STATE OF CONNECTICUT.

ANNUAL REPORT

—OF—

The Connecticut Agricultural Experiment Station

For 1892

Printed by Order of the General Assembly.

NEW HAVEN:
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1893

OFFICERS AND STAFF FOR 1892.

STATE BOARD OF CONTROL.

Ex-officio.

HIS EXC. MORGAN G. BULKELEY, *President.*

	Term expires.
Appointed by Connecticut State Agricultural Society:	
HON. E. H. HYDE, Stafford, *Vice-President.*	July 1, 1894.
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W. H. BREWER, New Haven, *Secretary and Treas.*	1893.
Ex-officio.	
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Chemists.

E. H. JENKINS, PH.D., *Vice-Director.*
A. L. WINTON, PH.B.
T. B. OSBORNE, PH.D.
A. W. OGDEN, PH.B.
CLARK VOORHEES, PH.B.*
WORTHINGTON SMITH, B.A.†

Mycologist.

WILLIAM C. STURGIS, PH.D.

Stenographer and Clerk.

MISS F. M. BIGELOW.

In charge of Buildings and Grounds.

CHARLES J. RICE.

Laboratory Helper.

HUGO LANGE.

* Till Oct. 1st. † From Oct. 1st.

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, milk, and other agricultural materials and products, to identify grasses, weeds, useful or injurious insects, moulds, blights, mildews, etc., and to give information on various subjects of Agricultural Science, for the use and advantage of the citizens of Connecticut.

The Station makes analyses of Fertilizers, Seed-Tests, etc., etc., 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 from stock now in the market, and in accordance with the Station instructions for sampling.
3. That the samples are fully described and retail prices given on the Station "Forms for Description."

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 farmers is essential for the full and timely protection of their interests. Granges, Farmers' Clubs and like Associations can efficiently work with the Station for this purpose, by sending in duly authenticated samples early during each season of trade.

All other work proper to the Experiment Station that can be used for the public benefit will be done without charge. Work 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.

Results of analysis or investigation that are of general interest will be published in the Bulletins, of which copies are sent to each Post Office in this State, and to every citizen of the State who applies for them. These results will be summed up in the Annual Reports made to the Governor.

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 any individual officer*, but simply to the

AGRICULTURAL EXPERIMENT STATION,
NEW HAVEN, CONN.

☞ Station Grounds, Laboratories and Office are on Suburban st., between Whitney avenue and Prospect st., 1⅝ miles North of City Hall. Suburban st. may be reached by Whitney ave. Horse Cars, which leave the corner of Chapel and Church sts. four times hourly, viz: on the striking of the clock and at intervals of fifteen minutes thereafter.

☞ The Station has Telephone connection and may be spoken from the Central Telephone Office, 118 Court st., or from Peck & Bishop's Office in Union R. R. Depot.

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REPORT OF THE TREASURER.

WM. H. BREWER, IN ACCOUNT WITH THE CONNECTICUT AGRICULTURAL EXPERIMENT STATION, FOR THE FISCAL YEAR ENDING JUNE 30TH, 1892.

RECEIPTS.

From the Governor	$6,000.00	
" " Comptroller,	2,000.00	
" " U. S. Treasurer,	7,500.00	
Analysis Fees due last fiscal year, collected this year	1,155.26	
" " " this " " " " "	2,095.00	
Miscellaneous Receipts	49.20	$18,799.46

EXPENDITURES.

	State Acc't.	U. S. Acc't.	Total.
Salaries	$4,855.00	$6,764.98	$11,619.98
General Laboratory Expenses	1,341.74	--------	1,341.74
Mycological Expenses	--------	232.64	232.64
Grass Investigation	790.50	--------	790.50
Tobacco Investigation	398.35	34.76	433.11
Field Experiments	--------	121.19	121.19
The Establishment, Repairs, Grounds, etc.	893.41	--------	893.41
Gas	236.85	--------	236.85
Water	147.00	--------	147.00
Coal	472.50	--------	472.50
Telephone	100.00	--------	100.00
Printing	212.80	346.43	559.23
Stationery	124.36	--------	124.36
Postage	105.18	--------	105.18
Library	372.52	--------	372.52
Collecting Fertilizers	276.03	--------	276.03
Expenses of the Board	58.23	--------	58.23
Unclassified Sundries	167.51	--------	167.51
Balance on hand	747.48	--------	747.48
	$11,299.46	$7,500.00	$18,799.46

FOR THE FISCAL THREE MONTHS ENDING SEPTEMBER 30TH, 1892.

RECEIPTS.

Balance from June 30th	$ 747.48	
From the State Comptroller	2,000.00	
" " U. S. Treasurer	1,875.00	
Analysis Fees due June 30, collected later	676.08	
" " of current three months	35.00	
Miscellaneous Receipts	.99	$5,334.55

EXPENDITURES.

	State Acc't.	U.S. Acc't.	Total.
Salaries	$1,247.50	$1,775.00	$3,022.50
General Laboratory Expenses	279.11	--------	279.11
Mycological Expenses	22.76	--------	22.76
Grass Investigation	334.31	65.69	400.00
Tobacco Investigation	--------	34.31	34.31
The Establishment, Grounds, Repairs, etc.	774.58	--------	774.58
Gas	43.80	--------	43.80
Coal	550.00	--------	550.00
Telephone	25.90	--------	25.90
Printing	44.98	--------	44.98
Stationery	3.15	--------	3.15
Postage	1.50	--------	1.50
Library	86.74	--------	86.74
Expenses of the Board	1.50	--------	1.50
Unclassified Sundries	43.72	--------	43.72
	$3,459.55	$1,875.00	$5,334.55

Memorandum.

The accounts for the fifteen months ending September 30th, 1892, in accordance with the new dates for the State fiscal year, were audited December 2d by the State Auditors of Public Accounts.

Analysis Fees due the previous fiscal year, but which came into the hands of the treasurer during this fifteen months, are placed in this account. The Analysis Fees of fertilizers known or believed to be on sale after May 1st, and subject to the law concerning commercial fertilizers, coming to his hands after the beginning of the fiscal year, will be credited to the new account.

Wm. H. Brewer, *Treasurer*.

Report of the Board of Control.

To His Excellency, the Governor of Connecticut:

The Annual Report of the Board of Control of the Connecticut Agricultural Experiment Station for the year ending November 1st, 1892, is as follows:

The "Act Concerning Commercial Fertilizers" which has been the law of this State now for ten years, requires the Director of this Station to cause one or more analyses of each fertilizer sold in the State for ten dollars or more per ton, to be made and published annually. Accordingly the Station has employed special deputies, Messrs. Dennis Fenn, of Milford and F. R. Curtiss, of Stratford, to collect and send to the Station samples of all the commercial fertilizers, coming within the law, that have been sold, offered or exposed for sale in Connecticut during the year. These gentlemen have made collections in more than 100 localities in 71 towns and villages, mostly from the stock on hand in the spring markets. Samples were collected to the number of 475 and represent 150 distinct brands. On these samples and on other fertilizers and manures about 300 analyses, mostly in duplicate, have been made. This branch of Station work has been in charge of Mr. Winton, assisted by Messrs. Ogden and Lange.

Work for the Dairy Commissioner in testing 13 samples of butter and oleomargarine, molasses and vinegar has been carried on as usual, by Dr. Jenkins and Mr. Winton, who have given their testimony in court on the call of the Dairy Commissioner.

The Station chemists have also made complete analyses of 18 samples of butter that were exhibited at the Dairy Convention held at Hartford in January, 1892, and 14 of cheese. In connection with Feeding trials, 88 detailed milk-analyses and not far from 1,000 fat determinations by the Babcock method have been executed.

On account of impaired health and by advice of his physician, after fifteen years of unremitted devotion to the interests of the Station, the Vice-Director applied to this Board for three months' leave of absence. This request was promptly granted, and early in July, Dr. Jenkins went to Europe where after a short rest he has taken the opportunity to visit several of the most noted Experiment Stations and to familiarize himself with the results and methods of various recent and important researches in agricultural science and practice.

Dr. Jenkins is about to return quite restored in health we understand, and eager to resume his most useful labors in behalf of the farmers of Connecticut.

The several lines of work which have been pursued and the results attained are concisely set forth in the following memoranda.

In addition to the chemical work, already mentioned, 19 analyses of tobacco leaves have been made, including determinations of water, ash, ether extract, fiber, total nitrogen, nitric acid, nicotine, ammonia, starch and sugars.

Eight ash analyses of tobacco have also been made and one toxical examination.

The following investigations have been carried on during the year:

1. An experiment with milch cows to determine the effect on the yield and composition of the milk, of feeding rations having different nutritive ratios.

2. An experiment with tobacco, at Poquonock on land owned by the Connecticut Tobacco Experiment Association and with their coöperation.

3. A study of the chemical composition of different parts of the tobacco plant in different stages of growth.

4. A study of the chemical changes which take place in tobacco during the fermentation in the case.

5. A continuation of observations on the growth of maize continuously on the same land.

6. The Gunning-Kjeldahl method and a modification applicable in the presence of nitrates.

7. A study of the methods of cheese analysis.

Considerable time and labor have been devoted to various gatherings of farmers. At seven farmers' institutes, and the meetings of the Connecticut Dairymen's Association, the State Board of Agriculture, the Fruit Growers' Association, the Creamery Association, as well as at meetings of farmers' clubs, and several open Grange meetings, addresses have been made by one, oftener by two and sometimes by three of the Station staff.

The work done by Dr. T. B. Osborne and Clark G. Voorhees since Nov. 1, 1891, is as follows:

The investigation of the proteids of the flaxseed has been completed. The crystalline proteids of the Brazil nut, hemp seed, castor bean and squash seed have been carefully studied. The results of these investigations are in the course of publication in the American Chemical Journal. The proteids of wheat have been subjected to an exhaustive examination and the investigation is now substantially concluded.

Dr. Sturgis reports as follows:

The past season has been peculiarly unfavorable for mycological work. The extreme dryness has served to prevent, to a very large degree, the damage to crops usually caused by the growth of parasitic fungi.

The work which has occupied the larger part of the time, has been the application of certain scientific principles to the process of tobacco-curing. A year ago a quantity of half-cured tobacco was sent to us, which, during the process of curing, had become affected by an organic decay known among growers as "pole-sweat." The cause of this decay was readily ascertained to be two different species of germs, or bacteria. Pure cultures of these bacteria were made, and studied with a view to determine the conditions of warmth and moisture most suitable to their growth. These conditions were found to be, first a considerable degree of moisture, and secondly a temperature of from 70° to 90° Fahrenheit. Upon this basis it was decided to construct, on a piece of land at Poquonock which was used by the Station for certain experiments in the fertilization of tobacco, a barn which should be provided with a more satisfactory system of natural ventilation than that at present in use, and to which some method of artificial heat could be adapted.

That these two important factors in the curing of tobacco—heat and moisture, could be easily and cheaply regulated by the methods proposed, was abundantly proved, but owing to the extreme dryness of the curing season this year, no danger from "pole-sweat" was to be apprehended, and the artificial heat was not employed. Its applicability however, has been proved, and it is probable that another season will render its use for practical purposes more obvious.

During the Summer an extensive experiment was conducted upon four acres of potatoes in the neighborhood of Norwich. It was designed to test the efficacy of certain fungicides, other than the Bordeaux mixture, in the prevention of "potato blight." Here again the dry weather was unfavorable to the fungus, and few traces of it were found even on the unsprayed portions of the field.

The vines however remained green much longer on that portion treated with Bordeaux mixture than on those where other fungicides were used, and the experiment demonstrated the fact that none of the fungicides used was superior to Bordeaux mixture in cheapness or facility of employment.

Experiments conducted in previous years at Milford for the prevention of the "leaf-blight" of Quince, were continued this year, and were useful again in proving the advantages attending the use of Bordeaux mixture.

One important fact seems proved by these series of experiments. Heretofore the Bordeaux mixture has been prepared as concentrated as was compatible with the safety of the foliage upon which it was used. This year in my experiments I used it only half as strong, and obtained equally good results as far as the destruction of the fungus was concerned, and of course at a much reduced cost.

Finally, a disease affecting Asters and other related flowering plants has been studied. The disease has been found to be due, at least in part, to microscopic nematode worms which infest the roots. Experiments are now in progress to discover, if possible, some substance which, combined with special methods of cultivation, will lessen the ravages of these root-infesting pests. The results of these experiments will be published in full before another season.

On the whole it may be said that, notwithstanding a season very unfavorable for the study of fungous diseases, the work of this department has been productive of good results during the past year, results which at least offer a guide to the future work.

A detailed account of all the work above referred to will be found in the Report of the Director, now in course of preparation.

All which is respectfully submitted.

WILLIAM H. BREWER,
Secretary.

New Haven, Conn., Nov. 1, 1892.

REPORT OF THE DIRECTOR.

The following pages contain a detailed account of the work of this Station during the past year so far as it is sufficiently advanced to justify its publication.

In the discussion of commercial fertilizers it is found necessary to reprint annually certain statements regarding the fertilizer law and the analysis and valuation of fertilizers, to answer the questions which are constantly addressed to the Station on these subjects.

EXPERIMENTS IN GROWING TOBACCO WITH DIFFERENT FERTILIZERS. SEASON OF 1892.

Organization of The Connecticut Tobacco Experiment Company.

In the winter of 1891–92 a Farmers' Institute was held at Windsor under the management of the State Board of Agriculture.

At this meeting the subject of tobacco growing and curing was quite fully discussed both by the tobacco growers and by the representatives of the Conn. Experiment Station.

It was the opinion of those who spoke that the quality of Connecticut tobacco might be greatly improved by proper fertilization and by improved methods of handling the crop after cutting, and that to this end carefully made experiments on the fertilization of tobacco and the methods of curing and fermenting were urgently needed.

The Station representatives pledged their full coöperation in any work of the sort which might be undertaken.

As a result of these and other subsequent discussions a considerable number of tobacco growers organized a joint stock company under the corporate name The Connecticut Tobacco Experiment

Company, "For the purpose of conducting and carrying on the business of an experiment in the culture and cure of tobacco, the same to be conducted and carried on in connection with and under the supervision of the Conn. Agricultural Experiment Station. The place where the said business is to be carried on is Poquonock, in the town of Windsor," Conn.

The stockholders elected the following officers:—President, S. O. Griswold; Vice-President, Eugene Brown; Secretary, E. S. Hough; Treasurer, L. R. Lord; Board of Management, H. H. Ellsworth, Eugene Brown, J. A. DuBon, H. W. Alford, J. G. Thrall, A. E. Holcomb and R. D. Case. An executive committee was also chosen consisting of H. H. Ellsworth, H. W. Alford and J. A. DuBon, to whom was committed the practical management of the experiment itself.

A stock subscription book was opened and the Company was soon able, from the proceeds of stock sales, to purchase one and one-half acres of land, judged to be perfectly adapted to its purposes, and to arrange for the building of a barn large enough to hold the crop of two acres of tobacco. The land was at once cleared and prepared for planting.

The company's committee and the representatives of this Station after full discussion agreed on this

General Plan of Experiment.

1. The following experiments should be carried out on the same land for at least five years in succession.

2. While the quantity of crop should be accurately determined, very special attention should be given to the judgment of its quality for cigar wrappers. This judgment should be given by men of large practical experience in the trade in leaf tobacco, and the samples should be so submitted that the judges should have no knowledge of any particulars regarding the manner in which the separate lots of leaf were raised.

3. The final judgment on its quality should be made after the leaf has been fermented in the usual way, and the whole crop rather than small samples from each crop should be fermented together.

4. The following questions are those which, as far as circumstances permit, should receive immediate attention:

a. What is the effect on quantity and quality of leaf of larger applications of cotton seed meal than are commonly used as a fertilizer?

b. What is the comparative effect on quantity and quality of leaf, of applications of castor pomace containing the same amounts of nitrogen as the cotton seed meal used in experiments under *a*?

c. If a heavy application of nitrogen in form of castor pomace proves injurious to the leaf, can the injury be lessened or prevented if a half of this quantity of nitrogen is supplied by castor pomace and the other half by nitrate of soda?

d. What are the comparative effects on quality and quantity of leaf of applications of equal quantities of potash in the following forms: Cotton hull ashes, high grade sulphate of potash, the same with lime, double sulphate of potash and magnesia, the same with lime, pure carbonate of potash, and pure nitrate of potash?

e. Is it possible to absolutely prevent "pole-burn" and to cure the crop perfectly on the stalk, by the use, in very damp "muggy" weather, of artificial heat simply as a means of ventilating and partly drying the air of the barns?

The company's committee requested the Station to plan the construction of the barn and the arrangement of the experiment, to take the general charge of it, to make and record all weights and to preserve and publish the results with suitable discussion of them.

The committee were fortunate to secure the services of Mr. John A. DuBon who planted, cultivated, harvested, cured and sorted the crop in coöperation with the Station.

Mr. DuBon did all this in the most thorough and efficient way and the success which has been attained this year in spite of the late organization of the company and the consequent hurry at planting time is largely due to his untiring work and careful attention to all the vexatious details incident to a somewhat extensive and carefully executed experiment; details which can only be fully understood by one who has had experience with them.

The Experiment Field.

The soil of this field is like much of the upland tobacco soil of the Connecticut valley and may be described as a very fine light sandy loam. Its chemical and mechanical examination will be noticed in another place.

For five or six years the field had scarcely been fertilized or cultivated at all and tobacco had not been raised there for a very long term of years. When bought it was covered with a neglected growth of "poverty grass" (*Andropogon scoparius*), blackberry vines, and wild growth of various sorts. After careful plowing and harrowing, the field was measured by the Station into twenty-three plots, each of them 27 feet wide and 80½ feet long, containing 2173½ square feet or 4½ square feet less than one twentieth of an acre. The plots were separated by a space 3½ feet wide and their boundaries were marked by stout chestnut posts.

Fertilizers.

The fertilizers were all sampled and analyzed by the Station. The raw materials used contained the following percentages of nitrogen, phosphoric acid and potash.

	Nitrogen.	Available Phosphoric Acid.	Potash.
Nitrate of Soda	15.9		----
Nitrate of Potash	13.8		44.9
Cotton Seed Meal	7.0	3.0	1.8
Castor Pomace	5.3	1.7	1.0
Cooper's Bone Dust	1.6	29.2	----
Cotton Hull Ashes		7.0	20.9
High Grade Sulphate of Potash			50.6
Double Sulphate of Potash and Magnesia	----		25.7
Carbonate of Potash	----	----	54.1

The quantities of chemicals for each plot were accurately weighed by the Station representative, mixed thoroughly under his supervision, bagged and labeled in such a way as to give no clue to any other person as to the contents of the bags or as to the plots for which they were intended.

The bags were carried to the several plots under his direction and their contents were sowed on the plots in his presence.

Certain manufacturers of tobacco manures subscribed to the stock of the company and requested that their manures as submitted by them might also be included in the experiment, subject to the same treatment as the other plots. The following persons and companies thus joined in the experiment: H. J. Baker & Bro., N. Y., Bowker Fertilizer Co., Boston, F. Ellsworth, Hartford, Mapes' Formula & Peruvian Guano Co., N. Y., L. Sanderson, New Haven.

The mixed fertilizers supplied by these manufacturers were also weighed, sampled and analyzed by the Station with the following results:

Analyses of Mixed Fertilizers.

	Baker's Tobacco Manure.	Baker's AA Phosphate.	Stockbridge Tobacco Manure.	Bowker's Fertilizer.	Ellsworth's Starter.	Ellsworth's Foundation.	Mapes' Tobacco Manure W. B. Normal.	Mapes' Tobacco Manure W. B. with extra Potash.	Mapes' Tobacco Manure W. B. with extra Potash and Phosphoric Acid.	Mapes' Starter.			Sanderson's Formula B.
	Plot Q	**Plot Q**	**Plot R**	**Plot S**	**Plot T**	**Plot T**	**Plot U**	**Plot V**	**Plot W**	**Plot U**	**Plot V**	**Plot W**	**Plot X**
Nitrogen as Nitrates	----	.34	1.65	2.72	7.38	----	1.53	1.42	2.19	.28	.25	.28	1.28
" as Ammonia	3.05	.96	----	----	----	----	3.23	2.86	2.58	.51	.51	.51	1.95
" Organic	1.34	1.57	3.31	2.75	1.11	5.12	1.34	1.69	----	2.14	2.11	2.08	2.45
Total Nitrogen	**4.39**	**2.87**	**4.96**	**5.47**	**8.49**	**5.12**	**6.10**	**5.97**	**6.21**	**2.93**	**2.87**	**2.87**	**5.68**
Soluble Phosphoric Acid	4.61	9.01	trace	trace	4.72	trace	trace	trace	trace	7.58	7.55	7.62	3.58
Reverted " "	1.06	2.86	4.08	2.95	2.41	4.52	3.97	3.63	4.00	3.77	3.77	3.46	5.12
Insoluble " "	trace	.22	6.26	4.00	.89	1.79	2.34	1.74	2.19	1.83	1.69	1.87	.86
Total Phosphoric Acid	**5.67**	**12.09**	**10.34**	**6.95**	**8.02**	**6.31**	**6.31**	**5.37**	**6.19**	**13.18**	**13.01**	**12.95**	**9.56**
Potash as Muriate	.89	2.60	1.53	2.44	----	----	1.20	1.47	.98	.70	.67	.53	.28
" as Sulphate	10.79	----	4.77	7.33	2.86	5.26	10.11	13.92	12.32	2.69	2.69	2.97	10.29
Total Potash	**11.68**	**2.60**	**6.30**	**9.77**	**2.86**	**5.26**	**11.31**	**15.39**	**13.30**	**3.39**	**3.36**	**3.50**	**10.57**
Chlorine	.67	3.18	1.15	1.83	trace	trace	.90	1.10	.74	.53	.50	.40	.21

These mixtures differ in some cases from the regular brands put on the market by the manufacturers. *The object is not by any means to make a competitive test of the regular brands of tobacco manures,* but rather to test the value of certain mixtures in order to afterwards alter the composition of the regular brands if the results of these trials shall make it seem advisable.

All the fertilizers were very carefully and evenly sown when no wind was blowing, under the personal direction of Mr. DuBon and the Station representative. The plots were immediately harrowed by Mr. DuBon, each by itself to avoid carrying fertilizer from one plot to the next. The whole piece was then "rowed out" in the usual way, the rows running east and west.

The following statement shows what fertilizers were put on each plot, their cost and the quantities of nitrogen, phosphoric acid and potash contained in them, *expressed in pounds per acre.*

Name of Plot.	FERTILIZERS APPLIED. Pounds per Acre.	Cost per Acre.	Fertilizer Contains pounds		
			Nitrogen.	Phosphoric Acid.	Potash.
A	1500 Cotton Seed Meal 1500 Cotton Hull Ashes	$50.25	105	150	341
B	2000 Cotton Seed Meal 1500 Cotton Hull Ashes	57.25	140	165	350
C	2500 Cotton Seed Meal 1500 Cotton Hull Ashes	63.75	175	180	359
D	3000 Cotton Seed Meal 1500 Cotton Hull Ashes	70.50	210	195	368
E	1980 Castor Pomace 1500 Cotton Hull Ashes	50.79	105	139	334
F	2640 Castor Pomace 1500 Cotton Hull Ashes	57.72	140	150	340
G	3300 Castor Pomace 1500 Cotton Hull Ashes	64.65	175	161	347
H	4000 Castor Pomace 1500 Cotton Hull Ashes	72.00	212	173	354
I	2640 Castor Pomace 1500 Cotton Hull Ashes 220 Nitrate Soda* 220 " " †	68.72	210	150	340

* Applied between rows at time of first cultivation.
† Applied between rows at time of second cultivation.

Name of Plot.	FERTILIZERS APPLIED. Pounds per Acre.	Cost per Acre.	Fertilizer Contains pounds		
			Nitrogen.	Phosphoric Acid.	Potash.
J	2640 Castor Pomace 1500 Cotton Hull Ashes 440 Nitrate Soda†	68.72	210	150	340
K	1500 Cotton Seed Meal 1220 Double Manure Salt 360 Cooper's Bone	43.95	110	150	341
L	1500 Cotton Seed Meal 1220 Double Manure Salt 360 Cooper's Bone and 300 Lime	44.70	110	150	341
M	1500 Cotton Seed Meal 620 High Grade Sulphate of Potash 360 Cooper's Bone	42.70	110	150	341
N	1500 Cotton Seed Meal 620 High Grade Sulphate of Potash 360 Cooper's Bone and 300 Lime	43.45	110	150	341
O	1500 Cotton Seed Meal 580 Carbonate of Potash 360 Cooper's Bone	74.95*	110	150	341
P	760 Nitrate of Potash 500 Cooper's Bone	66.47*	110	146	341
Q	2020 Baker's A. A. Superphosphate 3920 " Tobacco Manure	----	230	466	510
R	2000 Stockbridge Tobacco Manure	----	99	207	126
S	4000 Bowker's Tobacco Fertilizer	----	219	278	391
T	900 Ellsworth's "Starter" 2700 " "Foundation"	----	215	238	168
U	501 Lime 501 Mapes' Starter 2601 " Tobacco Manure W. B.	----	173	230	312
V	501 Lime 501 Mapes' Starter 2601 " Tobacco Manure Special	----	170	205	418
W	501 Lime 501 Mapes' Starter 2601 " Tobacco Manure Special	----	176	227	364
X	6080 Sanderson's Formula B.	----	345	581	643

* If bought in ton lots not chemically pure the cost would be considerably less.
† Applied between rows at time of first cultivation.

The Plants and Planting.

The plants were from seed raised by Mr. DuBon in 1890, of the so-called "Havana seed." It may be said for the benefit of those unfamiliar with the local meaning of this term, that it has been a practice to obtain seed from the island of Cuba, plant it in Connecticut and raise seed year after year from it. The plants in the first years are too small to suit the demands of our market but they increase in size and after the first four generations of plantings the size becomes satisfactory and seed saved in one year may be used for the planting of the next six to ten years. Seed so obtained is called "Havana" or "Conn. Havana" seed. The special variety, used by Mr. DuBon for the last ten years, is called the "Hubbard." He has generally raised the seed each year, though at two different times he has used one year's seed for the three next years' planting.

The rows were three feet and a half apart, eight rows in a plot, and the plants were accurately set seventeen inches apart, making about 8700 to the acre.

The plants were set out by Mr. DuBon and his men on June 8th.

Notes during the Growing Season.

Following is Mr. DuBon's record kept during the months that the crop was growing:

June 8.—Planted the whole piece to-day.

June 9.—Very heavy rain covering many of the plants with earth.

June 11.—Cut worms are destroying many of the plants. Reset 2500 plants.

June 20.—Plots D, G and L very slow to start growing. Some plants on them appear to be dying as if scorched by the fertilizer. Plots A, H, K, N start best of all. R and S next. U and V next.

July 2.—Plot P is the smallest of all; color yellowish green. D and G are a little backward.

July 3.—1000 more plants reset.

July 5.—11 pounds nitrate of soda applied on plot I, and 22 pounds on plot J.

July 10.—Tobacco on plot P is still very small. Color yellowish green, but is growing darker. Tobacco on O is also very small. That on Q is the largest of all. The tobacco on B, C, D, F, G, H is very uneven on account of the attack of cut-worms.

July 17.—Tobacco on P is still smallest of all and O comes next. Color of both pale green. Tobacco on Q is largest of all and very dark green. R and S have the next largest tobacco and of good color.

July 25.—Applied 11 pounds of nitrate of soda to plot I. Tobacco on Q very much larger than on other plots. P still the smallest and light in color.

July 26.—Commenced topping. Tobacco on Q was nearly all topped at first topping. On P only a few plants topped. On O one-tenth of the plants topped. On H and L one-fourth of them topped. On N and T four-fifths of them topped. I and J are improving very fast. The weather is very dry, but on those two plots the tobacco looks as if it had all the moisture it needed, while the rest of the piece is somewhat parched.

July 31.—A nice, quiet rain has fallen.

Aug. 6.—Finished topping.

Aug. 23.—Tobacco on P is still the smallest. Color light green. That on B is next smallest, O comes next. The tobacco on Q is the largest of all, H next largest, then J, then I, and then S. All are ripe except P. O has not improved in the last ten days.

Aug. 29.—Commenced cutting and cut fourteen plots.

Aug. 30.—The remaining nine plots were cut and all the crop was hung up to pole-cure. Most of the crops were slightly overripe except P, which is still somewhat green. The quality of tobacco on plots A, E, M and N has been injured by its getting over ripe. It has lost somewhat its elasticity, "life." This should be borne in mind in judging of its quality.

Harvest and Curing.

The delay in cutting was due to the delay of workmen in finishing the fittings of the curing barn.

Representatives of the Station were present at the cutting and each lath on which the stalks were strung was marked with the number of the plot, the total number of laths from each plot was noted, and all the tobacco from each plot was hung together in the barn. There were three "bents" for hanging tobacco, one over another, and a third of the tobacco from each plot was hung on each of these, so that there should be no difference in the exposure of the tobacco of different plots. The barn was kept securely locked during the curing time.

It should be said for the information of those unfamiliar with the process of tobacco curing in this State, that the leaves are cured on the stalk, whole plants being cut and strung on laths (six or seven stalks to a lath), by piercing the stalk near the butt with a "spear" which is slipped on the end of the lath. The laths rest by their ends on the bents in the barn and the stalks hang tip downwards.

The barn was fitted with furnaces to supply artificial heat in case pole-burn was feared; but the weather was so favorable for curing that they were not used.

On November 15 during a favorable "tobacco storm," all of the tobacco was taken down on the laths, and on November 16 and 17 the tobacco was stripped from the stalks and bundled. It was labeled and weighed by the Station representative and hauled to Mr. DuBon's sorting house.

The stalks from each plot will be cut small and returned to the plots from which they came.

As the tobacco was taken off the laths the latter were recounted and their number in each case tallied exactly with the number noted at cutting time.

Sorting.

The sorting was done by Mr. DuBon and a skilled laborer under his supervision. The representative of the Station was present during the whole time and made and recorded all weights.

The yield of each plot was sorted into long wrappers, short wrappers, top leaves and seconds.

The sorting began in the afternoon of November 28 and was finished at noon on December 6.

Sampling and Casing.

On the afternoon of December 6 the sorted tobacco was teamed to the public warehouse of Mr. L. B. Haas, 150 State street, Hartford. On the 7th it was sampled and its quality examined by Mr. Haas and Mr. James McCormick. Mr. Haas has been for many years a dealer in leaf tobacco and is believed to be one of the best judges of leaf tobacco in the country. Mr. McCormick has also had a very wide experience in judging of tobacco crops.

On the 7th and 8th of December the tobacco was cased down under Mr. Haas' and Mr. McCormick's direction for fermentation, in the presence of the Station representative. The cases, measuring three feet each way, were lined on bottom, sides and top with either seconds or top leaves so that the wrappers should all receive the full "sweat." The wrappers of different plots were separated by strings and marked with labels so that they can certainly be identified when the cases are opened.

The contents and weights of the cases are here recorded:

Mark.	Wrappers from plots marked	Lined with	Gross.	Tare.	Net.
Case No. 1	19–20–21	103 lbs. top leaves	393	93	300
" 2	22–23–14	97 " "	383	86	297
" 3	6–15–16	82 " "	386	86	300
" 4	17–18–2–13	95 " seconds	384	86	298
" 5	10–11–12–3	98 " "	386	86	300
" 6	4–3a–9–8	111 " "	399	86	313
" 7	7–1–5	114 " "	399	85	314
					2122

The crops from the different plots are designated by numbers and it is believed that only two persons understand to which particular plots these numbers refer.

The Tabulated Results.

The following tables present in detail all the data which have been gathered to assist in forming a judgment of the character of the crop and are followed by explanations and discussion of these data. *It must, however, be always borne in mind that no final judgment can be given as to the relative merits of these crops till they have been fermented and are ready to be rolled into cigars and put on the market.*

Weights of the Barn Cured Leaves from $\frac{1}{20}$ Acre.

Plot.	Gross Weight of Leaves.	Weight after Sorting. Long Wrappers.	Short Wrappers.	Top Leaves.	Seconds.	Waste and Shrinkage.	Net Weight of Sorted Tobacco.
A	90	38½	17½	12¼	18	3¾	86¼
B	87½	35¾	20¾	11¼	16	3¾	83¾
C	95	42¾	17	12½	18¼	4½	90½
D	99	54¼	15	8½	16	5¼	93¾
E	96½	36¾	18¾	19¼	19	2¾	93¾
F	97	38	21	14½	17¾	5¾	91¼
G	93½	44¾	13¾	10¾	18¾	5½	88
H	106½	55½	16½	10¼	18	6¼	100¼
I	107½	53	19½	12¼	17	5¾	101¾
J	116	64	17	11½	18	5½	110½
K	100½	47¾	20¾	10	18¼	3½	96¾
L	94½	48¼	22¾	6¼	14¼	3	91½
M	96	41¾	17¾	13½	19½	3½	92½
N	88½	37¼	15¼	12¼	20½	3¼	85¼
O	85	31¼	12¼	17½	19	5	80
P	67	15¾	7	15	24¾	4½	62½
Q	119½	63¾	22½	13¾	14	5½	114
R	91	36¼	18¾	14¾	18	3¼	87¾
S	108	56	20¾	12	14	5¼	102¾
T	113½	58½	16¾	14¼	20½	3½	110
U*	119	64½	19½	9¾	19¾	5½	113½
V*	93¾	44½	14¼	11½	18¾	4¾	89
W*	98¼	43¾	14¼	13¾	21½	5	93¼
X	95½	48½	16¼	11	15½	4¼	91¼

Per Cent. of the Four Different Grades.

Plot.	Long Wrappers.	Short Wrappers.	Total per cent. of Wrappers.	Tops.	Seconds.
A	45	20	65	14	21
B	43	25	68	13	19
C	47	19	66	14	20
D	58	16	74	9	17
E	39	20	59	21	20
F	42	23	65	15	20
G	51	16	67	12	21
H	56	16	72	10	18
I	52	19	71	12	17
J	58	16	74	10	16
K	49	22	71	10	19
L	52	25	77	7	16
M	45	19	64	15	21
N	44	18	62	14	24
O	39	16	55	21	24
P	25	11	36	24	40
Q	56	20	76	12	12
R	41	21	62	17	21
S	55	21	76	11	13
T	53	15	68	13	19
U	57	17	74	9	17
V	50	16	66	13	21
W	47	15	62	15	23
X	53	18	71	12	17

* Calculated to $\frac{1}{20}$ acre.

Mr. DuBon's Notes while Sorting.

A Color dark, quality good.
B Color very light, quality *extra*.
C Color light, quality good.
D Fine, color inclined to be light, quality good.
E Inclined to be dark, quality medium.
F Color light, extra good quality.
G Somewhat darker than C, quality good.
H Not recorded.
I Color very dark, quality good.
J Color medium dark, quality good. Not as good as K.
K Color light, good quality.
L Color light, *extra* good quality.
M Color medium light, quality fairly good.
N Color light, quality fairly good, a little heavy.
O Not recorded.
P Color light, quality poor.
Q Color dark, good quality, above medium weight.
R Color a little dark, quality fair.
S Color a little dark, quality good, size a little large.
T Color dark, quality good, a little heavy.
U Color a shade lighter than V, quality fair.
V Color dark, poor quality, heavy.
W Between plots V and U in quality and color.
X Color dark, quality medium.

Number of Leaves to the Pound.

	Long Wrappers.	Short Wrappers.		Long Wrappers.	Short Wrappers.
A	79	106	M	85	106
B	83	106	N	74	97
C	76	98	O	79	118
D	73	107	P	100	132
E	70	97	Q	65	92
F	79	101	R	98	118
G	75	101	S	54	95
H	71	107	T	62	82
I	75	89	U	61	86
J	67	81	V	76	109
K	68	96	W	64	103
L	80	112	X	62	97

COMPARATIVE CAPACITY OF HOLDING FIRE.*

	Long Wrappers.	Short Wrappers.	Calculated from the mean of both.
A	184	143	170
B	153	195	186
C	177	276	244
D	188	202	207
E	140	165	162
F	303	343	343
G	189	227	222
H	127	230	193
I	146	228	202
J	161	240	215
K	122	208	178
L	154	201	190
M	148	123	142
N	115	180	158
O	171	221	209
P	281	311	315
Q	132	100	121
R	189	190	200
S	129	202	173
T	100	160	141
U	131	138	142
V	126	147	145
W	110	138	100
X	103	130	124

APPEARANCE OF THE ASH OF LEAF WHEN BURNED AS A WRAPPER.

A Light gray, a little muddy.†
B Light gray, a little muddy.
C Light, but darker than B or D. Inclined to flake slightly.
D Light gray. Not muddy. Coals more than A or B. More flaky.
The ashes of the above are a shade darker than those of the next four.
E Light gray, rather more coal than A, B, C, D. Not flaky. Darker and muddier than G, H.
F About like E.
G Light gray, not quite as light as H. Very little muddy.
H Light color. Very flaky. Very little muddy.
I Not quite as light color but otherwise like H.
J Quite light color. No flake. Little muddy. Much like N. Very little coal.
K As light colored ash as any. Very little muddy. A little flaky.
L Quite light color. Like K and M, but not as flaky as either.
M Quite light. Little flake. No mud.
N Light gray. Not as light as S. Smooth, no flake. A little muddy.

* For explanation see page 17.
† That is, having a light brownish shade.

O About like N.
P A dark gray ash. *Much* darker than any other. No flake.
Q Very much like R, but a little more coal.
R Little darker than S. Somewhat flaky. A little muddy.
S Light as any except H. Slightly muddy.
T Quite light. Bad coal.
U Quite light. Very little flake.
V Darker than W and X. Bad coal.
W Light gray. No flake. More muddy than X.
X Light gray. More flaky than W. Very slightly muddy.

DISCUSSION OF THE RESULTS.

A single year's experiment cannot be expected to show conclusive results. It is only when the results of one season with another, of wet and dry summers, cold and hot years are studied together that the general value of a particular kind of fertilizer or method of curing can be fairly judged.

Moreover the real value of a tobacco crop cannot be fairly determined when it is cured, stripped and sorted.

Dealers in leaf tobacco all agree that it is easy to be mistaken in judging of the real value of a crop for wrappers, before it has gone through the fermentation or "sweat" in the case.

But while for the reasons just given no final judgment on the crops is attempted by the chosen experts, we may briefly call attention to some of the facts shown in the tables already given.

NET WEIGHT OF THE SORTED TOBACCO AND COLOR OF CROP.

The weight alone of course is of the least value in judging of the crop. A very heavy crop of large, dark, thick leaves is much less valuable than even a small crop of fine, medium-sized, light colored leaves, provided the burning quality of both kinds is alike.

