	*42.42*	27.00	37.90	*31.47*	7.42

* Calculated to same water content.

Composition of Feeding Stuffs—*Continued.*

Name.	Analyses.	Total Dry Matter.			Protein.			Fat.			Nitrogen-free Extr.			Fiber.			Ash.
		Min.	Max.	Aver.	Min.	Max.	Aver.	Min.	Max.	Aver.	Min.	Max.	Aver.	Min.	Max.	Aver.	
Hay and Dry Coarse Fodder—*continued.*																	
Black grass hay*	2	88.98	91.06	*90.02*	6.56	7.06	*6.81*	2.28	2.38	*2.33*	43 14	49.31	*46.26*	24.63	29.42	*27.01*	7.60
Maize fodder—field cured	6	60.63	77.07	*67.95*	3.39	4.97	*4.29*	.66	1.56	*1.24*	30.52	40.82	*35.96*	18.65	25.18	*22.14*	4.32
Buckwheat straw	2	89.50	89.60	*89.55*	3.33	4.38	*3.85*	1.42	1.70	*1.56*	32.08	34.49	*33.28*	44.93	46.83	*45.88*	5.05
Oat straw	3	87.50	93.47	*89.89*	2.30	5.08	*3.35*	1.00	3.15	*2.07*	26.42	44.26	*36.97*	35.21	55.96	*42.78*	4.72
Rye straw	2	87.50	90.27	*88.89*	2.19	6.89	*4.54*	1.00	2.68	*1.84*	35.70	41.04	*38.37*	34.20	43.29	*38.75*	1.84
Wheat straw	1	----	----	*93.50*	----	----	*4.98*	----	----	*1.49*	----	----	*41.99*	---	----	*38.08*	6.96
Cow pea vines	6	86.01	90.70	*88.95*	13.56	19.81	*15.68*	1.13	4.05	*2.87*	34.98	46.40	*42.17*	17.20	23.66	*19.82*	8.41
Roots, Bulbs, Tubers and other Vegetables and Fruits.																	
Beets—red	2	10.54	12.32	*11.43*	1.48	1.73	*1.60*	.14	.21	*.18*	7.16	7.64	*7.40*	.64	1.69	*1.16*	1.08
Beets—sugar	4	9.24	15.58	*11.95*	1.69	1.89	*1.78*	.05	.08	*.06*	5.67	11.75	*8.31*	.71	.93	*.82*	.98
Mangolds	3	7.18	8.56	*7.96*	1.57	1.89	*1.71*	.03	.51	*.20*	3.56	4.91	*4.18*	.76	.91	*.82*	1.05
Ruta bagas	1	----	----	*12.92*	----	----	*1.15*	----	----	*.09*	----	----	*9.11*	----	---	*1.16*	1.41
Turnips	1	----	----	*11.11*	----	----	*1.34*	----	----	*.09*	----	----	*8.11*	----	----	*.86*	0.71
Carrots	3	12.15	13.48	*12.94*	.84	1.99	*1.26*	.20	.71	*.52*	6 86	10.40	*8.32*	.99	2.32	*1.62*	1.22
Onions	6	6.48	18.43	*12.45*	.77	2.28	*1.41*	.22	.36	*.26*	3.77	14.09	*9.53*	.59	.76	*.69*	.56
Potatoes	5	19.61	23.80	*21.45*	1.14	2.50	*1.95*	.02	.14	*.09*	15.33	19.91	*17.99*	.28	.85	*.56*	.86
Sweet potatoes	3	26.61	34.04	*29.72*	.45	1.28	*.98*	.28	.36	*.32*	23.00	29.72	*26.13*	.60	2.50	*1.36*	.93
Yam	1	----	----	*28.77*	----	----	*2.06*	----	----	*.25*	----	----	*25.24*	----	----	*.70*	.67
Apples	2	15.89	22.70	*19.30*	.21	.50	*.35*	.28	.41	*.35*	14.26	19.96	*17.11*	.91	1.37	*1.14*	.35
Cucumbers	2	3.71	4.30	*4.01*	.79	.83	*.81*	.21	.22	*.22*	1.72	1.95	*1.84*	.53	.85	*.69*	.45

* *Juncus Gerardi.*

Composition of Feeding Stuffs—*Continued.*

Name.	Analyses.	Total Dry Matter.			Protein.			Fat.			Nitrogen-free Extr.			Fiber.			Ash.
		Min.	Max.	Aver.	Min.	Max.	Aver.	Min.	Max.	Aver.	Min.	Max.	Aver.	Min.	Max.	Aver.	
Roots, Bulbs, Tubers, &c.—*continued.*																	
Squashes	2	4.82	5.42	*5.12*	.64	.68	*.66*	.24	.32	*.28*	2.95	3.54	*3.24*	.53	.54	*.54*	.40
Tomatoes	1	----	----	*8.74*	----	----	*1.00*	----	----	*.47*	----	----	*5.84*	----	----	*.70*	.73
Peas	1	---	----	*21.94*	----	----	*4.37*	----	----	*.55*	----	----	*14.48*	----	----	*1.66*	.88
String beans	1	----	----	*16.54*	----	----	*2.75*	----	----	*.34*	----	----	*10.04*	----	----	*2.58*	.83
Cabbage	1	----	----	*6.41*	----	----	*2.01*	----	----	*.19*	----	----	*2.00*	----	----	*1.44*	.72
Cauliflower	1	----	----	*9.18*	----	----	*1.62*	----	----	*.79*	---	----	*4.94*	----	----	*1.02*	.81
Grain and other Seeds.																	
Buckwheat	8	85.10	89.10	*87.40*	8.60	11.00	*10.00*	2.20	2.40	*2.25*	62.60	65.40	*64.50*	7.80	9.40	*8.70*	2.00
Barley	9	87.43	92.77	*89.08*	8.59	15.73	*12.39*	1.49	3.15	*1.86*	66.72	73.91	*69.88*	1.28	4.17	*2.57*	2.38
Oats	21	86.50	91.10	*89.30*	8.00	14.40	*11.30*	4.10	5.80	*5.00*	57.10	66.90	*61.00*	1.50	12.90	*9.00*	3.00
Rye	6	86.80	91.30	*88.40*	9.50	12.10	*10.60*	1.40	2.10	*1.70*	70.70	73.90	*72.60*	1.40	2.10	*1.60*	1.90
Wheat—winter	240	83.77	92.90	*89.47*	8.25	16.63	*11 73*	1.26	3.93	*2.12*	68.08	76.64	*71 99*	.44	2.87	*1.77*	1.86
Wheat—spring	13	86.65	91.88	*89.63*	8.14	15.40	*12.51*	1.82	2.56	*2.20*	66.07	78.66	*71.19*	1.33	2 30	*1 82*	1.91
Wheat—unclassified	54	87.62	90.64	*89.28*	9.80	14.70	*11.97*	1.64	2.83	*2.09*	68.52	74.65	*71.49*	1.21	3.05	*1.91*	1.82
Wheat—average of all analyses	307	83.77	92.90	*89.45*	8.14	16.63	*11.86*	1.26	3.93	*2.10*	66.07	78.66	*71.87*	.44	3.05	*1.79*	1.83
Maize—dent	78	85.95	93.78	*89.90*	7.53	12.07	*10.34*	3.80	6.93	*5.13*	66.26	75.73	*70.59*	1.25	4.81	*2.29*	1.55
Maize—flint	69	81.84	93.41	*88.92*	7.00	13.65	*10.60*	3.40	7.13	*4.92*	64.95	74.62	*70.34*	.67	2.88	*1.63*	1.43
Maize—sweet	25	89.14	94.02	*91.27*	9.45	15.31	*11.63*	5.25	11.89	*8.32*	61.78	72.35	*66.58*	1.46	5.24	*2.82*	1.92
Maize—"western corn"	3	79.30	83.60	*80.90*	7.80	8.60	*8.30*	3.60	3.90	*3.70*	64.90	68.20	*66.00*	1.70	1.80	*1.75*	1.20
Maize—average of all analyses	184	79.30	94.02	*89.46*	7.00	15.31	*10.59*	3.40	11.89	*5.49*	61.78	75.73	*69.73*	.67	5.24	*2.10*	1.55
Sorghum seed	9	83.24	90.72	*87.48*	7.67	11.25	*8.88*	2.12	4.60	*3.65*	66.81	73.59	*71.27*	1.48	3.21	*1.88*	1.80
Cotton seed—hulls and kernel	1	----	----	*92.28*	----	----	*15.72*	----	----	*18.56*	----	----	*29.09*	----	----	*25.75*	3.16

Composition of Feeding Stuffs—*Continued.*

Name.	Analyses.	Total Dry Matter.			Protein.			Fat.			Nitrogen-free Extr.			Fiber.			Ash.
		Min.	Max.	Aver.	Min.	Max.	Aver.	Min.	Max.	Aver.	Min.	Max.	Aver.	Min.	Max.	Aver.	
Grain and other Seeds—*continued.*																	
Cow pea	5	79.20	89.99	*85.21*	19.30	23.00	*20.77*	1.30	1.60	*1.43*	48.10	61.99	*55.75*	3.37	5.00	*4.06*	3.20
Doura—brown	3	87.30	92.40	*89.00*	9.00	11.50	*10.30*	----	----	*4.20*	----	----	*69.90*	----	----	*1 50*	1.60
Soja bean	3	89.87	93.95	*91.41*	34.63	38.62	*36.22*	16.80	19.00	*17.92*	26.20	30.50	*28.66*	3.69	5.00	*4.24*	4.37
Flour and Meal.																	
Barley meal	3	83.80	86.00	*84.90*	8.80	13.90	*11.80*	.70	2.20	*1.70*	---	----	*70.90*	----	----	*.10*	.50
Buckwheat flour	3	85.06	87.22	*86.48*	4.18	8.00	*6.48*	.65	1.74	*1.33*	75.81	79.37	*77.34*	.21	.35	*.28*	1.05
Oat meal	6	91.16	93.77	*92.15*	12.87	16.25	*14.66*	6.05	8.77	*7.06*	66.62	68.99	*67.57*	.64	1.15	*.86*	2.00
Rye flour	4	86.42	87.65	*86.90*	6.00	7.05	*6.65*	.78	.89	*.84*	77.56	79.09	*78.28*	.35	.45	*.41*	.72
Wheat flour—from winter wheat*	1	----	----	*87.04*	----	----	*8.56*	----	----	*1.19*	----	----	*76.59*	----	----	*.17*	.53
Wheat flour—from spring wheat†	6	86.50	89·70	*87.68*	8.56	14.12	*10.68*	.56	2.01	*1.11*	68.32	78.11	*75 00*	.00	1.22	*.22*	.64
Wheat flour—unclassified	17	86.83	88.81	*87.54*	9.69	13.31	*11.28*	.81	1.88	*1.15*	69.52	76.93	*74.43*	.06	.99	*.16*	.52
Wheat flour—average of all analyses	24	86.50	89.70	*87.56*	8.56	14.12	*11.01*	.56	2.01	*1.14*	68.32	78.11	*74.67*	.00	1.22	*.18*	.56
Graham flour	3	86.30	87.90	*86.90*	11.30	12.40	*11.70*	1.50	1.90	*1.70*	69.80	70.00	*69.80*	1.80	2.00	*1.90*	1.80
Maize meal	34	75.46	90.14	*84.97*	7.11	13.94	*9.09*	2.23	4.63	*3.72*	60.72	73.96	*68.86*	.50	2.99	*1.85*	1.45
Hominy	2	86.38	86.64	*86.51*	8.08	8.41	*8.25*	.42	.46	*.44*	77.07	77.18	*77.12*	.31	.33	*.32*	.38
By-Products and Refuse.																	
Apple pomace	3	22.80	27.40	*25.90*	1.00	1.70	*1.40*	1.70	2.00	*1.90*	15.70	17.00	*16.70*	3.90	5.90	*5.20*	.70
Brewers' grains—from brewery	15	20.59	31.40	*24.99*	4.27	7.75	*5.57*	.79	2.94	*1.68*	10.11	15.73	*12.86*	3.05	5.58	*3.87*	1.01
Brewers' grains—"dried"	3	88.09	93.77	*91.81*	19.25	20.25	*19.89*	4.17	6.51	*5.56*	46.10	56.80	*51.75*	10.24	11.60	*11.01*	3.58
Brewers' grains—kiln-dried	1	----	----	*97.43*	----	----	*20.30*	----	----	*6.40*	----	----	*54.89*	----	----	*11.79*	3.97
Brewers' grains—from silo	3	26.14	33.23	*30.18*	5.85	7.14	*6.64*	1.79	2.57	*2.11*	13.65	16.86	*15.58*	3.89	5.43	*4.64*	1.21
Brewers' swill	1	----	----	*5.70*	----	----	*1.90*	----	----	*.80*	----	----	*2.00*	----	----	*.70*	.30

* The average of 18 analyses, most of them incomplete is: Total dry matter, 89.63; Ash, .64; Protein, 10.92.

† The average of 16 analyses, most of them incomplete is: Total dry matter, 88.55; Ash, .60; Protein, 11.63.

COMPOSITION OF FEEDING STUFFS—*Continued.*

Name.	Analyses.	Total Dry Matter.			Protein.			Fat.			Nitrogen-free Extr.			Fiber.			Ash.
		Min.	Max.	Aver.	Min.	Max.	Aver.	Min.	Max.	Aver.	Min.	Max.	Aver.	Min.	Max.	Aver.	
BY PRODUCTS AND REFUSE—*continued.*																	
Malt sprouts	3	88.03	92.69	*89.73*	21.00	25.91	*22.95*	1.09	2.98	*1.79*	45.47	50.30	*48.60*	9.30	11.99	*10.72*	5.67
Cotton seed meal	24	81.48	94.22	*91.67*	23.27	50 80	*42.06*	10.24	18.00	*13.24*	12.74	38.68	*23.43*	2.77	11.76	*5.69*	7.25
Linseed cake	4	89.20	91.65	*89.98*	31.81	34.93	*33.77*	4.00	6.06	*5.04*	33.44	39.11	*36.68*	7.97	9.36	*8.52*	5.97
Linseed meal—old process	4	90.00	93.83	*91.66*	27.68	32.43	*30.80*	8.20	11.57	*10.12*	31.29	41.89	*34.75*	7.26	12.90	*10.01*	5 98
Linseed meal—new process	12	86.65	93.21	*89.88*	27.12	37.10	*32.94*	1.30	6.83	*3.57*	36.54	48.03	*38.35*	7.12	13.99	*9.09*	5.93
Palm nut meal	3	89.16	93.86	*91.71*	13.53	16.01	*14.39*	6.41	18.73	*13.30*	33.85	41.66	*38.88*	18.75	23.98	*21.40*	3.74
Rye bran	3	86.30	89.70	*87.70*	12.60	16.80	*15.26*	1.79	2.60	*2.19*	59.75	67.00	*63.12*	2.50	4.10	*3.51*	3.62
Wheat bran	30	85.72	91.76	*87.92*	7.50	16.89	*14.82*	2.39	5.84	*3.67*	50.41	58.93	*55.04*	5.98	16.64	*8.55*	5.84
Wheat middlings	11	86.15	90.75	*88.37*	10.13	16.50	*12.92*	2.07	5.87	*3.51*	60.21	70.86	*64.65*	1.27	7.62	*4.61*	2.68
Wheat shorts	6	86.41	89.04	*88.15*	11.13	15.13	*13.14*	2.50	4.85	*3.79*	55.62	62.32	*58.96*	6.34	10.47	*7.94*	4.32
"Hominy chops," "hominy feed," "Baltimore meal," "white meal"	9	86.54	91.89	*88.59*	7.88	10.81	*9.61*	4.45	11.23	*8.17*	60.95	71.10	*64 82*	2.54	4.79	*3.56*	2.43
Gluten meal	6	88.32	92.69	*90.70*	24.95	35.00	*29.62*	3.49	8.73	*5.69*	44.72	58.53	*53.10*	.68	3.25	*1.54*	.75
Maize cob	13	85.58	92.82	*90.67*	1.23	3.73	*2.50*	.08	.92	*.47*	45.31	66.38	*55.99*	28.23	38.26	*30.36*	1.33
"Starch feed"—refuse from starch manufacture	5	27.81	37.73	*33.51*	3.56	6.55	*5.24*	1.31	3.97	*2.53*	18.69	28.90	*22.68*	1.58	4.34	*2.84*	.22
"Sugar feed"—refuse from glucose manufacture	2	89.60	93.40	*91.50*	13.10	13.50	*13.30*	5.90	11.20	*8.60*	54.90	61.40	*58.10*	8.40	10.70	*9.50*	2.00
"Glucose waste"—wet	1	----	----	*24.00*	----	----	*3.72*	----	----	*1.63*	----	----	*17.39*	----	----	*.75*	.51
Sorghum meal—from seed mostly decorticated	1	----	----	*86.84*	----	----	*8.25*	----	----	*3.85*	----	----	*71.27*	----	----	*1.88*	1.59
Sorghum bagasse	3	11 30	16.60	*14.50*	.62	.68	*.65*	----	----	----	----	----	*10.20*	2.80	3.30	*3.10*	.60

the concentrated foods cannot be fed by themselves but must be administered in connection with a coarse fodder whose digestibility has already been determined.

Many practical trials have been made, chiefly at German experiment stations, to determine accurately the digestibility of the feeding stuffs commonly in use. The larger number of trials were made with cattle and sheep, some also with horses and swine. Some of the results of these trials are given in the following table of the Digestibility of Feeding Stuffs or of Digestion Coefficients. This is made up in large part from the one given in Mentzel and Lengerke's Landw. Kalender, 1885. Use has also been made of the tables in Dr. H. P. Armsby's Manual of Cattle Feeding. The arrangement of the table is simple. Thus the figure 3 after pasture grass in the first column signifies the number of distinct lots of pasture grass which were tested. In the next column 6 means that with the three separate lots of pasture grass six distinct feeding experiments were made with ruminating animals: sheep, cows and oxen. The greater the number of experiments and lots of grass tested the more accurately will the average digestibility be determined. 77 in the fifth column indicates that of the dry organic substance contained in pasture grass, the ruminants digest on the average 77 per cent. or $\frac{770}{1000}$, while the maximum and minimum figures 78 and 75 mean that one of the three samples of hay tested had but 75 per cent. and another had as high as 78 per cent. of its organic substance digested. By use of the information given in the tables of the Composition and the Digestibility of Feeding Stuffs it is easy for the farmer to ascertain with reasonable accuracy how much real nutriment is at his disposal for stock feeding.

A single example may illustrate. It is required to know how much digestible food is contained in a ton of wheat bran. By reference to the table of Composition of Feeding Stuffs it is seen that wheat bran has the following average composition:

Dry matter	87.92
Protein	14.82
Fat	3.67
Nitrogen-free extract	55.04
Fiber	8.55
Ash	5.84

Digestibility of Feeding Stuffs (Digestion Coefficients).

	Number of samples tested.	Number of experiments.	Total dry organic matter.			Protein.			Fat.			Nitrogen-free extract.			Fiber.		
			Min.	Max.	Av.	Min.	Max.	Av.	Min.	Max.	Av.	Min.	Max.	Av.	Min.	Max.	Av.
Green Fodder.																	
Pasture grass	3	6	75	78	*77.*	72	79	*75.*	63	69	*66.*	75	84	*78.*	72	80	*75.*
Meadow grass [experiments with horses]	10	13	43	62	*50.*	54	69	*61*	9	42	*21.*	49	66	*57.*	33	57	*41.*
Meadow rowen	6	30	62	71	*64.*	61	68	*62.*	31	56	*46.*	63	74	*66.*	59	68	*64.*
Pasture clover, very young	1	2	--	--	*75.*	--	--	*78.*	--	--	*64.*	--	--	*78.*	--	--	*67.*
Red clover, just before blossoming	6	15	59	74	*66.*	60	76	*66.*	58	74	*64.*	63	83	*73.*	47	60	*53.*
Lucerne, before flowering and in flower	9	28	55	67	*60.*	67	83	*74.*	29	55	*39.*	61	73	*67.*	34	48	*43.*
Vetches*	--	--	--	--	--	73	80	*76.*	50	66	*60.*	63	67	*65.*	51	58	*54.*
Lupines*	--	--	--	--	--	73	76	*74.*	16	45	*30.*	57	66	*62.*	67	80	*73.*
Maize fodder (very good)	1	1	--	--	*70.*	--	--	*73.*	--	--	*75.*	--	--	*67.*	--	--	*72.*
Sorghum	1	1	--	--	*73.*	--	--	*62.*	--	--	*85.*	--	--	*78.*	--	--	*59.*
Beet leaves [ensilaged]	1	2	--	--	*57.*	--	--	*65.*	--	--	*60.*	--	--	*54.*	--	--	*54.*
Beans, peas, cabbage, turnip leaves, parsnip leaves	--	--	--	--	--	--	--	*71.*	--	--	*60.*	--	--	*100†*	--	--	--
Fodder rye, fodder oats, beet leaves, carrot leaves, buckwheat	--	--	--	--	--	--	--	*58.*	--	--	*46.*	--	--	*100†*	--	--	--
Hay.																	
Meadow hay	38	104	46	71	*62.*	42	72	*62.*	10	63	*52.*	49	76	*64.*	46	71	*57.*
Meadow hay (very good)	14	42	56	71	*65.*	57	70	*64.*	31	63	*50.*	58	76	*68.*	55	71	*62.*
Meadow hay (medium)	24	62	46	69	*60.*	42	72	*57.*	10	63	*48.*	49	73	*62.*	46	66	*58.*

* These co-efficients were obtained in experiments with very good hay of these plants but are approximately correct for the green fodder.

† The number 100 indicates that the sum of the digestible extract and fiber is equal to the total amount of nitrogen-free extract.

Digestibility of Feeding Stuffs (Digestion Coefficients)—*Continued.*

	Number of samples tested.	Number of experiments.	Total dry organic matter.			Protein.			Fat.			Nitrogen-free extract.			Fiber.		
			Min.	Max.	Av.	Min.	Max.	Av.	Min.	Max.	Av.	Min.	Max.	Av.	Min.	Max.	Av.
Hay—*continued.*																	
Meadow hay (inferior)	7	18	46	59	*55.*	42	56	*51.*	10	57	*41.*	49	61	*58.*	46	61	*54.*
Meadow hay (very good, experiments on horse)	3	4	49	55	*52.*	63	66	*64.*	14	42	*24.*	52	62	*57.*	36	46	*43.*
Meadow hay (medium, experiments on horse)	5	6	43	51	*48.*	54	62	*58.*	16	33	*23.*	49	61	*55.*	33	40	*37.*
Clover hay [very good]	6	12	58	63	*61.*	55	69	*62.*	44	72	*60.*	67	72	*70.*	39	52	*47.*
Clover hay (medium)*	6	19	54	62	*57.*	43	61	*55.*	35	70	*51.*	58	67	*65.*	39	52	*45.*
Clover hay (experiments on horse)	4	6	49	55	*51.*	51	60	*56.*	28	31	*29.*	61	67	*64.*	35	39	*37.*
Lucerne hay (very good)	9	28	55	67	*60.*	67	83	*74.*	29	55	*39.*	61	73	*66.*	34	48	*43.*
Hay of fodder vetches [before blossom]	1	6	--	--	*65.*	--	--	*76.*	--	--	*60.*	--	--	*66.*	--	--	*54.*
Lupine hay, in blossom	1	2	--	--	--	--	--	*74.*	--	--	*30.*	--	--	*62.*	--	--	*74.*
Roots.																	
Potatoes	3	23	83	90	*88.*	64	67	*65.*	--	--	--	89	96	*93.*	--	--	--
Potatoes [experiments with pigs]	5	8	--	--	*93.*	--	--	*73.*	--	--	--	--	--	*98.*	--	--	*55.*
Sugar beets	2	28	84	93	*89.*	56	68	*62.*	--	--	--	95	96	*95.*	--	--	--
Mangolds	2	16	87	88	*88.*	66	86	*76.*	--	--	--	94	96	*95.*	--	--	--
Turnips	1	8	--	--	*78.*	--	--	*57.*	--	--	--	--	--	*89.*	--	--	--
Grains.																	
Oats	6	31	62	74	*68.*	68	86	*77.*	75	97	*82.*	67	79	*74.*	0	26	*17.*
Oats (experiment with horse)	1	5	--	--	*72.*	--	--	*86.*	--	--	*78.*	--	--	*76.*	--	--	*24.*
Barley	1	2	--	--	*81.*	--	--	*77.*	--	--	*100.*	--	--	*87.*	--	--	--

* The digestibility of clover hay may serve as a basis for determining that of hay of other legumes, and the digestibility of meadow hay for determining that of hay from the cultivated grasses.

Digestibility of Feeding Stuffs (Digestion Coefficients)—*Continued.*

	Number of samples tested.	Number of experiments.	Total dry organic matter.			Protein.			Fat.			Nitrogen-free extract.			Fiber.		
			Min.	Max.	Av.	Min.	Max.	Av.	Min.	Max.	Av.	Min.	Max.	Av.	Min.	Max.	Av.
GRAINS—*continued.*																	
Barley (experiment with horse)	1	1	--	--	*87.*	--	--	*80.*	--	--	*42.*	--	--	*87.*	--	--	*100.*
Barley (experiments with pig)	4	8	82	85	*83.*	75	80	*78.*	65	77	*68.*	89	91	*90.*	0	27	*12.*
Maize	1	2	--	--	*89.*	--	--	*79.*	--	--	*85.*	--	--	*91.*	--	--	*62.*
Maize (experiment with horse)	1	1	--	--	*91.*	--	--	*78.*	--	--	*63.*	--	--	*94.*	--	--	*100.*
Maize (experiments with pig)	3	4	90	95	*92.*	84	88	*86.*	76	77	*76.*	93	96	*95.*	19	57	*40.*
Field beans	5	18	83	94	*89.*	81	95	*88.*	65	100	*87.*	88	95	*92.*	25	92	*72.*
Field beans (experiments with horse)	1	4	--	--	*87.*	--	--	*86.*	--	--	--	--	--	*93.*	--	--	*69.*
Peas	1	2	--	--	*90.*	--	--	*89.*	--	--	*75.*	--	--	*93.*	--	--	*66.*
Peas (experiment with horse)	1	1	--	--	*80.*	--	--	*83.*	--	--	*67.*	--	--	*89.*	--	--	*8.*
Peas (experiments with pigs)	5	10	88	95	*91.*	85	90	*88.*	36	67	*49.*	95	99	*96.*	55	89	*71.*
BY-PRODUCTS AND REFUSE.																	
Wheat bran (fed dry)	5	12	67	78	*72.*	71	89	*78.*	50	80	*69.*	70	82	*77.*	20	39	*33.*
Rye bran [experiments with pigs]	1	2	--	--	*67.*	--	--	*66.*	--	--	*58.*	--	--	*75.*	--	--	*4.*
Malt sprouts	1	3	--	--	*84.*	--	--	*82.*	--	--	*49.*	--	--	*88.*	--	--	*95.*
Brewers' grains	1	2	--	--	*63.*	--	--	*73.*	--	--	*84.*	--	--	*64.*	--	--	*39.*
Rape meal (oil extracted)	1	1	--	--	*68.*	--	--	*84.*	--	--	--	--	--	*85.*	--	--	--
Rape cake	2	7	56	75	*66.*	76	86	*81.*	69	88	*79.*	74	78	*76.*	0	16	*8.*
Linseed meal [oil extracted]	1	8	--	--	*71.*	--	--	*82.*	--	--	*91.*	--	--	*73.*	--	--	--
Linseed cake	2	10	78	83	*81.*	84	87	*86.*	89	91	*90.*	70	91	*80.*	26	62	*44.*

Digestibility of Feeding Stuffs (Digestion Coefficients)—*Continued.*

	Number of samples tested.	Number of experiments.	Total dry organic matter.			Protein.			Fat.			Nitrogen-free extract.			Fiber.		
			Min.	Max.	Av.	Min.	Max.	Av.	Min.	Max.	Av.	Min.	Max.	Av.	Min.	Max.	Av.
BY-PRODUCTS AND REFUSE—*continued.*																	
Palm-nut meal (oil extracted)	2	3	89	93	*91.*	89	100	*95.*	89	100	*95.*	92	96	*94.*	72	92	*82.*
Cotton-seed cake (decorticated)	1	2	--	--	*80.*	--	--	*85.*	--	--	*88.*	--	--	*95.*	--	--	--
Cotton-seed cake (not decorticated)	1	4	--	--	*50.*	--	--	*73.*	--	--	*91.*	--	--	*46.*	--	--	*23.*
Cocoanut cake	1	2	--	--	*78.*	--	--	*76.*	--	--	*100*	--	--	*81.*	--	--	*62.*
Cocoanut cake [experiments with pigs]	1	2	--	--	*80.*	--	--	*74.*	--	--	*83.*	--	--	*89.*	--	--	*60.*
Flesh meal	1	2	--	--	*95.*	--	--	*95.*	--	--	*98.*	--	--	--	--	--	--
Flesh meal [experiments with pigs]	1	8	--	--	*95.*	--	--	*97.*	--	--	*87.*	--	--	--	--	--	--
Blood meal	1	2	--	--	*63.*	--	--	*62.*	--	--	*100*	--	--	*100*	--	--	--
Blood meal [experiments with pig]	1	1	--	--	*72.*	--	--	*72.*	--	--	--	--	--	*92.*	--	--	--
Fish guano	1	2	--	--	--	--	--	*90.*	--	--	*76.*	--	--	--	--	--	--
STRAW.																	
Wheat straw*	2	3	45	48	*46.*	8	26	*17.*	27	44	*36.*	37	40	*39.*	52	59	*56.*
Wheat straw [experiments with horse]	1	2	--	--	*23.*	--	--	*19.*	--	--	*49.*	--	--	*17.*	--	--	*27.*
Rye straw	2	9	42	51	*46.*	17	25	*21.*	--	--	*32.*	35	38	*37.*	49	70	*60.*
Oat straw	4	8	48	56	*51.*	24	48	*41.*	20	49	*30.*	39	45	*46.*	55	64	*60.*
Barley straw	2	5	51	55	*53.*	17	24	*20.*	41	43	*42.*	51	57	*54.*	55	56	*56.*
Pea straw (very good)	1	2	--	--	*59.*	--	--	*61.*	--	--	*46*	--	--	*64.*	--	--	*52.*
Bean straw*	1	3	--	--	*50.*	--	--	*51.*	--	--	*55.*	--	--	*63.*	--	--	*36.*
Lupine straw	1	2	--	--	*55.*	--	--	*37.*	--	--	*30.*	--	--	*65*	--	--	*51.*

* The coefficients of wheat straw may also be applied to stover and those of bean straw to vetch straw.

