STATE OF CONNECTICUT.

ANNUAL REPORT

OF

The Connecticut Agricultural

EXPERIMENT STATION

For 1883.

PRINTED BY ORDER OF THE LEGISLATURE.

NEW HAVEN:
TUTTLE, MOREHOUSE & TAYLOR, PRINTERS.
1884.

OFFICERS

OF

The Connecticut Agricultural Experiment Station,

1883.

STATE BOARD OF CONTROL.

Ex-officio.

HIS EXC. THOMAS M. WALLER, *President.*

	Term expires
Appointed by Connecticut State Agricultural Society:	
HON. E. H. HYDE, Stafford, *Vice-President.*	July 1, 1885.
Appointed by Board of Trustees of Wesleyan University:	
PROF. W. O. ATWATER, Middletown.	1885.
Appointed by Board of Agriculture:	
T. S. GOLD, West Cornwall.	1886.
Appointed by Governor and Senate:	
EDWIN HOYT, New Canaan.	1886.
JAMES J. WEBB, Hamden.	1884.
Executive Committee. — *Appointed by Governing Board of Sheffield Scientific School:*	
W. H. BREWER, New Haven, *Secretary and Treasurer.*	1884.
Ex-officio.	
S. W. JOHNSON, New Haven, *Director.*	

Chemists.

E. H. JENKINS, PH.D., *Vice Director.*
E. H. BOGARDUS.
C. A. HUTCHINSON, B.S.
E. H. FARRINGTON, B.S.
MILTON WHITNEY.

In charge of Buildings and Grounds.

CHARLES J. RICE.

ANNOUNCEMENT.

THE CONNECTICUT AGRICULTURAL EXPERIMENT STATION was established in accordance with an Act of the General Assembly, approved March 21, 1877, "for the purpose of promoting Agriculture by scientific investigation and experiment."

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

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

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

All other work proper to the Experiment Station that can be used for the public benefit will be made without charge. Work done for the use of individuals will be charged for at moderate rates. The Station will undertake no work, the results of which are not at its disposal to use or publish, if deemed advisable for the public good. See p. 17.

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

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

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

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

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

AGRICULTURAL EXPERIMENT STATION,
NEW HAVEN CONN.

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

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

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REPORT OF THE BOARD OF CONTROL.

To the General Assembly of the State of Connecticut:

GENTLEMEN:—The Board of Control of THE CONNECTICUT AGRICULTURAL EXPERIMENT STATION herewith submits to your Honorable Body the Annual Reports of the Director and of the Treasurer, made to the Board at its Annual Meeting, held in Hartford, January 15th, 1884.

During the year the work of the Station has been carried on at its new quarters, which were already occupied and nearly ready for chemical work on the date of the previous annual meeting of the Board. The chemical laboratory was ready a few weeks later and has been in continuous use since. This use has confirmed the expectations of the Board as to its special adaptation to the work for which it was planned. The repairs and improvements on the place went on, however, until mid-summer.

The Building Committee have still eleven hundred sixty-one (1161) dollars of the special appropriation on hand. They report that the visible needs of the Station exceed this small sum, and they have therefore delayed expending it until the coming year, by which time the experience of the Station will decide which of the several needs are the most imperative, and how the balance can be most advantageously used.

The people of the State use the Station more and more each year and the problem becomes more difficult, how to best do the varied work asked for: and to facilitate the administration of the Station affairs in the new and enlarged quarters, the Board of Control has appointed Dr. Jenkins Vice Director.

THOMAS M. WALLER,
President.

WM. H. BREWER,
Secretary.

REPORT OF THE TREASURER.

WM. H. BREWER, *in account with The Connecticut Agricultural Experiment Station, Jan. 17th to Nov. 30th, 1883.*

RECEIPTS.

Balance from account of 1882	$1,673.68
State Treasurer (from Annual Appropriation)	6,000.00
Licenses for sale of Fertilizers and Fees for Analyses	2,443.30
Other receipts	8.55
	$10,125.53

PAYMENTS.

Salaries	$5,244.98
Laboratory Expenses	2,565.01
Furniture and repairs on house	299.67
The Grounds and Establishment	454.72
Fuel	311.50
Water	132.00
Gas	150.30
Insurance	39.50
Collecting Fertilizers	70.61
Traveling Expenses of Board of Control	19.11
Printing	202.10
Stationery	62.42
Postage	108.55
Telephone	107.55
Library	70.15
Miscellaneous Sundries	283.92
Cash balance on hand	3.44
	$10,125.53

WM. H. BREWER, *Treasurer.*

MEMORANDUM.

There is due the Station two hundred thirteen (213) dollars for analyses made in the laboratory; and an inventory of laboratory apparatus, office furniture, chamber furniture, books and publications on hand, Nov. 30th, 1883, is valued at two thousand four hundred and ninety-six (2,496) dollars.

The previous reports of the treasurer have covered fiscal years ending with the date of the annual meeting of the Board of Control, on the third Tuesday of January of each year. The above account is for the period embraced between the previous annual meeting of the Board of Control and the close of the fiscal year of the State of Connecticut. Hereafter the fiscal year of the Station will conform to that of the State.

Of the special appropriation "for the purpose of buying a lot and erecting thereon buildings, and equipping the same for the permanent use of the Station," there has been expended during the period above indicated, three thousand twenty-nine dollars and ninety-six cents ($3,029.96), leaving a balance of eleven hundred sixty-one (1,161) dollars in my hands for the completion of the work projected.

WM. H. BREWER, *Treasurer.*

REPORT OF THE DIRECTOR.

During the winter of 1882–83 the Station was without laboratory facilities. On the first of March, 1883, the new laboratory was so nearly completed that chemical work could be begun, and in the following pages is given an account of this work from March 1st to December 1st, so far as it is of interest to the public. Much time and pains have necessarily been given to testing analytical methods and controlling results, in order to insure the utmost accuracy, but, in most cases, this work having no general interest, is not suited to publication.

The fertilizer law requires the Director of this Station to "cause one or more analyses of each fertilizer to be made and published annually." This has considerably increased the work on fertilizers, and during the last nine months 219 analyses have been made, nearly one-half of them on samples of complex composition, each one requiring six determinations in duplicate. In connection with the fertilizer work, various investigations have been made, with a view to securing greater accuracy in work and rapidity in its execution. Some valuable results have been obtained, which are noticed on subsequent pages.

Fifteen partial or complete analyses of milk have been made for creameries and individual dairymen.

A modification of Liebermann's method for determining the fat in milk has been devised, which makes it possible to execute a large number of fat determinations in a short time, and which, it is believed, will be of service in work for the creameries of the State or in dairy experiments.

Three samples of butter, suspected of adulteration, have been tested with negative results.

Of fodders, twenty analyses have been made.

In connection with them a table has been prepared, giving the average composition (with the maximum and minimum figures) of American fodders and feeding-stuffs, compiled from all analyses which could be secured up to September 1st, 1883. The separate analyses are collected and preserved at the Station, with references to the journals in which they were first published.

One toxical examination has been made, which showed the presence of arsenic and copper (Paris green) in the bowel of a horse which had died suddenly.

One hundred and twenty-one seed examinations have been made, chiefly on onion seed, and some experiments on the best temperature for the germination of onion seed are reported in their proper place.

The Bulletins of the Station have been only four in number, but they have aggregated thirty-four carefully printed pages of the style of this Report, and were stitched for convenience of preservation. As required by law, two copies at least (usually a larger number) have been sent to each post-office in the State in special envelopes, on which was printed the following:

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

Section 10 *of "An Act Concerning Commercial Fertilizers," passed by the General Assembly, to take effect Sept.* 1, 1882.

☞ The postmaster will greatly serve the public by distributing the enclosed bulletins to farmers. ☜

The Bulletins have also been sent as usual to all of the Agricultural Societies and Farmers' Clubs, and to all the newspapers in the State. They have been reprinted in the *Connecticut Farmer* and in agricultural papers in other States.

FERTILIZERS.

The Connecticut Fertilizer Law.

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

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

1. In case of fertilizers that retail at ten dollars or more per ton, the law of 1882 holds the *seller* responsible for affixing a correct label or statement to every package or lot sold or offered, as well as for the payment of an analysis fee of ten dollars for each fertilizing ingredient which the fertilizer contains or is claimed to contain, unless the manufacturer or importer shall have provided labels or statements and shall have paid the fee. Sections 1 and 3.

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

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

Here follows the full text of the law, with explanatory footnotes by the Director:

AN ACT CONCERNING COMMERCIAL FERTILIZERS.

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

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

SECTION 1. Every person or company who shall sell, offer, or expose for sale, in this State, any commercial fertilizer or manure, the retail price of which is ten dollars, or more than ten dollars per ton, shall affix conspicuously to every package thereof a plainly printed statement, clearly and truly certifying the number of net pounds of fertilizer in the package, the name, brand, or trade-mark under which the fertilizer is sold, the name and address of the manufacturer, the place of manufacture and the chemical composition of the fertilizer, expressed in the terms and manner approved and currently employed by the Connecticut Agricultural Experiment Station.*

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

SEC. 2. Before any commercial fertilizer, the retail price of which is ten dollars, or more than ten dollars per ton, is sold, offered, or exposed for sale, the manufacturer, importer, or party who causes it to be sold, or offered for sale, within the State of Connecticut, shall file with the director of the Connecticut Agri-

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

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

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

Insoluble phosphoric acid may be stated or omitted.

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

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

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

cultural Experiment Station two certified copies of the statement named in section one of this act, and shall deposit with said director a sealed glass jar or bottle containing not less than one pound of the fertilizer, accompanied by an affidavit that it is a fair average sample thereof.*

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

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

SEC. 5. No person or party shall sell, offer, or expose for sale, in the State of Connecticut, any pulverized leather, raw, steamed, roasted, or in any form, as a fertilizer or as an ingredient of any

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

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

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

fertilizer or manure, without explicit printed certificate of the fact, such certificate to be conspicuously affixed to every package of such fertilizer or manure, and to accompany and go with every parcel or lot of the same.

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

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

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

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

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

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

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

OBSERVANCE OF THE FERTILIZER LAW.

Here follows a list of those manufacturers who up to Dec. 1, 1883, have essentially complied with Sections 2 and 3 of the above Act concerning Commercial Fertilizers, the names of the goods whose sale has thus been made legal, and the time of compliance.

Firm.	Articles.	Date.
Atlantic & Va. Fertilizing Co.	The Long Islander Ammoniated Superphosphate of Lime with Potash.	May 24.
	The Orient Complete Manure.	"
H. J. Baker & Bro., 215 Pearl St., New York.	Castor Pomace.	Apr. 26.
	Pelican Bone Fertilizer.	"
	A. A. Ammoniated Superphosphate.	"
	Complete Manure for Corn.	"
	" " Potatoes.	"
	" " Tobacco.	"
	Kainit.	May 16.
J. P. Barstow & Co., Norwich, Conn.	Rafferty and Williams Americus Bone Meal.	July 2.
P. W. Bennett, Rock Fall, Conn.	Ground Rone.	Oct. 5.
Bosworth Bros., Putnam, Conn.	Superphosphate of Lime.	May 8.
	Bone Meal.	"
Bowker Fertilizer Co., 43 Chatham St., Boston, Mass.	Stockbridge Grain Manure.	Apr. 12.
	" Vegetable Manure.	"
	" Forage Crop "	"
	Bowker's Hill and Drill Phosphate.	"
	" Brighton "	"
	" Fish and Potash.	"
	" Fine Ground Dry Fish.	"
	" Fresh Milled Kainit.	"
Bradley Fertilizer Co., 27 Kilby St., Boston, Mass.	Bradley's Superphosphate.	March 21.
	B. D. Sea Fowl Guano.	"
	Original Coe's Superphosphate.	"
	English Lawn Fertilizer.	June 27.
Robert B. Brown Oil Co., St. Louis.	I. X. L. Castor Pomace.	May 31.
Clark's Cove Guano Co., New Bedford, Mass.	Bay State Fertilizer.	March 6.
	Great Planet "A."	May 25.
E. Frank Coe, 16 Burling Slip, New York.	Ammoniated Bone Superphosphate.	Apr. 25.
Russell Coe, Linden, N. J.	Dissolved Bones.	"
	Russell Coe's Ammoniated Bone Superphosphate.	March 8.
Collier White Lead and Oil Co., St. Louis. By F. Ellsworth, Hartford.	Collier White Lead and Oil Co., Castor Pomace.	May 22.
Buffalo Fertilizer and Chemical Works, L. L. Crocker, Buffalo, N. Y.	Ammoniated Bone Superphosphate.	March 20.
	Potato, Hop and Tobacco Phosphate.	"
L. B. Darling & Co., Pawtucket, R. I.	Ground Bone.	March 22.
	Animal Fertilizer.	"
G. W. Dickinson, Essex, Conn.	Ivory and Bone Dust.	Sept. 20.
Dole's Common Sense Fertilizer Co., 42 Congress St., Boston, Mass.	Common Sense Fertilizer, No. 2.	May 5.
	" " No. 3.	"

Firm.	Articles.	Date.
Glidden & Curtis, Boston, Mass.	Soluble Pacific Guano.	Oct. 6, '82.
Geo. L. Harris & Son, Eagleville, Conn.	Pure Bone Phosphate.	Apr. 20.
	Pure Ground Bone.	"
Lister Brothers, Newark, N. J.	Ground Bone.	May 9.
	Potato Fertilizer.	"
	Ammoniated Dissolved Bone.	"
Manhattan Chemical Co., 276 Pearl St., N. Y.	Cooke's Blood Guano.	May 23.
The Mapes' Formula and Peruvian Guano Co., 158 Front St., N. Y.	The Mapes' Potato Manure.	May 2.
	" Corn "	"
	" Complete Manure for light soils.	"
	" Tobacco Manure, Connecticut Brand.	"
	" Tobacco Manure for use with stems.	"
	" Grass and Grain Spring Top Dressing.	"
	" Complete Manure, "A" Brand.	"
	Plain Superphosphate, High Grade.	"
The Geo. W. Miles Co., Milford, Conn.	I. X. L. Ammoniated Bone Superphosphate.	Apr. 9.
	"C" Island Dry Fish Guano.	"
	Fish and Potash.	"
Geo. W. Miller, Middlefield, Ct.	Raw Bone Phosphate.	June 18.
	Ground Bone	"
A. Mitchell, Linden, N. J.	Standard Superphosphate.	June 22.
National Fertilizer Co., Bridgeport, Conn.	Chittenden's Complete Fertilizer for Roots, Potatoes and Vegetables.	May 26.
	Chittenden's Complete Manure for Grain.	"
	Chittenden's Ammoniated Bone Superphosphate.	"
	Chittenden's Fish and Potash.	"
New Haven Fertilizer Co., New Haven, Conn.	Ammoniated Superphosphate.	May 9.
Peck Brothers, Northfield. Ct.	Ground Bone.	May 31.
Preston Fertilizer Co., Greenpoint Station, Brooklyn, N. Y.	Ammoniated Bone Superphosphate.	March 26.
	Dried and Ground Fish Guano.	"
	Ground Bone.	"
Quinnipiac Fertilizer Co., New London, Conn.	Quinnipiac Phosphate.	Apr. 30.
	Dry Ground Fish.	"
	Fish and Potash, crossed Fishes Brand.	"
	Fish and Potash, plain Brand.	"
Quinnipiac Co., Wallingford, Ct.	Meat and Plaster.	May 7.
	Quinnipiac Co's Bone.	"
Read & Co., 34 Beaver St., N. Y.	Farmers' Friend Fertilizer.	May 14.
	Matchless Tobacco Manure.	"
The Rogers & Hubbard Co., Middletown, Conn.	Pure Raw Knuckle Bone Meal.	June 1.
	Pure Raw Knuckle Bone, Fine, "A."	"
M. L. Shoemaker, Philadelphia. By F. Ellsworth, Hartford.	Swift-sure Bone Meal.	May 26.
St. Louis Lead and Oil Co. By F. Ellsworth, Hartford.	St. Louis Lead & Oil Co., Castor Pomace.	May 22.
F. C. Slade, Oakville, Conn.	Ground Bone.	June 1.
Edmund Smith, So. Canterbury, Conn.	Ground Bone.	June 11.

Firm.	Articles.	Date.
Paul Thompson, 238 State St., Hartford, Conn.	Mineral Manure for Tobacco and other Crops.	May 18.
Williams, Clark & Co., 109 Pearl St., New York.	Fish and Potash.	March 22.
	Universal Ammoniated Dissolved Bone.	"
	Americus Ammoniated Bone Superphosphate.	"
	Muriate of Potash.	May 21.
	Kainit.	May 15.

FERTILIZERS.*

Analyses.

In respect to its terms, the Station makes *two classes* of analyses of fertilizers and fertilizing materials: the first for the benefit of farmers, gardeners, and the public generally; the second for the private use of manufacturers and dealers. Analyses of the *first class* are made gratuitously, and the results are published as speedily and widely as possible for the guidance of purchasers and consumers. Those of the *second class* are charged for at moderate rates, and their results are not published in a way to interfere with their legitimate private use. The Station, however, distinctly reserves the liberty to use at discretion, for the public benefit, all results obtained in its laboratory, and in no case will enter into any privacy that can work against the public good.

During 1883, two hundred and nineteen (219) samples of fertilizers have been analyzed. Of these, 17 were examined for private parties, and the remainder, 102, for the general use of the citizens of the State.

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

* The matter of this and of several subsequent pages, explanatory of the sampling and valuation of fertilizers, is copied with a few appropriate alterations from the Report for 1881. This repetition appears to be necessary for the use of readers who have not seen former Reports.

The Station agents are instructed when drawing samples to open at least three packages of each brand of goods in every case, and if the number of packages is large, to take a portion from every tenth one. The contents of bags or barrels are rapidly and accurately sampled by means of a brass sampler made by McFadden and Dooley, New Brunswick, N. J., on a pattern suggested by Dr. A. T. Neale of the New Jersey Experiment Station. In the past the Station has been in several instances seriously embarrassed on account of the carelessness of those who have drawn and sent in samples for analysis. This trouble is avoided by the present system which could not earlier be adopted for lack of means.

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

THE CONNECTICUT

AGRICULTURAL EXPERIMENT STATION.

Instructions for Sampling Commercial Fertilizers.

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

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

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

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

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

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

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

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

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

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

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

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

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

THE CONNECTICUT

AGRICULTURAL EXPERIMENT STATION,

NEW HAVEN, CONN.

FORM FOR DESCRIPTION OF SAMPLE.

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

When a sample of fertilizer has been analyzed, the results are entered on a printed form, which is filed in the Station Record of Analyses, facing the "Description of Sample" that was received with the fertilizer to which it pertains, and there remains for future reference.

A copy of the analysis is also immediately reported to the party that furnished the sample, the report being entered on one page of another printed form and facing a second printed page of "Explanations," intended to embody the principles and data upon which the valuation of fertilizers is based.

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

EXPLANATION OF FERTILIZER-ANALYSIS AND VALUATION.

Nitrogen is commercially the most valuable fertilizing element. It occurs in various forms or states. *Organic nitrogen* is the nitrogen of animal and vegetable matters generally, existing in the albumen and fibrin of meat and blood, in the uric acid of bird dung, in the urea and hippuric acid of urine, and in a number of other substances. Some forms of organic nitrogen, as that of blood and meat, are highly active as fertilizers; others, as that of hair and leather, are comparatively slow in their effect on vegetation unless these matters are reduced to a fine powder or chemically disintegrated. *Ammonia* and *nitric acid* are results of the alteration of *organic nitrogen* in the soil and manure heap, and are the most active forms of nitrogen. They occur in commerce —the former in sulphate of ammonia, the latter in nitrate of soda.

Seventeen parts of ammonia, or 66 parts of pure sulphate of ammonia, contain 14 parts of nitrogen.

Eighty-five parts of pure nitrate of soda also contain 14 parts of nitrogen.

Soluble phosphoric acid implies phosphoric acid or phosphates that are freely soluble in water. It is the characteristic ingredient of superphosphates, in which it is produced by acting on "insoluble" or "reverted" phosphates with oil of vitriol. It is not only readily taken up by plants, but is distributed through the soil by rains. Once well incorporated with soil, it shortly becomes reverted phosphoric acid.

Reverted (*reduced or precipitated*) *phosphoric acid* strictly means phosphoric acid that was once freely soluble in water, but from chemical change has become insoluble in that liquid. It 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, but generally have less value than soluble phosphoric acid, because they do not distribute freely by rain.

Insoluble phosphoric acid implies various phosphates not freely soluble in water or ammonium citrate. In some cases the phos-

*To determine "reverted phosphoric acid," this Station continues to employ the method first described by Fresenius, Neubauer and Luck (known in this country also as the Washington method, because adopted by the Convention of Agricultural Chemists, held at Washington, in July, 1880), modified in a single particular, viz: manufactured phosphates are not pulverized.

phoric acid is too insoluble to be rapidly available as plant food. This is true of South Carolina rock phosphate, of Navassa phosphate, and especially of Canada apatite. The phosphate of coarse raw bones is at first nearly insoluble in this sense, because of the animal matter of the bone which envelopes it, but when the latter decays in the soil, the phosphate remains in essentially the "reverted" form.

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

The valuation of a fertilizer signifies estimating its worth in money, or its trade value; a value which, it should be remembered, is not *necessarily* proportional to its fertilizing effects in any special case.

Plaster, lime, stable manure, and nearly all the less expensive fertilizers have variable prices, which bear no close relation to their chemical composition; but guanos, superphosphates and other fertilizers, for which $30 to $80 per ton are paid, depend chiefly for their trade value on the three substances, *nitrogen*, *phosphoric acid* and *potash*, which are comparatively costly and steady in price. The money value per pound of these ingredients is easily estimated from the market prices of the standard articles which furnish them to commerce.

The average trade values, or cost in market per pound, of the ordinarily occurring forms of nitrogen, phosphoric acid and potash, as found in the Connecticut and New York markets, and employed by the Station during the last three years, have been as follows:

TRADE-VALUES FOR 1881, 1882 AND 1883.

	1881.	1882.	1883.
	—Cents per pound.—		
NITROGEN in nitrates,	26	26	20
" in ammonia salts,	22½	29	26
" in Peruvian Guano, fine steamed bone, dried and fine ground blood, meat and fish, superphosphates and special manures,	20	24	23
" in coarse or moist blood, meat or tankage, in cotton seed, linseed and Castor Pomace,	16	18	18
" in fine ground bone, horn and wool dust,	15	17	17
" in fine medium bone,	14	15	15
" in medium bone,	13	14	14
" in coarse medium bone,	12	13	13
" in coarse bone, horn shavings, hair and fish scrap,	11	11	11

	1881.	1882.	1883.
	—Cents per pound.—		
PHOSPHORIC ACID soluble in water,	12½	12½	11
" " "reverted" and in Peruvian Guano,	9	9	8
" " insoluble, in fine bone, fish guano and superphosphates,	6	6	6
" " insoluble, in fine medium bone,	5½	5½	5½
" " " in medium bone,	5	5	5
" " " in coarse medium bone,	4½	4½	4½
" " " in coarse bone, bone ash and bone black,	4	4	4
" " insoluble, in fine ground rock phosphate,	3½	3	2¼
POTASH in high grade sulphate,	7½	7	7
" in low grade sulphate and kainit,	5½	5	4¼
" in muriate or potassium chloride,	4½	5	4⅞

These "trade-values" of the elements of fertilizers are not fixed, but vary with the state of the market, and are from time to time subject to revision. They are not exact to the cent or its fraction, because the same article sells cheaper at commercial or manufacturing centers than in country towns, cheaper in large lots than in small, cheaper for cash than on time. These values are high enough to do no injustice to the dealer, and properly interpreted, are accurate enough to serve the object of the consumer.

To Estimate the Value of a Fertilizer we multiply the per cent. of nitrogen, etc., by the trade-value per pound, and that product by 20; we thus get the values per ton of the several ingredients, and adding them together we obtain the total estimated value per ton.

In case of *Ground bone*, the fineness of the sample is graded by sifting, and we separately compute the nitrogen value of each grade of bone which the sample contains, by multiplying the pounds of nitrogen per ton in the sample, by the per cent. of each grade, taking one one-hundredth of that product, multiplying it by the estimated value per pound of nitrogen in that grade, and taking this final product as the result in cents. Summing up the separate values of each grade, thus obtained, together with the values of each grade for phosphoric acid, similarly computed, the total is the estimated value of the sample of bone. For further particulars, see page 47.

The uses of the "Valuation" are, 1st, to show whether a given lot or brand of fertilizer is worth as a commodity of trade what it costs. If the selling price is no higher than the estimated value, the purchaser may be quite sure that the price is reasonable. If the selling price is but $2 to $3 per ton more than the estimated value, it may still be a fair price; but if the cost per

ton is $5 or more over the estimated value, it would be well to look further. 2d, Comparisons of the estimated values and selling prices of a number of fertilizers will generally indicate fairly which is the best for the money. But the "estimated value" is not to be too literally construed, for analysis cannot always decide accurately what is the *form* of nitrogen, etc., while the mechanical condition of a fertilizer is an item whose influence cannot always be rightly expressed or appreciated.

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

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

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

Experience leads to the conclusion that 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. It should be remembered that, in an Annual Report, the fluctuations in trade-value that may occur within the year cannot be accurately followed, and the comparisons of estimated values are mostly in retrospect.

The valuations for 1883 were adopted in consultation with Dr. Goessmann, Director of the Massachusetts Agricultural Experiment Station, Prof. Cook, Director of, and Dr. Neale, Chemist to, the New Jersey Agricultural Experiment Station, and have been employed by these gentlemen in their official Reports for 1883.

ANALYSES AND VALUATION OF FERTILIZERS.

The classification of the Fertilizers analyzed in the Station Laboratory from March 1st, to November 1st, 1883, is as follows:

5	native phosphates.
4	bone char.
6	plain (non-nitrogenous) superphosphates.
75	nitrogenous (ammoniated) superphosphates and guanos.*
31	special fertilizers or "formulas."
1	bat guano.
23	bone manures.
8	dry ground fish.
2	nitrate of soda.
2	sulphate of ammonia.
2	dried blood.
1	meat and plaster.
1	slaughter house refuse.
10	castor pomace and cotton-seed meal.
13	potash salts.
1	alkali deposit.
9	plaster.
4	limestone rocks.
1	rock.
2	quick lime.
1	waste slaked lime from paper mill.
2	infusorial earth.
2	ashes of cotton-seed hulls.
4	wood ashes.
3	leached ashes.
1	farm manure.
1	compost.
4	mucks.
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Of this number 14 were analyzed for private parties and are not noticed in the following pages, since the results are not of general interest or value.