There were seven crops of over 2000 pounds per acre, namely:

Q	Baker's Fertilizer	2280 pounds.
U	Mapes' Fertilizer	2270 "
J	210 lbs. nitrogen; half as castor pomace and half as nitrate†	2210 "
T	Ellsworth's Fertilizer	2200 "
S	Bowker's Two Ton Formula	2055 "
I	210 lbs. nitrogen, half as castor pomace and half as nitrate†	2035 "
H	210 " " all in form of castor pomace	2005 "

* See page 7.

The colors of the pole-cured leaves are described as "very dark" from plot I; as "dark" from plots Q, T, and U; as "medium dark," J; and as "a little dark," S. The color of H is not reported.

On the average the castor pomace plots produced a very little more than the corresponding cotton seed meal plots, 1866 pounds against 1771 pounds, the average difference amounting to 95 pounds per acre. The difference in yield of wrappers was however only 17 pounds per acre in favor of the castor pomace. The difference in color was slight, that raised on cotton seed meal inclined to be lighter than that from pomace. The lightest colors of all were in tobacco from the plots fertilized with cotton hull ash and either cotton seed meal or castor pomace. The single exception is plot P, raised on nitrate of potash and Cooper's bone, which was the lightest in the experiment; but the yield from this plot was very small and the burn was poor.

With the same quantities of nitrogen and phosphoric acid a like quantity of potash in form of double sulphate of potash and magnesia, gave a larger total crop and a larger weight of wrappers than either cotton hull ashes, high grade sulphate of potash or carbonate of potash (compare plots K and L with A, M, N and O). There was no very great difference in the color of the crops raised on these different forms of potash. That on A is dark, but on B, C and D, which also received the same quantities of cotton hull ashes with larger quantities of nitrogen, the color of the tobacco was light.

Plot P received only nitrate of potash and bone, the latter containing very little nitrogen. The tobacco on this plot appeared abnormal during all the season and was late in ripening. The total crop was only at the rate of 1250 pounds to the acre and of this only 455 pounds were wrappers.

Per Cent. of Wrappers in Crop.

It appears that a large yield is generally accompanied with a large percentage of wrappers. Of the ten crops which had more than 70 per cent. of wrappers in them six produced more than 2000 pounds to the acre and all of them over 1800 pounds.

Number of Leaves to the Pound of Wrappers.

This point, together with the burning quality of the leaf and the color, most largely determine the value of wrapper tobacco for manufacture. Our Connecticut leaf tends all the time to grow too large; so large that it cuts to great waste in the cigar manufacture. This can be certainly remedied by special attention to the growing of seed. It is an extremely important matter which may well receive the attention of growers.

The determinations of the weight of leaves in these crops was made with thirty leaves of the long wrappers and fifty leaves of the short wrappers on a balance sensitive to the one-thirtieth of an ounce.

From the table it appears that the lightest wrapper leaves (in weight, not color), were in the crops from R, Bowker's; L, double sulphate of potash and magnesia with lime; V, Mapes'; A, B and D, cotton seed meal and cotton hull ash; H, F and G, castor pomace and cotton hull ash; W, Mapes'; M, cotton seed meal and high grade sulphate; and lightest of all, were those from P. On O also the leaves were very light.

The heaviest leaves in the experiment were from plots S, Bowker; U, Mapes'; X, Sanderson; T, Ellsworth; W, Mapes'; Q, Baker; and J, heavy applications of castor pomace and nitrate of soda.

It must be borne in mind that the relative weight of the leaves may be very greatly changed by the "sweat" and that heavy leaves may lose in the "sweat" relatively more substance than lighter ones.

Comparative Capacity of Holding Fire.

This is one of the elements which determines the burning quality of a wrapper. It represents the time during which the leaf will continue to glow after it has been kindled.

The determination was made in the following way. Lighters were prepared according to a plan suggested by Dr. Nessler,* of Karlsruhe, as follows: 80 grams of gum arabic are soaked up in 120 c.c. of water and 40 grams of gum tragacanth in 250 c.c. of water. After 48 hours, when both are thoroughly diffused, 10 grams of powdered nitrate of potash are added and enough pulverized charcoal, about 350 grams, to make a thick mass which can be rolled upon a glass plate sprinkled with powdered charcoal, into sticks about 5 or 6 inches long and as large around as a cigar, and dried with a gentle heat. When these sticks are lighted they will slowly burn, without flame, till consumed, giving a live

* Landw. Versuchs-St, xl, 399.

coal like the tip of a cigar, which is just adapted to kindle the glow on a leaf.

The leaf is held horizontally over this lighter and brought down on its point till a circular hole is burned, glowing on the edges. It is quickly removed and the number of seconds which elapse till the last spark of fire goes out from the leaf is noted.

Six tests were made on each leaf, three on each side of the midrib, one near the base, one in the middle and midway between midrib and edge of leaf and the third near the tip. Five leaves from each lot of wrappers were thus tested making in all thirty trials from each lot and the average of the thirty was taken to represent the relative glowing capacity of the lot.

The lot which glowed for the shortest time is represented by 100 in the table.

Inspection of the table shows that the tobacco from the following plots glowed longer than that from any other:

Plot F, castor pomace and cotton hull ash; P, nitrate of potash and bone; C, cotton seed meal and ash; G, castor pomace and ash; J, castor pomace and ash with nitrate; O, cotton seed meal and carbonate of potash; D, cotton seed meal and ash.

The tobacco from the following plots glowed for a shorter time than any other:

Plot W, Mapes'; Q, Baker; X, Sanderson; T, Ellsworth; U, Mapes'; M, cotton seed meal and high grade sulphate; V, Mapes'.

Appearance of the Ash when the Leaf was used as a Wrapper.

A single leaf was picked by Mr. DuBon from the long wrappers of each plot during the sorting. He aimed to have it of about average color and from as near the same position on the stalk as could be. From this leaf, wrappers were cut and wound on small cigars (Clark's Little Beauty).

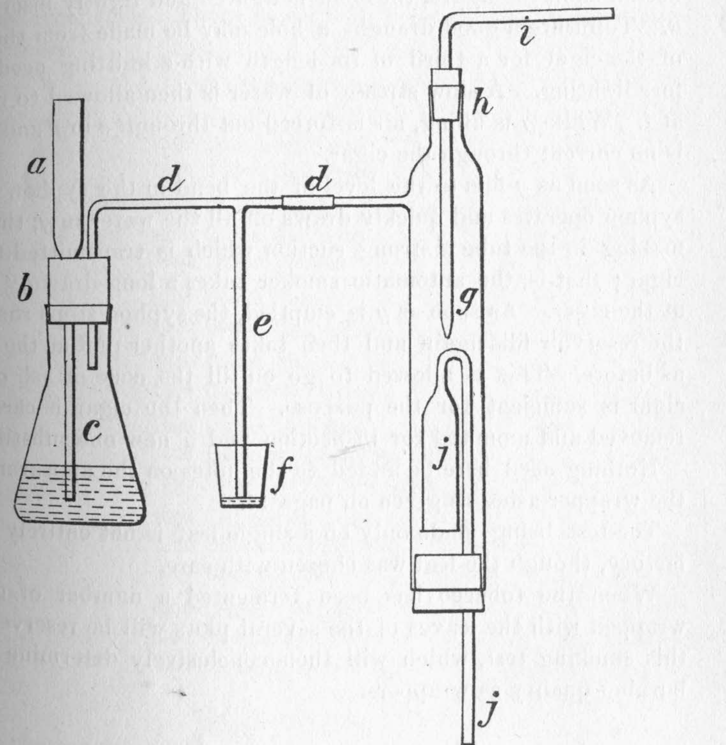
These cigars were then smoked for about one-third of their length in an apparatus specially made for this purpose, which is described and figured below. The cigars, with the ash adhering, were then fastened on pins in vertical position so that the whole series could be examined together and compared.

Description of the Smoking Apparatus.

If a continuous stream of air is drawn through a cigar it is much more liable to burn unevenly, one side more rapidly, than

if the draught is intermittent, as when it is "smoked." But the smoking of twenty or thirty cigars in succession, wrapped with unfermented leaves, is quite impossible for "the Station representative" or any one but a confirmed smoker with a sound stomach.

To meet these difficulties and to secure a perfectly uniform rate of smoking and a perfect cone of ash, this apparatus was devised by Prof. S. L. Penfield, of the Sheffield Scientific School, at our request. It has proved to be perfectly adapted to our needs.



The lighted cigar is set upright in the glass holder *a*, a tube which passes through a rubber stopper *b*, nearly to the bottom of the flask *c* of about 200 ccm. capacity, which contains water through which the smoke is drawn. The flask *c* is connected with the other parts of the apparatus by the tube *d*, an arm of which *e* dips very slightly below the surface of mercury contained in the beaker *f*. The other arm of the tube *d*, connects with the glass aspirator *g*. This consists of a cylinder of glass, narrow at the top and closed by a rubber stopper *h*. Through the stopper passes the tube *i* connected with a Mariotte bottle. By means of a stop-cock, water may be made to flow into *g* through *i* at a perfectly uniform rate. The lower stopper of *g* carries the syphon *j*, the short arm of which has a much larger diameter than the long arm. The aspirator *g* is held in vertical position by a clamp and *f* and *c* rest on a block of wood. The operation of the apparatus is as follows: The whole being connected as in the figure, the cigar is lighted and tightly inserted in *a*. To insure a good draught a hole may be made from the butt of the cigar for a third of its length with a knitting needle before lighting. A slow stream of water is then allowed to run in at *i*. While *g* is filling, air is forced out through *e* in *f* and there is no current through the cigar.

As soon as *g* fills to the level of the bend in the syphon *j*, the syphon operates and quickly draws off all the water in *g*, thereby making in the tube *d* strong suction which is transmitted to the cigar; that is, the automatic smoker takes a long drawn "pull" at the cigar. As soon as *g* is emptied, the syphon stops running, the reservoir fills again and then takes another puff at the cigar as before. This is allowed to go on till the cone of ash on the cigar is sufficient for the purpose. Then the cigar is carefully removed and mounted for inspection and a new one substituted.

Nothing need here be added to the notes on the appearance of the wrapper ashes as given on page 14.

The test being made only on a single leaf is not entirely satisfactory, though the leaf was chosen with care.

When the tobacco has been fermented a number of cigars wrapped with the leaves of the several plots will be reserved for this smoking test, which will then conclusively determine their burning quality as wrappers.

The Judgment of the Tobacco Experts.

It must be distinctly understood that this judgment is given on the appearance of the unfermented leaves, and it is expressly stated by the experts to be in no sense a final judgment on the quality of the crop.

The relative value of the tobacco from the several plots is liable to very great changes during the fermentation which no one can appreciate or estimate from an examination of the tobacco before it has been cased and fermented.

Too great emphasis cannot be laid on this, and it is particularly requested that if the experts' judgment is copied or republished, this preliminary statement may always appear with it.

The crop has been perfectly cared for and is in excellent condition. It would probably sell for thirty cents a pound right through.

All things considered from present appearances (December, 1892), the following are the best crops in the lot, the very best being placed at the head of the list and the others following in order of excellence. There is very little to choose between the last of them.

The Better Tobaccos.

From Plot	Fertilized with
A	1500 Cotton Seed Meal. 1500 Cotton Hull Ashes.
I	2640 Castor Pomace. 1500 Cotton Hull Ashes. 440 Nitrate of Soda.*
G	3300 Castor Pomace. 1500 Cotton Hull Ashes.
F	2640 Castor Pomace. 1500 Cotton Hull Ashes.
N	1500 Cotton Seed Meal. 620 High Grade Sulphate of Potash. 360 Cooper's Bone, 300 Lime.
K	1500 Cotton Seed Meal. 1220 Double Manure Salt. 360 Cooper's Bone.
O	1500 Cotton Seed Meal. 580 Carbonate of Potash. 360 Cooper's Bone.

The Poorer Tobaccos.

The poorest is placed at the head of the list and the others follow, each being better than those above it in the list.

From Plot	Fertilized with
V	501 Lime. 501 Mapes' Starter. 2601 Mapes' Tobacco Fertilizer with Extra Potash.
B	2000 Cotton Seed Meal. 1500 Cotton Hull Ashes.

* One-half at first cultivation, one-half at second cultivation.

Q	2020	Baker's A. A. Superphosphate.
	3920	Baker's Tobacco Fertilizer.
P	760	Nitrate of Potash.
	500	Cooper's Bone.
T	900	Ellsworth's Starter.
	2700	Ellsworth's Foundation.
R	2000	Bowker's Tobacco Manure.

V has the poorest burn of any. P burns rather black. L has a very little white vein, otherwise K and L are equal in value. There is *very* little if any difference in quality between H and D.

There is not a quarter of a cent a pound difference in the value of the other crops not specially named here and it must be remembered that the last crops named in both lists are not so very far apart in quality.

Chlorine in the Tobacco Fertilizer and in the Crop.

Why certain crops or leaves of tobacco burn well and others burn badly is not fully understood. It is likely that fat and proteids as well as the salts of mineral and organic acids have a decided influence on the burning quality.

But it has been demonstrated that tobacco which contains large quantities of chlorides does not burn well, especially when the quantity of potash present is small. Nessler found* from examination of 46 samples of tobacco grown in different parts of Baden on soils of diverse character, that the more potash and the less chlorine a leaf contains, the longer it will continue to glow when lighted. The higher the per cent. of potash the more chlorine may be present without seriously affecting the burn of the leaf. A Sumatra leaf for instance with .64–.78 per cent. of chlorine and 5 per cent. of potash burned very well, while a Baden tobacco with .4 per cent. chlorine and only 3 per cent. of potash burned badly. On the other hand the less chlorine there is in the leaf, the less potash is necessary to secure a good burning quality. He concludes that no tobacco burns well which has less than 2.5 per cent. potash if there is with it more than .4 per cent. chlorine.

It is therefore of interest to determine the quantities of chlorine applied in the formulas given on pages 6 and 7, as well as the quantities of potash and chlorine in the crops.

* Landw. Versuchs-St, xl, 407.

Below are given approximately the quantities of chlorine applied per acre in the formulas. The plots not named received very little if any chlorine.

Plot.	Quantity of Chlorine applied per acre.	Plot.	Quantity of Chlorine applied per acre.
I	1.3 pounds.	S	73.2 pounds.
J	1.3 "	U	26.0 "
K	22.0 "	V	31.3 "
L	22.0 "	W	21.9 "
Q	90.5 "	X	12.7 "
R	23.0 "		

The percentages of phosphoric acid, potash and chlorine in the pole-cured (unfermente d) long wrappers and short wrappers were as follows:

Plot.	Phosphoric acid		Potash		Chlorine	
	Long.	Short.	Long.	Short.	Long.	Short.
A	.65	.41	4.25	4.57	.18	.09
B	.39	.33	4.13	4.43	.08	.05
C	.51	.38	5.20	5.09	.11	.06
D	.57	.42	4.61	4.61	.09	.14
E	.75	.70	3.83	3.84	.21	.11
F	.47	.32	5.13	5.06	.05	.05
G	.58	.43	4.94	4.49	.08	.05
H	.44	.32	5.15	4.69	.08	.05
I	.50	.31	3.53	4.36	.16	.08
J	.47	.28	5.28	4.78	.17	.09
K	.48	.30	4.26	4.20	.36	.21
L	.58	.47	4.95	4.73	.08	.07
M	.67	.64	4.83	4.22	.12	.08
N	.45	.38	5.07	4.61	.21	.10
O	.52	.41	4.64	4.42	.07	.05
P	.63	.59	5.04	5.19	.06	.05
Q	.36	.29	3.25	3.90	.56	.47
R	.65	.49	4.72	4.21	.22	.15
S	.41	.31	4.59	4.64	.91	.54
T	.36	.29	3.77	3.58	.25	.15
U	.38	.30	3.80	3.84	.65	.36
V	.33	.29	4.20	4.77	.54	.26
W	.38	.33	5.06	4.59	.42	.21
X	.36	.28	4.45	4.14	.10	.06

Inspection of these figures with those given on page 14 shows:

1st. That of the tobaccos from the nine plots to which any considerable quantity of chlorine had been applied, viz: K, L, Q, R, S, U, V, W, X, six, viz: S, U, Q, V, W, K, had over a quarter of a per cent. chlorine in the wrappers and more than any others, and only two out of the nine had the average capacity of holding five, viz: L and R.

2nd. Five lots of tobacco on the other hand, viz: T, M, N, E, A, to which no chloride had been applied and none of which contained over a quarter of a per cent. chlorine, had less than the average capacity for holding fire.

It is not certain that any of these tobaccos have enough chlorine in them to seriously damage their burning quality, and after fermentation has altered the nature of the organic material of the leaf the relative burning quality may be considerably changed.

A certain small quantity of chlorine is absolutely necessary to the normal development of the plant, but growers do well to avoid applying it in other than very small quantities.

FORMULAS FOR TOBACCO.

The investigations made by the Director of this Station in 1872, as chemist of the State Board of Agriculture and those made since then in this Station have shown with sufficient accuracy what ingredients and how much of each are taken from the soil by a crop of wrapper-leaf tobacco as it is grown in this state.

Eight thousand tobacco plants set on an acre of land yield on the average 1875 pounds of pole-cured leaves or 1400 pounds of water-free leaf and 3200 pounds of pole-cured stalks, or about 1300 pounds of water-free stalks.

By this crop there are withdrawn from the soil per acre the following quantities (pounds) of nitrogen and mineral matters:

	In the Leaf.	In the Stalks.	Total.
Nitrogen	65	32	97
Phosphoric Acid	8	8	16
Potash	89	49	138
Soda	4	3	7
Lime	81	13	94
Magnesia	25	5	30
Sulphuric Acid	16	5	31
Chlorine	5	6	11

The crop takes relatively large quantities of nitrogen, (100 pounds), potash, (140 pounds), and lime, (100 pounds), and very little phosphoric acid, (16 pounds).

On pages 6 and 7 are a number of formulas approved by tobacco growers and by manufacturers.

Among these may be placed A, B, C, E, F, G, and those from Q on through the list. Below are given the number of pounds of nitrogen, phosphoric acid and potash removed from an acre by the crop and the maximum and minimum quantities supplied in these various formulas.

	Removed by Crop.	Supplied in the Formulas.
Nitrogen	100	99—345
Phosphoric Acid	16	150—581
Potash	140	168—643

The minimum quantity of phosphoric acid in any of these formulas is probably much larger than is necessary, the minimum quantities of nitrogen and potash are probably rather too small but the maximum quantities of each ingredient are prodigally wasteful if applied year after year.

Their use the first year might be justified because the land was new and had received no manure in many years, and of course much of the fertilizer applied would not be reached by the roots of the first crop, but would remain as a sort of "working capital" for future crops. Most of the excess of potash and phosphoric acid will be held by the soil till taken up by plants, while the nitrogen is likely to suffer loss by leaching, particularly in very light "tobacco" soils.

But it is certainly irrational to continue the heaviest applications year after year *except for purposes of experiment.*

It is likely also that many growers in their anxiety to secure light color and good burning quality regularly use a good deal more potash and phosphoric acid than is necessary, thus increasing by $10 to $20 per acre the cost of raising the crop. To illustrate:

A favorite formula in the Connecticut River valley, which has given very satisfactory results for the last six years, both as regards total yield, and also color and burning quality of wrappers is 2,000 pounds of cotton seed meal and 1,500 pounds of cotton hull ashes per acre. 2,600 pounds of castor pomace are preferred by some to the cotton seed meal.

As is seen on page 6, opposite plot B, this formula provided 140 pounds of nitrogen, 165 of phosphoric acid and 350 of potash. It contains in round numbers 40 pounds of nitrogen, 145 pounds of phosphoric acid and 210 pounds of potash *in excess* of the quantity actually removed by the crop. Considering that all the fertilizer which is applied cannot come within reach of the plant roots in the same season, that a certain excess in the soil is probably favorable to a rapid absorption by the roots of plants, and that nitrogen is specially liable to loss by leaching on the very light soils which are chiefly used for tobacco, the excess of nitrogen in the formula is surely not wasteful. But unless excessive applications of phosphoric acid and potash have some beneficial action on color, burning quality or ripening of the leaf, it must be irrational to apply year after year ten times as much phosphoric acid and two and a half times as much potash as the crop requires.

Whether an excess of phosphoric acid in the soil hastens the ripening of tobacco as it does of some other crops, sugar beets for instance, is not known. Nessler's observations go to show that the more phosphoric acid there is in the soil, the more is taken up by the tobacco plant and that a high percentage of phosphoric acid in the plant is likely to prevent the wrapper from giving a white ash.

Whether any unfavorable action is to be anticipated from excess of potash in the soil is not known and perhaps is not likely. The more potash there is in the tobacco the larger the quantity of chlorine which may be in it without injury to burning quality, and possibly an excess of potash may prevent injury that would otherwise be done by a great excess of phosphoric acid.

It would be desirable in any case to try lessening the expense of growing the crop by diminishing the quantity of cotton hull ashes used and noting whether there was any deterioration in quality. For the formula above given might be substituted for instance 2,000 pounds cotton seed meal and 800 pounds of cotton hull ashes which would supply about 136 pounds nitrogen, 119 of phosphoric acid and 201 of potash.

If 2,640 pounds of castor pomace were used instead of the cotton seed meal, it would supply with the ashes, 17 pounds less phosphoric acid and 7 pounds less potash than the above formula.

But it is likely that the supply of cotton hull ashes will be insufficient this year to meet the demands of the growers. If so, economy in the use of potash and phosphates will be more than ever desirable.

Three hundred and fifty pounds of high grade sulphate of potash, or 650 pounds of double sulphate of potash and magnesia, mixed with 2,000 pounds of cotton seed meal, or 2,550 pounds of

castor pomace, or 2,600 pounds of linseed meal, old process—which we are informed is to be introduced as a tobacco fertilizer the coming season,—will supply about 140 pounds of nitrogen, 48 to 56 pounds of phosphoric acid and 200 pounds of potash at a cost of from $36 to $43 per acre. Many growers in the Connecticut Valley would prefer to add to this, 200 to 300 pounds of lime to the acre, both to supply lime to the crop and also to maintain a mild alkaline reaction in the soil favorable to the decay and oxidation of nitrogenous organic matters. In the limestone soils of the Housatonic Valley this would probably be of no advantage.

The Connecticut Tobacco Experiment Co., plans to try several of these formulas this season, but it is of great importance that the experiments made in Poquonock should be repeated on soils of different character, the "meadow land" of that vicinity for instance, the different soils of the east bank of the Connecticut River and also in the Housatonic Valley. It is very well known that a system of fertilizing or manuring tobacco very suitable for one soil is much less suited to many other soils.

In the following table are given the average quantities of nitrogen, phosphoric acid, potash and chlorine contained in one hundred pounds of the materials most used in tobacco fertilizers in this State as determined by analyses made at this Station during the last six years:

Average Composition of Fertilizers used on Tobacco.

	No. of Analyses.	Pounds per 100. Nitrogen.	Phosphoric Acid.	Potash.	Chlorine.
Nitrate of Soda	13	16.02	----	----	.37
Sulphate of Ammonia	14	20.41	----	----	--
Cotton Seed Meal	35	6.80	2.60	1.70	--
Castor Pomace	23	5.40	1.90	1.10	--
New Process Linseed Meal	--	5.31	2.17	1.54	--
Dissolved Bone Black	19	----	17.05	----	--
Ground Bone	--	4.00	22.00	----	--
Double Sulphate of Potash and Magnesia	15	----	----	26.1	1.8
High Grade Sulphate of Potash	3	----	----	51.4	--
Double Carbonate of Potash and Magnesia†	1	----	----	18.1	.15
Wood Ashes, unleached	35	5.31	1.46	----	--
Cotton Hull Ashes	106	----	9.60	23.90	--
Tobacco Stems	4	1.91	.69	7.70	*
Tobacco Stalks	--	.87	.24	1.66	.20
Horse Manure (with litter)	3	.55	.43	.58	.07
Cow Manure	3	.54	.30	.43	.08

* Not determined. † See page 34.

See also analyses of the brands of manufactured Tobacco Manures given on pages 98 to 100 of this Report.

By multiplying the number of *hundred* pounds of fertilizer used per acre by the figures above given, may be approximately calculated how much of the three elements of plant food is applied. Thus if 300 pounds of nitrate of soda is used per acre, the quantity of nitrogen applied is (3×16.02), 48.06 pounds.

CHEMICAL CHANGES IN TOBACCO DURING FERMENTATION.

In December, 1891, three lots of tobacco were selected at the warehouse of Mr. A. C. Sternberg of Hartford, as follows: The lots were taken from a pole-cured crop raised with cotton seed meal and cotton hull ashes as a fertilizer.

Lot A was of upper leaves, cut of course when not fully ripe. From a pile ready for casing, two leaves were selected at a time, as nearly alike in color, size and texture as possible and put in two separate piles. Each pile contained 75 leaves which were tied in five "hands." The weight of the two piles was precisely alike, 1 pound 1½ ounces each. The hands from one pile were securely wrapped in oiled paper and brought to the laboratory where they were immediately analyzed, the others suitably labeled, were given to Mr. Sternberg who cased them down with other tobacco to be fermented. Lot B was selected in the way just described, from the "short seconds," the lower leaves on the stalks and therefore a little over-ripe when harvested. Each pile, precisely alike in weight, 1 pound, 9 ounces, contained 175 leaves, and was tied in seven hands. The hands from one were immediately analyzed, those from the other were cased down. Lot C was of "First Wrappers," the best leaves on the stalk, cut at the proper time. Each pile contained 140 leaves, weighed 2 pounds, 1½ ounces, and was tied in seven hands. The one sample was immediately analyzed, the other was cased down. Of this sample only a portion was taken for drying and analysis.

In the latter part of August, 1892, Mr. Sternberg opened the fermented, "sweated," tobacco and immediately sent to the Station the three samples, very carefully packed, to avoid any loss of moisture. The samples were at once dried and analyzed.

The condition of the tobacco when analyzed is shown in the following table:

	A Upper Leaves.		B Short Seconds.		C First Wrappers.	
	Unfermented.	Fermented.	Unfermented.	Fermented.	Unfermented.	Fermented.
Number of leaves in sample	75	75	175	175	60	60
Weight of the leaves, (grams)	505	456	713	625	401	365
Number of leaves in one pound	67	74	111	127	68	74
Per cent. of water in the leaves	23.5	23.4	27.4	21.1	27.5	24.9

The chemical analyses of the leaves are given in detail below:

Analyses of Fermented and Unfermented Leaves.

	A Upper Leaves.		B Short Seconds.		C First Wrappers.	
	Unfermented.	Fermented.	Unfermented.	Fermented.	Unfermented.	Fermented.
Water	23.50	23.40	27.40	21.10	27.50	24.90
Ash*	14.89	15.27	22.85	25.25	15.84	16.22
Nicotine	2.50	1.79	.77	.50	1.26	1.14
Nitric Acid (N_2O_5)	1.89	1.97	2.39	2.82	2.59	2.35
Ammonia (NH_3)	.67	.71	.16	.16	.33	.47
Other Nitrogenous matters†	12.19	13.31	6.69	6.81	11.31	11.62
Fiber	7.90	8.78	7.89	8.95	9.92	10.42
Starch	3.20	3.36	2.62	3.01	2.89	3.08
Other Nitrogen-free Extract	29.39	27.99	26.28	28.36	25.52	26.88
Ether Extract	3.87	3.42	2.95	3.04	2.84	2.92
	100.00	100.00	100.00	100.00	100.00	100.00

From the data obtained has been calculated the number of pounds of each ingredient of the leaves in one thousand pounds of the unsweated tobacco, and also how many pounds of each ingredient were left after fermentation. The differences should represent the losses incurred during the process.

* Free from carbonic acid and carbon.

† Nitrogen other than that of nicotine, nitric acid and ammonia, multiplied by 6¼.

Composition of 1000 Pounds of Unfermented Leaves and the Loss of each Ingredient During Fermentation.

	A Upper Leaves.			B Short Seconds.			C First Wrappers.		
	In 1000 Pounds Unfermented.	Left after Fermentation.	Lost in Fermentation.	In 1000 Pounds Unfermented.	Left after Fermentation.	Lost in Fermentation.	In 1000 Pounds Unfermented.	Left after Fermentation.	Lost in Fermentation.
Water	235.9	211.5	23.4	274.0	184.6	89.4	275.0	226.2	48.8
Dry Matter	765.0	691.3	73.8	726.0	692.0	34.0	725.0	683.1	41.9
Ash	148.9	138.1	10.8	228.6	221.5	7.1	158.3	147.5	10.8
Nicotine	25.0	16.2	8.8	7.7	4.4	3.3	12.5	10.5	2.0
Nitric Acid (N_2O_5)	18.6	17.7	.9	23.7	24.8	†1.1	25.9	21.3	4.6
Ammonia (NH_3)	6.7	6.5	.2	1.6	1.4	.2	3.3	4.3	†1.0
Other Nitrogenous matters*	121.0	120.1	.9	67.6	59.7	7.9	113.1	105.6	7.5
Fiber	79.1	79.5	------	78.9	78.6	.3	99.0	94.8	4.2
Starch	31.9	30.3	1.6	27.6	26.3	1.3	28.9	28.0	.9
Other Nitrogen-free Extract	29.52	252.0	43.2	260.6	248.6	12.0	255.6	244.5	11.1
Ether Extract	38.7	30.9	7.8	29.7	26.7	3.0	28.4	26.6	1.8

Total loss by Fermentation.—The Upper Leaves, Short Seconds and First Wrappers lost respectively, by fermentation, 9.7, 12.3 and 9.1 per cent. of their total weight.

But while three-fourths of the loss in the case of the Short Seconds consisted of water, in the case of the Upper Leaves almost three-fourths of the loss was of dry matter. The First Wrappers lost a little less dry matter than water.

Ingredients of the Leaf affected by Fermentation.—The quantities of nitric acid, ammonia, fiber and starch contained in the leaves are about the same after fermentation as before.

It will be noticed that there is an apparent loss of ash or mineral matter in each case. This cannot possibly be due to changes induced by fermentation but can only be explained by errors in weighing or analysis against which every precaution was exercised, or by the handling of the leaves by the persons who cased it down. Tobacco is usually shaken out very vigorously as it is cased to make the leaves smooth, and in this way adhering sand may be easily shaken out. This latter explanation is the most probable.

Aside from this, the chief loss of dry matter has been in nicotine, albuminoids and amide bodies, nitrogen-free extract and to a much less extent, ether extract.

* Nitrogen other than that of nicotine, nitric acid and ammonia, multiplied by 6¼.

† Apparent *gain!*

Thus the Upper Leaves lost more than a third of their nicotine, the Short Seconds somewhat less than half and the First Wrappers less than one-sixth of it.

The Upper Leaves in which fermentation was evidently the most active lost more than one-seventh of their nitrogen-free extract and one-fifth of their ether extract.

The First Wrappers claim special notice as they make up a large part and the most valuable part of any good crop.

The fermentation *in this case* destroyed only 5.8 per cent. of their dry matter. They lost but a little nicotine, and aside from the ash the chief losses were of nitrogenous matters other than nicotine and of nitrogen-free extract which includes the "gum" of tobacco.

Further experiments made on a much larger scale are desirable to accurately ascertain the nature of the fermentation and the possibility of regulating it to suit the special requirements of the leaf.

ANALYSES OF TOBACCO STALKS WHEN CUT AND AFTER CURING.

In the summer of 1891, three samples of stalks were taken by Mr. Winton from the standing crop of Mr. H. H. Austin of Suffield.

On August 22, three lots of four plants each were selected with care to secure those that were uniform in size and leaf development.

The plants of one lot, A, were cut at that time, the leaves were at once stripped off and the stalks after weighing were dried at 50° C. for analysis. At this time the lower leaves were ripe, but the whole plant was unripe and not ready to cut for curing on the stalks.

On September 7, a second lot, D, was cut, stripped, weighed and further treated like A. The plants were fully ripe and ready to harvest.

On the same date a third lot, C, was cut, labeled and hung in Mr. Austin's curing barn with the leaves still on it to cure with the rest of the crop. On October 16, the leaves were stripped off and the cured stalks were weighed, dried and analyzed like the others.

Following are the analytical data which are discussed further on :

ANALYSES OF TOBACCO STALKS.

Sample marked, Date of cutting, Weight when stripped,	A Aug. 22. 4 lbs. 11½ oz.		D Sept. 7. 4 lbs. 14 oz.		C Sept. 7. 1 lb. 11½ oz.*	
	Fresh.	Water-Free.	Fresh.	Water-Free.	Fresh.	Water-Free.
Water	86.46	------	86.38	------	61.52	------
Pure Ash	.90	6.64	.95	7.00	2.87	7.46
Sand and Soil	.19	1.44	.08	.56	.14	.36
Nicotine	.07	.52	.09	.69	------	------
Nitric Acid (N_2O_5)	.19	1.40	.23	1.72	.73	1.92
Other Nitrogenous matters†	1.31	10.13	1.56	11.69	6.37	16.69
Fiber	4.76	35.12	4.74	34.79	14.23	36.98
Starch	1.56	11.55	1.94	14.21	4.96	12.91
Dextrose or copper-reducing bodies	.39	2.87	.37	2.71	.25	.66
Other Nitrogen-free Extract	4.05	29.45	3.53	25.67	8.60	22.15
Ether Extract	.12	.88	.13	.96	.33	.87
	100.00	100.00	100.00	100.00	100.00	100.00

The complete analyses of the pure ash are as follows:

ANALYSES OF THE PURE ASH OF TOBACCO STALKS.

	Cut Aug. 22.	Cut Sept. 7.	Cut Sept. 7, and Cured.
Silica	.82	.57	.55
Oxide of Iron and Alumina	1.38	1.38	.72
Lime	14.01	16.58	14.85
Magnesia	6.64	7.36	6.91
Potash	56.34	54.46	55.43
Soda	1.28	1.16	.89
Sulphuric Acid	8.06	6.75	7.38
Phosphoric Acid	6.37	6.27	7.96
Chlorine	6.55	7.05	6.82
	101.45	101.58	101.51
Oxygen equivalent to chlorine	1.45	1.58	1.51
	100.00	100.00	100.00
Per cent. of pure ash in water-free Substance	6.64	7.00	7.46

From these data have been calculated how many pounds of the several ingredients were contained in the stalks from an acre of tobacco or 8000 plants and the results are here given :

* Pole-cured.

† Nitrogen (other than that of nicotine and nitric acid) multiplied by 6.25.

	A Cut Aug. 22. Unripe.	D Cut Sept. 7, Ripe.	C Cut Sept. 7 and Cured till Oct. 16.
Total weight per acre	9437	9750	3438
Water	8159.0	8422.0	2115.0
Dry matter	1279.0	1328.0	1323.0
Starch	147.0	189.0	171.0
Dextrose	38.0	36.0	8.7
Nicotine	6.6	8.8	?
Total Nitrogen	**25.5**	**32.2**	**41.8**
Phosphoric Acid	**5.5**	**5.8**	**7.9**
Potash	**47.8**	**50.6**	**54.7**
Soda	1.1	1.1	.9
Lime	11.9	15.4	14.7
Magnesia	5.6	6.8	6.9
Oxide of Iron and Alumina	1.2	1.3	.7
Sulphuric Acid	6.8	6.3	7.4
Chlorine	5.6	6.5	6.8

These figures show a slight gain by the stalk in almost every ingredient in the period of growth between August 22 and September 7.

If the different samples were exactly alike when cut there would be the same quantity of ash ingredients in the stalks after curing as there was before, for none of them are volatile or could be dissipated by fermentation. We find that they are practically alike except in the case of phosphoric acid and potash which are present in somewhat larger quantity in the cured than in the uncured stalks.

It is quite possible that nitrogen might be lost in the pole curing, but that the plants should acquire nitrogen is not conceivable; yet the cured stalks show 10 pounds more, per acre, than the uncured. This is to be explained by inequality in the samples which were drawn, unless indeed there has been, as some claim is possible, a transference of nitrogen (and to a less extent of phosphoric acid and potash) from the leaves to the stalk, during the curing process.

In curing, the stalks seem to have lost some starch by fermentation and the larger part of the sugar which they originally contained.

The analyses are principally interesting as showing the weight of the stalks and also the plant food which they take from the land while growing and return to it when plowed in.

The stalks on an acre of tobacco containing 8,000 plants weigh at the time of cutting about 9,500 pounds. Of this about 8,300 pounds or 4 1-7 tons is water, which has to be handled and hauled to the barns and hung on the poles. About 6,200 pounds, 3 1-10 tons, of water is evaporated in curing and the rest, a little over a ton of water, is taken down and carried back to the field in the cured stalks.

Averaging the data here given with other data collected by this Station in past years, the valuable fertilizing ingredients in the stalks from an acre, of 8,000 plants, of tobacco is as follows :

FERTILIZING INGREDIENTS IN STALKS [8,000] FROM AN ACRE OF TOBACCO.

	Average pounds.	Maximum pounds.	Minimum pounds.
Nitrogen	32	42	22
Phosphoric Acid	8	15	6
Potash	49	55	51
Soda	3	10	0.5
Lime	13	15	8
Magnesia	5	7	2
Sulphuric Acid	5	7	3
Chlorine	6	11	trace

A NEW POTASH SALT FOR TOBACCO.

The Station has received from the Stassfurt Syndicat, for use in the experiments on growing tobacco, one ton of their double carbonate of potash and magnesia. This salt has lately been put on the German market and is being tested by the tobacco growers of Baden and Elsass.

It is a very fine powder, dry to the touch, and a sample drawn by the Station agent from the ton lot has the following composition :

Potash	18.10
Soda	1.49
Lime	1.20
Magnesia	19.27
Oxide of iron and alumina	2.34
Chlorine	.15
Carbonic acid	32.55
Water, mostly combined	25.12
	100 22

The composition of this article may also be represented as follows:

Hydrous Carbonate of Potash	31.74
Hydrous Carbonate of Magnesia	60.21
Carbonate of Soda	2.32
Carbonate of Lime	2.14
Chloride of Sodium	.24
Oxides and carbonates of iron	3.35
	100.00

The quantity of chlorine present is too small to be of any significance for tobacco.

This material contains five or six per cent. less of actual potash than cotton hull ashes contain on the average, but seems to be well adapted for use on tobacco in place as either cotton hull or wood ashes.

REPORT OF THE MYCOLOGIST.

WM. C. STURGIS.

The past season has been an exceptionally favorable one for the farmer and fruit-grower so far as the prevalence of fungous diseases is concerned. The prolonged dry weather which marked the middle of June, the latter part of July and of August, and the first half of September, was most unfavorable to the development of parasitic fungi, fruit and garden crops suffered little if at all, hence the work of the mycological department was largely confined to a continuation of the experiments begun the previous year.

TOBACCO.

The work of this department upon tobacco this year was entirely of a preparatory nature.