The table of the Digestibility of Feeding Stuffs shows that in wheat bran about

78 per cent. of the protein,
69 per cent. of the fat,
77 per cent. of the nitrogen-free extract,
33 per cent. of the fiber,

are digested by oxen.

Multiplying the total amounts of the different constituents as expressed in per cent. or pounds per hundred by their percentage digestibility or "digestion coefficients" gives the actual amounts of digestible matter in 100 pounds of the bran, and this again multiplied by 20 will give the amounts of *digestible* protein, fat, etc., in 2000 pounds or one ton.

Digestible protein	$14.82 \times .78 = 11.56 \times 20 = 231.2$
Digestible fat	$3.67 \times .69 = 2.53 \times 20 = 50.6$
Digestible N.-free extract	$55.04 \times .77 = 42\ 38 \times 20 = 847.6$
Digestible fiber	$8.55 \times .33 = 2.82 \times 20 = 56.4$

By precisely the same method the actual nutriment of all the feeding stuffs used may be determined with sufficient accuracy.

The next step is to compound from these materials a ration which shall supply the animal with sufficient but not a wasteful excess of the different kinds of nutriment. With regard to the use of these various nutrients in the animal body it may be said that protein has a different physiological significance from fiber and the nitrogen-free extract, which latter consists of starch, the sugars, the gums and similarly constituted matters.

Protein may easily be made over by the animal into its own substance, i. e., into muscles, tendons and the various working tissues and membranes which are necessary parts of the animal machine, because it is made up of the same kind of materials, is, chemically speaking, of the same composition.

Fiber and the nitrogen-free extract on the other hand, probably cannot serve at all for building up the muscles and other parts of the growing animal and cannot restore the waste and wear of those parts of mature animals, because they are of a very different nature. They contain no nitrogen, an element which enters into all the animal tissues (albuminoids) to the extent of some sixteen per cent. of their dry matter.

Fiber and the N.-free extract cannot restore the worn out muscles or membranes of the animal any more than coal can be made to renew the used-up packing, bolts, valves, flues and gearing of

a steam-engine. Protein is to the ox or the man what brass and iron are to the machine, the materials of construction and repair.

Fat, fiber and N.-free extract are, furthermore, to the animal very much what coal and fuel are to the steam-engine. Their consumption generates the power which runs the mechanism. Their burning (oxidation) in the blood of animals produces the results of life just as the combustion of coal in the fire-place of the steam-engine produces the motion and power of that machine.

There is, however, this difference between the engine and the animal. The former may be stopped for repairs, the latter may run at a lower rate, but if it be stopped it cannot resume work. Hence the repairs of the animal must go on simultaneously with its wastes. Therefore, the material of which it is built must admit of constant replacement, and the dust and shreds of its wear and tear must admit of escape without impeding action. The animal body is as if an engine were fed not only with coal and water, but with iron, brass and all the materials for its repair, and also is as if the engine consumed its own worn out parts, voiding them as ashes or as gas and smoke. Protein or the blood- and tissue-former is thus consumed in the animal, as well as the fat, fiber and N.-free extract or fuel proper. The fact that protein admits of consumption implies that when the proper fuel is insufficient, protein may itself serve as fuel. Such is the case, in fact. But, nevertheless, the two classes of substances have distinct offices in animal nutrition, and experience has demonstrated, that for each special case of animal nutrition a special ratio of digestible protein to digestible fat, fiber and N.-free extract is the best and most economical, and, within certain limits, is necessary. This proportion we designate as the *nutritive ratio*, and these explanations make its significance evident.

It is believed that the digestible parts of fiber and of N.-free extract (i. e., of starch, sugar, and gums), have about the same nutritive value, i. e. answer essentially the same purposes in the body. The fat, however, has a greater value, formerly assumed to be two and a half times that of fiber and N.-free extract. This assumption is not entirely justified by our present knowledge, yet for the sake of uniformity and to avoid confusion, that factor must be retained till a more satisfactory one is agreed upon.

The rule then to determine the nutritive ratio in any feeding stuff or ration is to add together the amounts of digestible fiber

and N.-free extract, and the amount of digestible fat multiplied by $2\frac{1}{2}$ and divide that sum by the amount of digestible protein.

To illustrate: the nutritive ratio of the wheat bran, whose digestible nutrients are given above, is calculated as follows:

Digestible fiber	2.82
" nitrogen-free extract	42.38
" fat (2.53) × $2\frac{1}{2}$	6.32
	51.52

51.52 ÷ 11.56 = digestible protein = 4.46

Thus the nutritive ratio of wheat bran is 1 : 4.46.

III. Feeding Standards.

In the last paragraphs a comparison has been made between the animal and a steam engine. It is evident that the engine must be fed with sufficient fuel of a kind adapted for use in its furnace and beside this, to run it economically the amount of fuel and the rate of feeding it must be adapted to the work to be performed. If the engine is simply standing in readiness, with steam up, a very little fuel will do, if it is propelling a locomotive and approaching a steep grade with a heavy train the consumption of fuel must be enormously increased. The same holds with the animal machine: the amount of food must be suited to the performance required.

But the locomotive engine does a single kind of work; domestic animals on the contrary do several kinds—they produce beside animal heat, either flesh, milk, wool or muscular energy.

Not only is the total amount of food required for these various kinds of production different but, as experience proves, different proportions of the various digestible food-elements or nutrients are required to yield fat mutton than are needed to produce milk, or to sustain labor, or to keep the resting animal in fair condition; and again the most suitable milk-producing ration is not the one best adopted for the growth of wool.

A careful observant feeder of cattle by long trial can ascertain with approximate correctness in what quantity and proportion he can most profitably use the feeding stuffs which are at his command. His results may be adopted by his neighbors with profit provided that their feeding materials are of the same kind and of the same quality, but if their feed is different, if one is using early cut hay, the other late cut hay, if one uses corn meal, the

other wheat bran, if one has mangolds at his disposal, the other not, then the valuable experience of the one is of comparatively little use to the other. Some common standard of comparison is necessary in order to make the experience of one readily available for others. The best means of comparison as yet realized, is furnished by the table of Feeding Standards taken in connection with the other tables which have been already explained.

Table of Feeding Standards.

A. Pounds per day per 1,000 pounds live weight.

Kind of animal.	Total organic matter.	Protein.	Nitrogen-free extract and fiber.	Fat.	Total nutritive substances.	Nutritive ratio.
Horse at light work	21.0	1.5	9.5	0.40	11.40	1 : 7.0
" average work	22.5	1.8	11.2	0.60	13.60	1 : 7.0
" hard work	25.5	2.8	13.4	0.80	17.00	1 : 5.5
Oxen at rest in stall	17.5	0.7	8.0	0.15	8.85	1 : 12.0
" ordinary work	24.0	1.6	11.3	0.30	13.20	1 : 7.5
" hard work	26.0	2.4	13.2	0.50	16.10	1 : 6.0
Oxen fattening, first period	27.0	2.5	15.0	0.50	18.00	1 : 6.5
" " second "	26.0	3.0	14.8	0.70	18.50	1 : 5.5
" " third "	25.0	2.7	14.8	0.60	18.10	1 : 6.0
Milk Cows	24.0	2.5	12.5	0.40	15.40	1 : 5.4
Sheep, wool-producing (coarser breeds)	20.0	1.2	10.3	0.20	11.70	1 : 9.0
" wool-producing (finer breeds)	22.5	1.5	11.4	0.25	13.15	1 : 8.0
" fattening, first period	26.0	3.0	15.2	0.50	18.70	1 : 5.5
" " second "	25.0	3.5	14.4	0.60	18.50	1 : 4.5
Swine, fattening, first period	36.0	5.0	27.5		32.50	1 : 5.5
" " second "	31.0	4.0	24.0		28.00	1 : 6.0
" " third "	23.5	2.7	17.5		20.20	1 : 6.5
Growing Cattle.						
Age, Months. Average live weight per head.						
2–3 150 pounds	22.0	4.0	13.8	2.0	19.8	1 : 4.7
3–6 300 "	23.4	3.2	13.5	1.0	17.7	1 : 5.0
6–12 500 "	24.0	2.5	13.5	0.6	16.6	1 : 6.0
12–18 700 "	24.0	2.0	13.0	0.4	15.4	1 : 7.0
18–24 850 "	24.0	1.6	12.0	0.3	13.9	1 : 8.0
Growing Sheep.						
5–6 56 pounds	28.0	3.2	15.6	0.8	19.6	1 : 5.5
6–8 67 "	25.0	2.7	13.3	0.6	16.6	1 : 5.5
8–11 75 "	23.0	2.1	11.4	0.5	14.0	1 : 6.0
11–15 82 "	22.5	1.7	10.9	0.4	13.0	1 : 7.0
15–20 85 "	22.0	1.4	10.4	0.3	12.1	1 : 8.0
Growing Pigs.						
2–3 50 pounds	42.0	7.7	30.0		37.5	1 : 4.0
3–5 100 "	34.0	5.5	25.0		30.0	1 : 5.0
5–6 125 "	31.5	4.3	23.7		28.4	1 : 5.5
6–8 170 "	27.0	3.4	20 4		23.8	1 : 6.0
8–12 250 "	21.0	2.5	16.2		18.7	1 : 6.5

TABLE OF FEEDING STANDARDS—*Continued.*

B. POUNDS PER DAY AND HEAD.

KIND OF ANIMAL.	Total organic matter.	Protein.	Nitrogen-free extract and fiber.	Fat.	Total nutritive substances.	Nutritive ratio.
GROWING CATTLE.						
2–3 150 pounds	3.3	0.6	2.1	0.30	3.00	1 : 4.7
3–6 300 "	7.0	1.0	4.1	0.30	5.40	1 : 5.0
6–12 500 "	12.0	1.3	6.8	0.30	8.40	1 : 6.0
12–18 700 "	16.8	1.4	9.1	0.28	10.78	1 : 7.0
18–24 850 "	20.4	1.4	10.3	0.26	11.96	1 : 8.0
GROWING SHEEP.						
5–6 56 pounds	1.6	0.18	0.87	0.045	1.095	1 : 5.5
6–8 67 "	1.7	0.17	0.85	0.040	1.060	1 : 5.5
8–11 75 "	1.7	0.16	0.85	0.037	1.047	1 : 6.0
11–15 82 "	1.8	0.14	0.89	0.032	1.062	1 : 7.0
15–20 85 "	1.9	0.12	0.88	0.025	1.047	1 : 8.0
GROWING PIGS.						
2–3 50 pounds	2.1	0.38	1.50		1.88	1 : 4.0
3–5 100 "	3.4	0.50	2.50		3.00	1 : 5.0
5–6 125 "	3.9	0.54	2.96		3.50	1 : 5.5
6–8 170 "	4.6	0.58	3.47		4.05	1 : 6.0
8–12 250 "	5.2	0.62	4.05		4.67	1 : 6.5

This Table expresses the average results of many carefully conducted experiments with cattle in which the quantity of the food used and the material produced by the animals, whether beef, milk or wool, were all accurately and repeatedly determined. The table involves no guess-work or speculation, but is to be regarded simply as a convenient and concise way of expressing the general results of the best practical experience in cattle feeding. Like all such general statements it must be used intelligently to be of any value. The special circumstances of the feeder, the ruling prices of the different articles of feed used, the individual peculiarities of his stock, all have to be considered and all may have a modifying effect on the composition or effect of the ration.

These tables and explanations are not substitutes for common sense or experience in feeding, but are helps to them.

A single example may here be given to illustrate the method of using the tables:

There are available for feeding a herd of milk cows, a rather short allowance of Timothy hay, plenty of wheat straw and turnips, while brewers' grains can be got fresh daily at a low price.

It is first to be determined about how much digestible matter these feeding stuffs contain. From the Table of Average Composition, their probable percentage amount of protein fat, etc., can be learned, and from the Table of Digestibility is found what proportion of the protein, fat, etc., is to be regarded as digestible. The calculation is as follows:—

	Pounds per hundred.		Per cent. digestible.		Pounds per hundred digestible.
TIMOTHY HAY.					
Organic matter*	84.83				
Protein	6.02	×	57†	=	3.43
Fat	2.20	×	48	=	1.05
N.-free Extract	46.26	×	62	=	28.68
Fiber	30.35	×	58	=	17.60
WHEAT STRAW.					
Organic matter	86.54				
Protein	4.98	×	17	=	.84
Fat	1.49	×	36	=	.53
N.-free Extract	41.99	×	39	=	16.37
Fiber	38.08	×	56	=	21.32
TURNIPS.					
Organic matter	10.40				
Protein	1.34	×	57	=	.77
Fat	.09‡				.09
N.-free Extract	8 11	×	89	=	7.22
Fiber	.86‡				.86
BREWERS' GRAINS.					
Organic matter	23.98				
Protein	5.57	×	73	=	4.06
Fat	1.68	×	84	=	1.41
N.-free Extract	12.86	×	64	=	8.23
Fiber	3.87	×	39	=	1.51

The Table of Feeding Standards gives as the average daily ration for milk cows—*per* 1000 *pounds live weight*:—

Total Organic matter	24.0	pounds
Digestible Protein	2.5	"
" N.-free Extract§	12.5	"
" Fat	0.4	"
Nutritive ratio	1 : 5.4	"

* Dry matter less the ash.
† These are the digestion coefficients of medium meadow hay.
‡ Regarded as wholly digestible.
§ Including digestible fiber.

A few preliminary calculations may bring us to something like the following ration:—

		Organic matter, pounds.	Protein, pounds.	Fat, pounds.	N.-free Extract, pounds.	Fiber, pounds.
9 pounds	hay, containing digestible,	7.6	.31	.09	2.58	1.58
10 "	straw, " "	8.7	.08	.05	1.64	2.13
20 "	turnips, " "	2.1	.15	.02	1.44	.17
20 "	brewers' grains, "	4.8	.81	.28	1.64	.30
Total		23.2	1.35	.44	7.30	4.18

Comparing this ration with the Standard it has a little less organic matter, over one pound less protein and nitrogen-free extract (7.30 + 4.18 = 11.48), and the nutritive ratio is quite wide, viz. 1 : 9.3. Perhaps the ration under some circumstances might be economical. It needs the addition of some concentrated feed rich in albuminoids and N.-free extract, but poor in fat. Looking over the table of average composition of feeding stuffs, new process linseed meal seems to answer that description.

Calculating the amount of digestible food in it as in the cases just given it appears that four pounds of it will bring the digestible protein of the ration up to the Standard.

	Organic matter.	Protein.	Fat.	N.-free Extract.	Fiber.
Already in the ration	23.2	1.35	.44	7.30	4.18
4 pounds new process linseed meal	3.6	1.08	.13	1.14	
Total	26.8	2.43	.57	8.44	4.18
				12.62	
Feeding Standard	24.0	2.50	.40	12.50	

In this ration we have 2.8 pounds more organic matter and $\frac{1}{6}$ pounds more digestible fat than the Standard calls for, while digestible protein and nitrogen-free extract agree quite closely with the Standard. The nutritive ratio is 1 : 5.8.

It will be observed that the ration is calculated for 1000 *pounds live weight* and must be brought to correspond with the weight of the cows.

ANALYSES OF FEEDING STUFFS.

Wheat Feed.

In a following table are given analyses of sixteen articles of this kind.

CLXXXVII was sent by B. F. Case, of Canton Center, from stock of Smith, Northam & Robinson, Hartford. It is a very coarse article and the price was somewhat lower in consequence. CXC, CXCL were sent by N. P. Perkins, Willimantic. CCV, CCVI, CCVII were from stock of E. A. Buck & Co., Willimantic. CC, from stock of A. Arnold & Co., and CCI, CCII, from stock of J. E. Bugby & Co., Willimantic, all sent by Mr. Perkins.

CLXXXVII, was sent by W. H. Childs, North Manchester. The other samples were kindly furnished by D. B. Crittenden & Co., of New Haven.

All prices with exception of that of CLXXXVII, were quoted in June, 1885.

The third column from the right in the table of analyses is "Percentage digestibility of protein." The actual digestibility of feeding stuffs is only to be determined positively by experiments with animals. It is sometimes quite desirable, however, as in the present case, to know the *comparative* digestibility of the most valuable food ingredient, namely the protein. A method has been devised to accomplish this with reasonable accuracy and far less outlay of time and labor than is involved in feeding trials.

This method consists essentially in heating at the temperature of the body, a weighed portion of the fodder, first with an artificial gastric juice prepared from hogs' stomachs, afterwards with a pancreatic solution prepared from the sweetbreads of cattle, and finally determining the amount of protein undissolved; the object being to imitate as closely as possible the digestive process of the animal. Some further notice of the details of the process will be found elsewhere in this report together with comparisons of the results obtained by this artificial digestion and by actual digestion.

The results in the table indicate that the average digestibility of the protein of bran is about five per cent. less than that of middlings or fine feed and that the last named articles are about equally digestible.

The last column but one of the table is "Comparative valuation per ton." It is very difficult if not impossible to give a just valuation to feed of different kinds; to compare for instance, cotton seed meal and turnips, meadow hay and oats, on a money basis. It is not so difficult to compare a number of kinds of feed of the same general character like those in this table. These are all

ANALYSES OF WHEAT FEED.

Station No.	Name.	Water.	Ash.	Protein.	Fiber.	Nitrogen free Extract.	Fat.	Water-Free. Ash.	Water-Free. Protein.	Water-Free. Fiber.	Water-Free. Nitro-gen-free Extract.	Water-Free. Fat.	Percentage Digestibility of Protein.	Comp. valuation per ton.	Price per ton.
	Average of 30 samples of wheat bran	12.03	5.89	15.26	8.59	54.28	3.95	6.70	17.34	9.75	61.73	4.48	---	$18.00	
CLXXXVIII	Wheat bran	11.41	6.35	15.50	8.88	53.87	3.99	7.18	17.39	10.02	60.82	4.59	83.0	17.90	$17.00
CXCI	"	13.20	6.15	15.56	9.83	50.96	4.30	7.08	17.93	11.33	58.71	4.95	85.1	18.03	18.00
	Average of 6 samples of spring wheat bran	11.32	5.86	15.33	8.80	54.35	4.34	6.59	17.29	9.92	61.32	4.88	---	18.25	
CXCVI	Wheat bran from spring wheat	13.57	5.72	14.93	8.94	52.47	4.37	6.71	17.25	10.33	60.67	5.04	81.2	17.39	
CCV	" " " "	12.27	5.57	15.44	7.89	54.64	4.19	6.34	17.60	9.00	62.28	4.78	85.4	18.28	18.00
CCVI	" " " "	12.31	5.98	15.12	10.12	52.08	4.39	6.81	17.24	11.54	59.41	5.00	81.8	17.59	18.00
CCVII	" " " "	7.38	5.90	16.69	7.44	58.12	4.47	6.37	18.02	8.04	62.75	4.82	89.5	---	18.00
	Average of 6 samples of winter wheat bran	12.27	5.90	16.00	8.08	53.75	4.00	6.73	18.24	9.20	61.27	4.56	---	18.38	
CXCIV	Wheat bran from winter wheat	12.08	6.42	17.75	8.75	50.54	4.46	7.29	20.19	9.92	57.54	5.06	85.6	19.41	
CXCVIII	" " " "	13.35	6.01	16.50	8.93	51.15	4.06	6.92	19.03	10.28	59.09	4.68	85.2	18.50	
	Average of 10 samples of Middlings	11.50	3.44	16.60	3.86	60.28	4.32	3.88	18.76	4.35	68.14	4.87	---	20.05	
CLXXXVII	Middlings	10.23	3.58	19.18	3.28	59.16	4.57	3.98	21.35	3.65	65.94	5.08	---	---	
CXCVII	" from spring wheat	13.00	4.09	17.94	7.04	53.02	4.91	4.70	20.61	8.08	60.97	5.64	88.8	20.39	
CXCV	" " " "	12.73	3.75	17.63	4.31	57.38	4.20	4.28	20.21	4.93	65.77	4.81	89.7	20.32	
CXCIX	" " " "	13.68	2.13	18.19	1.90	60.95	3.15	2.46	21.08	2.20	70.62	3.64	90.7	20.58	
	Average of 4 samples of fine feed	12.46	3.80	15.88	4.72	59.07	4.07	4.34	18.14	5.39	67.48	4.65	---	19.37	
CXC	Fine feed	11.98	4.05	16.06	5.14	58.39	4.38	4.59	18.24	5.83	66.36	4.98	88.7	19.42	20.00
CC	" "	12.17	4.50	16.20	5.63	57.17	4.33	5.12	18.44	6.40	65.12	4.92	89.6	19.12	20.00
CCI	" "	12.89	4.16	15.44	5.75	57.55	4.21	4.78	17.72	6.59	66.08	4.83	89.1	18.71	22.00
CCII	" "	12.82	2.50	15.81	2.35	63.15	3.37	2.87	18.10	2.68	72.49	3.86	93.3	19.70	24.00

derived from the same source and do not differ greatly in digestibility or in their specific action on the animal. The method of calculation is as follows: Experiments with cattle have shown that in case of wheat bran about 33 per cent. of the fiber, 77 per cent. of the nitrogen-free extract and 69 per cent. of the fat are digestible. Taking the relative digestibility of the protein as a basis we may easily calculate the amounts of *digestible* protein, fiber, nitrogen-free extract and fat which each sample contains and thus acquire with tolerable certainty the proper data for comparison. It has been found in a large number of trials that if in concentrated food a pound of digestible protein and fat is valued at $4\frac{1}{3}$ cents, and a pound of digestible fiber and nitrogen-free extract at nine-tenths of a cent the valuation will agree fairly well with the market price. In our experience the valuation thus obtained is slightly higher than the market price. The valuation has been made in this way for each of these samples and also for "average of 30 samples of wheat bran." Each of these valuations amounts to $20.00 per ton or over. But the average price of bran is now about $18.00. Therefore the valuation of average bran is reduced to $18,00 and all others are reduced proportionally; the result being a comparison of the feeding value of the brans, middlings and fine feeds with bran of average quality;— in term of dollars and cents.

This comparison shows that when bran is worth $18.00 per ton, the average feeding value of middlings is about $20.00 and of fine feed about $19.37. To make the comparison of these articles more complete their manurial value should likewise be considered.

In the following table are given complete analyses made at this Station of the ash of wheat bran (sample CXCVIII) and of middlings (CXCV) and for comparison a single analysis of ash of wheat flour, the average of four analyses of the ash of whole wheat made at the U. S. Department of Agriculture and the average composition of the ash of European wheat as given by Wolff.

The figures show that the larger part of the mineral matter of the wheat kernel is in the exterior portions which form the bran: thus the ash constitutes only about 2 per cent. of the whole wheat, while $3\frac{3}{4}$ per cent. of middlings and 6 per cent of bran consists of ash or mineral matter. The ash of bran and middlings is considerably richer in phosphoric acid and poorer in potash and lime than that of the whole wheat.

Ash Analyses.

	Bran. CXCVIII.	Middlings. CXCV.	Flour. U. S. Dept.	Whole wheat. of Ag.	Winter wheat. Wolff's	Spring wheat. averages.
Per cent. of ash	6.01*	3.75†	.41	1.70	1.97	2.14
Composition of ash:						
Potash	26.60	26.53	31.54	29.08	31.16	29.99
Soda	3.49	1.75	2.93	1.31	2.25	1.93
Lime	.15	.92	5.87	3.51	3.34	2.93
Magnesia	9.55	11.79	9.05	15.06	11.97	12.09
Oxide of Iron	trace	trace	----	trace	1.31	.51
Manganese	----	----	----	.07	----	----
Sulphuric acid	1.20	.26	----	.28	.37	1.52
Phosphoric acid	53.62	54.22	49.63	47.76	46.98	48.63
Chlorine	----	----	----	.48	.22	.48
Silica and sand	.45	1.37	.98	2.45	2.11	1.64
Water and charcoal	3.83	2.46	----	----	----	----
Other matters by difference	1.11	.70	----	----	.29	.28
	100.00	100.00	100.00	100.00	100.00	100.00

With the aid of the analyses just given the manurial matter in a ton of bran and middlings may be calculated with tolerable accuracy and is as follows:—

In one ton of are contained pounds of	Bran.	Middlings.
Nitrogen	*48.8*	*.53*
Phosphoric acid	*63.3*	*38.0*
Potash	*31.4*	*18.6*
Soda	4.1	1.2
Lime	.2	.6
Magnesia	11.3	8.0
Sulphuric acid	1.4	.2
Silica and sand	.5	1.0

It is worth noticing that these kinds of wheat feed contain only about a quarter of one per cent. less nitrogen than average ammoniated superphosphates, and that the average car load (12 tons) of bran brought into the State brings with it in round numbers 570 pounds of nitrogen, 760 pounds of phosphoric acid and 370 pounds of potash.

It is impossible to assign a correct money value to the fertilizing ingredients contained in stable or yard manure because they are so largely diluted with water [75 to 80 per cent.] and other materials which increase enormously the cost of handling and transporting them. The actual value may be expressed however

* The average of 30 analyses gave 5.90 per cent. of ash.

† The average of 10 analyses gave 3.40 per cent. of ash.

in this way:—a ton of bran fed to cattle that are neither laying on flesh or giving milk will add to the manure about as much available nitrogen, phosphoric acid and potash as are contained in

500 pounds of fish.
100 " " ground bone and
60 " " muriate of potash.

Of course if milk and beef are being produced, certain quantities of the ash elements of the bran as well as of its nitrogen go with them and are more profitably utilized in those forms than in manure.

Albuminoid and non-albuminoid Nitrogen in Wheat Bran.

It is the universal practice to determine protein in feeding stuffs by multiplying the percentage amount of nitrogen which they contain, by the factor $6\frac{1}{4}$. This method rests on two assumptions: 1st, That all the nitrogen present is combined in true albuminoid bodies, and 2d, That all albuminoids contain 16 per cent. of nitrogen (16 per cent. $\times 6\frac{1}{4} = 100$ per cent.). As already stated, the second assumption is not fully justified by facts. Some of the vegetable albuminoids contain little more than 15 per cent. others nearly 18 per cent., so that the true factor in any case lies somewhere between $5\frac{1}{2}$ and $6\frac{3}{5}$. Generally however the factor $6\frac{1}{4}$ introduces only a small error. The other assumption is more widely at variance with what is at present known. Besides albuminoids there are in almost all feeding stuffs, other nitrogenous matters; either nitrates, ammonia salts, alkaloids, amido-acids or amides, or several of them together. In some, these are found only in very small amount, in others, notably in root-crops, beets, turnips, potatoes, etc., and in plants which are harvested while in rapid growth, fodder corn, hay, etc., a large part of the nitrogen, in some cases from a third to a half of it is in other forms than albuminoids, chiefly as amides or amido-acids. At present it is not advisable to change the method of expressing the nitrogen content of feeding stuffs, but it is very desirable that every analysis made should include a determination of non-albuminoid nitrogen, and if this is large, a determination also of the nitrogen present as amides or amido-acids.

The albuminoid nitrogen has been determined in three samples each of bran and middlings whose analyses have just been given. The results are as follows:

ALBUMINOID AND NON-ALBUMINOID NITROGEN OF WHEAT FEED.

No.	Name.	Per cent. of Nitrogen present. Total.	Albuminoid.	Non-Albuminoid.	Albuminoid nitrogen in per cent. of total nitrogen.
CXCIV.	Bran	2.84	2.54–	.30–	89.4
CXCVI.	Bran	2.39	2.00–2.04	.39–.35	84.5
CXCVIII.	Bran	2.64	2.18–2.18	.46–.46	82.6
CXCV.	Middlings	2.82	2.63–2.54	.19–.28	91.8
CXCVII.	Middlings	2.87	2.59–2.50	.28–.37	88.9
CXCIX.	Middlings	2.91	2.59–2.54	.32–.37	88.3

The average is 87.6 per cent. albuminoid nitrogen.

The method here employed is Stutzer's perfected method given in the Journal für Landwirthschaft, 1881, page 476, and is briefly as follows:

Heat 1 gram of the material with 100 c. c. absolute alcohol and 1 c. c. acetic acid to boiling on the water bath. Decant the clear solution through a small filter, using care to avoid bringing any more of the residue than can be helped with it, and wash the filter, to remove fat, with a little warm alcohol. Add to the contents of the beaker 100 c. c. of water and boil,—or if the substance has much starch, heat for 10 minutes on the water bath,—add 0.3–0.4 gram of $Cu(OH)_2$ suspended in water,* after cooling bring on the filter which has been already used, wash with a little water, twice with alcohol, to facilitate drying, dry at 100° C. and determine albuminoid nitrogen by combustion with soda-lime, or (more conveniently in our experience) by Kjeldahl's method.

CORN MEAL.

CCIV. Stock of Ansel Arnold & Co. Cost $23.60 per ton.

CLXXXIX. Cost $23.20 per ton.

CXCIII. High mixed corn, ground by E. A. Buck & Co., Willimantic. Cost $23.20 per ton.

CCIII. Ground at Swanton, Vt., for J. C. Bugby & Co. Cost $23.60 per ton.

The above were sampled from stock of Willimantic dealers and sent by N. P. Perkins. The prices were quoted in June.

ANALYSES OF CORN MEAL.

	Average of 34 Analyses.	CCIV.	CLXXXIX.	CXCIII.	CCIII.
Water	15.03	12.04	13.12	13.29	14.24
Ash	1.45	1.38	1.42	1.43	1.55
Protein	9.09	10.19	10.00	9 81	9.50
Fiber	1.85	1.88	1.75	2.71	1.28
N.-free Extract	68.86	70.14	69.21	68.20	70.80
Fat	3.72	4.37	4.50	4.56	2.63
	100.00	100.00	100.00	100.00	100.00

* Fassbender's preparation, Landw. Versuchs-St. XXVII, 125.

ANALYSES OF CORN MEAL.

	Average of 34 Analyses.	CCIV.	CLXXXIX.	CXCIII.	CCIII.
Ash	1.71	1.57	1.63	1.65	1.80
Protein	10.70	11.58	11.51	11.32	11.06
Fiber	2.18	2.13	2.00	3.12	1.52
N.-free Extract	81.04	79.75	79.68	78.66	82.56
Fat	4.37	4.97	5.18	5.25	3.06
	100.00	100.00	100.00	100.00	100.00
Percentage digestibility of Protein	84.0	82.8	80.6	86.0	85.5
Comparative valuation*	$24.00	$25.46	$25.12	$25.48	$23.84

The comparative feeding values of these samples are calculated in the same way as those of wheat feed described on page 37, the relative digestibility of the protein being determined as before by artificial digestion and the average digestion coefficients of the remaining nutrients of maize being taken from the table, page 26 as follows:

Fat	85 per cent.
Fiber	62 "
N.-free extract	91 "

These calculated values are based on the assumption that all the meals are equally relished by cattle and that they differ in feeding value only because of differences in composition and digestibility.