* Including "fish and potash."

Native Phosphates.

915. Fine-ground Crude Navassa Phosphate, Navassa Phosphate Co's agent, No. 12 Cliff street, New York. Sampled and sent by J. M. Milbank, Greenfield Hill.

993. Ground Phosphate Rock. Sold by A. E. Scribner & Co., 35 Broadway, N. Y. Sample obtained from Usher & Tinker, Plainville.

Analyses.

	915	993
Phosphoric acid soluble in ammonium citrate,	4.09	.37
Phosphoric acid insoluble in " "	25.81	34.85
Cost per ton,	$17.00†	$30.00*

Both of these samples are quite fine and readily pass through a sieve having $\frac{1}{50}$ inch meshes.

Bone Char.

Four samples of this material have been analyzed. **873** and **889** were sent to the Station by the purchaser. **1033** and **1042** were obtained from manufacturers in New Haven by the Station. They are all waste materials which have been used for case-hardening iron.

Analyses.

	873	889	1033	1042
Water,		25.91	2.38	
Carbonic acid,	2.15			1.18
Phosphoric acid,	29.17	28.34	16.63	21.34

This bone char is little more active as a fertilizer than fine ground phosphate rock, when applied directly to land. When properly treated with oil of vitriol, however, it makes an excellent superphosphate. See the following page.

Plain (Non-Nitrogenous) Superphosphates.

This class includes fertilizers which are made by treating some phosphate (rock phosphate, bone ash, bone char, etc.), with a very

* $22.00 per ton wholesale in N. Y.

† f. o. b. in N. Y., $18.00 to $18.50 in Southport.

strong acid, usually oil of vitriol, without the addition of nitrogenous matter or potash salts. They are valuable commercially only for the soluble phosphoric acid which they contain.

Six articles of this class have been analyzed.

877. Home Made Superphosphate. Sample taken 48 hours after it was prepared.

890A. Home Made Superphosphate. The same stock as **877**, but taken after it had lain in a pile one week.

890 B. The same after standing six months in a tightly closed jar.

916. Navassa Acid Phosphate. Made by the Navassa Phosphate Co., 12 and 14 Cliff street, New York. Sampled and sent by J. M. Milbank, Greenfield Hill.

942. Acid Phosphate of Lime. Made by the Bowker Fertilizer Co. From stock of Wilson & Burr, Middletown. Sampled and sent by J. M. Hubbard, Middletown.

987. High Grade Superphosphate. Made by the Mapes Formula & Peruvian Guano Co., N. Y. From stock of the Mapes Branch, Hartford. Sampled by the Station Agent.

1036. Packard's Concentrated Superphosphate. Imported by H. J. Baker & Bro., N. Y. Sample sent by the importers at the request of the Station.

Analyses.

	877	890A	890B	916	942	987	1036
Phosphoric acid soluble in water,	13.04	14.46	13.15	5.56	10.72	34.94	39.10
Reverted* Phosphoric acid,		3.07		6.43	1.08	1.43	6.70
Insoluble phosphoric acid,				4.55	2.84	1.56	.71
Cost per ton,				$23.00	24.00	70.00	
Cost of soluble phosphoric acid per 100 lbs.,					$11.20† $9.66‡	10.02 9.57	

877 was made from the bone char **873** whose analysis is given on the previous page, in the following way:

100 parts by weight of char were spread in a mortar bed and wet with 42 parts of water. 55 parts of strong oil of vitriol, "66° acid," were then added and the whole was thoroughly mixed with a hoe. The solvent action of the oil of vitriol contin-

* See page 23.

† Making no allowance for reverted and insoluble phosphoric acid.

‡ Allowing 8c. per lb. for reverted and 2¾c. for insoluble phosphoric acid.

ued for some time, as is shown by the higher percentage of soluble phosphoric acid in the material after lying for a week. As far as concerns its mechanical condition the superphosphate prepared as above was inferior to the best "acid phosphates" in our market. It was somewhat lumpy and could not be conveniently drilled without sifting. The lumps were very soft, however, and easily pulverized. Constant stirring with a hoe while the mixture is cooling does much to prevent the forming of lumps. In this case the operation was decidedly economical, for by it soluble phosphoric acid was got for about $8.00 per 100 lbs., while in market it was selling for from $10 to $12, and its fertilizing effect was satisfactory. Generally speaking the farmer can buy acid phosphate cheaper than he can make it. Home manufacture is only advisable when farm work is slack and the raw phosphate can be got at a very low price.

Ground bone is used considerably in case-hardening small articles of iron, and where the consumption is not large, manufacturers throw away the spent char, or will sell it at a low price. Such material it may be very profitable to utilize for superphosphate manufacture on the farm.

916 is made from the Navassa rock which contains much iron and alumina. A larger share of the phosphoric acid may have been soluble in water when the goods were first manufactured, but if so, a portion has reverted, or been made again insoluble in water. This effect is with great probability attributed to the iron and alumina present.

987 contains more than double the amount of soluble phosphoric acid usually found in high grade superphosphates and at $70 per ton retail we believe is the cheapest source of soluble phosphoric acid in our market. **1036** is an article of still higher grade than the last mentioned, but is not in the retail trade. **987** is manufactured in this country, **1036** is imported from England.

Nitrogenous (Ammoniated) Superphosphates and Guanos.

Here are included all those superphosphates which contain nitrogen in any form—excepting the formulas or "special manures," to be noticed in the next section—as well as guanos, either in their natural state or manipulated. The articles of this class with few exceptions also contain more or less potash and such are known as "complete manures."

75 samples of this class of fertilizers have been analyzed during the year, 7 of them for private parties. The analyses and valuations of 63 of them are given on pages 33 to 38.

34 are called by the manufacturers "phosphate" or "superphosphate;" 10, "Fish and Potash;" 4, "Mineral Manure;" 3, "Peruvian Guano;" 3, "Complete Manure," and 2, "Common Sense Fertilizer." The other 12 are "Alkalized Guano," "Menhaden Guano," "Fish Guano," "Sea Fowl Guano," "Blood Guano," "Soluble Pacific Guano," "Animal Fertilizer," "Pelican Bone Fertilizer," "Farmer's Friend Fertilizer," "Bay State Fertilizer" and "Great Planet A."

On page 38 are given the analyses of 5 superphosphates, whose retail prices were not reported. For that reason the analyses could not be arranged with reference to the relation of cost to estimated value as the others have been.

Chlorine has been determined in most cases in order to decide whether the potash in the fertilizer exists as muriate or sulphate. Potash is in all cases reckoned as muriate if sufficient chlorine is present in the fertilizer to combine with it. If there is more potash present than will combine with the chlorine, then this excess of potash is reckoned as sulphate.

998 "Alkalized Guano" is stated by the manufacturers to be an artificial guano made of ammonia salts, sulphate of potash and phosphoric acid "from organic sources." That portion of the guano which is insoluble in water has much the appearance of the phosphates that come from the West Indies, Curaçao, Mona Island, etc.

863 Chittenden's Fish and Potash is made from fish scrap which has not been acidulated. For that reason, only nitrogen and total phosphoric acid were determined at the time when the sample came, and the results were published in Bulletin No. 73, p. 13. The valuation then given was $25.20. For comparison with other brands of fish and potash it was necessary to separately determine phosphoric acid in the three forms and to change the valuation accordingly, which has been done in the table on page 37.

855, 856, 875 and **948** are samples of Paul Thompson's Mineral Manure for Tobacco and Other Crops. **856** was sampled and sent by W. A. Burr, West Hartford. The others were sampled by the manufacturer and the station agent. The analyses indicate a series of unsuccessful experiments in manufacture, and not a marketable article of tolerably uniform composition.

ANALYSES AND VALUATIONS.

Station No.	Nitrogen of Ammonia Salts.	Nitrogen of Organic Matters.	Soluble Phos. Acid.	Reverted Phos. Acid.	Insoluble Phos. Acid.	Potash.	Estimated value per ton.	Cost per ton.
875		1.14	2.63	.84	.39	.25	17.26	25.00
948		.80	.16	1.12	.38	1.31	10.56	25.00
855	.08	.19	none	1.76	.72	.16	5.19	25.00
856		.29		2.51				

The average cost of the nitrogenous superphosphates excluding the four just mentioned, is $41.42; the average estimated value is $34.92, and the average difference between cost and valuation is $6.50.

For the last four years the average cost and the average difference between cost and estimated value have been as follows:

	1880.	1881.	1882.	1883.
Average cost,	$39.00	43.00	40.58	41.42
Average difference,	$3.00	4.00	1.89	6.50

Since the trade values used by the Station in computing estimated values have been prepared yearly from the market reports and always in the same manner this larger discrepancy in the present year between cost and valuation cannot be due to any arbitrary change in our trade values. It is most likely explained by the fact that the prices of manufactured goods have not gone down during the last eighteen months while many of the raw materials used in their manufacture have been steadily becoming cheaper. A further discussion of this matter will be found in the Review of the Fertilizer Market.

About one-third (23) of the samples have not contained the full minimum amounts of nitrogen, phosphoric acid and potash, guaranteed by the makers. In most cases, however, the difference between the composition and guarantee was quite small and only involved a single ingredient.

The Comparison of Different Superphosphates of the Same Brand and of the Analyses with the Guarantees, on pages 39 to 43, serves to show first the variations in samples of the same brand which are caused by carelessness in the preparation of the goods or in their storage, errors in sampling, etc., and second, how nearly the actual composition of the superphosphates agrees with what is claimed for them by their manufacturers.

NITROGENOUS SUPERPHOSPHATES AND GUANOS.

Station No.	Name or Brand.	Manufacturer.	Dealer.	Sampled and Sent by
964	Peruvian Guano.		Mapes F. & P. G. Co., N. Y.	C. H. Cables, Thomaston.
998	Alkalized Guano.	Hurtado & Co., New York.	Southmayd & Gardiner, Middletown.	Station Agent.
921	Quinnipiac Phosphate.	Quinnipiac Fertilizer Co., New London.	John S. Morgan, Groton.	B. A. Copp, Groton.
912	Menhaden Guano.	Jas. Church & Co., Tiverton, R. I.	Manufacturers.	Geo. D. Harrison, Lakeville.
969	Pure Bone Phosphate.	G. H. Harris & Son, Eagleville.	"	Station Agent.
1011	Darling's Animal Fertilizer.	L. B. Darling & Co., Pautucket, R. I.	T. P. Pease & Sons' Co., Windsor Locks.	" "
918	Mapes' Complete Manure ("A" Brand)	Mapes F. & P. G. Co., N. Y. City.	Mapes F. & P. G. Co's Branch, Hartford.	" "
954	Ammon. Dissolved Bone Phosphate.	Lister Bros., Newark, N. J.	R. B. Bradley & Co., N. Haven.	" "
961	Bay State Fertilizer.	Clark's Cove Guano Co., New Bedford, Mass.	F. Ellsworth, Hartford.	" "
924	E. Frank Coe's Ammon. Bone Super.	E. Frank Coe, New York.		Andrew Kingsbury, Coventry.
963	Original Coe's Superphos. of Lime.	Wm. Bradley, Boston, Mass.	T. P. Pease & Sons' Co., Windsor Locks.	Station Agent.
991	World of Good Ammoniated Bone Superphosphate.	Thompson & Edwards, Chicago, Ill.	John S. Wells, Hebron.	" "
885	Fish and Potash, Crossed Fishes Brand.	Quinnipiac Fertilizer Co., New London.	Raymond Bros., Norwalk.	" "
974	Mapes' Complete Manure.	Mapes F. & P. G. Co., N. Y. City.	R. B. Bradley & Co., N. Haven.	" "
922	Bradley's Superphosphate.	Bradley Fertilizer Co., Boston.	Smith & Sons.	T. S. Gold, West Cornwall.
1013	Quinnipiac Phosphate.	Quinnipiac Fertilizer Co., New London.	Olds & Whipple, Hartford.	Homer C. Roberts, Silver Lane.
1001	G. W. Miles' Fish Fertilizer and Potash.	Geo. W. Miles Co., Milford.	S. J. Hall, Meriden.	Station Agent.
971	Bosworth Bros. Superphos. of Lime.	Bosworth Bros., Putnam.	J. A. Paine, Danielsonville	" "
886	Quinnipiac Phosphate.	Quinnipiac Fertilizer Co., New London.	Raymond Bros., Norwalk.	" "
1015	Fish and Potash, Crossed Fishes Brand.	Quinnipiac Fertilizer Co., New London.	Olds & Whipple, Hartford.	Olin Wheeler, Buckland.
957	Pelican Bone Fertilizer.	H. J. Baker & Bro., N. Y. City.	S. J. Hall, Meriden.	Station Agent.

Nitrogenous Superphosphates.—*Continued.*

Station No.	Name or Brand.	Manufacturer.	Dealer.	Sampled and Sent by
904	A. A. Ammoniated Superphosphate.	H. J. Baker & Bro., N. Y. City.	Tolles & McEwen, Naugatuck.	Station Agent.
1005	G. W. Miles' I. X. L. Ammoniated Bone Superphosphate.	Geo. W. Miles & Co., Milford.	S. J. Hall, Meriden.	" "
955	Americus Brand Ammoniated Bone Superphosphate.	Williams, Clark & Co., New York.	F. Ellsworth, Hartford.	" "
967	Fish and Potash, Plain Brand.	Quinnipiac Fertilizer Co., New London.	A. W. Allen, Jr., Thompsonville.	" "
920	A. A. Ammoniated Superphosphate.	H. J. Baker & Bro., New York.	W. R. Perry & Co., N. London.	C. A. Copp, Groton.
868	Bradley's Superphosphate of Lime.	Bradley Fertilizer Co., Boston.	Raymond & Bro., So. Norwalk.	F. Sherwood, Green's Farms.
1023	Quinnipiac Phosphate.	Quinnipiac Fertilizer Co., New London.	Olds & Whipple, Hartford.	Station Agent.
952	Ammoniated Bone Superphosphate.	Preston Fertilizer Co., Greenpoint, L. I.	J. B. Merrow & Sons, Merrow.	" "
869	Baker's A. A. Ammoniated Superphosphate.	H. J. Baker & Bro., New York.	John Alvord, Green's Farms.	F. Sherwood, Green's Farms.
982	Great Planet Brand "A."	Clark's Cove Guano Co., New Bedford, Mass.	Manufacturer.	Manufacturer.
956	The Long Islander Ammoniated Superphosphate of Lime with Potash.	Atlantic & Virginia Fertilizer Co., Orient, L. I., and Richmond, Va.	S. J. Hall, Meriden.	Station Agent.
925	Quinnipiac Phosphate.	Quinnipiac Fertilizer Co., New London.	W. B. Williams, Bolton Centre.	Andrew Kingsbury, Coventry.
898	Ammoniated Bone Superphosphate.	Geo. W. Miles Co., Milford.	Apothecaries' Hall, Waterbury.	Station Agent.
887	Soluble Pacific Guano.	Glidden & Curtis, Boston, Mass.	Raymond Bros., Norwalk.	" "
997	Bowker's Dissolved Bone.	Bowker Fertilizer Co., Boston and New York.	J. A. Paine, Danielsonville.	" "
927	Farmer's Friend Fertilizer.	Read & Co., New York.	A. C. Sternburg, Hartford.	" "
900	Bowker's Fish and Potash.	Bowker Fertilizer Co., New York.	Curtis & Abbott, Birmingham.	" "
988	No. 1 Peruvian Guano, Standard.	Hurtado & Co., New York.	Southmayd & Gardiner, Middletown.	" "
863	Chittenden's Fish and Potash.	Nat'l Fertilizer Co., Bridgeport.	Manufacturer.	" "
897	Geo. W. Miles' Fish and Potash.	Geo. W. Miles Co., Milford.	Apothecaries' Hall, Waterbury.	" "
893	Russell Coe's Ammoniated Bone Superphosphate.	Russell Coe, Linden, N. J.	Curtis & Abbott, Birmingham.	" "

Nitrogenous Superphosphates.—*Continued.*

Station No.	Name or Brand.	Manufacturer.	Dealer.	Sampled and Sent by
891	Chittenden's Universal Phosphate.	Nat'l Fertilizer Co., Bridgeport.	Manufacturer.	Station Agent.
958	The Orient Complete Manure.	Atlantic & Virginia Fertilizer Co., Orient, L. I., and Richmond, Va.	W. C. Reynolds, East Haddam.	" "
866	Chittenden's Ammoniated Bone Superphosphate.	Nat'l Fertilizer Co., Bridgeport.	Manufacturer.	" "
1010	Chittenden's Fish and Potash.	" " "	Southmayd & Gardiner, Middletown.	" "
977	Bowker's Hill and Drill Phosphate.	Bowker Fertilizer Co., New York and Boston.	Coburn & Gale, Hartford.	T. S. Gold, West Cornwall.
923	Ammoniated Bone Superphosphate.	Russell Coe, Linden, N. J.	Smith & Sons, W. Cornwall.	Station Agent.
896	" " "	Buffalo Fertilizer and Chemical Works.	Ruggles & Clark, Shelton.	Manufacturer.
983	Dole Common Sense Fertilizer, No. 3.	Dole Common Sense Fertilizer Co., Boston, Mass.	Manufacturer.	Station Agent.
901	Brighton Phosphate.	Bowker Fertilizer Co., N. Y. City.	Curtis & Abbott, Birmingham.	" "
960	Cook's Blood Guano.	Manhattan Chemical Co., N. Y.	A. C. Sternburg, Hartford.	" "
907	New Haven Fertilizer Co's Superphosphate.	New Haven Fertilizer Co.	Manufacturer.	" "
999	No. 1 Peruvian Guano, Lobos.	Hobson, Hurtado & Co, 63 Pine street, New York, Importers.	Southmayd & Gardiner, Middletown.	Jas. H. Barker, Branford.
861	Raw Bone Superphosphate.	G. W. Miller, Middlefield.	Manufacturer.	Station Agent.
1008	" Superphosphate.	" " "	C. E. Chapman, Westbrook.	Manufacturer.
984	Dole's Common Sense Fertilizer, No. 2.	Dole Common Sense Fertilizer Co., Boston, Mass.	Manufacturer.	Station Agent.
994	Mitchell's Standard Superphosphate.	Mitchell Standard Works, Linden, N. J.	John A. Paine, Danielsonville.	Manufacturer.
980	Bradley Fertilizer Co's Sea Fowl Guano.	Bradley Fertilizer Co., Boston.	Manufacturer.	"
846	G. W. Miles Co's I. X. L. Phosphate.	Geo. W. Miles Co., Milford.	"	"
844	G. W. Miller's Raw Bone Phosphate.	G. W. Miller, Middlefield.	"	"
845	"C." Island Dry Fish Guano.	G. W. Miles Co., Milford.	"	"
847	G. W. Miles Co's Fish and Potash, XX.	" " "	"	"

Nitrogenous Superphosphates.

Station No.	NAME.	Nitrogen of Nitrates.	Nitrogen of Ammonia Salts.	Nitrogen of Organic Matters.	Soluble Phos. Acid.	Reverted Phos. Acid.*	Insoluble Phos. Acid.	Potash.	Chlorine.	Estimated value per ton.	Cost per ton.	Valuation exceeds Cost.
964	Mapes Peruvian Guano	.15	3.18	1.57	5.73	6.38	10.00	5.37	2.40	$64.95	$54.00*	$10.95
998	Hurtado & Co's Alkalized Guano	.14	6.13	.15	.61	5.33	8.20	5.28	1.25	61.40	60.00	1.40
921	Quinnipiac Fertilizer Co's Phosphate	.64	....	2.85	7.47	2.28	1.75	2.66	2.34	40.11	40.00	.11
912	James Church & Co's Menhaden Guano	....	....	4.96	1.83	3 24	1.10	.29	....	33.60	33.60	
969	Harris' Pure Bone Phosphate	....	....	2.92	5.54	3.19	5.73	....	....	37.60	38.00	Cost exceeds valuation.
1011	L. B. Darling & Co's Animal Fertilizer	..	.47	3.44	1.19	5.26	8.71	4 68	3.50	43.73	45.00	$0.40
918	Mapes' Complete Manure ("A" Brand)	.66	.72	1.30	7.58	2.91	3.22	2.89	1.98	40.16	42.00	1.27
954	Lister Bro's Ammoniated Dissolved Bone Phosphate	....	....	1.69	9.76	.98	.94	1.89	2.02	33.55	35.00	1.84
961	Clark's Cove Guano Co's Bay State Fertilizer	.96	.76	1.13	8.99	.95	1.11	3.08	3.09	38.24	40.00	1.45
924	E. Frank Coe's Ammoniated Bone Superphosphate	....	....	2 19	7.31	2.22	3.73	....	....	34.18	36.00	1.76
962	Wm. Bradley's Original Coe's Superphosphate of Lime	.50	.20	2.11	8.61	1.37	3.06	.31	.24	37.81	40.00	1.82
991	World of Good Ammoniated Bone Superphosphate	....	....	1.90	8.59	1.74	3.62	....	....	34.76	37.00	2.19
885	Quinnipiac Fertilizer Co's Fish and Potash, Crossed Fishes Brand	1 38	.44	2.48	.83	4.12	3.62	4.38	7.31	35.70	38.00	2.24
974	Mapes Complete Manure (for light or sandy soil)	1.42	2.63	1.24	6.01	1.83	1.12	6.61	.41	51.51	54.00	2.30
922	Bradley Fertilizer Co's Superphosphate	.32	....	2.47	8.22	1.19	2.44	1.89	1.87	37.16	40.00	2.49
1013	Quinnipiac Fertilizer Co's Phosphate	....	1.68	1.80	5.15	1.78	2.48	2.77	....	36.53	40.00	2.84
1001	G. W. Miles' Fish Fertilizer and Potash	....	.25	2.49	3.88	1.63	1.94	3.84	3.47	29.49	33.00	3.47
971	Bosworth Bros' Superphosphate of Lime	....	.09	1.74	4.84	3.67	7.90	2.23	2.02	36.37	40.00	3.51
886	Quinnipiac Fertilizer Co's Phosphate	....	.52	2.48	5.81	3.11	2.31	2.02	2.15	36.36	40.00	3.63
1015	Quinnipiac Fertilizer Co's Fish and Potash (Crossed Fishes Brand)	....	1.48	2.60	.60	4.78	3.02	4.72	....	36.26	40.00	3.64
957	H. J. Baker & Bro's Pelican Bone Fertilizer	....	1.08	1.10	7.09	1.26	.56	2.65	4.10	31.21	35.00	3.74
												3.79

* $49.00 per ton in New York, in 5 ton lots. † See page 23.

Nitrogenous Superphosphates.—*Continued.*

Station No.	NAME.	Nitrogen of Nitrates.	Nitrogen of Ammonia Salts.	Nitrogen of Organic Matters.	Soluble Phos. Acid.	Reverted Phos. Acid.*	Insoluble Phos. Acid.	Potash.	Chlorine.	Estimated value per ton.	Cost per ton.	Cost exceeds valuation.
904	H. J. Baker & Bro's A. A. Ammoniated Superphosphate	....	1.88	.76	9.88	.17	.36	2.58	3.30	$37.91	$42.00	$4.09
1005	Geo. W. Miles' I. X. L. Ammoniated Bone Superphosphate	....	.37	1.67	7.23	1.09	3.29	1.93	1.26	32.84	37.00	4.16
955	Williams, Clark & Co's Americus Brand Ammoniated Bone Superphos.	....	....	2.27	7.03	1.06	4.98	2.38	2.28	35.60	40.00	4.40
967	Quinnipiac Fertilizer Co's Fish and Potash, Plain Brand	....	.44	2.14	.70	4.44	4.05	5.35	7.91	30.18	35.00	4.82
920	H. J. Baker & Bro's A. A. Ammoniated Superphosphate	....	1.99	.72	8.81	.68	.47	2.78	3.71	37.05	42.00	4.95
868	Bradley Fertilizer Co's Superphosphate of Lime	.45	.. ..	2.33	7.97	1.30	2.56	1.97	1.77	36.88	42.00	5.12
1023	Quinnipiac Fertilizer Co's Phosphate	....	.51	2.45	5.75	1.97	2.03	2.89	..	34.62	40.00	5.38
952	Ammoniated Bone Superphosphate (Preston's)	....	.45	1.50	6.46	1.19	3.31	1.08	2.18	30.24	36.00	5.76
869	H. J. Baker & Bro's A. A. Ammoniated Superphosphate	....	1.92	.56	8.52	59	.64	2.88	3.91	35.46	42.00	6.54
982	Clark's Cove Guano Co's Great Planet Brand "A"	.09	1.46	1.53	6.75	.31	1.81	8.90	4.89	41.40	48.00	6 60
956	Atlantic & Virginia Fertilizer Co's Ammoniated Superphos. of Lime	....	....	.99	6.98	1.78	2.57	5.31	4.65	30.35	37.00	6.65
925	Quinnipiac Fertilizer Co's Phosphate	.90	....	1.87	2.66	5.98	3.19	2.18	2 94	33.30	40.00	6.70
898	Geo. W. Miles Co's Ammoniated Bone Superphosphate	....	....	2.26	7.03	1.25	3.07	1.84	2.75	33.11	40.00	6.89
887	Glidden & Curtis' Soluble Pacific Guano	.61	.17	1.82	5.08	1.73	5.66	2.54	2.60	34.59	42.00	7.41
997	Bowker's Dissolved Bone	....	.14	1.53	7.44	.85	2.10	2.73	3.93	30.34	38.00	7.66
927	Read & Co's Farmers' Friend Fertilizer	1.14	....	1.03	7.07	.94	1.93	1.48	3.18	29.93	38.00	8.07
900	Bowker Fertilizer Co's Fish and Potash	....	....	2.52	2.85	2.46	2.10	4.08	9.20	27.79	36.00	8.21
988	Hurtado & Co's No. 1, Peruvian Guano Standard	.11	7.36	.74	5.14	2.68	4.81	.90	1.26	64.24	73.00	8.76
863	Chittenden's Fish and Potash	....	....	2.92	.26	4.38	1.85	4.67	8.57	27.20	36.00	8.80
897	Geo. W. Miles' Fish and Potash	....	....	2.64	4.69	1.15	2.69	3.68	4.90	30.66	40.00	9.34
893	Russell Coe's Ammoniated Bone Superphosphate	....	....	2.60	6.56	.78	1.42	1.20	4.52	30.36	40.00	9.64
891	Chittenden's Universal Phosphate	.68	....	1.81	7.55	.87	.83	2.60	4.37	32.26	42.00	9.74
958	Atlantic & Virginia Fertilizer Co's Orient Complete Manure	....	....	.93	7.34	1.73	2.97	1.51	3.57	28.04	38.00	9.96
866	Chittenden's Ammoniated Bone Superphosphate	....	....	1.74	5.19	1.21	2.14	2.38	4.40	25.94	36.00	10.06
1010	Chittenden's Fish and Potash	....	....	2.48	.37	2.60	3.46	4.91	3.38	24.94	36.00	11.06
977	Bowker Fertilizer Co's Hill and Drill Phosphate	....	.19	1.62	5.40	1.77	3.58	1.59	2.93	28.80	40.00	11.20

* See page 23.

