STATE OF CONNECTICUT.

11th

ANNUAL REPORT

OF

The Connecticut Agricultural

EXPERIMENT STATION

For 1887.

PRINTED BY ORDER OF THE GENERAL ASSEMBLY.

NEW HAVEN, CONN.:
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1888.

THE

Connecticut Agricultural Experiment Station.

OFFICERS FOR 1887.

STATE BOARD OF CONTROL.

Ex-officio.

HIS EXC. PHINEAS C. LOUNSBURY, *President.*

Appointed by Connecticut State Agricultural Society: Term expires
HON. E. H. HYDE, Stafford, *Vice-President.* July 1, 1891.

Appointed by Board of Trustees of Wesleyan University:
PROF. W. O. ATWATER, Middletown. 1888.

Appointed by Governor and Senate:
EDWIN HOYT, New Canaan. 1889.
H. L. DUDLEY, New London. 1890.

Appointed by Board of Agriculture:
T. S. GOLD, West Cornwall. 1889.

Executive Committee.

Appointed by Governing Board of Sheffield Scientific School:
W. H. BREWER, New Haven, *Secretary and Treas.* 1890.

Ex-officio.
S. W. JOHNSON, New Haven, *Director.*

Chemists.

E. H. JENKINS, PH.D., *Vice-Director.*
E. H. FARRINGTON, B.S.
A. L. WINTON, JR., PH.B.
T. B. OSBORNE, PH.D.

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

The Station makes analyses of Fertilizers, Seed-Tests, etc., etc., for the citizens of Connecticut, without charge, provided—

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

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. 23.

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 farmers is essential for the full and timely protection of their interests. Farmers' Clubs and like Associations can efficiently work with the Station for this purpose, by sending in duly authenticated 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 any individual officer*, 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., 1⅝ miles North of City Hall. Suburban st. may be reached by the Whitney ave. Horse Cars, which leave the corner of Chapel and Church sts. three times hourly, viz., on the striking of the clock and at intervals of twenty minutes thereafter.

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

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REPORT OF THE BOARD OF CONTROL.

To His Excellency, Phineas C. Lounsbury, Governor of Connecticut:

In accordance with the law establishing the CONNECTICUT AGRICULTURAL EXPERIMENT STATION, as amended by Chapter V, Sec. 20 of the acts of the last General Assembly, the Board of Control herewith submits its Annual Report. The Report of the Director will show that the work of the Station has gone on without interruption during the twelve-month just completed. Two hundred and ninety analyses of fertilizers, twenty-two of feeding stuffs, eight of potatoes, eight of insecticides and a number of analyses of miscellaneous articles will be included in his Report, and a large amount of efficient work has been done besides, in testing and improving methods and appliances for the analysis of fertilizers, soils, and feeding stuffs. The chemical work required by the Dairy Commissioner has been done at the Station. A field experiment has been carried out to test the agricultural value of certain phosphates, and a Forage Garden on the Station grounds has been established for the study of problems connected with the improvement of meadows and pastures. These subjects will be fully discussed in the Report of the Director which is in an advanced state of preparation, and will be ready for publication early in 1888. The Report of the Treasurer herewith presented exhibits the financial affairs of the Station for the last fiscal year. The Board of Control has held one special meeting relating to the Experiment Station bill which was passed by the 49th Congress and the Executive Committee has also held two meetings. The Board appointed delegates to a National Convention of representatives of Agricultural Colleges and Experiment Stations held in Washington, Nov. 22–24, called for the purpose of concerting measures to remedy a defect in that bill which failed to provide the special appropriation it was intended to make. It is now confidently expected that funds from this source will shortly be available for the use of this Station.

All which is respectfully submitted:

WM. H. BREWER, *Sec'y.*

REPORT OF THE TREASURER.

Wm. H. Brewer, *in account with the Connecticut Agricultural Experiment Station.*

July 1st, 1886 to June 30th, 1887.

Receipts.

Balance from old account	$192.88	
From Comptroller	8,000.00	
Analysis Fees	3,759.48	
Miscellaneous Receipts	97.45	
		$12,049.81

Expenses.

Salaries	$6,925.52	
Laboratory expenses	1,528.39	
The Buildings, Grounds and Establishment, repairs, etc.	1,023.06	
Printing	358.33	
Stationery	102.54	
Postage	219.43	
Library	188.79	
Collecting Fertilizers	468.97	
Traveling expenses of the Board of Control	29.12	
Telephone	100.15	
Water	132.00	
Gas	292.06	
Fuel	28.75	
Herbarium	198.30	
Special Grass investigation	202.70	
Miscellaneous sundries	248.31	
Balance on hand	3.39	
		$12,049.81

Memorandum.

There is due the Station ninety (90) dollars for laboratory work.

WILLIAM H. BREWER, *Treasurer.*

REPORT OF THE DIRECTOR.

Under the requirements of the State Fertilizer Law, the greater part of the time and labor of the operating force of this Station has been expended, as usual, in work connected with the collection and analysis of Commercial Fertilizers.

The total number of brands legally sold in the state during the past year has been 128. The law requires this Station to make and publish annually at least one analysis of each of these, while examinations of home-mixed fertilizers and waste-products have brought the total number of fertilizer analyses up to 291. These analyses have been performed by Messrs. Farrington, Winton and Osborne. During April and a part of May the Station employed as special agents, Messrs. E. C. Ellwood of Green's Farms and C. L. Gold of West Cornwall, who visited more than one hundred towns in Connecticut, and drew in all nearly 600 samples of fertilizers, reporting also any cases where the requirements of the law appeared not to be fully met.

Twenty-two analyses of feeding stuffs have been made and the results of all accessible American analyses of this kind which have been published during the year have been tabulated by Dr. Jenkins and will be found in this Report.

Eight analyses of potatoes have been executed and incidental to this work a considerable amount of labor has been expended in comparing the different methods currently employed for determining starch. The results of this investigation by Mr. Winton appear in the following pages.

Six samples of Paris Green, now largely used on fruit trees as an insecticide, have been analyzed by Dr. Osborne for the purpose of determining their purity.

One sample of milk and one of the internal organs of a cow have been examined for suspected poisons, in both cases with negative results.

At the request of Hon. J. B. Tatem, Dairy Commissioner, the Station has made chemical examination of 34 samples of suspected butter, all but one of which proved to be imitation butter.

A law passed at the last session of the General Assembly provided for the inspection of molasses by the Dairy Commissioner. The Commissioner applied to the Station to make the necessary examinations of suspected samples. The Director was unprepared on his own responsibility to accede to the Commissioner's request, and for the following reasons :—

1. The first section of the Act creating the Station declares "That for the purpose of promoting agriculture by scientific investigation and experiments, an institution is hereby established, to be called and known as The Connecticut Agricultural Experiment Station." Since molasses is not made in this State and is not an agricultural but a manufacturing product it is evident that its analysis for the purpose of discovering adulteration is no more the proper duty of this Station than the study of the adulterations of any other article of general consumption.