As regards their chemical composition all the samples are above the average of corn meal excepting CCIII, which has four tenths per cent. more protein but more than a per cent. less fat than average corn meal.

HOMINY MEAL.

CXCII. From Stock of Ansel Arnold & Co., Willimantic. Cost $22.00 per ton in June. Sent by N. P. Perkins, Willimantic.

	Analysis.	Water free.
Water	9.22	
Ash	3.12	3.44
Protein	11.20	12.34
Fiber	4.02	4.43
N.-free Extract	62.88	69.26
Fat	9.56	10.53
	100.00	100.00

This by-product of the hominy manufacture consists largely of the hull and the chit or germ of maize. It has considerably more protein than maize meal and more than two and a half times as much fat. The presence of so much fat makes the material more liable than maize meal to become rancid and unpalatable. Mr. Perkins has used it in past years in place of maize meal for milk cows. The daily ration per cow was 4 quarts of hominy meal, 2 quarts wheat bran and 2 quarts "fine feed," well mixed and fed wet. He states that the cows kept in excellent condition and gave more milk than on yellow corn meal. In Mr. Perkins' experience it cannot be fed to fatting cattle quite so freely as maize meal.

Rye Bran.

CCX. New York State Rye Bran, Stock of D. B. Crittenden & Co., New Haven. Sampled by the seller.

	Analysis.	Water-free.
Water	12.31	
Ash	4.35	4.91
Protein	16.06	18.30
Fiber	4.09	4.66
N.-free Extract	60.15	68.67
Fat	3.04	3.46
	100.00	100.00

New Process Linseed Meal.

CCIX. From lot purchased by T. S. Gold, West Cornwall.

		Water-free.
Water	12.70	
Ash	5.14	5.88
Protein	33.25	38.09
Fiber	8.08	9.36
N.-free Extract	37.19	42.51
Fat	3.64	4.16
	100.00	100.00

Gluten Feed.

CCVIII. Sold by Holmes and Keeler, Norwalk. Cost $25.00 per ton. Sampled and sent by D. H. Van Hoosear, Wilton.

	Analysis.	Water-free.
Water	8.86	
Ash	1.01	1.10
Protein	29.12	31.93
Fiber	.86	.94
N.-free Extract	53.91	59.20
Fat	6.24	6.83
	100.00	100.00

On the Artificial Digestion of Feeding Stuffs.

Stutzer, Journal für Landwirthschaft, 1880, 195, has applied the method of artificial digestion, which had often been used previously in experiments with animal albuminoids to the quantitative examination of the protein of feeding stuffs.

His object was to determine whether by long continued digestion with an acid pepsin solution at the temperature of the body all of the protein of cattle food could be dissolved; and if not, whether by such experiments any valuable conclusions could be drawn in reference to the actual digestibility of such food by cattle. His experiments were confined to a limited number of feeding stuffs but were made under a variety of conditions to determine what was the most efficient pepsin solution, the best proportion of the solution to the material examined, acidity of solution, time of digestion, etc. In following papers (same Journal 1880, 435, and 1881, 478) he also studied the effect of an alkaline pancreatic solution, by itself and also following the pepsin digestion. On the kinds of feed which he examined pancreas solution had no more effect in any case than pepsin solution and all his experiments led him to conclude:

1. That the so-called protein of fodders consists of two parts which are chemically and physiologically distinct, viz: "Albuminoids" which are freely soluble in pepsin or pancreas solution, and a substance insoluble in these reagents which he termed "nuclein."

2. That the digestibility of a fodder is directly conditioned on its chemical composition. Artificial digestion will accurately show the amount of "nuclein" and "albuminoids" present in it. The use of feeding experiments is to discover under what conditions the "albuminoids" can most perfectly be digested by the animal while nuclein (he leaves the reader to infer) is valueless as food.

Pfeiffer (same Journal, 1883, 221) makes an elaborate comparison of the results obtained by Stutzer's methods with the results of digestion experiments on sheep, and an examination of the so-called "nuclein."

His conclusions are, that Stutzer's "nuclein" is digested by sheep to the extent of 20–30 per cent.; that the portion of protein which is insoluble in Stutzer's reagent is not a nuclein and hence the name should be dropped; that Stutzer has given us a valuable means of comparing the digestibility of feeds (as re-

gards their protein), but care is necessary not to make too wide generalizations.

Pfeiffer gives results of 17 comparisons of the digestibility of protein by artificial digestion with the digestibility of protein in the same fodders determined by experiments on sheep.

They are as follows :—

Feed.	No. of Experiments.	Per cent. of the total protein which was digested :— By sheep.	By pepsin solution.
Meadow hay	1	60.4	68.4
Lucerne hay	2	73.8	76.0
Hay and barley	4	55.9	63.9
Hay, barley and conglutin	6	78.3	82.4
Hay, barley and fleshmeal	4	75.6	78.3

Stutzer in a subsequent paper (Zeitschrift für Physiolog. Chem. 1885, 211) drops the name "nuclein."

After learning of Pfeiffer's results he reviews his own, enlarges the number of materials experimented on and finds that in many of them a portion of the protein insoluble by pepsin is soluble by a pancreas solution to the extent of some 20 to 30 per cent. of this portion—the same extent in fact to which Pfeiffer had found it digestible by sheep. He therefore advises a digestion with pancreas solution following one with pepsin solution in all cases.

It is seen from the results given that the digestibility of protein by Stutzer's method is considerably higher than by direct experiments with animals. The experiments of Kellner (Centralblatt Ag. Chem. ix, 1880, 763, Landw. Versuchs-St., 1879, 434) and others make it evident that the results of feeding experiments involve an error which tends to make the results as to protein in some cases, at least, too low. The extent of this error is not yet fully determined and hence it is not possible yet to decide how closely the perfected methods will agree. The most important use of the method of artificial digestion at present is in the comparison of different samples of the same kind of feed, like the wheat bran and middlings already discussed. Here follows a description of Stutzer's mode of preparing and using the digestive solutions.

Pepsin Solution.

The inner membrane of a hog's stomach is cut into small pieces with shears and put in a flask with 5 liters of water 25 grams of salicylic acid and 75 c. c. of a ten per cent. hydrochloric acid.

Let the mixture stand 2–3 days with frequent shaking; strain, without pressure, through flannel and filter through paper. This solution will keep for months.

Pancreas Solution.

Free the sweet breads of neat cattle as much as possible from fat, let them lie 24 hours in the air, pulverize finely with sand, and to 400 grams fresh pancreas add 1 liter of glycerin and 1 liter of water. Shake frequently and after 4–6 days strain and filter.

The Digestion.

To 2 grams of the material, ground to pass a 1m.m. sieve, are added 250 c. c. of the pepsin solution in a beaker which is covered with a watch glass and placed in a water bath kept at 40° C. After 1 to 2 hours, 0.1 per cent. of hydrochloric acid is added and at regular intervals the same quantity is again added till at the end of 12 hours the solution contains in all 0.5 per cent. of hydrochloric acid. The lamp is removed and the beaker cooled gradually. The next day the digestion is continued as before for 12 hours and the amount of acid present is gradually brought to 1 per cent. The solution is then filtered and washed. To the residue are added 250 c. c. pancreas solution and one-half per cent. of sodium carbonate and the digestion at 40° C. is continued for 24 hours, when the residue is filtered, washed and dried and its nitrogen is determined in the usual way.

In the work done at this Station we have made certain modifications in the preparation of the solutions, suggested by Dr. R. H. Chittenden of the Sheffield Scientific School.

The pepsin solution is prepared by dissolving 5 grams of scale pepsin in 1 liter of 0.2 per cent. hydrochloric acid and filtering the solution.

The sweet breads from cows or steers are passed through a sausage cutter and put into a large quantity of alcohol where they remain for a week or more. The alcohol is strained off and the residue extracted with ether, thoroughly dried, ground and bottled. In this shape it will keep indefinitely. To prepare the solution, 20 grams of the dry pancreas, together with 2.5 grams of salicylic acid and 250 c. c. of water are heated at 40° C. for 12 hours. The solution is then filtered and the residue washed till filtrate and washings amount to 1 liter.

Of this solution 200 c. c. are used in each experiment, with 0.6 gram sodium carbonate and a few drops of a solution of 20 grams thymol in 100 c. c. of alcohol.

THE CONNECTICUT FERTILIZER LAW

The General Assembly at its session in 1882 passed a new Fertilizer Law, which went into effect September 1, 1882, and which repeals and takes the place of all previous legislation on this subject in this State.

Since a full understanding of the provisions and penalties of this law is important to all parties who buy or sell commercial fertilizers, attention is specially directed to the following points:

1. In case of fertilizers that retail at ten dollars or more per ton, the law holds the SELLER responsible for *affixing a correct label or statement* to every package or lot sold or offered, as well as for the *payment of an analysis fee* of ten dollars for each fertilizing ingredient which the fertilizer contains or is claimed to contain, *unless* the MANUFACTURER OR IMPORTER shall have provided labels or statements and shall have paid the fee. Sections 1 and 3.

2. The law also requires, in case of any fertilizer selling at ten dollars or more per ton, that a *certified statement* of composition. net weight in package, etc., shall be filed with the Director of the Experiment Station, and that a *sealed sample* shall be deposited with him by the MANUFACTURER OR IMPORTER. Section 2.

3. It is also provided that EVERY PERSON in the State, who sells *any commercial fertilizer of whatever kind or price* shall annually report certain facts to the Director of the Experiment Station, and on demand of the latter shall deliver a sample for analysis. Section 4.

4. All "CHEMICALS" that are applied to land, such as : Muriate of Potash, Kainite, Sulphate of Potash and Magnesia, Sulphate of Lime (Gypsum or Land Plaster), Sulphate of Ammonia, Nitrate of Potash, Nitrate of Soda, etc.—are considered to come under the law as "Commercial Fertilizers." Dealers in these chemicals must see that packages are suitably labeled. They must also report them to the Station, and see that the analysis fees are duly paid, in order that the Director may be able to discharge his duty as prescribed in Section 9 of the Act.

Here follows the full text of the law, with explanatory footnotes.

AN ACT CONCERNING COMMERCIAL FERTILIZERS.

GENERAL ASSEMBLY,
January Session, A. D. 1882.

Be it enacted by the Senate and House of Representatives in General Assembly convened:

SECTION 1. Every person or company who shall sell, offer, or expose for sale, in this State, any commercial fertilizer or manure, the retail price of which is ten dollars, or more than ten dollars per ton, shall affix conspicuously to every package thereof 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, the place of manufacture and the chemical composition of the fertilizer, expressed in the terms and manner approved and currently employed by the Connecticut Agricultural Experiment Station.*

Printed statement to be affixed to all packages and to go with all lots.

If any such fertilizer be sold in bulk, such printed statement shall accompany and go with every lot and parcel sold, offered, or exposed for sale.

SEC. 2. Before any commercial fertilizer, the retail price of which is ten dollars, or more than ten dollars per ton, is sold, offered, or exposed for sale, the manufacturer, importer, or party who causes it to be sold, or offered for sale, within the State of Connecticut, shall file with the Director of the Connecticut Agricultural Experiment Station two certified copies of the statement named in section one of this act, and shall deposit with said

Before sale *certified copies* of statement, and *Sealed Sample* to be deposited with Director.

* A statement of the per cents. of Nitrogen, Phosphoric Acid (P_2O_5) and Potash (K_2O), and of their several states or forms, will suffice in most cases. Other ingredients may be named if desired.

In all cases the per cent. of *nitrogen* must be stated. Ammonia may also be given when actually present in ammonia salts, and "ammonia equivalent to nitrogen" may likewise be stated.

The per cent. of soluble and reverted phosphoric acid may be given separately or together, and the term "available" may be used in addition to, but not instead of soluble and reverted.

Insoluble phosphoric acid may be stated or omitted.

In case of Bone, Fish, Tankage, Dried Meat, Dried Blood, etc., the chemical composition may take account of the two ingredients: Nitrogen, Phosphoric Acid.

For Potash Salts give always the per cent. of Potash (potassium oxide); that of Sulphate of Potash or Muriate of Potash may also be stated.

The chemical composition of other fertilizers may be given as found in the Station Reports.

director 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.*

SEC. 3. The manufacturer, importer, agent, or seller of any commercial fertilizer, the retail price of which is ten dollars or more than ten dollars per ton, shall pay on or before the first of May, annually, to the Director of the Connecticut Agricultural Experiment Station, an analysis fee of ten dollars for each of the fertilizing ingredients† contained or claimed to exist in said fertilizer: *provided*, that whenever the manufacturer or importer shall have paid the fee herein required for any persons acting as agents or sellers for such manufacturer or importer, such agents or sellers shall not be required to pay the fee named in this section.

Analysis Fee to be paid annually on or before May 1st.

SEC. 4. Every person in this State who sells, or acts as local agent for the sale of any commercial fertilizer of whatever kind or price, shall annually, or at the time of becoming such seller or agent, report to the Director of the Connecticut Agricultural Experiment Station his name, residence, and post-office address, and the name and brand of said fertilizer, with the name and address of the manufacturer, importer, or party from whom such fertilizer was obtained, and shall, on demand of the Director of the Connecticut Agricultural Experiment Station, deliver to said director a sample suitable for analysis of any such fertilizer or manure then and there sold or offered for sale by said seller or agent.‡

Yearly Report to Station of Dealers or Agents.

SEC. 5. No person or party shall sell, offer, or expose for sale, in the State of Connecticut, any pulverized leather, raw, steamed, roasted, or in any form, as a fertilizer or as an ingredient of any fertilizer or manure, without explicit printed certificate of the fact, such certificate to be conspicuously affixed to every package of such fertilizer or manure, and to accompany and go with every parcel or lot of the same.

Leather.

* The analysis of samples sent in accordance with section two is discretionary with the Station. Such samples are intended for preservation as manufacturers' standards.

† The Station understands "the fertilizing ingredients" to be those whose determination in an analysis is necessary for a valuation, viz: Nitrogen, Phosphoric acid and Potash. The analysis-fees in case of any fertilizer will therefore be ten, twenty or thirty dollars, according as one, two or three of these ingredients are contained or claimed to exist in the fertilizer.

On receipt of statements, samples and analysis-fees, the Station will issue Certificates of Compliance with the law.

‡ Blanks for Dealers' Reports will be mailed to applicants.

SEC. 6. Every manufacturer of fish guano, or fertilizers of which the principal ingredient is fish or fish-mass from which the oil has been extracted, shall, before manufacturing or heating the same, and within thirty-six hours from the time such fish or mass has been delivered to him, treat the same with sulphuric acid or other chemical, approved by the director of said experiment station, in such quantity as to arrest decomposition: *provided, however*, that in lieu of such treatment such manufacturers may provide a means for consuming all smoke and vapors arising from such fertilizers during the process of manufacture.

Fish-guano, &c.

SEC. 7. Any person violating any provision of the foregoing sections of this act shall be fined one hundred dollars for the first offense, and two hundred dollars for each subsequent violation.

Fines.

SEC. 8. This act shall not affect parties manufacturing, importing, or purchasing fertilizers for their own private use, and not to sell in this State.

Fertilizers for private use.

SEC. 9. The director of the Connecticut Agricultural Experiment Station shall pay the analysis-fees received by him into the treasury of the station, and shall cause one or more analysis of each fertilizer to be made and published annually. Said director is hereby authorized, in person or by deputy, to take samples for analysis from any lot or package of manure or fertilizer which may be in the possession of any dealer.

Director's duties and authority.

SEC. 10. The director of the Connecticut Agricultural Station shall, from time to time, as bulletins of said station may be issued, mail or cause to be mailed two copies, at least, of such bulletins to each post-office in the State.

Bulletins.

SEC. 11. Title sixteen, chapter fifteen, sections fifteen and sixteen, and title twenty, chapter twelve, section five of the general statutes, and chapter one hundred and twenty of the public acts of 1881, being an act concerning commercial fertilizers, are hereby repealed.

Repeal of former acts.

SEC. 12. This act shall take effect on the first day of September, 1882.

It will be noticed that the State exacts no license tax either for making or dealing in fertilizers. For the safety of consumers and the benefit of honest manufacturers and dealers, the State requires that it be known what is offered for sale, and whether fertilizers are what they purport to be. With this object in view the law provides, in section 9, that all fertilizers be analyzed and it requires the parties making or selling them to pay for these analyses in part; the State itself paying in part by maintaining the Experiment Station.

OBSERVANCE OF THE FERTILIZER LAW.

Manufacturers who have paid Analysis Fees as required by the Fertilizer Law, and Fertilizers for which the Fees have been thus paid for the year ending May, 1886.

Firm.	*Brand of Fertilizer.*
Adams & Thomas, Springfield, Mass.	Adams Market Bone Fertilizer.
	" Fine Ground Bone.
Anderson, W. H., Putnam, Ct.	Ground Bone.
Baker, H. J. & Bro., 215 Pearl St., New York.	A.A. Ammoniated Superphosphate.
	Pelican Bone Fertilizer.
	Potato Fertilizer.
	Corn "
	Tobacco "
	Castor Pomace.
	Kainit.
	Muriate of Potash.
Bennett, P. W., Rock Fall, Conn.	Ground Bone.
Bosworth Bros., Putnam, Conn.	Superphosphate of Lime.
	Ground Bone.
Bowker Fertilizer Co., 43 Chatham St., Boston, Mass.	Stockbridge Grain Manure.
	" Forage Crop Manure.
	" Vegetable "
	Bowker's Hill and Drill Phosphate.
	" Dissolved Bone.
	" Fish and Potash.
	" Dry Fish.
	" Kainit.
Bradley Fertilizer Co., 27 Kilby St., Boston, Mass.	Bradley's Superphosphate.
	B. D. Sea Fowl Guano.
	Original Coe's Superphosphate.
	Complete Manure for Corn and Grain.
	" " Potatoes and Root Crops.
	Circle Brand Bone and Potash.
Buffalo Fertilizer & Chemical Works, Buffalo, New York.	Buffalo Ammoniated Bone Superphosphate.
	Buffalo Potato, Hop and Tobacco Phosphate.
	Buffalo Superphosphate [2].
	Queen City Phosphate.
	Pure Ground Bone.
Chemical Ammoniate & Oil Co., N. Y., per Geo. A. Niles, Danielsonville, Ct.	Niles' Special Fertilizer.
Clark's Cove Guano Co., New Bedford, Mass.	Great Planet "A" Brand.
	Bay State Fertilizer.
	Unicorn Ammoniated Superphosphate.
Coe, E. Frank, 16 Burling Slip, New York.	Ammoniated Bone Superphosphate.
	Alkaline Bone.
	Excelsior Guano.
	Ground Bone.
	Ralston's Potato Phosphate.
Collier White Lead & Oil Co., St. Louis, Mo., by F. Ellsworth, Hartford, Ct.	Castor Pomace.
Common Sense Fertilizer Co., Boston, Mass.	Common Sense Fertilizer, No. 2.
	" " " [D].
Peter Cooper's Glue Factory, New York.	Bone Dust.

Firm.	*Brand of Fertilizer.*
Darling, L. B., Fertilizer Co., Pawtucket, R. I.	Darling's Ground Bone.
	" Animal Fertilizer.
Dickinson, D. B., Middle Haddam, Ct.	Ammoniated Bone Superphosphate.
Glidden & Curtis, Boston, Mass.	Soluble Pacific Guano.
Hall, W. Burr, Wallingford, Ct.	Ground Bone.
Harris, G. H. & Son, Eagleville, Ct.	Pure Ground Bone.
	Pure Bone Phosphate.
Hurtado & Co., 16 and 18 Exchange Place, New York City.	Peruvian Guano Standard.
Judson & Sparrow, 38 South Market St., Boston, Mass.	Sparrow's Bone and Potash Phosphate.
	" B. B. Phosphate.
Lister Bros., Newark, N. J.	Ground Bone.
	Crescent Bone.
	Standard Superphosphate.
	Ammoniated Dissolved Bone.
	Potato Fertilizer.
	U. S. Phosphate.
Lombard & Matthewson, Warrenville, Ct.	Ground Bone.
	Superphosphate.
Mapes' Formula and Peruvian Guano Co., 158 Front St., New York.	Mapes' Potato Manure.
	" Corn "
	" Complete Manure (Light Soil).
	" " " (General use).
	" Tobacco " (Conn. Brand).
	" " "(for use with stems)
	" Complete " (A Brand).
	" Nitrogenized Superphosphate.
	" High Grade Superphosphate.
	" Fine Dissolved Bone.
	" Muriate of Potash.
	" Nitrate of Soda.
	" Sulphate of Ammonia.
Meyer, C., Jr., Maspeth, L. I.	Acme Fertilizer, No. 1.
	" " No. 2.
Miles, George W., Milford, Ct.	I. X. L. Ammoniated Superphosphate Fish and Potash.
Miller, G. W., Middlefield, Ct.	Raw Bone Phosphate.
	Pure Ground Bone.
Mitchell, A., Linden, N. J.	Standard Phosphate.
National Fertilizer Co., Bridgeport, Ct.	Chittenden's Fish and Potash.
	" Ammoniated Bone Superphosphate.
	Chittenden's Complete Fertilizer.
	Cooke's Blood Guano.
New Haven Fertilizer Co.	Standard Superphosphate.
Niles, G. A. (See Chemical Ammoniate & Oil Co.)	
Peck Brothers, Northfield, Ct.	Peck Brothers' Pure Ground Bone.
Pinney, R. E., Suffield, Ct.	"Potash and Phosphoric Acid."
Plumb & Winton, Bridgeport, Ct.	Bone Fertilizer.
	Ground Bone.
Preston Fertilizer Co., Greenpoint, L. I.	Preston's Ammoniated Superphosphate
	" Ground Bone.
	" Fish Guano.
Quinnipiac Fertilizer Co., New London, Ct.	Nitrate of Soda.
	Fish and Potash, Plain Brand.
	" " Crossed Brand.
	Phosphate.
	Extra Phosphate.
	Dry Ground Fish.
Ralston, J. (See E. Frank Coe).	

Firm.	*Brand of Fertilizer.*
Read & Co., 88 Wall St., New York.	Farmers' Friend Fertilizer.
Rogers & Hubbard Co., Middletown, Ct.	Pure Raw Knuckle Bone A.
	Pure Raw Knuckle Bone Meal.
	Ground Bone AX.
	Bone Sawdust.
Russell Coe Fertilizer Co., 88 Wall St., New York.	Davidge's A.A. Ammoniated Bone Superphosphate.
	Davidge's Potato Manure.
	" Soluble Bone Phosphate.
Sanford, Chas., Redding Ridge, Ct.	Ammoniated Superphosphate.
Shoemaker, M. L. & Co., Philadelphia, by F. Ellsworth, Hartford, Ct.	Good-enough Phosphate.
	Echo Phosphate.
	Swift Sure Superphosphate.
	" " Bone Meal.
	Kainit.
Slade, F. C., Oakville, Ct.	Ground Bone.
Sisson & Strong, North Lyme, Ct.	Elizabethport Glue Works Ammoniated Superphosphate.
Smith, Edmund, South Canterbury, Ct.	Ground Bone.
St. Louis Lead & Oil Co., St. Louis, Mo.	Castor Pomace.
Stearns & Co., 149 Front St., New York.	Stearns' Ammoniated Bone Superphosphate.
	Eagle Brand Fish and Potash.
	Ground Fish Guano.
Thomson, Paul, 232 State St., Hartford.	Charter Oak Fertilizer.
Tropic Guano Co., Elizabethport, N. J.	XXX Guano.
Wilcox, L. & Co., Mystic Bridge, Ct.	Wilcox's Prepared Fertilizer.
	" Acidulated Fish Guano.
	" Dry Ground Fish.
Wilkinson & Co., 239 Center St., New York.	Wilkinson's Ammoniated Superphosphate.
Williams, Clark & Co., 101 Pearl St., New York.	Americus Ammoniated Superphosphate.
	" Potato Fertilizer.
	" Bone Meal.
	Royal Bone.
	Acorn Brand Muriate of Potash.
	" " German Potash Salts.
	Fish and Potash.
	Dry Ground Fish.
	Bone and Potash.
	Dried Blood.
	Americus Tobacco Fertilizer.

Analyses of Fertilizers.*

In respect to its terms, the Station makes *two classes* of analyses of fertilizers and fertilizing materials: the first for the benefit of farmers, gardeners, and the public generally; the second for the private use of manufacturers and dealers. Analyses of the *first class* are made gratuitously, and the results are published as

* The matter of this and several subsequent pages, explanatory of the sampling and valuation of fertilizers, is copied, with a few appropriate alterations, from the Report for 1885. This repetition appears to be necessary for the use of readers who have not seen former Reports.

speedily and widely as possible for the guidance of purchasers and consumers. Those of the *second class* are charged for at moderate rates, and their results are not published in a way to interfere with their legitimate private use. The Station, however, distinctly reserves the liberty to use at discretion, for the public benefit, all results obtained in its laboratory, and in no case will enter into any privacy that will work against the public good.

During 1885, two hundred and fifty-six (256) samples of fertilizers have been analyzed. Of these, 23 were examined for private parties, and the remainder for the general use of the citizens of the State.

Seventy-three samples analyzed for the public benefit have been sent in by purchasers and consumers. The rest have been supplied by agents of the Station who during the spring and early summer endeavored to visit all sections of the State, to take one or more samples from every brand of fertilizer offered for sale in the State, and to take them from the stock of dealers in remote places as well as from centers of trade.

The Station agents are instructed when drawing samples to open at least three packages of each brand of goods in every case, and if the number of packages is large, to take a portion from every tenth one, by means of a sampling tube, which withdraws a section or core through the entire length of the package.

The greatest care is necessary in sampling fertilizers that the small sample taken shall accurately represent the whole stock from which it is drawn. Otherwise serious injustice may be done.

During the year the Station has had to reject a number of samples sent in for analysis by purchasers on account of evident carelessness in drawing them.

The Station none the less desires the coöperation of farmers and Farmers' clubs in calling attention to new brands of fertilizers and in securing samples of all goods offered for sale. All such samples are understood to be taken in accordance with the printed instructions which the Station supplies to all applicants. Here follows a copy of these instructions.

THE CONNECTICUT

AGRICULTURAL EXPERIMENT STATION.

Instructions for Sampling Commercial Fertilizers.

The *valuation* of a high-priced Fertilizer requires the amounts *per cent.* of its principal fertilizing elements to be known. Chemical analysis of a small sample, so taken as to fairly represent a large lot, will show the composition of the lot. The subjoined instructions, if faithfully followed, will insure a fair sample. Especial care should be observed that the sample neither gains nor loses *moisture* during the sampling or sending, as may easily happen in extremes of weather, or from even a short exposure to sun and wind, or from keeping in a poorly closed vessel.

1. Provide a tea cup, some large papers, and for each sample a glass fruit-can or tin box, holding about *one quart*, that can be tightly closed—all to be clean and dry.

2. Weigh separately at least three (3) average packages (barrels or bags) of the fertilizer, and enter these *actual weights* in the "Form for description of Sample."

3. Open the packages that have been weighed, and mix well together the contents of each, down to one-half its depth, emptying out upon a clean floor if needful, and crushing any soft, moist lumps in order to facilitate mixture, but leaving hard, dry lumps unbroken, so that the sample shall exhibit the texture and mechanical condition of the fertilizer.

4. Take out five (5) equal cupfulls from different parts of the mixed portions of each package. Pour them (15 in all) one over another upon a paper, intermix again thoroughly but quickly to avoid loss or gain of moisture, fill a can or box from this mixture, close tightly, *label plainly*, and send, charges prepaid, to

The Conn. Agricultural Experiment Station,
New Haven, Conn.

The foregoing instructions may be over-nice in some cases, but they are not intended to take the place of good sense on the part of those who are interested in learning the true composition of a fertilizer. Any method of operating that will yield a *fair sample* is good enough.

In case of a fine, uniform and moist or coherent article, a butter-tryer or a tin-tube, like a dipper handle, put well down into the packages, in a good number of places, will give a fair sample with great ease. With dry, coarse articles, such as ground bone, there is liable to be a separation of coarse and fine parts on handling. Moist articles put up in bags or common barrels may become dry on the outside. It is in these cases absolutely necessary to mix thoroughly the coarse and fine, the dry and the moist portions before sampling. Otherwise the analysis will certainly misrepresent the article whose value it is intended to fix.

The quantity sent should not be too small. When the material is fine and uniform, and has been carefully sampled, a pint may be enough, but otherwise and especially in the case of ground bone, which must be mechanically analyzed, the sample should not be *less than one quart.*

It is also important that samples for analysis should be taken at the time when the fertilizer is purchased, and immediately dispatched to the Station. Moist fish, blood or cotton seed meal will soon decompose and lose ammonia, if bottled and kept in a warm place. Superphosphates containing much nitrogen will suffer reversion of their soluble phosphoric acid under similar circumstances. Most of the moist fertilizers will lose water unless tightly bottled, but some of the grades of potash salts will gather moisture from the air and become a slumpy mass if not thoroughly protected.

These changes in the composition of a sample not suitably preserved must invalidate any conclusions from its analysis, and work serious injustice either to the manufacturer or to the consumer.

It doubtless often happens that a purchaser on laying in a stock of fertilizers decides that he will not then trouble the Station to analyze the goods he has obtained, but will set aside samples which he can send for examination in case the crops report adversely as to their quality. It is always better to send all samples at once to the Station, where they can be directly analyzed or so prepared that they will keep without chemical change.

With the Instructions for Sampling, the Station furnishes a blank form for Description of Sample, a copy of which is here given.

THE CONNECTICUT

AGRICULTURAL EXPERIMENT STATION,

NEW HAVEN, CONN.

FORM FOR DESCRIPTION OF SAMPLE.

Station No.----------Rec'd at Station,----------18

Each sample of Fertilizer sent for gratuitous analysis must be accompanied by one of these Forms, with the blanks *below* filled out fully and legibly.

The filled out Form, if wrapped up with the sample, will serve as a label.

Send with each sample a specimen of any printed circular, pamphlet, analysis or statement that accompanies the fertilizer or is used in its sale.

Brand of Fertilizer,----------

Name and address of Manufacturer,----------

Name and address of Dealer from whose stock this sample is taken, ----------

Date of taking this sample,----------

Selling price per ton or hundred, bag or barrel,----------

Selling weight claimed for each package weighed,----------

Actual weight of packages opened,----------

Here write a copy of any analysis or guaranteed composition that is fixed to the packages.