As outlined in the Station Report for 1891, it was intended to try the value of artificial heat in counteracting unfavorable atmospheric conditions during the process of curing, resulting in the decay known as "pole-sweat." With this and similar ends in view, and in connection with the newly organized Connecticut Tobacco Experiment Co., a plot of land was secured for a term of years at Poquonock, and steps taken for an extensive series of experiments upon the fertilizing of tobacco and the quality of the product under various conditions of fertilization. The results of these experiments have already been published by the Station. Meanwhile a curing-barn built upon the principles of ventilation suggested in the Station Report for 1891, was erected upon the Company's land. The amount of tobacco planted for experimental purposes exceeded that originally proposed, so that it became necessary to alter the plans first made and make the barn considerably larger. The present structure is 60 ft. long by 31 ft. wide, and measures 16 ft. 8 in. from sill to eaves. The land upon which the barn is built slopes slightly, necessitating brick foundation piers to bring the sills level. The studs erected on the sills are 15 ft. apart, thus providing for the use of the usual fifteen-foot poles running the length of the barn, the ends of each pole resting upon

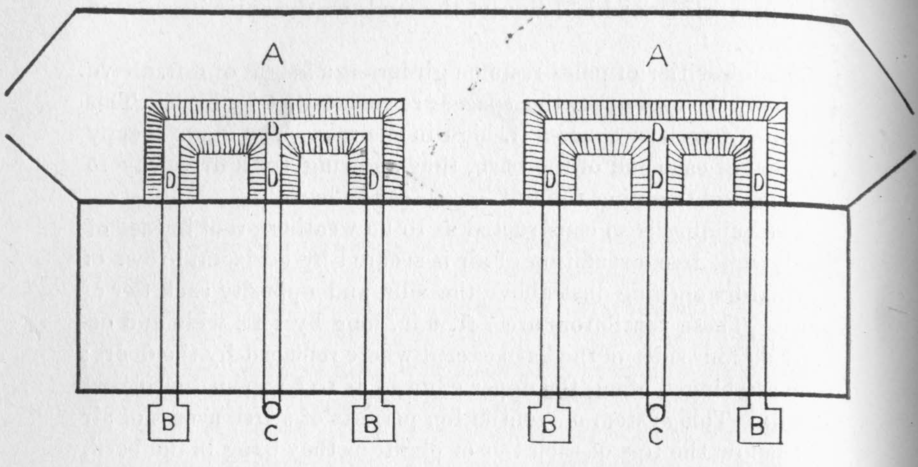
the heavy girders which connect the studs on the opposite sides of the barn.

The lower tier of poles rests on girders at a height of 6 ft. above the floor, the two upper tier spaces are each 5 ft. 4 in. high. This permits of one tier space 5 ft. high in the roof. The doors occupy one half of each end of the barn, thus allowing for a driveway 15 ft. 6 in. wide running the full length of the barn.

The building is so constructed as to be weather-proof in case of need, while free circulation of air is secured by horizontal rows of ventilators opening just above the sills and opposite each tier of poles. These ventilators are 7 ft. 6 in. long by 1 ft. wide and occupy all four sides of the barn except where replaced by the doors; they are hinged along the upper edge so as to be opened or closed at will. This system of ventilation permits of a free access of air just below the tips of each tier of plants as they hang in the barn, and precludes all possibility of damage from the air striking the plants directly as is the case where vertical ventilators are used. To assist further the circulation of air, especially when artificial heat is used in the barn, the gables are each provided with a large swinging ventilator which can be closed when necessary.

The total cost of this barn, not including the heating apparatus, was $657.56.

To find some system of heating the barn which should be both cheap and easily applicable to the style of barn at present in use, was a matter requiring some thought. It was finally decided to use seven and eight inch galvanized iron stove-piping for the flues, and for furnaces very simple stoves of sheet-iron. In laying the flues advantage was taken of the slope of the land. The furnaces, four in number, were placed along the lower side of the barn on the outside, and sunk so that the smoke-flue came within a foot of the surface of the ground. The flue was then continued within the barn until it reached the drive-way where it was sunk a few inches below the surface to allow of planks being placed over it so that the drive-way could be used when the flues were in position. The accompanying diagram illustrates the ground-plan of the flue-systems.



A, A, represent the driveway; B, B, B, B, the furnaces; the portion of the flues marked D is sunk below the level of the floor in trenches with sloping sides, indicated by the shaded portion. The whole drive-way can be covered with planks which are easily removed whenever the heat from the flues is required. The central flues of each system issue from the barn at C, C and connect with tile chimneys resting upon suitable brick foundations.

It will be noticed that this plan differs from that previously suggested, in that here the flues run across the barn instead of lengthwise, this change being necessitated by the greater length of the barn. Had the ground been level, of course the furnaces would have been sunk deeper so as to allow of the flue being laid on a slight incline sufficient to establish a draught, and yet be below the surface at the drive-way; but as the ground itself sloped considerably the flues could be a foot above the surface at B, rise gradually six inches in twenty feet, and yet be below the surface at D.

The total cost of the furnaces, flues, and chimneys amounted to $84.37 including labor; and with proper care, especially if the flues and furnaces are painted, the whole apparatus would last some years.

The flues were tested, and were found to be amply sufficient to raise the temperature of the air in the barn to any required degree, and to establish a current of warm air passing off through the ventilators in the eaves. Whether the latter will be sufficient to prevent an accumulation of hot air in the upper part of the barn,

remains to be seen. It may still be necessary to provide additional ventilation in the roof.

The barn was completed and the flues adjusted August 26th. The tobacco was cut and hung August 29th and 30th. On September 6th, 13th and 14th, there were heavy showers, but with these exceptions, until the first of November the weather was clear and cool with light northwesterly winds. No "pole-sweat" was to be found, and it was therefore impossible to continue the study of the organism producing the decay. It is possible that another season will present an opportunity for further investigation, and for experiments in preventing "pole-sweat" by the judicious use of artificial heat at critical periods of the curing process. We have at least devised a cheap and ready method of applying heat, and one easily applicable to any curing barn.

Potatoes.

Through the kindness of Mr. H. M. Yerrington of Norwich, four acres of potatoes on his farm were secured by the Station for the purpose of experimenting on a large scale with various fungicides in preventing potato blight and rot. Potatoes grown on this land had in previous years suffered considerably from the disease, and it was reasonable to presume that the conditions for an instructive experiment would again prevail. The potatoes were grown in two fields, the one containing two acres and a half, situated on dry upland; the other, distant about a quarter of a mile, situated on sloping ground protected by woods from excessive dryness, and containing an acre and a half. The upper field was reserved for experiments with Bordeaux mixture of two different degrees of strength, the lower for testing the comparative efficacy of acetate of copper in suspension, and an ammoniacal solution of sulphate of copper, using carbonate of ammonia as a solvent according to Johnson's formula.

The "seed" used in both fields was the same, consisting of three varieties: Polaris, Summit, and New Queen. Part of the "seed" was northern, and part native. It may be incidentally mentioned here that the northern "seed" proved by far the best, producing nearly double the yield of the native "seed."

The conditions of growth were further equalized by the use of the same fertilizers on the two fields; Williams & Clark's, Chittenden's, and Coe's, 500 lbs. to the acre broadcast, and 1,500 lbs. in the drills. On June 15th, both fields were staked off, the upper into three plots covering respectively one acre, one acre, and one-half acre; the lower into two plots, one covering an acre, the other half an acre. The first application of the fungicides was made the same day. A cask containing 50 gallons was mounted on a farm wagon, and fitted with a Gould double-acting force-pump provided with two discharge tubes each fifteen feet in length, and Vermorel nozzles. One man was required to drive, one to pump, and one to direct each spray. A little experience showed that the most expeditious method of using a rough contrivance of this nature was to drive the cart so that two rows came between the wheels; by stopping for a few seconds every twenty or thirty feet the man directing each spray could spray one row beneath the wagon and three on the side, making eight rows treated simultaneously. By attaching each nozzle and tube to a light stick four feet long, the labor of applying the spray was much decreased. There is no doubt that a great deal of time and energy was unnecessarily consumed by this inadequate method of applying the fungicide, and we hope before another season to perfect a cheap and simple device for spraying potatoes, by which one or at most two men will be enabled to spray three or four rows simulanteously as fast as a horse can walk. Even by the method described above, four men could spray an acre and a half in two hours although much time was lost in the frequent turns necessitated by the narrowness of the field. It was feared that much damage would be caused by running over the vines at each turning, but it proved much less than was expected, the vines being only slightly crushed even when almost full-grown, and recovering very quickly.

On the three plots comprising the upper field, which we will call A, B, and C, (C being the half acre) the fungicide used was sulphate of copper. Plot A received Bordeaux mixture in the proportion of 6 lbs. sulphate of copper and 5 lbs. lime to 50 galls. of water, this being about half the strength usually recommended. Plot B received the same diluted with twice the amount of water, viz: 6 lbs. sulphate, and 5 lbs. lime to 100 galls. of water. Plot C was sprayed with sulphate of copper alone in the proportion of ½ lb. to 40 galls. of water. With the fungicide applied to plots A and C Paris green was mixed, in the proportion of ½ lb. to 50 galls.; and plot B received ¼ lb. of Paris green to 50 galls. In the centre of the field three rows were left as checks. These received only Paris green.

The two plots comprising the lower field we will call D, and E, the latter being the larger. Plot D was sprayed with acetate of copper 10 oz., Paris green ¼ lb., water 40 galls. Plot E received the ammoniacal solution of sulphate of copper in the proportion of 1 lb. carbonate of ammonia, ½ lb. sulphate of copper, dissolved separately, and diluted with water to 62 galls. One corner of this field comprising about one-tenth of an acre was left untreated as a check.

The first spraying on all the plots was begun on June 15th and finished the following day. The vines made a very strong growth during the next three weeks and as there was no appearance of the rot, and the weather was comparatively dry, the second spraying was deferred until July 6th. On this date the vines were in full bloom and so high that it was evident that a third spraying would be impracticable. On July 16th the vines on the lower field began to blight, though no Phytophthora was to be found; the cause of the blight was not determined, inasmuch as the vines had dried and were completely dead before they could be submitted to sufficient microscopic examination.

The potatoes on the upper field, especially those sprayed with the stronger Bordeaux mixture, made a good growth and remained comparatively green until the latter part of August when digging was begun, and finished September 10th. The plots sprayed with Bordeaux mixture yielded an average of 291 bushels per acre; the plot treated with the ammoniacal solution of copper sulphate, 146½ bushels per acre; the plot treated with acetate of copper, 181 bushels per acre; and that treated with the simple solution of sulphate of copper, 272 bushels per acre.

Under date of November 8th, Mr. Yerrington writes with reference to the crop from the upper field where the Bordeaux mixture was used: "The potatoes are considered something wonderful here as the crop generally is a failure."

Although no Phytophthora appeared upon sprayed or unsprayed potatoes in this section and the experiment is therefore valueless as far as this disease is concerned, it is nevertheless instructive, and justifies the following conclusions:

1. Bordeaux mixture, even of half the usual strength, viz: copper sulphate 3 lbs., lime 2 lbs., water 22 galls., exercises a marked effect upon potato vines, considerably increasing their vitality and period of growth.

2. In this respect Bordeaux mixture is superior to the ammoniacal solution of copper sulphate, and to copper acetate.

3. The ammoniacal solution of copper sulphate prepared according to Johnson's formula has one serious objection. The carbonate of ammonia is not only difficult to procure in a perfectly fresh condition, but upon exposure to the air loses water and ammonia, becoming in the course of a few days soft and opaque, in which condition considerably more of the salt is required than when fresh, to dissolve the same quantity of copper sulphate. It is possible of course to procure the ammonia salt fresh and make up at once a sufficient quantity of the concentrated solution of copper sulphate to last during the season, but the quantity required for a season's spraying is not often known accurately, and on the whole it would seem more convenient to use liquid ammonia as a solvent for the copper salts.

4. The expenditure of time and labor in the application of Bordeaux mixture to potato vines, even with imperfect apparatus and methods, is much less than would be expected; the labor of three or four men for 1 hr. and 20 mins. being sufficient to apply the mixture thoroughly to an acre of potatoes almost fully grown. If the mixture is prepared in the proportion of copper sulphate 6 lbs., lime 4 lbs., water 50 galls., the cost of chemicals would be about 28 cents per acre for each application, about 63 galls. being required to spray that area.

An experiment similar to the above was conducted by Mr. F. T. Bradley, of Saybrook. Mr. Bradley used the Bordeaux mixture and a knapsack sprayer. Under date of November 16th he reports as follows: "So far as efficacy of the treatment is concerned I can say nothing, for there was no "rot" in this section this year. I can spray from three to four acres a day at a cost of material of from 40 cents to 60 cents per acre each time."

QUINCES.

LEAF-SPOT. ENTOMOSPORIUM MACULATUM, LÉV.

The experiments of former years in the orchard of Mr. Geo. F. Platt at Milford were continued this year with a view of determining the value of certain other fungicides as compared with the Bordeaux mixture hitherto used with marked success.

The fungicides used were the ammoniacal solution of copper sulphate (carbonate of ammonia as the solvent); modified Eau celeste; acetate of copper in suspension; and a mixture of copper sulphate dissolved in water, and powdered steatite, the latter

BLACK-ROT OF QUINCE.
Sphaeropsis Malorum. Peck.

furnished by Messrs. W. S. Powell & Co. of Baltimore. Each of these fungicides was used on two trees, the remainder of the orchard being sprayed as usual with Bordeaux mixture. The fungicides were applied May 24th, June 11th, and July 12th, and at the time of harvesting the crop no marked difference with regard to the prevalence of "leaf-spot," could be observed between these trees and those treated with Bordeaux mixture. At the time of the last spraying a very small amount of "rust" (*Roestilia aurantiaca*, Peck) was to be observed on all the trees in the orchard, attacking a young fruit here and there or a twig. The trees sprayed with the acetate of copper seemed to be more free from rust than any of the others, and this treatment will be continued another year as the acetate is cheap and easily applied.

None of the other fungicides used however, is in any way superior to Bordeaux mixture.

BLACK ROT OF QUINCES.

SPHÆROPSIS MALORUM, PECK.

Late in October the writer received from Mr. N. S. Platt of Cheshire several quinces more or less affected with a disease inducing a rapid decay of the fruit.

It was first noticed in August last, as a small brown stain on the exposed side of the fruit; the discolored area rapidly increased in size, the parts affected became shrunken and often badly cracked, and upon cutting the fruit open the interior was found to be brown and decayed to the core, and this notwithstanding the fact that all the trees had received thorough treatment with Bordeaux mixture before the blossoms had opened, again June 14th, and finally July 29th. The appearance of the diseased fruit is represented in the accompanying plate. Specimens of the fruit on which the disease had just appeared were placed upon a table in the laboratory. In the course of ten days the decay had involved the whole fruit, and at the end of three weeks numerous black pimples began to appear on the discolored surface of the now shrunken and wrinkled fruit. Finally the fruit became completely "mummified" and reduced by drying to a quarter of its original bulk.

Microscopic examination of the diseased fruit showed that the decay was caused by the presence of a fungus (*Sphæropsis Malorum*, Peck), the black pimples which appeared from three weeks to a month after the disease became apparent on the quinces, constituting the fruiting stage of the fungus. This disease is not peculiar to quinces, but has long been known on apples,* and has been frequently described. The "apple quince" seems to be more subject to its attacks than the "orange quince."

It would seem an easy matter to suggest remedial measures for this disease. It seldom makes its appearance before August when the fruit is well grown, a fact which would sufficiently account for its appearance on the sprayed trees this year, the last treatment being made July 29th. Two additional treatments with Bordeaux mixture in August, or one in August and one in September, would probably prevent its appearance. It is needless to say that every "mummified" fruit allowed to remain on the trees or on the ground beneath them, becomes a centre of the disease the succeeding year. All such fruit should be collected at the time of harvest, and buried, or better still, burned.

CELERY.

Blight. Cercospora Apii, Fres.

Early in July a letter was received from Mr. Gaston T. Hubbard of Middletown, requesting information regarding a disease which attacked and destroyed his celery the previous year. The description of the disease was too meagre to allow of any conclusions regarding its cause, but Mr. Hubbard was recommended to await further developments, and if the disease made its appearance, to send specimens to the Station, and to try dusting part of the plants with powdered sulphur, and using upon another portion a spray of sulphide of potassium in the proportion of ¼ oz. to 1 gall. of water. The recommendation was a mere hazard, as it seemed improbable that any fungicide would check a disease once started, and yet it was desirable to allow the disease to start in order that its nature might be determined. About Sept. 10th, specimens of diseased leaves were sent to the Station, and upon examination proved to be attacked by the common leaf-blight of celery, *Cercospora Apii*, Fres.†

Meanwhile the treatment recommended had been carried out since Sept. 1st, when the blight first showed itself. The result of the sulphur treatment seemed satisfactory, although owing to the

* F. L. Scribner, Fungus diseases of the Grape and other Plants, p. 81.

† Twelfth Annual Report N. J. Agr. Exp. Station, p. 250, 1891.

pressure of other work, personal supervision of the experiment by the writer was impossible, and none of the plants were left untreated as checks.

Under date of Nov. 5th, Mr. Hubbard reports: "The disease began to show about Sept. 1st, and I at once dusted half my crop with sulphur, spraying the other half with the potassium sulphide solution. I soon saw that the sulphur was proving the more effective, and henceforth used it on the whole crop. I dusted the plants four times, using two pounds each time on 1,200 plants. Last year I lost my whole crop by this disease. This year the disease was checked by the treatment and I have not lost a plant."

In accordance with past experience the sulphur was applied upon a warm day, in full sunlight, the commonly accepted theory being that under such conditions sulphur gives off a gas destructive to vegetable life, and known as sulphurous acid. This theory does not seem to have sufficient foundation in fact, sulphur being stable except at very high temperatures. We can only say with certainty that at moderately high degrees of temperature sulphur does exert a fungicidal action even when not in contact with any part of the fungus, and that consequently this action, whatever be its cause, is more marked in direct sunlight than upon a cool or cloudy day.

ASTERS, &c.

A disease caused by Nematodes.

On August 4th, 1892, I received from Prof. Galloway of the United States Department of Agriculture, two packages of diseased Asters which had been sent to the Department from Hartford, Conn.

Further investigation showed that the disease was not local, but wide-spread throughout New England. Nor was it confined to asters; calendulas, marigolds, and zinnias, all showed similar symptoms of disease. As it appears on asters, the disease is first manifested when the plants are about three inches high. The younger portions of the plant begin to put out long, spindly shoots which are provided here and there with dwarfed and misshapen leaves. These shoots present an unhealthy appearance as though grown in the dark; they are of a pale-yellow or whitish color, and eventually produce dwarf flowers which, like the shoots themselves, are bleached or etiolated. From the bleached and spindly appearance of the plants, the diseased condition is known among florists as "white-legs."

One symptom which, as far as I have observed, always accompanies the disease, has been overlooked by those who have examined the diseased plants. At a late stage of the disease the stem of the plant exhibits signs of decay beginning near the ground and gradually spreading upwards until sometimes the whole stem, especially the internal tissue, is involved.

At first sight one would be inclined to accept the usual theory concerning the disease, and conclude that it was due to the parasitic "blue aphis" which is often found in large numbers upon the roots. But certain considerations seem to preclude this view, though doubtless the aphides are in a measure responsible for the diseased appearance of plants whose roots are infested by them. Correspondence with various florists in Hartford and vicinity elicited the information that the usual remedies against the blue aphis seemed to have no effect in lessening the disease under consideration. Granulated tobacco and sulphur applied liberally to the beds and raked in before planting out the asters were quite inefficient, and no better results followed the application of the same substances at a later period about the base of each plant. Water heated to 140° and poured about the plants proved equally unavailing. The fact thus indicated, that the aphis was not the primary cause of the diseased condition of the plants, received further confirmation from a careful examination of the plants. Some of the specimens sent to me exhibited the characteristic symptoms of the disease, and their roots were swarming with the aphis. Others presenting the same symptoms, grown under the same conditions, and sent to me at the same time, showed not a trace of the aphis. One large grower last year had a lot of over 2,000 plants from which he did not get a perfect blossom. Four different persons examined the roots of these plants from time to time and were unable to find any signs of the aphis. There were plants in the neighborhood of these which showed no symptoms of disease and flowered profusely, yet, on examination of the roots, they were found to be covered with the aphis. These facts led me to examine the roots of the diseased plants more carefully, and as a result the presumable cause of the disease was found in the presence upon the roots of countless minute spherical or fusiform white galls caused by the attacks of microscopic "eel-worms" or nematodes. On crushing or cutting open these galls the worms were seen in several stages of development, generally encysted, but often in the egg or larval condition. Examination

of the decaying stems showed that the presence of the nematodes was not confined to the roots. The pith and inner tissues of such stems were found in all stages of decay even when appearing healthy externally, and in all cases the decayed tissues were swarming with adult nematodes of more than one species. The leaves and dwarfed flower-heads were examined with care but these organs were found to be free from the direct attacks of the worms.

Specimens of the diseased plants were sent to Prof. G. F. Atkinson, at that time biologist of the Alabama Experiment Station, and he kindly gave his opinion to the effect that the root-galls were caused by a species of nematode, *Heterodera radicicola* Müll., very commonly found in the roots of many plants both wild and cultivated. In the decaying Aster stems, two forms of nematodes belonging to different genera were found and determined by Prof. Atkinson. One of these, belonging to the genus Rhabditis, "is not," he writes "known to be harmful, feeding only on decaying vegetable matter." The other, a species of the genus Aphelenchus, is probably the primary cause of the disease. The various members of this genus are true parasites, feeding upon the tissues of living plants. One of them is known to cause a leaf-disease of Chrysanthemum, Begonia, Pelargonium, Salvia, Zinnia, &c.* Two others have recently been described† from Europe, producing distortions of the flowering axes of the Strawberry.‡ Owing to the lateness of the season it was impossible to continue the study of this subject further, and determine by means of pure cultures and inoculation of healthy plants, whether this nematode were, as it seemed to be, the primary, if not the sole cause of the disease; but enough was seen to warrant some suggestions regarding remedial measures.

All growers agree that asters planted upon new turf ground are exempt from the disease. It is therefore recommended that if it is desired to grow asters consecutively for several seasons in the same bed, six or eight inches of the old soil be removed each year and replaced by decayed and broken turf. If the asters were grown in only small quantities, as good results might be attained by removing the old surface-soil each year, and using in

* B. D. Halsted. Twelfth Annual Report N. J. Agr. Exp. Station, 1891, p. 310.

† Ritzema Bos. Zeitschrift für Pflanzenkrankheiten, Bd. I, Heft 1.

‡ For further information upon the life-history of nematodes the reader is referred to the U. S. Dept. Agric., Div. of Entomology, Bull. 20, and to "Nematode Root-galls," by Prof. Geo. F. Atkinson.

its place soil sterilized by heat. This could easily be done by means of the device commonly used for drying earth for use in the preparation of asphalt pavement. It consists of a piece of sheet iron, six or eight feet square, bent into a flattened semi-circle, the edges resting upon the ground. A fire of wood is built beneath it, a piece of stove-piping at one end which is partially closed, serves to create a draught and carry off the smoke. Fresh soil is placed upon the heated iron surface, removed after being heated for 10 or 15 minutes, and replaced by more fresh soil. In this way a large amount of soil can be thoroughly and quickly sterilized for garden use.

As to fertilizers, common experience is against the use of barnyard or stable manure. The cause is apparent upon examination of such manure, as it is found to be a most favorable breeding-place for nematodes, the latter often occurring in whitish masses visible to the naked eye. One grower writes: "Last year over 50% of the asters planted upon manured land were rendered worthless by the disease, while those planted upon turf soil were free from disease and the crop of flowers was excellent." The fertilizers which have given most satisfaction when used in connection with plants subject to nematode attacks, have been as a rule, alkaline mixtures containing but little nitrogenous matter. Kainite or muriate of potash have been used with good success, their effect upon the worms being decidedly deleterious, while nitrogen may be supplied by the liberal use of tobacco dust.

Much can probably be done against nematodes by a proper treatment of the soil previous to planting. Experiments have indicated* that they are susceptible to low as well as high degrees of temperature, and would therefore be very largely destroyed by ploughing or deep spading during the Winter.

Their development and spread is also largely arrested by an alkaline condition of the soil due to the presence of an excess of lime in any form, as was shown by the fact that violets affected by a nematode root disease at this Station upon being transplanted for the Summer into a soil containing a considerable quantity of broken mortar, recovered; the root-galls decayed, and in their place a vigorous growth of new, healthy roots, arose. A top-dressing of lime liberally applied to the beds in the late Autumn, followed in early Spring by a similar application well spaded in would doubtless do much to prevent the disease.

* Bull. 43, Cornell Univ. Agric. Exp. Station, p. 156, Sept. 1892.

Again, drought is fatal to nematodes. Thorough drainage of beds in which asters or other plants subject to nematode disease, are planted, is therefore essential to success.

Finally, it is evident that any diseased portion of a plant which is allowed to remain in the ground at a sufficient depth to be safe from hard freezing, harbors the worms, and becomes a source of infection the following season. All diseased plants should therefore be carefully pulled and burned in the Autumn while they still are in a condition to provide nourishment to the worms. It is probable that when a crop is thoroughly infected with nematodes, there are very few remaining in the soil, and if the plants are then pulled and destroyed, the soil will be left comparatively free of the worms. So important is this fact that in many localities abroad, before planting a crop known to be subject to nematode disease, the farmer plants the land with some rapid-growing and comparatively valueless crop attractive to nematodes. In these "catch-plants" as they are called, the worms collect and are destroyed with the plants, leaving a free field for the more valuable crop.

It must be borne in mind that these suggestions are tentative and rest upon few very conclusive experiments, but they serve at least to point out the direction from which we must look for help in combating this serious pest. For many of the above suggestions I am indebted to the practical florists of the State, especially to Messrs. John Gérard of New Britain, and C. H. Pember of Hartford, and to the valuable report of Dr. J. C. Neal to the U. S. Department of Agriculture, already referred to.

THE CONNECTICUT FERTILIZER LAW.

The General Assembly at its session in 1882 passed a Fertilizer Law which went into effect September 1, 1882, and which repealed and took the place of all previous legislation on this subject. The law is still in force without any amendment.

Copies of the law may be had on application to the Station. Attention is specially called to the following requirements.

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.

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.

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

A statement of the per cent. 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.

The percentage of 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.

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.

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 the Analysis Fees as required by the Law, and FERTILIZERS for which fees have been thus paid for the year ending May, 1893.

Firm.	*Brand of Fertilizer.*
Anderson, W. H., Putnam, Conn.	Ground Bone.
Baker, H. J. & Bro., 215 Pearl St., New York City.	Standard UnXLD Fertilizer. A. A. Ammoniated Superphosphate. Special Potato Manure. Special Corn Manure. Special Tobacco Manure. Pure Ground Bone. Castor Pomace.
Bowker Fertilizer Co., 43 Chatham St., Boston, Mass.	Stockbridge Tobacco Manure. " Grain Manure. " Grass Top Dressing. " Potato and Veg. Manure. " Fruit Manure. " Seeding Down Manure. Bowker's Hill and Drill Phosphate. " Ammoniated Bone Fertilizer. " Sure Crop Bone Phosphate. " Farm and Garden Phosphate " Potato Manure. " Potato Phosphate. " Tobacco Grower. " Fish and Potash. " Dry Ground Fish. " Fresh Ground Bone. Gloucester Fish and Potash. Kainit.
Bradley Fertilizer Co., 92 State St., Boston, Mass.	Bradley's Superphosphate. " Potato Manure. " Complete Manure for Potatoes and Vegetables. " Complete Manure for Top Dressing Grass and Grain. " Complete Manure for Corn and Grain. " Pure Fine Ground Bone. " Circle Brand Ground Bone and Potash. " Fish and Potash, Anchor Brand. " Fish & Potash, Triangle A Brand. " B. D. Sea Fowl Guano " Original Coe's Superphosphate. Farmers' New Method Fertilizer. High Grade Tobacco Manure.
Buckingham, C., Southport, Conn.	A1 Fertilizer.

Firm.	*Brand of Fertilizer.*
Coe, E. Frank, 16 Burling Slip, New York City.	Gold Brand Excelsior Guano. Potato Fertilizer. High Grade Ammoniated Bone Superphosphate. Alkaline Bone. Ground Bone and Potash.
Clark's Cove Fertilizer Co., Boston, Mass.	Bay State Fertilizer. Bay State Fertilizer G. G. King Philip Guano. Potato and Tobacco Fertilizer.
Cooper's, Peter, Glue Factory, 17 Burling Slip, New York City.	Bone Dust.
Crocker's Fertilizer & Chemical Co., Buffalo, N. Y.	Crocker's Ammoniated Bone Superphosphate. " Potato, Hop and Tobacco Phosphate. " Vegetable Bone Superphosphate. " Special Potato Manure. " Pure Ground Bone. " Wheat and Corn Phosphate. " New Rival Ammoniated Superphosphate. " Ammoniated Practical Superphosphate. " Buffalo Superphosphate, No. 2. " Ground Bone Meal.
Cumberland Bone Phosphate Co., Exchange Place, Boston, Mass.	Cumberland Superphosphate.
Danbury Fertilizer Co., Danbury, Conn.	Potato Manure. XL Fertilizer. Tobacco Manure. Tankage. Ground Bone.
Darling, L. B., Fertilizer Co., Pawtucket, R. I.	Animal Fertilizer. Fine Ground Bone. Extra Bone Phosphate. Potato and Root Crop Manure.
Davidge Fertilizer Co., 121 Front St., New York City.	Special Favorite Fertilizer.
Downes & Griffin, Birmingham, Conn.	Ground Bone.
Ellsworth, F., Hartford, Conn.	Shoemaker's Swift Sure Superphosphate. " " Bone Meal. Collier Castor Pomace.
Great Eastern Fertilizer Co., Rutland, Vt.	Great Eastern General Fertilizer for Grass and Grain. Great Eastern Vegetable, Vine and Tobacco Fertilizer. Great Eastern General Phosphate for Oats, Buckwheat and Seeding Down.

Firm.	*Brand of Fertilizer.*
Hull, H. C., Meriden, Conn.	Ground Bone.
Kelsey, E. R., Branford, Conn.	Bone, Fish and Potash.
Lister's Agricultural Chemical Works, Newark, N. J.	Standard Superphosphate. Ammoniated Dissolved Bone. Success Phosphate. Potato Manure No. 1. Celebrated Ground Bone.
Mapes Formula & Peruvian Guano Co., 143 Liberty St., New York City.	Complete Manure for Light Soils. " " " General Use. " " "A" Brand. Potato Manure. Corn Manure. Tobacco Starter. Fruit and Vine Manure. Peruvian Guano. Fine Dissolved Bone. Tobacco Manure, Wrapper Brand. Seeding Down Manure. Grass and Grain Spring Top Dressing.
Miller, G. W., Middlefield, Conn.	Flour of Bone Phosphate. Pure Ground Bone.
National Fertilizer Co., Bridgeport, Ct.	Chittenden's Complete Fertilizer. " Ammoniated Bone Phosphate. " Fish and Potash. " Ground Bone. Russell Coe's Phosphate.
Nuhn, Frederick, Waterbury, Conn.	Self Recommending Fertilizer.
Olds & Whipple, Hartford, Conn.	Red Seal Castor Pomace.
Pacific Guano Co., Box 1368, Boston, Mass.	Soluble Pacific Guano. Special Potato Manure.
Peck Bros., Northfield, Conn.	Pure Ground Bone.
Plumb & Winton, Bridgeport, Conn.	Bone Fertilizer.
Preston Fertilizer Co., Greenpoint, L. I.	Ammoniated Bone Superphosphate.
Quinnipiac Co., 7 Exchange Place, Boston, Mass.	Quinnipiac Phosphate. " Potato Manure. " Market Garden Manure. " Pure Bone Meal. " Fish and Potash—Crossed Fishes Brand. " Fish & Potash—Plain Brand. " Pine Island Phosphate. " Havana and Seed-Leaf Tobacco Fertilizer. " Dry Ground Fish. Sulphate of Ammonia. Dissolved Bone Black. Sulphate of Potash. Muriate of Potash.

Firm.	*Brand of Fertilizer.*
Read Fertilizer Co., Box 3121, New York City.	Standard Fertilizer. High Grade Farmers' Friend. Samson Fertilizer. Bone, Fish and Potash.
Reese, J. S. & Co., 10 South St., Baltimore, Md.	New England Favorite Fertilizer. Pilgrim Fertilizer.
Rogers & Hubbard Co., Middletown, Ct.	Pure Raw Knuckle Bone Flour. Strictly Pure Fine Bone. Soluble Potato Manure. Rogers & Hubbard Co.'s Grass and Grain Fertilizer. Fairchild's Corn Formula.
Rogers Mfg. Co., Rockfall, Conn.	Ground Bone.
Sanderson L., 114 Church St., New Haven, Conn.	Old Reliable Superphosphate. Pulverized Bone Meal. Blood, Bone and Meat. Fine Ground Fish. Muriate of Potash. High Grade Sulphate of Potash. Regular Sulphate of Potash. Nitrate of Soda. Sulphate of Ammonia. Dissolved Bone Black.
Wadsworth, D. S., Hartford, Conn.	Tankage.
Wilcox, Leander, Mystic, Conn.	Ammoniated Bone Phosphate. Potato Manure. High Grade Fish and Potash. Dry Ground Fish Guano.
Wilkinson & Co., 51 William St., New York City.	Economical Bone Fertilizer.
Williams & Clark Fertilizer Co., 81 Fulton St., New York City.	Americus Superphosphate. " Potato Phosphate. " High Grade Special. " Bone Meal. " Fine Wrapper Tobacco Brand. Royal Bone Phosphate.

ANALYSES OF FERTILIZERS.

During the year 267 analyses of fertilizers and manurial waste products have been made. A classified list of them is given on page 63.

Of these a small number were made for private parties and for other experiment Stations to compare and test methods of analysis. The others are given in detail on the following pages.

During April, May and June the authorized agents of the Station visited seventy-one towns and villages in Connecticut and carefully drew 475 samples representing 150 distinct brands of commercial fertilizers.

In this way one or more samples were secured of nearly every brand of fertilizer which is offered for sale within the State. When several samples of a single brand were drawn in different parts of the State the analysis was performed, not on any single sample, but on a mixture made of an equal weight of each of the several samples. Thus, it is believed, the average composition of the goods is more fairly represented than by the analysis of any single sample.

The Station agents are instructed in every case to open at least three packages of each brand for sampling, 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 bag or barrel.

As a rule, the Station will not analyze samples—

1. From dealer's stock of less than one ton.
2. From stock which has lain over from last season.
3. From stock which evidently is improperly stored, as in bags lying on wet ground or exposed to the weather, etc.

The Station desires the coöperation of farmers, farmers' clubs, and granges in calling attention to new brands of fertilizers, and in securing samples of all goods offered for sale. All samples drawn by other than Station agents *must* be drawn in accordance with the Station's Instructions for sampling, and properly certified, if the Station analysis is desired. A copy of these instructions and blank certificates will be sent on application.

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.

The following "Explanations" are intended to embody the principles and data upon which the valuation of fertilizers is based, a knowledge of which is essential to a correct understanding of the analyses that are given on subsequent pages.

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

Revised.

Nitrogen is the most rare, and commercially the most valuable fertilizing element.

Free Nitrogen is universally abundant, making up nearly four-fifths of the common air, and appears to be assimilable, with aid of certain bacteria, by leguminous plants (the clovers, alfalfa, peas, beans), and mustard, but cannot nourish cereals or other crops.

Organic Nitrogen is the nitrogen of animal or vegetable matters, which is chemically united to carbon, hydrogen and oxygen. Some forms of organic nitrogen, as those of blood, flesh and seeds, 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 (NH_3) *and nitric acid* (N_2O_5) are results of the decay of *organic nitrogen* in the soil and manure heap, and contain Nitrogen in its most active forms. 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.

Phosphorus is, next to nitrogen, the most costly ingredient of Fertilizers, in which it always exists in the form of phosphates, usually those of calcium, iron and aluminum, or in case of some "superphosphates," in the form of free phosphoric acid.

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 diluted sulphuric acid (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 a 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 the crystallized green 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 calcium in 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. The phosphoric acid of "Thomas-Slag" and of "Grand Cayman's Phosphate" is freely taken up by crops.

Phosphoric acid in all the Station analyses is reckoned as "anhydrous phosphoric acid" (P_2O_5) also termed among chemists, phosphoric anhydride, phosphoric oxide, and phosphorus pentoxide.

POTASSIUM is the constituent of fertilizers, which ranks third in costliness. In plants, soils and fertilizers, it exists in the form of various salts, such as chloride (muriate), sulphate, carbonate, nitrate, silicate, etc. Potassium itself is scarcely known except as a chemical curiosity.

Potash signifies the substance known in chemistry as potassium oxide (K_2O), which is reckoned as the valuable fertilizing ingredient of "pot-ashes" and "potash salts." In these it should be freely soluble in water and is most costly in the form of sulphate, and cheapest in the form of muriate (potassium chloride).

The Valuation of a Fertilizer, as practised at this station, consists in calculating the *retail Trade-value* or *cash-cost* (in raw material of good quality) of an amount of nitrogen, phosphoric acid and potash equal to that contained in one ton of the fertilizer.

Plaster, lime, stable manure and nearly all of the less expensive fertilizers have variable prices, which bear no close relation to their chemical composition, but guanos, superphosphates and similar articles, for which $30 to $50 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 trade-value per pound of these ingredients is reckoned from the current market prices of the standard articles which furnish them to commerce.

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

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 New England, New York and New Jersey markets, are as follows:

THE TRADE-VALUES FOR 1892 OF FERTILIZING INGREDIENTS IN RAW MATERIALS AND CHEMICALS.

The average Trade-Values or *retail cost per pound* of the ordinarily occurring forms of nitrogen, phosphoric acid and potash are as follows:

	Cts. per lb.
Nitrogen in ammonia salts	17½
nitrates	15
Organic nitrogen in dry and fine ground fish, meat and blood	16
in cotton seed meal and castor pomace	15
in fine bone and tankage	15
in fine medium bone and tankage	12
in medium bone and tankage	9½
in coarser bone and tankage	7½
in hair, horn shavings and coarse fish scrap	7
Phosphoric acid, soluble in water	7½
in ammonium citrate*	7
in dry ground fish, fine bone and tankage	7
in fine medium bone and tankage	5½
in medium bone and tankage	4½
in coarser bone and tankage	3
Potash as high-grade sulphate and in forms free from muriate (or chlorides)	5½
as muriate	4½

These Trade-values were agreed upon by the Experiment Stations of Massachusetts, New Jersey, Rhode Island, and Connecticut, for use in their respective States during 1892. They are the average prices at which, during the six months preceding March last, the respective ingredients were retailed for cash, in our large markets, in those raw materials which are the regular source of supply. They also correspond to the average wholesale price for the six months ending March 1st, plus about 20 per cent. in case of goods for which we have wholesale quotations. The valuations

* 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.

obtained by use of the above figures will be found to correspond fairly with the *average retail prices* at the large markets of standard raw materials, such as :

Sulphate of Ammonia,	Muriate of Potash,
Nitrate of Soda,	Sulphate of Potash,
Dried blood,	Plain Superphosphate,
Azotin,	Dry Ground Fish,
Ammonite,	Bone and Tankage,
Ground South Carolina Rock.	