2. The Station would require to make a considerable outlay for study of the methods and for the purchase of apparatus necessary for testing molasses, and to judge from its experience with oleomargarine would have to give much of the time of its chemists to this work.

The question was therefore referred to the Executive Committee, and it was decided that since the law would otherwise remain without effect, the Station should coöperate with the Dairy Commissioner as far as due regard to its other obligations would permit. Through the courtesy of Dr. Cook, Director, and Dr. Neale, Chemist, Dr. Jenkins was enabled to avail himself of the extensive experience in sugar analyses which these officers of the New Jersey Station have enjoyed, and spent some time at New Brunswick with their coöperation and assistance, in mastering the methods applicable to testing the purity of molasses. The Station has obtained from Germany the needful instruments for sugar-analysis, including a Polarimeter of the most improved construction (Halbschatten Polarisations-Apparat mit doppelter Keil-compensation, von Schmidt & Haensch). As yet but few examinations of molasses, have been completed for the Commissioner.

In continuation of his work, begun in 1886, Dr. Osborne has made further valuable contributions to the study of Methods of Mechanical Soil-Analysis and his results are included in this Report.

Mr. Farrington has made an elaborate comparison of Jodlbauer's modification of the Kjeldahl process of determining nitrogen, with the absolute method. His results are detailed in this Report.

Under arrangement with Mr. W. I. Bartholomew of Putnam a very instructive field experiment has been skilfully carried out to test the comparative value of certain phosphates on the corn crop, and in connection therewith a series of analyses have been made to determine the total quantities both of cattle food and mineral matters removed from an acre in the corn crop. Plans for performing a similar experiment which had been entered into were interrupted by the decease of Mr. Fairchild of Middletown.

In the latter pages of this Report will be found an account of the Forage Garden at this Station which was begun in September of 1886. The object in view in establishing this Garden and what has been accomplished thus far, are there set forth and need not be further noticed here. In carrying on that work the Station has been fortunate to be able to make avail of the very valuable and largely gratuitous services of Mr. J. B. Olcott, of South Manchester, who has labored for it and in it, with head and hands, in season and out of season. Mr. Farrington and Mr. Winton and especially Dr. Jenkins have contributed both mind and muscle to the care of this very troublesome but extremely interesting part of the Station grounds.

The Station has published and distributed in editions of 5000 copies, four printed bulletins, aggregating 49 pages. The object of these Bulletins is to place in the hands of those concerned the results of the Station work as promptly as possible.

As required by law, a package of each Bulletin is mailed to every post-office in the state. The package is directed to the postmaster, with a request to distribute to farmers. The number sent will be increased, in any case, on application. The distribution of these Bulletins is of course optional with the postmaster.

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

The Bulletins are sent, also, on application, to any individual who wishes them. Such application, as a rule, must be renewed annually early in the year.

The Station has also issued fourteen Weekly Statements printed in a very limited edition by the hektograph process and supplied as far as possible to the agricultural press, and to Secretaries of farmers' clubs and agricultural societies.

The necessary Station correspondence increases from year to year and during the last twelve months has involved the sending of some 1500 manuscript letters and reports of analyses.

Besides receiving many calls from individual farmers the Station has been visited the last year by the Green's Farms Farmer's Club in a body and also by the Cheshire Grange, whose members to the number of seventy-five, came to the Station on an appointed day, bringing their lunch, and made a picnic on the Station grounds. It is hoped that other organizations of farmers will follow this example during the coming season. The Station officers will do all in their power to make visits interesting and profitable.

THE CONNECTICUT FERTILIZER LAW.

The General Assembly at its session in 1882 passed a Fertilizer Law which went into effect September 1, 1882, and which repealed and took the place of all previous legislation on this subject. The law is still in force without any amendment. Since a full understanding of the provisions and penalties of this law is important to all who buy or sell commercial fertilizers the law is here reprinted and attention is specially directed to the following points:

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

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

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

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

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

AN ACT CONCERNING COMMERCIAL FERTILIZERS.

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

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

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

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.

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

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

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

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

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

Insoluble phosphoric acid may be stated or omitted.

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

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

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

director a sealed glass jar or bottle containing not less than one pound of the fertilizer, accompanied by an affidavit that it is a fair average sample thereof.*

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

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.

Yearly Report to Station of Dealers or Agents.

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.‡

Leather.

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

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

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

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

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

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

Fish-guano, &c.

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

Fines.

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

Fertilizers for private use.

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

Director's duties and authority.

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

Bulletins.

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

Repeal of former acts.

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

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

OBSERVANCE OF THE FERTILIZER LAW.

MANUFACTURERS who have paid Analysis Fees as required by the Fertilizer Law, and Fertilizers for which the Fees have been paid for the year ending May, 1888.

Firm.	*Brand of Fertilizer.*
Adams, Wm. P., 248 Front St., N. Y.	Adams' Ammoniated Bone Superphosphate.
Adams & Thomas, Springfield, Mass.	Adams' Market Bone Fertilizer.
American Oil Co., 18 Broadway, N. Y.	Cotton Hull Ashes.
Apothecaries Hall Co., Waterbury, Conn.	Victor Phosphate.
H. J. Baker & Bro., 215 Pearl St., N. Y.	A. A. Ammoniated Superphosphate.
	Pelican Bone Fertilizer.
	Potato Fertilizer.
	Corn Fertilizer.
	Strictly Pure Ground Bone.
	Castor Pomace.
	Ground Bone.
Bennett, P. W., Rockfall, Conn.	Stockbridge Grain Manure.
	" Forage Crop Manure.
	" Vegetable Manure.
Bowker Fertilizer Co., 43 Chatham St., Boston, Mass.	Bowker's Hill and Drill Phosphate.
	" Fish and Potash.
	" Ammoniated Dissolved Bone.
	" Dry Fish.
Bradley Fertilizer Co., 27 Kilby Street, Boston, Mass.	Bradley's Complete Manure for Potatoes and Vegetables.
	Bradley's Complete Manure for Corn and Grain.
	Bradley's Complete Manure for Top Dressing Grass and Grain.
	Bradley's Superphosphate.
	B. D. Sea Fowl Guano.
	Original Coe's Superphosphate.
	Circle Brand Ground Bone and Potash.
	Bradley's Potato Manure.
	Farmer's New Method Fertilizer.
	Pure Fine Ground Bone.
	Fish and Potash, Anchor Brand.
	" " " Triangle A Brand.
Clark's Cove Guano Co., New Bedford, Mass.	Bay State Fertilizer.
	Unicorn Ammoniated Superphosphate.
	King Phillip Alkaline Guano.
	Great Planet A Fertilizer.
	" " B "
Coe, E. Frank, 16 Burling Slip, N. Y.	High Grade Ammoniated Bone Superphosphate.
	Alkaline Bone.
	Red Brand Excelsior Guano.
	Ground Bone.
	Fish and Potash.
Coe, Russell, Tremley, N. J.	Ammoniated Bone Superphosphate.
Collier White Lead & Oil Co., St. Louis, Mo., by F. Ellsworth, Hartford, Conn.	Collier Castor Pomace.
Common Sense Fertilizer Co., 42 Congress St., Boston, Mass.	Common Sense Fertilizer, No. 2.
	" " " No. 22.