Nitrogenous Superphosphates.— *Continued.*

Station No.	NAME.	Nitrogen of Nitrates.	Nitrogen of Ammonia Salts.	Nitrogen of Organic Matters.	Soluble Phos. Acid.	Reverted Phos. Acid.*	Insoluble Phos. Acid.	Potash.	Chlorine.	Estimated value per ton.	Cost per ton.	Cost exceeds valuation.
923	Russell Coe's Ammoniated Bone Superphosphate	----	----	2.00	6.63	1.20	1.58	1.27	2.43	$28.69	$40.00	$11.31
896	Buffalo Fertilizer and Chemical Works' Ammoniated Bone Superphos.	----	----	2.87	6.20	1.18	3.14	1.16	1.35	33.49	45.00	11.51
983	Dole's Common Sense Fertilizer, No. 3	----	.43	2.21	.97	4.26	1.26	4.93	4.43	27.06	40.00	12.94
901	Bowker Fertilizer Co's Brighton Phosphate	----	----	1.37	6.90	1.20	1.61	1.71	3.72	26.78	40.00	13.22
960	Cook's Blood Guano	----	1.05	.74	5.84	1.56	.91	1.48	1.72	26.56	40.00	13.44
907	New Haven Fertilizer Co's Superphosphate	1.18	----	.93	5.59	.88	2.87	1.98	1.22	27.83	42.00	14.17
999	Hurtado & Co's No. 1, Peruvian Guano, Lobos	----	3.63	.74	.99	6.82	9.28	1.88	.86	48.52	63.00	14.48
861	G. W. Miller's Raw Bone Superphosphate	----	----	2.80	3.16	3.57	4.10	5.13	----	34.82	50.00	15.18
1008	G. W. Miller's Raw Bone Superphosphate	----	----	2.88	2.80	3.29	4.08	5.86	5.53	34.55	50.00	15.45
984	Dole's Common Sense Fertilizer, No. 2	----	.70	.65	.55	3.51	2.16	2.69	2.61	18.34	35.00	16.66
994	Mitchell's Standard Superphosphate	----	.10	.86	5.97	.90	1.33	2.85	7.87	23.07	40.00	16.93
980	B. D. Sea Fowl Guano	----	.76	1.89	7.31	1.44	2.48	3.35	3.39	36.85	------	-----
846	Geo. W. Miles Co's I. X. L. Phosphate	----	----	2.04	7.11	.75	3.51	1.61	----	31.80	------	------
844	G. W. Miller's Raw Bone Phosphate	---	3.74	3.08	2.80	3 21	2.80	5.91	----	33.84	------	------
845	G. W. Miles Co's "C" Island Dry Fish Guano	----	----	4.32	2 47	3.09	2.09	2.52	----	34.89	------	------
847	G. W. Miles Co's Fish and Potash, XX	----	----	2.89	4.81	1.55	2.11	3.60	----	31.94	------	------

* See page 23.

Comparison of Analyses of Superphosphates of the same Brand, and of the Analyses with the Guarantee.

Station No.	Name or Brand.		Nitrogen.	Phosphoric Acid — Soluble.	Phosphoric Acid — Reverted.†	Phosphoric Acid — Insoluble.	Potash.
		Guaranteed	2.5–3.3	10–12			2–3
904	Baker's A. A. Superphosphate	Found	2.6	9.9	.2	.4	2.6
920			2.7	8.8	.7	.5	2.8
869			2.5	8.5	.6	.6	2.9
		Guaranteed	2.3–3.1	7–10		2–3	1.5–2.5
922	Bradley's Superphosphate	Found	2.8	8.2	1.2	2.4	1.9
868			2.8	8.0	1.3	2.6	2.0
		Guaranteed	2.5–4.1	6–8*			4–6
863	Chittenden's Fish and Potash	Found	2.9	.3	4.4	1.9	4.7
1010			2.5	.4	2.6	3.5	4.9
		Guaranteed	2.5–3.5	5–8			3–5
1001	Miles Co's Fish and Potash	Found	2.7	3.9	1.6	1.9	3.8
897			2.6	4.7	1.2	2.7	3.7
847			2.9	4.8	1.6	2.1	3.6
		Guaratneed	2–3	8–12			1–3
1005	Miles Co's Superphosphate	Found	2.0	7.0	1.1	3.1	1.9
898			2.3	7.0	1.3	3.1	1.8
846			2.0	7.1	.8	3.5	1.6
		Guaranteed	3.1	6.0		2.8	5.9
1008	Miller's Superphosphate	Found	2.9	2.8	3.3	4.1	5.9
861			2.8	3.2	3.6	4.1	5.1
844			3.1	2.8	3.2	2.8	5.9

* Total Phosphoric Acid. † See page 23.

Comparison of Analyses of Superphosphates of the same Brand, and of the Analyses with the Guarantee—*Continued.*

Station No.	Name or Brand.		Nitrogen.	Phosphoric Acid: Soluble.	Phosphoric Acid: Reverted.‡	Phosphoric Acid: Insoluble.	Potash.
		Guaranteed	2.5–3.5	8–10		1–3	2–3
921	Quinnipiac Fertilizer Co's Phosphate	Found	3.5	7.5	2.3	1.8	2.7
886			3.0	5.8	3.1	2.3	2.0
1023			3.0	5.8	2.0	2.0	2.9
1013			3.5	5.2	1.8	2.5	2.8
925			2.8	2.7	6.0	3.2	2.2
		Guaranteed	3.3–4.3	3–5		2.0	3–5
885	Quinnipiac Fish and Potash	Found	4.3	.8	4.1	3.6	4.4
1015			4.1	.6	4.8	3.0	4.7
		Guaranteed	1.7–2.7	10–12		3	*2½–4
923	Russell Coe's Superphosphate	Found	2.0	6.6	1.2	1.6	1.3
893			2.6	6.6	.8	1.4	1.2

Comparison of the Analyses of Nitrogenous Superphosphates with the Guarantee.

Station No.	Name or Brand.		Nitrogen.	Phosphoric Acid: Soluble.	Phosphoric Acid: Reverted.‡	Phosphoric Acid: Insoluble.	Potash.
		Guaranteed	2–2.9	8–10			2–4
891	Chittenden's Universal Phosphate	Found	2.5	7.6	.9	.8	2.6
		Guaranteed	1.6–2.5	6–8		2	2–3
866	Chittenden's Ammoniated Bone Superphosphate	Found	1.7	5.2	1.2	2.1	2.4
		Guaranteed	4–6			10–12†	5–6
1011	Darling & Co's Animal Fertilizer	Found	3.9	1.2	5.3	8.7	4.7

* As Sulphate. † Total Phosphoric Acid. ‡ See page 23.

Comparison of the Analyses of Nitrogenous Superphosphates with the Guarantee—*Continued.*

Station No.	Name or Brand.		Nitrogen.	Phosphoric Acid: Soluble.	Phosphoric Acid: Reverted.†	Phosphoric Acid: Insoluble.	Potash.
		Guaranteed	3–6			4–6*	3–5
984	Dole's Common Sense Fertilizer, No. 2	Found	1.4	.6	3.5	2.2	2.7
		Guaranteed	3–6			5–7*	4–6
983	Dole's Common Sense Fertilizer, No. 3	Found	2.6	1.0	4.3	1.3	4.9
		Guaranteed	1.6–2.5	9–12		2–3	
924	E. Frank Coe's Ammoniated Bone Superphosphate	Found	2.2	7.3	2.2	3.7	
		Guaranteed	2–3	8–11			2–3.5
887	Glidden & Curtis' Soluble Pacific Guano	Found	2.0	5.1	1.7	5.7	2.5
		Guaranteed	2.9	4.9	7.1	2.7	
969	Harris' Pure Bone Phosphate	Found	2.9	5.5	3.2	5.7	
		Guaranteed	6.6–7.4			13–15*	5
998	Hurtado & Co's Alkalized Guano	Found	6.8	.6	5.3	8.2	5.3
		Guaranteed					
988	Hurtado & Co's No. 1 Peruvian Guano, Standard	Found	8.1	5.1	2.7	4.8	.9
		Guaranteed	4.9				
999	Hurtado & Co's No. 1 Peruvian Guano, Lobos	Found	4.4	1.0	6.8	9.3	1.9
		Guaranteed	1.6–2	8–10		2–3	1.5–2
954	Lister Bros. Ammoniated Dissolved Bone Phosphate	Found	1.7	9.8	1.0	.9	1.9
		Guaranteed					
964	Mapes' Peruvian Guano	Found	4.9	5.7	6.4	10.	5.4
		Guaranteed	2.5–3.3	10–12		2–4	2.5–3.5
918	Mapes' Complete Manure ("A" Brand)	Found	2.7	7.6	2.9	3.2	2.9
		Guaranteed	5–6.6			7–9*	6–8
974	Mapes' Complete Manure (for light or sandy soils)	Found	5.3	6.0	1.8	1.1	6.6

* Total Phosphoric Acid. † See page 23.

Comparison of the Analyses of Nitrogenous Superphosphates with the Guarantee—*Continued.*

Station No.	Name or Brand.		Nitrogen.	Phosphoric Acid—Soluble.	Phosphoric Acid—Reverted.‡	Phosphoric Acid—Insoluble.	Potash.
994	Mitchell's Standard Superphosphate	Guaranteed	1.6–2.9			8–10*	2–3
		Found	1.0	6.0	.9	1.3	2.9
956	Atlantic & Virg. Fert. Co's Ammon. Superphos. of Lime	Guaranteed	.8–1.6		8–11	2–3	5.7
		Found	1.0	7.0	1.8	2.6	5.3
958	Atlantic & Virginia Fert. Co's Orient Complete Manure	Guaranteed	1.6		8		1
		Found	.9	7.3	1.7	3.0	1.5
971	Bosworth Bro's Superphosphate of Lime	Guaranteed	2–2.5		11–13	2–5	2–3
		Found	1.8	4.8	3.7	7.9	2.2
997	Bowker's Dissolved Bone	Guaranteed	1.6–2.5		8–10	2	2–4†
		Found	1.7	7.4	.9	2.1	2.7
900	Bowker Fertilizer Co's Fish and Potash	Guaranteed	2.5–3.5			8–10*	4–6
		Found	2.5	2.9	2.5	2.1	4.1
977	Bowker Fertilizer Co's Hill and Drill Phosphate	Guaranteed	2–2.9		8–10	2	2–4†
		Found	1.8	5.4	1.8	3.6	1.6
901	Bowker Fertilizer Co's Brighton Phosphate	Guaranteed	1.6–2.5		7–9	2	4–6†
		Found	1.4	6.9	1.2	1.6	1.7
896	Buffalo Fertilizer Co's Ammoniated Bone Superphosphate,	Guaranteed	2.5–3.5		8–10	1–2	2–3†
		Found	2.9	6.2	1.2	3.1	1.2
980	B. D. Sea Fowl Guano	Guaranteed	2.5–3.2	7–8	2–3	2–3	2–3
		Found	2.7	7.3	1.4	2.5	3.4
962	Bradley's Original Coe's Superphosphate of Lime	Guaranteed	2.1–2.9	7–8	2–3	2–3	
		Found	2.8	8.6	1.4	3.1	.3
957	Baker's Pelican Bone Fertilizer	Guaranteed	1.8–2.3		8–10		2.2–2.7
		Found	2.2	7.1	1.3	.6	2.7

* Total Phosphoric Acid. † As Sulphate. ‡ See page 23.

Comparison of the Analyses of Nitrogenous Superphosphates with the Guarantee—*Continued.*

Station No.	Name or Brand.		Nitrogen.	Phosphoric Acid—Soluble.	Phosphoric Acid—Reverted.†	Phosphoric Acid—Insoluble.	Potash.
912	Church & Co's Menhaden Guano	Guaranteed	4.7		4.9		.3
		Found	5.0	1.8	3.2	1.1	.3
961	Clark's Cove Guano Co's Bay State Fertilizer	Guaranteed	2.1–2.8		8–11	3	2–3
		Found	2.9	9.0	1.0	1.1	3.1
982	Clark's Cove Guano Co's Great Planet Brand "A"	Guaranteed	2.5–3.3		7–8		9–11
		Found	3.1	6.8	.3	1.8	8.9
960	Cook's Blood Guano	Guaranteed	1.6–2.5		7	3	
		Found	1.8	5.8	1.6	.9	1.5
845	Miles Co's "C" Island Dry Fish Guano	Guaranteed					
		Found	4.3	2.5	3.1	2.1	
907	New Haven Fertilizer Co's Superphosphate	Guaranteed					
		Found	2.1	5.6	.9	2.9	2.0
952	Preston's Ammoniated Superphosphate	Guaranteed	2.5–3.5		10–12	1–2	2
		Found	2.0	6.5	1.2	3.3	1.1
967	Quinnipiac Fertilizer Co's Fish and Potash (plain brand)	Guaranteed	2–3		4–6	2	4–6
		Found	2.6	.7	4.4	4.1	5.4
927	Read & Co's Farmer's Friend Fertilizer	Guaranteed	1.6–2		8–10	2	.8–1
		Found	2.2	7.1	.9	2.0	1.5
991	World of Good Ammoniated Bone Superphosphate	Guaranteed	1.6–2		8–10	2	
		Found	1.9	8.6	1.7	3.6	
955	Williams, Clark & Co's Ammoniated Bone Superphos.	Guaranteed	1.6–2.5	6–8	3–4	1–3	1–2
		Found	2.3	7.0	1.1	5.0	2.4

† See page 23.

Special Fertilizers.

Station No.	Name or Brand.	Manufacturer.	Dealer.	Sampled and Sent by
972	Tobacco Manure (for use with stems).	Mapes' F. & P. G. Co., New York.	Mapes' F. & P. G. Co's Br'ch, Hart.	Station Agent.
965	Complete Tobacco Manure.	H. J. Baker & Bro., "	----------	" "
1043	Chittenden's Fertilizer for Corn and other Grain.	Nat'l Fertilizer Co., Bridgeport.	John S. Kirkham, Newington.	Dealer.
992	Grass Manure.	H. J. Baker & Bro., New York.	Olds & Whipple, Hartford.	Station Agent.
975	Potato Manure.	Mapes' F. & P. G. Co., "	R. B. Bradley & Co. N. Haven.	" "
1046	Chittenden's Potato Fertilizer.	Nat'l Fertilizer Co., Bridgeport.	Manufacturer.	John S. Kirkham, Newington.
1045	Chittenden's Tobacco Fertilizer.	" " "	"	" " "
882	Tobacco Fertilizer, Conn. Brand.	Mapes' F. & P. G. Co., New York.	David Beers, Danbury.	Station Agent.
1003	Stockbridge Seeding-Down Manure.	Bowker Fert. Co., Boston, Mass.	J. A. Paine, Danielsonville.	" "
926	Matchless Tobacco Manure.	Read & Co., 34 Beaver St., N. Y.	A. C. Sternburg, Hartford.	" "
959	Potato Fertilizer.	Lister Bros., Newark, N. J.	R. B. Bradley & Co., N. Haven	" "
1044	Potato Manure.	Mapes' F. & P. G. Co., New York.	Mapes' Branch, Hartford.	John S. Kirkham, Newington.
906	Corn Manure.	H. J. Baker & Bro., "	Tolles & McEwen, Naugatuck.	Station Agent.
905	Potato Manure.	" " "	"	" "
913	Chittenden's Root Fertilizer.	Nat'l Fertilizer Co., Bridgeport.	Manufacturer.	" "
914	Chittenden's Grain Fertilizer.	" " "	"	" "
979	Stockbridge Grain Manure.	Bowker Fert. Co., N. Y. & Boston.	E. A. Watrous, Meriden.	" "
976	Stockbridge Forage Crop Manure.	Bowker Fertilizer Co., New York.	J. A. Paine, Danielsonville.	" "
973	Grass and Grain Spring Top Dressing.	Mapes' F. & P. G. Co., "	R. B. Bradley & Co., N. Haven.	" "
902	Stockbridge Manure for Corn.	Bowker Fertilizer Co., "	Apothecaries' Hall, Waterbury.	" "
895	Potato, Hop and Tobacco Phosphate.	Buffalo Fert. and Chemical Works.	Ruggles & Clark, Shelton.	" "
899	Stockbridge Grass Top Dressing and Forage Crop Manure.	Bowker Fertilizer Co., New York.	Apothecaries' Hall, Waterbury.	" "
903	Stockbridge Manure for Potatoes and Vegetables.	" " "	" "	" "
1000	Bowker's Lawn Dressing.	Bowker Fert. Co., Boston & N. Y.	E. A. Watrous, Meriden.	" "
989	English Lawn Fertilizer.	Wm. L. Bradley, Boston, Mass.	J. L. Butler, Torrington.	" "

Special Fertilizers—*Continued.*

Station No.	Name.	Nitrogen of Nitrates.	Nitrog. of Ammonia Salts.	Nitrog. of Organic Matters.	Phosphoric Acid. Soluble	Reverted.*	Insoluble.	Potash.	Chlorine.	Estimated value per ton.	Cost per ton.	Cost exceeds Valuation
972	Mapes' Tobacco Manure (for use with stems)	1.20	2.90	1.21	7.52	2.08	1.31	4.35	1.02	$52.24	$54.00	$ 1.76
965	Baker's Tobacco Manure	.10	4.15	.60	3.41	1.52	.39	9.03	.77	47.22	50.00	2.78
1043	Chittenden's Fertilizer for Corn and other Grain,	----	3.25	1.39	7.71	.91	.60	5.59	4.14	47.18	50.00	2.82
992	Baker's Grass Manure	----	4.30	.57	4.33	.96	1.22	8.19	8.04	44.47	47.50	3.03
975	Mapes' Potato Manure	.45	1.58	2.52	5.44	3.44	1.84	6.39	4.06	47.27	51.00	3.73
1046	Chittenden's Potato Fertilizer	----	3.14	1.00	7.69	.59	.62	5.07	.67	46.15	50.00	3.85
1045	Chittenden's Tobacco Fertilizer	----	3.31	.89	7.27	.97	.60	4.98	.71	46.02	50.00	3.98
882	Mapes' Tobacco Manure, Conn. Brand	2.98	1.86	.57	4.88	2.76	1.20	6.70	1.02	49.45	54.00	4.55
1003	Stockbridge Seeding-Down Manure	.36	----	3.01	6.45	1.01	3.46	5.88	4.83	40.25	45.00	4.75
926	Read & Co's Matchless Tobacco Manure	2.96	1.86	.32	5.66	1.17	1.24	4.18	1.75	43.36	50.00	6.64
959	Lister's Potato Fertilizer	----	.79	3.00	7.30	.83	.74	8.43	7.88	43.36	50.00	6.64
1044	Mapes' Potato Manure	.70	2.14	1.06	3.90	3.19	4.25	6.72	3.75	44.25	51.00	6.75
906	Baker's Corn Manure	----	3.38	.77	6.10	.40	.78	7.91	9.79	42.84	50.00	7.16
905	Baker's Special Potato Manure	----	2.59	.67	6.87	.67	.43	9.76	7.75	41.55	50.00	8.45
913	Chittenden's Root Fertilizer	.09	----	3.74	6.33	1.07	1.27	6.49	5.79	40.24	50.00	9.76
914	Chittenden's Complete Manure for Grain	.11	----	3.73	7.02	.86	1.09	5.15	4.86	40.11	50.00	9.89
979	Stockbridge Grain Manure	.48	.13	2.78	6.43	.99	3.39	5.31	5.10	39.70	†50.00	10.30
976	Stockbridge Forage Crop Manure	.21	.17	2.91	6.48	.77	3.61	4.06	2.08	39.11	50.00	10.89
973	Mapes' Grass and Grain Spring Top Dressing	1.47	.66	1.98	4.32	2.77	2.67	5.98	4.97	40.83	52.00	11.17
902	Stockbridge Corn Manure	----	----	3.83	6.63	.49	2.57	2.79	3.93	38.44	50.00	11.56
895	Buffalo Fert. & Chem. Works, Pot., Hop & Tob. Phos.	----	----	2.11	6.74	.77	2.08	4.74	4.32	32.30	45.00	12.70
899	Stockbridge Grass Top Dressing & Forage Crop Man.,	1.86	----	2.18	5.85	.55	1.49	4.05	3.72	36.45	50.00	13.55
903	Stockbridge Potato and Vegetable Manure	----	----	2.94	5.86	.79	1.83	6.10	4.05	35.45	50.00	14.55
1000	Bowker's Lawn Dressing	1.65	.21	2.06	6.10	.53	4.18	4.11	3.50	39.95	‡	----
989	Bradley's English Lawn Fertilizer	4.30	----	.11	5.78	1.14	0.97	3.42	3.80	36.32	----	----

* See page 23. † Reckoned from cost per bag of 200 lbs. ‡ $3.00 per bag of 100 lbs.

Special Fertilizers or "Formulas."

Thirty-one samples of this class of nitrogenous superphosphates have been analyzed during the year; a part of them for private parties. The analyses and valuations of those which have general interest are given on pages 44 and 45. Numbers **989** and **1000** are Lawn Fertilizers. The demand for them is relatively small and they are usually sold in lots of 100 to 200 lbs. Ton prices are not given.

Leaving out of account these lawn fertilizers, the average cost of 23 special fertilizers has been $49.98, the average estimated value $42.53 and the difference between cost and valuation $7.45.

For the last four years the average cost and the difference between cost and valuation have been as follows:

	1880.	1881.	1882.	1883.
Cost,	48.00	48.04	50.22	49.98
Difference between cost and valuation,	3.35	4.93	3.29	7.45

It will be noticed that the average difference between the cost and valuation of the special fertilizers is about one dollar per ton more than what it is in the case of the ammoniated superphosphates: that is, the fertilizing ingredients have been cheaper the past year in the latter than in the former goods.

On page 47 is a table compiled from all the analyses of the special manures there named, which have been made in this Station and in the New Jersey Station since 1878. It shows the average composition of each brand as well as the fluctuations in the composition of each. It also shows that there is no uniform and striking difference between the composition of fertilizers which are claimed to be specially adapted to the demands of one particular crop and the composition of those made for another crop. The term "special" is meaningless and there is no apparent reason for calling one of the samples an Onion manure rather than a corn or potato manure, for it would be impossible for any one to decide from its composition either what crop it was best suited for, or for what crop its manufacturer designed it. The special manures are to be regarded simply as superphosphates of higher grade than others. Their cost is greater, their estimated value is higher, and pound for pound they may fairly be expected to produce a larger yield than goods of lower grade.

Corn Manure.

	No. of Analyses.	Nitrogen. Av.	Max.	Min.	Phos. Acid.* Av.	Max.	Min.	Potash. Av.	Max.	Min.
H. J. Baker's	3	4.5	5.0	4.2	5.6	5.8	5.4	8.0	9.5	8.0
Forrester's	6	4.9	5.5	3.9	6.6	8.0	5.3	9.8	14.6	6.6
Mapes'	8	3.7	4.0	3.4	9.4	11.7	5.4	7.0	11.2	4.6
Stockbridge's	7	4.8	6.2	3.8	6.1	7.4	3.8	6.0	7.0	3.9
Williams, Clark & Co's	1	5.2			5.2			6.0		

Potato Manure.

H. J. Baker's	4	4.7	7.4	3.5	5.4	6.3	4.9	10.3	12.9	9.1
Forrester's	7	4.5	5.7	3.4	6.0	7.6	5.3	10.2	11.4	9.0
Lister's	1	4.1			7.2			9.0		
Mapes'	5	3.7	3.9	3.4	8.0	10.3	4.6	8.0	14.8	5.0
Stockbridge's	7	3.3	3.5	2.9	7.0	7.6	6.4	6.3	10.2	4.9
Williams, Clark & Co's	3	2.9	3.3	2.5	6.2	7.3	5.4	10.7	11.9	8.6

Tobacco Manure.

H. J. Baker's	2	4.6	4.7	4.4	3.9	5.2	2.7	10.3	12.0	8.6
Forrester's	1	5.5			3.9			9.7		
Mapes'	4	5.0	5.9	3.6	7.1	7.8	5.6	6.3	9.0	4.4
Stockbridge's	2	5.9	6.1	5.7	3.8	6.1	1.4	6.5	7.4	5.6

Onion Manure.

H. J. Baker's	1	5.0			6.2			9.6		
Forrester's	5	6.2	7.4	5.1	5.1	6.2	4.5	6.7	7.4	5.7
Mapes'	1	5.7			6.2			7.5		
Stockbridge's	2	3.5	3.9	3.1	5.9	6.4	5.3	8.1	8.3	7.9

Bone Manures.

Method of Valuation.

For the benefit of those who have not the previous reports of the Station at hand, a detailed account of the method employed for the valuation of bone manures is here given, being in large part reproduced from former Reports.

Experience has led us to distinguish, for the purpose of valuation, five grades of ground bone, the proportions of which are found by a mechanical analysis, *i. e.*, by passing a weighed sample of the bone through a system of four sieves. These five grades have the dimensions, and during 1883, have had the trade-values below specified, viz:

* Soluble and reverted.

1883.