Signature and P. O. address of person taking and sending the sample.

On receipt of any sample of fertilizer from the open market, the filled out "Form for Description" which accompanies it is filed in the Station's Record of Analyses, and remains there as a voucher for the authenticity of the sample and for the fact that it has been taken fairly, or, at least, under suitable instructions. It is thus sought to insure that manufacturers and dealers shall not suffer from the publication of analyses made on material that does not correctly represent what they have put upon the market.

The "Form for Description," when properly filled out, also, contains all the data of cost, weight, etc., of a fertilizer which are necessary for making, with help of the analysis, a valuation of its fertilizing elements, and estimating the fairness of its selling price. Neglect to give full particulars occasions the Station much trouble, and it is evident that want of accuracy in writing up the description may work injustice to the manufacturers or dealers, as well as mislead consumers. It is especially important that the *brand* of a fertilizer and its *selling price* shall be correctly given. The price should be that actually charged by the dealer of whom it is bought, and if the article be purchased in New York or other distant market, that fact should be stated, and the cost at the nearest point to the consumer, on rail or boat, should be reported also.

In all cases, when possible, *ton prices* should be given, and if the sale of an article is only by smaller quantities, that fact should be distinctly mentioned.

Samples are analyzed as promptly as possible in the order in which they are received. As soon as an analysis is completed a copy of it is sent to the party who furnished the sample and also to the manufacturer, in order that there may be opportunity for explanation or protest, if desirable, before the results are published in the Bulletin.

With the analysis there is sent to the party furnishing the sample a printed page of "Explanations," intended to embody the principles and data upon which the valuation of fertilizers is based.

These Explanations are essential to a correct understanding of the analyses that are given on subsequent pages, and are, therefore, reproduced here, as follows:

Explanations Concerning the Analysis of Fertilizers and the Valuation of their Active Ingredients.

Revised.

Nitrogen is commercially the most valuable fertilizing element. *Organic nitrogen* is the nitrogen of animal and vegetable matters. Some forms of organic nitrogen, as those of blood and meat, are highly active as fertilizers; others, as found in leather and peat, are comparatively slow in their effect on vegetation, unless these matters are chemically disintegrated. *Ammonia* and *nitric acid* are results of the decay of *organic nitrogen* in the soil and manure heap, and are the most active forms of Nitrogen. They occur in commerce—the former in sulphate of ammonia, the latter in nitrate of soda. 17 parts of ammonia or 66 parts of pure sulphate of ammonia contain 14 parts of nitrogen. 85 parts of pure nitrate of soda also contain 14 parts of nitrogen.

Soluble Phosphoric acid implies phosphoric acid or phosphates that are freely soluble in water. It is the characteristic ingredient of Superphosphates, in which it is produced, by acting on "insoluble" or "reverted" phosphates, with oil of vitriol. Once well incorporated with the soil it gradually becomes reverted phosphoric acid.

Reverted (reduced or precipitated) Phosphoric acid means strictly, phosphoric acid that was once easily soluble in water, but from chemical change has become insoluble in that liquid. In present usage the term signifies the phosphoric acid (of various phosphates) that is freely taken up by strong solution of ammonium citrate, which is therefore used in analysis to determine its quantity. "Reverted phosphoric acid" implies phosphates that are readily assimilated by crops.

Recent investigation tends to show that soluble and reverted phosphoric acid are on the whole about equally valuable as plant-food and of nearly equal commercial value. In some cases, indeed, the soluble gives better results on crops, in others the reverted is superior. In most instances there is probably little to choose between them.

Insoluble Phosphoric acid implies various phosphates not soluble in water or ammonium citrate. In some cases the phosphoric acid is too insoluble to be readily available as plant food. This is especially true of Canada Apatite. Bone black, bone-ash, South Carolina Rock and Navassa Phosphate when in coarse powder are commonly of little repute as fertilizers though good results are occasionally reported from their use. When *very finely pulverized* ("floats") they more often act well, especially in connection with abundance of decaying vegetable matters. The phosphate of raw bones is nearly insoluble, because of the animal matter of the bones, which envelopes it; but when the latter decays in the soil, the phosphate remains in essentially the "reverted" form.

Potash signifies the substance known in chemistry as potassium oxide, which is the valuable fertilizing ingredient of "potashes" and "potash salts." It should be soluble in water and is most costly in the form of sulphate, and cheapest in the shape of muriate (potassium chloride).

The Valuation of a Fertilizer, as practised at this Station, signifies finding *the worth in money or trade-value, of its fertilizing ingredients.* This value, it should be remembered, is *not necessarily proportional to its fertilizing effects* in any special case.

Plaster, lime, stable manure and nearly all of the less expensive fertilizers have variable prices, which bear no close relation to their chemical composition, but guanos, superphosphates and similar articles, for which $30 to $60 per ton are paid, depend chiefly for their trade-value on the three substances, *nitrogen*, *phosphoric acid* and *potash*, which are comparatively costly and steady in price. The money-value per pound of these ingredients is reckoned from the current market prices of the standard articles which furnish them to commerce.

The consumer, in estimating the reasonable price to pay for high-grade fertilizers, should add to the *Trade Value of the above-named Ingredients*, a suitable margin for the expenses of manufacture, etc., and for the convenience or other advantage incidental to their use.

The average Trade-values or retail cost in market, per pound, of the ordinarily occurring forms of nitrogen, phosphoric acid and potash, as found in the New England, New York and New Jersey markets, are as follows :—

These Trade-values were agreed upon by the Experiment Stations of Connecticut, New Jersey and Massachusetts for use in their several States during 1885.

Trade Values of Fertilizing Ingredients in Raw Materials and Chemicals for 1885.

	Cents per lb.
Nitrogen in ammonia salts	18
" in nitrates	18
Organic nitrogen in dried and fine ground fish	18
" " in guanos, dried and fine ground blood and meat	18
" " in cotton seed, linseed meal and in castor pomace	18
" " in fine ground bone	18
" " in fine medium bone	16
" " in medium bone	14
" " in coarse medium bone	12
" " in coarse bone, horn shavings, hair and fish scrap	10
Phosphoric acid, soluble in water	9
" " soluble in ammonium citrate*	8
" " insoluble, in dry fine ground fish and in fine bone,	6
" " " in fine medium bone	5½
" " " in medium bone	5
" " " in coarse medium bone	4½
" " in coarse bone	4
" " " in fine ground rock phosphate	2
Potash as high grade sulphate	7¼
" kainit	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, 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 valuations obtained by use of the above figures will be found to

* Dissolved from 2 grams of the unground phosphate previously extracted with pure water, 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.

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 Superphosphate.	Ground So. Car. Rock.

Trade Values in Superphosphates, Special Manures and Mixed Fertilizers of High Grades.

The Organic Nitrogen in these classes of goods is reckoned at the highest figure laid down in the Trade-Values of Fertilizing Ingredients in Raw Materials, namely 18 cents per pound, it being assumed that the organic nitrogen is derived from the best sources, viz: bone, blood, animal matter, Peruvian guano or other equally good forms and not from leather, shoddy, hair or any low-priced inferior forms of vegetable matter, unless the contrary is ascertained.

Insoluble Phosphoric acid is reckoned at 4 cents, it being assumed that it is from bone or similar source and not from rock phosphate, unless found otherwise. In this latter form the insoluble phosphoric acid is worth commercially only 2 cents per pound or but one-half as much as if from fine bone. Potash is rated at 4¼ 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 is reckoned as sulphate.

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.

In 1885 the average selling price of Ammoniated Superphosphates and Guanos was $37.60, the average valuation was $30.47, and the difference $7.13—an advance of 23.4 per cent. on the

valuation and on the wholesale cost of the fertilizing elements in the raw materials.

In case of Specials the average cost was $44.80, the average valuation $38.70, and the difference $6.10 or less than 16.0 per cent. advance on the valuation.

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 *Ground Bone*, the fineness of the sample is graded by sifting, and we separately compute the nitrogen-value of each grade of bone which the sample contains, by multiplying the pounds of nitrogen per ton in the sample, by the per cent. of each grade, taking $\frac{1}{100}$th of that product, multiplying it by the trade-value per pound of nitrogen in that grade, and taking this final product as the result in cents. Summing up the separate values of each grade, thus obtained, together with the values of each grade for phosphoric acid, similarly computed, the total is the Valuation of the sample of bone.

The uses of the "Valuation" are twofold:

1, To show whether a given lot or brand of fertilizer is worth, as a commodity of trade, what it costs. If the selling price is not higher than the valuation, the purchaser may be quite sure that the price is reasonable. If the selling price is several dollars per ton more than the valuation, it may still be a fair price; but in proportion as the cost per ton exceeds the valuation there is reason to doubt the economy of its purchase.

2, Comparisons of the valuations and selling prices of a number of similar fertilizers will generally indicate fairly which is the best for the money.

But the valuation is not to be too literally construed, for analysis cannot always decide accurately what is the *form* of nitrogen, etc., while the mechanical condition of a fertilizer is an item whose influence cannot always be rightly expressed or appreciated.

For the above first-named purpose of valuation, the trade-values of the fertilizing elements which are employed in the computations should be as exact as possible, and should be frequently corrected to follow the changes of the market.

For the second-named use of valuation, frequent changes of the trade-values are disadvantageous, because two fertilizers cannot be compared as to their relative money-worth, when their valuations are deduced from different data.

Experience leads to the conclusion that the trade-values adopted at the beginning of a year should be adhered to as nearly as possible throughout the year, notice being taken of considerable changes in the market, in order that due allowance may be made therefor.

The Agricultural value of a fertilizer is measured by the benefit received from its use, and depends upon its fertilizing effect, or crop-producing power. As a broad, general rule, it is true that Peruvian guano, superphosphates, fish-scraps, dried blood, potash salts, plaster, etc., have a high agricultural value which is related to their trade-value, and to a degree determines the latter value. But the rule has many exceptions, and in particular instances the trade-value cannot always be expected to fix or even to indicate the agricultural value. Fertilizing effect depends largely upon soil, crop and weather, and as these vary from place to place, and from year to year, it cannot be foretold or estimated except by the results of past experience, and then only in a general and probable manner.

Classification of the Fertilizers Analyzed.

The fertilizers and manurial waste products analyzed at the Station laboratory from November 1st, 1884, to November 1st, 1885, were as follows:

Phosphate Rock,	1
Phosphatic Guano,	1
Precipitated Phosphate of Lime,	1
Superphosphates (plain),	16
Superphosphates [ammoniated] and Guanos,	100
Superphosphates and other fertilizers, home-made,	13
Special Manures,	27
Bone Manures,	34
Ammonite,	3
Dry Ground Fish,	10
Dried Blood,	2
Blood and Tankage,	1

Peat and Offal,	3
Buffalo Horn Dust,	1
Nitrates,	2
Sulphate of Ammonia,	4
Cotton Seed,	1
Potash Salts,	11
Cotton Hull Ashes,	9
Tobacco Stems,	1
Tobacco Stems and Bone,	1
Tobacco Dust,	1
Wool Waste,	1
Gas House Refuse,	1
Chloride of Lime,	1
Shell Lime,	1
Marine Mud,	2
Decomposed Rock Weed,	1
"Sea Lettuce,"	1
Swamp muck or Peat,	2
Cave Guano,	1
Ground Horn and Hoof,	1
Leather Extracted by Benzine,	1
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Of these 23 were samples analyzed for private parties and are not further noticed in these pages.

The remaining analyses are given in detail so far as they have any general interest, with such discussion as may make them more serviceable:

Phosphatic Guano.

1578. Bolivian Guano. Imported by the Quinnipiac Fertilizer Co., New London. Sampled by J. P. Little, Columbia, from his own stock. Guaranteed 16 per cent. Phosphoric acid. Cost $30.00 per ton.

Analysis.

Phosphoric Acid, soluble in ammonium citrate*	5.37
Phosphoric Acid, insoluble " "	11.87

The material contains only traces of nitrogen.

* See foot note, page 60.

Precipitated Phosphate of Lime.

1488. Precipitated Phosphate of Lime. Made by the Carteret Chemical Co. of New York.

Analysis.

Moisture at 100°	36.30
Loss on ignition (combined water)	8.14
Phosphoric Acid soluble in water	1.53
Phosphoric Acid, soluble in ammonium citrate	25.22
Phosphoric Acid, insoluble in " "	1.60
Lime	26.17

This is a by-product of chemical manufacture and consists largely of dicalcium phosphate.

Plain (non-nitrogenous) Superphosphates.

In a following table are given six analyses of fertilizers of this class with the prices at which they have been sold at retail in this State the past season.

We are informed by the manufacturer that the retail price of **1491** in Connecticut should be $30.00. Mr. Meeker writes that there are three parties in New Preston who offer the goods at $33 to $37 per ton. Similar discrepancies have been noted in the case of other brands.

Leaving out samples **1491** and **1494** which contain some potash, and assigning no value to reverted and insoluble phosphoric acid, soluble phosphoric acid has cost in these goods from 7.8 to 10.0 cents per pound, an average of 9 cents.

Valuing reverted at 8 cents and insoluble at 2 cents per pound, the soluble phosphoric acid has cost from 7.1 to 9.1 cents per pound, an average of 8.4 cents.

The following analyses, made at this Station during the year, of acid phosphate, from South Carolina rock will show the general nature of the material which is now most largely used in this country as a basis in the manufacture of ammoniated superphosphates.

Moisture	14.10					16.33	17.75
Soluble Phosphoric Acid,	16.28	14.24	12.08	11.89	10.76	9.94	13.33
Reverted Phosphoric Acid,	.44	1.48	2.22	1.78	1.43	1.73	
Insoluble Phosphoric Acid,	.09	.20	1.07	.06	0.00	.03	.82
Total Phosphoric Acid,	16.81	15.92	15.37	13.73	12.19	11.70	14.15

Plain (Non-Nitrogenous) Superphosphates.

Station No.	Name or Brand.	Manufacturer.	Dealer.	Sampled and sent by
1519	Dissolved Bone Black.	Geo. B. Forrester, 169 Front St., New York.	Manufacturer.	S. B. Wakeman, Saugatuck.
1429	Pure Dissolved Bone.	H. J. Baker & Bro., 215 Pearl St., New York.	Dennis Fenn, Milford.	Dennis Fenn, Milford.
1524	High Grade Bone Superphosphate.	Mapes' Formula & Peruvian Guano Co., New York.	Mapes' Branch, Hartford.	Station Agent.
1491	Russell Coe Fertilizer Co's Soluble Bone Phosphate.	Russell Coe Fertilizer Co., 88 Wall St., New York.	----------	E. E. Meeker, New Preston.
1494	Russell Coe Fertilizer Co's Soluble Bone Phosphate.	Russell Coe Fertilizer Co., 88 Wall St., New York.	----------	M. S. Baldwin. Saugatuck.
1528	Acid Phosphate, 17–19 per cent.	H. J. Baker & Bro., 215 Pearl St., New York.	Manufacturer.	Station Agent. From J. J. Webb.
1380	Acid Phosphate.	H. J. Baker & Bro., 215 Pearl St., New York.	"	J. J. Webb, Hamden.

Plain (Non-Nitrogenous) Superphosphates.

Station No.	Name or Brand.	Phosphoric Acid.							Cost per Ton.	Potash.
		Soluble.	Reverted.	Insoluble.	Total Phos. Acid.	Phos. Acid Guaranteed.	Available			
							Found.	Guaranteed.		
1519	Dissolved Bone Black, G. B. Forrester	17.75	.18	.08	18.01	----	17.93	----	$30.50*	----
1429	Pure Dissolved Bone, H. J. Baker & Bro.	15.83	1.24	.37	17.44	17.00	17.07	----	31.00†	----
1524	High Grade Bone Superphosphate, Mapes Co.	28.75	3.80	.93	33.48	----	32.55	33.00	58.00	----
1491	Russel Coe Fertilizer Co's Soluble Bone Phosphate	4.88	4.88	4.30	14.06	12.00	9.76	10.00	30.00	1.51
1494	Russel Coe Fertilizer Co's Soluble Bone Phosphate	6.53	3.90	5.49	15.92	12.00	10.43	10.00	31.00	2.14
1528	Acid Phosphate, 17–19 per cent., H. J. Baker & Bro.	18 57	.46	.07	19.10	----	19.03	----	----	----
1380	Acid Phosphate, H. J. Baker & Bro.	19.10	1.15	.46	20.71	----	20.25	----	29.42‡	----

* In Saugatuck. † $29.00 in New York. ‡ In New Haven.

Ammoniated Superphosphates and Guanos.

This class includes all superphosphates containing nitrogen, (except such as are compounded for special crops; the so-called "special manures,") also Peruvian guano and fish fertilizers which have been acidulated and mixed with potash salts. The analyses of dry ground fish will be considered by themselves.

In considering the tables of analyses of ammoniated superphosphates the following points require special notice.

1.) *Guarantees.* Of the sixty analyses there are two which show the goods to be below the guarantee in every particular, in four cases the goods are below guarantee in two particulars, three are below guarantee as regards a single ingredient, while the remainder, 86 per cent. of the whole number, are above guarantee in all respects. (In several instances the guarantee is not given.) This showing is decidedly better than that of any previous year.

In some cases manufacturers have guaranteed "ammonia" instead of nitrogen, and "sulphate of potash" without stating the equivalent actual potash (K_2O). Such statements are in a measure misleading and do not meet the legal requirement.

2.) *Cost and Valuation:*

Excluding the Common Sense Fertilizer, No. 2, and the two samples of Charter Oak Fertilizer, in which the valuation is less than half the cost and the actual composition does not come up to the guarantee, the average cost of the 55 Superphosphates was $37.60, the average valuation $30.47, the difference $7.13 or 23.4 per cent. of the valuation. The valuation, as has been explained, is designed to cover only retail cost of raw materials and does not cover cost of mixing, handling and selling. The 23.4 per cent. should represent the average cost of these last named items *plus* any profit which the manufacturer may have made.

The cost of mixing, handling and selling, and also profits are as legitimate and necessary items as cost of raw materials, consequently that cost should exceed the Station valuation is legitimate and necessary. That a fertilizer has a valuation higher than its cost does not prove that the manufacturer has lost money on it, nor does the fact that another is sold at a price far above valuation prove that the charge is exorbitant and covers a large profit. The cost of mixed fertilizers like that of most other things is largely governed by cost of production, and as a rule those firms which have the best facilities for getting their raw materials and

Nitrogenous Superphosphates and Guanos.

Station No.	Name or Brand.	Manufacturer.	Dealer.	Sampled and sent by
1523	Pure Fine Bone, Dissolved in Sulphuric Acid.	Mapes' Formula & Peruvian Guano Co., New York.	Mapes' Branch, Hartford.	Station Agent.
1490	XXX Guano.	Tropic Guano Co., Elizabethport, N. J.	Usher & Tinker, Plainville.	"
1357	Americus Superphosphate.	Williams, Clark & Co., 101 Pearl St., New York.	R. B. Bradley & Co., New Haven.	"
1365	Lister's Standard Superphosphate of Lime.	Lister Bros., Newark, N. J.	S. J. Hall, Meriden.	"
1540	Chittenden's Fish and Potash.	National Fertilizer Co., Bridgeport.	J. S. Kirkham, Newington.	T. R. Atwood, Newington.
1576	Americus Superphosphate.	Williams, Clark & Co., 101 Pearl St., New York.	J. P. Little, Columbia.	J. P. Little.
1362	Shoemaker's Swift Sure Superphosphate.	M. L. Shoemaker & Co., Philadelphia, Penn.	F. Ellsworth, Hartford.	Station Agent.
1369	Americus Superphosphate.	Williams, Clark & Co., 101 Pearl St., New York.	E. M. Jennings, Green's Farms.	Austin Jennings, Green's Farms.
1414	E. Frank Coe's High Grade Ammoniated Bone Superphosphate.	E. Frank Coe, 16 Burling Slip, New York.	J. P. Barstow, Norwich.	Station Agent.
1455	Mapes' Complete Manure for General Use.	Mapes' Formula & Peruvian Guano Co., 158 Front St., N. Y.	Mapes' Branch, Hartford.	"
1388	Acme Fertilizer, No. 2.	C. Meyer, Jr., Maspeth, L. I.	A. R. Russell & Co., Meriden.	"
1582	Dickenson's Bone Phosphate.	David B. Dickenson, Middle Haddam.	Manufacturer.	Oliver Brainard, East Hampton.
1510	Buffalo Fertilizer Works' Superphosphate [2].	Buffalo Chemical & Fertilizer Works, Buffalo, N. Y.	S. E. Case, New Hartford.	Station Agent.
1434	Niles' Special Fertilizer.	Chemical Ammoniate & Oil Co., Brooklyn, N. Y.	Geo. A. Niles, Danielsonville.	"

NITROGENOUS SUPERPHOSPHATES AND GUANOS—*Continued.*

Station No.	Name or Brand.	Manufacturer.	Dealer.	Sampled and sent by.
1492	Davidges' A. A. Ammoniated Bone Superphosphate.	Russell Coe Fertilizer Co., 88 Wall St., N. Y.	----------	E. E. Meeker, New Preston.
1474	Sanford's Bone Superphosphate.	Chas. Sanford, Redding Ridge.	Sanford's Factory.	Turney Sanford, Redding.
1389	Bowker's Dissolved Ground Bone.	Bowker Fertilizer Co., New York and Boston.	Coburn & Gale, Hartford.	Station Agent.
1372	G. W. Miller's Raw Bone Phosphate.	G. W. Miller, Middlefield.	Manufacturer.	Sent by Manf'r. Sampled by M. W. Terrell, Middlefield.
1385	Mapes' Complete Manure, "A" brand	Mapes' Formula & Peruvian Guano Co., 158 Front St., N. Y.	C. C. Hegemann & Co., Bridgeport.	Station Agent.
1394	Adams' Market Bone Fertilizer.	Adams & Thomas, Springfield, Mass.	A. W. Leighton & Co., 29 Broadway, New Haven.	"
1422	E. F. Coe's Alkaline Bone.	E. F. Coe, 16 Burling Slip, N. Y.	John O. Fox, Putnam.	"
1399	Darling's Animal Fertilizer.	L. B. Darling Fertilizer Co., Pawtucket, R. I.	Olds & Whipple, Hartford.	"
1432	Bosworth Bros'. Superphosphate of Lime.	Bosworth Bros., Putnam.	John A. Paine, Danielsonville.	"
1423	Bay State Fertilizer.	Clark's Cove Guano Co., New Bedford, Mass.	J. E. Leonard, Jewett City.	"
1478	Unicorn Ammoniated Superphosphate.	Clark's Cove Guano Co., New Bedford, Mass.	A. L. Chamberlain & Co., Fair Haven.	Dealer.
1437	Royal Bone.	Williams, Clark & Co., New York City.	John A. Paine, Danielsonville.	Station Agent.
1416	Farmer's Friend Ammoniated Dissolved Bone.	Read & Co., New York.	M. V. B. Lamb, Norwich.	"
1390	Bowker's Hill and Drill Phosphate.	Bowker Fertilizer Co., New York and Boston.	Coburn & Gale, Hartford.	"
1509	Ammoniated Bone Superphosphate.	Buffalo Fertilizer & Chemical Works, Buffalo, N. Y.	----------	*E. E. Meeker, New Preston.*

NITROGENOUS SUPERPHOSPHATES AND GUANOS—*Continued.*

Station No.	*Name or Brand.*	Manufacturer.	Dealer.	Sampled and sent by
1387	Acme Fertilizer, No. 1.	C. Meyer, Jr., Maspeth, L. I.	A. R. Russell & Co., Meriden.	Station Agent.
1575	E. F. Coe's High Grade, Ammoniated Bone Superphosphate.	E. F. Coe, 16 Burling Slip, N. Y.	J. P. Little, Columbia.	J. P. Little, Columbia.
1397	Quinnipiac Phosphate.	Quinnipiac Fertilizer Co., New London.	Olds & Whipple, Hartford.	Station Agent.
1448	Original Coe's Superphosphate of Lime.	Bradley Fertilizer Co., Boston, Mass.	Smith & Sons, West Cornwall.	"
1454	G. W. Miles' Fish Fertilizer and Potash.	Geo. W. Miles Co., Milford.	Burtis & Mead, New Canaan.	"
1386	Bradley's Patent Superphosphate of Lime.	Bradley Fertilizer Co., Boston, Mass.	Wheeler & Howes, Bridgeport.	"
1411	Ammoniated Bone Superphosphate.	Buffalo Fertilizer Works, Buffalo, N. Y.	James Greenfield, New London.	"
1430	Stearn's Fish and Potash, No. 1.	Stearns & Co., 124 Front St., New York.	J. E. Leonard, Jewett City.	"
1551	Bay State Fertilizer.	Clark's Cove Guano Co., New Bedford, Mass.	Lewis Chamberlain, Coventry.	A. H. Pomeroy, Coventry.
1356	Quinnipiac Extra Superphosphate.	Quinnipiac Fertilizer Co., New London.	R. B. Bradley & Co., New Haven.	Station Agent.
1449	Excelsior Guano.	E. Frank Coe, 16 Burling Slip, New York.	Noble Bennett, New Milford.	"
1410	Common Sense Fertilizer [D].	Common Sense Fertilizer Co., Boston, Mass.	James Greenfield, New London.	"
1573	Quinnipiac Phosphate.	Quinnipiac Fertilizer Co., New London.	J. P. Little, Columbia.	J. P. Little, Columbia.
1450	Ammoniated Bone Superphosphate.	H. Preston & Sons, Greenpoint, L. I.	Smith & Sons, West Cornwall.	"
1470	U. S. Superphosphate.	Lister Bros., Newark, N. J.	Swan's Seed Store, Bridgeport.	"

Nitrogenous Superphosphates and Guanos—*Continued.*

Station No.	Name or Brand.	Manufacturer.	Dealer.	Sampled and Sent by.
1477	Great Planet, A.	Clark's Cove Guano Co., New Bedford, Mass.	A. L. Chamberlain & Co., Fair Haven.	Dealer.
1395	Quinnipiac Fish and Potash, crossed fishes brand.	Quinnipiac Fertilizer Co., New London.	Olds & Whipple, Hartford.	Station Agent.
1506	Stearns' Ammoniated Bone Superphosphate.	Stearns & Co., New York.	The Platt Mill Co., Waterbury.	"
1504	Union County Fertilizer.	Union County Fertilizer Co., Linden, N. J.	Manufacturer.	Stephen Sanford, Redding Ridge.
1571	Quinnipiac Fish and Potash, plain brand.	Quinnipiac Fertilizer Co., New London.	J. P. Little, Columbia.	J. P. Little, Columbia.
1426	Mitchel's Superphosphate.	A. Mitchel, Linden, N. J.	Edward Fly, Putnam.	Station Agent.
1435	Williams, Clark & Co's Fish and Potash.	Williams, Clark & Co., New York.	John A. Paines, Danielsonville.	"
1580	Williams, Clark & Co's Fish and Potash.	Williams, Clark & Co., New York.	J. P. Little, Columbia.	J. P. Little, Columbia.
1572	Quinnipiac Fish and Potash, crossed fishes brand.	Quinnipiac Fertilizer Co., New London.	" "	" "
1401	Soluble Pacific Guano.	Glidden & Curtis, Boston, Mass.	H. A. Stillman, Hartford.	Station Agent.
1382	Cooke's Blood Guano.	National Fertilizer Co., Bridgeport.	Swan's Seed Store, Bridgeport.	"
1586	Charter Oak Fertilizer.	Paul Thomson, Hartford.	Paul Thomson, Hartford.	G. M. Barbour & Sons, New Britain.
1419	Common Sense Fertilizer, No. 2.	Common Sense Fertilizer Co., 42 Congress St., Boston.	James Greenfield, New London.	Station Agent.
1452	Charter Oak Fertilizer.	Paul Thompson, Colt's Dyke, Hartford.	S. W. Elliott, Salisbury.	"
1498	Miles' I. X. L. Superphosphate.	G. W. Miles Co., Milford.	Manufacturer.	*Henry Brown, 50 Chestnut St., New Haven.*
1469	Bowker's Fish and Potash.	Bowker Fertilizer Co., 43 Chatham St., Boston.	L. H. Keirns, Bristol.	*Station Agent.*
1445	Standard Superphosphate.	New Haven Fertilizer Co.	Manufacturer.	*Station Agent.*

Nitrogenous Superphosphates and Guanos.