Firm.	Brand of Fertilizer.
Cooper's, Peter, Glue Factory, 17 Burling Slip, New York.	Peter Cooper's Bone Dust.
Crocker's Fertilizer & Chemical Works, Buffalo, N. Y.	Ammoniated Bone Superphosphate.
	Potato, Hop and Tobacco Phosphate.
	Queen City Phosphate.
	Pure Ground Bone.
Cumberland Bone Co., Portland, Me.	Cumberland Superphosphate.
Dambmann Bros. & Co., 13 German St., Baltimore, Md.	The Improved Blood Guano.
Darling, L. B., Fertilizer Co., Pawtucket, R. I.	Darling's Animal Fertilizer.
	" Extra Phosphate.
	" Pure Fine Bone.
Dickenson, D. B., Middle Haddam, Conn.	Ammoniated Bone Phosphate.
Kelsey, E. R., Branford, Conn.	Fish and Potash.
Lister Agricultural Chemical Works, Newark, N. J.	Potato Fertilizer.
	Standard Phosphate.
	Ammoniated Dissolved Bone.
	Ground Bone.
Mapes' Formula & Peruvian Guano Co., 158 Front St., New York.	Mapes' Potato Manure.
	" Corn "
	" Complete Manure for light soil.
	" " " A Brand.
	" " " for general use.
	" Fine Bone Dissolved.
	" Ground Bone.
	" Tobacco Manure, Conn. Brand.
	" " " for use with stems.
	" Grass and Grain Spring Top Dressing.
	Mapes' Peruvian Guano.
Meyer, C., Jr., Maspeth, L. I.	Acme Fertilizer, No. 1.
	" " No. 2.
Miles, G. W., Agent, Milford, Conn.	Fish and Potash, Fish Brand.
	I. X. L. Ammoniated Bone Superphosphate.
Miller, G. W., Middlefield, Conn.	Flour of Bone Phosphate.
	Pure Ground Bone.
Mitchell, A., Tremley, N. J.	Standard Phosphate.
National Fertilizer Co., Bridgeport, Conn.	Chittenden's Complete Fertilizer.
	" Ammoniated Bone Phosph.
	" Fish and Potash.
	" Ground Bone.
Newton & Ludlam, 182 Front St., N. Y.	Cereal Fertilizer.
	Cecrops or Dragon's Tooth Fertilizer.
Orient Guano Manufacturing Co., Orient, L. I.	Orient Complete Manure.
	Fish and Potash.
Peck Bros., Northfield, Conn.	Pure Ground Bone.
Prentice, Charles, Putnam, Conn.	Potato Phosphate.
	Phosphate.
	Ground Bone.
Preston Fertilizer Co., Green Point, L. I.	Ammoniated Bone Superphosphate.
	Ground Bone.
Quinnipiac Co., New London, Conn.	Quinnipiac Phosphate.
	Pine Island Ammoniated Phosphate.
	Fish and Potash, Crossed Fishes Brand.
	" " " Plain Brand.
	Dry Ground Fish.
	Bone Meal.
	Potato Manure.
	Muriate of Potash.

Firm.	Brand of Fertilizers.
Rogers & Hubbard Co., Middletown, Ct.	Raw Knuckle Bone Flour.
	Ground Bone, Grade AX.
	Fairchild's Formula, Bone and Potash.
	Fairchild's Formula for Corn and Wheat.
Ruth, R. J. & Co., 88 Wall St., N. Y.	Good Luck Guano.
Sanderson, L., 113 Long Wharf, New Haven, Conn.	Sulphate of Ammonia.
	Dried Blood.
	Dissolved Bone Black.
	Ground Bone.
	Kainit.
	Muriate of Potash.
	Sulphate of Potash.
	Nitrate of Soda.
	Tankage.
Shoemaker, M. L. & Co., Philadelphia, by F. Ellsworth, Hartford, Conn.	Swift Sure Superphosphate.
	" " Bone Meal.
Soluble Pacific Guano Co., Gildden & Curtis, agents, Boston, Mass.	Soluble Pacific Guano.
Standard Fertilizer Co., 30 Kilby Street, Boston, Mass.	Fish and Potash.
	Standard Superphosphate.
St. Louis Lead & Oil Co., St. Louis, Mo., by Olds & Whipple, Hartford, Conn.	St. Louis Lead & Oil Co.'s Castor Pomace.
Wilkinson & Co., 239 Center St., N. Y.	Wilkinson's Economical Bone Fertilizer.
	" Ammoniated Superphosphate.
Williams & Clark Co., Hanover Square, New York.	Americus Bone Superphosphate.
	" Potato Fertilizer.
	" Bone Meal.
	" Tobacco and Onion Fertilizer.
	Royal Bone Phosphate.
	Fish and Potash.

Analyses of Fertilizers.*

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

* The matter of this and several subsequent pages, explanatory of the sampling and valuation of fertilizers, is copied, with a few appropriate alterations, from the Report for 1886. This repetition appears to be necessary for the use of readers who have not seen former Reports.

During 1887, two hundred and ninety (290) samples of fertilizers have been analyzed. Of these, a small number were examined for private parties and for testing methods in connection with other Experiment Stations, and the remainder for the general use of the citizens of the State.

During April and a part of May last, Messrs. E. C. Ellwood, of Green's Farms, and C. L. Gold, of West Cornwall, were employed as agents of the Station to collect fertilizer samples for analysis.

These gentlemen discharged their duties most satisfactorily as the following statement will show. One hundred and one towns or villages were visited:

In Litchfield County	16
Hartford "	15
Tolland "	9
Windham "	3
New London "	21
Middlesex "	2
New Haven "	10
Fairfield "	25
	101

About 560 samples of commercial fertilizers were drawn from lots which amounted in the aggregate to over 2700 tons. One or more samples were obtained of nearly every brand of goods sold in Connecticut.

When several samples of a single brand were collected the analysis was in most cases made on a mixture of equal quantities of each sample. A single analysis of such a mixture represents more nearly the average composition of a given brand than an analysis made on one sample or on a number of samples from one locality.

Besides the samples drawn by these special agents a considerable number have been taken by the Station chemists, 19 samples have been analyzed which were drawn by private persons and of these 13 were commercial fertilizers whose sale is regulated by the fertilizer law.

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

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

The Station desires the coöperation of farmers, farmers' clubs and granges in calling attention to new brands of fertilizers and in securing samples of all goods offered for sale. All samples drawn by other than Station agents 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.

Gratuitous Analysis of Commercial Fertilizers.