Grade.	Dimensions.	Estimated value per pound. Nitrogen.	Phos. Acid.
Fine,	smaller than one $\frac{1}{60}$ inch,	17 cts.	6 cts.
Fine medium,	between $\frac{1}{60}$ and $\frac{1}{25}$ inch,	15 "	5½ "
Medium,	" $\frac{1}{25}$ and $\frac{1}{12}$ inch,	14 "	5 "
Coarse medium,	" $\frac{1}{12}$ and $\frac{1}{6}$ inch,	13 "	4½ "
Coarse,	larger than $\frac{1}{6}$ inch,	11 "	4 "

The chemical and mechanical analysis of a sample of ground bone being before us, we separately compute the nitrogen value of each grade of bone which the sample contains, by multiplying the pounds of nitrogen per ton in the sample by the per cent. of each grade, taking $\frac{1}{100}$th of that product, multiplying it by the estimated value per pound of nitrogen in that grade, and taking this final product as the result in cents. Summing up the separate values of each grade, thus obtained, together with the values of each grade for phosphoric acid, similarly computed, the total is the estimated value of the sample of bone.

To illustrate, Rogers and Hubbard's Raw Knuckle Bone, A, Extra fine, No. **860,** contains 3.92 per cent. of nitrogen or 78.4 lbs. per ton, and 23.61 per cent. of phosphoric acid or 472.2 lbs. per ton. The mechanical analysis showed:

Fine,	35 per cent.
Fine medium,	33
Medium,	24
Coarse medium,	8
Coarse,	0
	100

The calculations are as follows:

$$78.4 \times 35 \div 100 \times 17 = \$4.67$$
$$78.4 \times 33 \div 100 \times 15 = 3.88$$
$$78.4 \times 24 \div 100 \times 14 = 2.63$$
$$78.4 \times 8 \div 100 \times 13 = .82$$

Estimated value of nitrogen, $12.00

$$472.2 \times 35 \div 100 \times 6 = \$9.92$$
$$472.2 \times 33 \div 100 \times 5\tfrac{1}{2} = 8.57$$
$$472.2 \times 24 \div 100 \times 5 = 5.67$$
$$472.2 \times 8 \div 100 \times 4\tfrac{1}{2} = 1.70$$

Estimated value of phosphoric acid, $25.86

$37.86

The result agrees with the cost price ($37.50) within 36 cents.

When the sample of bone contains foreign matters introduced as preservatives, dryers or adulterants, such as salt, salt-cake, niter-cake, ground oyster-shells, spent lime, plaster, or soil, these must be taken account of in the mechanical analysis, especially since they would be likely, on sifting, to pass chiefly or entirely into the finer grades. In such cases, the several grades as obtained by sifting must be separately examined, and the amounts of foreign matter which they contain must be suitably taken into the account if an *exact* valuation is desired.

A single examination of this kind has been made in the case of No. **884** Lister's Celebrated Ground Bone, which contains a considerable quantity of salt cake and some salt. A second mechanical analysis was made, agreeing essentially with the one given on page 53, and nitrogen and phosphoric acid were determined in each of the grades. The results were as follows reckoned on 100 lbs. of bone.

Grade.	Pounds per 100.	Per cent. of nitrogen.	Pounds of nitrogen. Per 100 lbs. bone.	Per cent. of phos. acid.	Pounds of phos. acid. Per 100 lbs. bone.
Fine,	45	1.54	.69	9.27	4.19
Fine medium,	15	2.39	.41	13.82	2.07
Medium,	17	2.92	.50	14.39	2.44
Coarse medium,	18	2.92	.53	17.46	3.15
Coarse,	5	3.35	.17	19.94	1.00
	100		2.30		12.85

The total nitrogen (2.30 pounds per hundred) and the total phosphoric acid (12.85 pounds per hundred) agree reasonably well with the amounts found by the usual method of analysis, viz: nitrogen, 2.41; phosphoric acid, 12.55. It will be seen that the percentage amount of nitrogen and phosphoric acid in the coarsest portion is more than twice that in the finest portion, which shows that the most of the foreign material—salt, salt-cake, etc.—sifts out with the finer part of the bone. Now, in computing the estimated value, nitrogen and phosphoric acid have a valuation which is higher in the finer grades (see page 24), and it is assumed that the percentage composition of all the grades is alike. If, as in this case, the finer grades have a lower percentage of nitrogen and phosphoric acid than the coarser, the valuation will be too high. To see whether the error is a considerable one, the valuation has been recalculated from the amounts of nitrogen and phosphoric acid actually found in each grade, and is $20.06 per

ton, while calculated in the usual way it is $20.78. The difference, 72 cents, is inconsiderable; less than might be expected between two samples of the same brand.

Even where the bone is unmixed with a dryer or adulterant, it may often happen that the proportions of nitrogen and phosphoric acid are not the same in the finer and coarser portions.

There is, however, a limit beyond which it is useless to attempt to refine the processes of valuation. When they become too complicated or costly, they defeat the object which they should serve. It is sufficient that the errors of valuation are no greater than those which arise from unavoidable variations in different portions of the same lot of fertilizer, or in different lots of the same brand. A difference of two or three dollars between cost and estimated value cannot ordinarily demonstrate that either is out of the way.

Bone Manures.

Analyses.

The analyses and valuations of 23 samples will be found on pages 52 and 53.

986 was quite wet, which explains its low percentage of nitrogen and phosphoric acid. It would be excellent material for composting or immediate application to land, but could not be transported far nor stored without loss.

939 is a waste product from the glue factory. A large part of the nitrogenous animal matter has been extracted, leaving it poor in nitrogen and correspondingly rich in phosphoric acid. It retails in New York at $30.00 per ton, and freight to Southport is $1.00; but farmers, by making up an order for a lot of 10 tons, got it for $29.50 on the dock at Southport.

985 is very coarse, 90 per cent. of it being held on a sieve with one-sixth inch meshes. It is doubtful if it deserves as high a valuation as has been given it.

1016 is manufactured by the Adamson process. The water and grease are nearly or entirely removed by the vapor of benzine, leaving the bone dry, brittle and porous.

The average cost per ton of ground bone in the samples examined this year is $35.88; the average estimated value, $32.95; and the difference between cost and valuation, $2.93.

"Rotted Bone."

871. From stock of James H. Baker, 104 Clymer street, Brooklyn. Sent by E. Hoyt, New Canaan.

Analysis and Valuation.

Water,	29.04
Sand and insoluble,	22.02
Nitrogen,	2.65
Phosphoric acid,	1.59
Estimated value per ton,	$14.10
Cost in New York,	$16.00

On the Solubility of Bone in Ammonium Citrate.

It is known that a very small part of the phosphoric acid of bones may be extracted from them with cold water, while a large amount is taken up by solution of ammonium citrate,* which is used to remove the so-called "reverted" phosphoric acid from superphosphates. Seventeen samples of bone have been extracted with ammonium citrate solution in order to learn their average solubility in it, and also to find out whether the phosphoric acid of bone which has been mixed with salt or salt-cake is more soluble than that of pure bone. Two grams of the bone, in the condition in which it came to the Station, were digested with 100 c. c. of neutral Am. Cit. solution (Sp. gr., 1.09) for half an hour at 40° C., shaken every five minutes, and then filtered at once. The samples are arranged according to their fineness, and the results are given on page 54.

An examination of the figures shows that on the average 18.9 per cent. of the phosphoric acid in the pure bones was soluble, 81.1 per cent. insoluble in Am. Cit. The solubility was greater in the finer bones *on the average.* In those which had no particles larger than one-twelth inch, the average solubility was 24.1 per cent. Where all the particles were smaller than one-sixth inch it was 19.1 per cent.; while in the coarser samples it was 10.2 per cent. The solubility is doubtless affected by other things than the fineness. The amount of grease present, the character of the bone, whether hard (from factories where bone is worked) or soft, and the method of grinding, all have an effect in hindering or helping the solvent action of water or ammonium citrate.

* This is the substance formed by saturating or neutralizing the acid of lemons by ammonia.

Bone Manures.

Station No.	Name or Brand.	Manufacturer.	Dealer.	Sampled and Sent by
1016	Swift Sure Bone Meal.	M. L. Shoemaker & Co., Phila.	F. Ellsworth, Hartford.	F. Ellsworth, Hartford.
939	Peter Cooper's No. 2 Bone.	Peter Cooper's Glue Factory.	Manufacturer.	E. S. Spring, Green's Farms.
892	Ground Bone.	F. C. Slade, Oakville.	"	F. C. Slade, Oakville.
883	Wilson's Pure Bone Flour.	Wilson, Norwalk.	Raymond Bros., South Norwalk.	Station Agent.
908	Ground Bone.	E. Smith, South Canterbury.	Manufacturer.	Manufacturer.
986	Damp Bone Sawings.	Rogers & Hubbard Co., Middletown.	"	"
860	Raw Knuckle Bone, "A" Extra Fine.	Rogers & Hubbard Co., Middletown.	"	"
950	Ground Bone.	M. McNamara, Trumbull.	"	J. H. Jennings, Green's Farms.
981	Bosworth Bros. Ground bone.	Bosworth Bros., Putnam.	"	Manufacturer.
1009	Bone, Grade "A" Extra Fine.	Rogers & Hubbard Co., Middletown.	Southmayd & Gardiner, Middletown.	Station Agent.
859	Raw Knuckle Bone, "Meal."	Rogers & Hubbard Co., Middletown.	Manufacturer.	Manufacturer.
1050	Ground Bone.	P. W. Bennett, Rock Fall.	"	"
1004	Pure Ground Raw Knuckle Bone, Grade Meal.	Rogers & Hubbard Co., Middletown.	Southmayd & Gardiner, Middletown.	Station Agent.
1012	Darling's Fine Ground Bone.	L. B. Darling & Co., Pautucket, R. I.	J. P. Barstow & Co., Norwich.	" "
985	Ground Bone.	W. P. Lawrence, Millbrook.	Manufacturer.	Manufacturer.
1007	Miller's Bone.	G. W. Miller, Middlefield.	C. E. Chapman, Westbrook.	Station Agent.
995	Bowker's Fine Ground Bone.	Bowker Fertilizer Co., Boston and New York.	E. A. Watrous, Meriden.	" "
970	Harris & Son's Ground Bone.	G. H. Harris & Son, Eagleville.	Manufacturer.	" "
990	Thompson & Edwards' Pure Fine Ground Bone.	Thompson & Edwards, Chicago.	J. S. Wells, Hebron.	" "
953	Peck Bros.' Pure Ground Bone.	Peck Bros., Northfield.	G. H. Alford & Co., Winsted.	" "
884	Lister's Celebrated Ground Bone.	Lister Bros., Newark, N. J.	Raymond Bros., South Norwalk.	" "
951	Ground Bone.	Preston Fertilizer Co., Greenpoint.	J. B. Merrow & Sons, Merrow.	" "
996	Crescent Bone.	Lister Bros., Newark, N. J.	J. P. Barstow & Co., Norwich.	" "

Bone Manures—Analyses and Valuations.

Station No.	Name.	Nitrogen.	Phos. Acid.	Finer than $\frac{1}{50}$ inch.	Finer than $\frac{1}{25}$ inch.	Finer than $\frac{1}{12}$ inch.	Finer than $\frac{1}{6}$ inch.	Coarser than $\frac{1}{6}$ inch.	Estimated value per ton.	Cost per ton.	Valuation exceeds Cost.
1016	Shoemaker's Swift Sure Bone Meal	6.61	19.84	60	35	5	0	0	$52.58	$45.00	$7.58
939	Peter Cooper's No. 2 Bone	1.67	28.99	35	18	27	20	0	35.99	28.50	7.49
892	Slade's Ground Bone	3.97	23.52	17	24	27	23	9	35.25	32.00	3.25
883	Wilson's Pure Bone Flour	3.92	23.61	19	29	52	----	----	36.85	35.00	1.85
908	Smith's Ground Bone	4.38	20.86	24	33	26	17	----	35.27	34.00	1.27
986	Rogers & Hubbard Co's Damp Bone Sawings	2.00	15.89	95	5	----	----	----	25.73	25.00	.73
860	" " " Raw Knuckle Bone, "A" Extra Fine	3.92	23.61	35	33	24	8	----	37.65	37.50	.15
											Cost exceeds Valuation.
950	McNamara's Ground Bone	4.03	20.32	19	15	24	32	10	31.70	31.75	.05
981	Bosworth Bros.' Ground Bone	3.68	22.17	32	38	25	4	1	35.54	36.00	.46
1009	Rogers & Hubbard Co's Bone, Grade A Extra Fine	3.84	24.48	19	16	52	13	----	36.69	37.50	.81
859	" " " Raw Knuckle Bone, "Meal"	3.87	23.36	50	43	7	----	----	39.04	40.00	.96
1050	Bennett's Ground Bone	3.09	24.32	16	18	24	22	20	32.58	34.00	1.42
1004	Rogers & Hubbard Co's Pure Gr'd Raw Kn'le Bone, Meal	3.97	23.80	35	33	32	----	----	38.48	40.00	1.52
1012	Darling's Fine Ground Bone	3.28	23.77	72	21	7	0	0	38.43	42.00	3.57
985	Lawrence's Ground Bone	3,95	22.55	0	1	3	6	90	27.28	32.00	4.72
1007	Miller's Bone	3.95	24.47	15	21	49	15	----	36.80	42.00	5.20
995	Bowker's Fine Ground Bone	3.27	22.82	49	19	21	11	----	35.40	42.00	6.60
970	Harris & Son's Ground Bone	3.82	19.17	----	2	17	39	42	26.30	33.00	6.70
990	Thompson & Edwards' Pure Fine Ground Bone	1.25	22.40	66	20	10	4	----	29.76	38.00	8.24
953	Peck Bros.' Pure Ground Bone	3.60	20.22	9	18	31	28	14	29.69	40.00	10.31
884	Lister Bros.' Celebrated Ground Bone	2.41	12.55	47	17	16	20	----	21.12	33.00	11.88
951	Preston's Ground Bone	3.56	10.65	38	17	16	13	16	21.68	35.00	13.32
996	Lister Bros.' Crescent Bone	1.76	11.57	50	15	15	15	5	18.01	32.00	13.99

The three samples, **996, 884** and **951,** all have an acid reaction, doubtless due to bisulphate of soda in the salt-cake which has been added to them. It was to be expected, therefore, that the phosphoric acid in them would be more soluble than in pure bone; 45.6 per cent. of their phosphoric acid on the average is soluble, and 54.4 per cent. insoluble. One of them, **884,** furnishes more soluble phosphoric acid, pound for pound, than pure bone, but less than half as much insoluble phosphoric acid and less than two-thirds as much nitrogen.

Solubility of Bone in Ammonium Citrate.

Station No.	Mechanical Analysis.					Soluble in Am. Cit.	Insoluble in Am. Cit.
	Fine $\frac{1}{50}$ in.	Fine medium $\frac{1}{25}$ in.	Medium $\frac{1}{12}$ in.	Coarse medium $\frac{1}{6}$ in.	Coarse.		
859	50	43	7	0	0	6.60	16.76
1012	72	21	7	0	0	6.75	17.02
990	66	20	10	4	0	3.73	18.80
981	32	38	25	4	1	3.12	19.07
1004	35	33	32	0	0	4.41	19.39
860	35	33	24	8	0	5.00	18.61
908	24	33	26	17	0	6.46	14.40
939	35	18	27	20	0	6.72	22.27
883	19	29	52	0	0	4.88	18.73
1007	15	21	49	15	0	2.90	21.57
1009	19	16	52	13	0	2.72	21.76
950	19	15	24	32	10	1.25	19.07
953	9	18	31	28	14	2.43	17.79
970	0	2	17	39	42	1.69	17.48
996	50	15	15	15	5	3.52	8.00
884	47	17	16	20	0	7.75	4.80
951	38	17	16	13	16	4.73	5.92

Dry Ground Fish.

[See next page.]

A part of the samples analyzed contained acidulated fish scrap making it desirable to determine the amount of soluble and reverted phosphoric acid. To make a fair comparison of the several brands, all have been treated in the same way.

865. Chittenden's Dry Ground Fish was valued at $45.51 per ton in Bulletin No. 73 (p. 13). The higher valuation given to soluble and reverted phosphoric acid raises its valuation to $47.51 per ton.

Fish Fertilizers.

Station No.	Name or Brand.	Manufacturer.	Dealer.	Sampled and Sent by
865	Chittenden's Fine Ground Fish.	National Fert. Co., Bridgeport.	Manufacturer.	Station Agent.
968	Dry Ground Fish.	Quinnipiac Fert. Co., N. London,	R. B. Bradley & Co., N. Haven.	"
1020	Mapes' Dry Ground Fish.	Mapes' F. & P. G. Co., N. Y. City.	Manufacturer.	Wm. C. Newton, Durham.
1006	Geo. W. Miles' Dry Fish Guano.	Geo. W. Miles Co., Milford.	F. Ellsworth, Hartford.	Station Agent.
1014	Dry Ground Fish.	Quinnipiac Fert. Co., N. London.	Olds & Whipple, Hartford.	Olin Wheeler, Buckland.
978	Bowker's Dry Ground Fish.	Bowker Fert. Co., N. Y. & Boston.	Coburn & Gale, Hartford.	Station Agent.
963	Preston & Son's Dried and Ground Fish Guano.	Preston & Sons, Greenpoint, L. I.	Wilson & Burr, Middletown.	"

Fish Fertilizers.

Station No.	Name.	Nitrogen of Ammonia Salts.	Nitrogen of Organic Matters.	Soluble Phos. Acid.	*Reverted Phos. Acid.	Insoluble Phos. Acid.	Estimated value per ton.	Cost per ton.	Valuation exceeds Cost.
865	Chittenden's Fine Ground Fish	----	8.35	1.21	1.96	2.75	$47.51	$45.00	$2.51
968	Quinnipiac Fertilizer Co's Dry Ground Fish	----	8.50	1.33	3.43	2.22	50.17	48.00	2.17
1020	Mapes' Dry Ground Fish	.15	6.99	.42	2.94	3.80	43.11	42.00	1.11
1006	Geo. W. Miles' Dry Fish Guano	----	7.75	1.27	3.02	2.54*	46.32	46.00	.32
									Cost exceeds Valuation.
1014	Quinnipiac Fertilizer Co's Dry Ground Fish	----	7.66	.87	2.95	3.25	45.77	46.00	.23
978	Bowker Fertilizer Co's Dry Ground Fish	.40	5.23	1.03	4.65	2.65	39.03	45.00	5.97
963	Preston & Son's Dried and Ground Fish Guano	1.04	1.90	2.96	1.72	.84	24.42	35.00	10.58

*See page 23.

963. Preston Sons' Dried and Ground Fish Guano contains rather less phosphoric acid and very much less nitrogen than is usually found in dried fish scraps.

The average cost of the samples analyzed (excepting **963**) is $45.33 per ton, the average estimated value $45.32.

Nitrate of Soda.

928. From stock of Mapes' Conn. Valley Branch, Hartford, stated not to be on sale in Connecticut.

941. Quinnipiac Fertilizer Co., New London. From stock of Wilson & Burr, Middletown. Sampled by J. M. Hubbard, Middletown.

Analyses.	928	941
Nitrogen,	15.48	15.46
Equivalent nitrate of Soda,	94.00	93.90
Cost,	$70.00	67.00
Nitrogen costs per 100 lbs.,	$22.61	21.67

Sulphate of Ammonia.

929. Sulphate of Ammonia from stock of Mapes' Connecticut Valley Branch, Hartford. Stated not to be on sale in Conn.

1018. Sulphate of Ammonia from Mapes F. & P. G. Co., New York. Sampled and sent by Michael Donovan, South Windsor.

Analyses.	929	1018
Nitrogen,	20.74	20.34
Equivalent sulphate of ammonia,	97.78	95.70
Cost per 100 lbs.,	$4.75	4.75
Nitrogen costs per 100 lbs.,	$22.90	$23.35

Both samples were of good quality. **1018** had a slight bluish tinge, due probably to the presence of a trace of cyanogen compounds insoluble in water. It contained no soluble cyanogen compounds [cyanides or sulphocyanides.] The soluble cyanides are poisonous to vegetation if applied in considerable quantity, but it is likely that their poisonous quality has been somewhat over-estimated. Maercker* found that one per cent. of ammonium sulphocyanide in a superphosphate did no damage, and 89 lbs. of it to the acre did not injure oats. Schumann on the other hand found that 178 lbs. per acre did serious injury to grass land.

* Centralblatt Ag. Chem., 1883, p. 497

Meat and Plaster.

919. Made by the Quinnipiac Co., of Wallingford. The sample consists of about $\frac{1}{3}$ meat and $\frac{2}{3}$ plaster. It contains 20.28 per cent. of water, 1.9 per cent. of nitrogen and about 65 per cent. of plaster. Allowing 18 cents per lb. for the nitrogen and 40 cents per 100 lb. for the plaster, its estimated value is $12.04 per ton.

Cotton Seed and Castor Pomace.

Analyses and Valuations.

880. Castor Pomace, manufactured by Robert B. Brown Oil Co., St. Louis, Mo. Sampled and sent by Geo. D. Martinez, General Agent.

935. Castor Pomace, manufactured by the Collier White Lead and Oil Co., St. Louis, Mo. Sampled from stock of Olds & Whipple, Hartford, by Station Agent.

966. Castor Pomace manufactured by H. J. Baker & Bro. Sampled from stock of A. W. Allen, Jr., Thompsonville, by Station Agent.

1002. I. X. L. Pomace, manufactured by Robt. B. Brown Oil Co., St. Louis, Mo. Sampled from stock of F. Ellsworth, by Station Agent.

876. Cotton Seed Meal, from the stock of G. C. Richards & Co., Unionville. Sampled and sent by Wm. Smith, Plainville.

1053. Cotton Seed Meal, from stock of E. Ellsworth, Hartford. Sampled and sent by H. S. Frye, Poquonock.

1054. Cotton Seed Meal, from stock of E. Ellsworth, Hartford. Sampled and sent by A. E. Holcomb, Poquonock.

Analyses and Valuations.

Station No.	Nitrogen.	Phosphoric Acid.	Potash.	Estimated value per ton.	Cost per ton.
880	5.64	1.87	.93		$23.00
935	5.76	2.07	1.03	$24.10	23.00
1002	5.50	2.10	1.06	23.22	23.00
966	4.58	1.59	1.07	19.31	20.00
876	6.95	2.51	1.91	29.65	31.00
1053	7.39	2.84	1.24	31.06	30.00
1054	7.25	3.07	1.37	30.94	30.00

Potash Salts.

Analyses and Valuations.

[See page 60.]

Four of the samples analyzed are high grade muriates, supplying potash at 3.9 to 4.4 cents per pound, and seven are kainit in which the potash costs from 5.8 to 7.4 cents per pound, or 6½ cents on the average.

During last spring kainit sold in N. Y. in ton lots at point of shipment for cash, at from $10 to $12.60. This included bags and cartage. (Bulletin XXVII, N. J. Experiment Station.) It was therefore possible for farmers in the central and western parts of the State at least, to get it for considerably less than $15 to $18, the price charged by Connecticut dealers.

Below are given complete analyses of the three potash fertilizers which are most used here at the present time. The analyses of Muriate of Potash and Double Sulphate of Potash and Magnesia were made by Dr. Goessmann, and published in Bulletin No. 3, of the Mass. Experiment Station, pp. 5 and 6. The kainit is No. **937**, analyzed at this Station.

Analyses of Potash Salts.

	Muriate.	Potash and magnesia sulphate.	Kainit.
Moisture at 100°,	2.88	4.90	15.30
Potash,	50.35	24.94	12.23
Soda,	8.33	2.09	16.05
Lime,		1.15	.43
Magnesia,	.40	11.30	11.16
Oxide of iron and alumina,			.25
Sulphuric acid,	.18	46.99	22.26
Chlorine,			27.98
Insoluble matter,	.60	.54	.26
Other matters not specified in the analysis,	37.26*	8.09	
			105.92
Deduct oxygen equivalent to chlorine,			6.31
	100.00	100.00	99.61

From these analyses it appears that the high grade muriate consists of about 80 per cent. of potassium chloride (muriate), 16 per cent. of sodium chloride (salt), and 4 per cent. of water and

* Mostly Chlorine.

various other matters. The double sulphate of potash and magnesia contains 46 to 47 per cent. of potassium sulphate, 33 to 34 per cent. of magnesium sulphate, 5 per cent. of water and 15 per cent. of sulphates of soda and lime, and other matters. Kainit contains about 85 per cent. of sulphates and chlorides of potassium, sodium and magnesium and 15 per cent. water.

Saltpeter Refuse.

853. From stock of S. J. Archer, 194 Duane street, New York. Sampled and sent by S. S. Green, New Milford, Ct.

Analysis.

*Nitric acid (N_2O_5),	4.44
Chlorine,	54.41
Potash,	4.27
Soda,	48.21
Insoluble matters,	.88
	112.21
Deduct oxygen equivalent to chlorine,	12.26
	99.95

* Nitrogen 1.15.

The compounds probably existing in this refuse are:

Potassium nitrate (saltpeter),	8.31
Potassium chloride,	.61
Sodium chloride (salt),	90.20
Insoluble matter,	.88
	100.00

It is a mixture of nine parts of salt and less than one part of saltpeter and is probably a waste product from some manufacturing process. Its cost is $10 per ton on cars in New York. Allowing 4¼ cents per lb. for the potash and 20 cents per pound for the nitrogen, its estimated value would be $8.23. It could be safely used only in moderate quantity since for every pound of saltpeter applied, 10 pounds of salt would also be applied. [If the price were lower, those who *salt* their meadows would find this an excellent material for the purpose.]

Potash Salts.

Station No.	Name.	Importer.	Dealer.	Sampled and Sent by
931	Muriate of Potash.	H. J. Baker & Bros., New York.	Southmayd & Gardiner, Middletown.	Station Agent.
930	" " 80 per cent.	----------	Mapes' Conn. Valley Branch, Hartford.	" "
943	" "	Quinnipiac Fertilizer Co., New London.	Wilson & Burr, Middletown.	J. M. Hubbard, Middletown.
932	" "	H. J. Baker & Bros., New York.	S. J. Hall, Meriden.	Station Agent.
933	Acorn Brand German Potash Salts.	Williams, Clark & Co., N. Y.	F. Ellsworth, Hartford.	"
938	Kainit.	H. J. Baker & Bros., New York.	H. K. Brainard, Thompsonville.	J. Thompson, Broad Brook.
940	"	Bowker Fertilizer Co.	"	"
937	" (Leopoldshall).	----------	Mapes' Branch, Hartford.	Station Agent.
917	"	----------	Navassa Phosphate Co., N. Y.	J. M. Millbank, Greenfield Hill.
934	"	Quinnipiac Fertilizer Co., New London.	Olds & Whipple, Hartford.	Station Agent.
936	"	----------	Usher & Tinker, Plainville.	" "

Analyses.