Valuation of Superphosphates, Special Manures and Mixed Fertilizers of High Grade.

The organic nitrogen in these classes of goods is reckoned at the price of nitrogen in raw materials of the best quality.

Insoluble Phosphoric Acid is reckoned at 2 cents per pound. Potash is rated at 4½ 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 at 5½ cents per pound.

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 and selling them. These charges are for grinding and mixing, bagging or barreling, storage and transportation, commission to agents and dealers, long credits, interest on investments, bad debts, and finally, profits.

The majority of the manufacturers agree that the average cost of mixing, bagging, handling and cartage ranges from $3.00 to $4.50 per ton.

In 1892 the average selling price of Ammoniated Superphosphates and Guanos was $35.28 per ton, the average valuation was $25.46, and the difference $9.82, an advance of 27.8 per cent. on the valuation and on the wholesale cost of the fertilizing elements in the raw materials.

In case of Special Manures the average cost was $38.28, the average valuation $30.70 and the difference $7.58 or 25.0 per cent. advance on the valuation.

To obtain the Valuation of a Fertilizer 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 sample is sifted into four grades and we separately compute the nitrogen-value of each grade by multiplying the pounds of nitrogen per ton, 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 of phosphoric acid, similarly computed, the total is the Valuation of the sample of bone.

The uses of the "Valuation" are two-fold:

1. To show whether a given lot or brand of fertilizers is worth, as a commodity of trade, what it costs. If the selling price is not higher than the valuation, the purchaser may be tolerably sure that the price is reasonable. If the selling price is twenty to twenty-five per cent. higher 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 valuation 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 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-value 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, 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 FERTILIZERS ANALYZED.

The fertilizers and manurial waste products analyzed at the Station laboratory from November 18th, 1891, to January 1st, 1893, were as follows:

RAW MATERIALS COMMONLY USED IN MIXED FERTILIZERS.	
1. *Containing Nitrogen as the Chief Valuable Ingredient.*	
Nitrate of Soda	4
Sulphate of Ammonia	1
Dried Blood	1
Cotton Seed Meal	11
Castor Pomace	4
2. *Containing Phosphoric Acid as the Chief Valuable Ingredient.*	
"Odorless Phosphate"	1
Phosphate Rock	3
Dissolved Bone Black	4
Dissolved South Carolina Rock	2
3. *Containing Potash as the Chief Valuable Ingredient.*	
High Grade Sulphate of Potash	4
Double Sulphate of Potash and Magnesia	2
Muriate of Potash	4
Kainit	2
4. *Containing Nitrogen and Phosphoric Acid.*	
Bone Manures	22
Tankage	13
Fish	6
MIXED FERTILIZERS.	
Bone and Potash	3
Nitrogenous Superphosphates	65
Special Manures	45
Home Mixtures	18
MISCELLANEOUS FERTILIZERS AND MANURES.	
Cotton Hull Ashes	25
Wood Ashes	15
Phosphatic Marl	3
Oyster Shell Lime	1
Soap Factory Refuse	1
Horn Waste	1
Wool Waste	2
Tobacco Dust	1
Muck	3
Total	267

These analysis are discussed in the order above given. In all cases where the contrary is not stated the samples were drawn by agents of the Station from stock in dealers' hands. The regular retail cash prices are given wherever possible. In many cases the actual cash prices paid by purchasers have been less than those here stated.

I. Raw Materials of High Grade Containing Nitrogen as the Chief Valuable Ingredient.

Nitrate of Soda.

Nitrate of Soda is mined in Chili and purified there before shipment. It usually contains about 16 per cent of nitrogen, equivalent to 97 per cent. of pure nitrate of soda. It contains besides, a little salt and some moisture. The usual guarantee is "96 per cent." of nitrate of soda equivalent to 15.8 per cent. of nitrogen.

3457. Sold by National Fertilizer Co., Bridgeport. Sampled by S. E. Curtiss.

3479. Sold by L. Sanderson, New Haven.

3491. Sold by Quinnipiac Co., Boston.

3511. Sold by Mapes F. & P. G. Co., N. Y.

The last three samples were drawn by an agent of the Station.

Analyses.

	3457	3479	3491	3511
Moisture	.29	1.25	1.08	1.22
Insoluble in water	.06	.06	.23	.00
Sodium Chloride, Salt	.40	.80	.40	1.06
Sodium Sulphate	.20	.25	.22	.16
Pure Sodium Nitrate	99.05	97.64	98.07	97.56
	100.00	100.00	100.00	100.00
Equivalent Nitrogen	16.34	16.11	16.18	16.10
Cost per ton	$46.00	$50.00	$50.00	$48.00
Nitrogen costs cents per pound	**14.0**	**15.5**	**15.4**	**14.9**

Sulphate of Ammonia.

This article, now made on a large scale as a by-product of gas-works, usually contains over 20 per cent. of nitrogen, the equivalent of from 94 to 97 per cent. of sulphate of ammonia. The rest is chiefly moisture. The usual guarantee is 25 per cent. of ammonia, which is equivalent to 20.6 per cent. of nitrogen, but commercial sulphate of ammonia commonly contains less than that quantity.

A single sample, **3648,** sold by L. Sanderson, New Haven, contained 20.52 per cent. of nitrogen, equivalent to 24.86 per cent. of ammonia and was sold for $72 per ton, equivalent to **17.5** cents per pound.

Cotton Seed Meal.

The seed of the cotton plant, after ginning to remove the fiber, passes through a mill which hulls or decorticates it. The hulled seed is ground and the oil expressed. The ground cake from the presses is used as a cattle food and fertilizer. The hulls are burned for fuel in the oil factory and the ashes, which contain from 20 to 30 per cent. of potash, are also used as a fertilizer.

Sometimes, however, hulls and seed are ground together, making "undecorticated meal" which contains considerably less nitrogen and has correspondingly less money value as a fertilizer or as a feed. When the meal has undergone heating or fermentation, its color changes from a deep yellow to brown or reddish-brown. It is then unfit for cattle food and is sold at a cheaper rate as a fertilizer.

3418. From stock of J. Marsh, New Milford.

3426. From stock of H. K. Brainard, Thompsonville. Sampled by Elam French, Enfield.

3427. Sampled by David French, Enfield.

3441. From stock of Olds & Whipple, Hartford. Sampled by Walter Smith, Windsor.

3442. From stock of Olds & Whipple, Hartford. Sampled by G. H. Fitch, Windsor.

3447. From stock of Olds & Whipple, Hartford. Sampled by E. J. Wells, Windsor.

3451. From stock of E. A. Buck & Co., Willimantic. Sampled by S. O. Griswold, Poquonock.

3469. From stock of Olds & Whipple, Hartford. Sampled by Eugene Brown, Poquonock.

3470. From stock of E. S. Hough, Poquonock. Sampled by Eugene Brown, Poquonock.

3471. From stock of E. S. Hough, Poquonock. Sampled by Eugene Brown, Poquonock.

3495. Breed, Pierce & Co., Boston. From stock of Olds & Whipple, Hartford.

ANALYSES.

	3418	3426	3427	3441	3442	3447	3451	3461	3470	3471	3495
Nitrogen	7.12	7.45	7.32	7.52	6.99	6.60	6.91	7.11	7.13	7.15	6.97
Phosphoric acid	3.10	---	---	2.15	2.32	3.30	2.56	2.78	2.79	2.80	2.21
Potash	1.80	---	---	.99	1.37	2.13	1.93	1.85	1.90	1.79	1.83
Cost per ton	$29.00	---	---	28.00	27.50	27.00	26.00	26.00	26.00	26.00	25.00
Nitrogen costs cents per lb.	15.9	---	---	15.8	16.3	15.2	14.7	14.1	14.0	14.1	14.3

The last sample, **3495**, was damaged meal, sold at a lower price because of its being "off color."

CASTOR POMACE.

The ground residue of castor beans from which castor oil has been extracted.

3566. Made by H. J. Baker & Bro., N. Y. Sampled from stock of F. S. Bidwell, Windsor Locks.

3450. Sold by Bowker Fertilizer Co., Boston, Mass. Sampled from stock of A. D. Bridge by T. J. Stroud, Shaker Station.

3567. Made by Collier Co., St. Louis, Mo. Sampled from stock of F. Ellsworth, Hartford.

3496. Made by Red Seal Castor Oil Co., St. Louis, Mo. Sampled from stock of Olds & Whipple, Hartford.

ANALYSES.

	3566	3450	3567	3496
Nitrogen	4.61	5.32	5.04	5.56
Phosphoric acid	1.34	2.15	1.73	1.70
Potash	1.08	1.25	1.13	.98
Cost per ton	$23.00	20.00	22.00	22.00
Nitrogen costs per pound in cents	21.6	14.7	18.2	16.6

The sample of H. J. Baker & Bro's pomace is evidently damaged. The manufacturers state that it does not at all represent their season's output. The Station endeavored to secure other samples of this brand from the Conn. market but was unable to find them.

II. RAW MATERIALS OF HIGH GRADE CONTAINING PHOSPHORIC ACID.

"ODORLESS PHOSPHATE."

3438. A sample of this material was drawn from stock purchased of Jacob Reese of Phila., by H. Von Tobel, Harwinton. It contained 18.42 per cent. of phosphoric acid and cost $20.00 per ton.

This is Basic Slag from steel works formerly known as "Thomas-slag."

If Basic Slag could be purchased cheaply enough, it would be well worth the attention of those tobacco growers who endeavor to avoid the use of any but a small quantity of sulphates on their land. While it is relatively an "insoluble" form of phosphoric acid, experience has shown that in many cases it is much more readily available to crops than ground rock phosphate, and on some soils meets the requirements of crops as well as an equal money value of superphosphate. On other soils, however, it does not show this equality. See Reports of this Station for 1887, p. 110, also for 1888, p. 112, and for 1889, p. 203.

DISSOLVED BONE BLACK, DISSOLVED BONE AND ACID PHOSPHATE.

Superphosphates made by treating waste and spent bone black from the sugar refineries, bone dust, or phosphate rock with oil of vitriol which renders the phosphoric acid largely soluble in water.

Dissolved Bone Black.

3455. Sold by the National Fertilizer Co., Bridgeport. Sampled by S. E. Curtiss, Stratford.

3477. Sold by L. Sanderson, New Haven.

3499. Sold by Quinnipiac Co. Stock of Olds & Whipple, Hartford.

Dissolved Bone.

3456. Sold by National Fertilizer Co., Bridgeport. Sampled by S. E. Curtiss, Stratford.

ACID PHOSPHATE.

3689. Sold by Quinnipiac Co., New London. Stock of Olds & Whipple, Hartford.

ANALYSES.

	3455	3477	3499	3456	3689
Phosphoric acid, soluble	17.44	16.10	15.46	13.37	6.02
reverted	.06	.52	.25	1.59	5.53
insoluble	.35	.07	none	.67	1.61
Cost per ton	$20.00	26.00	26.00	15.00	20.00
Soluble phosphoric acid costs per pound in cents	5.7	7.8	8.3	4.6	4.8

III. Raw Materials of High Grade containing Potash.

High Grade Sulphate of Potash.

This material should contain over 90 per cent. of pure sulphate of potash or about the same quantity of actual potash as the muriate, but no more than a trace of chlorine.

3449. Sold by Bowker Fertilizer Co., Boston, Mass. Sampled from stock of A. D. Bridge, Hazardville, by T. J. Stroud, Shaker Station.

3467. Sold by L. Sanderson, New Haven. Sampled by O. B. Phillips, Enfield Bridge.

3481. Sold by L. Sanderson. Sampled by Station agent.

3492. Sold by Quinnipiac Co., New London. Stock of Olds & Whipple, Hartford. For analyses see next table.

Double Sulphate of Potash and Magnesia.

This material is usually sold as "sulphate of potash" or "manure salts," on a guarantee of "48–50 per cent. sulphate," which is equivalent to 25.9–27 per cent. of actual potash. Besides some 46–50 per cent. of sulphate of potash it contains over 30 per cent. of sulphate of magnesia, chlorine equivalent to 3 per cent. of common salt, a little sulphate of soda and lime, with varying quantities of moisture.

3480. Sold by Quinnipiac Co., New London. Stock of Olds & Whipple, Hartford.

3482. Sold by L. Sanderson, New Haven.

Analyses of High Grade Sulphate and Double Sulphate of Potash.

	3449	3467	3481	3492	3480	3482
Potash found	50.26	51.26	50.34	47.84	26.24	26.23
Equivalent sulphate of potash	92.94	94.79	93.13	88.5	48.54	48.54
Guaranteed	95.0	90.0	----	90.0	48.0	48.0
Cost per ton	$55.00	55.00	55.00	55.00	30.00	30.00
Potash costs per pound in cents	5.5	5.36	5.46	5.7	5.71	5.71

Muriate of Potash.

Commercial muriate of potash contains about 80 per cent. of muriate of potash (potassium chloride) 15 per cent. or more of common salt (sodium chloride), and 4 per cent. or more of water. It is generally retailed on a guarantee of 80 per cent. muriate, which is equivalent to 50.5 per cent. of actual potash.

3454. Sold by National Fertilizer Co., Bridgeport. Sampled by S. E. Curtiss, Stratford.

3483. Sold by L. Sanderson, New Haven.

3493. Sold by Mapes Branch, Hartford.

3571. Sold by Quinnipiac Co., New London. Sampled from stock of A. P. Wakeman, Saugatuck. For analyses see next table.

Kainit.

Kainit is less uniform in composition than the other potash salts. It contains from 11 to 15 per cent. of potash, more than that quantity of soda, and rather less magnesia. These "bases" are combined with chlorine and sulphuric acid. Unless "calcined" it contains more water than the sulphate or muriate of potash. It is usually sold on a guarantee of 12 to 15 per cent. of potash, or 23 to 25 per cent. "sulphate of potash." It cannot properly be called a sulphate of potash, because it contains more than enough chlorine to combine with all the potash present and there is every reason to believe that its potash exists as muriate and not as sulphate.

3572. Sold by Bowker Fertilizer Co., Boston. Sampled from stock of W. H. Anderson, Putnam.

Analyses of Muriate of Potash and Kainit.

	3454	3483	3493	3571	3572
Potash	50.90	48.65	51.81	51.13	11.93
Equivalent muriate of potash	80.4	76.9	81.9	80.8	18.9
Guaranteed	----	80.0	80.0	80.0	19.7
Cost per ton	$40.00	42.50	42.50	48.00	16.00
Potash costs per pound in cents	3.9	4.37	4.1	4.7	6.7

IV. Raw Materials containing Nitrogen and Phosphoric Acid.

Bone Manures.

The terms "Bone Dust," "Ground Bone," "Bone Meal" and "Bone" applied to fertilizers, sometimes signify material made from dry, clean and pure bones; in other cases these terms refer to the result of crushing fresh or moist bones which have been thrown out either raw or after cooking, with more or less meat, tendon, and grease—and if taken from garbage or ash heaps, with ashes or soil adhering; again they denote mixtures of bone, blood, meat and other slaughter-house refuse which have been cooked in steam-tanks to recover grease, and are then dried and sometimes sold as "tankage;" or, finally, they apply to bone from which a large share of the nitrogenous substance has been extracted in the glue manufacture. The nitrogen of all these varieties of bone when they are in the same state of mechanical subdivision has essentially the same fertilizing value.

1. *Sampled by Station Agents.*

In the tables on pages 71 and 72 are tabulated 18 analyses.

Sample **3594**, Lister's Celebrated Ground Bone, is a mixture of bone and salt cake or sulphate of soda.

Sample **3552**, Bowker's Bone according to the statement of the manufacturer, is made almost wholly from the head bones of cattle, sheep and calves which are slaughtered at the Brighton abattoir, to which some oil of vitriol is added to prevent heating. This addition of oil of vitriol causes a part of the finer material to clump together in soft "pebbles." These require to be disintegrated by washing or crushing before a mechanical analysis is made.

The oil of vitriol moreover makes a portion of the phosphoric acid soluble in water. Analyzed as a superphosphate this bone contains:

Phosphoric acid, soluble	4.43	per cent.
"reverted"	10.94	"
insoluble	3.26	"

Treated as a superphosphate its valuation will be $33.60, 48 cents higher than is given in the table.

Bone Manures Sampled by the Station.

Station No.	Name or Brand.	Manufacturer.	Dealer.	Dealers' cash price per ton.
3555	Pure Bone Dust.	Peter Cooper's Glue Factory, 17 Burling Slip, N.Y.	Apothecaries Hall Co., Waterbury.	$28.00
3565	Pure Ground Bone.	H. J. Baker & Bro., 215 Pearl St., N. Y.	J. H. Jennings, Green's Farms.	32.00
3559	Ground Bone.	Plumb & Winton, Bridgeport.	Manufacturer.	30.00
3680	Bone Meal.	Danbury Fertilizer Co., Danbury.	Raymond Bros., South Norwalk.	29.00
			J. B. Beers, Brookfield.	30.00
			Manufacturer.	30.00
			H. H. Davenport, Pomfret.	30.00
3553	Fine Ground Bone.	Bradley Fertilizer Co., 27 Kilby St., Boston, Mass.	S. A. Billings, Meriden.	32.00
			J. A. Lewis, Willimantic.	31.00
			J. E. Holmes, Stratford.	33.00
			Manufacturer.	35.00
3551	Pure Fine Bone.	W. H. Anderson, Putnam.	Olds & Whipple, Hartford.	35.00
3556	Ground Bone.	L. B. Darling Fertilizer Co., Pawtucket, R. I.	J. P. Barstow & Co., Norwich.	34.00
			W. W. Cooper, Suffield.	38.00
			J. P. Barstow & Co., Norwich.	38.00
3561	Swift Sure Bone Meal.	M. L. Shoemaker & Co., Philadelphia, Pa.	F. Ellsworth, Hartford.	40 00
			E. P. Matherson, Pomfret.	35.00
3557	Chittenden's Ground Bone.	National Fertilizer Co., Bridgeport.	Daniel Moriarty, South Meriden.	39.00
3506	Raw Knuckle Bone Flour.	Rogers & Hubbard Co., Middletown.	Olds & Whipple, Hartford.	36.00
			Manufacturer.	30.00
3564	Ground Bone.	Downs & Griffin, Ansonia.	Manufacturer.	32.00
3509	Strictly Pure Fine Bone.	Rogers & Hubbard Co., Middletown.	H. K. Brainard, Thompsonville.	36.00
3552	Fresh Ground Bone.	Bowker Fertilizer Co., 43 Chatham St., Boston, Mass.	J E Leonard, Jewett City,	31.00
			A. P. Wakeman, Fairfield.	30.00
3560	Ground Bone.	Quinnipiac Co., 7 Exchange Place, Boston, Mass.	G. M. Williams & Co., New London.	35.00
			Apothecaries Hall Co., Waterbury.	35.00
3593	Self-Recommending Fertilizer.	F. Nuhn, Waterbury.	D. B. Wilson, Waterbury.	35.00
3562	Pure Bone Meal.	Williams & Clark Fertilizer Co., 83 Fulton St., N. Y.	Daniel Morgan, Poquonock Bridge.	34.00
			S. D. Woodruff & Sons, Orange.	32.00
			D. B. Wilson, Waterbury.	30.00
3558	Pure Ground Bone.	Peck Bros., Northfield.	Apothecaries Hall Co., Waterbury.	28.00
			W. H. Parmelee, Essex.	32.00
3594	Celebrated Ground Bone.	Lister's Agricultural Chem. Works, Newark, N.J.		

ANALYSES OF BONE MANURES.—SAMPLED BY THE STATION.

Station No.	Name or Brand.	Chemical Analysis. Nitrogen.	Chemical Analysis. Phos. Acid.	Mechanical Analysis. Finer than 1/50 inch.	Finer than 1/25 inch.	Finer than 1/12 inch.	Coarser than 1/12 inch.	Cost per ton.	Valuation per ton.	Percentage difference between cost and valuation.
										Valuation exceeds cost.
3555	Peter Cooper's Pure Bone Dust	1.96	29.54	49	19	20	12	$28.00	$38.77	27.7
3565	Baker's Pure Ground Bone	3.50	23.67	62	23	15	..	32.00	39.21	18.4
3559	Plumb & Winton's Ground Bone	4.58	21.25	47	26	16	11	30.00	35.99	16.6
3680	Danbury Fertilizer Co's Bone Meal	3.91	23.03	33	28	34	5	30.00	34.79	13.7
3553	Bradley's Fine Ground Bone	3.50	20.43	58	30	12	..	31.00	34.95	11.3
3551	W. H. Anderson's Pure Fine Bone	1.87	24.82	88	10	2	..	35.00	39.22	10.8
3556	Darling's Ground Bone	2.67	24.75	68	22	10	..	35.00	39.14	10.6
3561	Shoemaker's Swift Sure Bone Meal	5.72	22.35	54	36	10	..	40.00	43.06	7.1
3557	National Fertilizer Co's Ground Bone	1.37	30.55	44	20	22	14	35.00	37.47	6.5
3506	Rogers & Hubbard Co's Raw Knuckle Bone Flour	4.03	24.82	48	43	9	..	39.00	41.14	5.2
3564	Downs & Griffin's Ground Bone	4.31	22.11	28	19	26	27	30.00	31.52	4.8
3509	Rogers & Hubbard Co's Strictly Pure Fine Bone	3.92	22.46	32	24	27	17	32.00	33.35	3.7
3552	Bowker's Fresh Ground Bone*	3.23	18.63	40	32	26	2	33.00	33.12	0.4
3560	Quinnipiac Ground Bone	3.34	21.62	53	28	17	2	35.00	35.03	0.1
										Cost exceeds valuation.
3593	Nuhn's Self-Recommending Fertilizer	4.55	20.57	46	20	18	16	35.00	34.19	2.3
3558	Peck Bros' Pure Ground Bone	4.00	21.02	12	21	35	32	28.00	27.13	3.2
3562	Williams & Clark's Pure Bone Meal	3.52	18.93	54	26	18	2	35.00	32.24	8.6
3594	Lister's Celebrated Ground Bone*	3.98	14.83	36	20	19	25	32.00	24.66	29.7

* See remarks on page 70.

Cost and Valuation.

Excluding 3594, which is a mixture of bone and salts, the average cost of the seventeen brands is $33.12, and the average valuation is $35.90, which is a tolerably satisfactory agreement, though the Station valuation is still higher than is fully justified by the state of the market.

2. *Manufacturers' Samples.* 3. *Samples drawn by private individuals.*

Here are given analyses of samples sent to the Station by the manufacturers. No samples of these brands were drawn by the sampling agents, and it is therefore necessary,—to meet the requirement of the law which calls for an annual analysis of each brand—to analyze the samples deposited at the Station by manufacturers. With these is the analysis of one sample drawn by a private individual.

Manufacturers' Samples.

3587. Ground Bone Meal. Made by the Crocker Fertilizer and Chemical Co., Buffalo, N. Y.

3589. Pure Ground Bone. Made by the Crocker Fertilizer and Chemical Co.

3563. Ground Bone. Made by the Rogers Manufacturing Co., Rockfall.

Sampled by private individual.

3462. Ground Bone, made by J. W. Wadsworth, Hartford. Sampled from stock of R. R. Wolcott by John Hamner, Wethersfield.

ANALYSES OF MANUFACTURERS' SAMPLES AND SAMPLE FROM PRIVATE INDIVIDUAL.

MECHANICAL ANALYSES.

	3587	3589	3563	3462
Fine, smaller than 1/50 inch	79	27	28	31
Fine medium, smaller than 1/25 inch	13	21	28	31
Medium, smaller than 1/12 inch	8	49	42	22
Coarse, larger than 1/12 inch	0	3	2	16
	100	100	100	100

CHEMICAL ANALYSES AND VALUATIONS.

	3587	3589	3563	3462
Nitrogen	2.22	4.33	4.13	3.45
Phosphoric acid	28.25	24.92	23.41	23.19
Valuation per ton	$43.64	36.59	35.18	32.87

Tankage.

This name is properly applied only to the sediment remaining in tanks where meat scrap with some bone is rendered to separate the fat. After boiling or superheating with steam, the fat rises to the surface of the water and is removed, the soup is run off, and the settlings at the bottom are dried and sold as tankage. Such material contains as large or larger percentage of nitrogen than of phosphoric acid. But the name tankage is also loosely applied to mixtures that consist largely of bone and do not differ greatly in composition from pure bone.

1. Sampled by Station Agent.

3679. Made by Danbury Fertilizer Co., Danbury.

3478. Pulverized Bone and Meat. Sold by L. Sanderson, New Haven.

3502. Sold by Olds & Whipple, Hartford.

3592. Blood, Bone and Meat. Sold by L. Sanderson, New Haven.

2. Sampled by the Manufacturer.

3588. Made by D. S. Wadsworth, Hartford.

3. Sampled by private individuals.

3694. Made by D. S. Wadsworth, Hartford. Sampled by F. H. Stadtmüller, Elmwood.

3448. From Bowker Fertilizer Co., Boston. Sampled from stock of A. D. Bridge, Hazardville, by T. J. Stroud, Shaker Station.

3578. Sold by Williams & Clark Fertilizer Co., N. Y. Sampled by Andrew Kingsbury, Coventry.

3590. Made by Bartholomew & Co., Meriden. Sampled by J. Norris Barnes, Yalesville. For analyses see page 75.

Dried Fish.

The samples whose analyses are here given are unacidulated but are analyzed as superphosphates for comparison with other samples of fish to which oil of vitriol has been added to preserve them.

3570. Sold by Bowker Fertilizer Co., Boston, Mass. Sampled from stock of W. F. Andross, East Hartford.

Analyses of Tankage.

Station No.	Name or Brand.	Chemical Analysis.		Mechanical Analysis.				Cost per ton.	Valuation per ton.	Percentage difference.
		Nitrogen.	Phos. acid	Finer than 1/50 inch.	Finer than 1/25 inch.	Finer than 1/12 inch.	Coarser than 1/12 inch.			Valuation exceeds cost.
	1. Sampled by Station Agent.									
3679	Danbury Fertilizer Co's Tankage	4.25	20.37	59	29	10	2	$30.00	$36.84	18.6
3478	Sanderson's Pulverized Bone and Meat	5.07	20.81	81	15	3	1	35.00	42.23	17.1
3502	Olds & Whipple's Tankage	5.82	17.87	77	18	4	1	35.00	40.03	12.5
										Cost exceeds valuation.
3592	Sanderson's Blood, Bone and Meat	6.50	10.68	52	23	20	5	35.00	29.42	19.0
	2. Sampled by Manufacturer.									
3588	Wadsworth's Tankage	2.94	24.87	56	17	13	14	----	36.69	
	3. Sampled by private individuals.									
3694	Wadsworth's Tankage	3.20	24.96	56	17	13	14	----	37.44	----
3448	Bowker's Tankage	7.32	1 36	*	--	--	--	----	25.32	----
3518	Williams & Clark's Tankage	5.00	8.79	48	29	18	5	----	23.16	----
3590	Bartholomew's Tankage	5.34	17.08	40	25	15	20	----	32.65	----

* Very fine.

3490. Sold by Quinnipiac Co., New London. Sampled from stock of Olds & Whipple, Hartford.

3484. Sold by L. Sanderson, New Haven.

3642. Made by L. Wilcox, Mystic. Sampled from stock of Fred Gallup, New London, J. A. Lewis, Willimantic, H. K. Brainard, Thompsonville, W. W. Cooper, Suffield.

ANALYSES AND VALUATIONS.

	3570	3490	3484	3642
Nitrogen	8.68	8.18	8.77	8.75
Phosphoric acid, soluble	.57	none	.67	.56
reverted	5.14	3.55	3.65	4.12
insoluble	1.77	2.64	2.69	2.30
Cost per ton	$35.00	35.00	35.00	35.00
Nitrogen costs per pound in cents*	15.1	17.5	15.9	15.7

* Allowing 7½, 7, and 2 cents per pound respectively for soluble, reverted and insoluble phosphoric acid.

MIXED FERTILIZERS.

I. BONE AND POTASH.

3595. A 1 Fertilizer, made by C. Buckingham, Southport. Sampled by Station agent from stock of R. C. Wilcox, Guilford.

3591. Circle Brand Bone and Potash, made by Bradley Fertilizer Co., Boston, Mass. Sampled by manufacturer.

3569. Ground Bone and Potash, made by E. Frank Coe, New York. Sampled by Station agent from stock of City Coal and Wood Co., New Britain.

ANALYSES AND VALUATIONS.

MECHANICAL ANALYSES.*

	3595	3591	3569
Fine, smaller than $\frac{1}{50}$ inch	58	52	62
Fine medium, smaller than $\frac{1}{25}$ inch	21	36	20
Coarse medium, smaller than $\frac{1}{12}$ inch	15	12	12
Coarse, larger than $\frac{1}{12}$ inch	6	0	6
	100	100	100

CHEMICAL ANALYSES.

	3595	3591	3569
Nitrogen	4.06	2.66	1.37
Phosphoric acid	15.44	17.59	10.26
Potash	6.31	5.06	2.90
Valuation per ton	$35.10	34.29	18.89

II. NITROGENOUS SUPERPHOSPHATES AND GUANOS.

Here are included those mixed fertilizers containing nitrogen, phosphoric acid and in most cases potash, which are not designed by their manufacturers for use on any special crop. "Special Manures" are noticed further on.

1. *Samples drawn by Station Agents.*

In the tables on pages 80 to 87 are tabulated the analyses of forty-six brands made on samples collected by the Station agents.

In the table on page 85 is an analysis of Sanderson's Formula A, No. **3596.** Another analysis of this brand previously made on a sample drawn by our agent from stock of E. B. Clark, Milford, No. **3513,** is given below. The manufacturer objected that this did not fairly represent the quality of the brand. Analy-

* In these mixtures the potash salts are washed out before making the mechanical analysis.

sis No. **3596** was then made and also No. **3597**, given below, from another lot of goods. These two later analyses show tolerable agreement and a considerably better quality than the first analysis. See also analyses of this brand on page 91.

OTHER ANALYSES OF SANDERSON'S FORMULA A.

	3513	3597
Nitrogen as nitrates	1.55	1.95
organic	1.92	2.91
Total nitrogen	3.47	4.86
Phosphoric acid, soluble	5.44	4.99
reverted	3.65	3.57
insoluble	1.55	.68
Total	10.64	9.24
Potash as muriate	5.64	7.43
Chlorine	6.88	6.25
Cost per ton	$35.00	35.00
Valuation per ton	$29.76	34.60

THE GUARANTEES.

The law of Connecticut requires every package of fertilizer to bear a statement of the actual composition of the goods. This usually expresses the quantities of nitrogen, phosphoric acid and potash within certain limits, as "nitrogen 2–4 per cent."

If a fertilizer with such a guarantee actually contains 2 per cent. of nitrogen, it is within the manufacturer's guarantee.

It is the lowest figures of the guarantee therefore that purchasers should regard.

Of the forty-six brands here reported eleven are below their minimum guarantee in respect of one ingredient, and four in respect of two ingredients. That is, one-third of all the nitrogenous superphosphates in our market contain less of one or of two ingredients than they are claimed to contain.

It is urged that an excess of one ingredient over the guarantee should be held to make good the deficiency of another. But with reasonable care and skill in the manufacture and in the sampling and analysis of the goods the actual analysis should not fall below the minimum guaranteed in any respect particularly when wide limits are allowed in the guarantees themselves.

Comparison of the tables of analyses with those of past years shows that certain brands have about the same composition year after year, while others fluctuate considerably and cannot be depended on to be alike year after year.

COST AND VALUATION.

Cost.

The method used to ascertain the retail cash price of the phosphates is as follows:

The sampling agents inquire and note the price at the time each sample is drawn. The analysis when done is reported to each dealer from whom a sample was taken, with an enclosed postal card addressed to the Station, and a request to note on it whether the retail cash price is correctly given and to mail to the Station.

To each manufacturer is also sent a request that he will notify the Station regarding the probable average cash price at freight centers in Connecticut, of such brands as he sells in the State.

From these data the average prices are computed.

Valuation.

The valuation has been computed in all cases in the usual manner.

Percentage Difference given in the last column of the table shows the percentage excess of the cost price over the average retail cost of the nitrogen, phosphoric acid and potash contained in the fertilizer.

This information puts the purchaser in a position where he can figure as to the probable relative value of the different brands and the probable relative economy of buying fertilizers mixed or unmixed.

Which method of buying is preferable can only be determined by each individual farmer, who should know best what his soil and crops need and what his facilities for purchase and payment are.

No general rule can be given. In one case ready-mixed, in another, home-mixed fertilizers may be found the more profitable to use.

The average cost of the nitrogenous superphosphates, excluding the last two analyses of the table in which cost exceeds valuation by considerably more than fifty per cent., is $35.28. The average valuation, $25.46, and the percentage difference 27.8.

Last year the corresponding figures were:

Average cost $33.93, Average valuation $28.13, Percentage difference 20.6.

Nitrogenous Superphosphates and Guanos Sampled by the Station.