Station No.	Name or Brand.	Nitrogen.		Phosphoric Acid.						Potash.		Cost per Ton.	Valuation per Ton.	Valuation exceeds Cost.
								Available.						
		Nitrogen Found.	Nitrogen Guaranteed.	Soluble in water.	Reverted.	Insoluble.	Total Phos. Acid Found.	Phos. Acid Guaranteed.	Found.	Guaranteed.	Found.	Guaranteed.			
1523	Mapes' Pure Fine Bone, Dissolved in Sulphuric Acid	2.07	*2.06*	5.34	15.25	1.86	22.45	------	20.59	*12.00*	-----	----	$35.00	$42.94	$7.94
1490	Tropic Guano Co's XXX Guano	1.66	*1.65*	6.22	7.89	4.75	18 86	------	14.11	*11.00*	4.55	*4 00*	33.00	37.47	4.47
1357	Americus Superphosphate	3.33	*1.65*	10.61	1.38	.70	12.69	*10.00*	11.99	---- -	3.04	*2.00*	38.00	37.89	Cost exce'ds valua'n .11
1365	Lister's Standard Superphosphate	2 75	*2.34*	8.72	1.98	1.09	11.79	------	10.70	*10.00*	1.55	*1.50*	32.00	30.97	1.03
1540	Chittenden's Fish and Potash	4.72	*3.29*	3 81	3.16	.80	7.77	*6.00*	6.97	---- -	4.90	*4 00*	35.00	33.71	1.29
1576	Americus Superphosphate	2.93	*1·64*	10.83	1.61	.33	12.77	*10.00*	12.44	*9.00*	2.74	*2.00*	38.00	36.48	1.52
1362	Shoemaker's Swift Sure Superphosphate	3.14	*2.47*	7.71	3.57	3.28	14.56	*14.00*	11.28	*9.00*	5.12	*2.17*	40.00	37.86	2.14
1369	Americus Superphosphate	2.72	*1.65*	11.19	1 39	.21	12.79	*10.00*	12.58	---- -	2.24	*2.00*	38.00	35.27	2.73
1414	E. F. Coe's High Grade Superphosphate	2.30	*2.06*	8.17	2.22	1.91	12.30	---- --	10.39	*9.00*	1.68	*1.08*	34.00	30.30	3.70
1455	Mapes' Complete Manure, for General Use	5.71	*5.00*	7.70	3.32	1.97	12.99	*10.00*	11.02	- ----	3.69	*3.00*	48.00	44.45	3.55
1388	Acme Fertilizer, No. 2	6.13	*5 10*	8.54	.15	.06	8.75	*8.50*	8.69	*8.00*	6.54	*5.00*	47.00	43.29	3.71
1582	Dickenson's Bone Phosphate	3.18	---	4.58	7.44	2.64	14.66	---- --	12.02	- ----	2.92	----	40.00	36.17	3.83
1510	Buffalo Fertilizer Works Superphosphate. [2]	.11		11.43	2.44	.47	14.34	*13.00*	13.87	*11.00*	1.52	*1.35*	30.00	26.13	3.87

NITROGENOUS SUPERPHOSPHATES AND GUANOS—*Continued.*

Station No.	Name or Brand.	Nitrogen.		Phosphoric Acid.							Potash.		Cost per Ton.	Valuation per Ton.	Cost exceeds Valuation.
									Available.						
		Nitrogen Found.	Nitrogen Guaranteed.	Soluble in Water.	Reverted.	Insoluble.	Total Phos. Acid Found.	Phos. Acid Guaranteed.	Found.	Guaranteed.	Found.	Guaranteed.			
1434	Niles' Special Fertilizer	2.60	*2.69*	9.07	.89	.61	10.57	*11.23*	9.96	*10.00*	6.74	*5.12*	$38.00	$33.33	$4.67
1492	A. A. Ammoniated Bone Superphosphate	2.14	*2.06*	7.06	3.39	3.07	13.52	*12.00*	10.45	*9.00*	2.38	*1.50*	35.00	30.30	4.70
1474	Sanford's Bone Superphosphate	2.38	*1.65*	4.05	2.55	5.90	12.50	*8.00*	6.60	----	6.50	*2.00*	35.00	30.19	4.81
1389	Bowker's Dissolved Ground Bone	2.23	*2.06*	9.69	1.17	.63	11.49	*10.00*	10.86	*8.00*	2.34	*2.16*	35.00	29.83	5.17
1372	G. W. Miller's Raw Bone Phosphate,	4.89	----	4.44	3.83	.49	8.76	------	8.27	----	5.23	----	42.00	36.56	5.44
1385	Mapes' Complete Manure, "A" Brand	2.62	*2.47*	7.13	4.19	3.31	14.63	------	11.32	*10.00*	3.23	*2.50*	40.00	34.36	5.64
1394	Adams' Market Bone Fertilizer	3.40	*3.50*	4.51	5.14	.96	10.61	*10.00*	9.65	----	3.43	*3.00*	38.00	32.27	5.73
1422	Coe's Alkaline Bone	1.39	*.82*	7.46	2.46	2.29	12.21	------	9.92	*9.00*	1.52	----	32.00	26.04	5.96
1399	Darling's Animal Fertilizer	4.43	*3.29*	.65	6.55	3.51	10.71	*10.00*	7.20	----	5.39	*4.00*	42.00	34.99	7.01
1432	Bosworth's Superphosphate of Lime,	2.23	*2.00*	4.94	5.25	4.51	14.70	*13.00*	10.19	*11.00*	2.77	*2.00*	38.00	31.28	6.72
1423	Bay State Fertilizer	3.42	*2.40*	9.12	.80	1.06	10.98	*9.50*	9.92	*8.00*	2.82	*2.00*	40.00	33.26	6.74
1478	Unicorn Ammoniated Superphosphate	2.69	*1.85*	7.10	1.37	2.42	10.89	------	8.47	*8.50*	2.47	*2.25*	36.00	29.05	6.95
1437	William Clark & Co's Royal Bone	1.14	*.82*	4.25	3.24	1.31	8.80	*7.00*	7.49	----	2.69	*2.00*	27.50	20.40	7.10
1416	Farmer's Friend Ammoniated Dissolved Bone	2.46	*1.82*	7.15	2.11	1.18	10.44	------	9.26	*8.00*	2.14	*2.00*	35.00	27.87	7.13
1390	Bowker's Hill and Drill Phosphate	2.80	*2.50*	8.88	1.16	.74	10.78	*11.00*	10.04	----	2.59	*2.00*	38.00	30.71	7.29
1509	Buffalo Fertilizer Co's Bone Superphosphate	3.35	*2.90*	7.82	1.82	2.23	11.87	------	9.64	*8.00*	1.64	*1.00*	40.00	32.22	7.78

NITROGENOUS SUPERPHOSPHATES AND GUANOS—*Continued.*

Station No.	Name or Brand.	Nitrogen.		Phosphoric Acid.							Potash.		Cost per Ton.	Valuation per Ton.	Cost exceeds Valuation.
									Available.						
		Nitrogen Found.	Nitrogen Guaranteed.	Soluble in Water.	Reverted.	Insoluble.	Total Phos. Acid Found.	Phos. Acid Guaranteed.	Found.	Guaranteed.	Found.	Guaranteed.			
1387	Acme Fertilizer, No. 1	4.36	*3.70*	8.37	.10	.06	8.53	*8.50*	8.47	*8.00*	9.35	*9.00*	$47.00	$38.93	$8.07
1575	Coe's Ammoniated Superphosphate	2.46	*2.06*	7.78	1.92	1.50	11.20	*10.00*	9.70	*9.00*	3.47	*2.00*	40.00	31.84	8.16
1397	Quinnipiac Phosphate	3.25	*2.47*	7.86	1.97	.73	10.56	------	9.83	*8.00*	2.37	*2.00*	40.00	31.59	8.25
1448	Original Coe's Superphosphate of Lime	2.69	*2.05*	8.56	1.80	1.76	12.12	------	10.36	*9.00*	----	----	38.00	29.38	8.62
1454	Geo. W. Miles' Fish Fertilizer and Potash	2.52	*2.47*	6.16	1.06	2.09	9.31	------	7.22	*5.00*	3.23	*3.00*	35.00	26 28	8.72
1386	Bradley's Patent Superphosphate of Lime	2.70	*2.27*	8.59	2.15	1.56	12.30	------	10.74	*9.00*	1.51	*1.50*	40.00	31.15	8.85
1411	Buffalo Fertilizer Co's Bone Superphosphate	3.07	*2.90*	8.43	1.68	.85	10.96	------	10.11	*8.00*	1.73	*1.00*	40.00	31.06	8.94
1430	Stearns' Fish and Potash, No. 1	2.54	*2.47*	2.80	2.10	5.02	9.92	------	4.90	*3.00*	4.86	*4.00*	35.00	25.69	9.31
1551	Bay State Fertilizer	2.95	*2.06*	7.56	1.68	1.90	11.14	------	9.24	*9.00*	3.42	*2.00*	40 00	30.55	9.45
1356	Quinnipiac Extra Superphosphate	2.34	*1.43*	6.14	2.65	1.05	9.84	*10.00*	8.79	*8.00*	2.14	*2.00*	36.00	26.37	9.63
1449	Coe's Excelsior Guano	3.69	*3.29*	8.59	1.06	1.30	10.95	*10.00*	9.65	----	2.83	*2.70*	45.00	35.27	9.73
1410	Common Sense Fertilizer, [D]	1.09	*1.00*	.64	1.86	.38	2.88	*2.00*	2.50	----	1.80	*1.00*	20.00	9.88	10.12
1573	Quinnipiac Phosphate	3.01	*2.50*	7.64	1.54	.35	9.53	*9.00*	9.18	*8.00*	2.30	*2.00*	40.00	29.29	10.71
1450	Preston's Ammoniated Bone Superphosphate	2.57	*2.50*	6.48	1.68	2.02	10.18	------	8.16	*10.00*	1.85	*2.00*	37.50	26.78	10.72
1470	U. S. Superphosphate	1.72	*1.31*	5.37	1.78	.55	7.70	------	7.15	*6.00*	2.52	*2.00*	32.00	21.28	10.72
1477	Great Planet A	3.95	*3.29*	6.02	1.12	1.06	8.20	------	7.14	*7.00*	11 05	*9.50*	48.00	37.15	10.85

NITROGENOUS SUPERPHOSPHATES AND GUANOS—*Continued.*

Station No.	Name or Brand.	Nitrogen. Nitrogen Found.	Nitrogen. Nitrogen Guaranteed.	Phosphoric Acid. Soluble in Water.	Phosphoric Acid. Reverted.	Phosphoric Acid. Insoluble.	Phosphoric Acid. Total Phos. Acid Found.	Phosphoric Acid. Phos. Acid Guaranteed.	Phosphoric Acid. Available. Found.	Phosphoric Acid. Available. Guaranteed.	Potash. Found.	Potash. Guaranteed.	Cost per Ton.	Valuation per Ton.	Cost exceeds Valuation.
1395	Quinnipiac Fish and Potash, crossed fishes brand	3 55	*3.25*	.66	3.41	3.17	7.24	*5.00*	4.07	*3.00*	3.90	*3.00*	$38.00	$27.03	$10.97
1506	Stearns' Ammoniated Bone Superphosphate	2.65	*2.27*	7.71	1.49	.91	10.11	------	9.20	*8.00*	2.83	*2.00*	40.00	28.94	11.06
1504	Union County Fertilizer	1.08	*1.65*	3.38	1.55	5.36	10.29	*8.00*	4.93	----	2.39	*2.00*	30.00	18.77	11.23
1571	Quinnipiac Fish and Potash, plain brand	2.72	*2.00*	1.52	4.22	1.84	7.58	*6.00*	5.74	*4.00*	4.58	*4.00*	36.00	24.64	11 36
1426	Mitchel's Superphosphate	1.31	*2.06*	6.15	3.09	1.15	10.39	*10.00*	9.24	*8.00*	1.28	*3.00*	35.00	22.74	12.26
1435	Williams, Clark & Co's Fish and Potash	3.35	*3.29*	.52	4.07	2.71	7.30	*3.00*	4.59	----	4.64	*3.00*	38.00	25.62	12.38
1580	Williams, Clark & Co's Fish and Potash	3.10	*3.29*	.37	2.67	3.93	6.97	*3.00*	3.04	----	4.36	*3.00*	36 00	23.05	12.95
1572	Quinnipiac Fish and Potash, crossed fishes brand	3.62	*3.50*	.95	3.93	1.27	6.15	*5.00*	4.88	*3.0*	3.57	*3.00*	39.00	25 09	13.91
1401	Soluble Pacific Guano	2.72	*2.00*	7.75	1.91	2.57	12.23	------	9.66	*8.00*	1.75	*2.00*	45.00	30.34	14.66
1382	Cooke's Blood Guano	1.35	*1.24*	5.16	2.94	1.50	9.60	------	8.10	*7.00*	1.71	----	38.00	21.50	16.50
1586	Charter Oak Fertilizer	1.00	*1.65*	.00	.77	.76	1.53	------	.77	*2.50*	1.79	*2.00*	25.00	6.96	18.01
1419	Common Sense Fertilizer, No. 2	1.65	*2.00*	.10	3.08	.88	4.06	*4.00*	3.18	----	2.72	*3.00*	35.00	14.06	20.94
1452	Charter Oak Fertilizer	1.18	*1.65*	trace	.95	.28	1.23	------	.95	*2.50*	2.67	*2.00*	30.00	8.26	21.74
1498	Miles' I. X. L. Superphosphate	2.17	----	6.27	1.72	3.59	11.58	------	7.99	----	1.98	----	------	26.40	----
1469	Bowker's Fish and Potash	2.62	*2.25*	4.66	2.18	1.14	7.98	*8.00*	6.84	----	4.94	*4.00*	------	26.42	----
1445	N. H. Fertilizer Co's Superphosphate	2.77	----	6.54	1.60	.37	8.51	------	8.14	----	3.14	----	------	28.75	----

for manufacturing, will sell at prices least above valuation and still make a fair profit. Of course this rule does not hold when different concerns indulge in the expensive luxury of making war on each other by reducing prices so as to allow no profit.

It will be noticed that in two cases the valuation is more than the cost, in 14 cases valuation is less than $5.00 below cost, in 24 it is between $5 and $10 below, and in 14 between $10 and $15 below cost.

The large manufacturers mostly appear to desire that their goods shall be retailed at a uniform rate throughout the State, and when, as sometimes happens, a local dealer by accident or intent charges or reports a price in advance of that commonly charged, the manufacturer is aggrieved to find in the Station publications that his goods are reported as dearer than he intended.

The purchaser is also made unhappy by finding that he has paid for a brand of superphosphate a higher price than others have got it for.

The Station gives what information it is able to gather relative to retail prices and will use its best efforts to fully represent the facts.

3. *The Drawing of Samples.*

19 of the samples under discussion were drawn by others than the Station agents. A number of analyses of samples so drawn have been omitted from the report because there was good reason to believe that they were not properly taken and a published analysis of a sample improperly taken works injury to all parties.

Objection is sometimes made that the whole annual output of a given brand of goods is judged by the results of a single analysis which may or may *not* be a fair representative.

It is out of the question for the Station with its present means to double or more than double the work done on fertilizers, by making a larger number of analyses. Another plan which has been tried in two or three cases this year is to draw as many samples of each brand as possible and make a careful mixture of equal portions of each sample. The analysis of this mixture then represents the average of a large number of analyses made on different samples.

To illustrate:—below are given

1. Analysis of a mixture of 2 samples of H. J. Baker's Pelican Bone Fertilizer; one drawn at Winsted, cost $35, and one at

Litchfield, cost $33. The manufacturer writes that "the retail price all through Connecticut should be $32.50 as published in our pamphlets." Guaranteed nitrogen 1.85—Available phos. acid 8—Potash 2.25.

2. Analysis of a mixture of 2 samples of H. J. Baker's A. A. Ammoniated Superphosphate; one drawn in West Cornwall, the other in Litchfield. Cost of each $37.50. Guaranteed nitrogen 2.47—Available phos. acid 10—Potash 2.

3. Analysis of a mixture of 7 samples of Williams, Clark & Co's Americus Ammoniated Superphosphate drawn in New London, New Milford, East Canaan, Washington Depot, Danbury, New Canaan and East Haddam. Cost prices were $40, $37, $36, $38, $35, $38, $35. Guaranteed nitrogen 1.65—Available phos. acid 9—Potash 2.

	Pelican Bone Fertilizer.	A. A. Superphosphate.	Americus Superphosphate.
Nitrogen,	2.39	2.80	2.76
Soluble Phosphoric Acid,	9.50	11.50	10.26
Reverted Phosphoric Acid,	1.15	.54	1.24
Insoluble Phosphoric Acid,	.38	.17	.81
Potash,	2.86	2.62	2.77
Average Valuation per ton,	$30.27	$34.01	$34.75

4. *Certain analyses call for special notice.*

Miles I. X. L. Superphosphate **1498** was bought at an auction sale.

1586 and **1452** are samples of the Charter Oak Fertilizer made by Paul Thomson of Hartford.

A more complete analysis of **1452** is as follows:—

Water,	22.54
Sand and Soil,	43.51
Organic matter,	12.70
(Containing 1.18 per cent. nitrogen.)	
Phosphoric Acid,	1.23
Potash soluble in Water,	2.67
Other matters (by difference,)	17.35
	100.00

More than three-fifths of this "fertilizer" is made up of sand and water. Its cost is more than three and one half times its valuation.

The "Common Sense" Fertilizer D, **1410,** costs more than twice as much as its valuation and the "Common Sense" Fertilizer No. 2, **1419,** costs about two and a half times as much as its valuation.

1500 No. 1 Standard Peruvian Guano. Sold by Hurtado & Co., 16 and 18 Exchange Place, New York. From stock of Southmayd and Gardiner, Middletown. Sample drawn by Station agent.

Analysis.	Found.	Guaranteed.
Nitrogen,	7.44	**7.41**
Soluble Phosphoric Acid,	3.78	
Reverted Phosphoric Acid.	3.58	
Insoluble Phosphoric Acid,	4.48	
Total Phosphoric Acid,	11.84	**13.00**
Potash,	1.87	**2.00**
Cost,	$65.00	

If calculated in the usual way, the valuation of this article would be $44.48.

In regard to its valuation, Messrs. Hurtado & Co. write, under date of May 9, 1885: "The Chilian government fixes the prices at 21 shillings per unit of nitrogen and 4 shillings sixpence per unit of phosphoric acid in the ton of 2240 pounds. However exorbitant these figures may be, the goods cannot be purchased any lower, and we believe that some mention of it could be made in order to show the cost of the raw material, which is higher than any other, and therefore the valuation of our goods, based on the average price of other and cheaper articles, does not seem to us an equitable one. We notice that a different valuation is placed upon the nitrogen of coarse bone, hair and fish scraps than upon that of nitrates and ammonia salts, because the latter command a higher wholesale price; the same should apply to Peruvian Guano."

At 21 shillings per unit in ton of 2240 pounds nitrogen costs $22\frac{1}{2}$ cents per pound. Phosphoric acid at 4 shillings sixpence the unit, costs $4\frac{4}{5}$ cents per pound. These are *wholesale prices* in Chili; a fair retail price here would raise these figures very considerably and it is evident that our schedule of valuations applied to genuine Peruvian Guano without any explanation would be unfair to the dealer. It would serve the purpose however of comparing Peruvian Guano with other commercial fertilizers, on a money basis, and would suggest at once the question whether it would pay to use guano while the Chilian government put such a high price on it.

Genuine Peruvian Guano is understood to contain a considerable portion of nitrogen as uric acid and urates of the alkalies. These are not readily soluble in water. The uric acid can be very readily detected even when present in minute quantity. Genuine Peruvian Guano contains also a small amount of sulphuric acid, 2–3 per cent. on the average.

The sample of "No. I Standard Peruvian Guano" **1500** contains *no trace* of uric acid, more than 84 per cent. of the nitrogen in it is in the form of ammonia salts *readily soluble* in water, and it contains 13.67 per cent. of sulphuric acid soluble in water. It has the color and somewhat the odor of Peruvian Guano, but in our judgment is not wholly that, but a mixture of some genuine guano with considerable sulphate of ammonia and possibly other materials.

In the next table are given eight analyses of "Manufacturers' Samples." The Station is required to "cause one or more analyses of each fertilizer to be made and published annually." Its agents have not succeeded in obtaining samples of certain brands from the retail market, and it is therefore obliged to analyze the samples which have been sent by the manufacturers.

For more convenient reference the various brands of Fish and Potash are tabulated by themselves on page 82. Their average cost has been $36.70, average valuation $26.64, and difference between the two is 35½ per cent. of the valuation. They have therefore been more expensive fertilizers than other superphosphates.

A Statement.

In April last a supply of a fertilizer was sent to several agents in this State for sale, from one of whom samples were drawn by the Station and analyzed. The analyses showed the goods to be well above the manufacturer's minimum guarantee. They were reported to the manufacturer who claimed that a mistake had been made in the grade of goods shipped and that the grade shown by the analyses was not as high as was expected and intended for the Connecticut trade. He requested the analyses to be withheld from publication and promised to immediately withdraw the goods from the State. The Executive Committee, at a meeting held April 17th, ordered the analyses to be withheld from publication and this statement to be published in the Annual Report.

MANUFACTURERS' SAMPLES OF AMMONIATED SUPERPHOSPHATES.

Station No.	NAME.	Nitrogen.		Phosphoric Acid.							Potash.			Cost per Ton.	Valuation per Ton.
							Available.								
		Nitrogen Found.	Nitrogen Guaranteed.	Soluble in Water.	Reverted.	Insoluble.	Total Phos. Acid Found.	Phos. Acid Guaranteed.	Found.	Guaran-teed.	Found.	Guaranteed.			
1557	Bradley's B. D. Sea-Fowl Guano	2.37	*2.50*	8.14	2.76	1.00	11.90	*11.00*	10.90	*9.00*	1.36	*2.00*		---	$29.54
1558	Bradley's "Circle Brand" Bone and Potash	1.96	*1.85*	3.05	5.28	2.38	10.71	*8.00*	8.33	----	2.76	*2.00*		----	25.25
1552	Buffalo Fertilizer Co's Queen City Phosphate	1.88	*1.65*	7.38	1.79	.64	9.81	*9.00*	9.17	*8.00*	1.67	*1.00*		----	24.85
1562	G. H. Harris' Pure Bone Phosphate	2.50	*3.00*	2.82	5.64	2.18	10.64	*17.00*	8.46	----	----	----		----	24.84
1553	Shoemaker's Good-enough Phosph.	1.83	*1.24*	7.02	4.40	2.41	13.83	*12.00*	11.42	*8.00*	2.16	*1.60*		----	30.03
1559	Shoemaker's Echo Phosphate	1.34	*.82*	4.47	3.74	3.41	11.62	*9.00*	8.21	*7.00*	1.99	*1.08*		----	23.27
1556	Sparrow's B. B. Phosphate	2.34	----	8.12	2.96	.58	11.66	----	11.08	----	2.74	----		----	30.57
1554	Wilkinson's Ammoniated Superphosphate	2.84	*2.50*	10.43	1.25	.16	11.84	----	11.68	*10.00*	3.37	*3.00*		----	33.97

FISH AND POTASH.

	Chittenden's.	George W. Miles'.	Stearns'.	Quinnipiac's Crossed-Fishes.	Quinnipiac's Plain Brand.	Williams, Clark & Co's	Williams, Clark & Co's	Bowker's.
	1540	**1454**	**1430**	**1395**	**1571**	**1435**	**1580**	**1469**
Nitrogen	4.72	2.52	2.54	3.55	2.72	3.35	3.10	2.62
Soluble Phosphoric Acid	3.81	6.16	2.80	.66	1.52	.52	.37	4.66
Reverted Phosphoric Acid	3.16	1.06	2.10	3.41	4.22	4.07	2.67	2.18
Insoluble Phosphoric Acid	.80	2.09	5.02	3.17	1.84	2.71	3.93	1.14
Potash	4.90	3.23	4.86	3.90	4.58	4.64	4.36	4.94
Cost	$35.00	$35.00	$35.00	$38.00	$36.00	$38.00	$36.00	----
Valuation	$33.71	$26.28	$25 69	$27.03	$24.64	$25.62	$23.05	$26.42
Nitrogen Found	4.72	2.52	2.54	3.55	2.72	3.35	3.10	2.62
Nitrogen Guaranteed	*3.29*	*2.47*	*2.47*	*3.25*	*2.00*	*3.29*	*3.29*	*2.25*
Phosphoric Acid Found	7.77	9.31	9.92	7.24	7.58	7.30	6.97	7.98
Phosphoric Acid Guaranteed	*6.00*	----	----	*5.00*	*6.00*	*3.00*	*3.00*	*8.00*
Potash Found	4.90	3.23	4.86	3.90	4.58	4.64	4.36	4.94
Potash Guaranteed	*4.00*	*3.00*	*4.00*	*3.00*	*4.00*	*3.00*	*3.00*	*4.00*

HOME-MIXED FERTILIZERS.

Following are two analyses of a home-mixed fertilizer prepared by J. J. Webb, of Hamden. The ingredients used and their prices were

12000 lbs. acid phosphate @ $28.00 per ton	$168.00
4145 lbs. muriate potash @ 1.8 cts. per lb.	77.76
4084 lbs. sulphate of ammonia @ 3¼ cts per lb.	132.73
Freight bills to New Haven	15.15
	$393.64

20229

Or $38.91 per ton for the goods in New Haven, unmixed

The two samples, **1481** and **1489**, were drawn by different persons at different times. With the analyses is given the *calculated* composition of the mixture derived from analyses made at this Station, of the materials used :

	Calculated.	**1481.**	**1489.**
Nitrogen	4.19	4.07	4.30
Soluble Phosphoric Acid	----	11.77	----
Reverted Phosphoric Acid	----	.71	----
Insoluble Phosphoric Acid	----	.25	----
Total Phosphoric Acid	12.28	12.73	12.73
Potash	10.61	10.50	10.23
Valuation	$45.91	46.10	46.71

The crude materials were bought in New York in February.

Later in the season (July) another mixture made by Mr. Webb was analyzed. It was compounded according to the following formula:

Dissolved Bone Black	4,000 pounds.
Bone and Blood (Tankage)	6,205 "
Sulphate of Ammonia	1,251 "
Muriate of Potash	2,000 "
	13,456 "

One sample of this mixture was drawn by Mr. Webb, another by a Station agent.

The analyses follow together with the calculated composition derived from analyses of the raw materials :

	Formula.	Mr. Webb's Sample.	Station Sample.
		1538.	**1539.**
Nitrogen	5.20	5.02	5.09
Soluble Phosphoric Acid		6.15	6.20
Reverted Phosphoric Acid		1.75	2.65
Insoluble Phosphoric Acid		1.54	.62
Total Phosphoric Acid	9.09	9.44	9.47
Potash	7.76	8.05	8.10
Valuation per ton		$40.01	$41.09

The composition of the two samples is almost identical. They contain somewhat more potash and phosphoric acid and a little less nitrogen than corresponds to the formula, but the agreement is as close as could be expected.

The total cost of the materials (13,456 pounds) delivered in New Haven, was stated by Mr. Webb to be $215.06 or $31.96 per ton.

1508. Home-mixed Tobacco Fertilizer. Sampled and sent by Abner Trask, East Hartford. It is stated to consist of a mixture of

2,000	pounds	Cotton Seed Meal.
1,000	"	Cotton Hull Ashes.
500	"	Lime.
500	"	Plaster.
4,000		

and to cost $25.42 per ton. Whether this includes the cost of mixing, is not stated.

1475. Home-mixed fertilizer sent by J. M. Brown, Poquonnock, made according to the same formula as Mr. Trask's sample. Price "about $26.00."

ANALYSES.

	1508.	1475.
Nitrogen	3.37	3.52
Soluble Phosphoric Acid	Trace	Trace
Reverted Phosphoric Acid	2.08	5.01
Insoluble Phosphoric Acid	.12	.27
Potash,	5.44	6.64
Valuation	$23.40	$30.43

1479. Home-mixed Potato Fertilizer. Made by W. F. Andross, East Hartford, according to the following formula:

850	pounds Mapes' Dissolved Bone.
400	pounds Bowker's Dry Fish.
400	pounds H. J. Baker & Co's Castor Pomace.
350	pounds Muriate of Potash.
2000	

With regard to it Mr. Andross writes: "Its actual cost is $33 per ton, allowing the chemicals at the retail market price, which the farmer generally has to pay when he mixes his own formulas. This allows nothing for labor for mixing. I have had as good

success with this mixture for the past three years under test conditions as I have had with any of the best manufactured specials for potatoes and root crops, corn or cabbage, varied to suit the requirements of the crop. I have never found anything better and I can save from 30 to 40 per cent. in the cost of the goods."

ANALYSIS.

Nitrogen	4.05
Soluble Phosphoric Acid	1.92
Reverted Phosphoric Acid	10.35
Insoluble Phosphoric Acid	1.50
Potash	7.09
Valuation per ton	$41.83

A fertilizer perfectly mixed according to the formula given would contain not far from 3.6 per cent. of nitrogen, 11.4 per cent. phosphoric acid and 9.0 per cent. of potash and its valuation per ton would be about $38.00. The explanation of this discrepancy is either that the goods which were mixed were not correctly weighed or that the sample did not fairly represent the goods.

SPECIAL FERTILIZERS.

Twenty-six analyses of this kind of ammoniated superphosphates are tabulated below. Eleven of them were drawn by others than Station agents. Seven of them are below their guarantee as regards one ingredient and one of them as regards two ingredients.

Their average cost has been $44.80 and average valuation $38.70. The difference, $6.10, is less than 16 per cent. of the valuation. It appears this year, as last, that the special fertilizers are generally of higher grade than the other ammoniated superphosphates, and if the quality of materials used in their manufacture is the same, are cheaper sources of plant food than other superphosphates. The reasons for this were discussed in the last Report and do not call for further notice here.

1465 is a mixture of equal parts of two samples, one from West Cornwall, the other from Newtown. The cost was the same in both places.

Special Manures.

Station No.	Name or Brand.	Manufacturer.	Dealer.	Sampled and sent by
1514	Forrester's Onion Manure.	Geo. B. Forrester, 169 Front St., New York.	Manufacturer.	S. B. Wakeman, Saugatuck.
1502	Mapes' Tobacco Manure for use with Stems.	Mapes Formula and Peruvian Guano Co., 158 Front St., N. Y.	Mapes' Branch, Hartford.	Station Agent.
1418	Mapes' Grass and Grain Spring Top Dressing.	Mapes Formula and Peruvian Guano Co., 158 Front St., N. Y.	J. P. Barstow, Norwich.	"
1458	Mapes' Tobacco Manure, Conn. Brand.	Mapes' Formula and Peruvian Guano Co., 158 Front St., N. Y.	Mapes' Branch, Hartford.	"
1513	Forrester's Potato Manure.	G. B. Forrester, 169 Front St., New York.	Manufacturer.	S. B. Wakeman, Saugatuck.
1512	Forrester's Corn Manure.	G. B. Forrester, 169 Front St., New York.	Manufacturer.	S. B. Wakeman, Saugatuck.
1483	Mapes' Potato Manure.	Mapes' Formula and Peruvian Guano Co., New York.	Josiah Hawkins, Southport.	Edward Osborn, Fairfield.
1468	Americus Brand Tobacco Fertilizer.	Williams, Clark & Co., 101 Pearl St., New York.	E. S. Roberts, East Canaan.	Station Agent.
1384	Mapes' Complete Manure for Potatoes.	Mapes Formula and Peruvian Guano Co., New York.	C. C. Hegemann, Bridgeport.	"
1471	Chittenden's Complete Fertilizer for Tobacco.	National Fertilizer Co., Bridgeport.	J. S. Kirkham, Newington.	Thos. R. Atwood, Newington.
1392	Stockbridge Forage Crop Manure.	Bowker Fertilizer Co., New York and Boston.	Coburn & Gale, Hartford.	Station Agent.
1472	Chittenden's Grain Fertilizer.	National Fertilizer Co., Bridgeport.	John S. Kirkham, Newington.	Joshua Belden, Newington.
1473	Chittenden's Root Fertilizer.	National Fertilizer Co., Bridgeport.	John S. Kirkham, Newington.	Joshua Belden, Newington.