	931	930	943	932	933	938	940	937	917	934	936
Potash	54.26	57.82	52.29	51.55	12.59	12.97	11.80	12.23	12.24	12.45	11.52
Equivalent Muriate of Potash	85.94	91.58	82.82	81.65	----	----	----	----	----	----	----
" Sulphate of Potash	----	----	----	----	23.30	23.98	21.80	22.62	22.63	23.09	21.30
Cost	$42.00	45.00	42.00	45.00	15.00	15.00	15.00	18.00	16.00	15.00	17.00
Potash costs per 100 lbs.	$ 3.87	3.89	4.01	4.36	5.90	5.78	6.36	7.36	6.54	6.02	7.38

Plaster.

894. Plaster; ground by Knickerbocker Plaster Mills, New York; sold by Ruggles & Clark, Shelton, Ct. Sampled by Station Agent.

949. Plaster.

1028. Double Ground Land Plaster. J. B. King & Co., New York. From stock of R. B. Bradley & Co., New Haven.

849. Nova Scotia Land Plaster, ground by G. W. Miller, Middlefield.

858. Nova Scotia Land Plaster, ground by V. C. & C. V. King, New York City.

850. Onondaga Land Plaster, ground by E. B. Alvord & Co., Jamesville, N. Y.

1029. A. A. Union Ground Plaster, Whitmore Bros., Boston. From stock of J. A. Paine, Danielsonville.

1030. Nova Scotia Land Plaster, Newburgh Plaster Works, N. Y. From stock of Wilcox & Judd, Bristol.

1031. Pure Ground Nova Scotia Plaster, John Hurd, Bridgeport. From stock of G. H. Alvord & Co., Winsted.

949, 849, 858, and **850** were sent by Harvey Elliott, North Guilford, the other samples were taken by Station agents.

It will be noticed that **894** and **949** consist of burned and unburned plaster in approximately equal proportions.

Onondaga Plaster, **850,** contains, as usual, over 20 per cent. of carbonates. The Nova Scotia variety is a purer sulphate of lime. **1030** has a larger percentage of carbonate than is commonly present in Nova Scotia plaster.

A correspondent inquires:

"1st. What is the comparative value of Cayuga and Nova Scotia plaster as fertilizers?

"2d. Are the carbonates found in Cayuga plaster of any value in agriculture, and if so, how much?"

It was replied in substance: Commercially considered, the plaster that gives us the most sulphate of lime for the money is the best, provided the pulverization is equal; agriculturally the same is true in general. Carbonate of lime sometimes, no doubt, may act well where sulphate of lime would be pronounced useless and in such a case the Cayuga plaster would be better than the Nova

PLASTER-ANALYSES.

	894	949	1028	849	858	850	1029	1030	1031
Sulphuric acid	52.20	52.08	46.08	43.65	43.98	34.38	44.66	40.84	44.86
Water	8.57		19.30				19.85	18.47	20.02
Insoluble in acids	.98	.51	.54	1.88	2.67	4.64	2.56	.99	2.57
Lime		(36.61)							
Undetermined	1.71	.56	1.81	4.28	2.77	†21.44	1.43	†11.20	0.97
Hydrated sulphate of lime (gypsum)	40.94	48.88	92.21	93.84	94.56	73.92	96.01	87.81	96.46
Sulphate of lime (anhydrite or burned plaster)	56.37	50.05	5.44						
	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
Pure gypsum equivalent to total sulphate of lime	112.23	111.97	99.07						
Cost per ton	$11.50	....	*$15.00	$8.00	$5.50	$6.00	$10.00	$8.00	$9.00

* Reckoned from price per bag of 200 lbs.

† Chiefly carbonate of lime.

Scotia. But carbonate of lime is much commoner and ought to be much cheaper than sulphate; so that there is entire propriety in insisting on the superiority of a pure over an impure article in any *general* statement or comparison. If a farmer ordering ground plaster should have ground limestone supplied him at $8 to $10 per ton he would feel abused even though the result on his crops were as good as it would have been had he got what he ordered. Carbonate may help the crops and at the same time outrage the moral sense.

LIMESTONE ROCK.

Four samples of this material have been analyzed at the request of Professor B. F. Koons of the Storrs Agricultural School.

Professor Koons has kindly communicated the following particulars with regard to them, as well as the analysis of a fifth sample made by Professor J. H. Washburn of the Storrs School.

ANALYSES OF LIMESTONES.

	Near Bolton Notch. 944	Near Bolton Notch. 945	Lebanon. 946	N. W. of Norwich. 947	No. Stonington. Analysis by Prof. J. H. Washburn.
Insoluble in acids,	1.73	80.26	46.51	32.24	4.39
Oxide of iron and alumina,	1.50	5.71	4.78	7.56	2.57
Lime,	53.51	6.67	26.65	22.82	31.17
Magnesia,	.54	.98	.92	.60	17.80
Phosphoric acid,	.07	.09	.09	.15	
Carbonic acid and undetermined matter,	42.65	6.29	21.05	16.63	44.07
	100.00	100.00	100.00	100.00	100.00
Carbonate of lime,	95.56	11.91	47.59	40.75	55.66
Carbonate of magnesia,	1.13	2.06	1.93	1.26	37.38

"Nos. **944** and **945** are from a large layer occurring on the east side of the ridge through which the N. Y. and N. E. railroad cuts at Bolton Notch, about twelve miles east of Hartford.

"No. **945** was taken from the walls of the cut where the layer is about fifty feet thick and resembles the adjoining massive and schistose rocks so much that it was only by the aid of acid that the presence of lime was detected. At the center of this layer the effervescence was very decided with dilute hydrochloric acid, but this character was less marked as the top or bottom of the layer

was approached. I am not certain as to just where in the fifty feet layer No. 945 was taken, although I think from near the middle.

"No. **944** comes from a series of old abandoned hydromica slate quarries on the east side of the ridge extending for half a mile or more south from the railroad cut. The quarries have exposed the limestone in considerable quantities, yet at no place could I find the whole thickness of the layer as it is in the cut at the railroad.

"The stone varies considerably in character, some of it resembling that exposed in the cut, and again in places thin layers of highly crystalline, almost pure white, limestone occur. No. **944** comes from one of these layers about three inches thick. Just to the north of the railroad there is a larger bluff of this limestone and the outcrop can be traced a mile or more to the north.

"No. **946** was taken from a line of boulders in the town of Lebanon. These may have been carried there from the outcrop near Willimantic, possibly from Bolton, yet the direction of the line would indicate that they came from neither of these localities, but from some place not yet discovered, between these, and to the north of where the boulders are found.

"No. **947** is from a very extensive bed about three miles to the northwest of the city of Norwich. This doubtless is the most extensive exposure of limestone in Eastern Connecticut, as the outcrop extends two and a half or three miles along the brow of a hill, and at an old "Gold Mine" a layer fifty feet thick is exposed. The rock is deceptive in appearance, looking much like gneiss and has a great deal of feldspar, intermingled also in large veins.

"Professor Forrest Shepherd showed me where some lime, burned in an indifferent way from this outcrop, and spread in a careless manner upon a grass field near the city had caused a yield of from four to six times as much grass as grew where the lime had not been placed.

"This limestone has easy transportation down hill to the railroad.

"The purest limestone of eastern Connecticut that occurs in abundance is found in very extensive beds on the line between Preston and North Stonington. The accompanying analysis by Prof. J. H. Washburn, of the Storrs Agricultural School, exhibits the chemical composition of a sample. (See Table of Analyses.) This limestone has a bluish tint, is said to cut like Italian marble, and is admired for its strength and durability. It is densely crystalline so as to exclude moisture, hence frost has but little effect upon it.

"Lime was burned here a great many years ago, and from Prof. Forrest Shepherd, with whom I visited the locality, I learn that the cement (made from this lime) having suffered eighty years' exposure, still remains firm.

"The limestone near Willimantic is underrated as to its extent in the account given of it in the Station Report for 1881, pp. 58, 59. I have made several visits to the locality, and find the beds much thicker than there reported. At one place there is a horizontal surface of fifty feet exposed, and the layers have a dip of twenty-two degrees, which would give us a bed of over eighteen feet in thickness instead of *three* feet as stated.

"The Norwich and North Stonington limestone beds are destined to become of great value to the agricultural interests of eastern Connecticut as a source of fertilizing material. The North Stonington deposits would also appear to have considerable value for architectural purposes.

Mansfield, Conn., Nov. 28th, 1883."

Rock from a Ledge in New Canaan.

With regard to this material, Edwin Hoyt, of New Canaan, wrote as follows:

"The stone came from a ledge on the land of one of our farmers, which he has had ground in the past, and finds it to make very green and luxuriant grass. * * * He says it grinds as easily as plaster, and thinks it better as a fertilizer."

The analysis is as follows:

	1027
Water at 100°,	2.15
Combined water,	9.60
Sand and undecomposed silicates,	16.19
Silica from decomposable silicates,	26.44
Oxide of iron and alumina,	8.65
Lime,	7.63
Magnesia,	24.35
Potash,	.32
Soda,	trace
Carbonic acid,	5.30
Phosphoric acid,	.04
	100.67

To Mr. Hoyt was written in substance as follows:

The excess (.67) over 100 per cent. is due to slight and unavoidable errors of analysis. The rock consists essentially of 16 per cent. of quartz and silicates which are not attacked by strong acids, 12 per cent. of carbonate of lime, and 72 per cent. of hydrous silicates of iron, alumina, lime and magnesia, with a little potash. Applied to land it would supply a considerable quantity of magnesia, probably in a form readily available to plants. It is not likely, however, that soils in your part of the State are at all deficient in magnesia, and its favorable effect on land is rather to be attributed to its furnishing lime; perhaps, also, to its mechanical action as an "amendment" and to the presence of the hydrous silicates, which have important uses in the soil, both as a source of plant food and in absorbing and retaining plant food which might otherwise pass into the subsoil out of the reach of vegetation.

Quick Lime.

Two samples of quick lime were sent by R. E. Pinney, Suffield, with the inquiry, Which is the cheaper for agricultural use?

910. Barrel lime. Costs $13.00 in Suffield.

911. Paper mill lime. Costs $10.00 to $10.50 in Suffield.

Analyses.	910	911
Insoluble in acid,	1.40	2.85
Carbonic acid,	.30	.25
Lime,	55.33	85.08
Combined water,	3.36	6.15
Magnesia,	*36.37	5.67
Other matters by difference,	3.24	
	100.00	100.00

910 is probably made from Canaan limestone, which is a carbonate of lime and magnesia (dolomite). More than one-third of it is magnesia. **911** contains nearly 30 per cent. more lime than **910.** The former is therefore the better of the two at the same price.

Waste Lime from Paper Works.

854. From F. Whittlesey's paper mill, Windsor Locks. Sampled and sent by R. E. Pinney.

Analysis.	
Insoluble in acid,	1.99
Oxide of iron and alumina,	.87
Lime,	45.08
Carbonic acid,	5.95
Combined water,	12.06
Water at 100°,	33.19
Undetermined,	.86
	100.00

It contains in round numbers 50 per cent. of slaked lime, 13½ per cent. of carbonate of lime, 33 per cent. of water, and 3½ per cent. of other matters. This sample had dried out somewhat before reaching the Station; the fresh material is a paste. Two and a half tons of it would not yield more slaked lime than one ton of paper mill lime **911.**

Infusorial Earth.

870. Sent by Ellis Bagley, Branford, as a "marl."

872. Sent by Joseph Sellers, Portland. Taken from the bed of a pond which dried up in the Summer. It forms a layer four to five feet deep under a bed of muck eighteen inches deep.

Analyses.	870	872
Silica and sand,	94.70	92.07
Loss on ignition (organic matter and water),	2.57	4.44
Oxide of iron and alumina,	2.18	3.49
Undetermined,	.55	
	100.00	100.00

These samples have no fertilizing value. The silica in them consists in part of the siliceous "skeletons" of a low order of vegetable life, which is aquatic. Such material, when free from sand, is used for fine polishing.

Ashes of Cotton Seed Hulls.

To prepare cotton seed for grinding and pressing, it is "decorticated" or hulled. The hulls make up about half the entire weight of the seed. They have no value as food, and at the mills are used for fuel in connection with wood or coal. As the analyses show, the ash of the hulls burned alone or with some wood is very

valuable as a fertilizer, containing over 20 per cent. of potash and 9 to 13 per cent. of phosphoric acid.

When burned with coal the ashes would be of very inferior value or worthless. When the ashes of the hulls can be got clean from coal ash, they are well worth the price which has been asked for them.

Below are given the analyses of two samples made here during the year, the average of seven analyses of cotton hull ashes from the market and an analysis of the pure ash, free from any wood ashes, sand, coal and carbonic acid, made by Dr. C. W. Dabney, Jr. (Rep. N. C. Exp't Station, 1882, p. 99):

	852	909	Average composition.	Pure ash of Hull.
Potash,	25.83	26.79	21.89	57.95
Lime,				7.28
Magnesia,				15.53
Oxide of iron,				1.87
Alumina,				0.45
Phosphoric acid,	12.95	9.65	10.11	4.07
Sulphuric acid,				4.18
Soluble silica,				1.67
Chlorine,				2.39
Soda, undetermined and loss,				4.61
Water,	5.69	12.10	15.02	
Insoluble in acid,		11.63	12.45	
				100.00

The solubility of the phosphoric acid in **852** and **859** was as follows:

	852	909
Phosphoric acid, soluble in water,	.90	3.49
" " " in ammonium citrate,	7.96	5.39
" " insoluble in water and am. cit.,	4.09	.77
	12.95	9.65

Composition of House Ashes.

1026. Ashes from 46¾ lbs. of Gray Birch from Holderness, N. Hampshire. The wood was 2–6 inches diameter, 18 inches long and well seasoned. The ash as analyzed weighed 1 lb. 1⅛ oz.

1032. Ashes from 105¾ lbs. of well seasoned hickory wood. Sticks 2 feet long, 2–7 inches diameter. The ash weighed 2 lbs. 2 oz.

1040. Ashes from 105¼ lbs. of well seasoned oak wood. Sticks 2 feet long, 1½ to 6 inches diameter. The ash weighed 1 lb. 1½ oz.

1051. Ashes from 55½ lbs. of well seasoned chestnut wood. Sticks 1 foot long, 6–12 inches diameter. Cut on the Station land one year ago. The ashes weighed 4 4/10 oz.

1032 and **1040** were from wood bought of a dealer in New Haven and probably grown in this State.

All of these woods were burned on a clean brick hearth without the addition of any other kind of fuel. The bits of charcoal, left from the fire were sifted out and burned by themselves and the ash from them was added to the other. With these analyses are given analyses of ashes from the same kinds of wood which were prepared by G. H. Glover, Esq., of North Branford, in a stove, and noticed in the report of this Station for 1879, page 45. [Nos. **253, 254, 255.**] The amount of insoluble matter [sand, etc.] in them is much larger than in the others.

Next in the table is given the average of 13 analyses of wood from household fires as reported by Dr. F. H. Storer (Bull. Bussy Institution, part III, 1874, p. 193).

The last column of the table represents the average composition of unleached Canada ashes calculated from 13 analyses published in Bulletins II and IV of the Massachusetts Agricultural Experiment Station.

	Birch.	Hickory.		Oak.		Chestnut.		Average of 13 analyses by Storer.	Canada Ashes Unleached.
	1026	1032	255	1040	254	1051	253		
Potash	8.15	7.54	4.56	9.26	9.37	3.96	3.07	8.50	5.77
Soda	.43	1.57	.53	1.38	1.92	.92	.42		
Lime	35.31	42.60	36.29	43.20	29.65	39.72	29.15		38.99
Magnesia	4.36	6.51	5.71	4.28	3.65	5.82	9.63		
Oxide of Iron and Alumina,	.73	.56	2.79	.98	3.73	2.61	5.21		
Phosphoric acid	2.30	2.19	1.63	1.92	2.42	1.69	2.51	2.04	1.17
Sulphuric acid	.39	.90	.99	.96	1.88	1.08	2.46		
Chlorine		.16	.19	.63	1.49		.17		
Carbonic acid	26.72	31.65	23.22	27.45	16.57	24.00	12.80	25.53	
Sand and Silica	10.30	3.70	18.09	7.15	22.07	15.80	26.70	6.97	7.07
Charcoal	6.65	.88	1.51	.85	1.97	2.40	3.26		
Water	4.05	1.93	4.49	1.35	5.28	1.80	4.62		11.40
Undetermined	----	----		----	----	----	----	----	----
	99.39	100.19	100.00	99.41	100.00	99.80	100.00		
Per cent. of crude ash in the wood	2.27	2.01		1.04		.50			

The two samples of chestnut ashes differ remarkably from oak, birch and hickory ashes in having very much less potash. A

large number of analyses would be necessary to decide whether this difference is more than an accidental one. Canada ashes apparently have rather less potash and phosphoric acid than clean burned birch, hickory and oak, and less than the average of ashes from house fires as found by Dr. Storer.

A cord of hickory wood, as we are informed by wood dealers in this city, weighs from 3400 to 4300 lbs. and on the average about 3500 lbs. A cord of oak wood weighs from 2300 to 2400 lbs. The weight of birch and chestnut wood per cord could not be ascertained.

From these figures and the analyses, the amounts of potash and phosphoric acid recoverable in the ashes of a cord of oak and of hickory are found to be as follows:

	Oak.	Hickory.
Potash,	2.3	4.3 lbs.
Phosphoric acid,	.5	1.3

Leached Wood Ashes.

1024. Made by J. F. Bartlett, Winsted. From stock of J. L. Bartlett, Simsbury. Sampled and sent by L. G. Goodrich, Simsbury.

1038. From stock of J. E. Wardwell, Southport.

1039. From stock of N. Alvord, Southport.

The last two samples were sent by E. C. Birge of Southport.

Analyses.

	1024	1038	1039
Potash,	1.33	1.54	1.41
Soda,	1.30	.78	.63
Lime,	24.69	26.92	26.85
Magnesia,	2.63	2.70	2.10
Oxide of iron and alumina,	4.16	2.27	2.17
Phosphoric acid,	1.86	1.24	1.15
Sulphuric acid,	0.19		
Carbonic acid,	16.39	17.25	16.94
Insoluble in acids and silica,	15.60	10.19	5.81
Charcoal,	2.61	2.67	1.81
Water,	28.58	33.03	39.65
Undetermined and loss,	.66	1.41	1.48
	100.00	100.00	100.00
Weight of one bushel,		63 lbs.	62 lbs.
Cost per bushel,	19c.	14c.	14c.

All the samples are of good quality.

Swamp Muck.

842. Peat, No. 1. Taken from the middle of a swamp. The layer was over 8 feet deep.

843. Peat, No. 2. Taken from the edge of a swamp. The layer 3 feet deep.

These two samples were sent by G. M. Denison, New London, Conn.

857. Muck sent by A. P. Hine, Torrington, Conn.

1017. Muck sent by Prof. B. F. Koons of the Storrs Agricultural School, Mansfield, Conn.

Analyses.

The fresh material contains—	842	843	857	1017
Water,	85.46	74.47	75.03	79.49
Organic and volatile matters,	13.88	10.21	17.31	18.38
Ash,	.66	15.32	7.66	2.13
	100.00	100.00	100.00	100.00
With nitrogen,	.23	.32	.46	.47
The ash contains—				
Silica and insoluble,	.30	14.38	7.25	1.12
Oxide of iron, alumina, and phosphoric acid,		.52	.15	.26
Lime,	.12	.17	.16	.43
Magnesia,				.11
Undetermined,	.24	.25	.11	.22
	.66	15.32	7.66	2.13
The dry muck contains—				
Organic and volatile matters,	95.46	39.95	69.32	89.62
Nitrogen,	1.58	1.24	1.84	2.30
Silica and insoluble,	2.08	56.32	29.03	5.45
Oxide of iron, alumina, etc.,		2.04	.56	1.26
Lime,	.82	.68	.64	2.10

Review of the Fertilizer Market.

Organic nitrogen in dried blood and azotin was quoted in New York *at wholesale* in November, 1882, at $19.70 to $20.10 per 100 pounds. The same prices ruled through December and January. Since then its cost in dried blood has steadily declined, and in November, 1883, stood at from $13.70 to $15.20. From March till August the cost in azotin remained at $18.90, then dropped again, and in November, 1883, it was quoted at $15.20 per 100 pounds.

According to thirteen analyses of ammonite, dried blood and fish scrap, made at the New Jersey Station in the Spring of 1883,* the average retail cost of nitrogen in those articles was $20.08 per 100 pounds.† The highest price was $22.90; the lowest, $15.50. These were *manufacturers' cash retail prices* for ton lots, including bags, but not freightage nor the charges of middlemen.

The cost of nitrogen in dried fish scrap, containing from 5.3 to 8.3 per cent. of phosphoric acid and from 2.9 to 8.5 per cent. of nitrogen, from the stock of *retail agents* in this State, has ranged from $22.70 to $48.26 per 100 pounds.

Rejecting this highest figure the average retail cost in six articles has been $24.54.

Nitrogen in four samples of castor pomace from *retail agents* in this State has cost from $17.05 to $18.76 per 100 pounds, averaging $17.79; and the average cost in three samples of cotton seed meal has been the same, $17.81.

Nitrogen in ammonia salts cost *at wholesale* in New York, in November, 1882, $22.20 per 100 pounds. Since then it has quite steadily declined, and was quoted in November last at $16.40.

In the New York and Philadelphia markets it cost *at retail in ton lots*, including packages, from $19.75 to $21.50 per 100 pounds;‡ average cost, $20.78.

Two samples from the stock of *retailers* in this State furnished nitrogen at $22.90 and $23.35.

* Bulletin XXVII, N. J. Exp't Station.

† Allowing six cents per pound for the phosphoric acid present in the goods.

‡ Bulletin XXVII, N. J. Exp't Station.

Nitrogen in nitrates has this year, as last, cost less at wholesale than in any other form. In November, 1882, it was quoted at *wholesale* in New York at $17.60 per 100 pounds. In January it rose to $17.90, fell again in May to $16.30, declined still further in the Summer, and in November, 1883, stood at $15.20 per 100 pounds.

Last Spring in New York and Philadelphia it was bought of *importers at retail in ton lots* at from $18.40 to $20.60 per 100 pounds, $19.65 on the average.

The two samples analyzed here from stock of *retail dealers* in this State furnished nitrogen at $22.61 and $21.67 per 100 pounds.

Phosphatic materials have not shown striking fluctuations. The wholesale New York quotation for *bone black* in November, 1882, was $24.50 per ton. It remained at that figure till March, declined to $21.50 in June, and has since remained steady at $22.00.

Charleston rock, crude, in New York, was quoted at $9.00 per ton in January, 1882. It fell to $8.50 in March, and still remains at that figure.

Ground bone, quoted at $33.50 in November, 1882, rose in April to $35.00, and declined in June to $32.00, where it still remains.

Sulphuric acid, 66°, was quoted at 1½ cents per pound from November, 1882, to July, 1883, and since then has been quoted at 1⅜ cents.

In plain superphosphates, containing over ten per cent. of soluble phosphoric acid, the latter has cost* $9.80 per 100 pounds *at retail for cash*, bought of the manufacturers. No allowance is made for reverted and insoluble phosphoric acid. Such an allowance would make the soluble acid cost still less.

Only two analyses of plain high grade superphosphates from the open market have been made at this Station during the year. They furnished soluble phosphoric acid at $10.02 to $11.20 per 100 pounds.

Actual potash in high grade muriate cost in New York *at wholesale* in December, 1882, $3.58 per 100 pounds, which is the highest figure for the year. In November, 1883, it was quoted at $3.20. It has *retailed* in Connecticut during 1883 for $3.87 to $4.36 per 100 pounds.

* Average of nine analyses, Bulletin XXVII, N. J. Exp't Station.

Kainit has not fallen in price. In December, 1882, it cost *at wholesale* in New York $8.62 per ton; it has been as low as $7.47, but in November last was quoted at $8.75, the highest price of the year.

Since kainit contains on the average 12½ per cent. of actual potash, the wholesale cost of potash in kainit at $8.75 per ton is $3.50 per 100 pounds. Its *retail price* in ton lots in New York and Philadelphia* was, last Spring, $4.52 per 100 pounds, but in this State it has retailed as high as $7.38.

To recapitulate: Charleston rock has remained steady, bones and bone black have fallen slightly, and oil of vitriol is a shade lower perhaps, but in general we may say that phosphoric acid is not much cheaper this year than last.

Tankage, red and black blood, azotin, nitrate of soda and sulphate of ammonia have all fallen very considerably in price. It should be, and will be possible by using care in buying, to get them at a less cost than a year ago.

Potash as muriate is a little lower this year than last; as kainit it is at present a shade higher.

The market quotations given above are taken from the "Oil, Paint and Drug Reporter," published in New York. The weekly quotations for each month are averaged, and this average is taken as the quotation for the month. The following explanations will be helpful in the examination of the market quotations, and will also serve to show the basis on which they have been interpreted in this review:

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

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

Blood, azotin and ammonite are quoted at so much "per unit of ammonia." A "unit of ammonia" is one per cent., or 20 pounds per ton. To illustrate: if a lot of dried blood has 7.0 per cent. of nitrogen, equivalent to 8.5 per cent. of ammonia, it is said to contain 8½ units of ammonia, and if it is quoted at $3.75 per unit, a ton of it will cost $8\frac{1}{2} \times 3.75 = \$31.88$.

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

* Bulletin XXVII, N. J. Exp't Station.

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

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

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

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

At	5	cents	per lb.	Nitrogen costs	24.4	cents per lb.
"	4⅞	"	"	"	23.7	"
"	4¾	"	"	"	23.1	"
"	4⅝	"	"	"	22.5	"
"	4½	"	"	"	21.9	"
"	4⅜	"	"	"	21.3	"
"	4¼	"	"	"	20.7	"
"	4⅛	"	"	"	20.1	"
"	4	"	"	"	19.5	"
"	3⅞	"	"	"	18.9	"
"	3¾	"	"	"	18.3	"
"	3⅝	"	"	"	17.6	"
"	3½	"	"	"	17.0	"
"	3⅜	"	"	"	16.4	"
"	3¼	"	"	"	15.8	"
"	3⅛	"	"	"	15.2	"
"	3	"	"	"	14.6	"

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

If quoted at	3⅜	cents per lb.	Nitrogen costs	23.2	cents per lb.
"	3½	"	"	22.3	"
"	3⅜	"	"	21.5	"
"	3¼	"	"	20.8	"
"	3⅛	"	"	19.9	"
"	3	"	"	19.2	"
"	2⅞	"	"	18.3	"
"	2¾	"	"	17.6	"
"	2⅝	"	"	16.9	"
"	2½	"	"	16.0	"
"	2⅜	"	"	15.2	"
"	2¼	"	"	14.4	"
"	2⅛	"	"	13.6	"
"	2	"	"	12.8	"

Commercial muriate of potash usually has 80 per cent. of the pure salt, or 50½ per cent. of actual potash.