Station No.	Name or Brand.	Manufacturer.	Dealer.	Dealers' cash price per ton.
3620	Pure Fine Dissolved Bone.	Mapes' Formula & Peruvian Guano Co., 143 Liberty St., New York.	Mapes' Branch, Hartford.	$32.00
3596	Formula A.	L. Sanderson, New Haven.	Manufacturer.	35.00
3672	X L Fertilizer.	Danbury Fertilizer Co., Danbury.	Manufacturer.	30.00
3512	Old Reliable Superphosphate.	L. Sanderson, New Haven.	E. B. Clark, Milford.	30.00
3627	Complete Manure, A Brand.	Mapes' Formula & Peruvian Guano Co., 143 Liberty St., New York.	City Coal and Wood Co., New Britain.	37.00
			Wilson & Burr, Middletown.	36.00
			Mapes' Branch, Hartford.	35.00
3674	Chittenden's Ammoniated Bone Phosphate.	National Fertilizer Co., Bridgeport.	Manufacturer.	30.00
			S. D. Woodruff & Sons, Orange.	32.00
			T. H. Eldridge, Norwich.	34.00
			E. P. Matherson, Pomfret.	33.00
			D. M. Mitchell, South Britain.	32.00
3621	Complete Manure for General Use.	Mapes' Formula & Peruvian Guano Co., 143 Liberty St., New York.	Mapes' Branch, Hartford.	38.00
			G. K. Nason, Willimantic.	40.00
			City Coal & Wood Co., New Britain.	40.00
3498	Peruvian Guano.	Mapes' Formula & Peruvian Guano Co., 143 Liberty St., New York.	Mapes' Branch, Hartford.	43.00
3616	Animal Fertilizer.	L. B. Darling Fertilizer Co., Pawtucket, R. I.	Olds & Whipple, Hartford.	38.00
			F. S. Bidwell, Windsor Locks.	36.00
3529	Farmers' New Method Fertilizer.	Bradley Fertilizer Co., 27 Kilby St., Boston, Mass.	W. W. Cooper, Suffield.	38.00
			J. E. Comstock, New London.	33.00
			W. J. Starr, Groton.	34.00
			J. M. Young, Norwich.	30.00
			Wilson & Burr, Middletown.	30.00
			J. A. Lewis, Willimantic.	30.00
			W. F. Andross, East Hartford.	33.00
			S. A. Billings, Meriden.	33.00

Nitrogenous Superphosphates and Guanos Sampled by the Station.—*Continued.*

Station No.	Name or Brand.	Manufacturer.	Dealer.	Dealers' cash price per ton.
3675	Chittenden's Complete Fertilizer.	National Fertilizer Co., Bridgeport.	D. M. Mitchell, South Britain.	$40.00
			T. E. Greene, Torrington.	40.00
			David Fitzgerald, Stratford.	43.00
3600	Sea Fowl Guano.	Bradley Fertilizer Co., 27 Kilby St., Boston, Mass.	F. S. Bidwell, Windsor Locks.	33.00
			W. W. Cooper, Suffield.	38.00
3631	Market Garden Phosphate.	Quinnipiac Co., 7 Exchange Place, Boston, Mass.	Meeker Bros., Norwalk.	39.00
			C. A. Young, Danielsonville.	42.00
3638	Ammoniated Bone Phosphate.	Leander Wilcox, Mystic.	Frederic Gallup, New London.	32.25
			J. A. Lewis, Willimantic.	30.00
			H. K. Brainard, Thompsonville.	34.00
			C. M. Smith, East Hartford.	34.00
3524	A. A. Ammoniated Superphosphate.	H. J. Baker & Bro., 215 Pearl St., New York.	W. F. Andross, East Hartford.	37.00
			A. L. Winton, Bridgeport.	37.50
			E. Hawley, Newtown.	37.50
			S. J. Hall, Meriden.	37.50
3605	Original Coe's Superphosphate.	Bradley Fertilizer Co., 27 Kilby St., Boston, Mass.	Peck Bros., Northfield.	32.00
3613	Standard Phosphate.	Lister's Agricultural Chemical Works, Newark, N. J.	A. N. Clark, Milford.	32.00
3530	High Grade Ammoniated Bone Superphosphate.	E. Frank Coe, 16 Burling Slip, New York.	I. W. Denison, Mystic.	32.00
			F. P. Burr, Middletown.	32.00
			J. P. Barstow & Co., Norwich.	32.00
			J. O. Fox & Co., Putnam.	32.00
			Arnold Rudd, New London.	34.00
3637	Bay State Fertilizer.	Clarke Cove Fertilizer Co., Boston, Mass.	H. H. Davenport, Pomfret.	32.00
3678	Chittenden's Fish and Potash.	National Fertilizer Co., Bridgeport.	T. H. Eldridge, Norwich.	34.00

NITROGENOUS SUPERPHOSPHATES AND GUANOS SAMPLED BY THE STATION.—*Continued.*

Station No.	Name or Brand.	Manufacturer.	Dealer.	Dealers' cashprice per ton.
3525	Hill and Drill Phosphate.	Bowker Fertilizer Co., 43 Chatham St., Boston, Mass.	J. H. Larned, Pomfret.	$34.00
			B. Curtis & Son, Stepney.	35.00
			C. H. Bell, Portland.	38.00
			E. M. Brewster, Norwich.	38.00
			C. W. Michael & Co., Yalesville.	38.00
3634	High Grade Farmers' Friend Fertilizer.	Read Fertilizer Co., Box 3121, New York.	C. O. Wolcott, Buckland.	37.50
3577	Ammoniated Bone Fertilizer.	Bowker Fertilizer Co., 43 Chatham St., Boston, Mass.	G. W. Mitchell, South Britain.	30.00
			E. M. Brewster, Norwich.	32.00
			Southington Lumber and Feed Co., Southington.	34.00
3579	Gloucester Fish and Potash.	Bowker Fertilizer Co., 43 Chatham St., Boston, Mass.	W. H. Anderson, Putnam.	28.00
			B. Curtis & Son, Stepney.	30.00
3527	Superphosphate.	Bradley Fertilizer Co., 27 Kilby St., Boston, Mass.	A. C. Sternberg, Hartford.	35.00
			S. A. Billings, Meriden.	37.00
			W. J. Starr, Groton.	37.00
			Wilson & Burr, Middletown.	35 00
			J. M. Young, Norwich.	35.00
			J. A. Lewis, Willimantic.	35.00
			W. F Andross, East Hartford.	35.00
			T. F. Powers, Waterford.	35.00
			Wheeler & Howe, Bridgeport.	37.00
			J. E. Holmes, Stratford.	36.00
3643	High Grade Fish and Potash.	Leander Wilcox, Mystic.	H. K. Brainard, Thompsonville.	32.00
			Frederic Gallup, New London.	31.25
			C. M. Smith, East Hartford.	34.00
			L. C. Gray, Jewett City.	30.00

NITROGENOUS SUPERPHOSPHATES AND GUANOS SAMPLED BY THE STATION.—*Continued.*

Station No.	Name or Brand.	Manufacturer.	Dealer.	Dealers' cashprice per ton.
3543	Quinnipiac Phosphate.	Quinnipiac Co., 7 Exchange Place, Boston, Mass.	J. E. Leonard, Jewett City.	$35.00
			Meeker Bros., Norwalk.	36.00
			C. A. Young, Danielsonville.	35.00
			G. M. Williams & Co., New London.	33.00
3547	Ammoniated Bone Superphosphate.	Crocker Fertilizer Co , Buffalo, N. Y.	C. A. Young, Danielsonville.	35.00
			John Bransfield, Portland.	40.00
			J. E. Leonard, Jewett City.	35.00
			G. W. Clark, Milford.	----
			F. C. Sturtevant, Hartford.	38.00
3578	Sure Crop Phosphate.	Bowker Fertilizer Co., 43 Chatham St., Boston, Mass.	C. T. Leonard, Norwalk.	30.00
			G. W. Mitchell, South Britain.	25.00
3541	Ammoniated Bone Superphosphate, Americus Brand.	Williams & Clark Fertilizer Co., 83 Fulton St., New York.	H. K. Brainard, Thompsonville.	36.00
			C. E. Stagg, Stratford.	34.00
			D. B. Wilson, Waterbury.	36.00
			F. S. Bidwell, Windsor Locks.	35.00
			Daniel Morgan, Poquonock Bridge.	34.00
			John Bransfield, Portland.	36.00
			W. H. Anderson, Putnam.	35.00
			J. P. Kingsley's Sons, Plainfield.	32.00
			S. D. Woodruff & Sons, Orange.	33.00
3676	Russell Coe's Superphosphate.	National Fertilizer Co., Bridgeport.	T. H. Eldridge, Norwich.	32.00
			Wilson & Burr, Middletown.	30.00
3582	Farm and Garden Phosphate.	Bowker Fertilizer Co., 43 Chatham St., Boston, Mass.	T. E. Greene, Torrington.	33.00
			D. N. Clark, Shelton.	36.00
3602	Triangle A Fish and Potash.	Bradley Fertilizer Co., 27 Kilby St., Boston, Mass.	F. S. Bidwell, Windsor Locks.	29.00
			J. F. Elwood, Southport.	30.00
			G. W. Grant, Wapping.	32.00

NITROGENOUS SUPERPHOSPHATES AND GUANOS SAMPLED BY THE STATION.—*Concluded.*

Station No.	Name or Brand.	Manufacturer.	Dealer.	Dealers' cashprice per ton.
3630	Pine Island Phosphate.	Quinnipiac Co., 7 Exchange Place, Boston, Mass.	Olds & Whipple, Hartford.	$35.00
3619	Alkaline Bone Phosphate.	E. Frank Coe, 16 Burling Slip, New York.	H. L. Hall, 2d, Wallingford.	33.00
			C. H. Lounsbury, Seymour.	32.00
3610	Soluble Pacific Guano.	Pacific Guano Co., Box 1368, Boston, Mass.	John Bransfield, Portland.	36.00
			R. H. Tucker, Saybrook.	35.00
			L. J. Grant, Wapping.	35.00
3644	New England Favorite.	J. S. Reese & Co , 10 South St., Baltimore, Md.	Montgomery & Co., Groton.	35.00
3639	Samson Fertilizer.	Read Fertilizer Co., Box 3121, New York.	J. F. Silliman, New Canaan.	38.00
			W. H. Anderson, Putnam.	38.00
			H. W. Morse, Jewett City.	38.00
3608	Fish and Potash, Plain Brand.	Bowker Fertilizer Co., 43 Chatham St., Boston, Mass.	E. J. Dickerman, Mt. Carmel.	34.00
3635	Fish and Potash.	Read Fertilizer Co., Box 3121, New York.	W. Kyle, Bethel.	32.00
			H. W. Morse, Jewett City.	29.00
			C. O. Wolcott, Buckland.	32.00
3611	King Phillip Alkaline Guano.	Clark's Cove Fertilizer Co., Boston, Mass.	H. H. Davenport, Pomfret.	28.00
3617	New Rival Ammoniated Phosphate.	Crocker Fertilizer Co., Buffalo, N. Y.	W. L. L. Spencer, Lebanon.	32.00
			F. C. Sturtevant, Hartford.	36.00
			E. H. Talcott, Torrington.	32.00
3609	Gold Brand Excelsior Guano.	E. Frank Coe, 16 Burling Slip, New York.	D. N. Clark, Shelton.	42.00
3632	Fish and Potash (Crossed Fishes Brand).	Quinnipiac Co., 7 Exchange Place, Boston, Mass.	Olds & Whipple, Hartford.	36.00
3677	Davidge Special Favorite.	Davidge Fertilizer Co., 121 Front St., New York.	H. S. Benedict, Newtown.	35.00
3633	Standard Fertilizer.	Read Fertilizer Co., Box 3121, New York.	J. F. Silliman, New Canaan.	32.00
			Eli H. Stevens, Brookfield.	*32.00*
			W. H. Anderson, Putnam.	*32.00*
			H. W. Morse, Jewett City.	*29.00*

ANALYSES OF NITROGENOUS SUPERPHOSPHATES AND GUANOS SAMPLED BY THE STATION.

Station No.	Name or Brand.	Nitrogen. Nitrogen as Nitrates.	Nitrogen. Nitrogen as Ammonia.	Nitrogen. Nitrogen, Organic.	Nitrogen. Total Nitrogen Found.	Nitrogen. Nitrogen Guaranteed.	Phosphoric Acid. Soluble.	Phosphoric Acid. Reverted.	Phosphoric Acid. Insoluble.	Phosphoric Acid. Total Found.	Phosphoric Acid. Total Guaranteed.	Phosphoric Acid. Available. Found.	Phosphoric Acid. Available. Guaranteed.	Potash. Found.	Potash. Guaranteed.	Chlorine.	Cost per Ton.	Valuation per Ton.	Percentage Difference between Cost and Valuation.
3620	Mapes' Pure Fine Dissolved Bone	....	....	3.00	3.00	*2.1*	5.90	10.62	1.13	17.65	*12.0*	16.52	....	....	....	....	$32.00	$33.77	*5.2
3596	†Sanderson's Formula A	1.06	.74	2.44	4.24	*3.3*	3.65	5.03	2.13	10.81	*10.0*	8.68	*6.0*	8.21	*6.0*	4.77	35.00	34.71	.8
3672	Danbury Fertilizer Co's X L Fertilizer	....	....	2.97	2.97	*2.1*	4.12	7.00	.42	11.54	*8.0*	11.12	....	3.30	*3.0*	.58	30.00	29.23	2.6
3512	Sanderson's Old Reliable Superphosphate	....	....	1.82	1.82	*1.7*	11.74	1.12	.38	13.24	*10.0*	12.86	*7.0*	2.65	*2.0*	.20	30.00	28.01	7.1
3627	Mapes' Complete Manure, A Brand	.38	.47	2.06	2.91	*2.5*	9.76	3.31	.30	13.37	*12.0*	13.07	*10.0*	3.11	*2.5*	2.78	36.00	31.57	14.0
3674	Chittenden's Ammoniated Bone Phosphate	trace	....	2.66	2.66	*1.7*	7.20	2.96	1.16	11.32	*9.0*	10.16	*7.0*	2.81	*2.0*	2.52	31.50	26.45	19.1
3621	Mapes' Complete Manure for General Use	.78	.86	1.81	3.45	*3.3*	9.28	1.99	.15	11.42	*10.0*	11.27	*8.0*	4.33	*4.0*	4.20	38.00	31.81	19.4
3498	Mapes' Peruvian Guano	....	1.86	1.15	3.01	*2.5*	2.78	9.30	13.51	25.59	*20.0*	12.08	....	2.77	*3.0*	2.01	43.00	35.27	21.9
3616	Darling's Animal Fertilizer	.17	.57	2.95	3.69	*3.3*	4.32	3.03	2.05	9.40	*10.0*	7.35	....	6.05	*4.0*	3.87	36.00	29.11	23.6
3529	Bradley's Farmers' New Method Fertilizer	....	....	2.34	2.34	*1.7*	6.92	3.02	1.63	11.57	*10.0*	9.94	*8.0*	3.31	*3.0*	3.57	32.00	25.73	24.3
3675	Chittenden's Complete Fertilizer	.23	.31	3.67	4.21	*3.3*	4.05	4.13	1.48	9.66	*8.0*	8.18	*6.0*	6.26	*6.0*	4.69	39.50	31.60	25.0
3600	Bradley's Sea Fowl Guano	....	....	2.73	2.73	*2.5*	7.12	3.01	1.38	11.51	*11.0*	10.13	*9.0*	2.28	*2.0*	1.82	33.00	26.23	25.8
3631	Quinnipiac Market Garden Phosphate	.12	1.13	2.09	3.34	*3.3*	6.98	2.40	.09	9.47	*9.0*	9.38	*8.0*	7.11	*7.0*	3.95	40.00	31.65	26.4
3638	L. Wilcox's Ammoniated Bone Phosphate	.17	.54	2.55	3.26	*2.5*	3.81	3.02	1.60	8.43	*7.0*	6.83	*6.0*	5.02	*5.0*	6.84	32.50	25.67	26.6
3524	Baker's A. A. Ammoniated Superphosphate	.36	1.81	.91	3.08	*2.5*	8.99	2.12	.74	11.85	*11.0*	11.11	*10.0*	2.61	*2.0*	3.35	37.50	29.44	27.4
3605	Bradley's Original Coe's Superphosphate	....	....	2.44	2.44	*1.7*	7.12	2.93	1.82	11.87	*11.0*	10.05	*8.0*	1.96	*1.0*	2.06	32.00	25.08	27.6
3613	Lister's Standard Phosphate	....	.45	2.15	2.60	*1.7*	7.14	2.44	1.97	11.55	*12.0*	9.58	*10.0*	1.81	*1.0*	1.45	32.00	25.01	27.9

* Valuation exceeds cost. † See notice on p. 77.

ANALYSES OF NITROGENOUS SUPERPHOSPHATES AND GUANOS SAMPLED BY THE STATION.—*Continued.*

Station No.	Name or Brand.	Nitrogen.					Phosphoric Acid.							Potash.		Chlorine.	Cost per Ton.	Valuation per Ton.	Percentage Difference between Cost and Valuation.
		Nitrogen as Nitrates.	Nitrogen as Ammonia.	Nitrogen, Organic.	Total Nitrogen Found.	Nitrogen Guaranteed.	Soluble.	Reverted.	Insoluble.	Total Found.	Total Guaranteed.	Available. Found.	Available. Guaranteed.	Found.	Guaranteed.				
3530	E. F. Coe's High Grade Ammoniated Bone Superphosphate	----	.80	1.44	2.24	*2.0*	7.52	2.25	1.48	11.25	*11.0*	9.77	*9.0*	2.41	*2.0*	.45	$32.00	$24.96	28.2
3637	Clark's Cove Fertilizer Co's Bay State Fertilizer	----	----	2.53	2.53	*2.7*	6.27	3.17	1.97	11.41	*10.0*	9.44	*8.5*	2.45	*2.0*	2.08	32.00	24.95	28.3
3678	Chittenden's Fish and Potash	----	----	3.42	3.42	*3.3*	3.92	2.45	2.00	8.37	*6.0*	6.37	----	5.09	*5.0*	.59	34.00	26.49	28.4
3525	Bowker's Hill and Drill Phosphate	.86	----	1.84	2.70	*2.5*	7.70	3.57	2.55	13.82	*12.0*	11.27	*8.0*	2.10	*2.0*	1.63	36.00	27.93	28.9
3634	Read's High Grade Farmers' Friend Fertilizer	----	.39	2.91	3.30	*3.3*	3.73	2.44	.38	6.55	----	6.17	*5.0*	10.26	*10.0*	9.30	37.50	29.08	29.0
3577	Bowker's Ammoniated Bone Fertilizer	.83	----	1.53	2.36	*2.0*	6.56	3.28	3.03	12.87	*10.0*	9.84	*8.0*	1.88	*2.0*	4.25	32.00	24.71	29.5
3579	Bowker's Gloucester Fish and Potash	.12	----	.84	.96	*.8*	9.34	1.32	3.03	13.69	*9.0*	10.66	*6.0*	1.51	*2.0*	1.99	28.00	21.48	30.3
3527	Bradley's Superphosphate	.12	----	2.75	2.87	*2.3*	7.18	3.15	1.37	11.70	*11.0*	10.33	*9.0*	2.04	*1.5*	2.34	35.00	26.73	30.9
3643	L. Wilcox's High Grade Fish and Potash	----	.27	3.38	3.65	*3.2*	3.10	2.25	.73	6.08	*6.0*	5.35	*5.0*	4.47	*4.0*	7.34	31.50	23.87	31.9
3543	Quinnipiac Phosphate	trace	----	2.82	2.82	*2.5*	6.72	3.34	1.33	11.39	*10.0*	10.06	*9.0*	2.01	*2.0*	2.44	35.00	26.12	34.0
3547	Crocker's Ammoniated Bone Superphosphate	----	----	2.99	2.99	*2.9*	5.47	4.68	2.83	12.98	*11.0*	10.15	*10.0*	1.08	*1.0*	1.58	35.50	26.43	34.3
3578	Bowker's Sure Crop Phosphate	.06	----	.88	.94	----	7.90	2.25	4.14	14.29	----	10.15	----	1.21	----	2.13	28.00	20.75	34.9
3541	Williams & Clark's Bone Superphosphate (Americus Brand)	.07	----	2.62	2.69	*2.5*	7.04	3.21	.96	11.21	*10.0*	10.25	*9.0*	1.95	*2.0*	2.37	35.00	25.85	35.4
3676	National Fertilizer Co's Russell Coe's Superphosphate	----	----	2.07	2.07	*1.6*	3.74	4.40	5.02	13.16	*9.0*	8.14	*8.0*	2.70	*1.0*	2.64	31.00	22.83	35.8

ANALYSES OF NITROGENOUS SUPERPHOSPHATES AND GUANOS SAMPLED BY THE STATION.—Concluded.

Station No.	Name or Brand.	Nitrogen.					Phosphoric Acid.							Potash.		Chlorine.	Cost per Ton.	Valuation per Ton.	Percentage Difference between Cost and Valuation.
		Nitrogen as Nitrates.	Nitrogen as Ammonia.	Nitrogen, Organic.	Total Nitrogen Found.	Nitrogen Guaranteed.	Soluble.	Reverted.	Insoluble.	Total Found.	Total Guaranteed.	Available. Found.	Available. Guaranteed.	Found.	Guaranteed.				
3582	Bowker's Farm and Garden Phosphate	.47	----	1.99	2.46	----	6.72	2.07	3.20	11.99	----	8.79	----	2.48	----	4.25	$33.00	$24.27	35.9
3602	Bradley's Triangle A Fish and Potash	----	----	2.62	2.62	*2.0*	4.72	2.38	.73	7.83	*6.0*	7.10	*4.0*	3.72	*4.0*	7.18	31.00	22.43	38.2
3630	Quinnipiac Pine Island Phosphate	----	----	2.46	2.46	*2.1*	5.58	4.07	1.10	10.75	*10.0*	9.65	*9.0*	2.08	*1.0*	2.11	34.00	24.25	40.2
3619	E. F. Coe's Alkaline Bone Phosphate	----	----	1.51	1.51	*.8*	6.56	3.33	3.31	13.20	*9.0*	9.89	*7.0*	1.98	*1.8*	.21	32.00	22.77	40.6
3610	Pacific Guano Co's Soluble Pacific Guano	----	----	2.30	2.30	*2.2*	7.14	2.85	1.64	11.63	*10.5*	9.99	*8.5*	2.34	*2.0*	1.98	35.00	24.83	41.0
3644	Reese's New England Favorite Fertilizer	----	----	2.38	2.38	*2.4*	3.68	6.76	.29	10.73	*11.0*	10.44	*10.0*	2.18	*2.0*	2.85	35.00	24.68	41.8
3639	Read's Samson Fertilizer	.31	----	2.54	2.85	*2.5*	6.83	1.03	.46	8.32	*9.0*	7.86	*8.0*	6.49	*5.0*	5.80	38.00	26.78	41.9
3608	Bowker's Fish and Potash—Plain Brand	----	----	2.17	2.17	*2.2*	6.72	1.12	4.15	11.99	*8.0*	7.84	----	3.73	*4.0*	3.89	34.00	23.61	44.0
3635	Read's Fish and Potash	----	.23	2.54	2.77	*2.5*	3.26	2.08	.29	5.63	*6.0*	5.34	*4.0*	3.42	*4.0*	4.35	29.00	19.94	45.4
3611	Clark's Cove Fertilizer Co's King Philip Alkaline Guano	----	----	1.13	1.13	*1.3*	5.71	2.53	1.53	9.77	*9.0*	8.24	*8.0*	2.45	*3.0*	.23	28.00	18.98	47.5
3617	Crocker's New Rival Ammoniated Phosphate	----	----	1.49	1.49	*1.2*	6.77	2.73	2.51	12.01	*11.0*	9.50	*10.0*	1.60	*1.6*	1.67	32.00	21.19	51.0
3609	E. F. Coe's Gold Brand Excelsior Guano	----	.73	1.41	2.14	*2.5*	6.61	2.04	1.75	10.40	*8.0*	8.65	*6.0*	5.37	*6.0*	.33	40.00	26.37	51.7
3632	Quinnipiac Fish and Potash—Crossed Fishes Brand	----	.43	2.85	3.28	*3.3*	1.79	3.41	2.69	7.89	*5.0*	5.20	*3.0*	3.50	*3.0*	7.43	34.00	22.33	52.2
3677	Davidge Special Favorite Fertilizer	----	----	2.01	2.01	*1.2*	8.48	1.15	.59	10.22	*11.0*	9.63	*10.0*	1.61	*1.5*	1.53	35.00	22.45	55.9
3633	Read's Standard Fertilizer	----	----	1.08	1.08	*.8*	6.90	1.81	.08	8.79	*10.0*	8.71	*8.0*	3.89	*4.0*	4.82	31.00	19.87	56.1

Fish and Potash.—Sampled by the Station.

	Chittenden's.	Bowker's Gloucester.	Wilcox's.	Bradley's* Triangle A.	Bowker's Plain Brand.	Read's.	Quinnipiac Crossed Fishes.
	3678	**3579**	**3643**	**3602**	**3608**	**3635**	**3632**
Nitrogen as Ammonia	....	....	.27	....	....	.23	.43
Nitrogen, Organic	3.42	.84	3.38	2.62	2.17	2.54	2.85
Soluble Phosphoric Acid	3.92	9.34	3.10	4.72	6.72	3.26	1.79
Reverted Phosphoric Acid	2.45	1.32	2.25	2.38	1.12	2.08	3.41
Insoluble Phosphoric Acid	2.00	3.03	.73	.73	4.15	.29	2.69
Potash	5.09	1.51	4.47	3.72	3.73	3.42	3.50
Cost	$34.00	$28.00	$31.50	$31.00	$34.00	$29.00	$34.00
Valuation	26.49	21.48	23.87	22.43	23.61	19.94	22.33

* See also analysis of Bradley's Anchor Brand manufacturer's sample on page 91.

Fish and Potash.

The samples of Fish and Potash included in the previous tables are tabulated by themselves for comparison on page 88.

2. *Sampled by Manufacturers and* 3. *Sampled by private individuals.*

(For tabulated analyses see page 91).

2. *Sampled by Manufacturers.*

These samples were sent to the Station in compliance with the terms of the Fertilizer Law and were analyzed because no samples of the brands named were found in market by our sampling agents:

3598. Fish and Potash, Anchor Brand, made by Bradley Fertilizer Co., Boston, Mass.

3647. Buffalo Superphosphate, No. 2, made by Crocker Fertilizer Co., Buffalo, N. Y.

3651. Vegetable Bone Superphosphate, made by Crocker Fertilizer Co., Buffalo, N. Y.

3652. Ammoniated Practical Superphosphate, made by Crocker Fertilizer Co., Buffalo, N. Y.

3650. Garden and Lawn Fertilizer, made by L. B. Darling Fertilizer Co., Pawtucket, R. I.

3654. Success Phosphate, made by Lister's Agricultural Chemical Works, Newark, N. J.

3655. Ammoniated Dissolved Bone, made by Lister's Agricultural Chemical Works, Newark, N. J.

3656. Ammoniated Bone Superphosphate, made by Preston Fertilizer Co., Greenpoint, L. I.

3653. Pilgrim Fertilizer, made by J. S. Reese & Co., Baltimore, Md.

3. *Sampled by private individuals.*

The following analyses were made on samples submitted by private individuals.

3521. Bone Fish and Potash, made by E. R. Kelsey, Branford. Sampled and sent by E. C. Warner, Fair Haven.

3681. Fertilizer made for Conn. Valley Orchard Co., by the Quinnipiac Co., N. Y. Sampled by D. L. Rogers, New Britain.

3537. Formula A, made by L. Sanderson, New Haven. Sampled by F. R. Curtiss, Stratford.

3698. Formula A, made by L. Sanderson, in the fall of 1892.

3699. Formula A, made by L. Sanderson, in the spring of 1892.

The last two samples were drawn by F. H. Todd, North Haven.

III. Special Manures.

1. *Sampled by Station Agents.*

For Analyses and Valuations see pages 93 to 100.

Here are included such Nitrogenous Superphosphates as are claimed by their manufacturers to be specially adapted to the needs of particular crops.

Notice of Particular Analyses.

Fairchild's Formula for Corn and General Crops No. **3507** is a mixture of nitrate of soda, muriate of potash and fine bone flour, 90 per cent. of which passes a round mesh $\frac{1}{25}$ inch in diameter.

An analysis **3534** was made of 6 samples of the Quinnipiac Potato Manure with the results given below. The manufacturer protested against the analysis because it did not represent the average quality of the goods which should show a much higher per cent. of potash than was indicated in this analysis. The Station, therefore, determined potash separately in each of the samples with the following results:

From Taylor & Hubbell, Newtown	1.79 per cent.
D. C. Wood	5.66 "
Olds & Whipple	5.39 "
W. L. L. Spencer	5.41 "
C. A. Young	5.24 "
G. M. Williams	4.69 "

It is evident that the sample from Taylor & Hubbell is totally unlike the others. A new mixture of samples was, therefore, prepared from which this sample low in potash was excluded. The analysis of this second sample, No. **3684**, is given in the table on page 100.

	3534
Nitrogen, organic	2.71
Phosphoric acid, soluble	5.52
reverted	2.74
insoluble	.75
Total	9.01
Potash	4.65
Chlorine	3.41

Nitrogenous Superphosphates—Sampled by Manufacturers and by Private Individuals—Analyses and Valuations.

	3598	**3647**	**3651**	**3652**	**3650**	**3654**	**3655**	**3656**	**3653**	**3521**	**3681**	**3537**	**3698**	**3699**
Nitrogen as nitrates	....	....	....	....	.98	....	....	....	....	....	.71	....	....	1.36
as ammonia	....	....	....	....	.23	.27	.47	.39	.31	.66	....	....	....	....
organic	3.85	....	5.70	.82	2.51	1.58	1.72	2.09	1.25	3.34	1.98	....	.89	2.16
Total nitrogen found	3.85	....	5.70	.82	3.72	1.85	2.19	2.48	1.56	4.00	2.69	3.54	.89	3.52
Nitrogen guaranteed	**2.2**	....	**5.0**	**.82**	....	**1.0**	**1.8**	**2.3**	**1.0**	**3.3**	....	**3.3**	**3.3**	**3.3**
Phosphoric acid, soluble	3.55	10.80	6.35	5.63	4.80	6.38	5.89	4.90	1.68	2.88	6.83	....	14.16	7.10
reverted	2.90	1.43	.73	3.41	3.52	2.92	3.49	4.21	7.89	2.09	3.96	....	1.01	3.57
insoluble	1.70	.95	.75	1.64	2.00	2.85	2.07	2.24	1.65	.26	1.34	....	.22	.96
Total phosphoric acid found	8.15	13.18	7.83	10.68	10.32	12.15	11.45	11.35	11.22	5.23	12.13	9.79	15.39	11.63
Phosphoric acid guaranteed	**5.0**	**12.0**	**7.0**	**9.0**	....	....	**11.0**	....	**7.5**	**4.0**	....	**10.0**	**10.0**	**10.0**
Available phosphoric acid found	6.45	12.23	7.08	9.04	8.32	9.30	9.38	9.11	9.57	4.97	10.79	....	15.17	10.67
Available phosphoric acid guar.	**3.0**	**11.0**	**6.0**	**8.0**	....	**10.5**	**9.0**	**9.0**	**6.5**	....	....	**6.0**	**6.0**	**6.0**
Potash	3.84	2.16	6.73	2.17	6.97	1.98	1.89	3.83	2.25	2.83	2.81	7.97	6.37	6.75
Potash guaranteed	**3.0**	**1.35**	**6.0**	**1.0**	....	**1.5**	**1.5**	**2.0**	....	**3.0**	....	**6.0**	**6.0**	**6.0**
Chlorine	1.98	1.95	6.06	2.05	5.61	1.58	1.72	2.08	3.00	.43	2.71	....	6.06	5.48
Valuation	$26.09	20.52	35.15	18.45	30.98	22.59	23.41	25.85	21.34	23.35	27.34	....	31.32	33.10

Guarantees.

Of the thirty-nine brands of special manures analyzed, sixteen are below the manufacturer's minimum guarantee in respect of one ingredient, and one is below in respect of two ingredients.

Cost, Valuation and Percentage Difference.

The average cost per ton of the special manures has been $38.28, the average valuation $30.70, and the percentage difference 25.0, a little higher than in case of the nitrogenous superphosphates.

Last year the corresponding figures were: Average cost $38.84, average valuation $31.64, percentage difference 22.8.

2. *Sampled by Manufacturers, and* 3. *Sampled by Private Individuals.*

2. *Manufacturers' Samples.*

These samples were sent to the Station in compliance with the terms of the Fertilizer Law and were analyzed because no samples of the brands named were found in market by our sampling agents.

3599. Complete Manure for Grass and Grain, made by the Bradley Fertilizer Co., Boston, Mass.

3649. Potato and Root Crop Manure, made by Darling Fertilizer Co., Pawtucket, R. I.

3. *Samples drawn by Private Individuals.*

3687. Mapes' Tobacco Manure, Wrapper Brand, from stock of W. H. Filley, Windsor. Sampled by O. P. Parsons, Poquonock.

3688. Fine Wrapper Brand Tobacco Grower, made by Williams and Clark Fertilizer Co., N. Y. Stock of I. J. Beardsley, New Preston. Sampled by G. B. Ackley.

Analyses and Valuations.

	3599	3649	3687	3688
Nitrogen as nitrates	5.99	.37	1.51	----
as ammonia	----	.23	3.20	2.64
organic	----	2.94	1.67	3.33
Total Nitrogen	**5.99**	**3.54**	**6.38**	**5.97**
Phosphoric acid, soluble	2.72	4.16	.61	.18
reverted	3.70	3.79	3.08	5.49
insoluble	1.60	2.69	2.50	5.60
Total Phosphoric Acid	**8.02**	**10.64**	**6.19**	**11.27**
Potash as muriate	.36	6.78	.90	1.06
as sulphate	2.98	----	10.44	9.58
Total Potash	**3.34**	**6.78**	**11.34**	**10.64**
Chlorine	.27	7.13	.68	.79
Valuation	$31.46	30.05	39.60	41.60

Special Manures Sampled by the Station.

Station No.	Name or Brand.	Manufacturer.	Dealer.	Dealers' cashprice per ton.
3507	Fairchild's Formula for Corn and General Crops.	Rogers & Hubbard Co., Middletown.	Daniel Moriarty, South Meriden.	$48.00
			Manufacturer.	35.00
3671	Tobacco Fertilizer.	Danbury Fertilizer Co., Danbury.	Manufacturer.	30.00
3673	Potato Manure.	Danbury Fertilizer Co., Danbury.	J. B. Beers, Brookfield.	35.00
			Manufacturer.	37.50
3629	Manure for Seeding Down.	Mapes' Formula & Peruvian Guano Co., 143 Liberty St., New York.	Mapes Branch, Hartford.	
3625	Manure for Fruit and Vines.	Mapes' Formula & Peruvian Guano Co., 143 Liberty St., New York.	Mapes Branch, Hartford.	38.00
3626	Tobacco Starter.	Mapes' Formula & Peruvian Guano Co., 143 Liberty St , New York.	Southington Lumber & Feed Co., Southington.	36.00
			F. S. Bidwell, Windsor Locks.	37.00
			Wilson & Burr, Middletown.	36.00
			Mapes Branch, Hartford.	35.00
			C. O. Jelliff & Co., Southport.	38.00
3576	Corn Manure.	H. J. Baker & Bro., 215 Pearl St., New York.	G. K. Nason, Willimantic.	43.00
3545	Manure for Light Soil.	Mapes' Formula & Peruvian Guano Co., 143 Liberty St., New York.	Raymond Bros., South Norwalk.	42.00
			Mapes Branch, Hartford.	42.00
			Wilson & Burr, Middletown.	43.00
			J. P. Barstow & Co , Norwich.	42.00
3508	Soluble Potato Manure.	The Rogers & Hubbard Co., Middletown.	Daniel Moriarty, South Meriden.	39.00
			Manufacturer.	38.00
3585	Complete Manure for Potatoes and Vegetables.	Bradley Fertilizer Co., 27 Kilby St., Boston, Mass.	J. E. Holmes, Stratford.	39.00
			Peck Bros., Northfield.	40.00
3526	Grass and Grain Spring Top Dressing.	Mapes' Formula & Peruvian Guano Co., 143 Liberty St., New York.	J. P. Barstow & Co., Norwich.	40.00
			G. K. Nason, Willimantic.	41.00
			Wilson & Burr, Middletown.	40.00
			Mapes Branch, Hartford.	39.00

SPECIAL MANURES SAMPLED BY THE STATION.—*Continued.*

Station No.	Name or Brand.	Manufacturer.	Dealer.	Dealers' cashprice per ton.
3575	Complete Tobacco Manure.	H. J. Baker & Bro., 215 Pearl St., New York.	H. K. Brainard, Thompsonville.	$40.00
			E. Hawley, Newtown.	42.50
			F. S. Bidwell, Windsor Locks.	41.50
			W. F. Andross, East Hartford.	42.00
3640	Potato, Onion and Tobacco Fertilizer.	Leander Wilcox, Mystic.	L. C. Gray, Jewett City.	33.00
			Frederic Gallup, New London.	34.25
			J. A. Lewis, Willimantic.	32.00
			C. M. Smith, East Hartford.	36.00
3646	Havana and Seed Leaf Tobacco Fertilizer.	Quinnipiac Co , 7 Exchange Place, Boston, Mass.	Olds & Whipple, Hartford.	50.00
3544	Manure for Corn.	Mapes' Formula & Peruvian Guano Co., 143 Liberty St., New York.	F. S. Bidwell, Windsor Locks.	40.00
			G. K. Nason, Willimantic.	40.00
			J. H. Ray & Son, Greenwich.	43.00
			Mapes Branch, Hartford.	39.00
			J. P. Barstow & Co., Norwich.	40.00
			C. W. Beardsley, Milford.	42.00
3584	Stockbridge Top Dressing.	Bowker Fertilizer Co., 43 Chatham St., Boston, Mass.	F. S. Bidwell, Windsor Locks.	
3628	Tobacco Manure—Wrapper Brand.	Mapes' Formula & Peruvian Guano Co., 143 Liberty St , New York.	Southington Lumber & Feed Co., Southington.	47.50
			F. S. Bidwell, Windsor Locks.	49.00
			Mapes Branch, Hartford.	48.00
3603	High Grade Tobacco Manure.	Bradley Fertilizer Co., 27 Kilby St., Boston, Mass.	F. S. Bidwell, Windsor Locks.	49.00
			G. W. Grant, Wapping.	48.00
			Carter & Strong, Manchester.	50.00
3550	Complete Potato Manure.	H. J. Baker & Bro., 215 Pearl St., New York.	S. J. Hall, Meriden.	42.00
			C. O. Jelliff & Co., Southport.	38.00
			W. F. Andross, East Hartford.	40.00
			E. W. Hawley, Newtown.	42.50

SPECIAL MANURES SAMPLED BY THE STATION.—*Continued.*

Station No.	Name or Brand.	Manufacturer.	Dealer.	Dealers' cashprice per ton.
3612	Potato and Tobacco Fertilizer.	Clark' Cove Fertilizer Co., Boston, Mass.	W. H. Anderson, Putnam.	$32.00
3533	Potato Manure.	Mapes' Formula & Peruvian Guano Co., 143 Liberty St., New York.	J. P. Barstow & Co., Norwich.	41.00
			Mapes Branch, Hartford.	41.00
			Wilson & Burr, Middletown.	42.00
			G. K. Nason, Willimantic.	42.50
			C. W. Beardsley, Milford.	42.00
			Wheeler & Howe, Bridgeport.	45.00
3641	High Grade Special Fertilizer.	Williams & Clark's Fertilizer Co., 83 Fulton St., New York.	H. L. Vibberts, Manchester.	40.00
			John Bransfield, Portland.	40.00
			S. D. Woodruff & Sons, Orange.	37.00
3549	Great Eastern Vegetable and Tobacco Fertilizer.	Great Eastern Fertilizer Co., Rutland, Vermont.	S. D. Woodruff & Sons, Orange.	33.00
			F. E. Mirritt, Noank.	31.00
			J. E. Comstock, New London.	32.00
			W. Burr & Son, Fairfield.	34.00
			S. C. Lewis, Stratford.	33.00
3535	Stockbridge Manure for Potatoes and Vegetables.	Bowker Fertilizer Co., 43 Chatham St., Boston, Mass.	L. Browning, New London.	42.00
			C. W. Michael & Co., Yalesville.	42.00
			C. H. Bell, Portland.	42 00
			J. E. Leonard, Jewett City.	40.00
			E. M. Brewster, Norwich.	42.00
			W. H. Anderson, Putnam.	40.00
3583	Tobacco Grower.	Bowker Fertilizer Co., 43 Chatham St., Boston, Mass.	H. K. Brainard, Thompsonville.	45.00
			M. McNamara, New Milford.	40.00
			G. W. Mitchell, South Britain.	38.00
3532	Special Potato Manure.	Crocker Fertilizer Co., Buffalo, N. Y.	J. E. Leonard, Jewett City.	40.00
			W. H. Anderson, Putnam.	36.00
			W. L. L. Spencer, Lebanon.	40.00

SPECIAL MANURES SAMPLED BY THE STATION.—*Continued.*

Station No.	Name or Brand.	Manufacturer.	Dealer.	Dealers' cashprice per ton.
3604	Complete Manure for Corn and Grain.	Bradley Fertilizer Co., 27 Kilby St., Boston, Mass.	M. G. Beach & Son, New Milford.	$41.00
			Strong & Tanner, Winsted	38.00
3548	Great Eastern Grass and Grain Fertilizer.	Great Eastern Fertilizer Co, Rutland, Vt.	J. E. Comstock, New London.	32.00
			W. Burr & Son, Fairfield.	34.00
			S. C. Lewis, Stratford.	33.00
			F. E. Mirritt, Noank.	
3581	Stockbridge Manure for Corn and Grain.	Bowker Fertilizer Co., 43 Chatham St., Boston, Mass.	Southington Lumber & Feed Co., Southington.	41.50
			G. H. Larned, Pomfret.	40.00
			G. W. Mitchell. South Britain.	38.00
			J. A. Lewis, Willimantic.	40.00
			Waldo Tillinghast.	40.00
			W. B. Martin, Rockville.	41.00
			J. A. Weed, New Canaan.	42 00
3614	Potato Manure.	Lister's Agricultural Chemical Works, Newark, N. J.	A. N. Clark, Milford.	40.00
3546	Ammoniated Wheat and Corn Phosphate.	Crocker Fertilizer Co., Buffalo, N. Y.	G. W. Clark, Milford.	
			W. L. L. Spencer, Lebanon.	32.00
			J. E. Leonard, Jewett City.	31.00
			W. H. Anderson, Putnam.	33.00
			W. Tillinghast, Plainfield.	35.00
			C. A. Young, Danielsonville.	33.00
3618	Potato Fertilizer.	E. Frank Coe, 16 Burling Slip, New York.	J. O. Fox & Co, Putnam	34.00
			City Coal & Wood Co., New Britain.	36.00
			Arnold Rudd, New London.	38.00

SPECIAL MANURES SAMPLED BY THE STATION.—*Continued.*

Station No.	Name or Brand.	Manufacturer.	Dealer.	Dealers' cashprice per ton.
3684	Potato Manure.	Quinnipiac Co., 7 Exchange Place, Boston, Mass.	D. C. Wood, Stratford.	$38.00
			Olds & Whipple, Hartford.	40.00
			W. L. L. Spencer, Lebanon.	35.00
			C. A. Young, Danielsonville.	36.00
			G. M. Williams, New London.	33.00
3606	Potato Phosphate.	Bowker Fertilizer Co., 43 Chatham St., Boston, Mass.	B. Curtiss & Son, Stepney.	35.00
			G H Larned, Pomfret.	
			T. E. Greene, Torrington.	38.00
3531	Potato, Tobacco and Hop Phosphate.	Crocker Fertilizer Co., Buffalo, N. Y.	F. C. Sturtevant, Hartford.	38.00
			John Bransfield, Portland.	36.00
			J. E. Leonard, Jewett City.	35.00
			W. H. Anderson, Putnam.	32.00
			C. A. Young, Danielsonville.	35.00
			Waldo Tillinghast, Plainfield.	36.00
3528	Potato Manure.	Bradley Fertilizer Co., 27 Kilby St., Boston, Mass.	S. A. Billings, Meriden.	38.00
			Wilson & Burr, Middletown.	35.00
			J. M. Young, Norwich.	35.00
			J. E. Holmes, Stratford.	37.00
			T. F. Powers, Waterford.	35.00
			A. C. Sternberg, Hartford.	37.00
			J. A. Lewis, Willimantic.	36.00
			J. E. Comstock, New London.	36.00
3542	Potato Phosphate.	Williams & Clark Fertilizer Co., 83 Fulton St., New York.	H. K. Brainard, Thompsonville.	36.00
			J. P. Kingsley's Sons, Plainfield.	32.00
			W. H. Anderson, Putnam.	36.00
			D. B. Wilson, Waterbury.	36.00
			C. E. Stagg, Stratford.	36.00
			Daniel Morgan, Poquonock Bridge.	34.00
3615	General Fertilizer for Oats, Buckwheat and Seeding Down.	Great Eastern Fertilizer Co., Rutland, Vermont.	J. E. Comstock, New London.	31.00
			E. B. Calkin, Lyme.	
3645	Special Potato Fertilizer.	Pacific Guano Co., Box 1368, Boston, Mass.		32.00
			P. J. Bolan, Waterbury.	35.00

ANALYSES OF SPECIAL MANURES SAMPLED BY THE STATION.