To insure justice to manufacturers, dealers and consumers alike, the Station will make gratuitous analyses of Commercial Fertilizers only on samples taken by the Agents of the Station or on such other samples as are fully described on the Station Forms for Description and taken in accordance with the Station Instructions for sampling and furthermore are properly authenticated by the certificate of the person drawing the sample *and in addition* the witness, either

1. Of a Selectman;
2. Of an Officer of a farmer's club, grange or local agricultural society; or
3. Of the Dealer from whose stock the sample is taken.

In case a Dealer takes samples of his own stock, the witness of one of the Officers aforesaid will be required.

In special cases of importance the Station may send its Agent to draw samples.

Instructions for Sampling Commercial Fertilizers.

1. Provide a teacup, 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. Open at least three full and unbroken packages, or if there are more than thirty, every tenth package, and mix well together the contents of each for a foot in depth, take out two cupfuls from different parts of the mixed portions of each package, pour them [six in all] one over another upon a paper, intermix thoroughly but quickly to avoid gain or loss of moisture, fill the can or box from this mixture, close tightly, fix securely on the outside of the can a label with some distinguishing letter or mark (which is to be copied in the "Description of Sample" as *sampler's mark*), and

send prepaid to the Agricultural Experiment Station, New Haven, Conn.

3. If convenient weigh separately at least three packages and enter these *actual weights* in the "Description of Sample."

4. When a sample has been taken it should *always* be bottled, labeled and the form for its description filled out completely *before* beginning to sample another fertilizer.

Further Remarks on Sampling.

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 several places, will give a fair sample with great ease.

With dry, coarse articles, such as ground bone, there is liable to be a separation of coarse and fine parts on handling. Moist articles put up in bags or common barrels may become dry on the outside. It is in these cases absolutely necessary to mix thoroughly the coarse and fine, the dry and the moist portions before sampling.

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

It is important that samples for analysis should be taken at the time when the fertilizer is purchased, and *immediately dispatched* to the Station. Moist fish, blood or cotton seed meal will soon decompose and lose ammonia, if bottled and kept in a warm place. Superphosphates containing much organic 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.

Samples as to whose authenticity or fairly representative character there is any reasonable doubt, the Station will not analyze. The Station reserves the right to reject samples taken from less than half a ton of stock or those drawn from goods that have been wintered over from last year.

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

Description of Sample.

Station No.________ Rec'd at Station,__________________, 188

Each sample of Commercial Fertilizer sent for gratuitous analysis *must* be accompanied by a Description made by filling out legibly and as fully as possible, the blanks that follow:

Sampler's Mark,______________________________

Brand of Fertilizer,______________________________

Name and address of Manufacturer,______________________________

____

Name and address of Dealer from whom this sample was taken,

____

Date of taking this sample,______________________________

Is it stated to be fresh stock?______________________________

Dealer's cash price per ton or hundred, bag or barrel,__________

Selling weight claimed for each package weighed,__________

Actual weight of the several packages opened __________

Number of packages from which the sample was taken,__________

Here write the per cents of valuable ingredients which the fertilizer is guaranteed to contain.

Soluble Phosphoric Acid,______________Nitrogen,__________

Reverted Phosphoric Acid,______________(Ammonia,________)

(Available Phosphoric Acid,______________) Potash,__________

Insoluble Phosphoric Acid,______________________________

Certificate of Person taking the Sample.

I, the undersigned, certify that the accompanying sample marked______was taken by me from full packages, and in accordance with the Station's Instructions for Sampling and to the best of my knowledge and belief fairly represents the stock from which it was drawn, and that said stock when sampled was properly housed and in good condition. I also certify that the foregoing description is correct.

Signature ______________________________

Post Office address______________________________

Witness of Officer or Dealer.

The above described sample was drawn in my presence.

Signature ______________________________

Title ______________________________

Township ______________________________

Post Office Address______________________________

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

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

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

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

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

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

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

Revised.

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

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

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

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

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

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

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

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

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

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

These Trade-values were agreed upon by the Experiment Stations of Connecticut, New Jersey and Massachusetts for use in their several States during 1887.

Trade Values of Fertilizing Ingredients in Raw Materials and Chemicals for 1887.

	Cents per lb.
Nitrogen in ammonia salts	17½
" " nitrates	16
Organic nitrogen in dried and fine ground fish	17½
" " azotin, ammonite and dry ground meat	17½
" " castor pomace	17½
" " dried and fine ground blood	16½
" " fine ground bone and tankage	16
" " fine-medium bone and tankage	14
" " medium bone and tankage	12
" " coarse-medium bone and tankage	10
" " coarse bone and tankage, horn shavings, hair and fish scrap	8
Phosphoric acid, soluble in water	8
" " soluble in ammonium citrate*	7½
" " in dry ground fish	7
" " in fine bone and tankage	7
" " in fine-medium bone and tankage	6
" " in medium bone and tankage	5
" " in coarse medium bone and tankage	4
" " in coarse bone and tankage	3
" " in fine ground rock phosphate	2
Potash as high grade sulphate and in forms free from muriate (or chlorides)	5½
" as kainit	4½
" as muriate	4½

The above trade-values are the figures at which on March 1st, the respective ingredients could be bought at retail for cash, in our markets, in the *raw materials* which are the regular source of supply. They also correspond to the average wholesale prices for the six months ending March 1st, plus about 20 per cent. in case of goods for which we have wholesale quotations. The valuations obtained by use of the above figures will be found to

* Dissolved from 2 grams of the unground phosphate previously extracted with pure water, by 100 c.c. neutral solution of Ammonium Citrate, sp. gr. 1.09, in 30 minutes, at 65° C., with agitation once in five minutes. Commonly called "reverted" or "backgone" Phosphoric Acid.

agree fairly with the *reasonable retail price* in case of standard raw materials such as:—

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

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

The Organic Nitrogen in these classes of goods is reckoned at the highest figure laid down in the Trade-Values of Fertilizing Ingredients in Raw Materials, namely $17\frac{1}{2}$ cents per pound, it being assumed that the organic nitrogen is derived from the best sources, viz: bone, tankage, blood, fish, castor pomace or other equally good forms and not from leather, shoddy, hair or any low-priced inferior forms of vegetable matter, unless the contrary is ascertained.

Insoluble Phosphoric Acid is reckoned at 3 cents, it being assumed, unless found otherwise, that it is from bone or similar source and not from rock phosphate. In this latter form the insoluble phosphoric acid is worth but 2 cents per pound. Potash is rated at $4\frac{1}{4}$ cents, if sufficient chlorine is present in the fertilizer to combine with it to make muriate. If there is more potash present than will combine with the chlorine, then this excess of potash is reckoned as sulphate at $5\frac{1}{2}$ cents.

In most cases the valuation of the Ingredients in Superphosphates and Specials falls below the retail price of these goods. The difference between the two figures, represents the manufacturer's charges for converting raw materials into manufactured articles. These charges are for grinding and mixing, bagging or barreling, storage and transportation, commission to agents and dealers, long credits, interest on investment, bad debts, and finally, profits. The majority of manufacturers agree that the average cost of mixing, bagging, handling and cartage ranges from $3.00 to $4.50 per ton.