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

The following table shows the fluctuations in the wholesale prices of a number of fertilizing materials in the New York market, during the last 27 months. The price given for each month is the average of the four weekly quotations in that month. Sulphate of ammonia is assumed to contain 20.5 per cent. and nitrate of soda 15.6 per cent. nitrogen, and muriate of potash 50½ per cent. of actual potash or 80 per cent. of the pure salt. For three months azotin and ammonite were not quoted at all.

		COST OF NITROGEN AT WHOLESALE IN				COST OF POTASH AT WHOLESALE IN
		Blood. cts. per lb.	Azotin or Ammonite. cts. per lb.	Nitrate of Soda. cts. per lb.	Sulphate of Ammonia. cts. per lb.	Muriate of Potash. cts. per lb.
1881.	May	21.3	21.8	21.9	24.7	3.78
	June	21.5	21.8	21.1	24.8	3.86
	July	22.0	21.8	20.8	25.6	3.92
	August	22.4	22.1	20.8	25.2	4.06
	September	23.8	----	20.9	24.7	3.78
	October	23.0	24.3	20.8	24.9	3.64
	November	23.3	24.3	20.4	25.6	3.62
	December	23.1	----	20.3	25.7	3.60
1882.	January	23.0	----	19.9	25.6	3.71
	February	22.3	22.2	19.8	25.6	3.60
	March	19.6	20.1	18.3	25.0	3.36
	April	19.7	19.7	18.4	23.8	3.24
	May	19.1	19.7	18.3	22.7	3.26
	June	18.9	19.7	16.9	22.4	3.28
	July	19.8	19.5	16.8	22.4	3.40
	August	19.5	19.5	16.8	22.4	3.52
	September	19.7	20.3	17.7	22.4	3.60
	October	19.7	20.1	17.8	22.3	3.56
	November	19.7	20.0	17.6	22.2	3.56
	December	19.7	20.1	17.6	21.8	3.58
1883.	January	19.7	20.1	17.9	20.7	3.51
	February	19.4	19.7	17.9	21.9	3.42
	March	18.0	18.9	17.8	20.7	3.42
	April	18.2	18.9	17.9	20.1	3.40
	May	18.2	18.9	16.3	20.1	3.34
	June	17.8	18.9	16.3	20.0	3.36
	July	17.2	18.9	15.6	19.0	3.23
	August	16.0	18.9	15.3	18.6	3.18
	September	15.3	17.0	14.8	17.6	3.21
	October	15.0	15.2	14.8	17.3	3.12
	November	14.5	15.2	15.2	16.4	3.20

On the Composition of Leaves at Different Periods of Growth.

Dead leaves collected in the fall are valued for litter and as an absorbent in stables, but it is generally understood have no great fertilizing value in themselves. The experiments of Zöller and Rissmüller have shown that while in early summer the leaves contain very considerable amounts of nitrogen, phosphoric acid and potash, these substances are withdrawn into the wood of the

tree with the advancing season, so that before the leaves fade they have lost the larger part of what was most valuable in them, which the tree retains for its further use. Rissmüller's investigations on the leaves of the beech tree* show that in their dry substance the highest *percentage amount* of nitrogen, phosphoric acid and potash, is found when they open in May, and this percentage quite regularly decreases till they ripen and fall, but the *absolute* amount of nitrogen, phosphoric acid and potash is greatest in July and from that time on decreases.

From an oak tree standing on a lawn at the Station, leaves were carefully picked at three different periods, as follows:

Oct. 16. The leaves were bright green and showed no signs of fading or changing color.

Nov. 13. The leaves were brown, having almost entirely lost their reddish tinge. Leaves were falling from the tree, but not rapidly. It retains part of its leaves till the buds start in the spring.

March 17. The upper branches were quite bare, but the lower ones had still many leaves.

Two samples of leaves from a chestnut tree (*Castanea vesca*) which stands on the Station land were also gathered on the following dates:

Oct. 16. The leaves were green and unfaded.

Nov. 13. The leaves were ripe and ready to fall.

The tree was nearly bare and the next day was entirely so.

ANALYSES OF THE FRESH LEAVES.

	Oak.			Chestnut.	
	Oct. 16.	Nov. 13.	Mar. 17.	Oct. 16.	Nov. 13.
Water	56.630	29.743	10.496	60.215	31.675
Albuminoids	5.287	3.403	3.898	4.314	4.215
Fiber	9.185	20.379	24.322	6.705	13.395
Non-nitrogenous Extract	24.938	39.335	52.858	23.473	42.333
Ether Extract	1.630	3.340	3.898	3.480	5.407
Ash	2.330	3.800	4.528	1.813	2.975
	100.000	100.000	100.000	100.000	100.000

* Landwirthschaft. Versuchs-Stationen XVII, 30.

The ash contains:

	Oak.			Chestnut.	
	Oct. 16.	Nov. 13.	Mar. 17.	Oct. 16.	Nov. 13
Potash	.326	.173	.072	.353	.384
Soda	.015	.029	.005	.016	.021
Lime	.688	1.426	1.817	.404	.864
Magnesia	.162	.288	.284	.928	.443
Oxide of Iron	.081	.077	.119	.181	.164
Phosphoric Acid	.263	.260	.084	.186	.230
Sulphuric Acid	.060	.090	.154	.086	.149
Carbonic Acid	.418	.815	1.229	.259	.512
Silica and insoluble in acid	.317	.642	.764	.100	.208
	2.330	3.800	4.528	1.813	2.975

To facilitate comparison, these analyses are reduced to a water-free basis.

Albuminoids	12.19	4.84	4.36	10.84	6.17
Fiber	21.18	29.00	27.17	16.86	19.60
Non-nitrogenous Extract	57.50	55.98	59.06	58.99	61.93
Ether Extract	3.76	4.76	4.36	8.75	7.93
Ash	5.37	5.42	5.05	4.56	4.37
	100.00	100.00	100.00	100.00	100.00

The ash contains:

Potash	.75	.25	.08	.89	.56
Soda	.04	.04	.01	.04	.03
Lime	1.58	2.03	2.03	1.02	1.28
Magnesia	.37	.41	.32	.57	.61
Oxide of Iron	.19	.11	.13	.46	.24
Phosphoric Acid	.61	.37	.09	.47	.34
Sulphuric Acid	.14	.13	.17	.21	.22
Carbonic Acid	.96	1.16	1.37	.65	.75
Silica and insoluble	.73	.92	.85	.25	.31
	5.37	5.42	5.05	4.56	4.37

The leaves gathered on Oct. 16th had very nearly finished their assimilating function, those gathered Nov. 13th we may assume had nearly or quite ceased to lose through resorption into the wood, and those gathered March 17th represented dead leaves which had been exposed to leaching and the action of frost for nearly four months.

The green oak leaves lost between one-third and one-half of the percentage of nitrogen in their dry substance, between the time

that they began to change color and the time when they became brown ("dead"). The corresponding gain is found chiefly in the fiber and also in the ether extract. The relative amount of potash in the second period is only one-third of what it is in the first, the relative amount of phosphoric acid is much less, while lime, silica and phosphoric acid are relatively more abundant.

The same changes to a less extent are noticed in the chestnut leaves, except that there is a loss instead of a gain in ether extract.

These analyses show the composition of the leaves at different periods, they do not *prove* an absolute loss of nitrogen, potash, etc., during the fading of the leaves, though such a loss no doubt occurs. The *percentage* amounts of these elements can be lessened either by the withdrawal of them from the leaves or by the further deposit of fiber, fat, etc., in the leaves.

Between Nov. 13th and March 17th, the dry matter of the oak leaves has become, pound for pound, somewhat poorer in nitrogen, fiber and ash, and the ash has lost in large part its potash and phosphoric acid. In this case the loss must be absolute as well as relative, for there can scarcely be any other than a physical connection between the leaf and the wood of the tree. The loss has been occasioned by the weathering and leaching of the leaves in the winter storms.

From the analyses of the oak and chestnut leaves gathered on Nov. 13th, it is seen that the newly fallen leaves, with about 30 per cent. of water, contained in 100 lbs:

	Oak.	Chestnut.
Nitrogen	.54 lbs.	.67 lbs.
Potash	.17	.38
Phosphoric acid	.26	.23

Stable manure with 70 per cent. of water, contains about .5 lbs. nitrogen, .4 lbs. potash and .5 lbs. phosphoric acid. While the nitrogen in stable manure is readily available, it is likely that that of fallen leaves is comparatively inert.

The amount of leaves which fall yearly, according to Ebermayer,* varies considerably, being larger in wet seasons than in dry, larger on a rich soil than on a poor one. It also varies with the thickness of the woods. Other things being equal, trees produce more foliage when standing apart than when standing in dense woods.

* Versuchs-Stationen: XVIII, 63.

Nor is the composition of the fallen leaves, at least of the ash constituents, at all constant. J. Nessler* found in the dry substance of newly fallen oak leaves, phosphoric acid and potash as follows:

	Phosphoric Acid.	Potash.
1867	.224 per cent.	.347 per cent.
1868	.073 "	.232 "

and in dry beech leaves:

1867	.360	.503
1868	.104	.282

Similar observations were made by Zöller and Rissmüller.

Composting Dead Leaves.

Under date of March 31, 1883, Mr. George A. Ross, of Jewett City, writes as follows:

I wish to make a compost heap of the following:

Dead leaves that have drifted behind a wall for the last 25 years and more, also the soil under these leaves, which is a dark brown loam filled with small roots; and unslaked lime.

1st. Now how shall I compost it?

2d. In what proportion shall I use the lime and loam?

3d. Shall I use the lime unslaked or slaked, at first?

4th. Shall I let it stand a year?

I should be very happy to hear you make any suggestion that you think will benefit me.

To Mr. Ross was replied in substance:

1st. Use fresh slaked lime.

2d. One bushel of unslaked lime to 15 or 20 of the loam would probably be an ample quantity. (1 bush. of lime to 10 of pure swamp-muck is enough.)

3d. Mix or interstratify well. Put down 20 bushels, two or three inches deep, then sprinkle on the one bushel of lime still warm from the slaking. Add another layer of loam and another of lime, and so on until the heap is several feet high.

4th. The heap may remain through a summer and may then be mixed by cutting down and shoveling over.

5th. If a bushel of salt (to six bushels of lime) be dissolved in water and the brine be used to slake the lime, the action will be

* Jahresbericht Ag. Chem., XI, 360.

much more rapid and a few weeks will suffice to set up a decomposition, when the heap may be overhauled, and the compost will be ready in a few weeks more.

6th. Instead of salt, muriate of potash may be advantageously used. It will probably act as well in the compost and will also supply indispensable potash to the crops.

The favorable effect of "salt and lime mixture" is explained in my Report on "Peat and Its Uses as Fertilizer and Fuel," page 73, as follows:

"When quick-lime is slaked with a brine of common salt (chloride of sodium), there are formed by double decomposition, small portions of caustic soda and chloride of calcium, which dissolve in the liquid. If the solution stand awhile, carbonic acid is absorbed from the air, forming carbonate of soda; but carbonate of soda and chloride of calcium instantly exchange their ingredients, forming insoluble carbonate of lime and reproducing common salt. When the fresh mixture of quick-lime and salt is incorporated with any porous body, as soil or peat, then, as Graham has shown, unequal diffusion of the caustic soda and chloride of calcium occurs from the point where they are formed, through the moist porous mass, and the result is, that the small portion of caustic soda which diffuses most rapidly, or the carbonate of soda, formed by its speedy union with carbonic acid, is removed from contact with the chloride of calcium.

Soda and carbonate of soda are more soluble in water and more strongly alkaline than lime. They, therefore, act on peat more energetically than the latter. It is on account of the formation of soda and carbonate of soda from the lime and salt mixture, that this mixture exerts a more powerful decomposing action than lime alone. Where salt is cheap and wood ashes scarce, the mixture may be applied accordingly to advantage. Of its usefulness we have the testimony of practical men."

Case of Poisoning with Paris Green.

"East Hartford, Sept. 25, 1883.

Prof. S. W. Johnson:

Dear Sir:—Here inclosed I send you a portion of the bowel of a horse for analysis, which I have very strong suspicion was poisoned. Dr. Cressy made the post-mortem examination, and is of that opinion also. An early reply will greatly oblige

Yours very truly,

Jno. E. Lathrop."

The material came to hand on the 29th of September, and was immediately examined. It contained both copper and arsenic, which, with acetic acid, are the constituents of Paris green (aceto-arsenite of copper). Paris green was, therefore, undoubtedly the cause of death.

FEEDING STUFFS.

Twenty samples of feeding stuffs have been under examination during the year, as follows:

Meal from entire corn	1 sample.
Hominy meal	6 "
Gluten meal	2 "
Wheat middlings	3 "
Shorts	1 "
Bran	1 "
Cotton seed meal	3 "
New process linseed meal	1 "
Dried grains from ale brewery	1 "
Steam-dried brewers' grains	1 "
	20

Maize Meal and Hominy Feed.

[See Table of Analyses on page 78.]

CLVIII. Meal from entire corn. From stock of W. H. Childs, of North Manchester. Sent by H. A. Slater, of North Manchester. Price in February, 1883, $30.00 per ton. This meal is rather below the average as regards its content of fat.

The next six analyses are of "hominy feed;" also called "Baltimore meal" or "white meal." This material is a by-product in the manufacture of hominy. It consists of the hull of the corn and of the soft portions around the chit.

CLIV and CLVII were sent by Oliver Rice, of Meriden. Cost $1.30 per 100 pounds at retail, $23.00 per ton in car lots in Meriden in February, 1883.

CLX. Sent by H. A. Slater, from stock of W. H. Childs, North Manchester. Price, $25.00 per ton in February, 1883.

CLXIII. Sent by Andrew Kingsbury, Coventry. Price, $1.25 per 100 pounds (yellow corn meal retailing at $1.40).

CLXIV. Sent by N. P. Perkins, Willimantic, from stock of J. C. Bugby & Co. Price, $1.25 per 100 pounds in June, 1883 (yellow corn retailing at $1.40 per 100 pounds).

ANALYSES.

	Maize Meal.	Hominy Chops, Hominy Feed, Baltimore Meal or White Meal.					
	CLVIII.	CLIV.	CLVII.	CLX.	CLXIII	CLXIV.	CLXXIII.
Water	18.81	8.65	11.14	13.46	12.91	10.64	11.46
Ash	1.30	----	2.32	2.54	----	3.39	2.30
Albuminoids	8.81	8.69	9.50	9.75	9.00	8.69	7.88
Fiber	1.35	----	2.54	2.79	----	----	3.30
Nitrogen-free Extract (Starch, Sugar, etc.)	67.37	----	67.66	64.27	----	----	67.68
Fat	2.36	7.16	6.54	7.19	7.17	5.95	7.38
	100.00		100.00	100.00			100.00
Cost per ton	$30.00	$23.00*	$23.00*	$25.00			$23.00
" " 100 lbs.		$1.30	$1.30		$1.25	$1.25	$1.20
Water Free.							
Ash	1.60	----	2.62	2.93	----	3.79	2.60
Albuminoids	10.85	9.53	10.73	11.27	10.33	9.71	8.89
Fiber	1.66	----	2.86	3.22	----	----	3.73
Nitrogen-free Extract (Starch, Sugar, etc.)	82.98	----	76.46	74.26	----	----	76.54
Fat	2.91	7.85	7.33	8.32	8.23	6.65	8.24
	100.00		100.00	100.00			100.00

* In car lots.

CLXXIII. Sent by O. L. Buell, West Simsbury, from stock of J. & H. Woodford, Avon. Cost $1.20 per 100 pounds, or $23.00 per ton in December, 1883.

On the average hominy meal contains 9.3 per cent. of albuminoids and 7.5 per cent. of fat; maize meal, 9.0 of albuminoids and 3.8 of fat: and flint corn, 10.9 of albuminoids and 4.9 of fat.

Presumably the albuminoids and fat in hominy meal are severally as digestible as they are in ordinary maize meal. They are cheaper, and the relative quantity of them, especially of the fat, is larger. For these reasons it appears that, as far as can be judged *from chemical analysis*, it is more economical at the prices given to use hominy meal in a ration than corn meal. Experience in its use must decide whether it is as healthful as maize meal, and whether in the case of milk cows it has a favorable or unfavorable effect on the milk yield, or imparts any peculiar flavor to the milk. In substituting it for corn meal, it should be considered that hominy meal contains twice as much fat as corn meal, and the ration should be modified accordingly. This large proportion of fat evidently makes it needful to use some caution as to the quantity fed.

Mr. N. P. Perkins, of Willimantic, writes that he and others of the same place, are feeding hominy meal instead of yellow corn meal to milch cows, with good results. The cows keep in excellent condition and give more milk than on yellow corn meal. The daily ration per cow is 4 quarts hominy meal, 2 quarts wheat bran and 2 quarts of "fine feed," well mixed and fed wet; one-half in the morning and the other half at night.

Mr. Perkins also feeds it to horses and hogs in the same way that maize meal is fed. But in fatting cattle it cannot be quite so freely used as the maize meal. A fatting cow which ate a peck of the latter daily became cloyed when a peck of hominy meal was substituted, and refused it altogether.

Mr. A. Kingsbury, of Coventry, also reports favorably with regard to using hominy meal for cows.

GLUTEN MEAL.

CLV. Sent by Burdett Loomis, Hartford, February, 1883.

CLXXII. Sampled and sent by Newton & Fuller, Springfield, Mass., from their stock. Price in November, 1883, $1.40 per 100 pounds.

ANALYSES.

	CLV.	CLXXII.	Water free. CLV.	CLXXII.
Water	10.73	10.54		
Ash	.72	.67	.80	.75
Albuminoids	31.75	30.00	35.54	33.53
Fiber	1.26	.60	1.40	.67
Nitrogen-free extract	50.57	54.93	56.69	61.42
Fat	4.97	3.26	5.57	3.63
	100.00	100.00	100.00	100.00

Gluten meal is a by-product in the manufacture of glucose, which has lately come into the market. It is not easy to compare this with the ordinary kinds of feed. It ranks among concentrated feeding stuffs, because of its large content of albuminoids (or protein). Beans with 24 per cent., linseed cake with 29 per cent., and malt sprouts with 26 per cent. of albuminoids come nearest to it in respect to this, the most costly element of food. The gluten meal is, however, richer in fat than beans or malt sprouts, and much less rich than linseed and cotton seed meal. It most resembles the "new process" linseed meal, which contains on the average 35½ per cent. of albuminoids and 4½ per cent. of fat, and it is likely that its feeding value will approach that of "new process" linseed. Actual use in feeding can alone decide positively its value, which, from its source and its composition, is presumably high. Its proper use is in connection with coarse and unconcentrated foods, to supply their deficiency of albuminoids.

DRIED BREWERS' GRAINS.

CLVI. Dried grains from ale brewery. Sent by Burdett Loomis, Hartford, February, 1883.

CLXVII. "Dried Brewers' Grains for Horse and Cattle Feed." Prepared by the Concentrated Feed Company, 422 East 62d St., New York City. Sample drawn from a bag of 100 pounds presented to the Station by the company.

ANALYSES.

	CLVI.	CLXVII.	Water free. CLVI.	CLXVII.
Water	6.23	11.91		
Ash	3.31	3.63	3.53	4.11
Albuminoids	19.25	20.25	20.53	22.98
Fiber	10.24	11.60	10.92	13.17
Nitrogen-free extract	56.80	46.10	60.58	52.37
Fat	4.17	6.51	4.44	7.37
	100.00	100.00	100.00	100.00

The prejudice against brewers' grains, which has been quite general, has arisen largely from the improper feeding of them and from the fact that, being very wet, they spoil quickly and have to be brought from the brewery fresh every day or two, or else are liable to be fed sour unless pitted or ensilaged. When properly fed they give excellent results.

The Concentrated Feed Company now prepare them by drying, so that they can be kept indefinitely. In composition they differ from gluten meal by containing some 12 per cent. less of albuminoids and 10 per cent. more of fiber, with 2 per cent. more of ash.

WHEAT BRAN, MIDDLINGS AND SHORTS.

CLXVIII. Wheat bran. Sent by M. C. Dean, from stock of E. W. Spurr, Falls Village. Cost $20 per ton on cars in August, 1883.

CLXI. "White middlings." Sent by H. A. Slater, North Manchester, from stock of W. H. Childs. Cost $28 per ton in February, 1883.

CLXV and CLXVI. Wheat middlings. Sent by H. Page, Durham Center.

CLIX. Shorts. Sent by H. A. Slater, North Manchester, from stock of W. H. Childs.

ANALYSES.

	Bran.	Wheat Middlings.			Shorts.
	CLXVIII.	CLXI.	CLXV.	CLXVI.	CLIX.
Water	14.18	13.85	11.62	11.35	13.59
Ash	5.97	2.45	....	....	5.23
Albuminoids	12.69	15.00	14.25	14.31	13.87
Fiber	7.69	1.27	....	....	8.99
Nitrogen-free Extract	56.21	63.70	....	....	55.62
Fat	3.26	3.73	3.50	3.98	2.70
	100.00	100.00			100.00
Water Free.					
Ash	6.95	2.84	....	....	6.05
Albuminoids	14.79	17.41	16.11	16.15	16.05
Fiber	8.97	1.48	....	....	10.40
Nitrogen-free Extract	65.50	73.94	....	....	64.37
Fat	3.79	4.33	3.96	4.49	3.13
	100.00	100.00			100.00

CLXV and CLXVI represent two different lots of wheat middlings offered to the sender, who wished to know which was the better article. CLXVI has about one-half a per cent. more of fat in it, which, other things being equal, would make it more valuable. To Mr. Dean's inquiry with regard to the sample of wheat bran sent by him answer was made as follows:

"Your questions, as to the value for feeding and for manure of this sample, are not easy to answer. The value of bran as of any other similar kind of feed depends upon the place in the ration, bran alone being a very poor feed, while bran in suitable mixture with other fodders is very valuable. In the Reports of this Station and in "Armsby's Manual of Cattle Feeding," also in a recent book by Stewart on the same subject this matter is more or less fully discussed. You will find in the Station Report of 1881, a paper by Dr. Armsby, pp. 90 to 105, which will give you the principal points. As to the value of the manure, I can only say that the richer the food, other things being equal, the richer will be the manure. Bran contains an abundance of nitrogen and phosphates. In the mature animal these ingredients pass entirely into the manure when the animal is not increasing in weight or giving milk or nourishing young. The manure from bran fed animals will therefore be richer in these elements than that furnished by hay-fed cattle. As to feeding, one word further: but a limited, rather small amount of bran can be fed to an animal without injury to its health. The proper use of bran in a cattle ration is as an addition to common hay or other coarse feed and the coarsest feed like straw and chaff may be advantageously fed to animals when a suitable quantity of bran or similar concentrated feed is used at the same time."

Cotton Seed Meal and New Process Linseed Meal.

CLXII. Cotton Seed Meal. Sent by Wm. Smith, of Plainville, from stock of G. Richards & Co., Unionville. Cost, $31.00 per ton. Its analysis as a fertilizer will be found on page 57, No. **876.**

CLXX. Cotton Seed Meal. Sent by H. S. Frye, Poquonock.

CLXXI. Cotton Seed Meal. Sent by A. E. Holcomb, Poquonock.

These two samples were from stock of F. Ellsworth, Hartford. Cost $30.00 per ton in November, 1883.

CLXIX. New Process Linseed Meal. Made by Cincinnati Linseed Oil Co. Sample drawn Nov. 1, 1883, from five 100-lb. bags, presented by the company to this Station.

Analyses.

	Cotton Seed Meal.			New Process Linseed Meal.
	CLXII.	CLXX.	CLXXI.	CLXIX.
Water	----	7.61	7.29	13.35
Ash	----	6.53	6.85	6.08
Albuminoids	43.44	46.12	45.31	34.25
Fiber	----	4.90	5.32	8.00
Carbhydrates	----	21.67	21.93	37.02
Fat	----	13.17	13.30	1.30
		100.00	100.00	100.00
Water Free.				
Ash		7.06	7.38	7.00
Albuminoids		49.91	48.87	39.51
Fiber		5.30	5.74	9.22
Carbhydrates		23.48	23.67	42.78
Fat		14.25	14.34	1.49
		100.00	100.00	100.00

The samples of Cotton Seed Meal are of average quality. This material has been used to some extent as a fertilizer in this State and when it has been damaged by water, smoke, etc., or has become musty, this is the only use to be made of it; but the clean fresh meal can most economically be used first as cattle food and then as a fertilizer. When the nitrogen of any such material can with small outlay of money or time be converted into milk or beef it is certainly wasteful to turn it back into the ground and after nine months or a year recover it again in vegetables or grain. That part of the cotton seed, not assimilated by the cattle is saved in their manure and may then be applied to the land.

The "new process" of preparing linseed meal effects a more complete exhaustion of the oil or fat contained in the cake after it has been pressed. Linseed "cake" as will be seen from the table following, has about 29.7 per cent. of albuminoids and 11¼ per cent. of fat. Nearly all of this fat is removed by the new process and the meal after the extraction contains, pound for pound, more albuminoids than the cake.

CLXIX contains less oil than any sample previously examined here, though the albuminoids are not proportionally high.

It is of no special advantage to the farmer that the oil should be so perfectly extracted (for a certain amount of fat is desirable in the ration), unless by this means the feed can be bought cheaper or rather unless the albuminoids, pound for pound, cost him less. The necessary fat in the ration can be then supplied in cheaper form from cotton seed.

Table of the Composition of American Feeding Stuffs.

By Dr. E. H. Jenkins.

On the following pages is given the average composition of the fodders commonly used in the country, compiled exclusively from American analyses. The compiler has aimed to bring together all analyses which have been published and could be obtained up to September 1st, 1883. Probably a few have been overlooked.

In the first column of the tables is given the total number of analyses from which the average was obtained. The probable accuracy of the average increases with the number of analyses on which it is based.