Station No.	Name or Brand.	Nitrogen. Nitrogen as Nitrates.	Nitrogen as Ammonia.	Nitrogen, Organic.	Total Nitrogen Found.	Nitrogen Guaranteed.	Phosphoric Acid. Soluble.	Reverted.	Insoluble.	Total Found.	Total Guaranteed.	Available. Found.	Available. Guaranteed.	Potash. Found.	Potash. Guaranteed.	Chlorine.	Cost per Ton.	Valuation per Ton.	Percentage difference between Cost and Valuation.
3507	Fairchild's Formula for Corn and General Crops	3.61	----	2.13	5.74	5.0				13.05	12.0	----	----	13.66	12.0	11.07	$46.00	$45.11	1.9
3671	Danbury Fertilizer Co's Tobacco Fertilizer	1.78	----	2.89	4.67	3.3	3.04	6.43	1.60	11.07	6.0	9.47	----	4.16	4.5	.64	35.00	33.20	5.4
3673	Danbury Fertilizer Co's Potato Manure	----	----	2.84	2.84	2.9	4.34	6.97	1.10	12.41	8.0	11.31	----	6.71	7.0	3.63	35.00	32.22	8.6
3629	Mapes' Manure for Seeding Down	.58	----	2.58	3.16	2.5	----	7.98	8.11	16.09	----	7.98	7.0	11.03	10.0	9.69	37.50	34.35	9.1
3625	Mapes' Manure for Fruit and Vines	.32	.59	1.68	2.59	1.7	6.32	2.74	.80	9.86	----	9.06	7.0	10.75	11.0	.76	38.00	33.67	12.8
3626	Mapes' Tobacco Starter	.38	.61	1.98	2.97	2.5	7.73	4.35	1.06	13.14	12.0	12.08	8.0	3.07	2.5	.37	35.00	31.00	12.9
3576	Baker's Corn Manure	----	3.78	.95	4.73	4.9	6.24	.75	.25	7.24	----	6.99	6.2	7.40	7.0	5.07	38.00	33.56	13.2
3545	Mapes' Manure for Light Soils	1.03	1.68	2.39	5.10	4.9	6.56	2.45	.78	9.79	8.0	9.01	6.0	7.07	6.0	6.87	42.00	36.56	14.8
3508	The Rogers & Hubbard Co's Soluble Potato Manure	.69	.23	3.97	4.89	5.0	1.82	5.59	2.90	10.31	10.0	7.41	----	5.28	5.0	.54	38.00	32.97	15.2
3585	Bradley's Complete Manure for Potatoes & Vegetables	.38	1.13	2.12	3.63	3.7	6.86	2.84	1.24	10.94	9.0	9.70	8.0	6.45	6.0	3.11	38.00	32.92	15.4
3526	Mapes' Grass and Grain Spring Top Dressing	.95	1.05	2.95	4.95	4.2	5.66	2.78	.75	9.19	7.0	8.44	5.0	5.54	5.0	5.32	39.00	33.64	15.9
3575	Baker's Complete Tobacco Manure	----	3.36	1.15	4.51	4.2	4.42	.94	.08	5.44	----	5.36	4.0	10.55	10.0	.60	41.00	34.87	17.5
3640	L. Wilcox's Potato, Onion and Tobacco Fertilizer	.67	.59	2.54	3.80	3.2	3.39	3.92	.46	7.77	8.0	7.31	7.0	6.24	6.0	2.26	34.00	28.79	18.1

ANALYSES OF SPECIAL MANURES SAMPLED BY THE STATION.

Station No.	Name or Brand.	Nitrogen. Nitrogen as Nitrates.	Nitrogen as Ammonia.	Nitrogen, Organic.	Total Nitrogen Found.	Nitrogen Guaranteed.	Phosphoric Acid. Soluble.	Reverted.	Insoluble.	Total Found.	Total Guaranteed.	Available. Found.	Available. Guaranteed.	Potash. Found.	Potash. Guaranteed.	Chlorine.	Cost per Ton.	Valuation per Ton.	Percentage difference between Cost and Valuation.
3646	Quinnipiac Havana and Seed Leaf Tobacco Fertilizer	----	2.17	3.34	5.51	5.7	.32	5.54	4.90	10.76	6.0	5.86	5.0	12.28	10.0	1.05	50.00	41.72	19.8
3544	Mapes' Manure for Corn	.88	.78	2.12	3.78	3.7	6.56	3.34	1.78	11.68	10.0	9.90	8.0	6.37	6.0	5.55	40.00	33.11	20.8
3584	Stockbridge Top Dressing	2.91	----	2.13	5.04	5.0	1.76	5.66	4.91	12.33	6.0	7.42	3.0	5.52	5.0	6.08	40.00	33.04	21.0
3628	Mapes' Tobacco Manure, Wrapper Brand	1.16	3.16	1.89	6.21	6.7	.61	3.49	1.85	5.95	4.5	4.10	----	11.49	10.5	.86	48.00	39.54	21.3
3603	Bradley's High Grade Tobacco Manure	----	3.03	2.73	5.76	5.7	1.68	2.57	1.25	5.50	4.0	4.25	----	10.70	10.8	.80	46.00	37.52	22.6
3550	Baker's Complete Potato Manure	.18	2.62	.93	3.73	3.3	5.01	1.18	.65	6.84	----	6.19	5.0	10.66	10.0	3.54	40.50	32.90	23.1
3612	Clark's Cove Fertilizer Co's Potato and Tobacco Fert.	----	----	2.38	2.38	2.5	7.52	2.61	1.47	11.60	9.0	10.13	8.0	3.05	3.0	3.12	32.00	25.89	23.6
3533	Mapes' Potato Manure	.83	.78	2.15	3.76	3.7	6.90	2.21	.55	9.66	8.0	9.11	8.0	7.45	6.0	.44	42.00	33.84	24.1
3641	Williams & Clark's High Grade Special for Potatoes, Tobacco, etc.	.24	1.19	2.22	3.65	3.7	6.00	2.74	.93	9.67	8.0	8.74	7.0	7.13	7.0	5.35	40.00	31.63	26.4
3549	Great Eastern Vegetable and Tobacco Fertilizer	.05	----	2.20	2.25	2.1	7.57	.95	.84	9.36	9.0	8.52	8.0	6.28	6.0	5.83	33.00	25.87	27.5
3535	Stockbridge Manure for Potatoes and Vegetables	1.54	----	2.11	3.65	3.2	5.66	2.95	2.14	10.75	8.0	8.61	7.0	6.66	5.0	7.21	40.00	30.83	29.7
3583	Bowker's Tobacco Grower	.91	----	1.67	2.58	2.5	6.99	2.77	1.18	10.94	12.0	9.76	8.0	6.45	7.0	2.47	39.00	29.35	32.8
3532	Crocker's Special Potato Manure	----	.20	3.47	3.67	3.7	6.16	1.20	2.27	9.63	9.0	7.36	8.0	6.09	5.4	6.15	39.00	29.11	33.9

ANALYSES OF SPECIAL MANURES SAMPLED BY THE STATION.

Station No.	Name or Brand.	Nitrogen.					Phosphoric Acid.							Potash.		Chlorine.	Cost per Ton.	Valuation per Ton.	Percentage difference between Cost and Valuation.
		Nitrogen as Nitrates.	Nitrogen as Ammonia.	Nitrogen, Organic.	Total Nitrogen Found.	Nitrogen Guaranteed.	Soluble.	Reverted.	Insoluble.	Total Found.	Total Guaranteed.	Available. Found.	Available. Guaranteed.	Found.	Guaranteed.				
3604	Bradley's Complete Manure for Corn and Grain	.29	.60	2.29	3.18	*2.9*	7.60	2.90	.76	11.26	*9.0*	10.50	*8.0*	4.19	*3.0*	4.29	40.00	29.83	34.0
3548	Great Eastern Grass and Grain Fertilizer	trace	....	2.95	2.95	*2.9*	7.42	1.27	.76	9.45	*9.0*	8.69	*8.0*	2.11	*2.0*	4.10	33.00	24.55	34.4
3581	Stockbridge Manure for Corn and Grain	1.15	....	2.01	3.16	*3.2*	7.12	3.14	1.51	11.77	*9.0*	10.26	*8.0*	4.46	*7.0*	4.11	40.00	29.57	35.2
3614	Lister's Potato Manure	....	1.56	2.23	3.79	*3.7*	5.92	1.11	.74	7.77	*7.0*	7.03	....	6.51	*7.0*	5.93	40.00	29.18	37.1
3546	Crocker's Ammoniated Wheat & Corn Phosphate	....	....	2.25	2.25	*2.0*	6.91	2.77	2.63	12.31	*10.0*	9.68	*9.0*	1.61	*1.6*	2.00	33.00	23.95	37.8
3618	E. F. Coe's Potato Fertilizer	....	.70	1.63	2.33	*2.0*	6.05	2.39	1.67	10.11	....	8.45	*8.0*	4.96	*5.8*	.71	36.00	26.04	38.2
3684	Quinnipiac Potato Manure	....	....	2.78	2.78	*2.5*	4.64	2.83	1.30	8.77	*7.0*	6.47	*6.0*	5.29	*5.0*	3.83	36.00	25.14	43.1
3606	Bowker's Potato Phosphate	.70	....	1.78	2.48	*2.5*	6.85	1.80	3.43	12.08	*11.0*	8.65	*7.0*	2.43	*3.0*	3.51	35.00	24.15	44.9
3531	Crocker's Potato, Tobacco and Hop Phosphate	....	....	2.15	2.15	*2.0*	6.26	2.81	2.35	11.42	*11.0*	9.07	*10.0*	3.21	*3.5*	3.63	35.00	24.03	45.6
3528	Bradley's Potato Manure	.21	....	2.63	2.84	*2.5*	4.67	2.30	1.50	8.47	*8.0*	6.97	*6.0*	5.26	*5.0*	6.59	36.00	24.61	46.2
3542	Williams & Clark's Potato Phosphate	....	....	2.56	2.56	*2.5*	5.17	2.11	.78	8.06	*7.0*	7.28	*6.0*	5.64	*5.0*	3.09	36.00	24.59	46.4
3615	Great Eastern Fertilizer for Oats, Buckwheat and Seeding Down	trace	....	1.41	1.41	*0.8*	7.20	1.10	.90	9.20	*9.0*	8.30	*8.0*	4.59	*4.0*	5.95	32.00	21.34	49.9
3645	Pacific Guano Co's Special Potato Fertilizer	....	.31	2.56	2.87	*3.0*	3.25	2.74	1.71	7.70	*7.0*	5.99	*5.0*	4.92	*5.0*	5.74	35.00	23.11	51.4

HOME MIXED FERTILIZERS.

Following are the formulas, analyses and valuations of all the Home mixtures which have been received at this Station for analysis during the past season.

The prices quoted except in the case of **3443** are *regular market retail rates*, at which the goods can be bought without discounts. In most cases special and much lower prices were paid partly on account of large orders and cash payments.

The mechanical condition of most of these mixtures was excellent, being as fine and as dry as average factory-mixed goods.

The average cost of the raw material used in the mixtures, excluding 3443 was $33.25 at regular market rates, disregarding discounts, which most of the purchasers received. If we add to this $1.50 for freight and $2.00 per ton for mixing, an allowance which is very ample, the total average cost will be $36.75 per ton. The average valuation is $33.16 per ton, and the percentage difference between cost and valuation $10.8.

The percentage differences between cost and valuation in case of the factory-mixed superphosphates and special manures this year is more than twice as large, indicating that there was in these cases great economy in home-mixing.

3443. Made by S. E. Curtiss, Stratford.

FORMULA.

2530	pounds	Muriate of Potash.
800	"	Nitrate of Soda.
6400	"	Dissolved Bone.
1400	"	Dissolved Bone Black.
4500	"	Tankage.
15630	"	

Costing $176.00 or $22.52 per ton.

3476. For General Use, made by J. Norris Barnes, Yalesville.

300	pounds	Nitrate of Soda.
1000	"	Pulverized Bone and Meat.
4000	"	Blood, Bone and Meat.
1200	"	Raw Bone.
800	"	Dissolved Bone Black.
1125	"	Muriate of Potash.
800	"	Double Sulphate Potash and Magnesia.
9225	"	

Costing $35.27 per ton delivered at Yalesville at regular rates.

3486. For General Use, made by N. D. Platt, Milford.

2000 pounds	Tankage.
2000 "	Dissolved Bone Black.
500 "	Ground Bone.
500 "	Sulphate of Ammonia.
500 "	Muriate of Potash.
500 "	Double Sulphate of Potash.
6000 "	

Costing, at regular rates, $35.00 per ton in Milford.

3487. For General Use, made by R. M. Treat, Woodmont.

450 pounds	Tankage.
170 "	Sulphate of Ammonia.
1000 "	Dissolved Bone Black.
280 "	Muriate of Potash.
100 "	Bone Black.
2000 "	

Costing, at regular rates, $34.67 per ton.

3488. Made by G. F. Platt, Milford.

800 pounds	Blood, Bone and Meat.
400 "	Ground Bone.
550 "	Dissolved Bone Black.
50 "	Sulphate of Ammonia.
100 "	Nitrate of Soda.
50 "	Sulphate of Potash.
50 "	Muriate of Potash.
2000 "	

Costing, at retail rates $34.51 per ton.

3489. For general use. Made by W. L. and S. T. Merwin, Milford.

170 pounds	Muriate of Potash.
950 "	Dissolved Bone Black.
580 "	Tankage.
175 "	Sulphate of Ammonia.
125 "	Ground Bone.
2,000 "	Costing, at regular rates, $34.60 per ton.

3503. For general use. Made by N. E. Smith & Son, Woodmont.

475 pounds	Tankage.
145 "	Sulphate of Ammonia.
1,000 "	Dissolved Bone Black.
280 "	Muriate of Potash.
100 "	Bone Black.
2,000 "	Costing, at regular rates, $34.09 per ton.

3504. For Potatoes. Made by T. J. Stroud, Shaker Station.

500 pounds	Castor Pomace.
600 "	Tankage.
300 "	High grade Sulphate of Potash.
100 "	Nitrate of Soda.
400 "	Dissolved Bone Black.
100 "	Plaster.
2,100 "	Costing about $30.25 per ton.

3505. For Oats. Made by T. J. Stroud, Shaker Station.

700 pounds	Castor Pomace.
800 "	Tankage.
200 "	Muriate of Potash.
300 "	Nitrate of Soda.
100 "	Plaster.
2,100 "	Costing about $30.60 per ton.

3517. Made by E. Kingsbury, Coventry.

1,000 pounds	Tankage.
400 "	Muriate of Potash.
400 "	Dissolved Bone Black.
300 "	Nitrate of Soda.
2,100 "	Costing $36.00 in Coventry, allowing $1.00 for mixing.

3519. For Corn. Made by G. F. Platt, Milford.

200 pounds	Nitrate of Soda.
300 "	Ground Bone.
800 "	Dissolved Bone Black.
600 "	Blood, Bone and Meat.
100 "	Muriate of Potash.
2,000 "	Cost at regular rates, $32.82 per ton in Milford.

3520. For Potatoes. Made by Dennis Fenn, Milford.

12 bushels	Unleached Ashes.
200 pounds	Dissolved Bone Black.
400 "	Blood, Bone and Meat.
100 "	Nitrate of Soda.

3539. Made by S. O. Parker, Somerville.

662 pounds	Tankage.
662 "	Dissolved Bone Black.
534 "	Double Sulphate of Potash and Magnesia.
142 "	Sulphate of Ammonia.
2,000 "	Costing unmixed, $34.00 per ton.

3540. For Corn. Made by Dennis Fenn, Milford.

700	pounds	Blood, Bone and Meat.
500	"	Dissolved Bone Black.
500	"	Bone.
200	"	Nitrate of Soda.
180	"	Muriate of Potash.
2,000	"	Costing, at regular rates, $36.83.

3574. For Oats and Seeding Down. Made by Stephen Hoyt's Sons, New Canaan.

1,000	pounds	Bone Dust.
600	"	Double Sulphate of Potash and Magnesia.
200	"	Muriate of Potash.
200	"	Nitrate of Soda.
2,000	"	Costing $36.25 per ton at regular rates.

3586. For Corn. Made by T. J. Stroud, Shaker Station.

800	pounds	Castor Pomace.
900	"	Tankage.
200	"	Muriate of Potash.
100	"	Nitrate of Soda.
100	"	Plaster.
2,100	"	Costing about $31.00 per ton at regular rates.

3601. Special for Corn. Made by Dennis Fenn, Milford.

25	bushels	Hen Manure.
400	pounds	Land Plaster.
200	"	Dissolved Bone Black.
100	"	Muriate of Potash.

3607. For Corn. Made by N. E. Smith & Son.

600	pounds	Blood, Bone and Meat.
300	"	Ground Bone.
800	"	Dissolved Bone Black.
200	"	Nitrate of Soda.
100	"	Muriate of Potash.
2,000	"	Costing, at regular rates, $32.82 per ton.

HOME MIXED FERTILIZERS.—ANALYSES AND VALUATIONS.

Station No.	Name.	Nitrogen.					Phosphoric Acid.					Potash.		Chlorine.	Valuation, Per Ton.	Cost of Raw Materials per ton, delivered.
		As Nitrates.	As Ammonia.	Organic.	Total Found.	Total Calculated.	Soluble.	Reverted.	Insoluble.	Total Found.	Total Calculated.	Found.	Calculated.			
3443	S. E. Curtiss, Home Mixture	.72	----	1.53	2.25	----	7.06	1.90	1.27	10.23	----	7.62	*8.2*	----	$27.68	*22.52
3476	J. N. Barnes, Mixture for Gen'l Use	.43	----	3.67	4.10	*4.5*	1.58	4.79	3.74	10.11	*11.5*	11.09	*8.4*	5.75	34.27	35.27
3486	N. D Platt, Mixture for Gen'l Use,	----	1.77	2.07	3.84	*3.7*	6.34	3.59	3.03	12.96	*14.5*	6.03	*6.2*	4.06	34.12	35.00
3487	R. M. Treat, Mixture for Gen'l Use,	----	1.76	1.24	3.00	*3.1*	8.99	1.80	2.51	13.30	*14.2*	7.61	*6.8*	7.32	33.98	34.67
3488	G. F. Platt, Mixture for Potatoes,	.63	.58	2.94	4.15	*4.4*	5.14	5.02	5.47	15.63	*13.7*	1.82	*1.9*	1.24	31.94	34.51
3489	W. L. & S. T. Merwin, Mixture for General Use,	----	1.46	1.99	3.45	*3.9*	9.46	2.91	1.74	14.11	*12.6*	4.54	*4.3*	4.86	34.53	34.60
3503	N. E. Smith & Son, Mixture for Gen'l Use.	----	2.10	1.37	3.47	*3.2*	9.63	1.95	1.66	13.27	*12.1*	6.94	*6.8*	5.01	35.87	34.09
3504	T. J. Stroud, Mixture for Potatoes,	.56	----	3.30	3.86	----	4.37	.76	.18	5.31	----	7.25	----	.41	27.80	30.25
3505	T. J. Stroud, Mixture for Oats,	2.39	----	4.60	6.99	*6.8*	.90	1.00	.06	1.96	*1.3*	4.68	*5.1*	3.97	28.87	30.60
3517	E. Kingsbury, Home Mixture,	2.23	----	2.31	4.54	*5.0*	2.76	3.03	1.18	6.97	*8.7*	10.12	*9.5*	----	32.04	36.00
3519	G. F. Platt, Mixture for Corn,	1.46	----	2.39	3.85	*4.1*	7.50	4.59	2.78	14.87	*13.5*	2.50	*2.5*	----	33.08	32.82
3520	Dennis Fenn, Mixture for Potatoes,	1.63	----	2.22	3.85	----	1.43	1.85	5.57	8.85	----	2.39	----	trace.	21.59	----
3539	S. O. Parker, Home Mixture,	----	1.37	2.39	3.76	*3.9*	4.48	2.39	1.42	8.29	*6.1*	7.22	*6.9*	.72	38.60	34.00
3540	Dennis Fenn, Mixture for Corn,	1.26	----	2.72	3.98	*4.6*	4.35	5.91	4.21	14.47	*13.5*	4.07	*4.3*	----	32.62	36.83
3574	Stephen Hoyt's Sons, Mixture for Oats and Seeding Down,	2.79	----	2.42	5.21	*3.2*	----	----	----	9.98	*9.3*	9.80	*12.8*	2.25	39.17	36.25
3586	T. J. Stroud, Mixture for Corn,	.92	----	3.34	4.26	*5.9*	3.68	.86	trace.	4.54	*1.4*	6.50	*5.2*	5.73	26.02	31.00
3601	Dennis Fenn, Mixture for Corn (Special),	----	----	1.05	1.05	----	1.09	2.04	----	3.13	----	4.18	----	----	11.62	----
3607	N. E. Smith & Son, Mixture for Corn,	1.52	----	2.14	3.66	*4.1*	7.36	5.02	.92	13.30	*13.6*	5.05	*2.5*	4.32	34.40	32.82

* Not at regular market rates.

Miscellaneous Fertilizers and Manures.

Cotton-Hull Ashes.

The analyses of 25 samples of this material are tabulated on page 107.

Samples **3473** and **3636** represent damaged or refuse stock, sold as such by Messrs. Soper & Co., on the basis of the Station's analysis, and at a very low price.

Excluding these two analyses, the actual potash in Cotton-Hull ashes has cost as high as 11.4 cents per pound, as low as 3.2 cents per pound, and on the average 5.3 cents.

The per cent. of potash has ranged from 31.3 to 11.3, and the average has been 24.1 per cent.

Unleached Ashes.

From various Dealers.

3497. From W. E. Fyfe & Co., Clinton, Mass. Sampled by Station agent from stock of A. C. Sternberg, Hartford.

3715. From James Hartness Soap Co., Detroit, Mich. Sampled by J. N. Barnes from stock bought by him.

3522. From Forest City Hardwood Ash Co. Sampled by E. C. Warner, Fair Haven, from stock purchased by him.

3705. From Forest City Hardwood Ash Co. Sampled and sent by H. G. Swift, West Hartford.

Sold by Chas. Allison & Co., New York City.

3417. Sampled by L. S. Ellsworth, Simsbury.
3428. Sampled by W. H. Whitehead, Simsbury.
3445. Sampled by Jay Barnard, Simsbury.
3692. Sampled by C. S. Gillette, Cheshire.

Sold by F. R. Lalor, Dunnville, Ontario, Canada.

3416. Sampled by Station agent.

3437, 3538. Two samples from the same pile, drawn by T. J. Stroud, Shaker Station.

3439 and **3440.** Sampled by C. F. Smith, Orange.

3693. Sampled by Station agent from goods purchased by E. J. Peck, Stratford.

3695. Sampled by Julius Moss, West Cheshire.

3696. Sampled by C. C. Hart, Southington.

Analyses of Cotton Hull Ashes.

Station No.	Dealer or Purchaser.	Sampled by	Soluble Phosphoric Acid.	"Reverted" Phosphoric Acid.	Insoluble Phosphoric Acid.	Potash Soluble in Water.	Cost per ton.	Valuation per ton.	Potash, costs per pound in cents.
3460	H. K. Brainard, Thompsonville	R. L. Clapp, Thompsonville	2.08	7.64	1.03	28.26	$36.00	$49.00	3.2
3423	T. Soule & Co., New Milford	E. A. Wildman, New Milford	2.96	6.69	1.63	31.34	35.00	49.93	3.3
3463	H. K. Brainard, Thompsonville	James Wood, West Suffield	1.84	7.63	1.46	26.14	33.00	42.78	3.6
3444	H. K. Brainard, Thompsonville	G. F. Chapin, Thompsonville	2.34	6.15	2.72	28.96	36.00	45.07	3.9
3424	T. Soule & Co., New Milford	E. A. Wildman, New Milford	2.24	6.23	1.38	27.53	35.00	42.91	4.1
3453	Olds & Whipple, Hartford	H. S. Frye, Poquonock	2.64	7.06	2.75	29.42	40.00	47.30	4.3
3475	L. L. Spencer, Suffield	C. W. Austin, Suffield	1.47	6.27	2.17	27.00	35.00	41.56	4.3
3472	Olds & Whipple, Hartford	Eugene Brown, Poquonock	2.40	7.10	1.89	25.88	37.00	42.77	4.4
3446	Olds & Whipple, Hartford	E. J. Wells, East Windsor Hill	2.37	7.37	2.82	28.46	40.00	46.31	4.4
3434	W. J. Barber, Canton	W. J. Barber, Canton	1.17	7.46	2.03	28.37	40.00	44.23	4.7
3435	W. J. Barber, Canton	W. J. Barber, Canton	1.28	6.01	2.94	24.18	35.00	38.11	4.8
3468	Olds & Whipple, Hartford	Eugene Brown, Poquonock	1.04	8.82	2.55	25.82	40.00	43.33	4.8
3414	Olds & Whipple, Hartford	Olds & Whipple, Hartford	.59	7.77	1.53	22.07	35.00	36.67	5.1
3425	L. L. Spencer, Suffield	L. F. Woodworth, Thompsonville	1.04	7.51	2.94	20.44	35.00	35.73	5.3
3573	F. W. Rising, West Suffield	F. C. Root, Suffield	1.22	7.61	3.09	24.62	42.00	40.81	5.7
3704	Eugene Brown, Poquonock	Eugene Brown, Poquonock	.60	6.71	.77	25.83	40.00	39.01	5.7
3465	D. L. Brockett, Suffield	D. L. Brockett, Suffield	.50	6.85	1.41	21.54	36.00	34.59	5.8
3433	Chas. L. Austin, Suffield	F. C. Root, Suffield	1.02	6.08	2.17	21.40	37.00	34.45	6.1
3452	G. H. & J. H. Hale, Glastonbury	S. O. Griswold, Poquonock	1.34	5.67	2.67	20.90	37.00	34.01	6.2
3436	E. S. Clark, Hartford	E. S. Clark, Hartford	.....	4.23	1.81	21.00	33.00	29.74	6.3
3422	A. D. Bridge	W. P. Henry, Scitico	.64	8.22	2.05	17.22	35.00	32.23	6.3
3623	Seth Viets, West Suffield	F. C. Root, Suffield	.74	6.75	2.07	16.02	42.00	29.01	9.5
3622	Seth Viets, West Suffield	F. C. Root, Suffield	.80	5.60	3.00	11.27	36.00	22.63	11.4
3473	J. E. Soper & Co., Boston, Mass.*	Arthur Sikes, Suffield	.24	3.40	1.30	7.02	.....	13.36	.....
3636	J. E. Soper & Co., Boston, Mass.*	Arthur Sikes, Suffield	.93	3.17	1.57	8.67	.....	16.01	.....

* See note on page 106.

Analyses of Unleached Canada Ashes.

	3497	3715	3522	3705	3417	3428	3445	3692	3416	3437	3538	3439	3440	3693	3695	3696
Potash, soluble in water	3.34	4.68	3.59	2.66	4.36	4.36	5.40	5.39	4.92	4.21	4.17	4.30	4.76	4.70	3.14	6.34
Potash, total	...	...	...	4.71	...	...	...	7.46	...	...	5.02	...	...	6.09	3.75	8.15
Phosphoric acid	1.15	1.44	1.05	1.38	1.47	1.03	1.41	.90	1.73	1.00	1.16	...	...	1.41	.83	1.47
Cost per ton	$12.00	10.00*	11.50	11.00*	12.00	12.00	12.00	...	12.00	11.00	11.00	12.00	12.00	12.00	...	11.00

* In car lots.

Notes of Certain Samples.

3705 was bought on agreement that the ashes were to be dry, weighing 40 to 50 pounds per bushel. The actual weight proved to be 85 pounds per bushel.

The full analysis was as follows:

Water	42.29
Sand and silica	2.61
Charcoal	.75
Potash, soluble in water, (mostly carbonate)	1.54
Potash, only soluble in acids, (as silicates)	2.73
Phosphoric acid	.80
Lime, magnesia, oxide of iron, alumina, soda, sulphuric acid, and carbonic acid, not separately determined,	49.28
	100.00

3437 and **3538** were bought on a guarantee of "five per cent. potash." It is seen that while the ashes contain 5.02 per cent. of actual potash, only about 4.2 per cent. is soluble in boiling water. The rest exists in the form of silicates, quite insoluble in water and much less readily available to plants.

3439 and **3440** represent small samples drawn from two places in a car load of ashes, and there is no proof that they represent the average quality of the whole.

Attention is again called to the Station's instructions for sampling ashes. A strict adherence to them is necessary in order to secure a *fair sample*, without which a chemical analysis is worse than useless. These are as follows:

Instructions for Sampling Ashes.

In case of Fertilizers in bulk as Canada Ashes or Cotton Hull Ashes, it is needful that at least 20 or 30 small portions, cupfuls,* be taken from as many different parts of the car load or heap—from its top, center and bottom, and from each end and side. These should be thrown into a clean box or barrel and thoroughly intermixed, *and of this mixture* 1 *quart* should be put in a sealed jar for analysis.

* A shovel may be used if the material is a moist and coherent powder, but in cases of dry and lumpy fertilizers a cup or deep scoop should be used and all heaping, which allows the lumps to roll away from the finer substance, should be avoided.

Ashes must be sampled before exposure to rain or sun as their composition is liable to considerable alteration by such exposure.

The sample *must* be described and its correctness certified on a blank form which the Station will send as requested.

"Fossiliferous Phosphatic Marl."

"Natural Plant Food."

A sample of material, **3747**, bearing this name, was brought to this Station by Alpheus Winter, of Middletown, general agent of The Southern Phosphate Co. of Richmond, Va. The circulars accompanying the sample describe it as phosphatic marl, which is obtained from the valley of the Pamunkey River in Virginia, and is said to be used in that State as a fertilizer with wonderful results.

The Station is informed that it is being introduced here and sold in considerable quantities at $9.75 per ton.

The published analyses of different strata of the marl show from 6.4 to 14.6 per cent. of phosphoric acid and from .35 to 2.66 per cent. of potash. Evidently it is not of very uniform composition.

The sample above referred to had the following composition:

Potash	.23
Lime	8.10
Magnesia	.55
Oxide of iron and alumina	3.81
Sand and silica	68.86
Carbonic acid	5.60
Phosphoric acid	1.69
Sulphuric acid	.76
Water	8.93
Undetermined matters	1.47
	100.00

The Station is informed that this sample represents the average quality of shipments about to be made.

The analysis shows that more than eighty per cent. of the sample consists of sand, silica and moisture, matters of no value whatever in a fertilizer. The phosphoric acid is insoluble in water, and for the most part insoluble in ammonium citrate, and it is probably about as available to plants as that of the phosphatic guanos. The phosphatic and potash-yielding marls have been used with great success in New Jersey and Virginia for years, where they could be had at a cost of very little more than the carting, and were applied in large quantities, and it is likely that many of our soils would respond satisfactorily to heavy applications of this marl.

Whether at the price asked the marl can profitably be used by Connecticut farmers is a question to be settled by practical trials; whether the shipments can be made of uniform quality further analyses must determine.

Phosphatic Marl.

Below are given two analyses of marl; one sample **3685**, taken near the surface, the other, **3686**, six feet below the surface. These were drawn near Richmond, Va., by Capt. J. K. Bucklyn, of Mystic, Conn., and are similar in general character to the marl referred to above, but richer in phosphates.

Analyses.	3685.	3686.
Potash	.49	.52
Soda	.62	.65
Lime	14.39	19.09
Magnesia	.52	.36
Oxide of iron and alumina	5.17	3.61
Sand and silica	60.57	54.26
Carbonic acid	5.20	4.30
Phosphoric acid	5.93	8.99
Sulphuric acid	1.99	2.07
Water	5.12	6.15
	100.00	100.00

Oyster Shell Lime.

3415. Made by H. A. Stevens, 39 South Front street, New Haven. 600 bushels make a car load, 42–45 pounds per bushel. Cost 12 cents per bushel. The ton, of 46 bushels, costs $5.52.

Analysis.	
Insoluble matters	.93
Water (free and combined)	23.17
Carbonic acid	3.85
Lime	69.55
Magnesia	.76
Oxide of iron amd alumina	.58
Phosphoric acid	trace
Sulphuric acid	.72
Undetermined and loss	.44
	100.00

This material has been quite extensively used the last year by tobacco growers and others.

A Soap Factory Refuse.

3697. Regarding this, J. M. Hubbard, of Middletown, writes: "It is produced by Allison Brothers, soap manufacturers. It consists of tankage from their works, mixed with dry ashes to facilitate handling. They make from one to two tons per week, hardly enough to pay for drying and thorough manipulation."

ANALYSIS.

Nitrogen	.84
Soluble phosphoric acid	trace
Reverted phosphoric acid	1.56
Insoluble phosphoric acid	4.12
Potash	1.23
Moisture	28.76

Calculated by the same schedule as commercial fertilizers, its valuation per ton would be $7.87, but owing to its wetness and unfavorable mechanical condition, this valuation is quite too high.

Silk Worm Waste.

3523. A sample of this material from Cheney Brothers, of South Manchester, contained 8.92 per cent. of nitrogen, .48 of phosphoric acid and .40 of potash.

Horn Waste.

3682. A sample, consisting apparently of very thin horn turnings, contained 14.43 per cent. of nitrogen and not more than traces of either potash or phosphoric acid.

Wool Waste.

3683. A sample of waste from "carbonizing" burry wool and camel's hair, from a woolen mill in Naugatuck, sent by M. S. Baldwin. The carbonizing liquor contained oil of vitriol, salt and chloride of aluminum.

The material contains neither phosphoric acid or potash, but 5.50 per cent. of nitrogen. This nitrogen is no doubt almost wholly from the wool, and is only very slowly available.

3721. "Refuse waste and dust from a shoddy mill," sent by Thomas Barrett, Scitico, contains 3.78 per cent. nitrogen.

Tobacco Dust.

3485. Used as an insecticide and fertilizer. Made by H. F. Stoothoff, New York City. Sampled from stock of Olds & Whipple, Hartford, by Station agent.

The sample contained 1.76 per cent. of nitrogen, .52 of phosphoric acid, and 1.76 per cent. of potash.

Muck.

3702, light brown in color, **3703** dark brown, sent by Ira F. Dudley, North Guilford. **3722.** Sent by Ezekiel Reynolds, Stanwich.

ANALYSES.

	3702.		3703.		3722.	
	As received.	Water-free.	As received.	Water-free.	As received.	Water-free.
Water	71.12	---	71.90	---	72.26	---
*Vegetable matter	7.79	26.95	23.45	83.39	19.03	68.57
Oxide of iron and alumina	1.46	5.07	.98	3.47	---	---
Lime	.24	.84	.92	3.25	---	---
Magnesia	.24	.83	trace	trace	---	---
Potash	.06	.21	.03	.11	.04	.14
Soda	.03	.10	.04	.15	---	---
Sulphuric acid	.15	.52	.20	.79	---	---
Phosphoric acid	trace	trace	trace	trace	.06	.20
Sand and silica	18.91	65.48	2.48	8.84	5.62	---
	100.00	100.00	100.00	100.00		
*Containing nitrogen	.25	.86	.35	1.23	.43	1.54

REVIEW OF THE FERTILIZER MARKET.

For the Twelve Months ending December 31, 1892.

Nitrogen.

Nitric Nitrogen.

The *wholesale* New York quotation of nitrogen in nitrate of soda, which was 13.3 cents per pound in December, 1891, opened in January, 1892 at 12.9 and fell gradually, being quoted in May at 10.5 cents. It then rose to 11.1 in July, and since then has risen steadily and rapidly, being 13.7 cents in November and December. This sharp rise is due to the scarcity of nitrate of soda in this country, owing to a limitation of the output by the Chilian manufacturers.

The average *wholesale* quotation for 1892 has been 12.1 cents per pound. The corresponding figures for 1891 and 1890 respectively, were 12.9 and 11.5 cents.

The *retail* ton price of nitrogen in nitrate of soda in this State during the last season has been from 14 to 15½ cents per pound.

Ammonic Nitrogen.

The *wholesale* price in New York of nitrogen in sulphate of ammonia has been quite uniform. The average monthly quotation was 14.7 cents from January till September. It fell to 14.0 cents in October, and has remained at that figure ever since.

The average *wholesale* quotation for the twelve months has been 14.5 cents per pound. The average for the years 1891 and 1890 has been 15.6 cents and 16 cents respectively.

The *retail* price of nitrogen in sulphate of ammonia in Connecticut has been not far from 17½ cents per pound for the whole season.

Organic Nitrogen.

The *wholesale* quotation of nitrogen in high grade Red Blood, which was 12.2 cents per pound in January, fell to 11.5 in March, and since then has risen steadily and in the last months of the year rapidly, being 13 cents in October, 14.1 cents in November, and 14.6 cents in December.

The quotations of nitrogen in black blood, are as a rule, from three-tenths to five-tenths of a cent per pound less.

The average quotation for the whole year has been 12.4 cents per pound for nitrogen in red blood and 12.0 cents in black blood. In 1891 these average figures were 12.3 and 11.7. In 1890 they were 11.8 and 11.3 cents.

Dried blood is seldom met with in the Connecticut retail market. Nitrogen in Azotin was quoted in January and February last at 11.5 cents *wholesale*, from then till September at 11.2, and since then has risen rapidly to 12.6 in October, 13.7 in November, and 14.8 in December. Its average quotation for the year has been 11.9 cents against 11.5 cents in 1891.