In 1887 the average selling price of Ammoniated Superphosphates and Guanos was $35.74, the average valuation was $28.45 and the difference $7.29, an advance of 25.6 per cent. on the valuation and on the wholesale cost of the fertilizing elements in the raw materials.

In case of Specials the average cost was $42.52, the average valuation $35.20, and the difference $7.32 or about 20.9 per cent. advance on the valuation.

To obtain the Valuation of a Fertilizer (i. e. the money-worth of its fertilizing ingredients), we multiply the pounds per ton of Nitrogen, etc., by the trade-value per pound. We thus get the values per ton of the several ingredients, and adding them together we obtain the total valuation per ton.

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

The uses of the "Valuation" are twofold:

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

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

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

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

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

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

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

Classification of Fertilizers Analyzed.

The fertilizers and manurial waste products analyzed at the Station laboratory from November 1st, 1886, to Nov. 1st, 1887, were as follows:

Phosphate rock	2
Thomas-Slag	1
Superphosphates (plain)	14
Superphosphates (nitrogenous) and guanos	16
Home-mixed Superphosphates and other fertilizers	11
Special Manures	28
Bone Manures	26
Bone and Potash	2
Tankage and Animal Dust	16
Dried Blood	6
Tallow Scrap	1
Castor Pomace	3
Nitrate of Soda	4
Sulphate of Ammonia	3
Sulphate of Potash	7
Muriate of Potash	13
Kainit	6
Cotton Hull Ashes	10
Plaster	1
Wood Ashes	6
Waste Lye from Soap Works	1
Lime Kiln Ashes	1
Corn Cob Ashes	1
Coal Ashes	1
Tobacco Stalks	1
"Muck"	2
Salt Marsh Mud and Soil	8
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A number of these samples were analyzed in connection with other Experiment Stations for the purpose of testing methods and comparing results, and for private persons. The remaining analyses are given in detail so far as they have any general interest, with such discussion as may make them more serviceable. In all cases the samples were drawn by agents of the Station unless the contrary is stated.

Thomas-Slag.

2150. This by-product of the manufacture of steel from ores containing phosphorus is a fine powder which easily passes a $\frac{1}{50}$ inch sieve. A sample drawn from stock of J. H. Ives, Danbury, bought by him for experiment, had the following composition:

Phosphoric acid soluble in water	none
" " soluble in ammonium citrate	6.29
" " insoluble in ammonium citrate	13.19
Total phosphoric acid	19.48

This more nearly represents the average composition of the goods than the analysis of another sample given in last year's report. For results of the use of Thomas-Slag as a fertilizer on Indian corn see page 122.

Plain Superphosphates.

These are superphosphates which do not contain notable quantities either of potash or nitrogen. They are prepared from phosphatic materials of various kinds by treatment with oil of vitriol, [sulphuric acid], which renders a large proportion of the phosphoric acid soluble in water. Most superphosphates sold in this State are made from bone, bone black, South Carolina phosphate rock or Navassa phosphate. They are usually sold with a guarantee of the percentage of "available" phosphoric acid. This is a trade name for the phosphoric acid which is soluble either in water or in a neutral solution of ammonium citrate. See foot note, page 27.

1942. Dissolved Bone Black. Made by C. Meyer, Jr., Maspeth, L. I. Stock of G. F. Platt, Milford.

1893. Dissolved Bone Black. Stock of L. Sanderson, New Haven.

2005. Dissolved Bone Black. Made by C. M. Beach, West Hartford, and used in home mixtures.

1941. Pure Dissolved Bone. Sold by H. J. Baker & Bro., N. Y. Stock of Dennis Fenn, Milford.

2143. "Dissolved Bones." Made by H. Preston & Son, Greenpoint, Long Island. Stock of J. B. Merrow & Son, Merrow Station.

2142. "Plain Dissolved Bone." Made by Williams, Clark & Co., New York. Stock of A. P. Smith & Son, Lebanon.

2006. Dissolved South Carolina Rock. Bought of G. H. Nichols & Co., N. Y., by C. M. Beach, West Hartford, and used in home mixtures.

ANALYSES.

	1942	1893	2005	1941	2143*	2142	2006
Soluble Phosphoric Acid	13.62	15.55	9.05	17.35	4.36	10.88	13.15
Reverted Phosphoric Acid	2.55	.10	4.99	.17	10.21	2.28	.36
Insoluble Phosphoric Acid	.25	.18	3.74	.11	6.25	1.14	1.89
Cost per ton	$31.00†	26.00	24.00	26.00	32.00	25.00	16.40‡

No. **2005** was made by the following formula:

1000 lbs. bone black.
400 " oil of vitriol, 66° B.
400 " water.

The bone black cost $22.00 per ton in New York, the oil of vitriol cost $1.25 per 100 lbs., and the total cost per ton of the superphosphate is reckoned at $24.00. Only in exceptional cases will it pay to buy bone black and dissolve it on the farm. The experiment in this case seems to have been successful. A larger proportion of acid would have more completely decomposed the bone black.

In general the cost of soluble phosphoric acid in bone black superphosphate has been somewhat higher than that adopted by the Station for the valuation of mixed fertilizers:—thus the actual costs of soluble, reverted and insoluble phosphoric acid in the three samples of bone black superphosphate, Nos. **1942**, **1893** and **1941** were, for soluble phosphoric acid, 8.5 cents per pound,

* This sample also contained .67 per cent of nitrogen.
† In Milford.
‡ At the Farm.

for reverted phosphoric acid, 8 cents and for insoluble phosphoric acid, 2.1 cents; but the Station valuation for phosphoric acid is high when applied to superphosphates made from South Carolina rock which is the base most commonly used. The actual costs in No. **2006** were: for soluble phosphoric acid, 5.9 cents per pound, for reverted, 5.5 cents, and for insoluble, 1.5 cents.

NITROGENOUS SUPERPHOSPHATES AND GUANOS.

Here are included all mixed fertilizers containing nitrogen, phosphoric acid, and in most cases, potash, which are not designed by their manufacturers for use on any special crops. "Special Manures" are noticed further on. Fish scrap is classified with these goods because it is sometimes acidulated with oil of vitriol to preserve it, thus making it a nitrogenous superphosphate.

I. SAMPLES DRAWN BY STATION AGENTS.

In the tables on pages 38–49 are given sixty-six analyses of this kind. After the name of a brand of goods the names of a number of dealers are frequently given. This indicates that a sample of the goods was drawn by our agent from each dealer named and that the corresponding analysis was made on a mixture of equal parts of each of these samples.

The Station assumes full responsibility for accuracy of sampling and analysis only on such samples as are drawn by its own agents. On samples drawn by other persons the Station holds itself responsible only for the accuracy of analysis, but requires before making an analysis a formal statement that the person who drew the sample did it in accordance with the Station directions. See page 21.