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

Composition of Feeding Stuffs.

Compiled from all available analyses made in this country—Posted to September 1, 1883.

Name.	Analyses.	Total Dry Matter.			Protein.*			Fat.			Nitrogen-free Extr.			Fiber.			Ash.
		Min.	Max.	Aver.	Min.	Max.	Aver.	Min.	Max.	Aver.	Min.	Max.	Aver.	Min.	Max.	Aver.	
Green Fodder.																	
Maize fodder	18	7.20	28.90	**17.66**	0.56	1.80	**1.29**	0.10	0.60	**.28**	3.20	17.70	**9.83**	1.90	9.80	**5.04**	1.22
Maize fodder—ensilaged	28	12.32	27.88	**19.63**	0.90	2.77	**1.47**	0.30	1.80	**.72**	5.62	14.23	**10.12**	4.04	10.02	**5.96**	1.36
Pea vine—ensilaged	1	----	----	**18.36**	----	----	**2.40**	----	----	**.80**	----	----	**7.60**	----	----	**5.57**	1.99
Rye	5	----	----	**25.3†**	2.30	3.00	**2.60**	0.60	0.70	**.65**	4.90	6.70	**5.90**	13.40	14.90	**14.30**	1.90
Sorghum leaves	3	23.30	32.70	**27.00**	2.40	3.70	**3.10**	----	----	----	----	----	**15.1‡**	4.30	6.80	**5.20**	3.50
Cow pea vines, green and succulent, with the pods	2	13.97	17.90	**15.94**	3.00	3.25	**3.12**	0.58	0.62	**.60**	5.34	8.46	**6.91**	2.87	4.09	**3.48**	1.83
Cow pea vines, probably after the pods were removed	1	----	----	**27.19**	----	----	**1.85**	----	----	**.21**	----	----	**7.86**	----	----	**15.27**	2.00
Soja bean vines	2	30.15	30.65	**30.40**	3.88	3.94	**3.91**	1.05	1.55	**1.30**	14.24	14.39	**14.32**	8.26	8.91	**8.58**	2.29
Carrot leaves	1	----	----	**16.70**	----	----	**4.26**	----	----	**.86**	----	----	**5.99**	----	----	**2.25**	3.34
Beet leaves	1	----	----	**11.16**	----	----	**2.74**	----	----	**.60**	----	----	**2.49**	----	----	**2.50**	2.83
Hay and Dry Coarse Fodder.																	
Low meadow hay	10	85.50	93.60	**89.50**	4.60	10.40	**7.70**	0.70	3.60	**2.20**	39.80	55.20	**43.60**	21.40	40.00	**30.20**	5.80
Maize fodder, field cured	9	61.00	85.20	**72.63**	3.40	5.80	**4.56**	.66	1.60	**1.29**	30.50	49.20	**38.62**	18.65	30.94	**23.76**	4.39
Meadow hay	7	----	----	**85.7†**	10.10	21.50	**12.40**	1.60	5.10	**3.10**	32.70	45.20	**39.60**	14.90	31.70	**23.00**	7.60
Low meadow hay	10	85.50	93.60	**89.50**	4.60	10.40	**7.70**	0.70	3.60	**2.20**	39.80	55.20	**43.60**	21.40	40.00	**30.20**	5.80
Salt marsh hay	11	81.40	92.80	**89.53**	4.30	7.80	**5.90**	1.63	3.10	**2.32**	34.10	53.67	**42.42**	27.00	37.90	**31.47**	7.42
Timothy hay	16	----	----	**85.7†**	4.80	9.60	**6.29**	1.10	3.30	**2.01**	39.98	48.60	**44.31**	25.10	33.35	**28.92**	4.17
Timothy and Red top	4	----	----	**85.7†**	6.00	9.00	**7.60**	1.50	2.50	**2.00**	39.20	46.90	**44.10**	24.70	28.50	**26.50**	5.50
Clover hay	8	78.18	91.53	**85.51**	8.87	13.54	**11.42**	1.47	3.10	**2.18**	35.03	45.47	**40.40**	23.79	28.64	**25.83**	5.63
Hungarian grass hay. Reckoned to average water content	6	----	----	**83.30**	5.72	10.67	**7.02**	1.30	2.47	**1.72**	34.85	42.40	**41.79**	27.30	28.94	**27.31**	5.43
Black grass hay (*Juncus gerardi*)	2	88.98	91.06	**90.02**	6.56	7.06	**6.81**	2.28	2.38	**2.33**	43.14	49.31	**46.26**	24.63	29.42	**27.01**	7.60

* Or albuminoids. † Calculated to average water content. ‡ Includes fat.

Composition of Feeding Stuffs—*Continued.*

Name.	Analyses.	Total Dry Matter.			Protein.*			Fat.			Nitrogen-free Extr.			Fiber.			Ash.
		Min.	Max.	Aver.	Min.	Max.	Aver.	Min.	Max.	Aver.	Min.	Max.	Aver.	Min.	Max.	Aver.	
HAY AND DRY COARSE FODDER—*cont.*																	
Black grass hay, with seed	1	....	....	**90.84**	....	....	**7.50**	....	....	**2.96**	....	....	**51.44**	....	....	**22.10**	6.84
Buckwheat straw	2	89.50	89.60	**89.60**	3.30	4.40	**3.80**	1.40	1.70	**1.60**	32.10	34.50	**32.20**	44.90	46.80	**45.90**	5.10
Wheat straw	2	88.63	92 22	**90.43**	2.19	2.56	**2.37**	1.24	2.53	**1.89**	41.51	47.01	**44.27**	37.32	40.05	**38.68**	3.22
Oat straw	3	87.50	93.47	**89.89**	2.30	5.08	**3.35**	1.00	3.15	**2.07**	26.42	44.26	**36.97**	35.21	55.96	**42.78**	4.72
Rye straw	1	....	....	**87.5†**	....	....	**6.89**	....	....	**2.68**	....	....	**35.70**	....	....	**34.20**	8.03
Cow pea vines	1	....	....	**89.78**	....	....	**19.81**	....	....	**1.13**	....	....	**34.98**	....	....	**23.66**	10.20
ROOTS, BULBS AND TUBERS.																	
Mangolds	3	7.18	8.56	**7.96**	1.57	1.89	**1.70**	.03	.51	**.20**	3.56	4.91	**4.19**	.76	.91	**.82**	1.05
Ruta bagas	1	....	....	**12.92**	....	....	**1.15**	....	....	**.09**	....	....	**9.11**	....	....	**1.16**	1.41
Turnips	1	....	....	**11.11**	....	....	**1.34**	....	....	**.09**	....	....	**8.11**	....	....	**.86**	.71
Carrots	2	11.18	12.15	**11.67**	.97	1.35	**1.16**	.65	.71	**.68**	6.86	7.39	**7.13**	.86	2.32	**1.59**	1.11
Beets	1	....	....	**12.32**	....	....	**1.73**	....	....	**.21**	....	....	**7.64**	....	....	**1.69**	1.05
Onions	1	....	....	**14.74**	....	....	**2.28**	....	....	**.22**	....	....	**10.80**	....	....	**.76**	.68
Sweet potato	1	....	....	**26.61**	....	....	**1.28**	....	....	**.28**	....	....	**23.00**	....	....	**.98**	1.07
Yam	1	....	....	**28.77**	....	....	**2.06**	....	....	**.25**	....	....	**25.24**	....	....	**.75**	.67
FRUITS, GRAINS AND OTHER SEEDS.																	
Cucumbers	1	....	....	**4.30**	....	....	**.83**	....	....	**.21**	....	....	**1.95**	....	....	**.85**	.46
Tomato	1	....	....	**8.74**	....	....	**1.00**	....	....	**.47**	....	....	**5.84**	....	....	**.70**	.73
Squash	2	4.82	5.42	**5.12**	.64	.68	**.66**	.24	.32	**.28**	2.95	3.54	**3.24**	.53	.54	**.54**	.40
Peas	1	....	....	**21.94**	....	....	**4.37**	....	....	**.55**	....	....	**14.48**	....	....	**1.66**	.88
Apples	1	....	....	**15.89**	....	....	**.21**	....	....	**.28**	....	....	**14.26**	....	....	**.91**	.23
Barley	9	87.40	92.80	**88.90**	8.60	15.70	**12.40**	1.50	3.20	**1.80**	66.70	73.00	**69.30**	1.30	4.20	**2.90**	2.50
Buckwheat	8	85.10	89.10	**87.40**	8.60	11.00	**10.00**	2.20	2.40	**2.25**	62.60	65.40	**64.50**	7.80	9.40	**8.70**	2 00
Cotton seed, hulls and kernel	1	....	....	**92.28**	....	....	**15.72**	....	....	**18.56**	....	....	**29.09**	....	....	**25.75**	3.16

* Or albuminoids.

† Calculated to average water content.

Composition of Feeding Stuffs—*Continued.*

Name.	Analyses.	Total Dry Matter.			Protein.*			Fat.			Nitrogen-free Extr.			Fiber.			Ash.
		Min.	Max.	Aver.	Min.	Max.	Aver.	Min.	Max.	Aver.	Min.	Max.	Aver.	Min.	Max.	Aver.	
FRUITS, GRAINS AND OTHER SEEDS—*cont.*																	
Cow pea	5	79 20	89.99	**85.21**	19.30	23.00	**20.77**	1.30	1.60	**1.43**	48.10	61.99	**55.75**	3.37	5.00	**4.06**	3.20
Soja bean	3	89.87	93.95	**91.41**	34.63	38.62	**36.22**	16.80	19.00	**17.92**	26.20	30.50	**28.66**	3.69	5.00	**4.24**	4.37
Doura, brown (Durha)	3	87.30	92.40	**89.00**	9.00	11 50	**10.30**	....	....	**4.20**	....	....	**69.90**	....	....	**1.50**	1.60
Maize kernel (flint)	50	81.80	95.90	**88.99**	7.90	13.70	**10.87**	3.40	7.10	**4.94**	65.00	77.30	**70.12**	0.80	2.70	**1.61**	1.45
Maize kernel (dent)	26	84.80	93.80	**88.80**	8.10	11.80	**10.50**	3.80	6.30	**4.70**	66.30	75.30	**70.20**	1.30	3.00	**1.80**	1.50
Maize kernel (sweet)	14	89.10	94.00	**91.20**	10.20	14.40	**12.20**	5.30	9.30	**8.00**	62.70	72.40	**66.90**	1.50	4.90	**2.30**	1.90
Maize kernel ("Western corn")	3	79.30	83.60	**80.90**	7.80	8.60	**8.30**	3.60	3.90	**3.70**	64.90	68.20	**66.00**	1.70	1.80	**1.75**	1.20
Maize kernel, aver. of all varieties	100	79.30	95.90	**88.89**	7.80	15.30	**10.81**	3.40	9.30	**5.31**	61.80	77.30	**69.47**	0.90	4 90	**1.80**	1.50
Oats	21	86.50	91.10	**89.30**	8.00	14.40	**11.30**	4.10	5.80	**5.00**	57.10	66.90	**61.00**	1.50	12.90	**9.00**	3.00
Rice	10	86.00	88.60	**87.60**	5.90	8.60	**7.40**	0.30	0.60	**.40**	77.50	80.60	**79.20**	0.10	0.40	**.20**	0.40
Rye	6	86.80	91.30	**88.40**	9.50	12.10	**10.60**	1.40	2.10	**1.70**	70.70	73.90	**72.60**	1.40	2.10	**1.60**	1.90
Sorghum seed	13	83.20	90.70	**87.24**	7.70	12.66	**9.12**	2.10	4.60	**3.71**	66.80	73.60	**70.57**	1.50	3.20	**2.03**	1.81
Sorghum seed (decorticated), (see also sorghum meal below)	2	89.43	90.07	**89.75**	9.54	9.98	**9.76**	3.95	4.60	**4.27**	71.56	73.59	**72.58**	1.48	1.52	**1.50**	1.64
Wheat (winter)	58	86.20	92.50	**88.80**	8.40	14.50	**11.70**	1.30	2.70	**1.90**	68.10	81.70	**71.80**	1.20	1.90	**1.70**	1.70
Wheat (spring)	10	86.70	92.10	**89.50**	8.10	15.40	**13.00**	1.80	2.60	**2.20**	66.10	78.70	**70.60**	1.40	2.30	**1.90**	1.80
Wheat (average of all varieties)	99	86.20	92.50	**88.96**	8.10	15.94	**12.21**	1.20	2.99	**2.15**	66.10	77.70	**71.08**	1.10	2.30	**1.66**	1.86
Peanuts (without hulls)	2	93.20	93.80	**93.50**	....	....	**28.30**	41.20	51.50	**46.40**	....	....	**1.80**	....	....	**13.90**	3.30
Sword bean seed (*Canavalia gladiata*)	1	....	....	**89.63**	....	....	**26.60**	....	....	**3.12**	....	....	**53.10**	....	....	**4.13**	2.68
Chinese corn kernel	1	....	....	**92.13**	....	....	**9.63**	....	....	**3.75**	....	....	**75.50**	....	....	**1.79**	1.46
FLOUR AND MEAL.																	
Barley meal	3	83.80	86.00	**84.90**	8.80	13.90	**11.80**	0.70	2.20	**1.70**	....	....	**70.90**	....	....	**.10**	0.50
Buckwheat flour	3	85.10	87.20	**86.50**	4.20	8.00	**6.50**	0.70	1.70	**1.30**	75.80	79.40	**77.30**	0.20	0.40	**.30**	1.10

* Or albuminoids.

Composition of Feeding Stuffs—*Continued.*

Name.	Analyses.	Total Dry Matter.			Protein.*			Fat.			Nitrogen-free Extr.			Fiber.			Ash.
		Min.	Max.	Aver.	Min.	Max.	Aver.	Min.	Max.	Aver.	Min.	Max.	Aver.	Min.	Max.	Aver.	
Flour and Meal—*continued.*																	
Graham flour	3	86.30	87.90	**86.90**	11.30	12.40	**11.70**	1.50	1.90	**1.70**	69.80	70.00	**69.80**	1.80	2.00	**1.90**	1.80
Hominy	2	86.40	86.60	**86.50**	8.10	8.40	**8.30**	0.40	0.50	**.50**	77.10	77.20	**77.15**	0.30	0.30	**.30**	0.40
Maize meal	13	78.30	90.14	**85.49**	7.40	13.94	**9.07**	2.50	4.63	**3.82**	60.72	72.70	**69.16**	0.90	2.99	**1.87**	1.57
Oat meal	6	91.10	93.70	**92.10**	12.90	16.30	**14.70**	6.10	8.80	**7.00**	66.60	69.00	**67.50**	0.60	1.20	**.90**	2.00
Rye flour	4	86.40	87.70	**86.90**	6.00	7.10	**6.70**	0.80	0.90	**.85**	77.60	79.10	**78.30**	0.40	0.50	**.45**	0.70
Wheat flour	49	86.50	91.70	**88.40**	8.60	13.50	**11.10**	0.60	2.00	**1.10**	68.30	78.50	**75.40**	0.10	1.20	**.20**	0.60
By-Products and Refuse.																	
Apple pomace	3	22.80	27.40	**25.90**	1.00	1.70	**1.40**	1.70	2.00	**1.90**	15.70	17.00	**16.70**	3.90	5.90	**5.20**	0.70
Brewers' grains, from brewery	8	21.50	31.40	**25.35**	4.70	7.80	**5.92**	0.80	2.90	**1.91**	10.10	15.94	**12.47**	3.10	5.60	**3.97**	1.06
Brewers' grains, from Silo	1	----	----	**33.20**	----	----	**6.90**	----	----	**2.60**	----	----	**16.90**	----	----	**5.40**	1.40
Brewers' grains, kiln dried	1	----	----	**97.40**	----	----	**20.40**	----	----	**6.40**	----	----	**54.90**	----	----	**11.80**	4.00
Brewers' swill	1	----	----	**5.70**	----	----	**1.90**	----	----	**.80**	----	----	**2.00**	----	----	**.70**	0.30
Cotton seed meal	14	90.90	94.32	**91.96**	38.69	50.81	**43.97**	11.29	18.00	**13.72**	12.70	25.19	**21.44**	3.10	11.80	**5.68**	7.15
"Hominy chops," "hominy feed," "Baltimore meal," "white meal"	5	86.50	93.20	**88.34**	9.50	10.20	**9.73**	4.45	10.20	**8.26**	61.00	71.10	**64.18**	3.20	4.80	**3.82**	2.35
Sorghum meal (from seed mostly decorticated)	1	----	----	**86.84**	----	----	**8.25**	----	----	**3.85**	----	----	**71.27**	----	----	**1.88**	1.59
Linseed cake	12	89.20	93.80	**90.96**	26.00	35.60	**29.70**	2.80	16.20	**11.25**	29.10	41.90	**35.03**	4.50	15.70	**8.54**	6.44
Linseed meal	3	87.57	92.87	**90.45**	30.88	33.95	**32.84**	4.94	6.83	**5.64**	36.54	41.11	**38.51**	7.12	8.87	**7.80**	5.66
Linseed meal ("new process")	3	87.10	90.10	**88.70**	32.00	37.60	**35.50**	2.70	5.90	**4.50**	----	----	**34.18**	----	----	**8.80**	5.80
Palm nut meal	2	89.16	93.86	**91.51**	13.63	16.01	**14.82**	6.41	18.73	**12.57**	33.80	41.66	**37.74**	21.57	23.98	**22.77**	3.61
Maize cob	9	85.60	92.80	**90.80**	1.20	2.70	**2.20**	0.10	0.90	**0.40**	45.30	59.60	**54.90**	29.80	38.30	**32.00**	1.30
Gluten meal	2	91.57	92.60	**92.13**	28.03	35.00	**31.51**	8.01	8.73	**8.37**	44.72	54.46	**49.60**	.73	3.25	**1.99**	.66
Malt sprouts	2	88.40	92.69	**90.55**	22.94	25.90	**23.92**	1.10	2.98	**2.04**	45.60	50.30	**47.86**	9.30	10.88	**10.09**	6.64

* Or albuminoids.

Composition of Feeding Stuffs—*Continued.*

Name.	Analyses.	Total Dry Matter.			Protein.*			Fat.			Nitrogen-free Extr.			Fiber.			Ash.
		Min.	Max.	Aver.	Min.	Max.	Aver.	Min.	Max.	Aver.	Min.	Max.	Aver.	Min.	Max.	Aver.	
By-Products and Refuse—*continued.*																	
Rye bran	3	86.30	89.70	**87.70**	12.60	16.80	**15.26**	1.79	2.60	**2.19**	59.75	67.00	**63.12**	2.50	4.10	**3.51**	3.62
Sorghum bagasse	3	11.30	16.60	**14.50**	0.62	0.68	**0.65**	----	----	----	----	----	**10.20**	2.80	3.30	**3.10**	0.60
"Starch feed," refuse from starch manufacture	2	27.80	37.70	**32.90**	3.60	5.70	**4.60**	1.30	2.00	**1.60**	18.80	28.90	**23.80**	1.60	3.40	**2.50**	0.20
"Sugar feed," refuse from glucose manufacture (dry)	2	89.60	93.40	**91.50**	13.10	13.50	**13.30**	5.90	11.20	**8.60**	54.90	61.40	**58.10**	8.40	10.70	**9.50**	2.00
Glucose waste (wet)	1	----	----	**24.00**	----	----	**3.72**	----	----	**1.63**	----	----	**17.39**	----	----	**.75**	0.51
Vegetable ivory sawdust	1	----	----	**81.20**	----	----	**3.40**	----	----	**.70**	----	----	**68.60**	----	----	**7.50**	1.10
Wheat middlings	6	86.70	89.40	**88.20**	10.10	14.20	**12.20**	2.10	3.70	**3.00**	60.20	70.90	**65.60**	3.50	7.50	**4.80**	2.60
Wheat bran	15	86.10	91.35	**88.24**	7.80	16.88	**14.88**	2.60	5.84	**3.90**	50.41	58.90	**55.07**	5.90	16.60	**8.70**	5.69
Wheat shorts	5	87.80	89.00	**88.50**	11.10	15.10	**13.00**	2.50	4.90	**4.00**	56.30	62.30	**59.70**	6.30	10.50	**7.70**	4.10
Rice flour	1	----	----	**89.68**	----	----	**14.00**	----	----	**13.49**	----	----	**51.22**	----	----	**6.12**	4.85
Rice meal	1	----	----	**84.90**	----	----	**9.30**	----	----	**1.60**	----	----	**59.90**	----	----	**8.10**	6.00
Rice "Polish"	1	----	----	**88.79**	----	----	**12.93**	----	----	**7.69**	----	----	**62.96**	----	----	**2.41**	2.80
Rice feed	1	----	----	**89.67**	----	----	**11.43**	----	----	**11.49**	----	----	**47.20**	----	----	**9.93**	9.62
Rice bran	1	----	----	**90.70**	----	----	**12.78**	----	----	**5.23**	----	----	**62.34**	----	----	**2.00**	8.35
Rice bran "Douse"	1	----	----	**91.22**	----	----	**10.93**	----	----	**8.20**	----	----	**41.93**	----	----	**17.76**	12.40
Rice Hulls	2	91.50	92.30	**91.90**	3.12	4.68	**3.90**	0.55	0.65	**.60**	38.74	41.60	**40.17**	30.27	38.57	**34.42**	12.81
Rice straw	1	----	----	**96.34**	----	----	**4.68**	----	----	**1.74**	----	----	**50.90**	----	----	**28.31**	10.71

* Or albuminoids.

SEED TESTS.

During the year 122 samples of seeds have been tested with regard to their vitality, and many of these tests have been repeated a number of times in experimenting with new forms of apparatus and in studying the effect of temperature on germination.

In this study attention has been chiefly directed to onion seed because its production is a long established business in this State, and the station is more often called upon to test this than any other kind of seed.

Onion Seed.

Within the last few years the Station has tested a considerable number of samples which were sent in by growers or wholesale dealers with information as to the variety of the seed, its age, and the locality where it was grown. These samples represented seed ready for market after winnowing and separating the small, light seed.

On the following pages are tabulated the results of those tests which were made on seed reputed to be less than one year old.

Numbers 130, 131, 138, 230, 253, 254, 255 and 258 are believed to have been more than one year old at the time of testing. This is indicated by their low vitality and the fact that so large a percentage of seed remained hard at the end of the sprouting test. See Report of this Station for 1882, page 95.

Excluding these eight samples, the *vitality* of 72 samples is found to be on the average 81.8 per cent., ranging from 58.8 to 99.5 per cent., and the average weight of 79 samples, per 1000 seeds is 3.773 grams.

On only four varieties have a considerable number of tests been made. Their average vitality and weight are as follows:

Variety.	No. of tests.	Average vitality.	Average weight per 1000 seed (grams).
White Portugal	11	73.5	3.440
Wethersfield Large Red	16	80.9	3.758
Danvers Yellow	18	84.1	3.849
White Globe	10	84.0	3.836

The results of these tests show that the vitality of seed of the same variety and raised in the same geographical region

Onion Seed Tests.

Variety.	Station No.	Where raised.	When raised.	Seed sprouted.	Seed remained hard (per ct.)	1-2 sprouted seed germinated in days.	1,000 seeds weigh (grams).
Wethersfield Large Red	224	R. I.	1882	86.8	4.5	5	3.793
" "	48	Conn.	1879	92.5	7.0	4	3.910
" "	53	"	1879	82.3	9.0	4	3.950
" "	131	"	1880	75.3	18.5	4	4.284
" "	138	"	1880	44.3	34.5	3	4.241
" "	225	"	1882	75.8	4.5	5	3.754
" "	246	"	1882	77.3	8.0	4	3.920
" "	247	"	1882	73.0	17.5	4	4.217
" "	85	Mich.	1880	74.0	13.0	4	3.966
" "	86	"	1880	80.0	4.0	4	4.150
" "	132	"	1880	85.3	5.5	4	4.373
" "	255	"	1882	37.5	38.0		2.977
" "	117	Cal.	1880	89.5	1.0	3–7	2.890
" "	181	"	1882	79.5	2.0	5	2.869
" "	226	"	1882	70.0	7.0	8–11	3.104
" "	46	"	1878	92.5	4.5	5	3.737
Large Red Globe	112	Conn.	1879	90.5	5.0	4	3.797
" "	228	"	1882	86.5	9.5	5	4.493
" "	249	"	1882	85.5	7.0	4	4.189
" "	182	Cal.	1882	89.0	3.7	6	3.285
Early Large Red Globe	227	"	1882	75.8	7.5	6	3.506
Early Red Globe	84	Conn.	1880	85.8	7.2	5	4.352
" "	229	"	1882	72.6	13.0	6	4.004
" "	259	Mich.	1882	58.7	14.5	6	3.039
Second Early Red	235	R. I.	1882	66.2	14.5	5	3.825
Extra Early Red	244	Conn.	1882	75.0	12.5	4	3.990
" "	245	"	1882	69.0	15.0	4	4.010
" "	240	Cal.	1882	89.3	1.5	4	3.362
Extra Early Flat Red	80	Conn.	1880	82.5	12.0	5	4.485
" "	223	"	1882	74.0	9.0	5	4.220
" "	183	Cal.	1882	96.3	2.0	4	3.612
" "	222	"	1882	77.8	5.0	5	3.895
Extra Early	170	Conn.	1882	99.5	2.7	5	4.341
Danvers Yellow	230	R. I.	1882	35.3	30.0	5	3.347
" "	101	Conn.	1880	92.2	5.5	5	4.179
" "	102	"	1880	80.3	7.2	5	4.107
" "	109	"	1880	85.2	7.7	5	4.172
" "	110	"	1880	97.8	1.5	4	4.009

ONION SEED TESTS.