Special Manures—*Continued.*

Station No.	Name or Brand.	Manufacturer.	Dealer.	Sampled and sent by
1579	Americus Potato Fertilizer.	Williams, Clark & Co., New York.	J. P. Little, Columbia.	J. P. Little, Columbia.
1391	Stockbridge Vegetable Manure.	Bowker Fertilizer Co., New York and Boston.	Coburn & Gale, Hartford.	Station Agent.
1400	Potato, Hop and Tobacco Phosphate.	L. L. Crocker, Buffalo, N. Y.	H. A. Stillman, Hartford.	"
1465	Complete Potato Manure.	H. J. Baker & Bro., New York.	----------	"
1421	Ralston's Potato Fertilizer.	John Ralston, 16 Burling Slip, New York.	Arnold Rudd, New London.	"
1447	Bradley's Complete Manure for Potatoes and Roots.	Bradley Fertilizer Co., Boston Mass.	Strong & Tanner, Winsted.	"
1428	Americus Brand Potato Fertilizer.	Williams, Clark & Co., New York.	John A. Paine, Danielsonville.	"
1497	Davidge Brand Potato Manure.	Russell Coe Fertilizer Co., 88 Wall St., New York.	M. S. Baldwin, Naugatuck.	M. S. Baldwin, Naugatuck.
1392	Stockbridge Grain Manure.	Bowker Fertilizer Co., New York and Boston.	Coburn & Gale, Hartford.	Station Agent.
1406	Chittenden's Complete Fertilizer for Roots.	National Fertilizer Co., Bridgeport.	Wm. Fowler, Milford.	"
1462	Baker's Complete Corn Manure.	H. J. Baker & Bro., 215 Pearl St., New York.	C. S. Smith, Kent.	"
1511	Stockbridge Potato Manure.	Bowker Fertilizer Co., New York and Boston.	Hubbell & Bradley, Saugatuck.	S. B. Wakeman, Saugatuck.
1555	Bradley's Complete Manure for Corn and Grain.	Bradley Fertilizer Co., Boston.	Manufacturer's Sample.	Manufacturer.

Special Manures.—Analyses and Valuations.

Station No.	Name or Brand.	Nitrogen.		Phosphoric Acid.							Potash.		Chlorine.	Cost per Ton.	Valuation per Ton.	Valuation Exceeds Cost.
		Found.	Guaranteed.	Soluble in Water.	Reverted.	Insoluble.	Total Phos. Acid Found.	Phos. Acid Guaranteed.	Available. Found.	Available. Guaranteed.	Found.	Guaranteed.				
1514	Forrester's Onion Manure	6.21	*5.35*	7.79	.09	.12	8.00	------	7.88	*3.50*	7.65	*7.00*	2.89	$45.00	$45.41	$ .41
1502	Mapes' Tobacco Manure for use with Stems	6.15	*5.35*	7.80	3.46	2.69	13.95	*10.50*	11.26	-----	3.90	*3.50*	.82	50.00	48.88	Cost Exceeds Valuation. $1.12
1418	Mapes' Grass and Grain Spring Top Dressing	5.54	*4.12*	7.68	3.10	.84	11.62	*7.00*	10.78	-----	6.75	*5.00*	6.07	47.00	45.13	1.87
1458	Mapes' Tobacco Manure, Conn. Brand	5.43	*4.74*	6.75	3.03	.98	10.76	*7.75*	9.78	-----	7.79	*7.75*	.88	50.00	47.93	2.07
1513	Forrester's Potato Manure	4.91	*3.50*	5.68	.28	.27	6.23	------	5.96	*5.25*	10.42	*10.00*	1.05	45.00	42.84	2.16
1512	Forrester's Corn Manure	4.82	*3.91*	8.87	.11	.22	9.20	------	8.98	*6.50*	9.69	*8.00*	7.38	45.00	41.92	3.08
1483	Mapes' Potato Manure	4.27	*3.70*	8.70	2.72	.69	12.11	*8.00*	11.42	-----	7.75	*6.00*	3.59	48.00	44.31	3.69
1468	Americus Brand Tobacco Fertilizer	3.96	*4.12*	5.13	1.13	.13	6.39	------	6.26	*4.00*	10.07	*8.00*	2.40	42.00	38.09	3.91
1384	Mapes' Complete Manure for Potatoes	4.08	*3.70*	8.13	2.54	1.37	12.04	------	10.67	*8.00*	7.55	*6.00*	3.95	48.00	44.04	3.96
1471	Chittenden's Complete Fertilizer for Tobacco	4.30	*3.29*	4.82	4.47	3.84	13.13	*10.00*	9.29	*6.00*	4.74	*4.32*	.90	45.00	40.54	4.46
1393	Stockbridge Forage Crop Manure.	5.43	*5.50*	6.49	1.00	.92	8.41	*6.00*	7.49	*5.00*	2.98	*2.50*	1.29	42.50	*36.85*	*5.65*
1472	Chittenden's Grain Fertilizer	4.30	*3.70*	5.28	4.43	2.40	12.11	*8.00*	9.71	*6.00*	6.04	*5.00*	5.79	*45.00*	*39.12*	*5.88*

Special Manures.—*Continued.*

Station No.	Name or Brand.	Nitrogen.		Phosphoric Acid.							Potash.		Chlorine.	Cost per Ton.	Valuation per Ton.	Cost Exceeds Valuation.
		Found.	Guaranteed.	Soluble in Water.	Reverted.	Insoluble.	Total Phos. Acid Found.	Phos. Acid Guaranteed.	Available. Found.	Available. Guaranteed.	Found.	Guaranteed.				
1473	Chittenden's Root Fertilizer	4.40	*3.29*	5.47	3.35	2.22	11.04	*8.00*	8.82	*6.00*	6.08	*6.00*	5.85	$45.00	$38.00	7.00
1579	Americus Potato Fertilizer	3.31	*2.47*	6.16	.98	.18	7.32	*6.00*	7.14	*5.00*	7.94	*8.00*	1.08	43.00	35.37	7.63
1391	Stockbridge Vegetable Manure	3.80	*3.25*	6.54	1.01	1.11	8.66	------	7.55	*8.00*	7.11	*7.00*	6.49	42.50	33.99	8.51
1400	Potato, Hop and Tobacco Phosphate	2.90	*2.00*	7.13	1.93	1.30	10.36	*9.00*	9.06	*8.00*	5.68	*3.50*	5.07	40.00	32.19	7.81
1465	Baker's Complete Potato Manure	3.35	*3.30*	5.45	.90	.14	6.49	*5.25*	5.35	-----	10.34	*10.00*	2.15	45.00	36.70	8.30
1421	Ralston's Potato Fertilizer	1.73	*1.65*	7.90	1.53	1.86	11.29	------	9.43	*8.00*	4.91	*3.70*	.57	40.00	31.00	9.00
1447	Bradley's Complete Manure for Potatoes and Roots	3.14	*3.29*	8.58	1.61	1.39	11.58	------	10.19	*8.00*	6.38	*4.50*	5.89	45.00	35.85	9.15
1428	Americus Brand Potato Fertilizer	3.04	*2.47*	6.16	1.19	.14	7.49	*6.00*	7.35	*5.00*	8.55	*8.00*	1.14	45.00	35.53	9.47
1497	Davidge Brand Potato Manure	2.09	*2.47*	5.92	5.39	3.85	15.16	------	11.31	*8.00*	5.22	*4.10*	4.68	44.00	34.32	9.68
1392	Stockbridge Grain Manure	3.80	*3.25*	7.71	1.86	.67	10.24	*7.00*	9.57	*6.00*	4.66	*4.00*	5.05	42.50	35.03	7.47
1406	Chittenden's Complete Fertilizer for Roots, Potatoes and Vegetables.	3.84	*3.29*	6.27	1.57	1.20	9.04	*8.00*	7.84	*6.00*	7.60	*6.00*	6.49	45.00	35.04	9.96
1462	Baker's Complete Corn Manure	4.70	*5.00*	6.04	.40	.09	6.53	------	6.44	*6.25*	7.68	*7.00*	9.99	45.00	35.03	9.97
1511	Stockbridge Potato Manure	3.81	*3.29*	6.79	.57	.95	8.31	------	7.36	-----	6.40	*7.00*	3.89	45.00	33.79	11.21
1555	Bradley's Complete Manure for Corn and Grain	2.93	*3.30*	8.60	1.78	1.33	11.71	------	10.38	*9.00*	6.03	*4.00*	5.46	-----	35.08	

Bone Manures.

On the following pages are tabulated 30 analyses of articles of this class; 15 of the samples were drawn by a station agent, and 15 by other parties.

Ivory sawdust, **1405**, is a perfect fertilizer of this class. It has every appearance of being pure bone, it is white and clean, its content of nitrogen and phosphoric acid is exceptionally high, and its mechanical condition is excellent.

Peter Cooper's bone, **1404** and **1354**, is a residue from glue manufacture and a considerable portion of nitrogen has been removed in form of glue.

The low per cent. of nitrogen and phosphoric acid in **1349** is due to the large amount of water present. The material is produced by sawing bone in water.

Samples **1363, 1583, 1420, 1525,** all contain more or less sulphate of soda and salt, which are used as dryers and preservatives.

The average cost of the bone manures has been $34.59; the average valuation $34.58.

The method of valuation applied to bone is explained on page 62.

Bone Manures.

Station No.	Name or Brand.	Manufacturer.	Dealer.	Sampled and sent by
1405	Ivory Saw Dust.	B. B. Warner & Son, Plainville.	Manufacturer.	J. W. Hemingway, Plainville.
1404	Bone Dust.	Peter Cooper's Glue Factory, New York.	Gilbert Thompson, New York.	J. W. Hemingway, Plainville.
1354	Peter Cooper's Ground Bone.	Peter Cooper's Glue Factory, New York.	Manufacturer.	C. H. Cables, Thomaston.
1349	Rogers & Hubbard Co's Damp Bone Saw Dust.	Rogers & Hubbard Co., Middletown.	"	Station Agent.
1352	Rogers & Hubbard Co's Raw Knuckle Bone Extra Fine A.	Rogers & Hubbard Co., Middletown.	"	"
1361	Swift Sure Bone Meal.	M. S. Shoemaker & Co., Philadelphia.	F. Ellsworth, Hartford.	"
1351	Rogers & Hubbard Co's Raw Knuckle Bone Meal.	Rogers & Hubbard Co., Middletown.	Manufacturer.	"
1376	Americus Brand Pure Bone Meal.	Williams, Clark & Co., 101 Pearl St., New York.	E. M. Jennings, Southport.	George P. Jennings, Green's Farms.
1436	Pure Ground Bone.	Buffalo Fertilizer Works, Buffalo, New York.	J. E. Leonard, Jewett City.	Station Agent.
1375	Plumb & Winton's Pure Ground Bone.	Plumb & Winton, Bridgeport.	From stock purchased by T. B. Wakeman.	G. P. Jennings, Green's Farms.
1368	Pure Bone Meal.	Williams, Clark & Co., 101 Pearl St., New York.	E. M. Jennings, Green's Farms.	Austin Jennings, "
1402	Darling's Ground Bone.	L. B. Darling Fertilizer Co., Pawtucket, R. I.	Olds & Whipple, Hartford.	Station Agent.

BONE MANURES—*Continued.*

Station No.	Name or Brand.	Manufacturer.	Dealer.	Sampled and sent by
1363	Lister's Celebrated Ground Bone.	Lister Bros., Newark, N. J.	S. J. Hall, Meriden.	Station Agent.
1371	G. W. Miller's Ground Bone.	G. W. Miller, Middlefield.	Manufacturer.	W. W. Terrill, Middlefield.
1350	Rogers & Hubbard Co's Ground Bone, Fine A. X.	Rogers & Hubbard Co., Middletown.	"	Station Agent.
1431	Fine Ground Bone.	W. H. Anderson, Putnam.	"	"
1574	Americus Brand Pure Bone Meal.	Williams, Clark & Co., New York.	J. P. Little, Columbia.	J. P. Little, Columbia.
1583	Preston & Son's Ground Bone.	H. Preston & Sons, Greenpoint, L. I.	Peck & Allen, Port Chester, N. Y.	Joshua Lyon, Greenwich.
1353	Peck Bro's Pure Ground Bone.	Peck Bros., Northfield.	Manufacturer.	C. H. Cables, Thomaston.
1417	Ground Bone, (Fine).	Lombard & Matthewson, Warrenville.	Durkee, Styles & Co., Willimantic.	Station Agent.
1360	Americus Brand Pure Bone Meal.	Williams, Clark & Co., 101 Pearl St., New York.	R. B. Bradley & Co., New Haven.	"
1398	Adams' Fine Ground Bone.	Adams & Thomas, Springfield, Mass.	A. W. Leighton & Co., New Haven.	"
1420	Preston's Ground Bone.	H. Preston & Sons, Greenpoint, L. I.	Brewster & Burnett, Norwich.	"
1377	Plumb & Winton's Bone Fertilizer.	Plumb & Winton, Bridgeport.	T. B. Wakeman.	G. P. Jennings, Green's Farms.
1525	Crescent Bone.	Lister Bros., Newark, N. J.	Swan's Seed Store, Bridgeport.	Station Agent.
1461	Ground Bone.	----------	----------	Harvey Elliot, North Guilford.
1560	P. W. Bennett's Ground Bone.	P. W. Bennett, Rockfall, Ct.	Manufacturer.	Manufacturer.
1564	G. H. Harris & Son's Pure Ground Bone.	G. H. Harris & Son, Eagleville, Ct.	"	"
1561	E. Smith's Bone.	E. Smith, South Canterbury, Ct.	"	"
1565	Wilkinson's Extra Fine Ground Bone.	Wilkinson & Co., 239 Center St., N. Y.	"	"

BONE MANURES.—ANALYSES AND VALUATIONS.

Station No.	Name or Brand.	Nitrogen.	Phos. Acid.	Finer than $\frac{1}{50}$ inch.	Finer than $\frac{1}{25}$ inch.	Finer than $\frac{1}{12}$ inch.	Finer than $\frac{1}{6}$ inch.	Coarser than $\frac{1}{6}$ inch.	Cost per ton.	Valuation per ton.	Valuation exceeds cost.
1405	B. B. Warner & Son's Ivory Saw Dust	5.41	24.77	98	2	0	0	0	$30.00	$49.10	$19.10
1404	Peter Cooper's Bone Dust	1.41	30.99	34	12	34	20	0	31.20	37.13	5.93
1354	Peter Cooper's Ground Bone	1.62	31.70	40	15	24	21	0	23.75*	39.06	5.31
1349	Rogers & Hubbard Co's Damp Bone Saw Dust	2.35	15.67	97	3	0	0	0	25.00	27.19	2.19
1352	Rogers & Hubbard Co's Raw Knuckle Bone Extra Fine A	3.96	25.15	25	15	33	27	0	36.00	37.80	1.80
1361	Shoemaker & Co's Swift Sure Bone Meal	6.04	21.98	72	24	4	0	0	45.00	46.65	1.65
1351	Rogers & Hubbard Co's Raw Knuckle Bone Meal	3.96	24.57	32	33	35	0	0	38.00	39.58	1.58
1376	Williams, Clark & Co's Americus Brand Pure Bone Meal	3.93	20.10	51	19	28	2	0	35.00	35.36	.36
1436	Buffalo Fertilizer Co's Pure Ground Bone	4.26	23.53	37	26	37	0	0	40.00	39.51	Cost exceeds valuation, .49
1375	Plumb & Winton's Pure Ground Bone	3.32	22.88	41	16	17	14	12	35.00	34.35	.65
1368	Williams, Clark & Co's Pure Bone Meal	3.94	20.06	58	19	22	1	0	37.00	35.90	1.10
1402	Darling's Ground Bone	3.16	25.22	78	22	0	0	0	42.00	40.81	1.19
1363	Lister's Celebrated Ground Bone	3.61	13.72	30	15	27	28	0	27.00	25.16	1.84

* In New York.

BONE MANURES—*Continued.*

Station No.	Name or Brand.	Nitrogen.	Phos. Acid.	Finer than $\frac{1}{50}$ inch.	Finer than $\frac{1}{25}$ inch.	Finer than $\frac{1}{12}$ inch.	Finer than $\frac{1}{6}$ inch.	Coarser than $\frac{1}{6}$ inch.	Cost per ton.	Valuation per ton.	Cost exceeds valuation.
1371	G. W. Miller's Ground Bone	3.90	21.34	10	13	41	35	1	$34.00	$32.10	$1.90
1350	Rogers & Hubbard Co's Ground Bone, Fine AX	4.11	19.51	14	19	48	19	0	34.00	32.03	1.97
1431	W. H. Anderson's Fine Ground Bone	2.93	23.71	64	26	10	0	0	40.00	37.37	2.63
1574	Americus Pure Bone Meal	3.92	19.63	53	20	24	3	0	38.00	34.96	3.04
1583	Preston & Son's Ground Bone	4.39	11.77	45	20	16	9	10	30.00	26.42	3.58
1353	Peck Brothers' Pure Ground Bone	4.10	20.91	8	15	32	25	20	35.00	31.13	3.87
1417	Lombard & Mathewson's Ground Bone (fine)	4.12	19.93	38	18	23	21	0	38.00	34.10	3.90
1368	Williams Clark & Co's Americus Brand Pure Bone Meal,	3.63	20.27	45	21	25	9	0	38.00	33.97	4.03
1398	Adams' Fine Ground Bone	4.14	17.30	37	25	29	9	0	36.00	31.95	4.05
1420	Preston's Ground Bone	4.25	13.29	50	17	16	9	8	32.00	27.95	4.05
1377	Plumb & Winton's Bone Fertilizer	3.78	19.61	26	13	18	17	26	35.00	30.05	4.95
1525	Lister Bros.' Crescent Bone	3.55	12.64	44	19	21	15	1	30.00	25.00	5.00
1461	Ground Bone	3.99	21.61	2	2	7	11	78	------	26.75	
1560	P. W. Bennett's Ground Bone	3.60	24.05	5	9	29	47	10	32.00	32.23	
1564	G. H. Harris & Son's Pure Ground Bone	4.48	20.04	3	10	23	49	15	------	30.18	
1561	E. Smith's Bone	4.14	21.18	33	28	25	14	0	34.00	35.78	
1565	Wilkinson's Extra Fine Ground Bone	3.69	23.35	32	31	34	3	0	42.00	37.23	

BONE AND POTASH.

The samples whose analyses are given below, contain some potash.

They are valued in the same way as other bone manures with allowance of $4\frac{1}{4}$ cents per pound for the potash.

1433. E. F. Coe's ground bone, from stock of J. A. Paine, Danielsonville.

1577. E. F. Coe's ground bone, from stock of J. P. Little, Columbia. Sampled by the dealer.

1507. Bone and Potash, made by Williams, Clark & Co., N. Y. Stock of J. F. Silliman, New Canaan.

ANALYSES AND VALUATIONS.

Mechanical Analyses.

	1433.	**1577.**	**1507.**
Finer than $\frac{1}{50}$ inch	64	64	58
" " $\frac{1}{25}$ "	16	19	15
" " $\frac{1}{12}$ "	12	13	20
" " $\frac{1}{6}$ "	8	4	6
Coarser " $\frac{1}{6}$ "	0	0	1
	100	100	100

Chemical Analyses.

	1433.	**1577.**	**1507.**
Nitrogen	2.63	4.09	1.65
Phosphoric Acid	15.42	11.43	8.40
Potash	2.05	3.01	4.90
Cost per ton	$38.00	$35.00	$34.00
Valuation	26.30	29.42	19.48

DRY GROUND FISH.

Five samples of this article have been analyzed. The analyses follow.

1451. Preston's Fish Guano is not Dry Ground Fish in the ordinary meaning of the term, but is tabulated here for convenience.

The average cost of 4 samples of dry fish is $38.50, the average valuation $40.33, showing substantial agreement between actual cost and Station valuation.

Dry Ground Fish.

Station No.	Name or Brand.	Manufacturer.	Dealer.	Sampled and sent by
1501	Williams, Clark & Co., Dry Ground Fish.	Williams, Clark & Co., New York, N. Y.	W. C. Reynolds, East Haddam.	Station Agent.
1359	Quinnipiac Dry Ground Fish.	Quinnipiac Fertilizer Co., New London.	R. B. Bradley & Co., New Haven.	Station Agent.
1479	Bowker's Dry Fish.	Bowker Fertilizer Co., 43 Chatham St. Boston.	Coburn & Gale, Hartford.	W. F. Andross, East Hartford.
1425	Stearns' Fish Guano.	Stearns & Co., New York, N. Y.	J. E. Leonard, Jewett City.	Station Agent.
1587	Wilcox Dry Fish Guano.	L. Wilcox & Co., Mystic Bridge.	Manufacturer.	Manufacturer.
1451	Preston's Fish Guano.	H. Preston & Son, Greenpoint, L. I.	Smith & Sons, West Cornwall.	Station Agent.

Dry Ground Fish—Analyses and Valuations.

Station No.	Name or Brand.	Nitrogen.		Phosphoric Acid.					Available.		Cost per Ton.	Valuation per Ton.	Valuation exceeds Cost.
		Found.	Guaranteed.	Soluble in Water.	Reverted.	Insoluble.	Phos. Acid Found.	Phos. Acid Guaranteed.	Found.	Guaranteed.			
1501	Williams, Clark & Co's Ground Fish	8.68	----	1.02	4.12	1.23	6.37	----	5.14	----	$38.00	$40.66	$2.66
1359	Quinnipiac Dry Ground Fish	8.67	*7.00*	.77	2.46	3.51	6.74	*6.00*	3.23	*4.00*	38.00	40.18	2.18
1479	Bowker's Dry Fish	8.05	*8.00*	.93	4.44	2.17	7.54	*7.00*	5.37	----	38.00	39.49	1.49
1425	Stearns' Fish Guano	8.70	*7.80*	.93	3.89	2.00	6.82	*6.90*	4.82	----	40.00	41.01	1.01
1587	Wilcox Dry Fish Guano	8.41	*8.64*	.60	5.59	1.01	7.20	----	6.19	----	-----	41.10	
													Cost exceeds Val'n.
1451	Preston's Fish Guano	3.91	*3.50*	2.42	2.55	.84	5.81	*5.00*	4.97	----	37.50	23.19	4.31

Dried Blood.

1467. Dried Blood. Sold by Williams, Clark & Co., 101 Pearl street, New York. Stock of E. S. Roberts, East Canaan.

Analysis.

Nitrogen	11.67
Cost per ton	$40.00
Nitrogen costs per pound	17.1 cts.

Bone and Blood.

1529. Bone and Blood. Sold by Sperry & Barnes, New Haven. Stock of Sperry & Barnes. Sampled and sent by J. J. Webb, Hamden.

Analysis.

Nitrogen	7.14
Phosphoric acid	7.39
Valuation per ton	$34.57

Tankage.

1463. A mixture of peat and offal. Made by F. S. Andrew & Co., New Haven. Sampled and sent by W. T. Andrew, Tyler City.

Analysis.

Nitrogen	4.02
Phosphoric acid	4.83
Cost per ton	$20.00
Valuation	$20.67

Buffalo Horn Saw Dust.

1403. Buffalo horn saw dust. Made by B. B. Warren & Son, Plainville. Sampled and sent by J. W. Heminway, Plainville.

Nitrogen	14.85
Phosphoric acid	.08
Cost per ton	$30.00
Nitrogen costs per pound	10.1 cents.

Nitrate of Soda.

1515. Nitrate of soda. Mapes Formula and Peruvian Guano Co., New York. From stock of Wilson & Burr, Middletown. Sample drawn by Station agent.

Analysis.

Nitrogen	16.13
Equivalent nitrate of soda	97.90
Cost per ton	$52.50
Nitrogen costs per pound	16.2 cents.

Sulphate of Ammonia.

1379 and **1527.** Sulphate of Ammonia, made by E. H. Wardwell, No. 10 Warren street, New York, from stock purchased by J. J. Webb, Hamden.

1379. Sampled by J. J. Webb. **1527** by Station Agent.

1522. Sulphate of Ammonia, sampled by Station Agent from stock of Mapes Branch, Hartford.

Analyses.

	1379	1527	1522
Nitrogen	20.76	20.65	20.57
Equivalent ammonia	25.21	25.07	24.90
Cost per ton	$66.80*		76.00
Nitrogen costs per pound	16.1 cents.		18.4 cents.

Potash Salts.

1438. Muriate of Potash, stock of H. J. Baker & Bro., sampled and sent by Dennis Fenn, Milford.

1526. Muriate of Potash, 83.7 per cent., sold by H. J. Baker & Bro., New York, sampled by Station agent from stock purchased by J. J. Webb, Hamden.

1378. Muriate of Potash, 83.5 per cent., stock purchased of H. J. Baker & Bro., New York, by J. J. Webb, Hamden.

1374. Muriate of Potash, 70 per cent., sold by H. J. Baker & Bro., from stock of R. B. Bradley & Co., New Haven, sampled and sent by C. P. Augur, Whitneyville.

1520. Muriate of Potash, stock of G. B. Forrester, New York, sampled and sent by S. B. Wakeman, Saugatuck.

1521. Muriate of Potash, stock of G. B. Forrester, New York, sampled and sent by W. H. Couch, Saugatuck.

1499. Muriate of Potash, sold by Mapes F. & P. G. Co., New York, stock of Wilson & Burr, Middletown, sampled by Station Agent.

1466. Double Sulphate of Potash and Magnesia, Quinnipiac Fertilizer Co., New London, sampled by Station Agent, from stock of E. S. Roberts, East Canaan.

Analyses of Potash Salts.

	1438	1526	1378	1374	1520	1521	1499	1466
Potash found	50.66	51.23	51.82	42.06	53.43	52.65	50.84	26.62
Equivalent muriate	80.2	81.1	82.1	66.6	84.6	83.4	80.5	
Cost per ton	$44.50	41.85	40.30	38.00	44.00†	44.00*	42.50	35.00
Potash costs per lb.	4.4 cts.	4.1 cts.	3.9 cts.	4.5 cts.	4.1 cts.	4.2 cts.	4.2 cts.	6.6 cts.

*In New Haven. † $42.50 in New York.

Cotton Hull Ashes.

1407. Cotton Hull Ashes purchased by F. Ellsworth, Hartford, sampled and sent April 20, by H. S. Frye, Poquonock.

1408. Cotton Hull Ashes purchased by F. Ellsworth, sampled and sent by H. W. Alford, Poquonock.

1441. Cotton Hull Ashes sampled and sent by Olds & Whipple, Hartford. The sample was taken from a car load which had been thoroughly worked over and mixed.

1476. Cotton Hull Ashes sampled and sent by J. M. Brown, Poquonock, from stock of R. E. Pinney, Suffield.

1482. Potash and Phosphoric Acid sampled and sent by John Mason, Warehouse Point, from stock bought of R. E. Pinney, Suffield.

1344. Cotton Hull Ashes sampled and sent by H. S. Frye, Poquonock.

1505. "Lime and Potash Mixture" sent by D. G. Sperry, Windsor Hill.

Cotton Hull Ashes—Analyses and Valuations.

	1407	1408	1441	1476	1482	1344	1505
Soluble phosphoric acid	1.19	1.92	2.27	2.02	.40		.47
Reverted phosphoric acid	5.06	4.61	7.69	8.06	5.60	8.81	7.99
Insoluble phosphoric acid	1.53	1.33	1.17	1.42	.36		.44
Potash soluble in water	24.82	28.74	24.53	13.14	22.28	19.51	21.36
Insoluble in acid	19.32	14.51					
Cost per ton	$35.00	35.00	35.00	39.00	39.00	39.00	
Valuation per ton	$46.48	53.04	52.43	44.85	42.13	42.38	44.78

1343 is a sample of the clinker from furnaces in which cotton hulls are burned.

It contains:

Sand and silicates undecomposed by hydrochloric acid	39.32
Phosphoric acid soluble in ammonium citrate	5.45
" " insoluble " "	3.61
Potash soluble in water	9.20
" insoluble "	8.00

It is questionable whether it would pay to transport this material to the north, although it would be an excellent source of potash for farmers near the place where it is produced.

Cotton hull ashes vary considerably in composition, those which are lightest in color being usually richest in potash. They are at present by far the cheapest source of potash in our market and are specially prized by tobacco growers. The supply is however limited.

Tobacco Stems and Tobacco Dust.

1486. A sample of Tobacco Stems believed to be somewhat damaged.

1346. Tobacco Dust from the factory of A. Wassermann, New York, sent by J. S. Kirkham, Newington. We are informed that this material, which is a uniform and quite fine powder, is the siftings from tobacco "clippings." It costs 40 cents per 100 lbs. The analyses follow:

	1486	1346
Moisture	46.70	9.64
Organic and volatile matters (by difference)	43.26	44.68
(Containing nitrogen	1.62	2.42)
Sand and soil	.49	32.28
Oxide of iron and alumina	.01	2.35
Lime	1.85	4.15
Magnesia	.45	1.62
Potash	6.26	2.82
Soda	.10	.59
Sulphuric acid	.33	.79
Phosphoric acid	.41	.52
Chlorine	.14	.56
	100.00	100.00
Cost per ton	$14.50	$8.00

Valuing nitrogen at 18 cents per pound, phosphoric acid at 6 cents, the potash which will combine with the chlorine present at 4¼, and the excess of potash at 7¼ cents, the valuation of the tobacco stems is $15.28, of the tobacco dust $12.98 per ton.

1355. Spent Chloride of Lime. "Refuse from bleaching in knitting mills." Sent by James N. Bishop of Plainville. The material was a pasty mass which had the following composition:

Sand	1.34
Lime	23.48
Magnesia	0.38
Sulphuric acid	0.91
Chlorine as hypochlorite	1.65
Chlorine as calcium chloride	3.61
Water and matters undetermined	68.63
	100.00

The 1.65 per cent. of chlorine as hypochlorite corresponds to about 3 per cent. of calcium hypochlorite, which is the essential constituent of bleaching powder or so-called "Chloride of Lime."

The remaining 3.61 per cent. of chlorine corresponds to 9.7 per cent. of calcium chloride. There are then, 12.7 per cent. of lime salts present which are highly soluble in water, and unless greatly diluted, injurious. The hypochlorite is extremely corrosive and poisonous to vegetation. The calcium chloride if diluted with near one thousand times its weight of water would not be harmful and might be beneficial, but in a concentrated state would damage plants and injure the soil. It would not be wise to apply this lime to land or muck except in a small way as an experiment. Small quantities of this spent "Chloride of Lime" might perhaps be advantageously used in composting muck. The vegetable matter would neutralize or destroy the hypochlorite, but careful trials would be necessary to establish its value. If spread out thinly on land before plowing, especially on sod in the fall, it might be very useful for the lime it contains.

1516. Mud from a salt creek.

1517. Marine Mud.

1518. "Sea Lettuce."

The three last samples were sent for analysis by Borstelmann and Lobdell, Bridgeport.