Early in the year a circular was sent to all manufacturers whose goods were sold in Connecticut, asking them to inform the Station what would be about the average cash price of their goods in this State during the coming season. Replies were received from most of them. In the tables with the various *dealers'* quotations is also given for comparison the *manufacturers'* statement of the average retail cash price per ton in the State. The cash prices are usually about five per cent. lower than the credit or "time" prices.

The retail cash price of the same fertilizer as quoted by different dealers varies in some cases considerably, partly on account of differences in freight-rates, presence or absence of competition, etc.

The last column of the table of analysis is "Percentage Difference between Cost and Valuation." Its significance and the method of calculating it may be seen by noticing the fourth analysis in the table on page 46, No. **2046**. Here the cost is $28, the valuation is $26.65, and the difference between them is $1.35. By multiplying this difference, $1.35, by 100, and dividing it by the valuation, $26.65, we get the percentage advance of selling price over valuation, which advance should represent the costs and profits of the manufacturer in converting the raw materials into a mixed fertilizer, selling it and collecting on his sales.

Certain brands of superphosphates on which analysis fees have been paid as required by law are not included in the tables for they were not found by our agents in any of the places visited by them.

In case the manufacturers of these brands sent samples, this year, in compliance with the law, such samples have been analyzed and tabulated on page 51 as "Manufacturers' Samples."

1. *Special Notice of Certain Analyses.*

2119. Victor Phosphate. This brand is made for the Apothecaries Hall Co. by a fertilizer company outside of this State. In May last a Station Agent drew a sample from six bags of this brand in stock of Apothecaries Hall Co., Waterbury. Its analysis is given below, No. **2017**. The analysis was a disappointment to the Apothecaries Hall Co., who protested to the manufacturer. The manufacturer insisted that the analysis was wrong because he knew what was in the goods! At the request of the Apothecaries Hall Co., another agent was sent June 7 who drew from 18 packages the sample numbered **2069** whose analysis is given below.

The manufacturer still objected and the Station then proposed to send an agent to meet an agent of the manufacturer and that they together should sample the goods and divide the sample. This was done August 10th and a sample was taken from every tenth bag in the stock; these samples were mixed and the lot divided. The analysis is No. **2113**.

These three analyses which illustrate the degree of accuracy obtainable in sampling have been averaged and the average is given in the table No. **2119**, page 47. Because of the lower grade of the goods the Apothecaries Hall Co. have reduced the price below what it was in 1886.

	2017	2069	2113
Nitrogen	1.04	1.02	1.15
Soluble Phosphoric Acid	6.94	7.25	6.93
Reverted Phosphoric Acid	1.90	1.47	1.79
Insoluble Phosphoric Acid	1.14	1.33	1.17
Total Phosphoric Acid	9.98	10.05	9.89
Potash	2.41	2.58	2.09
Chlorine	2.64	2.52	2.39
Valuation per ton	$20.32	20.37	20.51

The tables contain two analyses each, of G. W. Miles' Fish and Potash, **2042** and **2095**, and of his IXL superphosphate **2039** and **2088**.

The earlier analysis of each was objected to by the manufacturer as misrepresenting the goods and the stock subsequently analyzed was stated to be of representative quality. There is, however, but little difference in quality in either case between the two samples.

There are also two analyses of Russell Coe's superphosphate **2033** and **2115** both from stock of Wilson and Burr, Middletown. It was claimed that the first sample, drawn April 14, misrepresented the goods and therefore another sample **2115** was drawn in August which had a very different composition and higher valuation. It represented, however, a different lot of goods which were received from the manufacturer later in the season.

Two analyses of the Economical Bone Fertilizer **1997** and **2016** illustrate the varying quality of this brand. In one case the percentage difference between cost and valuation is 48 per cent., in the other 68 per cent.

The dealer's cash price for Acme Fertilizer No. 2, No. **2038**, page 39, should be $45 instead of $47.

The manufacturer of Acme Fertilizer No. 1, Nos. **2111** and **2037**, page 47, calls attention to the fact that analysis No. **2037**, which was made on a sample drawn from a single ton of stock, does not represent the general character of the goods, being lower in potash and higher in nitrogen than the goods average.

With the nitrogenous superphosphates should be classed **2029** Bowker's Dry Ground Fish. In this brand only nitrogen is guaranteed. The analysis was made on a mixture of two samples, one from T. Pease and Sons Co., Windsor Locks, cost $40, the other from H. K. Brainard, Thompsonville, cost $38. The mixture contained 8.31 per cent. of nitrogen, guaranteed 8.0.

Fish and Potash.—This brand has been for a long time a popular one in this state and for ready comparison the different brands are tabulated by themselves on page 37.

Their average cost is $31.86, valuation $25.25 and per cent. difference between cost and valuation, 26.1, about the same as that of other nitrogenous superphosphates. Most of them are not, as the name properly implies, simple mixtures of fish scrap and potash salts, but contain considerable quantities of added phosphates. In three cases a large proportion of the phosphoric acid is insoluble.

2. *Difference between Cost and Valuation.*

Leaving out the last three analyses in the tables, whose percentage difference is over 50 per cent., the average cost of 63 superphosphates has been $35.74, the average valuation $28.45. The difference is $7.29, and the percentage difference 25.62. This means that the same quantities of nitrogen, phosphoric acid and potash, which were contained in a ton of the average superphosphate, could be bought in ton lots in this State for $28.45 cash, that the price asked for them in mixed goods was $35.74 and hence that mixing, bagging, selling and profits required an addition of 25.62 per cent. to the cost of the materials themselves.

3. *Guarantees.*

In nineteen brands the percentage of one ingredient was more than two-tenths per cent. below the minimum guarantee and in four brands two ingredients were thus deficient.

In most cases the deficit was on potash and came about by an inaccurate (and in this State illegal) method of stating the guarantee. The law provides that the guarantee shall be "expressed in the terms and manner approved and currently employed by the Connecticut Agricultural Experiment Station." The terms and manner of statement have been clearly set forth in the reports of this Station from the time the law went into force. The amount of *actual potash* must be stated. If desired, the equivalent of sulphate of potash may also be given. The phrase "Potash [sulphate] 4.0 per cent." correctly understood, means 4.0 per cent. of actual potash in the form of sulphate and not 4.0 per cent. of sulphate of potash which contains but little more than half its weight of actual potash.

Fish and Potash.—Sampled by the Station.