Dried Fish Scrap, which is considerably used in mixed fertilizers which was quoted in the earlier months of the year at $23.75 per ton, *wholesale*, rose in October to $24.50, in November to $24.90, and in December to $26.00. The catch of fish this year is said to have been extremely small.

Acidulated Fish Scrap has fluctuated from $12.07 to $15.00, at which latter figure it was quoted in December.

Most of the organic nitrogen sold at *retail* in this State, in unmixed goods, has been in the form of bone and tankage, or in cotton seed meal and castor pomace. As has been shown on page 66 the nitrogen of cotton seed meal has cost at *retail* in this State during the last year from 14.1 cents to 16.3 cents per pound; in castor pomace from 14.7 to 18.12 cents.

Phosphatic Materials.

Refuse Bone Black was quoted at about $18.50 per ton till September, when it began to rise, and was quoted in December at $19.50 per ton.

Rough Bone has fallen during the year from $21.50 to $19.50, and *Ground Bone* also, from $23.25 to $22.25.

Ground Charleston Rock, quoted in January and February at $9.25, has since then been quoted at $8.75.

Acid Phosphate, 14 per cent. available phosphoric acid, was quoted at 73¾c. per unit till August, and since then at 66c. per unit, which is equivalent to 3.7 cents and 3.3 cents per pound for available phosphoric acid at *wholesale*.

The *retail* price in Connecticut of available phosphoric acid in dissolved bone black, as seen on page 68, has been from 5.7 cents to 8.3 cents per pound. Acid phosphate made from Charleston rock, though much cheaper, does not come into our retail market.

POTASH.

Muriate of Potash.

The *wholesale* price of actual potash in this form has advanced during the year from 3.62 cents to 3.78 cents per pound.

It has *retailed* in Connecticut during the year for from 3.9 to 4.7 cents per pound. See page 69.

Double Sulphate of Potash and Magnesia.

The *wholesale* quotation of potash in this form has remained quite constant during the year at 4.77 cents per pound.

It has *retailed* in Connecticut at about 5.7 cents per pound. See page 68.

High Grade Sulphate of Potash.

The *wholesale* New York quotation of potash in this form has remained quite steady at 4.48 cents per pound.

The *retail* price in Connecticut has been from 5.36 to 5.7 cents per pound. See page 68.

Kainit.

The New York *wholesale* quotation has remained steady at \$9.00 per ton during the whole year, at which price the actual *wholesale* cost of the potash would be about 3.7 cents per pound.

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 help in the examination of the market quotations, and will also 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 (or multiply the percentage of ammonia by 14 and divide that product by 17). A "unit of ammonia" is one per cent., or 20 pounds per ton. To illustrate: if a lot of tankage 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 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	\$3.00	per unit is	equivalent to	nitrogen at	18.2	cts. per lb.
"	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	"
"	1.90	"	"	"	11.6	"
"	1.80	"	"	"	11.0	"

Commercial Sulphate of Ammonia contains on an average 20.5 per cent. of nitrogen, though it varies considerably in quality. With that per cent. of nitrogen (equivalent to 24.3 per cent. of ammonia),

At	4	cents per lb.	Nitrogen	costs	19.5	cents per lb.
"	$3\frac{7}{8}$	"	"	"	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	"
"	$2\frac{7}{8}$	"	"	"	14.0	"
"	$2\frac{3}{4}$	"	"	"	13.4	"

Commercial Nitrate of Soda averages 95 per cent. of pure salt or 16.0 per cent. of nitrogen.

If quoted at	3.0	cents per pound,	Nitrogen costs	18.8	cents per lb.
"	2.9	"	" "	18.2	"
"	2.8	"	" "	17.5	"
"	2.7	"	" "	16.9	"
"	2.6	"	" "	16.2	"
"	2.5	"	" "	15.6	"
"	2.4	"	" "	15.0	"
"	2.3	"	" "	14.4	"
"	2.2	"	" "	13.8	"
"	2.1	"	" "	13.2	"
"	2.0	"	" "	12.5	"
"	1.9	"	" "	11.9	"
"	1.8	"	" "	11.3	"
"	1.7	"	" "	10.6	"

Commercial Muriate of Potash and also High Grade, 98 per cent., Sulphate of Potash usually contain 50½ per cent. of actual potash.

If quoted at	2.60	cents per lb.	Actual Potash costs	5.15	cents per lb.
"	2.50	"	" "	4.95	"
"	2 40	"	" "	4.75	"
"	2.30	"	" "	4.55	"
"	2.25	"	" "	4.45	"
"	2.20	"	" "	4.35	"
"	2.15	"	" "	4.25	"
"	2.10	"	" "	4.15	"
"	2.05	"	" "	4.06	"
"	2.00	"	" "	3.96	"
"	1.95	"	" "	3.86	"
"	1.90	"	" "	3.76	"
"	1.85	"	" "	3.66	"
"	1.80	"	" "	3.56	"
"	1.75	"	" "	3.46	"
"	1.70	"	" "	3.36	"

The Double Sulphate of Potash and Magnesia has about 26½ per cent. of actual potash.

If quoted at	1.00	cent per lb.	Actual Potash costs	3.77	cents per lb.
"	1.05	"	" "	3.96	"
"	1.10	"	" "	4.15	"
"	1.15	"	" "	4.34	"
"	1.20	"	" "	4.53	"

The following table shows the fluctuations in the wholesale prices of a number of fertilizing materials in the New York market, since January, 1890. The price given for each month is the average of the four weekly quotations of that month. Sulphate of ammonia is assumed to contain 20.5 per cent. and nitrate of soda 16.0 per cent. nitrogen, and muriate of potash 50½ per cent. of actual potash or 80 per cent. of the pure salt.

Wholesale Prices of Fertilizing Materials.

		Dried Blood.		Cost of Nitrogen at wholesale in			Cost of Potash at wholesale in			
		Red. Cents per pound.	Black or low grade. Cents per pound.	Azotin or Ammonite. Cents per pound.	Nitrate of Soda. Cents per pound.	Sulphate of Ammonia. Cents per pound.	Muriate of Potash. Cents per pound.	Double Manure Salt. Cents per pound.	High Grade Sulphate of Potash. Cents per pound.	Available Phosphoric Acid in Dissolved South Carolina Rock. Cents per pound.
1890.	January	12.4	11.9	12.7	12.1	15.4	3.64	4.44	4.97	4.06
	February	12.4	11.8	12.5	12.0	15.4	3.64	4.44	4.97	4.06
	March	12.1	11.8	12.2	11.9	15.4	3.64	4.44	4.89	4.06
	April	12.0	11.7	12.2	11.2	15.4	3.64	4.42	4.77	4.06
	May	11.9	11.3	12.2	11.2	15.3	3.62	4.42	4.77	4.05
	June	11.9	11.4	12.1	11.2	15.8	3.62	4.42	4.77	4.00
	July	11.9	11.4	12.0	11.2	16.6	3.62	4.42	4.77	3.69
	August	11.6	11.0	11.5	11.0	16.6	3.62	4.42	4.77	3.69
	September	11.3	10.7	11.3	11.1	16.6	3.62	4.42	4.77	3.69
	October	11.4	10.8	11.7	11.6	16.5	3.62	4.42	4.17	3.69
	November	11.5	10.9	11.4	11.6	16.5	3.55	4.27	4.06	3.69
	December	11.5	10.9	11.4	11.6	16.5	3.62	4.53	4.31	3.69
1891.	January	11.0	10.5	11.5	10.9	16.5	3.58	4.53	4.33	3.69
	February	12.0	11.0	11.5	12.5	16.5	3.58	4.53	4.33	3.69
	March	12.5	11.9	11.5	14.3	16.5	3.68	4.53	4.53	3.69
	April	12.4	12.0	11.5	14.4	16.5	3.68	4.53	4.33	3.69
	May	12.3	11.7	11.5	13.6	16.0	3.68	4.53	4.33	3.69
	June	12.3	11.7	11.5	13.2	15.5	3.68	4.53	4.33	3.69
	July	12.2	11.6	11.5	12.2	15.4	3.68	4.53	4.33	3.69
	August	12.3	11.8	11.5	11.3	15.4	3.68	4.53	4.33	3.69
	September	12.3	12.0	11.5	12.2	14.8	3.68	4.53	4.33	3.69
	October	12.3	12.0	11.5	13.6	14.7	3.68	4.53	4.33	3.69
	November	12.6	12.3	11.5	13.5	14.7	3.68	4.53	4.23	3.69
	December	12.4	12.1	11.5	13.3	14.7	3.63	4.63	4.41	3.69
1892.	January	12.2	11.5	11.5	12.9	14.7	3.62	4.79	4.45	3.69
	February	11.6	11.3	11.5	12.0	14.7	3.64	4.77	4.48	3.69
	March	11.5	11.0	11.2	12.1	14.7	3.71	4.77	4.48	3.69
	April	11.8	11.3	11.2	11.0	14.7	3.78	4.77	4.48	3.69
	May	12.0	11.5	11.2	10.5	14.7	3.78	4.77	4.48	3.69
	June	11.7	11.2	11.2	10.6	14.7	3.78	4.77	4.48	3.69
	July	12.1	11.7	11.2	11.1	14.7	3.78	4.77	4.48	3.69
	August	12.3	12.1	11.2	11.7	14.7	3.78	4.77	4.48	3.60
	September	12.4	12.0	12.0	12.4	14.2	3.78	4.77	4.48	3.30
	October	13.0	12.6	12.6	12.9	14.0	3.78	4.77	4.48	3.30
	November	14.1	13.8	13.7	13.7	14.0	3.78	4.77	4.48	3.30
	December	14.6	14.2	14.8	13.7	14.0	3.78	4.77	4.48	3.30

THE BEHAVIOR OF NITROGEN IN THE SOIL.

The following correspondence answers questions which are frequently addressed to the Station, and is therefore of general interest.

A Connecticut farmer writes:—

"I would like you to tell me about how much of the nitrogen a crop of potatoes would get from a fertilizer that contained four per cent., and what would become of what the crop did not use. I would like to ask the same about nitrate of soda, sulphate of ammonia, dried blood and tankage, it being understood that these articles were sown in the drill at the planting time.

In the second place, if ground plaster is mixed with these goods, would the potatoes get any more of the nitrogen than without?

How long after nitrogen in the above forms is put in the ground does it take to so change it that the plant cannot get it, if not used before the change takes place?"

Reply was made as follows:

Your questions cannot be answered very satisfactorily. Under favorable circumstances, most of the nitrogen of quick-acting fertilizers, used in the moderate quantities commonly employed, is taken up by the crops. In drought, the crop does not grow and the fertilizer remains unchanged in the soil. In warm and wet weather some nitrogen leaches out of the soil, and more or less according to the quantity of water which runs off in the drainage, and according to the kind of fertilizer.

In soils where there is free access of air for a good depth, the nitrogen of ammonia and of animal matters, like blood and tankage and of urine, passes more or less rapidly into nitric acid, provided there be present carbonate of lime or other alkaline body to form a nitrate, and provided also there be moderate moisture and a summer temperature. The nitrates thus formed, if not taken up by plants, are freely washed out of the soil by drainage water.

On the other hand, when stable-manure or leaf-mold or grass-roots slowly decay in a wet soil where access of air is imperfect and the temperature low, nitrogen of these and of nitrates, ammonia-salts, blood, etc., passes into a comparatively inactive form like that of swamp-muck. Virgin soil from forest or prairie contains most of its nitrogen in the latter form, which under cultivation (tillage, etc.), is slowly changed into nitrates.

Land long left to grass and natural herbage or in wood, becomes richer in nitrogen; that under tillage, poorer. In the soil of forests there is said to be no nitrates. From drained lands, under tillage, there is considerable annual loss of nitrates, and drained lands in pasture and meadow also lose nitrogen as nitrates, although there is accumulation of nitrogen at the surface in the *humus* (decayed vegetable matter).

What is thus far written is the result of all the trustworthy investigations yet made known, but there is doubtless much more to be learned on these subjects than is now understood.

As to your question—would potatoes get more nitrogen from fertilizers if plaster were mixed with them, it may be said that so far as known, plaster would have no influence in case of nitrate of soda or sulphate of ammonia. When tankage, blood or urine begin to change in the soil under the moist warmth of spring time, they at first yield carbonate of ammonia—the same as one may smell in the air of a warm horse stable. The process of nitrification is checked by too much alkali. Plaster and carbonate of ammonia in the presence of water become carbonate of lime and sulphate of ammonia, neither of which oppose nitrification. It may be that this effect is favorable in the soil, especially when the fertilizer is sown in the hill or drill and not thoroughly mixed with earth, but water enough to *wet* the soil would be essential to the result.

OBSERVATIONS ON THE GROWTH OF MAIZE CONTINUOUSLY ON THE SAME LAND.

In the years 1888 and 1889 a parcel of land containing $1\frac{1}{5}$ acres was dressed with commercial fertilizers and planted to corn. The fertilizers and crops were analyzed, and the exhaustion or enrichment of the soil by the dressing and cropping accurately determined.

In 1890 this land was divided into four strips, each containing three tenths of an acre, and dressed as shown in the accompanying diagram. Corn was planted in drills which were four feet apart, and the stalks stood ten inches apart in the drill. The crop from each plot was separately weighed and analyzed. The same thing was repeated in 1891 and the results with full particulars of the method of planting, cultivating and harvesting are given in the Report of this station for 1891, pages 139, 149.

The same work has been repeated this year, 1892, with the same variety of seed, and under like conditions of planting, cultivating and harvesting as far as it was possible.

It is not necessary to rehearse these particulars, as they have been fully described in the Report already referred to.

The land was plowed May 5, 1892, planted May 24, the crop was cultivated June 11, July 2, and again late in July. It was cut Sept. 19, husked, weighed and harvested Oct. 25.

South.

Plot A.—Cow Manure at the rate of 10 cords per acre.

Plot B.—Hog Manure at the rate of $13\frac{1}{2}$ cords per acre.

Plot C.—Fertilizer Chemicals at the rate of 1700 pounds per acre.

Plot D.—No manure or fertilizer of any kind.

North.

Table I presents the gross weight of field cured kernels, cobs and stover on the several plots.

Inasmuch as the kernels were air-dried on the cob, the weight of the latter in the field-cured condition could not be ascertained. The weight therefore of the kernels in the table is slightly higher and that of the cobs correspondingly lower than it should be. But the error is insignificant.

TABLE I.—GROSS YIELD OF THE PLOTS IN POUNDS PER ACRE.

	Plot A Cow manure.	Plot B Hog manure.	Plot C Chemicals.	Plot D No fertilizer.
Kernels	4858.7	5637.8	4864.4	2230.1
Cobs	515.8	688.0	714.7	237.4
Stover	5545.5	6274.2	4291.2	2662.5
	10920.0	12600.0	9870.3	3130.0

DRY SUBSTANCE OF THE CROPS IN POUNDS PER ACRE.

A strict comparison of yields can only be made on the water-free substance, since the field-cured crops contain large and variable quantities of water. Such a comparison is given below in Table II.

TABLE II.—DRY MATTER OF THE CROPS, POUNDS PER ACRE.

	In kernels.	In cobs.	In stover.	Total.
Plot A, cow manure	3018.3	460.7	3701.6	7180.6
Plot B, hog manure	3501.7	614.4	4116.5	8232.6
Plot C, fertilizer chemicals	3564.6	638.2	2858.7	7061.5
Plot D, no fertilizer	1592.3	212.0	1704.9	3509.2

YIELD OF EACH FOOD INGREDIENT, IN POUNDS PER ACRE.

From Table IV, given further on, and from the gross weights of the crops, has been calculated Table III, which shows how many pounds of each food ingredient were harvested in the kernels, the cobs and the stover separately, and how much in all together.

The cobs were not analyzed, but as their total weight was comparatively small, and as their composition is not likely to vary widely, the average composition of cobs, as determined in other analyses, was applied for the calculation.

DIFFERENCES IN CHEMICAL COMPOSITION OF CROP CAUSED BY DIFFERENCES IN FERTILIZATION.

Table IV gives the analyses of kernels and stover from the four plots, both in the field-cured and water-free condition. The latter serves best for comparison.

TABLE III.—YIELD OF EACH FOOD INGREDIENT IN POUNDS PER ACRE.

	Plot A.				Plot B.				Plot C.				Plot D.			
	Kernels.	Cob.	Stover.	Total.	Kernels.	Cob.	Stover.	Total.	Kernels.	Cob.	Stover.	Total.	Kernels.	Cob.	Stover.	Total.
Water	1840.4	55.1	1843.9	3739.4	2136.1	73.6	2157.7	4367.4	1299.8	76.5	1432.4	2808.7	637.8	25.4	957.6	1620.8
Ash	46.1	7.2	237.3	290.6	54.7	9.6	267.3	331.6	49.1	10.0	170.7	229.8	20.5	3.3	90.8	114.6
Albuminoids	352.2	12.4	222.4	587.0	421.7	16.5	284.2	722.4	394.5	17.1	176.8	588.4	155.7	5.7	110.5	271.9
Fiber	46.6	155.3	1206.1	1408.0	54.1	207.1	1329.5	1590.7	61.8	215.1	953.9	1230.8	28.3	71.5	559.1	658.9
Nitrogen-free extract	2409.2	283.2	1978.1	4670.5	2779.4	377.8	2175.3	5332.5	2873.4	392.4	1516.1	4781.9	1309.3	130.3	918.5	2358.1
Fat	164.2	2.6	57.7	224.5	191.8	3.4	60.2	255.4	185.8	3.6	41.2	230.6	78.5	1.2	26.0	105.7
	4858.7	515.8	5545.5	10920.0	5637.8	688.0	6274.2	12600.0	4864.4	714.7	4291.1	9870.2	2230.1	237.4	2662.5	5130.0

TABLE IV.—ANALYSES OF FIELD-CURED MAIZE KERNELS AND STOVER FROM PLOTS A, B, C, D.

PLOT.	ANALYSIS OF FIELD-CURED MAIZE.						ANALYSIS, CALCULATED WATER-FREE.				
	Water.	Ash.	Albuminoids.	Fiber.	Nitrogen-Free Extract. (Starch, Gum, etc.)	Fat.	Ash.	Albuminoids.	Fiber.	Nitrogen-Free Extract. (Starch, Gum, etc.)	Fat.
KERNELS.											
A.	37.87	.95	7.25	.96	49.59	3.38	1.53	11.67	1.54	79.83	5.43
B.	37.89	.97	7.48	.96	49.30	3.40	1.56	12.04	1.55	79.38	5.47
C.	26 72	1.01	8.11	1.27	59.07	3.82	1.37	11.05	1.74	80.62	5.22
D.	28.60	.92	6.98	1.27	58.71	3.52	1.29	9.80	1.78	82.21	4.92
STOVER.											
A.	33.25	4.28	4.01	21.75	35.67	1.04	6.40	6.00	32.60	53.45	1.55
B.	34.39	4.26	4.53	21.19	34.67	.96	6.50	6.93	32.28	52.82	1.47
C.	33.38	3.98	4 12	22.23	35.33	.96	5.97	6.18	33.36	53.05	1.44
D.	35.97	3.41	4.15	20.99	34.50	.98	5.32	6.48	32.77	53.90	1.53

Quantities of Nitrogen, Phosphoric Acid and Potash applied in the Manure or Fertilizer and Removed by the Crop.

The manure used, which was made from the same kind of feed and of animals as in 1890, was not analyzed again in 1891 or 1892, but was assumed to have the same composition as in the previous year.

In Table V are given, first, the total quantities of nitrogen, phosphoric acid and potash which have been applied to the land in the years 1888, 1889, 1890 and 1891, in excess of the quantities removed by the crops of those years, then second, the quantities applied in 1892, third, the quantities removed by the maize crop of 1892, and fourth, the quantities of these ingredients added in five years in excess of what was removed by the five crops, marked [+], or the quantities of each removed by the crops in excess of what was supplied in fertilizers, marked [−].

The larger quantity of phosphoric acid and smaller quantity of potash in excess on Plot B as compared with A is explained by differences in the feed of the cattle which made the manure used. The cows ate large quantities of hay and stover, relatively rich in potash while the hogs had phosphates in the bones which came in garbage, but potash in the food was relatively small in quantity.

So heavy an application as 13½ cords per acre of this hog manure while supplying nitrogen and phosphoric acid in very great excess of the quantity which the crop removes, supplied this year less potash than the corn crop removed.

Yields of "Shelled Corn," and Percentage Composition of Dry Matter for Five Years.

Table VI shows the largest crops of dry matter, reckoned to the acre, which were harvested in 1888 and 1889 and their percentage composition, together with all crops from drills in 1890 and from Plots A, B, C, D in 1891 and 1892 calculated to an acre. The rows were four feet apart in all four years.

The plots marked A were on cow manure, B were on hog manure, C on commercial fertilizers, and D had no fertilizer in the years 1890, 1891 and 1892.

Table V.—Enrichment or Impoverishment of Soil by Five Years' Manuring and Cropping.

	Cow Manure. Plot A.			Hog Manure. Plot B.			Fertilizer Chemicals. Plot C.			No Fertilizer. Plot D.		
	Nitrogen.	Phos. acid.	Potash.	Nitrogen.	Phos. acid.	Potash.	Nitrogen.	Phos. acid.	Potash.	Nitrogen.	Phos. acid.	Potash.
After four years' cropping	+302.1	+340.2	+330.5	+550.7	+1219.9	+72.3	+106.2	+403.8	+92.2	−183.6	+97.1	−10.8
Applied in 1892	286.3	136.4	204.5	419.9	586.5	72.4	172.0	162.0	69.0	00.0	00.0	00.0
Taken off in Crop of 1892	93.9	29.6	94.6	115.6	40.0	101.3	94.1	29.1	65.3	43.5	14.6	18.5
Leaving in excess (+) or deficiency (−) after five years' cropping	+494.5	+447.0	+410.4	+855.0	+1766.4	+43.4	+184.1	+536.7	+95.9	−227.1	+82.5	−29.3

TABLE VI.—YIELD OF DRY MATTER AND "SHELLED CORN" PER ACRE FOR FOUR YEARS AND COMPOSITION OF DRY MATTER.

	Year.	Distance of Planting.	Yield of Dry Matter per Acre.	Bushels of Sound Shelled Corn.	Percentage Composition of Dry Matter: Ash.	Albuminoids.	Fiber.	Nitrogen-free Extract.	Fat.
Fertilized alike	1888	Stalks 12 inches apart,	7350	75	3.3	7.8	19.4	66.1	3.4
	1888	" 6 " "	7980						
	1889	" 12 " "	6144	60	3.5	6.1	21.7	69.7	3.0
	1889	" 6 " "	6352						
On Cow Manure	1890A	" 10 " "	9014	91	4.0	7.9	19.8	65.7	2.6
On Hog Manure	1890B	" 10 " "	9436	97	4.2	8.0	19.6	65.5	2.7
On Fertilizer Chemicals	1890C	" 10 " "	8070	87	3.9	8.0	21.2	64.4	2.5
No Manure or Fertilizer	1890D	" 10 " "	6626	51	3.8	6.2	20.7	66.7	2.6
On Cow Manure	1891A	" 12 " "	8176	103	3.2	7.5	15.5	70.2	3.6
On Hog Manure	1891B	" 12 " "	7599	89	3.3	7.6	16.2	69.3	3.6
On Fertilizer Chemicals	1891C	" 12 " "	6708	70	3.2	6.4	18.5	68.8	3.1
No Manure or Fertilizer	1891D	" 12 " "	5391	60	3.1	6.0	17.4	70.2	3.3
On Cow Manure	1892A	" 12 " "	7181	72	4.0	8.2	19.6	65.1	3.1
On Hog Manure	1892B	" 12 " "	8233	84	4.0	8.8	19.3	64.8	3.1
On Fertilizer Chemicals	1892C	" 12 " "	7062	86	3.2	8.3	17.5	67.8	3.2
No Manure or Fertilizer	1892D	" 12 " "	3509	38	3.3	7.7	18.8	67.2	3.0

As it is customary to judge of a maize crop by the yield of "shelled corn" in bushels, the yields have also been calculated in this way with the results given in the fourth column of the table. In this calculation twenty per cent. has been added to the weight of water-free kernels for the water in corn cured enough to shell and 50 pounds have been assumed as the weight of such shelled corn per bushel.

Further discussion of the results here tabulated is reserved till more data are gathered as each year's cropping adds to their interest and value.

ANALYSES OF CREAMERY AND PRIVATE DAIRY BUTTER.

The samples whose analyses are given below were taken from the Exhibit made at the meeting of the Connecticut Dairymen's Association, at Hartford, Jan. 19, 1892.

They represent all the butter which was there exhibited.

The samples were scored by the judges on the following scale:

Perfection requires,	Flavor	50 points.
	Grain	25
	Color	15
	Salt	5
	Package or appearance	5
		100

The scores and chemical analyses are given on page 131.

A sample of Ayrshire butter not entered in competition, had the following composition:

Water	9.12
Salt	3.52
Curd	1.30
Fat	86.06
	100.00

From these analyses, with those given in the Report for 1891, numbering 17 in all, is calculated the average composition of creamery butter. From the 22 analyses of Private Dairy butter is also calculated its average composition as follows:

	Creamery Butter. Average.	Creamery Butter. Range of Composition.	Private Dairy Butter. Average.	Private Dairy Butter. Range of Composition.
Water	**10.08**	6.5—12.8	**10.87**	8.2—15.2
Salt	**3.17**	2.1— 4.8	**3.39**	.7— 2.5
Curd	**1.14**	.9— 1.6	**1.29**	1.2— 7.8
Fat	**85.61**	82.0—88.4	**84.45**	80.7—87.7
	100.00		**100.00**	

Creamery Butters.

Number:	2	1	14	13	9	12	6	4	11	10	8
Score —											
Flavor	45.6	45.2	47.3	45.9	45.6	45.0	45.1	45.3	45.1	45.7	43.6
Grain	23.6	27.0	23.0	22.0	23.1	22.0	22.3	21.9	21.8	19.7	22.7
Color	14.5	13.0	13.0	14.2	12.7	14.0	13.4	13.4	13.5	13.4	12.0
Salt	4.8	4.0	4.5	4.0	4.7	4.5	4.4	4.5	4.4	4.6	4.4
Package	4.8	4.0	4.6	4.7	4.5	4.5	4.7	4.4	4.6	4.6	4.7
	93.3	93.2	92.4	90.8	90.6	90.0	89.7	89.5	89.4	88.0	87.4
Chemical Analysis:											
Water	11.49	10.60	9.18	12.22	11.56	9.04	10.33	12.83	8.55	9.96	10.97
Salt	3.95	3.70	3.72	4.77	2.94	2.37	2.19	3.99	2.23	3.28	3.35
Curd	1.02	1.24	1.13	1.06	1.08	1.10	1.03	1.12	1.48	1.37	1.12
Fat	83.54	84.46	85.97	81.95	84.42	87.49	86.45	82.06	87.74	85.39	84.56
	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00

Private Dairy Butters.

Number:	1	9	5	6	12	7	11	3	2	4	8
Score —											
Flavor	45.0	44.6	41.6	40.4	44.0	43.0	36.0	36.0	36.6	35.0	31.0
Grain	23.4	23.6	21.6	22.2	19.0	21.6	23.8	24.0	22.2	21.6	16.8
Color	14.4	14.0	14.0	13.6	12.8	10.4	14.8	12.2	14.8	9.2	11.6
Salt	4.6	4.6	4.6	3.8	4.4	4.0	3.4	4.4	3.4	5.0	4.8
Package	4.6	4.8	4.8	4.8	4.2	4.8	3.8	5.0	4.4	4.2	4.4
	92.0	91.6	86.6	84.8	84.4	83.8	81.8	81.6	81.4	75.0	68.6
Chemical Analysis:											
Water	11.37	9.56	8.62	12.44	8.24	13.33	15.23	9.91	10.94	12.10	8.64
Salt	1.90	2.38	3.46	4.22	3.96	2.55	3.44	2.72	3.07	1.81	3.19
Curd	1.03	.70	1.81	.90	1.27	1.55	.99	.80	.92	1.02	1.00
Fat	85.70	87.36	86.11	82.44	86,53	82.57	80.34	86.57	85.07	85.07	87.17
	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00

PROTEIDS OF THE FLAXSEED.

Abstract of a Paper published in the American Chemical Journal, vol. 14, pp. 629–661.

By Thomas B. Osborne.

The extensive use, as a cattle-food, of flaxseed partly freed from oil by expression or extraction, under the name of linseed-meal, renders desirable as complete a knowledge as possible of its chemical composition. As the chief value of this feed is due to the large amount of albuminoids contained in it, a careful study of these bodies is important from a practical as well as from a scientific standpoint.

Although extended search has been made, the writer has nowhere found any investigation relating to the proteids contained in this seed. A study of these proteids was accordingly undertaken, the results of which are here briefly stated.

Ground flaxseed, freed from oil by extraction with benzine or ether, yields to both water and solutions of sodium chloride, a large proportion of its proteid matter. After complete exhaustion with water, 10-per cent. sodium chloride brine extracts a further portion of proteids. Neither water nor salt solution removes all the proteids, for there always remains in the extracted residue more or less proteid soluble in dilute potash-water, as well as some nitrogenous substance, probably proteid, which the alkali fails to remove.

Flax Globulin.—Of the substance soluble in water or sodium chloride solution as well as of that taken up directly by dilute potash-solution, a very large part is a globulin which has been separated in a crystalline form and prepared, it is believed, in a state of purity.

The composition of this globulin is shown by the following analyses of ten distinct preparations obtained under different conditions.

Flax Globulin.

Extracted by water at 20°.

	1	2	3
Carbon	51.42	----	51.69
Hydrogen	7.06	----	----
Nitrogen	18.61	18.74	18.70
Sulphur	0.76	----	0.73
Oxygen	22.15	----	-- --
	100.00		

Extracted by salt solution.

	After water at 20°. 4	After water at 40°. 5	Direct. 6	Direct. 7
Carbon	51.17	51.46	51.32	51.59
Hydrogen	6.90	6.94	6.87	7.27
Nitrogen	18.95	18.41	18.60	18.34
Sulphur	0.88	0.99	0.82	22.80 (Sulphur and Oxygen)
Oxygen	22.10	22.29	22.39	
	100.00	100.00	100.00	100.00

Extracted by $\frac{2}{10}$ per cent. potash solution.

	Prep. 6 dissolved in potash and precipitated. 8	9	10	Average. 1-10
Carbon	51.67	51.53	51.50	51.48
Hydrogen	6.92	6.94	6.95	6.94
Nitrogen	18.79	18.45	18.37	18.60
Sulphur	0.82	0.73	23.18 (Sulphur and Oxygen)	0.81
Oxygen	21.80	22.35		22.17
	100.00	100.00	100.00	100.00

These results agree so closely with the analyses of the globulin obtained from squash-seed, that there can be no doubt that the two proteids are identical. This agreement is shown by the following figures:

	Flax Globulin.	Squash-seed Globulin.		
	Osborne.	Chittenden and Hartwell.*	Ritthausen.†	Grübler.‡
Carbon	51.48	51.60	51.61	51.48
Hydrogen	6.94	6.97	7.00	6.76
Nitrogen	18.60	18.80	----	18.14
Sulphur	0.81	1.01	----	0.96
Oxygen	22.17	21.62	----	22.66
	100.00	100.00		100.00

In pure distilled water at 20° this proteid, whether separated from solution by cooling or by dialysis, is wholly insoluble, while in water at 40° it is very slightly soluble. In 10 per cent. sodium chloride solution it is mostly soluble, a part (Weyl's "albuminate") generally remaining undissolved, which, however, dissolves readily on warming the solution and partly separates, on cooling, in very finely developed crystals. In glycerin diluted with water the substance separated by dialysis is wholly insoluble, either at 20° or 40°; while the substance separated from a warm sodium chloride solution is largely soluble at 20°.

* J. Physiol. **11**, 440. † J. prakt. Chem. **25**, 136. ‡ J. prakt. Chem. **44**, 369.

It dissolves easily in $\frac{2}{10}$ per cent. potash solution and is thrown down by exact neutralization, without change of composition or properties.

This Globulin, when separated by dialysis, dissolves in 10 per cent. sodium chloride brine to a solution which on heating gives successively three minute coagula of other globulins at 67°, 80° and 88° respectively.

Saturation with sodium chloride gives a small precipitate which consists partly of these other globulins, for the filtrate from this precipitate, when diluted so as to contain 10-per cent. of sodium chloride, yields but a trace of coagulum on heating to boiling, while the precipitate itself dissolved in 10-per cent. sodium chloride yields a solution which coagulates at the various tempertures observed in the solution before saturation.

Saturation with ammonium sulphate and also with magnesium sulphate completely precipitates this proteid from its solutions.

Flax Albumin.—After separating the globulin by dialysis and filtration, the clear liquid can be heated to boiling without producing a coagulum, but if concentrated to a small volume a coagulation gradually takes place. If the dialysed liquid be treated with about 2 per cent. of sodium chloride, and a little hydrochloric acid be added, a precipitate is produced consisting of a proteid resembling an albumin in its solubility in water but like a globulin in that, when precipitated by salt and acid, it forms an acid compound soluble in water nearly or wholly free from salts. On the other hand it is thrown out of such solutions upon neutralization with sodium carbonate.

FLAX-ALBUMIN.

Carbon	50.14
Hydrogen	6.72
Nitrogen	17.54
Sulphur / Oxygen	25.70
	100.00

Similar substances to the foregoing were found in the extracts of the maize kernel and in Chittenden and Osborne's paper* on the proteids of that seed, were described as albumins.

Flax Proteose.—Together with this albumin there is precipitated more or less proteose, resembling closely in composition the deuterovitellose obtained by Chittenden and Hartwell from the crystallized proteid of the squash-seed.† After separating the coagulable proteids by concentrating their solution to a small volume and filtering, there was always found in the filtrate more or less proteoses and peptones which were separated from solution by precipitation with alcohol.

* Am. Chem. Jour., **13**, 453, 529; **14**, 20. † J. Physiology, **11**, 435.

The mixture of these substances was very readily soluble in water to a solution which, when saturated with ammonium sulphate while hot, and filtered, gave a strong red biuret-reaction, and no precipitate with copper sulphate, thus showing the presence of peptones. This was observed in all of the five preparations examined. The aqueous solution was precipitated by copper sulphate, gave a precipitate with nitric acid which dissolved on heating and reappeared on cooling, and a precipitate with ammonium sulphate. These reactions show the presence of proteoses.

The composition of the proteose and that of the deuterovitellose, obtained by Chittenden and Hartwell, by artificial digestion of the squash-seed globulin with pepsin, are as follows:

	FLAXSEED PROTEOSE.	SQUASH VITELLOSE.	
Carbon	49.98	50.42	49.27
Hydrogen	6.95	6.74	6.70
Nitrogen	18.78	18.43	18.78
Sulphur / Oxygen	24.29	24.41	25.25
	100.00	100.00	100.00

The composition of the peptone and that of a small amount of proteid extracted by potash-water after exhausting flax-meal with sodium chloride solution, could not be determined.

THE AMOUNT OF THE VARIOUS PROTEIDS SEPARATED FROM THE FLAXSEED.

The results of this investigation, thus far recorded, show that the extracts of the flaxseed contain a globulin precipitable by dialysis; a proteid, resembling both globulin and albumin, precipitable by long continued heating at 100°, as well as by sodium chloride in the presence of acid; proteose and peptone-like bodies, and a proteid not extracted by sodium chloride solution, but soluble in dilute potash-water.

All attempts to determine the amounts of these various substances failed because of their change, while in solution, into non-proteid bodies. The relative amounts of the various proteids that could be separated were very variable and it is almost certain that the more soluble forms were largely, if not wholly, derived from the globulin in consequence of its alteration during extraction and separation. These operations were in all cases greatly prolonged on account of the gum contained in the seed, which rendered filtration extremely difficult and slow. Putrefaction, however, was entirely prevented by the use of thymol. Numerous attempts were made to determine the total proteid-nitrogen in the seed, but in no case did the nitrogen extracted and recovered in the proteid precipitates, added to that in the extracted residue, equal the total nitrogen contained in the flaxseed meal.

This may be illustrated by the following figures: 100 grams of flaxseed meal, containing 8.40 per cent. of nitrogen, were extracted, first with water, then with 10-per cent. sodium chloride solution and, finally, with $\frac{2}{10}$ per cent. potash-water. Out of 8.4 grams of total nitrogen 0.4255 gram remained in the residue of the seed, showing that 94.94 per cent. of the total nitrogen was soluble in the reagents employed. The nitrogen extracted by potash-water amounted to 2.15 per cent. of the total, so that by water and by sodium chloride solution 92.79 per cent. of the total nitrogen was extracted. The nitrogen recovered from these solutions amounted to but 38.59 per cent. of the total, accordingly the nitrogen lost equaled 4.5528 grams, or 54.2 per cent. This loss must have been due either to the presence of non-proteid nitrogenous substances, or to a decomposition of the proteid matter into diffusible compounds.

A careful examination of the seed failed to detect any non-proteid nitrogenous compounds, but it was found that during dialysis of solutions of the proteids here described, nitrogenous substances continuously and slowly separated which gave none of the usual proteid reactions. In this way a very large proportion of the proteid nitrogen was lost.

When flaxseed meal was directly extracted with dilute potash-water, 32.74 per cent. of the meal was obtained in the form of a precipitated proteid, on neutralizing the solution. The insoluble residue of the meal further yielded nitrogen equivalent to 8.0 per cent. of proteid reckoned as globulin.* The nitrogen of the neutralization precipitate was equivalent to 29.4 per cent. of globulin. The sum of these would be 37.4 per cent. of the meal.

The results of this investigation, already given, show that the

* With 18.6 per cent. of nitrogen.

globulin and the body extracted by dilute potash are the only proteids found in the extract which are precipitated from an alkaline solution on neutralization. Therefore these two proteids must be the only ones contained in the precipitate. If we assume that the proteids in the flax-seed have, on the average, 18 per cent. of nitrogen, the meal extracted in this case would contain 48.0 per cent. of proteids. The 37.4 per cent. thus accounted for amounts to 78.0 per cent. of the total proteids.

This would indicate that the globulin formed at least four-fifths of the proteid matter of the seed.

It is exceedingly desirable to determine as accurately as possible the amount of each proteid contained in the seed, and to know exactly its nitrogen content so that an accurate factor may be obtained for calculating the proportion of proteids from the nitrogen found.