Analyses.	1516	1517	1518
Water	72.98	69.18	72.19
Organic and volatile matter†	9.69	17.08	12.91
Ash*	17.33	13.74	14.90
	100.00	100.00	100.00
Containing nitrogen†	.35	.47	.36
Containing phosphoric acid*	.06	.13	.07
Potash	.16	.14	.53
Sand	11.80	7.46	8.19

Swamp Muck.

1581. A sample of Swamp Muck dug in 1883 and allowed to lie for two years on hard ground. The sample was taken from the middle of the heap.

Analysis.	
Water	28.78
Organic and volatile matters*	22.96
Ash	48.26
	100.00
With nitrogen*	.61

The ash contains :

	Analysis.
Sand and soil	43.43
Oxide of iron and alumina	2.55
Lime	.41
Magnesia	.39
Phosphoric acid	.13

The dry muck contains:

Organic and volatile matter	32.23
Nitrogen	.86
Sand and soil	60.99
Oxide of iron and alumina	3.59
Lime	.59

Review of the Fertilizer Market.

Nitrogen.

Nitrogen of organic matter.

In Dried Blood at wholesale, nitrogen was quoted in the New York market at 12 cents per pound in December, 1884. It rose to 13.4 cents in March and 14.3 cents in May, which was the highest figure for the year. It fell to 13.6 cents in July, rallied slightly in August, fell again in September to 13.4 cents and rose again to 13.9 cents in November. The average wholesale quotation for the year has been 13.4 cents; for the last 6 months 13.7.

In Azotin at wholesale*, nitrogen was quoted at 12.8 cents per pound in December, 1884, it rose to 13.7 cents in March and has remained at about that ever since. The average price for the year and also for the last six months has been not far from 13.6 cents per pound.

In *Dry Ground Fish at wholesale*, nitrogen was quoted in New York at $30.25 per ton in December, 1884. It fell to $29.00 in January of this year and to $27.50 in April. In May it was quoted at $29.00 and has remained there ever since.

Dry ground fish has averaged this year, according to 9 analyses made in Massachusetts, New Jersey and this State, 8.6 per cent. of nitrogen and 6.9 per cent. of phosphoric acid. Now if we take 4.8 cents per pound as the wholesale cost of phosphoric acid in fish (6 cents the retail price less 20 per cent.), we may reckon *approximately* the wholesale cost of nitrogen in dry fish which will be, at $27.50 per ton of dry fish, 12.2 cents; at $29.00 per ton of dry fish 13.0 cents.

* Azotin and Ammonite are trade names for animal matter (meat scrap, cracklings) very dry and free from grease.

The retail cost of organic nitrogen per pound at New York and Philadelphia factories during the last season has been about as follows :*—

In dried blood, 3 samples,	15.5 cents.
In dried fish, 3 samples,	14.8 "
In ammonite and tankage, 5 samples,	16.1 "

Retail Connecticut prices have been

Dried blood, 1 sample,	17.1
Dry fish, 5 samples	17.8

Nitrogen of Ammonia Salts.

At wholesale in New York, the nitrogen of sulphate of ammonia was quoted at about 15.4 cents per pound, from December, 1884, till July of this year. It fell to 14.9 cents in September where it still remains.

The average retail price of nitrogen in the same goods at New York and Philadelphia factories during the year (average of 8 analyses) has been† 16.7 cents per pound.

In Connecticut it has been sold at 16.1 and 18.4 cents per pound.

Nitrogen of Nitrate of Soda.

At wholesale in New York nitrogen in nitrate of soda was quoted at 14.4 cents per pound in December, 1884. It fell to 13.2 cents in April, rose again suddenly to 14.8 cents in August, 15.4 in September, 16 in October, while the average quotations for November were about 15.4 cents.

The average retail price of nitrogen in the same goods has been 16.7 cents per pound.‡

It has been sold in Connecticut at retail for 16.2 cents per pound.

The production of nitrate of soda is now controlled by a syndicate established in June, 1884, which aims to put on the market only enough to meet the demand and maintain steady, remunerative prices.

The syndicate has not yet fully realized the purpose for which it was formed because the stocks on hand when it was organized

* Bull. N. J. Ag'l Exp't St., xxxv, p. 9.
† Bull. N. J. Ag'l Exp't St., xxxv, p. 8.
‡ Bull. N. J. Ag'l Exp't St., xxxv, p. 8.

were very large, and moreover the state of the beet sugar market in Europe discouraged production of beets, lessened demand for nitrate of soda and so made the production of the nitrate for 1885 which had been determined on by the producers (ten million quintals), excessive.

During the first six months of 1885, nitrate of soda was sold in New York below London prices, and at times below cost of importation.

"Since 1870 with the exception of 1884, nitrate of soda was never so low as at present.

But at the same time the conditions are more favorable to a higher range of values, or at least the disturbing elements which have induced wide and violent fluctuations are absent, the production now being limited to the consumptive requirements of the world."—*New York Oil, Paint and Drug Reporter*, Jan. 6, 1886.

Phosphatic Materials.

Refuse Bone Black, which was quoted at $16.50 per ton in December, 1884, rose to $17.50 in April and is still quoted at that figure.

Ground Bone previously quoted at $29.00 per ton rose to $29.50 in May last and still remains at that figure.

Charleston Rock, f. o. b. in New York, was quoted at $8.75 per ton till September when it fell somewhat and is now quoted at $8.25.

Sulphuric Acid, 60°, quoted at 1.19 cents per pound in December, 1884, fell to 1.00 in April, rose again in October and was quoted at 1.05 cents per pound in November.

The above are wholesale quotations of the crude materials from which superphosphates are made. If we assume that soluble, reverted and insoluble phosphoric acid have *commercial* values (to be distinguished from agricultural values) which stand in the ratio of 9, 8 and 2, then the retail cost per pound of phosphoric acid in plain superphosphates bought direct of New York and Philadelphia manufacturers, as shown in analyses reported by the New Jersey Station* has been as follows:—

* Bulletin xxxv.

	Soluble.	Reverted.	Insoluble.
In Superphosphates from Bone Black, Bone Ash, etc.	7.8 cents.	6.9 cents.	1.7 cents.
In Superphosphates from So. Carolina and other mineral phosphates	8.6 "	7.6 "	1.9 "

In the four samples of plain superphosphates whose analyses have been given in this Report, the average costs of soluble reverted and insoluble phosphoric acid have been 8.4, 7.4, and 1.8 cents per pound respectively.

Actual Potash.

In Muriate of Potash.

Potash at wholesale in New York was quoted at 3.3 cents per pound in December, 1884. It rose in March to 3.6 cents, fell again in June to 3.36 and has averaged about that ever since, being quoted at 3.38 cents per pound in November.

At retail in New York and Philadelphia, potash in high grade muriate has cost about 4.13 cents per pound.

The Connecticut retail price has been from 3.9 and to 4.4 cents per pound.

In Kainit.

Kainit at wholesale in New York was quoted at $6.76 per ton in December, 1884. It rose steadily till April to $9.25. Again it fell and was quoted at $6.85 in July. Since then it has risen to $7.40 in November.

Kainit varies considerably in composition. Assuming 12.2 per cent. of potash as its actual content the above quotations may be expressed in cost of actual potash as follows:—

At wholesale in New York, actual potash in Kainit cost .82 cents per pound in December, 1884. It rose steadily till April, when it was quoted at 3.8 cents. Again it fell to 2.8 cents in July. Since then it has risen to 3 cents in November.

At retail in New York and Philadelphia it has cost about 4.5 cents per pound.

New Grades of Potash Salts.

There are two new grades of potash salts that have recently come into market, which deserve special attention from those who intend to purchase this class of fertilizers for use in the Spring.

One is "95 to 98 per cent. Muriate of Potash," a purer form of muriate than the 80 per cent. The other is "96 to 98 per cent. Sulphate of Potash," which was sold *at wholesale in New York* in November last at $2\frac{1}{4}$ cents per pound or about 4.4 cents per pound of actual potash.

This would make the retail cost of potash in the form of sulphate not far from 5.3 cents per pound instead of $7\frac{1}{4}$ cents which has been its valuation in double sulphate of potash and magnesia during the last year.

To recapitulate:

The fertilizer market, as far as we have been able to learn, has been subject to the usual temporary fluctuations, but there has been no considerable and permanent change in the market price of any of the standard raw materials from which mixed goods are made. The market quotations given above are taken from the "Oil, Paint and Drug Reporter," published in New York. The weekly quotations for each month are averaged, and this average is taken as the quotation for the month.

The following explanations will be helpful in the examination of the market quotations, and will also serve to show the basis on which they have been interpreted in this review:

Phosphate rock, kainit, bone, fish scrap, tankage, and some other articles are quoted and sold by the ton. The seller usually has an analysis of his stock, and purchasers often control this by an analysis at the time of purchase.

Sulphate of ammonia, nitrate of soda and muriate of potash are quoted and sold by the pound, and generally their wholesale and retail rates do not differ very widely.

Blood, azotin and ammonite are quoted at so much "per unit of ammonia." To reduce ammonia to nitrogen multiply the per cent. of ammonia by the decimal .824. A "unit of ammonia" is one per cent., or 20 pounds per ton. To illustrate: if a lot of dried blood has 7.0 per cent. of nitrogen, equivalent to 8.5 per cent. of ammonia, it is said to contain $8\frac{1}{2}$ units of ammonia, and if it is quoted at $2.25 per unit, a ton of it will cost $8\frac{1}{2} \times 2.25 = 19.13$.

The term "ammonia" is *properly* used only in those cases where the nitrogen actually exists in the form of ammonia, but it is a

usage of the trade to reckon all nitrogen, in whatever form it occurs, as ammonia.

To facilitate finding the actual cost of nitrogen per pound from the cost per unit of ammonia in the market reports, the following table is given:

Ammonia at	$4.00	per unit	is equivalent to	nitrogen at	24.3	cts.	per lb.
"	3.90	"	"	"	23.7	"	"
"	3.80	"	"	"	23.0	"	"
"	3.70	"	"	"	22.4	"	"
"	3.60	"	"	"	21.8	"	"
"	3.50	"	"	"	21.2	"	"
"	3.40	"	"	"	20.6	"	"
"	3.30	"	"	"	20.0	"	"
"	3.20	"	"	"	19.4	"	"
"	3.10	"	"	"	18.8	"	"
"	3.00	"	"	"	18.2	"	"
"	2.90	"	"	"	17.6	"	"
"	2.80	"	"	"	17.0	"	"
"	2.70	"	"	"	16.4	"	"
"	2.60	"	"	"	15.8	"	"
"	2.50	"	"	"	15.2	"	"
"	2.40	"	"	"	14.6	"	"
"	2.30	"	"	"	14.0	"	"
"	2.20	"	"	"	13.4	"	"
"	2.10	"	"	"	12.8	"	"
"	2.00	"	"	"	12.2	"	"

Commercial sulphate of ammonia contains on the average 20.5 per cent. of nitrogen, though it is found to vary considerably in quality. When it has that amount of nitrogen (equivalent to 24.3 per cent. of ammonia),

At	5	cents	per lb.	Nitrogen	costs	24.4	cents per lb.
"	$4\frac{7}{8}$	"	"	"		23.7	"
"	$4\frac{3}{4}$	"	"	"		23.1	"
"	$4\frac{5}{8}$	"	"	"		22.5	"
"	$4\frac{1}{2}$	"	"	"		21.9	"
"	$4\frac{3}{8}$	"	"	"		21.3	"
"	$4\frac{1}{4}$	"	"	"		20.7	"
"	$4\frac{1}{8}$	"	"	"		20.1	"
"	4	"	"	"		19.5	"
"	$3\frac{7}{8}$	"	"	"		18.9	"
"	$3\frac{3}{4}$	"	"	"		18.3	"
"	$3\frac{5}{8}$	"	"	"		17.6	"
"	$3\frac{1}{2}$	"	"	"		17.0	"
"	$3\frac{3}{8}$	"	"	"		16.4	"
"	$3\frac{1}{4}$	"	"	"		15.8	"
"	$3\frac{1}{8}$	"	"	"		15.2	"
"	3	"	"	"		14.6	"

Commercial nitrate of soda averages 95 per cent. of the pure salt or 15.6 per cent. of nitrogen.

If quoted at	$3\frac{5}{8}$	cents per lb.	Nitrogen costs	23.2	cents per lb.
"	$3\frac{1}{2}$	"	"	22.3	"
"	$3\frac{3}{8}$	"	"	21.5	"
"	$3\frac{1}{4}$	"	"	20.8	"
"	$3\frac{1}{8}$	"	"	19.9	"
"	3	"	"	19.2	"
"	$2\frac{7}{8}$	"	"	18.3	"
"	$2\frac{3}{4}$	"	"	17.6	"
"	$2\frac{5}{8}$	"	"	16.9	"
"	$2\frac{1}{2}$	"	"	16.0	"
"	$2\frac{3}{8}$	"	"	15.2	"
"	$2\frac{1}{4}$	"	"	14.4	"
"	$2\frac{1}{8}$	"	"	13.6	"
"	2	"	"	12.8	"

Commercial muriate of potash usually has 80 per cent. of the pure salt, or $50\frac{1}{2}$ per cent. of actual potash.

If quoted at	2.00	cts. per lb.	Actual potash costs	3.96	cts. per lb.
"	1.95	"	"	3.86	"
"	1.90	"	"	3.76	"
"	1.85	"	"	3.66	"
"	1.80	"	"	3.56	"
"	1.75	"	"	3.46	"
"	1.70	"	"	3.36	"
"	1.65	"	"	3.26	"
"	1.60	"	"	3.16	"
"	1.55	"	"	3.06	"
"	1.50	"	"	2.96	"

The following table shows the fluctuations in the wholesale prices of a number of fertilizing materials in the New York market, since May, 1882. The price given for each month is the average of the four weekly quotations in that month. Sulphate of ammonia is assumed to contain 20.5 per cent. and nitrate of soda 15.6 per cent. nitrogen, and muriate of potash $50\frac{1}{2}$ per cent. of actual potash or 80 per cent. of the pure salt.

		COST OF NITROGEN AT WHOLESALE IN				COST OF POTASH. AT WHOLESALE IN
		Blood. cts. per lb.	Azotin or Ammonite. cts. per lb.	Nitrate of Soda. cts. per lb.	Sulphate of Ammonia. cts. per lb.	Muriate of Potash. cts. per lb.
1882.	May	19.1	19.7	18.3	22.7	3.26
	June	18.9	19.7	16.9	22.4	3.28
	July	19.8	19.5	16.8	22.4	3.40
	August	19.5	19.5	16.8	22.4	3.52
	September	19.7	20.3	17.7	22.4	3.60
	October	19.7	20.1	17.8	22.3	3.56
	November	19.7	20.0	17.6	22.2	3.56
	December	19.7	20.1	17.6	21.8	3.58
1883.	January	19.7	20.1	17.9	20.7	3.51
	February	19.4	19.7	17.9	21.9	3.42
	March	18.0	18.9	17.8	20.7	3.42
	April	18.2	18.9	17.9	20.1	3.40
	May	18.2	18.9	16.3	20.1	3.34
	June	17.8	18.9	16.3	20.0	3.36
	July	17.2	18.9	15.6	19.0	3.23
	August	16.0	18.9	15.3	18.6	3.18
	September	15.3	17.0	14.8	17.6	3.21
	October	15.0	15.2	14.8	17.3	3.12
	November	14.5	15.2	15.2	16.4	3.20
	December	14.4	17.0	15.2	16.4	3.22
1884.	January	12.9	13.2	14.8	16.4	3.28
	February	13.2	13.7	14.3	15.0	3.23
	March	13.6	13.7	14.2	14.6	3.34
	April	13.6	13.6	14.0	14.6	3.38
	May	14.0	13.9	14.4	15.3	3.44
	June	13.9	13.5	13.8	14.6	3.36
	July	13.2	13.5	14.2	14.9	3.37
	August	13.6	13.3	14.3	14.7	3.36
	September	12.8	13.3	14.4	14.4	3.28
	October	12.9	13.2	14.3	14.8	3.38
	November	12.4	12.6	14.4	15.2	3.26
	December	12.1	12.8	14.4	15.2	3.32
1885.	January	12.3	13.0	14.1	15.2	3.32
	February	12.6	13.4	14.4	15.2	3.36
	March	13.4	13.7	13.2	15.2	3.58
	April	13.6	13.7	13.2	15.2	3.51
	May	14.3	13.7	14.1	15.2	3.54
	June	13.9	13.7	14.0	15.2	3.36
	July	13.6	13.6	14.0	15.0	3.31
	August	13.8	13.6	15.0	14.9	3.34
	September	13.4	13.5	15.6	14.8	3.36
	October	13.4	13.5	16.0	14.8	3.36
	November	13.8	13.5	15.6	14.8	3.38

ANSWERS TO CORRESPONDENTS.

How much Nitrogen, Phosphoric Acid and Potash are removed from an Acre of Land in an Average Corn Crop?

From an acre of land on the New Jersey State College Farm* under ordinary cultivation there were harvested in 1884,

3824 pounds of shelled corn.
4041 " dried stalks.
950 " cobs.

These contained the following percentages of nitrogen, phosphoric acid and potash.

	Nitrogen.	Phosphoric Acid.	Potash.
Shelled Corn	1.38	0.71	0.40
Stalks	0.65	0.37	0.82
Cobs	0.31	0.27	0.50

Therefore the total amount of these ingredients, calculated in pounds to the acre, is as follows :—

	Nitrogen. pounds.	Phosphoric Acid. pounds.	Potash. pounds.
In shelled corn	52.7	27.2	15.3
In dried stalks	26.3	15.0	33.1
In cobs	2.9	2.6	4.8
Total	81.9	44.8	53.4

What is the best Fertilizer?

"The question as to which is the most serviceable and best fertilizer is like the question, which is the best and most serviceable medicine—impossible to answer. All depends on the patient, on what ails him, and on how he is being treated otherwise.

"The Experiment Station might be compared to a sanitary engineer, but not to a practicing physician! We are unable to prescribe for land. The only way is for the practical farmer to make trials on his land with fertilizers or fertilizing chemicals which he knows are of good quantity and study the effects."

"I cannot advise you as to which is the best patented manure for potatoes and corn? Few, if any, of the Fertilizers sold in this State are patented. They all claim to be good and most of them are good. There is a choice among them in respect to cost which you can make by referring to the Station Reports.

"There is a choice also in respect to action on the crop. This will depend somewhat on the character of your soil and can only

* See Report N. J. Ag'l Exp't Station, 1884, 127.

be learned by experience. One fertilizer will appear to be best one year or on some crops and land and another season owing to different weather, wet or drought, or on other land or plants, another kind of fertilizer will give the best result. I should try a fertilizer that would give me *a good percentage of nitrogen, soluble phosphoric acid and potash for the least money.*"

"We can give no formula for an Onion Manure. The food which the onion requires is the same that all other crops require. If it requires any special proportions of fertilizing ingredients neither we or any one else can positively say what that is. Probably a fertilizer having about the composition of the "special" onion, potato, tobacco or corn manures would be as profitable a fertilizer as you could apply to the onion."

Cotton Seed Meal.

A correspondent writes, "I wish you would tell me if there is much variation in the value of cotton seed meal for feeding purposes.

Do they make two kinds of cotton seed meal, one including the hull and the other not?

Does the cotton seed meal of your analyses Report of 1884 include the hull ground with the kernel?

I wish you would advise me which is preferable to fatten cattle and sheep: cotton seed meal or 'New Process' linseed meal."

It was replied:

"The best cotton seed meal is that which is ground from the 'decorticated seed.' It contains no hull and no cotton fibre. It has a nearly pure yellow color.

Damaged cotton seed meal, originally good but injured by wet and mould, or ground from damaged seeds often comes into the market at low rates, but is properly used as a fertilizer only.

Cotton seed meal made from the entire seed, after removal of cotton fibre as far as practicable, is another inferior grade and may be recognized by the dark particles of hull which it contains. A sample of this article analyzed here in 1881 (the cost of which was $30.00 per ton) contained 22.25 per cent. of protein while the best (decorticated) cotton seed meal contains about 42 per cent. of protein.

The comparative feeding values of the two sorts are, roughly speaking, in the ratio of their content of protein. The undecorticated meal contains but little more than half as much as the other

and also contains the indigestible and therefore worse than useless hulls.

Cotton seed meal and new process linseed meal have the following average composition.

	Cotton seed meal 24 analyses.	New process linseed meal. 12 analyses.
Water	8.33	10.12
Ash	7.25	5.93
Protein	42.06	32.94
Fibre	5.69	9.09
Nitrogen-free extract	23.43	38.35
Fat	13.24	3.57
	100.00	100.00

You will notice that cotton seed contains some nine per cent. more protein and 9¾ per cent. more fat than new process linseed meal. It therefore contains considerably more nutritive matter and if the selling price is the same is considerably cheaper.

The very concentrated nature of cotton seed meal, however, renders the more caution necessary in its use. Cattle can only stand small quantities of it without digestive disturbance."

It may be added that in England the undecorticated cake is preferred by some for feeding to the other kind, because as alleged it seldom if ever produces unfavorable symptoms in the cattle. This it has been claimed is due to astringent and medicinal properties in the hulls, but is very likely due to the fact that undecorticated cake is less concentrated and therefore is less likely to be fed in excessive amount. Cotton seed which is not *perfectly* sweet is entirely unfit for food. It is not unlikely that the albuminoids which make up about half of the dry substance of cotton seed meal when they begin to decompose on account of dampness, may give rise to poisonous alkaloids similar in nature to those formed from nitrogenous animal matter under like circumstances and like those developed in damaged maize to which in Italy the disease called *pellagra* has been attributed.

The Application of Potash Salts.

The following observations in regard to this subject freely translated from a book by Dr. Märcker of the Halle Experiment Station (Die Kalisalze und ihre Anwendung in der Landwirthschaft), are of value to the farmers of this State in view of the increasing use which is being made of this class of fertilizers.

After a careful review of recorded experiments on the matter Dr. Märcker concludes:

1. Failure in the use of potash salts is very often due to a lack of phosphoric acid and nitrogen in the soil.

2. A *direct* action of potash salts is only to be expected on such soils as are naturally deficient in potash, especially light porous soils.

3. Since by absorption in the soil all potash salts pass into combination with silica, it is of no consequence as far as supplying a deficiency of potash is concerned whether muriate or sulphate is used. Frequently therefore the cheapest form of potash is the best.

4. There is no reason to believe that the potash salts containing chlorine are injurious to vegetation: on the contrary the muriate is often to be preferred because its potash is more thoroughly diffused in the soil.

5. Potatoes and sugar beets form an exception since the starch or sugar production is decreased by muriates. Tobacco is also injured as to burning quality by the same.

The prejudice against magnesium chloride in potash salts is also unreasonable. In dilute solution it is no more hurtful than potassium or sodium chlorides.

6. The impure (low grade) potash salts have indirect effects as follows:

a. They act as solvents on the plant food held in the soil.

b. They keep the soil more moist.

c. They tend to make summer grain ripen earlier.

From his observations of the effect of potash salts on particular crops, we select the following:

Potatoes. In almost all cases potash salts have increased the yield, when used in connection with nitrogenous and phosphatic manures. In very few cases was the per cent. of starch in the potatoes increased, in many cases (12 out of 21) it was considerably diminished. The depression of starch was greatest when potash salts were applied nearest planting time. The muriates decreased the starch yield more than the sulphates especially when applied late. Low grade salts or the muriate if used, should therefore be applied as early as possible, at the latest in December, any excess which might do no harm on other crops should be avoided, and if the potash must be applied near planting time only sulphate should be used.

Fodder Beets. Here too the potash salts were generally only useful when phosphates and nitrogenous manure were used together with them. In some cases common salt was as effectual as potash salts, indicating that the indirect action of the salts was the most important.

Muriates gave better results than sulphates. A late application of potash salts containing much chlorine specially favored the development of leaves.

When muriates were applied late they increased the dry substance of the crop less than sulphates.

In general potash salts produce good effects on all crops if used rationally in connection with nitrogenous matter and phosphates.

With regard to the soils which are specially adapted for utilizing potash salts, Dr. Märcker says: "They work with absolute certainty on all moor lands. On light sandy soils their action is also tolerably certain when used in connection with nitrogen and phosphoric acid."

Necessary conditions for success in the use of potash salts are that there shall be no accumulation of free acid or of soluble iron salts in the soil nor of standing water in the subsoil. Standing water must be got rid of by drainage, iron salts and free acid by an application of lime.

Here follow certain rules for the use of muriate of potash issued by the Stassfurt Syndicate of Potash Manufacturers:

Rules for the Employment of Muriate of Potash for Manuring Purposes.

The best time for manuring with muriate of potash depends chiefly on the quality of the soil. For heavy soils, manuring in autumn and winter is to be recommended; while for light and sandy soils, early spring is the most suitable time. For meadows, also moorland and all kinds of land liable to be flooded, manuring in spring is advisable.

The best method for employing muriate of potash for field and garden cultivation is to strew it by hand, broad cast, on the unplowed field or the rough furrow. A top dressing of manure is only recommended for meadows, clover and lucerne, but it must be done in early spring with care and if possible, during wet weather. To place the muriate near the seed in drills or hills is not advisable. When strewed by hand, it is recommended that

the muriate of potash be mixed with an equal or double quantity of dry earth or peat-dust, also in distributing by sowing machines a previous mixing with other artificial manures such as superphosphate, guano, etc., is recommended. Deep and regular plowing is of great importance when the plants have to be hoed. For cultivating vines and fruits, it is advisable to make a solution of the salts and to mix the same with liquid manure (in spring).

The quantity required for potash manuring is, of course, dependent on the chemical condition of the soil and also the amount of potash the intended crop requires. However it may be taken as a general rule, that $1\frac{1}{2}$ to $4\frac{1}{2}$ cwts. of 80 per cent. muriate of potash for one acre are necessary and remunerative.

On Methods of Testing the Agricultural Value of Nitrogen in Mixed Fertilizers.

It is a fact of common farm experience that nitrogenous manures differ widely in their efficiency. Nitrate of soda for example often has a visible effect on grass land within ten days after sowing; dried blood requires a longer time to affect the color or growth of grass, while an application of leather or hair may never show the slightest effect. The nitrogen of nitrate of soda and of blood is said to be "available" while that of leather or hair is called "inert."

These terms are relative. Probably any form of nitrogen in the soil may to some extent and at some time become "available," as the potash contained in granite, or the phosphoric acid in apatite are gradually changed into soluble plant food. It is nevertheless justly demanded that the nitrogen of commercial fertilizers, which is their most costly ingredient, shall be in such a form that it is readily and completely assimilated by vegetation so that the value of the application may be largely realized in one season. Only such forms of nitrogen can be fairly called available.

A considerable number of manufacturing wastes, rich in nitrogen but differing greatly in their value as plant food, are now on the market and their use is urged upon manufacturers of mixed fertilizers. In general, such of these waste products as are agriculturally of least value are also least expensive, and therefore the temptation to use them in manufactured goods is to some very strong.

It is highly desirable to know in the first place how these

nitrogenous wastes compare with each other and with some standard such as nitrate of soda in availability, and various experimenters have already accomplished something in this direction.* In the next place it is important either to be able to identify these various "ammoniates" in mixed fertilizers, or else to have some means of distinguishing in such fertilizers between available and inert nitrogen;—some measure of its availability. Unfortunately it has hitherto been difficult or impossible to identify with certainty most of the inferior ammoniates either by inspection or by ordinary chemical tests. The treatment with acid during the process of manufacture, the grinding and the mixture with phosphatic material and potash salts, so alters the structure and appearance that in many cases the microscope fails to identify anything and chemical tests are not generally applicable. A study of the solubility of the ammoniates in given reagents or the rapidity of their decomposition by fermentation under given conditions may lead to some practical method of determining the availability of nitrogen in mixed fertilizers.

It is believed that plants take their supply of nitrogen from the soil chiefly in the form of nitric acid and therefore organic nitrogenous matter must undergo decomposition and solution in the soil water before its nitrogen can be available. Such nitrogenous matters as are most readily soluble or most readily fermented in the soil will, other things being equal, be most available as fertilizers.

It is impossible to imitate exactly the solvent action of the soil water and the fermentation which takes place when a small amount of nitrogenous matter is mixed with large quantities of earth as in ordinary farm practice, but the relative solubility and rapidity of fermentation of these ammoniates can be tested under accurately controlled conditions and also their relative crop-producing power. Then if these two methods of examination give concordant results, the first named may be adopted as a

* See Storer, Bulletin Bussey Institution, 1877, part I, 58, On the Fertilizing Power of Roasted Leather. Petermann, Centralblatt, Ag. Chem., 1881, 590, On the Agricultural Value of Leather Meal. Same Journal, 1882, 454, On the Agricultural Value of so-called "Dissolved Wool." Same Journal, 1883, 658, On the Agricultural Value of Dried Blood. Märcker, Centralblatt, Ag. Chem., 1883, 584, On the Value of Different Nitrogenous Compounds as Plant Food and their Influence on the Composition of Barley (Nitrate of Soda, Sulphate of Ammonia, Blood Meal, Horn Meal and Leather Meal).

test of the availability of nitrogen in mixed goods which from the nature of the case could not be tested by the method of field or pot experiment.

Stutzer and Klinkenberg, Journal für Landwirthschaft, 1882, p. 363, proposed to digest nitrogenous fertilizers with an artificially prepared gastric juice and determine the solubility of the nitrogen in this reagent as a measure of its comparative solubility in the soil.

The results obtained by these investigators need not here be repeated in detail, since they have been republished recently in this country in an article by Drs. Shepard and Chazal of South

Results of Drs. Shepard and Chazal.

Nitrogenous Organic Matters and Mixtures examined by Shepard and Chazal. Description.	Containing of total Nitrogen.	Of 100 Parts of Nitrogen contained in each substance	
		Were Dissolved Parts.	Were not Dissolved Parts.
	Per cent.		
1. Dried Blood (preëminently red)	15.19	99.81	0.19
2. Dried Blood (preëminently black)	14.49	78.61	21.39
3. Dried and ground fish-scraps after expression of oil	11.56	88.67	11.33
4. Dried animal matter from slaughter house	12.84	61.29	38.71
5. Dried Flesh (principally muscular)	14.17	93.32	6.68
6. Dried Limulus Polyphemus (King Crab), shell and all. Said to be abundant in supply	12.15	52.10	47.90
7. Acidulated Fish-scraps	7.14	84.59	15.41
8. Roasted Leather Meal	9.92	37.80	62.20
9. Cotton Seed (pressed and ground)	7.76	83.18	16.82
10. The above after extraction of remaining oil by bisulphide of carbon	8.56	85.67	14.33
11. Cotton Seed, simply ground, neither linted, pressed nor cleaned	4.23	83.10	16.90
12. Mixture, ⅓ Cotton Seed Meal, ⅓ Kainite and ⅓ English Acid Phosphate	2.66	88.35	11.65
13. Mixture, ⅓ Cotton Seed Meal, ⅓ Kainite and ⅓ Phosphate Dust (Floats)	2.78	79.14	20.86
14. Acid Phosphate ammoniated with leather meal and dried out with burnt marl*	1.70	30.25	69.75
15. Acid Phosphate ammoniated with No. 4, and dried out with burnt marl*	2.14	85.80	14.20
16. Mixture, Acid Phosphate, Kainite, Nitrate of Soda, Sulphate of Ammonia and No. 8	3.18	52.99	47.01
17. The same, except with No. 1, instead of No. 8	3.10	90.32	9.68
18. The same, except with No. 4, instead of either 8 or 1	2.74	74.50	25.50

* In both of these cases the ammoniating matter was thoroughly soaked with acid before adding the phosphatic powder. The acid employed was of 50° B. strength.