	Quinnipiac Plain Brand.	Kelsey's.	Bradley's Triangle A.	Bowker's.	Miles'.	Pacific Guano Co's.	Quinnipiac, Crossed Fishes Brand.	Chittenden's.	Miles'.	Orient.	E. F. Coe's.
	2064	**1957**	**2052**	**2028**	**2095**	**2047**	**1999**	**2022**	**2042**	**2075**	**2053**
Nitrogen as Ammonia	.65	----	.69	----	.32	.37	.65	.21	----	.44	----
Nitrogen, Organic	3.15	3.78	3.09	2.54	2.27	1.97	3.46	3.32	2.23	2.99	2.36
Soluble Phosphoric Acid	1.01	1.17	2.80	1.86	6.44	4.89	.91	.65	7.56	3.24	3.02
Reverted Phosphoric Acid	4.33	1.77	3.34	2.92	.68	3.22	4.73	5.02	.67	.90	2.86
Insoluble Phosphoric Acid	1.86	.24	2.53	7.96	.28	1.39	1.75	3.29	.28	.32	2.65
Potash	4.83	3.32	3.99	4.19	4.53	4.92	5.02	4.82	3.51	9.11	3.60
Cost	$28.00	$22.00	$33.00	$30.00	$30.00	$32.50	$36.00	$34.50	$32.00	$37.50	$35.00
Valuation	$26.65	$20.72	$27.63	$24.59	$24.41	$25.85	$28.27	$27.00	$24.14	$26.47	$22.03
Nitrogen found	3.80	3.78	3.78	2.54	2.59	2.34	4.11	3.53	2.23	3.43	2.36
Nitrogen guaranteed	2.00	2.50	2.00	2.30	2.50	2.50	3.30	3.30	2.50	3.00	3.30
Phosphoric Acid found	7.20	3.18	8.67	12.74	7.40	9.50	7.39	8.96	8.51	4.46	8.53
Phosphoric Acid guaranteed	6.00	3.00	6.00	8.00	----	6.00	5.00	6.00	----	----	----
Potash found	4.83	3.32	3.99	4.19	4.53	4.92	5.02	4.82	3.51	9.11	3.60
Potash guaranteed	4.00	3.00	4.00	4.00	*3.00	4.00	3.00	5.00	*3.00	*14.00	*4.00

* As Sulphate.

NITROGENOUS SUPERPHOSPHATES AND GUANOS SAMPLED BY THE STATION.

Station No.	Name or Brand.	Manufacturer.	Dealer.	Dealer's cash price per ton.	Manufacturer's statement of average cash price per ton.
2010	Quinnipiac Dry Ground Fish.	Quinnipiac Co., New London, Ct.	R. B. Bradley & Co., New Haven.	----	$37.00
			Olds & Whipple, Hartford,	$37.00	
1912	Fish Scrap.		D. C. Wood, Stratford.	38.00	
			L. Sanderson, Long Wharf, New Haven.	35.00	35.00
1918	Swift Sure Superphosphate.	M. L. Shoemaker & Co., Phila.	F. Ellsworth, Hartford.	38.00	38.00
2046	Fish and Potash, Plain Brand.	Quinnipiac Co., New London, Ct.	Wilson & Burr, Middletown.	28.00	28.00
			P. & G. M. Williams, New London.	26.00	
1957	Kelsey's Fish and Potash.	E. R. Kelsey, Branford, Conn.	R. B. Bradley & Co., New Haven.	----	
			M. S. Baldwin, Meriden.	22.00	
2079	Pure Fine Bone Dissolved in Sulphuric Acid.	Mapes' Formula and Peruvian Guano Co., 158 Front St., N. Y.	Mapes' Branch, Hartford.	35.00	----
2065	Peruvian Guano, Cargo Jonas.	Mapes' Formula and Peruvian Guano Co., 158 Front St., N. Y.	Strong & Backus, Colchester.	36.00	35.00
			Mapes' Branch, Hartford.	47.00	47.00
1969	Quinnipiac Phosphate.	Quinnipiac Co., New London, Ct.	R. B. Bradley & Co., New Haven.	----	36.00
			E. A. Godfrey, Southport.	36.00	
			D. B. Mansfield, Campville.	36.00	
			J. F. Silliman, New Canaan.	38.00	
			R. N. Birchard, Darien.	38.00	
1965	A. A. Ammoniated Superphosphate.	H. J. Baker & Bro., 215 Pearl St., New York.	R. B. Bradley & Co., New Haven.	----	37.00
			C. O. Jelliff & Co., Southport.	37.50	
			Dennis Fenn, Milford.	37.50	
			Allen Betts, Norwalk.	37.00	
			S. J. Hall, Meriden.	37.50	
2025	Standard Superphosphate of Lime.	Lister Fertilizer and Chemical Works, Newark, N. J.	E. A. Brock & Co., Willimantic.	----	35.00
			J. O. Fox & Co., Putnam.	35.00	
			S. J. Hall, Meriden.	31.00	
			A. N. Clark, Milford.	32.00	
			Martin Bros., Wallingford.	32.00	

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

Station No.	Name or Brand.	Manufacturer.	Dealer.	Dealer's cash price per ton.	Manufacturer's statement of average cash price per ton.
1988	Farmer's New Method Fertilizer.	Bradley Fertilizer Co., 27 Kilby St., Boston, Mass.	T. Pease & Sons Co., Windsor Locks.	$34.00	$34.00
			Strong & Tanner, Winsted.	34.20	
			D. N. Clark & Sons, Milford.	34.00	
			Beach & Son, New Milford.	35.00	
			J. L. Butler, Torrington.	----	
2038	Acme Fertilizer, No. 2.	C. Meyer, Jr., Maspeth, L. I.	A. S. Russell & Co., Meriden.	47.00	45.00
			J. H. Ives, Danbury.	45.00	
2052	Fish and Potash, Triangle A Brand.	Bradley Fertilizer Co., 27 Kilby St., Boston, Mass.	A. H. Dimond, Bethel.	33.00	----
2045	Pine Island Phosphate.	Quinnipiac Co., New London, Conn.	H. J. Standift, New Hartford.	30.00	32.00
			D. C. Wood, Stratford.	30.00	
2011	Mapes' Complete Manure for General Use.	Mapes' Formula and Peruvian Guano Co., 158 Front St., N. Y.	R. B. Bradley & Co., New Haven.	----	41.00
			Mapes' Branch, Hartford.	41.00	
			Birdsey & Foster, Meriden.	42.50	
			Southington Lumber and Feed Co., Southington.	41.50	
			J. O. Fox & Co., Putnam.	41.00	
			Dunham & Co., Cheshire.	42.00	
			Dean & Horton, Stamford.	42.00	
1971	Americus Brand, Ammoniated Bone Superphosphate.	Williams & Clark Co., Hanover Square, New York.	J. F. Silliman, New Canaan.	38.00	36.00
			Atwood & Wilson, Watertown.	36.00	
			E. M. Jennings, Southport.	35.00	
2108	Chittenden's Ammoniated Bone Superphosphate.	National Fertilizer Co., Bridgeport, Conn.	R. B. Bradley & Co., New Haven.	----	----
			Soule & Staub, New Milford.	38.00	
			G. W. Eaton, Plainville.	34.00	
			W. W. Cooper, Suffield,	34.00	
			L. N. Currier, Bridgeport.	35.00	