It is evident from the preceding statements that it is impossible to say exactly what this factor should be for flax-seed, but a pretty close approximation can be made—one at least far more accurate than the factor at present in use based on a content of 16 per cent. of nitrogen. It has been shown that about 93 per cent. of the nitrogen of the seed is extracted by salt solutions. This nitrogen belongs chiefly to the globulin which contains 18.6 per cent. of nitrogen. The albumin-like body was found to contain 17.5 per cent. of nitrogen, and the proteose prepared in a pure state contained in one case 18.78 per cent. and in another 18.33 per cent. of nitrogen. If, then, we assume the proteids to contain collectively an average of 18.00 per cent. of nitrogen we will not be very far from the truth. The factor then for flax-seed would be 5.55 instead of 6.25, and, for a sample of linseed meal containing 7 per cent. of nitrogen, would give a content of proteid of 38.85 per cent. instead of 43.75—a difference of very considerable magnitude.

CRYSTALLIZED VEGETABLE PROTEIDS.

Abstract of a Paper published in the American Chemical Journal, vol. 14, pp. 662–689.

BY THOMAS B. OSBORNE.

The existence of crystallised proteids in seeds was pointed out by Hartig in 1855. Four years later, Maschke obtained hexagonal plates of proteid matter by extracting Brazil-nuts with water heated to 40°–50° and evaporating the filtered extract at 40°. Nägeli* investigated the crystal-like forms from the Brazil-nut as well as the artificially produced crystals of Maschke and concluded that they differed in some respects from true crystals. He therefore designated them as "crystalloids."

Sachsse† following Maschke's method, and also by precipitating the aqueous extract with carbonic acid, obtained several preparations of proteid from the Brazil-nut, which he analysed. These preparations were, however, not composed of distinct crystals, but of small discs.

Schmiedeberg‡ obtained crystallized products by treating the aqueous extract of the Brazil-nut with carbon dioxide, washing the precipitated proteid, digesting the precipitate with magnesia suspended in water at 35°, filtering and evaporating at the same temperature. These crystals he considered to be a compound of the proteid with magnesia.

Drechsel‖ obtained crystals, presumably hexagonal plates, by submitting the solution containing the "magnesia compound," prepared as Schmiedeberg suggested, to dialysis in a vessel containing alcohol.

Drechsel afterwards obtained finely developed crystals by allowing a warm sodium chloride solution saturated with the proteid of the Brazil-nut to cool slowly.§

At Drechsel's suggestion Grübler applied this method with some modification to the proteids of squash-seed, and made a large number of preparations of perfectly formed octahedral crystals whose properties and composition he described at length.¶

* Botanische Mittheilungen (München, 1863), vol. 1.

† Die Farbstoffe, Kohlenhydrate und Proteinsubstanzen (Leipzig, 1877), p. 315.

‡ Ztschr. physiol. Chem., **1**, 205.

‖ J. prakt. Chem., **19**, 331.

§ Grübler: *cf. ibid.*, **23**, 100.

¶ J. prakt. Chem., **23**, 97.

Ritthausen* obtained crystallised preparations from the castor-bean, hemp-seed, and sesame-seed, which separated from a warm sodium chloride solution on cooling in the form of regular octahedrons. The composition and properties of the crystals obtained from the hemp-seed and castor-bean he described in a subsequent paper.†

The writer next prepared rhombohedral and octahedral crystals from the oat-kernel by cooling a warm dilute sodium chloride solution saturated with the proteid.‡

The writer has also obtained octahedral crystals from flax-seed by extracting with a solution of sodium chloride and dialysing the filtered extract; the proteid separating in well-formed crystals as the salts were removed.‖

The fact that these proteid substances can be artificially crystallised is not only interesting in itself, but is important as presumably furnishing a means for making preparations of undoubted purity which will afford a sure basis for further study of their properties. The contradictory statements made by the various investigators, not only in regard to properties and composition of these bodies but also in respect to the value of the methods of solution and separation which have been employed hitherto, render an exact knowledge of all the facts relating to these substances a matter of the highest scientific and practical importance.

An examination of the literature indicates that definitely crystallised preparations from the Brazil-nut have never been analyzed, and also shows that the published analyses do not agree sufficiently to fix the composition of the substance.

Ritthausen's observations on the properties of the crystallised proteids of the hemp-seed and castor-bean indicate that they are closely related to, if not identical with, the body obtained by Grübler from the squash-seed; yet the results of Ritthausen's analyses differ widely from those first made by Grübler.

The composition of the crystallised proteid of the squash-seed has been fixed within narrower limits by the analyses of Chittenden and Hartwell,§ Ritthausen,¶ and Grübler.** It seemed desirable, therefore, that the composition and properties of the

* J. prakt. Chem., **23**, 481.

† *Ibid.*, **25**, 130.

‡ Report Conn. Agri. Expt. Station 1890, and Am. Chem. J., **13**, 408; **14**, 212.

‖ Am. Chem. J., **14**, 329, 629.

§ J. of Physiology, **11**, 435.

¶ J. prakt. Chem., **25**, 137.

** *Ibid.*, **44**, 369.

various crystallised proteids should be investigated anew in order to determine the relations of these substances.

As the writer has already prepared crystallised products from the oat-kernel and flax-seed, he determined to reinvestigate the similar bodies obtainable from the Brazil-nut, hemp-seed, castor-bean and squash-seed, and a summary of the results of this investigation are here given.

I. The crystallised globulins of the Brazil-nut and of the oat-kernel are distinct substances. Their composition is seen from the following analyses:

	Brazil-nut.	Oat-kernel.
Carbon	52.18	52.18
Hydrogen	6.92	7.05
Nitrogen	18.30	17.99
Sulphur	1.06	0.53
Oxygen	21.54	22.34
	100.00	100.00

If the differences in nitrogen- and sulphur-content are not perhaps sufficient to distinguish these two proteids, their reactions prove them to be distinct, for when prepared in the same manner they are unlike in many respects.

In distilled water heated to 60° the globulin of the Brazil-nut is wholly insoluble, while that of the oat-kernel dissolves completely. Saturation of a 10-per cent. sodium chloride solution of these substances with salt almost completely precipitates the proteid of the oat-kernel, that of the Brazil-nut being unaffected. Saturation of similar solutions with magnesium sulphate precipitates but little of the Brazil-nut, but all of the oat-globulin. When solutions of these bodies in 10-per cent. sodium chloride brine are heated, the Brazil-nut globulin begins to separate at 70°, a flocculent coagulum forming at 84°, which increases on raising the temperature to boiling, the proteid being largely, but not wholly, precipitated. The globulin of the oat-kernel, on the other hand, is not coagulated at all by boiling.

II. The crystalline globulins of the hemp-seed, castor-bean, squash-seed, and flax-seed are almost identical in composition, as may be seen by comparing the analyses:

	Hemp-seed.	Castor-Bean.	Squash-seed.	Flax-seed.
Carbon	51.28	51.31	51.66	51.48
Hydrogen	6.84	6.97	6.89	6.94
Nitrogen	18.84	18.75	18.51	18.60
Sulphur	0.87	0.76	0.88	0.81
Oxygen	22.17	22.21	22.06	22.17
	100.00	100.00	100.00	100.00

The carbon content of the hemp and castor globulins is less than that of the squash and flax globulins by about 0.25 per cent., a difference too slight to have importance, if it were not constant for almost all the preparations analysed. The deportment of these globulins toward reagents is also very similar, but in this respect the hemp and castor globulins show slight differences from those of the squash and flax-seed; the two former are, however, almost exactly alike, and the two latter likewise closely agree together. The following table plainly exhibits these relations:

HEAT COAGULATIONS.

	Hemp.	Castor.	Squash.	Flax.
Turbidity	75°	87°	--	67°
Flocks	86	89	--	80
Filtered,				
Turbidity	88	87	87	90
Flocks	95	95	95	96
Filtered,				
Boiling	no coagulum.	ditto.	ditto.	ditto.
Filtered and acetic acid added,	heavy pp.	ditto.	ditto.	ditto.

SOLUBILITY.*

	Hemp.†		Castor.		Squash.	Flax.	
	A.	B.	A.	B.	A. B.	A.	B.
H_2O at 20°	P.	I.	P.	I.	I.	I.	I.
H_2O at 40°	S.	I.	S.	I.	I.	P.	I.
Glycerine at 20°	S.	I.	S.	I.	I.	P.	I.
Glycerine at 50°	S.	I.	S.	I.	I.	P.	I.
10-per cent. NaCl sol. diluted	Pp.	Pp.	Pp.	Pp.	Pp.	Pp.	Pp.
Saturated with NaCl	T. pp.	T. pp.	T. pp.	T. pp.	No Pp.	V.	V.
Saturated with $MgSO_4$,	C. pp.	C. pp.	C. pp.	C. pp.	C. pp.	C. pp.	C. pp.

* P. = Partly soluble; I. = Insoluble; S. = Soluble; Pp. = Precipitate; T. pp. = Trace of precipitate; C. pp. = Completely precipitated; V. = Very little precipitate.

† A. indicates preparations obtained by cooling warm salt solutions; B. those obtained by dialysis.

The proteids coagulating at the lower temperature are traces of other globulins imperfectly separated from the crystalline globulin. The coagulum separating at the higher temperature is undoubtedly a part of the crystalline globulin which is broken up when heated to this temperature. It is seen that the temperature at which this coagulum separates is the same for all four substances.

In solubility these four proteids are very nearly alike, the most noticeable difference being that the globulins of the hemp-seed and castor-bean, when separated from a warm sodium chloride solution, are soluble in water and diluted glycerin, while the other preparations, both of this substance and the globulins of other seeds, are insoluble under the same conditions.

Of the flax-seed globulin separated from a warm salt solution, a little dissolves in water at 40°.

The small precipitate obtained by saturating a sodium chloride solution of the globulins with salt, undoubtedly consists mostly of traces of other globulins.

It is at present impossible to assert that these four globulins are the same, but since differences exist between different preparations of globulin from the same seed as great as those found among the globulins of these different seeds, the writer is disposed to consider these four globulins as identical.

PROTEIDS OF THE WHEAT-KERNEL.

Abstract of a Paper nearly ready for publication.

By Thomas B. Osborne and Clark L. Voorhees.

The proteids contained in the wheat-kernel are:

I. A *Globulin* belonging to the class of vegetable vitellins, soluble in saline solutions, precipitated therefrom by dilution and also by saturation with magnesium sulphate or ammonium sulphate but not by saturation with sodium chloride. Partly precipitated by boiling, but not coagulated at temperatures below 100°. The wheat-kernel contains between 0.6 and 0.7 per cent. of this globulin. When dried at 110° its composition was found to be as follows:

Wheat Globulin.

Carbon	51.03
Hydrogen	6.85
Nitrogen	18.39
Sulphur	0.69
Oxygen	23.04
	100.00

II. An *Albumin*, coagulating at 52°, which differs from animal albumin in being precipitated on saturating its solutions with sodium chloride or with magnesium sulphate, but not precipitated on completely removing salts by dialysis in distilled water. It was found to form between 0.3 and 0.4 per cent. of the wheat-kernel and to have the following composition when separated from solution in the coagulated form by heating to 60° C.

Wheat Albumin.

Carbon	53.02
Hydrogen	6.84
Nitrogen	16.80
Sulphur	1.28
Oxygen	22.06
	100.00

III. A *Proteose*, precipitated (after removing the globulin by dialysis, and the albumin by coagulation), by saturating the solution with sodium chloride or by adding 20 per cent. of sodium chloride and acidifying with acetic acid. This body was not analysed in its unaltered form. On concentrating its solutions by boiling, a coagulum was gradually developed which formed about 0.3 per cent. of the wheat-kernel and had the following composition :

COAGULUM.

Carbon	51.86
Hydrogen	6.82
Nitrogen	17.32
Sulphur } Oxygen }	24.00
	100.00

The solution filtered from the substance just described, still contained a proteose-like body which was not obtainable in a pure state. Its amount could only be roughly estimated by precipitating the concentrated filtrate from the preceding substance with alcohol, and multiplying the nitrogen contained in the precipitate by 6.25. The amount of this proteose was from 0.2 to 0.4 per cent. of the seed. Both these substances are unquestionably derivatives of some other proteid in the seed, presumably the proteose first mentioned.

IV. *Gliadin*, soluble in dilute alcohol and forming about 4.25 per cent. of the seed. It has the following composition :

GLIADIN.

Carbon	52.72
Hydrogen	6.86
Nitrogen	17.66
Sulphur	1.14
Oxygen	21.62
	100.00

This is the proteid called gliadin by Taddei and plant-gelatin by Dumas and Cahours. Mixed with impurities or altered to a greater or less extent by the processes of separation, it has been described by Ritthausen under the names of gluten-fibrin, plant-gelatin, or gliadin, and mucedin, and by Martin has been termed insoluble phytalbumose. The mucin of Berzelius and of De Saussure were impure preparations consisting chiefly of this proteid. It is soluble in distilled water to opalescent solutions which are precipitated by adding a very little sodium chloride. It is completely insoluble in absolute alcohol, but slightly soluble in 90-per cent. alcohol, and very soluble in 70 to 80-per cent. alcohol and is precipitated from these solutions on adding either much water or strong alcohol, especially in the presence of much salts. Soluble in very dilute acids and alkalies and precipitated from these solutions by neutralization, unchanged in properties and composition. This proteid is one on which the formation of gluten largely depends.

V. *Glutenin*, a proteid insoluble in water, saline solutions and dilute alcohol which forms the remainder of the proteids of the wheat-kernel, generally about 4. to 4.5 per cent. of the seed. This substance is soluble in dilute acids and alkalies and is precipitated from such solutions by neutralization. Dissolved in $\frac{2}{10}$ per cent. potash water, precipitated by neutralization and, after thorough extraction with alcohol and ether, again dissolved in potash water, the solution filtered *clear*, precipitated by neutralization and dried at 110°, it has the following composition :

GLUTENIN.

Carbon	52.34
Hydrogen	6.83
Nitrogen	17.49
Sulphur	1.08
Oxygen	22.26
	100.00

Unless prepared as above described the impurities are not removed and the analyses are discordant. This proteid was first described by Taddei under the name of zymom. Liebig as well as Dumas and Cahours named it plant-fibrin. Ritthausen called it gluten-casein, Weyl and Bischoff considered it to be an albuminate form of a myosin-like globulin. Martin named it gluten-fibrin and likewise considered it to be an albuminate form of a myosin-like globulin.

VI. Wheat-gluten is composed of gliadin and glutenin. Both these proteids are necessary for its formation. The gliadin with water forms a sticky medium, which by the presence of salts is prevented from becoming wholly soluble. This medium binds together the particles of flour, rendering the dough and gluten tough and coherent. The glutenin imparts solidity to the gluten, evidently forming a nucleus to which the gliadin adheres and from which it is consequently not washed away by water. Gliadin and starch mixed in the proportion of 1 to 10 form a dough, but yield no gluten, the gliadin being washed away with the starch. The flour freed from gliadin gives no gluten, there being no binding material to hold the particles together, so that they may be brought into a coherent mass.

Soluble salts are also necessary in forming gluten, as in distilled water gliadin is readily soluble. In water containing salts it forms a very viscid semi-fluid mass, which has great power to bind together the particles of flour. The mineral constituents of the seeds are sufficient to accomplish this purpose, for gluten can be obtained by washing a dough with distilled water.

VII. No ferment action occurs in the formation of gluten, for its constituents are found in the flour having the same properties and composition as in the gluten, even under those conditions which would be supposed to completely remove antecedent proteids, or to prevent ferment action. All the phenomena which have been attributed to ferment action are explained by the properties of the proteids themselves, as they exist in the seed and in the gluten.

ANALYSES OF FEEDING STUFFS.

The following analyses of feeding stuffs have been made at this Station within the last two years:

Cotton Seed Meal.

3110. Sampled from stock on sale in Middletown.

3148. Sampled and sent by T. J. Stroud.

3409. Made by Charlotte Oil & Fertilizer Co., Charlotte, N. C. Sent by H. S. Lathrop, Suffield.

3726. Sold by Thomas A. Shaw, Hartford. Sent by W. H. Olcott, South Manchester.

3408. "Cotton Seed Feed." Made by the Charlotte Oil & Fertilizer Co. "Claimed to be a complete food for cattle and sheep. Twenty-five pounds a day said to be sufficient for a cow or steer with no other food. Price one-half that of cotton seed meal." Sent by H. S. Lathrop, Suffield.

Linseed Meal.

3359. Made by Detroit Linseed Oil Works. Sent by T. A. Stanley, New Britain. Cost in 1891, $24.00 per ton in car lots delivered in Connecticut.

3718. The same delivered in 1892. Cost $24.90 per ton in car lots delivered.

3142. Marked "Pure Ground Oil Cake." Bought of Taylor & Richards, Westport. Sampled by E. C. Birge, Southport. Cost $30.00 in 1891.

3143. The same, but marked "Linseed Meal." Cost $30.00 in 1891.

3725. Bought of Thomas A. Shaw, Hartford. Sent by W. H. Olcott, South Manchester. Cost $31.00 in January, 1893.

Cream Gluten.

3363. Made by Chas. Pope Glucose Co., Geneva, Ill. Sold by Smith, Northam & Robinson, Hartford, September, 1891. Sent by T. J. Stroud, Shaker Station.

Gluten Feed and Gluten Meal.

3536. Gluten Meal. Bought in East Hartford. Sent by W. H. Olcott, South Manchester. Cost by single bag (100 pounds), $1.40.

3716. Buffalo Gluten Feed. Sent by T. A. Stanley, New Britain. Cost $23.50 per ton in car lots delivered in Connecticut.

3728. Buffalo Gluten Feed. Bought of Stephen Hurd for $1.15 per 100 pounds. Sent by M. H. Wetmore, Winchester.

3736. Buffalo Gluten Feed. Made by American Glucose Co., Buffalo, N. Y. Sent by F. M. Bartholomew, East Wallingford. Cost $1.15 per 100 pounds.

3727. Chicago Gluten Meal. Bought of N. Bennett, West Winsted, for $1.25 per 100 pounds. Sent by M. H. Wetmore, Winchester. Messrs. C. M. Cox & Co., sales agents for Buffalo Gluten Feed claim that the three samples above noted do not fairly represent the quality of the article.

Wheat Feeds.

3717. Spring Bran, bought of James Lincoln, Berlin. Cost December, 1892, $16.25 per ton in car lots, delivered. Sent by T. A. Stanley, New Britain.

3719. Acme Bran, bought by Noble Bennett, New Britain. Cost $17.00 per ton in car lots, delivered. Sent by T. A. Stanley.

3720. Acme Bran, from Dakota. Bought of Levi Wells. Cost $17.00 per ton in car lots, delivered. Sent by T. A. Stanley.

3729. Middlings, bought of N. Bennett, West Winsted, for $1.15 per 100 pounds. Sent by M. Wetmore, Winchester.

3405. Fine White Wheat Middlings, used in feeding experiment at the Webb farm.

3737. Shorts, bought of Wilder & Puffer, Springfield, for $16.35 per ton in car lots, delivered. Sent by T. J. Stroud, Shaker Station.

3706. "Mixed Feed," made by Acme Milling Co. and sold by J. M. Williams, Manchester, at $21.00 per ton. Said to be the entire waste in the process of making fine flour. Sent by W. H. Olcott.

Oat Feed.

3124. Sent by B. F. Case, Canton Center. Cost $30.00 per ton in March, 1891.

3724. Sold J. M. Williams, Manchester, for $25.00 per ton in December, 1892. Sent by W. H. Olcott, South Manchester.

Miscellaneous Feeds.

3421. Western Corn Meal, sent by N. S. Baldwin, Meriden.

3420. "Corn and Cob Meal," ground by N. S. Baldwin, from Eastern grown corn.

3117. Hominy Feed. Sent by F. H. Stadtmueller, Elmwood.

3510. Kiln-dried Starch Feed, costing $20.00, sent by E. A. Bradley, Centerville.

3147. Buffalo Kiln-dried Sugar Meal. Bought of American Glucose Co., Buffalo, N. Y., for use in feeding experiments.

3401. Malt Sprouts, bought of E. A. Talcott, Harwinton, for $20.00 per ton, January, 1892, by Henry Von Tobel, Harwinton.

3464. Buckwheat Flour. Sent by Theron F. Griswold, Little Haddam.

With the analyses are given for comparison the average composition of most of the feeds named as determined from a considerable number of analyses formerly made at American Experiment stations.

The comparison of the composition of "Western Corn Meal" with corn and cob meal made from sound Connecticut-grown corn shows the latter to be much drier, and to contain half a per cent. less albuminoids, but half a per cent. more fat, six per cent. more fiber, and one and eight tenths per cent. less of starchy matter.

There is nothing in the chemical analysis to indicate a decided difference in feeding value between the two.

Analyses of Feeding Stuffs.

			Analysis.						Analysis, Calculated Water-Free.				
			Water.	Ash.	Protein.	Fiber.	Nitrogen-Free Extract, (Starch, Gum, etc.)	Fat.	Ash.	Protein.	Fiber.	Nitrogen-Free Extract. (Starch, Gum, etc.)	Fat.
Cotton Seed Meal,	from Middletown.	**3110**	8.23	7.62	44.50	4.38	25.77	9.50	8.3	48.5	4.8	28.1	10.3
	T. J. Stroud.	**3148**	9.43	7.52	41.12	6.07	29.93	5.93	8.3	45.4	6.7	33.1	6.5
	H. S. Lathrop.	**3409**	7.47	6.29	44.24	9.64	23.12	9.24	6.8	47.8	10.4	25.0	10.0
	T. A. Shaw.	**3726**	-----	-----	40.06	-----	-----	-----	-----		-----	-----	-----
Average Composition,		----	**8.20**	**7.20**	**42.30**	**5.60**	**23.60**	**13.10**	**7.8**	**46.1**	**6.1**	**75.8**	**14.2**
Cotton Seed Feed, half hulls and half meal,		**3408**	8.86	2.87	17.81	24.52	42.99	2.95	3.2	19.4	26.9	47.2	3.3
Linseed Meal,	T. A. Stanley.	**3359**	11.34	5.53	36.72	-----	-----	3.43	6.2	41.4	-----	-----	3.9
	T. A. Stanley.	**3718**	9.33	5.53	36.75	8.25	34.91	5.23	6.1	40.5	9.1	38.6	5.7
	E. C. Birge.	**3142**	10.92	5.54	35.69	7.50	33.05	7.30	6.1	40.1	8.4	37.2	8.2
	E. C. Birge.	**3143**	10.40	5.68	35.43	7.75	34.26	6.48	6.4	39.6	8.7	38.2	7.1
	W. H. Olcott.	**3725**	-----	-----	31.25	-----	-----	-----	-----	-----	-----	-----	-----
Old Process, Average Composition.		----	**9.20**	**5.70**	**32.90**	**8.90**	**35.40**	**7.90**	**6.3**	**36.2**	**9.7**	**39.2**	**8.6**
New Process, Average Composition,		----	**10.10**	**5.80**	**33.20**	**9.50**	**38.40**	**3.00**	**6.5**	**36.9**	**10.5**	**42.8**	**3.3**
Cream Gluten,	T. J. Stroud.	**3363**	8.98	.75	38.19	1.34	34.99	15.75	.9	42.0	1.4	38.4	17.3
Gluten Meal,	W. H. Olcott.	**3536**	-----	-----	24.06	-----	-----	-----	-----	-----	-----	-----	-----
Buffalo Gluten Meal,	T. A. Stanley.	**3716**	8.93	.70	24.06	5.79	48.82	11.70	.8	26.5	6.4	53.5	12.8
	M. H. Wetmore.	**3728**	7.85	.79	21.65	7.62	51.84	10.25	.9	23.5	8.2	56.2	11.2
	F. M. Bartholomew.	**3736**	7.79	.78	23.56	7.85	48.88	11.14	.9	25.6	8.5	53.0	12.0
Chicago Gluten Meal,	M. H. Wetmore.	**3727**	7 15	1.07	25.90	5.24	48.98	11.66	1.2	27.9	5.6	52.7	12.6
Wheat Feed, Spring Bran	T. A. Stanley.	**3717**	9.56	5.68	16.19	9.93	53.04	5.60	6.3	18.0	11.0	58.5	6.2
Acme Bran,	T. A. Stanley.	**3719**	9.86	5.90	17.75	7.15	54.39	4.95	6 5	19.8	8.0	60.2	5.5
Acme Bran,	T. A. Stanley.	**3720**	9.68	5.66	19.56	7.10	52.30	5.70	6.3	21.6	7.9	57 9	6.3
Bran, Average Composition.		----	**11.90**	**5.80**	**15.40**	**9.00**	**53.90**	**4.00**	**6.6**	**17.4**	**10.2**	**61.3**	**4.5**
Middlings,	M. H. Wetmore.	**3729**	9.44	4.40	18.57	6.22	56.12	5.25	4.9	20.5	6.9	61.9	5.8
Fine Middlings,	Station.	**3405**	9.54	-----	19.25	3.44	-----	4.23	-----	21.3	3.8	-----	4.7
Middlings, Average Composition,		----	**12.10**	**3.30**	**15.60**	**4.60**	**60.40**	**4.00**	**3.8**	**17.8**	**5.2**	**68.7**	**4.5**
Shorts,	T. J. Stroud.	**3737**	10.77	6.06	16.94	9.44	51.50	5.29	6.8	19.0	10.6	57.7	5.9
Mixed Feed,	W. H. Olcott.	**3706**	12.55	5.27	17.25	7.10	53.15	4.68	5.9	19.8	8.1	60.8	5.4

Analyses of Feeding Stuffs—(Continued.)

			Analysis.						Analysis. Calculated Water-Free.				
			Water.	Ash.	Protein.	Fiber.	Nitrogen-Free Extract. (Starch, Gum, etc.)	Fat.	Ash.	Protein.	Fiber.	Nitrogen-Free Extract. (Starch, Gum, etc.)	Fat.
Oat Feed,	B. F. Case.	**3134**	8.23	4.13	17.87	7.60	55.37	6.80	4.5	19.5	8.3	60.3	7.4
	W. H. Olcott.	**3724**	6.68	3.94	16.86	8.18	56.66	7.68	4.2	18.0	8.8	60.7	8.3
Average Composition,			**7.70**	**3.70**	**16.00**	**6.10**	**59.40**	**7.10**	**4.0**	**17.3**	**6.6**	**64.4**	**7.7**
Western Corn Meal,	N. S. Baldwin.	**3421**	18.02	1.05	9.18	1.49	67.18	3.08	1.2	11.2	1.8	82.0	3.8
Average Composition,*			**15.00**	**1.40**	**9.20**	**1.90**	**68.70**	**3.80**	**1.6**	**10.8**	**2.2**	**81.0**	**4.4**
Corn and Cob Meal,	N. S. Baldwin.	**3420**	13.65	1.45	8.56	7.42	65.34	3.58	1.7	9.9	8.6	75.7	4.1
Average Composition,			**15.10**	**1.50**	**8.50**	**6.60**	**64.80**	**3.50**	**1.7**	**10.0**	**7.8**	**76.4**	**4.1**
Hominy Feed,	F. H. Stadtmueller.	**3117**	12.95	2.54	10.81	3.70	61.90	8.10	2.9	12.4	4 3	71.1	9.3
Average Composition,			**11.10**	**2.50**	**9.80**	**3.80**	**64.50**	**8.30**	**2.8**	**11.0**	**4.3**	**72.6**	**9.3**
Kiln-dried Starch Feed,	E. A. Bradley.	**3510**	9.24	.63	17.06	5.65	59.04	8.38	.7	18.8	6.2	65 1	9.2
Buffalo Kiln-dried Sugar Meal,	Station.	**3147**	11.45	1.22	21.82	5.17	49.21	11.13	1.4	24.6	5.8	55.6	12.6
Malt Sprouts	H. Von Tobel.	**3401**	12.91	6.19	23.13	11.58	44.81	1.38	7.1	26.6	13.3	51.5	1.5
Average Composition,			**10.20**	**5.70**	**23.20**	**10.70**	**48.50**	**1.70**	**6.3**	**25.8**	**11.8**	**54.2**	**1.9**
Buckwheat Flour,	T. F. Griswold.	**3464**	15.18	.92	5.63	.50	76.94	.83	1.1	6.6	.6	90.7	1.0
Average Composition,			**14.60**	**1.00**	**6.90**	**.30**	**75.80**	**1.40**	**1.2**	**8.0**	**.4**	**88.8**	**1.6**

* 77 analyses of corn meal from all localities.

EXAMINATION OF THE SEED OF ORCHARD GRASS,

Dactylis glomerata.

This species is one of the best meadow grasses. It roots deeply and is less affected by drought than most other grasses, it grows better in the shade than timothy or red-top and is earlier in bloom, it is believed to be more permanent than timothy on land suited to it and gives large crops. If cut before full bloom the hay is nutritious and not coarser or more strawy than timothy.

But little orchard grass is grown in this State. Many who have tried it have either failed to get a good catch or have got a catch altogether too good of grasses other than orchard grass, notably of meadow fescue, *Festuca pratensis*, perennial rye grass, *Lolium perenne*,—perennial only in name—and chess or cheat, *Bromus secalinus*. This fescue is a good meadow grass, but rye-grass and chess are very inferior or worthless.

The failures made in sowing orchard grass and the consequent indifference to it are largely to be explained by the quality of seed which is offered in market. To learn the state of the trade, this Station has examined six samples of seed bought by farmers of seedsmen in this State and six samples purchased in Boston and five in New York. The results of the botanical analyses and germination tests are given in the following table. The per cents of different seeds found in the samples are by *weight* and not by number. No attempt was made to identify other seeds than those named in the table. Many seeds were immature and the duplicate sprouting tests did not in some cases agree closely, but that the conditions of the tests were suitable is shown by the fact that good mature seed sprouted freely in the testing apparatus. Four tests were made of each of the samples from A to G and two tests of each of the others. The highest result in each case is given in the table. The last column of the table is prepared by multiplying the per cent. of pure orchard grass seed by the per cent. of this pure seed that is capable of sprouting and dividing the product by 100.

The result of this examination may be summarized as follows:

1. Of the 17 samples of Orchard grass seed purchased in New York, Boston, and at various places in Connecticut, one sample contained as much as 98.8 per cent. of pure seed the remainder being chaff.

Another contained no orchard grass seed whatever, and consisted mainly of Lolium perenne, or perennial rye-grass.

Excluding this sample the other 16 samples contained on the average 77.4 per cent. of pure seed.

2. Seven out of sixteen samples contained notable quantities, from 8.3 to 35.5 per cent., of seed of perennial rye-grass, Lolium perenne, which is less valuable and sells at a lower price. "Tested" Orchard grass seed is quoted at 11 cents per pound and "tested" perennial rye grass at 4½ cents. A single sample contained 14.1 per cent. of a species of Bromus, probably secalinus or chess.

3. In one sample as high as 88 per cent. of the orchard grass seed sprouted, in another as low as 4.5 per cent. and on the average of 16 samples 50.0 per cent.

4. Taking the 16 samples together, the average quantity of pure orchard grass seed which was capable of sprouting was 40 per cent.; i. e. out of every 100 pounds bought, 40 pounds was pure, live seed. Probably the quantity that would produce healthy plants was less than this.

EXAMINATION OF ORCHARD GRASS SEED FROM THE CONNECTICUT, BOSTON, AND NEW YORK MARKETS.

Mark.	Botanical Analysis.					1000 seeds weigh grams.	Sprouting Test.	
	Orchard Grass.	Meadow Fescue.	Perennial Rye.	Bromus.	Other Seed, Chaff and dirt.		Per cent. sprouting.	Per cent. of pure seed in sample capable of sprouting.
A	58.6	----	20.5	----	20.9	.666	41.0	**24.0**
B	69.6	----	----	14.1	16.3	.571	27.5	**19.1**
C	76.1	2 5	8.3	----	13.1	.773	43.0	**32.7**
D	67.2	4.7	8.9	----	19.2	.537	32.5	**21.8**
F	94.7	----	----	----	5.3	.621	40.5	**38.4**
G	43.9	----	23.1	----	33.0	.535	36.0	**15.8**
I	92.9	----	----	----	7.1	.729	54.5	**50.6**
J	87.8	----	----	----	12.2	.495	42.5	**37.3**
K	60.3	----	----	----	29.7	.588	44.0	**26.5**
L	88.2	----	----	----	11.8	.838	79.0	**69.7**
M	none.	----	----	----	----	----	----	**none.**
N	65.7	----	31.4	----	2.9	.609	4.5	**3.0**
O	98.8	----	----	----	1.2	.902	35.0	**34.6**
P	92.0	----	----	----	8.0	.555	88.0	**81.0**
Q	97.7	----	----	----	2.3	.740	76.5	**74.7**
R	81.6	----	15.7	----	2.7	.745	77.0	**62.8**
S	62.7	----	35.5	----	1.8	.779	82.5	**51.7**

It is very likely that rye grass is sometimes added as a "make-weight," and it may easily escape detection in a casual examination, but it often grows with orchard grass, and when the two kinds of seed are harvested together it is impossible by mechanical means to separate them.

Moreover, the trade seed of orchard grass even when pure is known to have a low germinating power both abroad and in this country, so that 30 to 35 pounds per acre of it make only moderate seeding.

The table of analyses shows however that it is still possible, if one will take pains enough and pay enough, to get quite clean seed of this grass of which over 60 per cent. will germinate.

A part of the trouble with the seed market is that while the best seed is naturally the most expensive, cheap seed is always the most popular.

The sample P represents seed for which there is absolutely no market in its pure state; it is too good for the trade and is mixed again for sale with inferior and less "expensive" seed.

It is obvious however that as compared with sample A, sample P is by far the more economical. In the first place a pound of P will produce more than three times as many plants of orchard grass as A. Again A will seed the land with some rye grass which is quite inferior to orchard grass. And lastly the catch of grass from the A seed will probably be poor, and very likely so poor that the land will have to be re-seeded. In this case it may lie idle for six months or a year and confirm the owner in the idea that orchard grass is not worth a trial.

To any one in the State desiring them, a few seeds each of Orchard grass, Perennial rye grass and Meadow Fescue will be sent by the Station to aid in their identification.

ASH ANALYSIS OF WHITE GLOBE ONIONS.

From several barrels of White Globe Onions grown at Green's Farms were selected twenty-two bulbs of fair size which weighed five pounds and one ounce.

After drying and pulverizing them, a weighed sample of the powdered material was burned with the usual precautions and the ash submitted to analysis with the following results:

Per cent. Composition of the Pure Ash.

[Station No. 3005.]

Potash	43.49
Soda	1.26
Lime	10.87
Magnesia	4.46
Oxide of iron	1.07
Phosphoric Acid	19.08
Sulphuric Acid	15.98
Chlorine	2.36
Sand and Silica	1.96
	100.53
Deduct oxygen equivalent to chlorine	.53
	100.00

The fresh onions contain .27 per cent. of nitrogen and .48 per cent. of pure ash.

From these data are calculated the quantities of these ingredients contained in one ton (2000 pounds), of onions as follows:

Nitrogen and Mineral Matter in One Ton of Onions (Bulbs).

Nitrogen	2.70	pounds.
Phosphoric Acid	.92	"
Potash	2.09	"
Soda	.06	"
Lime	.52	"
Magnesia	.21	"
Oxide of Iron	.05	"
Sulphuric Acid	.77	"
Chlorine	.11	"
Sand and Silica	.09	"

ANALYSES OF SOME AMERICAN CHEESES.

During the last few years a marked advance has been made in this country in the methods of cheese making, and there is scarcely one of the celebrated foreign cheeses that is not closely imitated in the United States. On page 157 are given analyses of eighteen samples of cheese, all of which, except the sample of Roquefort, are of American manufacture. The methods used for the analyses are essentially those described in the U. S. Dep't. Ag., Div. of Chem., Bull. 35, page 224. A description of the samples follow.

3754. Full cream cheese. Made by the Lebanon Cheese Co., Lebanon, Conn.

3755 and **3756.** Purchased in New Haven for 16 cents per pound. These represent fairly the kind of cheese most commonly sold in our market.

3757. Full cream cheese, old. Bought in New Haven.

3758–3761. Pineapple cheese from E. Norton, Goshen, Conn. The Goshen factory is the oldest in the United States, and the pineapple cheese has a wide reputation.

3762 and **3763.** Skim milk cheese. Bought in New Haven, 12 cents per pound.

3764. Neufchatel. Small cheeses wrapped in tin foil. Sell for 5 cents apiece.

3765. Fromage de Brie. Said to be made in Orange Co., N. Y.

3766. Imitation Old English cheese. 20 cents per pound. Bought in New Haven.

3767. Swiss ["Schweitzer"]. 20 cents per pound. Bought in New Haven.

3768. Cream cheese. Crown Brand. 25 cents apiece. Bought in New Haven.

3769. Limburger. Bought in New Haven.

3770. A cheese resembling pineapple in texture, made by J. Hohlridge, West Burlington, N. Y. Sample received from Hon. T. S. Gold, West Cornwall.

3771. Roquefort. Imported. 50 cents per pound. Bought in New Haven.

ANALYSES OF CHEESE.

Station No.		Water.	Ash, excluding Salt.	Salt.	Protein (N X 6¼).	Fat.	Organic Acids and other matters by difference.	Volatile Fatty Acids in 2.5 grams Fat.*
3754	Full cream (Lebanon)	34.88	2.64	1.32	23.06	35.10	3.00	----
3755	" "	36.75	3.64		23.19	35.12	1.30	14.0
3756	" "	35.67	2.63	1.19	24.00	34.74	1.77	15.1
3757	Full cream, old	29.87	2.80	.99	28.31	35.62	2.41	----
3758	Pineapple, yellow, 4 months old	30.95	3.29	2.34	27.00	33.26	2.16	13.4
3759	" white, 8 "	28.01	2.96	2.14	27.12	37.25	2.52	14.6
3760	" yellow, 16 "	25.69	3.57	2.61	28.81	36.76	2.56	12.6
3761	" " 5 years old	11.62	4.02	1.86	34.45	45.20	2.75	13.8
3762	Skim milk	52.15	2.45	1.70	26.31	15.35	2.04	16.5
3763	"	53.08	3.09	1.22	26.81	13.80	2.00	14.7
3764	Neufchatel	57.25	1.06	1.42	15.03	22.30	2.94	13.4
3765	Fromage de Brie	60.20	1.13	.40	15.94	20.96	1.37	16.2
3766	Imitation Old English	20.74	3.68	1.47	30.12	42.72	1.27	15.8
3767	Swiss	33.79	3.22	1.85	26.12	33.25	1.77	----
3768	Cream, Crown Brand	31.40	.45	2.72	5.25	57.98	2.20	----
3769	Limburger	42.12	1.59	3.51	23.00	29.40	.38	14.6
3770	Cheese made by J. Hohlridge	18.66	3.76	1.38	32.16	41.80	2.24	----
3771	Roquefort	39.28	1.53	5.27	22.62	29.53	1.77	9.1

* Volatile fatty acids were determined by Reichert's method in 2.5 grams of the ether extract. The figures represent cubic centimeters of $\frac{1}{10}$ normal potash solution required to neutralize the volatile acids. The small quantity of volatile fatty acids found in Roquefort is probably to be explained by the decomposition of fats during the peculiar ripening process.

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