Carolina on Available Nitrogen. In general the results showed good agreement with the results of field trials, in that the nitrogen of approved ammoniates, such as blood, raw and steamed bone and Peruvian guano, was quite soluble in gastric juice (from 88 to 98 per cent.) and the nitrogen of ammoniates known to be inferior, leather, horn and wool waste, was quite insoluble (2.7—40.7). The articles experimented with were blood meal, roasted leather meal and horn meal, horn shavings, poudrette, wool waste (actual wool), raw bone meal, steamed bone meal, and Peruvian guano. Drs. Shepard and Chazal, in the pamphlet referred to, have extended the investigation of Stutzer and Klinkenberg to other ammoniates such as are used in this country. The results are here given in full, with the explanations.

3. This sample of dried and ground fish-scraps was an exceedingly well prepared one.

4. This sample had been through the process of "rendering" with superheated steam, which may have removed some of the "available" nitrogen.

5. A very admirable preparation of dried meat-scraps.

6. The king crab was chopped into bits and then dried, shell and all. Although quite nitrogenous, it does not appear to be "available." Perhaps after the extraction of its oil, it might prove more so.

7. A sample of acidulated fish-scraps. Had this article been as well prepared as No. 3, the results might have proven better.

8. An excellent article, so far as preparation goes, and one capable of being used in the fertilizer trade without much fear of detection. The result agrees with that obtained by Stutzer and Klinkenberg.

9, 10. The extraction of the oil remaining in No. 9 increases relatively its content of nitrogen, as also its availability.

12, 13. The cotton seed in these mixtures affords about the same amount of available nitrogen as it does by itself, although that mixed with the acid phosphate yielded the best results of any.

14. It will be noted that this treatment of the leather meal did not improve its solubility.

15. Whereas the same treatment increased the availability of the dried animal matter.

16. The mixture was proportioned to contain about 2 per cent. of nitrogen from leather alone; and, throwing out of the calculation the rest of the nitrogen, it will be found that about 25 per cent. of the leather's nitrogen was dissolved. This result agrees with No. 14 rather than with No. 8.

17. Mixture calculated to contain about 2 per cent. of nitrogen from No. 1 (dried blood). Throwing aside the nitrogen due to the presence of nitrate of soda and sulphate of ammonia, it will be seen that 85 per cent. of the nitrogen due to the dried blood was dissolved.

18. Mixture calculated to contain about 2 per cent. of nitrogen from No. 4 (dried animal matter). Here 35 per cent. of the nitrogen in the dried animal matter failed to be dissolved, which agrees quite tolerably with result No. 4 (38.71 per cent.).

"Our conclusion, based on the preceding results, leads us to believe that this method may probably be developed into a useful adjunct in the examination of nitrogenous organic matters, and possibly in that of the ordinary commercial manures containing nitrogen. Already we believe that it is susceptible of improvement, and we do not doubt that it will experience material modification in the hands of those analytical chemists who may try it. To them we would commend it as a very interesting mode of investigation. Ultimately it may prove of value to the agricultural public."

At the time of publication these gentlemen hoped to continue this investigation, but as nothing has since been published by them and as the matter is of great importance to those who have the responsibility of official fertilizer examinations, this Station undertook last summer a further study of the subject.

The object was to compare under exactly the same conditions every kind of ammoniating material with which we were familiar in reference to the solubility of the nitrogen in pepsin solution, and so to learn whether the method would in all cases distinguish by their solubility ammoniates which were known to be agriculturally valuable from those which were believed to be agriculturally worthless and then to test the applicability of the method to mixed fertilizers.

The present paper is chiefly concerned with the examination of the different ammoniates by themselves.

The preparation of reagents and the details of the process are as follows:

Pepsin solution was made by dissolving 5 grams of Golden Scale Pepsin, made by the New York & Chicago Chemical Co., in 1000 c. c. of 0.2 per cent. hydro-

chloric acid and filtering the solution. A large amount of the dry, thoroughly mixed pepsin was kept on hand and the solution was made up only as required.

The Digestion.—Two grams of the nitrogenous material in a beaker of 300 c. c. capacity was treated with 200 c. c. of pepsin solution, and the beaker, covered with a watch-glass, was placed in a water bath kept at 40° C. This bath consisted of a galvanized iron box 8 inches deep, 16 inches long by 12 inches wide, standing on legs with a well-fitting cover perforated to admit a thermometer. Inside, five inches below the upper edge of the box was a diaphragm full of perforations on which the beakers stood and sufficient water was poured in to fill the bath about on a level with the solution in the beakers. This large amount of water in the bath made the regulation of temperature comparatively easy. After two hours digestion 0.1 per cent. of hydrochloric acid was added (2 c. c. of a 10 per cent. solution) with vigorous stirring. Every three hours this was repeated, so that at the end of 12 hours the total amount of hydrochloric acid present was six-tenths of one per cent. The heat was then removed and the solution allowed to cool in the bath. The next day the heating was continued for 12 hours, acid being added as before till one per cent. of acid was present. The solutions were then filtered on paper with the aid of the pump. The residues were washed with water and dried and nitrogen was determined, deduction being made when necessary for nitrogen in the filter paper.

The determination of nitrogen was in all cases made by Kjeldahl's method and thus was avoided all necessity for cutting the filter paper fine. All materials experimented on were ground so as to pass a $\frac{1}{60}$ in. sieve.

Preliminary Experiments.

Effect of acid without pepsin.

Hydrochloric acid has of itself a peptonizing action and experiments with wheat bran had shown that this acid alone dissolved very nearly as much nitrogenous matter as it did when pepsin was present.

To ascertain whether the same would hold true with the materials under examination, parallel experiments were made with ground leather and dried blood, using in one case acid alone, in the other pepsin solution.

	Of the total nitrogen were dissolved by acid alone.	by pepsin solution.
From dried blood	17.7 per cent.	96.8 per cent.
From leather	14.5	25.4

The addition of pepsin is evidently necessary.

Effect of Salts.

Certain salts are known to hinder the solvent action of pepsin solution. It is proposed to remove all salts which are soluble in water, previous to the digestion, when they are present in consid-

erable quantity; but calcium phosphate and to some extent calcium sulphate cannot be so removed. To decide whether their presence interfered seriously with the solution of nitrogen, digestions were made in the manner described, both with dried blood and with dry fish, adding in each case certain quantities of the salts named. The tri-calcium phosphate was a chemically pure article prepared by precipitation and therefore more easily soluble in dilute acid than ordinary rock phosphate. Calcium sulphate was in the form of fine ground land plaster. The results were as follows:

	Of the total nitrogen were dissolved.
2 grams dried blood	98.1 per cent.
2 grams dried blood + 1 gram phosphate	96.9 "
2 grams dried blood + 2 grams phosphate	95.9 "
2 grams dried blood + 2 grams phosphate + 1 gram gypsum	94.8 "
2 grams dried blood + 2 grams phosphate + 2 grams gypsum	93.7 "
2 grams dried blood + 4 grams phosphate + 4 grams gypsum	75.3 "
2 grams dry fish	70.0 per cent.
2 grams dry fish + 1 gram phosphate	70.1 "
2 grams dry fish + 2 grams phosphate	67.1 "
2 grams dry fish + 2 grams phosphate + 1 gram gypsum	68.7 "
2 grams dry fish + 2 grams phosphate + 2 grams gypsum	62.4 "
2 grams dry fish + 4 grams phosphate + 4 grams gypsum	47.6 "

When present in large quantity these salts seriously interfere with the solution of nitrogen. In none of the ammoniates however is the ratio of organic to inorganic matter lower than 1 to 1, and in none is the inorganic matter so readily soluble and so liable in consequence to interfere as in these artificial mixtures of an ammoniate with salts. These results, as well as those of Shepard and Chazal, indicate that the presence of phosphate and sulphate of lime affects the solubility of nitrogen but not so seriously as to impair the usefulness of the method.

Effect on digestion of the added acid.

As digestion proceeds, hydrochloric acid combines with the albuminoids, and if the amount of nitrogenous matter present is large the quantity of free acid may be so much reduced that the process of digestion is arrested. To obviate this, free acid is added from time to time, but if the total quantity of free acid rises much above 0.2 per cent. digestion is likewise hindered or stopped. To study the effect of the added acid under the con-

ditions of these experiments digestions were made with ground leather and with dried blood in the usual way, and other digestions were made as usual except that no acid was added besides that contained in the pepsin solution.

	Of the total nitrogen was made soluble.	
	0.8 pr. ct. acid added.	No acid added.
Dried blood	96.8 per cent.	93.8 per cent.
Leather	25.4	44.4

The 0.4 gram hydrochloric acid present in the pepsin solution was not enough to complete the digestion of dried blood.

Leather seems to be very slowly soluble in pepsin solution and the addition of acid checks its digestion, whereas without added acid the digestion will slowly continue till the experiment is closed.

The Time of Digestion.

A considerable number of comparative trials showed that while certain materials were as fully digested in 12 hours as in 24 hours, others were not, and therefore in the experiments hereafter described, the time of digestion was always 24 hours unless the contrary is stated.

Solubility of Ammoniates in Pepsin Solution.

Here follows a description of the materials tested.

	Per cent. Nitrogen.
Blood No. 1. Kiln dried or black blood	13.44
Blood No. 2. Kiln dried or black blood. Probably of same origin as blood No. 1	13.47
Ammonite No. 1536. Sent by the committee on nitrogen of the Association of Official Chemists	12.85
Ammonite A, No. 1569. Made and sent by M. L. Shoemaker & Co., Phila.	12.73
Ammonite B, No. 1588. Made and sent by M. L. Shoemaker & Co. Both these samples are made from animal matter, beef and pork "cracklings," etc., from which all grease is removed by benzine	12.68
Fish No. 1598. This sample of menhaden was taken directly from a factory. It had been cooked as usual to extract the oil and had lain in the pile about a week. It was rapidly dried in the laboratory over oil of vitriol	10.64
Dry Ground Fish, No. 1439. This is the commercial article of good quality	8.76
Dried Horse Meat, not acidulated. The commercial article from a New York dealer	8.12
Ground Bone No. 1197. An exceptionally clean, hard raw bone from button factory	4.11
Cotton Seed Meal, No. 1532, decorticated	6.68
Castor Pomace, No. 4	6.88

	Per cent. Nitrogen.
Maize Refuse from starch extraction	5.55
Cave Guano from the Caribbean Sea	5.41
Buffalo Horn Saw Dust, No. 1403	14.85
Horn Shavings, a manufacturing waste	15.37
Fine Ground Horn and Hoof, No. 1567	13.69
Wool Waste, No. 1537. It appears to be sweepings or the refuse dustings of wool. It has apparently very little oil in it	11.25
Felt Waste, a loosely woven material	13.12
Leather, No. 3. A sample received some years ago of material then offered in market. It was fine and brittle, but the method of preparation is not known	8.13
Leather treated by the benzine process, No. 1568	8.40
Leather reduced by superheated steam, dried and ground in a disintegrator	6.85
"Prepared Ammonite." An article sold at a low price and said to be quite extensively used in centers of fertilizer manufacture	8.06
Hair and Leather, another ammoniate which is being pushed into market and thought to be quite extensively used	6.91

In the following table are given the results of digestion with the reagents and in the manner above described.

Material.	Per cent. of Nitrogen. Total.	Insoluble in pepsin solution (Duplicate trials).		Insoluble. (Average).	Of the total nitrogen were dissolved, per cent.
Blood No. 1	13.44	.52	.34	.43	96.8
Blood No. 2	13.47	.25	.29	.27	97.9
Ammonite No. 1536	12.85	2.69	2.77	2.73	78.7
Ammonite A*	12.73	1.82	1.91	1.87	85.4
Ammonite B*	12.68	2.91	2.81	2.86	77.5
Fish No. 1598	10.64	1.31	1.17	1.24	85.9
Dry Ground Fish No. 1439	8.76	2.54	2.53	2.53	71.2
Dried Horse Meat	8.12	3.35	2.93	3.14	61.3
Bone No. 1197	4.11	.04	.06	.05	98.8
Cotton Seed Meal No. 1532	6.68	.47	.52	.49	92.7
Castor Pomace No. 4	6.88	.52		.52	92 4
Maize Refuse	5.55	1.00	.91	.95	82.9
Cave Guano	5.41	5.05	4.91	4.98	7.9
Buffalo Horn Dust No. 1403	14.85	13.24	14.32		7.2
Horn Shavings		13.80			
Fine Ground Horn and Hoof No. 1567*	15.37	12.57	12.55	12.56	22.4
Wool Waste No. 1537	13.69	9.78	9.89	9.83	28.2
Felt Waste	11.25	11.17	10.24	10.71	4.8
Leather No. 3	13.12	12.15	12.33	12.24	7.2
Leather by benzine process, No. 1568	8.13	6.03	6.10	6.06	25.4
Leather by superheated steam	8 40	5.25	4.98	5.38	35.9
Prepared Ammonite	6.85	5.13	5.15	5.14	33.3
Hair and Leather	8.06	5.25	5.24	5.24	34.9
	6.91	5.93	6.00	5.96	13.8

* 12 hours digestion.

The sample of Dry Ground Fish No. 1439, is the least soluble of all of the better class of ammoniates. In order to see if this was exceptional, all the samples of dry ground fish which have been received this year were tested.

The results are given in tabular form.

Station No.	Time of Digestion, hours.	Per cent. of Nitrogen.				Of the total nitrogen were dissolved, per cent.
		Total.	Insoluble in pepsin solution (Duplicate trials).		Insoluble. (Average).	
1439	12	8.76	2.54	2.23	2.38	72.8
1425	12	8.78	2.93	3.09	3.01	65.7
	24		2.61		2.61	70.0
	36		2.34		2.34	73.3
1451	12	4.01	1.47	1.50	1.48	63.1
	24		1.22		1.22	69.6
	36		1.13		1.13	70.0
1359	12	8.71	3.43		3.43	60.6
	24		2.86		2.86	67.2
	36		2.66		2.66	69.6
1424	12	8.68	3.61	3.79	3.70	57.4
1501	12	8.72	3.75	3.79	3.77	56.7
	24		3.07		3.07	64.8
	36		2.86		2.86	67.2
1479	12	8.11	3.70		3.70	54.3
	24		3.11		3.11	61.6
	36		2.91		2.91	64.1
1587	12	8.80	4.18	4.27	4.23	51.9
	24		3.72		3.72	57.7
	36		3.36		3.36	61.9

The solubility of nitrogen in all these samples was considerably less than had been observed in other ammoniates of the better class. Experiments were made to ascertain, if possible, the reason of this.

Effect of Oil.

Fish always contains a considerable amount of oil which may partly envelope the nitrogenous matter, and hinder or prevent perfect contact with the pepsin solution. It is also possible that by exposure to air a portion of the oil may be converted into a substance similar to linoxyn which would offer even more resistance to the action of solvents. Linoxyn as described by Mulder (Die Chemie der austrockenenden Oele, p. 98) is heavier than water, amorphous, elastic, *insoluble in water, alcohol and ether*, as well as in *dilute mineral acids*. It swells in chloroform or carbon bisulphide and finally dissolves. The best solvent is said to be a mixture of chloroform and alcohol.

Fish No. 1439 dried and extracted continuously with absolute

ether for six hours yielded 13.61 per cent. of extract. The residue extracted with chloroform gave 3.09 per cent. of a dark brown, nearly black substance, scarcely fluid even at 100° C., which had a strong fish odor.

Seven grams of fish No. 1479 gave 8.84 per cent. ether extract. Further extraction for 3 hours gave .24 per cent. The residue yielded to boiling chloroform in 4 hours 3.35 per cent. and nothing on further extraction with carbon bisulphide.

Seven grams of fish No. 1451 treated as above yielded 8.19 per cent. of ether extract, 1.39 per cent. chloroform extract.

The seven grams of Fish No. 1479 contained	.5677 grams of nitrogen.
The total residue after extraction "	.5399
Extracted by ether and chloroform	.0278

or 0.39 per cent. of nitrogen.

The seven grams of Fish No. 1451 contained	.2807 grams of nitrogen.
The total residue after extraction "	.2517
Extracted by ether and chloroform	.0290

or 0.41 per cent. of nitrogen.

No attempt was made to ascertain the nature of the nitrogenous matter which was soluble in ether and chloroform. It may possibly have been lecithin which is found in fish eggs.

Portions of 2 grams of these extracted samples were digested in the usual way for 12 hours. The calculated results are as follows :

No. 1479 before extraction had .5677 grams nitrogen × 54.3 per cent. soluble	=.3082 grams soluble nitrogen.
After extraction had .5399 grams nitrogen × 53.3 per cent. soluble	=.2878 grams soluble nitrogen.

If the nitrogen removed by ether and chloroform would have been soluble in pepsin solution, then the total soluble nitrogen after extraction with ether would be .3156, and the percentage solubility of nitrogen in the extracted sample, 55.6, a gain of only 1.3 per cent. in solubility over the sample which contained oil.

A similar experiment with No. 1451 gave practically the same result.

As a further test, samples of 2 grams each of blood No. 1, and of bone No. 1197, were weighed into beakers, and to each was added about .20 grams (10 per cent.) of fish oil. The beakers

stood in a room where the temperature was little below 70° Fahr. by day and 10–20 degrees lower at night.

After a month the solubility of nitrogen in the blood was 97.9 per cent., in the bone 95.6 per cent. as against 96.8 and 98.8 respectively, in the trials previously made without any addition of oil. After nearly two months the solubility of nitrogen in fish was 98.0 per cent., in bone 96.1 per cent.

That the comparatively low solubility of nitrogen in fish is due to some change in it during the drying and storing is indicated by the fact that the nitrogen of fresh cooked menhaden is much more freely soluble in acid pepsin solution (see fish No. 1598) than that of the fish dried and cured in the usual way.

Effect of Salt.

A certain quantity of salt in solution will depress the solvent action of acid pepsin. To learn how far this fact might go towards explaining the behavior of fish scrap with pepsin solution, certain samples were washed with water previous to extraction till the washings were free from chlorine. The results of digestion were as follows:

No.	Time of digestion, hours.	Of the total nitrogen, there were dissolved per cent. In the washed sample.*	In the unwashed sample.
1479	24	57	61
1451	24	71	69
1425	36	71	73
1587	36	56	60
1501	24	64	64

These trials indicate that the amount of salt present in these samples has no marked effect on the solubility of nitrogen.

Presence of gelatin or glue.

In the process of extracting fish oil, the fresh fish are cooked for 20 minutes or half an hour in open tanks, in water which is heated by steam, led into it under more or less pressure. It is possible that by this means more or less glue is produced which is known to be very slowly soluble in pepsin solution. To remove any glue, two grams of fish No. 1587 were heated with water to boiling, the solution was filtered, the boiling was repeated and finally the residue was brought on to the filter and washed with

* Including what nitrogen was removed by the preliminary washing.

hot water. A sample of bone, 1363 was treated in the same way. These residues were then digested with pepsin solution for 12 hours. The results were:

	Of the total nitrogen were dissolved per cent. In original sample.	In the treated sample.*
Fish No. 1587	50	56
Bone No. 1363	67	69

Effect of a long continued digestion without additional acid.

Different portions of fish 1501, were digested for 12, 24, 48 and 60 hours in the usual way, except that no acid was added during digestion to that already in the pepsin solution. Samples of leather were treated in the same way as a control on the experiment described on page 122.

The results were as follows:

Time of digestion. Hours.	Of the total Nitrogen were dissolved, per cent. Fish No. 1501.	Leather No. 3.
12	53	41
24	57	47
48	65	52
60	69	49
60	76†	54†

But nothing so far discovered fully explains the rather low solubility of dry ground fish in pepsin solution.

The solubility of nitrogen in various grades of bone was next determined as follows:

The first three samples in the table which have the highest solubility are known to be raw, hard, selected bone, free from adhering flesh and from any large amount of grease. No. 1354 is a residue from glue works. It has been steamed and all glue removed. Nos. 1363, 1525, and 1433 at the bottom of the list, are residues containing little hard bone but mixed with salt and salt-cake. A sample of No. 1363 was washed with water to remove the salt cake, before digestion, but the solubility of its nitrogen was not affected by the treatment.

The nitrogen of hard raw bone is considerably more soluble than that of the mixture of soft bone with cartilage muscular

* Including nitrogen removed by boiling water.

† In these two cases at the end of thirty-six hours the solution was removed by filtration, fresh pepsin solution was added, and the digestion continued for twenty-four hours. The slow continued solution of leather by pepsin solution when the amount of free acid is not over 0.2 per cent. is here apparent as in the other experiment.

Station No.	Per cent. of Nitrogen.				Of the total Nitrogen were dissolved per cent.
	Total.	Insoluble in pepsin solution. (Duplicate trials.)		Insoluble average.	
1197	4.11	.40	.60	.05	98.8
1405	5.40	.20	.22	.21	96.1
1561	4.14	.27	.25	.26	93.7
1354	1.62	.15	.18	.16	89.0
1436	4.38	.50	.61	.55	87.2
1375	3.53	.45	.47	.46	87.0
1371	3.90	.63	--	.63	84.0
1353	4.10	.61	.68	.64	84.4
1565	3.69	.79	.52	.65	82.4
1402	3.16	.68	--	.68	78.5
1564	4.48	1.13	--	1.13	74.8
1431	2.93	.79	.78	.79	73.0
1361	6.04	1.68	1.59	1.64	72.8
1394	3.40	.91	.91	.91	73.2
1398	4.14	1.29	1.36	1.32	68.1
1368	3.84	1.20	1.29	1.24	67.7
1363	3.70	1.13	1.18	1.15	68.9
1525	3.55	1.25	1.29	1.27	64.2
1399	4.43	1.63	---	1.63	63.2
1433	2.63	1.29	1.20	1.25	52.5

tissue and grease, which makes up "kitchen bone." It may be too that the process of boiling or steaming as usually conducted partly converts cartilage into glue, which is less soluble in pepsin solution, although it decays more readily than other forms of albuminoid matter.

The nitrogen of Peruvian guano directly treated with pepsin solution does not readily go into solution. From a sample containing 16.01 per cent. of nitrogen, pepsin solution dissolved only 11.14 per cent., or 69 per cent. of the total nitrogen present. The reason is that guano contains a considerable proportion of nitrogen in the form of uric acid, which is insoluble in water and dilute acid, although it is easily resolved into ammonium carbonate by fermentation, and so becomes available. Stutzer & Kleinkenberg propose to remove uric acid by digesting two grams of guano with 250 c. c. of a 1 per cent. borax solution for two hours on a water bath, and afterwards digesting the residue with pepsin solution. The guano above referred to, treated in this way, had its nitrogen dissolved to the extent of 98.3 per cent.

In the case of mixed fertilizers, however, such treatment is inadmissible, because leather itself gives up its nitrogen after treatment with borax. Thus, a sample of leather, reduced by superheated steam, after treatment with borax, gave up 83.8 per cent. of nitrogen to pepsin solution, while only 33.3 per cent. of it was soluble

in pepsin solution without the treatment with borax. It is easy, however, to detect uric acid in any mixture, so that in any case due account may be given to it.

To illustrate the practical application of the method, four samples of superphosphates were prepared as follows:

A

24 grams leather,
7 " sulphate of ammonia,
8 " muriate of potash,
61 " S. C. acid phosphate.
100

B

13 grams black blood,
29.3 " steamed leather,
8.5 " muriate of potash,
49.2 " S. C. acid phosphate.
100

C

39 grams cave guano,
7 " sulphate of ammonia,
6 " muriate of potash,
48 " S. C. acid phosphate.
100

D

13 grams black blood,
5 " horn and hoof,
8 " muriate of potash,
74 " S. C. acid phosphate.
100

The analyses of the mixtures are:

	A	B	C	D
Nitrogen	3.47	3.75	3.56	2.44
Phosphoric acid	9.1	7.4	7.2	11.1
Potash	4.3	4.5	3.2	4.3

A contained 2.02 per cent. of nitrogen from leather, and 1.45 per cent. from sulphate of ammonia. **B** contained 1.75 per cent. from blood, and 2.00 from leather. **C** contained 2.11 from cave guano and 1.45 from ammonia, and **D** 1.75 from blood and .69 from horn and hoof.

Four portions, of 5 grams of each sample, were washed on a filter with about 400–500 c. c. of cold water. In two of these portions the *nitrogen insoluble in water* was determined, in the other two samples was determined the *nitrogen insoluble in water and in pepsin solution.*

The results were as follows:

	A	B	C	D
Nitrogen insoluble in water	2.05	3.74	1.66	2.44
Nitrogen insoluble in water and in pepsin solution	1.57	1.66	1.43	.62

From this is calculated that of 100 parts of nitrogen insoluble in water (organic) are dissolved by pepsin solution:

	A	B	C	D
Nitrogen dissolved	23.4	55.6	13.8	74.6

Samples **A** and **C** are clearly condemned by their low solubility. The chemist who made the determinations, being ignorant of the composition of the samples, also reported that tannic acid was present in both **A** and **B**. This fact, taken with the low solubility of **B** would condemn that also. Sample **D**, which contains between one-third and one-fourth of its nitrogen in form of horn and hoof, would not be suspected of containing an inferior ammoniate.

Review of the Results Obtained by Drs. Shepard and Chazal and this Station.*

1. The nitrogen of dried blood red and black (4 samples), cotton seed (4 samples), castor pomace and maize refuse (each one sample) was in every case soluble in pepsin solution, by 24 hours digestion, to the extent of 75 per cent. or more.

2. The nitrogen of fish (10 samples), dried animal matter (tankage, horse-meat, etc., 3 samples) and of bone (20 samples), was in every case soluble to the extent of over 52 per cent.

3. The nitrogen of leather steamed or extracted by benzine was in no case soluble to the extent of over 36 per cent. That of horn shavings, horn dust, ground horn and hoof, cave guano, felt waste and wool waste was considerably less soluble than the nitrogen of leather.

4. This method divides all ammoniates into two classes according to the solubility of their nitrogen. In one class more than half of the nitrogen is soluble, in the other scarcely more than one-third is soluble. In the first class belong *all* the ammoniates whose nitrogen is known to be "available" in the sense referred to in the beginning of this paper, in the second class the most soluble are leathers variously manipulated which are known to be almost valueless as fertilizers. To some extent this method is therefore a measure of the agricultural value of nitrogen. How far it is a measure must be determined by vegetation experiments under accurately controlled conditions in which nitrogen is supplied in the same ammoniates which have been tested by digestion experiments.

In the mean time the method has decided value because in many

*Stutzer and Klinkenberg's results are not here repeated because they apply to ammoniates which probably differ from ours somewhat in method of preparation, etc.

cases it will distinguish in mixed fertilizers between such ammoniates as the general sense of practical farmers accepts as available and such as the same general sense condemns as inert.

Experiments on the Putrefaction of Ammoniates.

Some experiments have also been made on the relative rapidity of the solution of nitrogen in various ammoniates when exposed to putrefactive fermentation, a method proposed by Morgen.*

The materials above described were used for this study. The method employed was to bring one gram of the substance into a precipitating flask with 350 c. c. of water and 5 c. c. of an aqueous extract of rotting stable manure. The flasks were kept in a water bath at 30° C. (28°–35°), shaken once daily, and fresh water was added when necessary to replace what evaporated. After two weeks digestion the solutions were filtered and nitrogen was determined in the washed residue.

The results are here presented in tabular form:—

MATERIAL.	Per Cent. of Nitrogen.			Of the total Nitrogen, were dissolved, per cent.
	Total.	Undissolved.	Average.	
Blood, No. 1,	13.44	3.12	3.12	76.8
Blood, No. 2,	13.47	4.64	4.64	65.6
Ammonite, No. 1536,	12.85	3.00—3.32	3.16	75.4
Fish, No. 1598,	10.68	2.63—2.03	2.33	78.1
Fish, No. 1479,		3.45—3.86	3.65	54.6
Fish, No. 1501,		3.50	3.50	59.8
Dry Horse Meat,	8.12	2.77—3.40	3.08	62.0
Bone, No. 1525,		1.36	1.36	61.7
Bone, No. 1561,		.91—.82	.86	79.0
Cotton Seed,	6.68	1.45—1.36	1.40	78.9
Castor Pomace,	6.88	1.87	1.87	72.8
Maize Refuse,	5.55	.77	.77	86.1
Cave Guano,	5.41	4.45—4.40	4.42	18.3
Buffalo Horn Saw Dust,	14.85	12.10—14.87	12.10	18.5
Horn Shavings,	15.37	12.33	12.33	19.8
Ground Horn and Hoof,	13.69	9.94—9.46	9.70	29.1
Leather, No. 3,	8.13	7.14	7.14	12.2
Steamed Leather,	6.85	4.14—3.77	3.95	42.3
"Prepared Ammonite,"	8.06	5.18	5.18	35.7

In some cases the duplicate nitrogen determinations do not agree closely which indicates that putrefaction did not go on as rapidly in one case as in the other. There is much less variation in the solubility of the nitrogen of the different ammoniates

*Landwirthsch. Versuchs-Stationen, 1880, 50.

whose nitrogen is available than was noticed in case of digestion with pepsin solution.

In the latter case from 52 to 98 per cent. of nitrogen was dissolved, but by this putrefaction test from 54 to 86.

This test of putrefaction draws the same line between the two classes of ammoniates that was drawn by the pepsin digestion.

Steamed leather, "Prepared Ammonite" and horn and hoof which were the most soluble of their class in pepsin solution are also the most soluble after putrefaction.

This method is deserving of further examination.

The experiments described in this paper have been almost wholly carried out by Mr. E. H. Farrington and Mr. A. L. Winton, Jr., chemists in this station.

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