Variety.	Station No.	Where raised.	When raised.	Seed sprouted.	Seed remained hard (per ct.)	1-2 sprouted seed germinated in days.	1,000 seeds weigh (grams).
Danvers Yellow	136	Conn.	1880	88.5	6.5	4	4.333
" "	133	Mich.	1880	91.3	4.0	4	4.137
" "	258	"	1882	39.8	30.5	5	3.141
" "	58	N. Y.	1879	94.3	2.3	5	4.050
" "	97	"	1880	98.0	3.0	6	4.305
" "	98	"	1880	90.8	5.0	5	4.099
" "	134	"	1880	92.2	3.8	6	4.350
" "	135	"	1880	87.3	8.8	5	4.241
" "	49	"	1879	85.8	10.5	4	3.490
" "	55	"	1879	64.8	11.0	7	3.585
" "	118	Cal.	1880	88.5	0.8	4	2.662
" "	241	"	1882	74.8	4.0	5	3.052
" "	242	"	1882	78.0	9.5	4	3.990
Flat Danvers Yellow	231	N. Y.	1882	69.8	6.0	6	4.057
" " "	180	Cal.	1880	94.5	0.8	5	2.981
" " "	233	"	1882	82.3	1.0	6	3.169
Globe Danvers Yellow	179	"	1882	77.0	2.0	6	2.890
" " "	232	"	1882	68.0	3.5	6	3.279
Yellow Dutch	111	Conn.	1880	80.0	4.8	5	3.350
"	253	Mich.	1882	57.3	23.0	6	3.014
White Portugal	50	Conn.	1879	75.8	14.0	3	3.720
"	114	"	1880	91.8	2.5	6	4.040
"	115	"	1880	88.0	7.0	5	4.190
"	116	"	1880	89.0	5.5	5	3.767
"	220	"	1882	60.0	3.5	5	3.788
"	131	N. Y.	1879	64.5	27.5	7	3.952
"	256	Mich.	1882	48.0	1.5	5	2.681
"	257	"	1882	69.5	14.0	6	3.254
"	178	Cal.	1882	73.8	2.8	5	2.605
"	221	"	1882	69.5	3.0	5	2.851
"	243	"	1882	70.0	2.5	6	3.000
White Globe	57	Conn.	1879	96.0	0.0	4	3.830
"	113	"	1880	93.8	2.0	4	4.444
"	218	"	1882	75.0	6.0	6	3.747
"	219	"	1882	70.8	7.0	6	3.946
"	250	"	1882	73.2	16.0	6	3.920
"	251	"	1882	88.7	8.0	5	4.260
"	129	N. Y.	1880	89.7	7.0	6	4.123
"	254	Mich.	1882	20.0	65.0	6	4.418
"	177	Cal.	1882	89.5	0.8	6	2.890
"	217	"	1882	77.0	0.5	6	3.258

varies considerably from year to year with the character of the season. For instance, the season of 1882 is said to have been an extremely bad one for raising seed in Michigan, and it is seen that the Michigan grown seed of that year is very light and sprouts poorly.

It is held by some growers that onion seed more than a year old raised in a favorable season gives a better crop than seed raised a year later in a poor season.

The average weight of 1000 onion seed, as found in 79 samples representing 14 "varieties" grown in different sections of the country, was 3.773 grams. The maximum weight was 4.493 grams; the minimum, 2.605 grams. From these figures we may compute the number of seeds per pound which is, in round numbers—

Average number of onion seed in the pound	12,000
Maximum number of onion seed in the pound	17,400
Minimum number of onion seed in the pound	10,000

The California grown onion seed seems to be smaller than eastern grown, and it has been found considerably lighter in all cases where it has been tested. To illustrate, the average weight of 1000 seeds of Wethersfield large red onion, Connecticut grown, in 16 trials was 3.95 grams; Michigan grown, 3 trials, 4.16 grams; California grown, 3 trials, 2.95 grams. White Portugal onion, Connecticut grown, 4 trials, 3.901 grams; California grown, 3 trials, 2.818 grams. Danvers yellow onion, Connecticut grown, 11 trials, 3.786 grams; New York grown, 5 trials, 4.236 grams; California grown, 3 trials, 3.234 grams, etc., etc.

The temperature most suitable for the germination of onion seed in laboratory tests has been made the subject of experiment. Haberlandt* has observed the germinating power of 56 species of seeds and the rapidity of their germination at 62°, 77°, 89°, 100°, 111°, 122° F., but onion seed was not among the number. In each trial made at this station three lots of two hundred seeds each were placed in three sprouting beds of the kind described below, and left to germinate at 51°, 60° and 85° F., respectively. These temperatures were not entirely constant, but the fluctuations were inconsiderable. A maximum and minimum thermometer stood with each apparatus, and the figures given are the average temperature. From time to time the seeds already sprouted were counted and removed.

* Landwirthsch. Versuchs-Stationen xvii 104.

Following are the results:

Station No.	Variety.	Per cent. of seed sprouted at 51° F.	60°	85°
237	Italian	63.0	57.5	42.5
238	Italian	35.5	45.0	29.0
239	Italian	47.5	55.0	32.0
240	Extra Early Red	82.0	88.5	51.5
245	Extra Early Red	58.0	62.0	40.5
241	Yellow Danvers	78.5	83.0	45.0
242	Yellow Danvers	71.0	69.0	51.0
248	Yellow Danvers	64.5	82.5	29.0
243	White Portugal	65.0	69.0	39.0
246	Large Red Wethersfield	70.5	76.0	39.5
249	Large Red Globe	78.5	84.5	49.0
250	White Globe	77.0	77.0	50.5
251	White Globe	82.0	83.5	62.5
254	White Globe	20.5	15.5	10.0
253	Yellow Dutch	48.5	43.5	23.0
252	White Silver Skin (French)	67.0	73.0	47.0
	Average	**63.0**	**66.5**	**40.0**

It appears from these results that in every case fewer seeds germinated at 85° than at either of the lower temperatures. This difference is very decided in every instance except, perhaps, in No. 254, and amounts, on the average, to 25 per cent.

More seed germinated at 60° than at 51° in all the trials but one, No. 237. The differences, however, with the exception of No. 248, are seen to be comparatively small when it is considered that duplicate tests made at the same temperature not infrequently vary by 5 per cent.

One-half of the germinating seed sprouted within 10 days, on the average, from the beginning of the test at 51°; within 7 days at 60°, and 6 days at 85°.

The results demonstrate that a temperature not far from 60° F. is the most suitable for the germination of onion seed in the laboratory. Probably a difference of 5 degrees in either direction would make no essential difference in the results.

Lettuce Seed.

The *vitality* of 28 samples of lettuce seed, representing 23 alleged "varieties," received from wholesale dealers, and stated by them to be fresh seed, winnowed and ready for market, was, on the average, 98.3 per cent. The maximum vitality was 100 per cent.; the minimum 93 per cent. Since there was so little difference in the vitality of the samples, the results of the tests are not here given in detail. The varieties were the following: Boston Curled, Extra Boston Curled, Early Boston Curled, Boston Market, Curled Simpson, black seed; Curled Simpson, white seed; Extra Curled Simpson, Early Simpson, Butter Salad, black seed; Butter Salad, white seed; Butter Salad, yellow seed; Tennis Ball, white seed; Early Tennis Ball, Hanson's, Large India, All the Year Round, Drum Head, Cabbage, or Malta Drum Head; White Paris, Frankfort Head, Early Curled Silesia, Ferry's Prize Head, Green Fringed, Philadelphia Butter.

The weight of 1000 seeds of the samples above referred to was on the average 1.28 grams. The maximum weight, 1.56 grams; the minimum, 1.00. Most of the samples were California grown.

Four samples of Early Boston Curled and two of White Paris are not included in the averages for this reason. The White Paris seed averaged .717 grams per 1000, and the four samples of Boston Curled .808 grams per 1000. These weights it will be seen are very much lower than the minimum of all the other 28 samples.

Seeds from the U. S. Department of Agriculture.

Twenty-five varieties of vegetable seeds distributed by the Department of Agriculture last winter have been tested with the following results:

Variety.	Station No.	Seed sprouted. Per cent.	Seed remained sound. Per cent.	1-2 sprouted seed germinated in days.
LETTUCE—				
Yellow Seeded Butter	184	99.0	2.0	3
Salamander	185	98.8	1.0	3
California Gardeners'	186	95.2	0.0	6
CABBAGE—				
Jersey Wakefield	187	98.8	0.0	5
Early Summer	188	96.2	3.5	5
Henderson's Early Summer	189	78.5	0.0	6
TURNIP—				
Purple Top Rutabaga	190	94.8	2.0	5
Sweet German Rutabaga	191	90.3	0.0	5
CARROT—				
Long Orange	192	53.0	30.5	6
Improved Long Orange	193	52.5	24.7	7
RADISH—				
Long Scarlet	194	71.7	0.0	4
White Tipped Scarlet Turnip	195	61.7	0.0	4
PEAS—				
Daniel O'Rourke	163	96.0	0.0	9
Challenge	164	94.0	0.0	9
Yorkshire Hero	165	95.0	0.0	9
Improved Daniel O'Rourke	166	94.0	0.0	8
SWEET CORN—				
Early Minnesota	168	60.5	0.0	13
Early Marblehead	169	83.5	0.0	14
ONION—				
Extra Early Onion	170	95.5	3.0	5
Extra Early Red	171	53.8	33.0	6
White Portugal	172	74.5	15.5	6
Red Globe	173	31.0	39.0	6
TOMATO—				
Trophy	175	45.5	?	5
Large Smooth	174	76.8	0.0	6
Acme	176	78.3	0.0	5

Most of them were of good quality as far as vitality is concerned. One sample of onion seed, 173, was evidently old and comparatively worthless. 31.0 per cent. sprouted, while 39 per cent. remained hard at the close of the test. One other sample, 171, is undoubtedly old seed.

It will be noticed that a laboratory test can only take into account three of the factors which determine the quality of a sample of seed, viz: its purity, that is, its freedom from seeds of other species of plants, its germinating power, and its weight.

At present it is not possible in most cases from such a test to decide whether the seed will produce vigorous or feeble plants, or whether it is true to name, in so far as to be free from all other varieties of the same species.

Apparatus for Testing the Vitality of Seeds.

During the year the apparatus here described has been tested and found to give perfectly satisfactory results with onion and lettuce seed. Other species of seeds have not as yet been tried in it.

The apparatus consists of a pan of copper or galvanized iron two and a half feet long, ten and a half inches wide and one and three-quarters inches deep. At one end is a small horizontal tube let into the side near the bottom, which may be closed with a cork. The pan has a slightly arched cover, two feet and four inches long, ten inches wide, with a rim three inches deep. It is provided with a handle and has two three-quarter inch orifices on top through which a thermometer can be introduced if desired, which also secures sufficient ventilation for small seed. The tiles which hold the seed to be tested are made of a very light* and coarsely-porous earthen ware which absorbs water almost as rapidly and abundantly as a sponge. This material is manufactured by S. L. Pewtress & Co., of New Haven, as a filtering medium, and is quite unlike any other earthenware that has come under our notice. Each tile is nine inches, by eight and one-half, by one and one-half. The upper surface is grooved, by help of a broad file, so as to form seven channels or beds, about one-quarter of an inch apart, running the length of the tile, each seven-eighths of an inch wide and three-sixteenths of an inch deep.

* One of them weighs, when dry, 2 pounds 11 ounces.

Each channel receives two hundred seeds, previously soaked for six to twelve hours, and a slip of paper with the proper label or number.

The water and seeds may be emptied together into the dry channel from the capsule in which they have been soaked and distributed evenly with the help of a wash bottle.

Each pan will carry three tiles or twenty-seven samples of seeds. The bottom of the pan is covered with water a quarter of an inch deep, the cover is put on and the apparatus placed where the temperature is tolerably constant and suitable for the germination of the seeds under trial.

The air in this apparatus is constantly saturated with moisture, the seed bed is also saturated but can never have water standing on it; the holes in the cover secure necessary ventilation, but the evaporation from the porous tiles is not so rapid as to reduce their temperature. These considerations and the fact that little care is necessary to keep the water supply constant, have led us to adopt this form of apparatus, after finding that the results of its use closely agreed with those obtained with moist filter paper as a sprouting medium. In sixty-six trials by the two methods a difference of ten per cent. or more occurred in four cases; the average difference was 0.7 per cent.

This sprouting apparatus thus appears to give unexceptionable results, and in convenience of use much surpasses any arrangement we have hitherto met with. For use with large seeds additional ventilation may be needful.

The Station's instructions for sampling seeds are as follows:

THE CONNECTICUT

AGRICULTURAL EXPERIMENT STATION,

NEW HAVEN, CONN.

Instructions for Sampling Seeds.

The *Purity* and *Germinating Power* of Seeds intended for Farm and Garden use are learned by examining a small average sample. From a weighed amount of seed the pure seeds are culled out and weighed, foreign matters and especially noxious seeds are identified, the vitality of the pure seed is tested by careful sprouting trials, and a report is drawn up of the results.

As the test of germinating power requires some time for its completion, a report on samples sent in cannot be ordinarily expected in less than two weeks.

The examination of *grass-mixtures* can only be undertaken in special cases. It requires a large outlay of time and labor which is not often justified by the results.

In selecting a sample for examination the greatest care should be used to have it represent accurately the whole amount from which it was taken. This result will be secured by proceeding as follows:

1. Mix well together with the hand and arm the contents of the package (bag or barrel) or packages of seed.
2. Take out five or six small handfuls or cupfuls* from various parts of the package, mix these together and take a part of this mixture for the sample.
3. Send of the smaller seeds—red top, white clover, timothy, etc., two (2) ounces; of beets, turnips, red clover, etc., four (4) ounces; of wheat and cereals, and of peas and other legumes, eight (8) ounces.
4. Samples may be sent by mail, or otherwise, prepaid, and should be *plainly labelled* and addressed to

CONN. AGRICULTURAL EXPERIMENT STATION,
New Haven, Conn.

* A small cup may be closed with the palm of the hand, forced down to the desired place, then filled and withdrawn.

Seeds sent in for gratuitous examination must be accompanied by the following form:

THE CONNECTICUT

AGRICULTURAL EXPERIMENT STATION,

NEW HAVEN, CONN.

Form for Description of Sample.

Station, No. Received at Station, 188 .

Each sample of seed sent for gratuitous examination must be accompanied by one of these Forms, with the blanks *below* filled out as fully as practicable.

This Form, filled out and sent with the sample, will serve as a label; but it should be returned *in good order* for filing in the Station Records.

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

Name or label of seed,

Name and address of Producer or Importer,

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

Date of taking this Sample,

Selling price per pound or bushel,

Known or reputed age of seed,

Number of packages from which sample is taken,

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

The results of the examination are reported to the party sending, on a Form, of which the following is an example:

REPORT OF SEED TEST.

CONNECTICUT

AGRICULTURAL EXPERIMENT STATION.

NEW HAVEN, CONN., 188 .

Examination of

Received 188 Station No.
From

Pure seed,		per cent. by weight.
Impurities,		per cent. by weight.
Pure seed sprouted during	days.	per cent. by number.
Pure seed decayed during	days.	per cent. by number.
Pure seed sound (unsprouted) after	days.	per cent. by number.
Of sprouted seed, $\frac{1}{2}$ germinated in		days.
1000 seeds weighed		grams.
Per cent. value,		

The "per cent. value" of a sample of seed is obtained by multiplying its per cent. (by weight) of pure seed into the per cent. (by number) found, or able, to germinate, and dividing by 100. It refers the number of seeds found, or able, to germinate, from "pure seed" back upon the sample itself, in terms of per cent. In case of *perennials only* it takes account of $\frac{1}{3}$ of the unsprouted sound seeds, the proportion which, on an average of many observations, has been found to germinate under favorable conditions.

Director

MILK.

Analyses of Milk of Ayrshire Cows.

In March last, S. M. Wells, Esq., of Wethersfield, gave the station opportunity to make analyses of a number of samples of the milk of single Ayrshire cows from his well-known herd. The results are tabulated below. Two of the analyses are incomplete as respects some ingredients.

Name of Cow.	Mysie.	Mysie Athol.	Mysie McCrae.	Flora McArthur.	Flora 34
Water,	88.40	87.45	87.66	85.83	87.24
Casein and albumin,	3.03	3.07	3.26	----	3.05
Fat,	3.17	3.78	3.82	4.96	3.74
Sugar,	4.82	4.94	4.32	4.71	----
Ash,	.58	.76	.94	----	----
	100.00	100.00	100.00		
Total solids,	11.60	12.55	12.34	14.17	12.76
Date of dropping last calf,	Oct. 26, '82.	Feb. 27, '83.	Dec. 26, '81.	Mar. 21, '83.	Mar. 6, '83.

The milk was received Mar. 28, 1883. As will be seen, three of the cows were fresh in milk, one had been four months in milk and one fifteen months.

With perhaps the exception of the milk of Flora McArthur who calved only a week before the sample was taken, the analyses show as close agreement as could be expected between analyses of the milk of a single cow on different days, or at different stages of lactation. The average total solids amount to 12.76 per cent., which shows excellent quality.

Case of Watered Milk.

In March, 1883, a sample of milk was brought to this station by the purchaser, who suspected adulteration. This suspicion was confirmed by the analysis I, see below.

It was reported to the sender that the milk might possibly be a genuine milk of extraordinary and abnormal composition, taken from a single cow; but in all probability it was rich milk (probably Jersey or Guernsey), which had been mixed with about one-third its weight of water. That to test the matter beyond all doubt a sample taken by a third party at the time of milking and known to be unwatered, might be sent for analysis; and if this trial should be refused the fact of watering would be rendered pretty certain.

A sample taken as suggested was soon afterwards analyzed with the following results, II:

	I.	II.
Specific gravity,	1.024	1.030
Solids, per cent.	10.04	14.14
Fat, "	3.31	5.48

The fact of watering thus proved was not denied, and the seller made the restitution demanded.

A sample of milk from the same party taken three weeks later contained 14.28 per cent. of solids and 4.40 per cent. of fat.

Examination of Market Milk.

Incidental to the proving of a method of determining fat in milk, partial analyses have been made of fifteen samples of milk bought at groceries or meat markets in New Haven in December, 1883. The price paid in all cases was four cents a pint. The results are as follow:

No.	Solids.	Fat.
48	9.25	2.81
49	13.03	4.19
50	10.32	2.95
51	11.32	3.46
52	13.03	3.79
53	9.77	2.99
54	11.41	3.71
55	13.55	4.49
56	11.06	3.00
57	12.52	3.99
58	12.04	3.94
59	13.88	5.38
60	12.61	4.33
61	14.26	5.66
62	12.77	4.15

Three of these samples, Nos. 48, 50 and 53 have probably been skimmed or watered, one other, No. 56, is of poor quality, the rest are, no doubt, pure milk. Nos. 59 and 61 are unusually rich.

These samples were not bought primarily with the object of finding out the quality of the milk kept on hand at the places

visited, and they do not accurately show it. They show only what quality of milk a purchaser is likely to get. No pains are usually taken to stir the milk thoroughly in the can before dipping out, and it may easily happen that one customer will receive rich milk and another very poor milk from the same can.

Effect of Worry on the Quality of Milk.

On May 14, Mr. Wm. F. Morgan of Woodbridge, brought to the station a sample of milk from a cow recently purchased by him and turned in with his herd. The animal was represented to be a good milker, but the quality of her milk was inferior and no cream could be got from it. A partial analysis of the milk was made with the following results:

Specific gravity,	1.031
Solids, per cent.	11.28
Fat, "	2.16

The cow had been a pet and had not previously run in a herd. It was suggested by Mr. Morgan that she might be somewhat harrassed by the other cows. It is well known that excitement or "nervousness" often has an effect on the milk secretion and that the quality was thus strikingly influenced in this case is rendered highly probable by the following analyses of two samples of milk from the same cow, taken at later dates—which show excellent quality.

	Aug. 1, '83.	Jan. 15, '84.
Water, per cent.	87.50	84.92
Solids, per cent.	12.50	15.08
Casein and albumin, per cent.	2.81	3.34
Fat, per cent.	3.94	5.54

The present State law with regard to the sale of milk is as follows:

An Act to Prevent the Adulteration of Milk.

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

Section 1. Whoever shall knowingly sell, supply, or bring to be manufactured to any butter or cheese manufactory in this State any milk diluted with water, or adulterated by the addition of

any foreign substance, or from which any cream or milk commonly known as strippings has been taken; or whoever shall knowingly bring or supply milk to any butter or cheese manufactory that is tainted or partly sour, shall, for each offense, forfeit and pay a sum not less than twenty-five dollars nor more than one hundred dollars with cost of suit, to be sued for in a court of competent jurisdiction, for the benefit of the person or persons, firm or association, or corporation, or their assigns, upon whom such fraud shall be committed.

Sec. 2. The usual test for quality and the certificate of analysis of the director of the Connecticut Agricultural Experiment Station shall be deemed *prima facie* proof of adulteration.

Sec. 3. No person shall sell, or expose for sale any milk from which the cream or any part thereof has been removed, without distinctly and durably affixing a label, tag, or mark of metal in a conspicuous place upon the outside, and not more than six inches from the top of every can, vessel, or package containing such milk, and such metal label, tag, or mark shall have the words "Skimmed Milk" stamped, printed, or indented thereon in letters not less than one inch in height, and such milk shall only be sold or retailed out of a can, vessel or package so marked.

Sec. 4. No person shall sell or offer for sale, or shall have in possession with intent to sell or offer for sale, any impure or adulterated milk.

Sec. 5. Every person who shall violate the provisions of sections three and four of this act shall be deemed guilty of a misdemeanor, and on conviction thereof shall be fined not more than seven dollars, or be imprisoned not more than thirty days or both.

Sec. 6. A printed notice of this law shall be conspicuously posted in all public places, creameries, or factories where milk is received or sold.

Approved, April 25, 1882.

On the Determination of Nitrogen by Combustion with Calcium Hydroxide.

In a paper by the Director, published in the American Chemist for 1873 (vol. III, p. 161), it was shown that the mixture of sodium hydroxide and calcium hydroxide or oxide, proposed by Will and Varrentrapp as a reagent for converting organic nitrogen into ammonia for the purposes of analysis may be advantageously replaced by a more easily prepared mixture of sodium carbonate and calcium hydroxide. When preparing that paper some combustions were made with simple calcium hydroxide and in case of uric acid for instance, the amount of nitrogen obtained fell short of the theoretical quantity by less than one per cent. As no entirely satisfactory results were then reached by burning with simple slaked lime, it was concluded that the presence of an alkali hydroxide, which it was thought might be formed in small quantity in the process of combustion, was necessary to the complete conversion of the nitrogen into ammonia. Further trials were then contemplated but not until recently has the opportunity offered to carry them out. A series of analyses whose results are here given, demonstrate that this further simplification of the Will and Varrentrapp method applies to all those classes of substances, which are ordinarily encountered in technical work.

The calcium hydroxide was prepared from a good quality of quick lime by slaking with water in but slight excess, drying off any surplus of water at a moderate heat, rubbing gently in a mortar, passing through a sieve of $\frac{1}{25}$ inch holes and bottling in well-closed "fruit jars."

The tubes were filled and the combustions were made in the way indicated in the Report of this Station for 1878, page 116. The points to be observed are chiefly these. For the burning of 0.5 gram of substances containing 8 per cent. of nitrogen or less, a tube of 14 inches is long enough. For dried blood or albuminoids containing from 12 to 17 per cent. of nitrogen a tube 2–4 inches longer is desirable.

The mixture of substance and slaked lime must not quite half fill the tube in length-wise direction. The long anterior layer of slaked lime must be brought to a *full red heat* before heating the mixture, and must be so kept throughout the combustion.

No fumes or tarry matters, indicative of incomplete combustion, should appear in the bulb containing standard acid.

When the combustion proper is begun it may be carried on quite rapidly until completed.

The tube is cooled below a red heat before aspirating.

The ammonia from the combustion is received in standard hydrochloric acid and titrated with a standard ammonia solution, using tincture of cochineal as an indicator.

The advantages of using cochineal tincture instead of litums solution are very considerable. It can be kept unaltered indefinitely, as litmus cannot, it is not seriously affected by the presence of carbonic acid in solutions, and as an indicator it is more sensitive.

In our use of the mixture of slaked lime and sodium carbonate, the acid in the bulb-tube is frequently colored more or less deeply red. This in nowise interferes with the alkalimetry, for the red color fades as the point of neutralization is reached. In burning with simple slaked lime, the standard acid has almost invariably remained colorless, a fact which shows that the combustion with the latter is more perfect. Evidently it is highly heated water vapor which at once oxidizes the carbon and hydrogenizes the nitrogen, and the slaked lime alone, operates more effectually because it supplies more water in a given bulk of charge.

As was to be anticipated, the lime, at the full red heat to which it must be exposed, does not retain all the carbon dioxide that is formed; the gases which pass the standard acid give a copious precipitate in baryta-water. The standard acid, however, takes up from the heated gases too little carbon dioxide to sensibly affect the point of neutralization, and the entire accuracy of the determination is in no degree impaired.

The contents of the tube, after the combustion is finished, are mostly quicklime with some carbonate, since they slake strongly and effervesce slightly in dilute acid.

The following are some of the results obtained by the two methods. Soda-lime here signifies the mixture of about equal bulks of sodium carbonate and slaked lime. The combustions have been executed by Mr. E. H. Farrington.

	Theory.	Soda-lime.	Slaked lime.
Crystallized potassium ferrocyanide,	19.93	19.82	19.86
Anhydrous " "	22.80	22.78	22.83
Potassium ferricyanide,	25.49	25.42	25.40
		25.46	25.42
Strychnine,	8.38		8.30
			8.32
Hippuric acid,	7.81	7.79	7.83
Dried oak leaves,		1.81	1.76
Dried chestnut leaves,		1.54	1.63
Wheat middlings,		2.28	2.30
Dried peat,		2.03	1.94
Castor pomace,		4.54	4.53
		2.48	2.39
"Fish and Potash,"		3.75	3.75
Superphosphate,		3.46	3.37
Bone,		3.93	4.02
"		6.70	6.61
Fish scrap,		7.16	7.12
" "		7.61	7.70
Dried blood,		11.79	11.88
		11.79	11.79
" "		11.18	11.26
		11.23	11.33

In the case of bone, fish and superphosphates, a still closer agreement would probably have been obtained by the two reagents if the materials analyzed had admitted of finer pulverization and more accurate sampling.

A considerably larger number of comparisons have been made, but in no case, except that of strychnine, was the difference greater than is indicated by the determinations above given.

The combustion of strychnine is more difficult than that of the other substances named above, and for good results it is needful to use it in small quantities, as seen from the subjoined statement.

			Soda-lime.	Slaked lime.
Strychnine,	0.5 grm. :	tube 12–14 in.	7.82	7.89
			7.85	7.98
"	0.3 "	" 14 "	7.44	
		" 20–22 "	8.14	8.14
			8.05	8.20
"	0.2 "	" 20 "	8.14*	8.25
"	0.1 "	" 20 "		8.30
				8.32

* Will & Varrentrapp's Soda-lime, made by Merck.

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