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

Station No.	Name or Brand.	Manufacturer.	Dealer.	Dealer's cash price per ton.	Manufacturer's statement of average cash price per ton.
2028	Fish and Potash.	Bowker Fertilizer Co., 43 Chatham Street, Boston, Mass.	T. Pease & Sons Co., Windsor Locks.	$33.00	$30.00
			H. K. Brainard, Thompsonville.	30.00	
2111	Acme Fertilizer, No. 1.	C. Meyer, Jr., Maspeth, Long Island.	Dunham & Co., Cheshire.	33.00	
			A. S. Russell & Co., Meriden.	45.00	45.00
1972	Extra Fine Ground Bone with Potash, Circle Brand.	Bradley Fertilizer Co., 27 Kilby Street, Boston, Mass.	Lockwood Bros., Watertown.	32.00	32.00
			Charles Jennings & Son, Southport.	33.00	
2095	Fish and Potash.	G. W. Miles, Agent for John Guyer, Milford, Conn.	J. L. Butler, Torrington.	35.00*	
			John Guyer, New Haven.	30.00	30.00
1985	High Grade Ammoniated Bone Phosphate.	E. F. Coe, 16 Burling Slip, New York.	Manufacturer.†	35.00	35.–38.00
2037	Acme Fertilizer, No. 1.	C. Meyer, Jr., Maspeth, L. I.	J. H. Ives, Danbury.	45.00	45.00
2008	Mapes' Complete Manure for Light Soil.	Mapes' Formula & Peruvian Guano Co., 158 Front Street, New York.	Dean & Horton, Stamford.	46.00	45.00
			R. B. Bradley & Co., New Haven.	45.00	
			Birdsey & Foster, Meriden.	46.50	
			D. B. Beadsley, Southport.	45.00	
			Wilson & Burr, Middletown.	45.00	
			Mapes' Branch, Hartford.	45.00	
1968	Chittenden's Complete Manure.	National Fertilizer Co., Bridgeport, Conn.	Allen Betts, Norwalk.	43.00	----
			W. W. Cooper, Suffield.	45.00	
			L. N. Currier, Bridgeport.	45.00	
2034	Darling's Animal Fertilizer.	L. B. Darling & Co., Pawtucket, R. I.	J. M. Belden, New Britain.	40.00	38.00
			Dunham & Co., Cheshire.	37.50	
			E. F. Davis, Plainville.	38.00	
			Olds & Whipple, Hartford.	40.00	
			J. W. Cutler, Putnam.	38 00	
			L. A. Hall, South Coventry.	38.00	
			N. C. Barker & Co., Lebanon.	38.00	

* Sold in small lots.

† Sampled from a lot bought by a number of farmers in *Middlefield.*

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

Station No.	Name or Brand.	Manufacturer.	Dealer.	Dealer's cash price per ton.	Manufacturer's statement of average cash price per ton.
2023	Bay State Fertilizer.	Clark's Cove Guano Co., New Bedford, Mass.	J. B. Carman, South Coventry.	$38.00	----
			R. H. Hall, East Hampton.	38.00	
			E. C. Dennis, Stafford.	38.00	
			J. H. Ives, Danbury.	40.00	
			A. L. Chamberlain, Fair Haven.	38.00	
2047	Fish and Potash.	Soluble Pacific Guano Co., Boston, Mass.	W. H. Tucker, Lebanon.	32.00	----
			B. Curtis & Son, Stepney Depot.	33.00	
1999	Fish and Potash, Crossed Fishes Brand.	Quinnipiac Co., New London, Conn.	J. F. Silliman, New Canaan.	38.00	$35.00
			S. N. Osborn, Easton.	38.00	
			Wilson & Burr, Middletown.	35.00	
			D. B. Mansfield, Campville.	36.00	
			R. B. Bradley & Co., New Haven.	35.00	
			Olds & Whipple, Hartford.	37.00	
1966	High Grade Ammoniated Bone Superphosphate.	E. F. Coe, 16 Burling Slip, New York.	Wheeler & Howes, Bridgeport.	35.00	35.–38.00
			Simon Banks, Southport.	34.00	
			Allen Betts, Norwalk.	33.00	
			Walker & Nutting, Waterbury.	38.00	
2022	Chittenden's Fish and Potash.	National Fertilizer Co., Bridgeport, Conn.	W. W. Cooper, Suffield.	35.00	----
			G. W. Eaton, Plainville.	34.00	
			T. H. Eldredge, Norwich.	35.00	
			David Fitzgerald, Stratford.	33.25	
2119	Victor Phosphate.	Made for the Apothecaries Hall Co., Waterbury.	Apothecaries Hall Co., Waterbury.	26.00	----
2074	Darling's Extra Phosphate.	L. B. Darling Fertilizer Co., Pawtucket, R. I.	J. P. Barstow & Co., Norwich.	36 00	38.00
			Olds & Whipple, Hartford.	38.00	
2032	Unicorn Ammoniated Superphosphate.	Clark's Cove Guano Co., New Bedford, Mass.	A. L. Chamberlain, Fair Haven.	34.20	----

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

Station No.	Name or Brand.	Manufacturer.	Dealer.	Dealer's cash price per ton.	Manufacturer's statement of average cash price per ton.
2003	Ammoniated Bone Superphosphate.	Crocker Fertilizer and Chemical Works, Buffalo, N. Y.	J. M. Belden, New Britain.	$40.00	----
			J. H. Reay, Greenwich.	35.00	
			E. T. Morehouse, New Hartford.	40.00	
			Sherman Foote, Brookfield Centre.	35.00	
2018	Pelican Bone Fertilizer.	H. J. Baker & Bro., 215 Pearl St., New York.	Dennis Fenn, Milford.	32.50	$32.50
			Jas. Greenfield, New London.	32.50	
1975	Patent Superphosphate of Lime.	Bradley Fertilizer Co., 27 Kilby St., Boston, Mass.	Beach & Son, New Milford.	38.00	37–38
			Peck Bros., Northfield.	38.00	
			Lockwood Bros., Watertown.	36.00	
			J. L. Butler, Torrington.	----	
			D. N. Clark & Sons, Milford.	37.00	
			O. A. Hubbell, Harwinton.	----	
			Wilson & Burr, Middletown.	38.00	
			Walker & Nutting, Waterbury.	38.00	
			Raymond Bros., Norwalk.	38.00	
			Strong & Tanner, Winsted.	38.00	
			A. A. Hubbard, Canaan.	38.00	
2009	Mapes' Complete Manure, A Brand.	Mapes' Formula and Peruvian Guano Co., 158 Front St., New York.	Southington Lumber and Feed Co., Southington.	38.50	38.00
			Dunham & Co., Cheshire.	39.00	
			J. E. Dean, Winsted.	40.00	
			A. F. Roberts, Lakeville.	38.00	
			J. O. Fox & Co., Putnam.	40.00	
			Birdsey & Foster, Meriden.	39.50	
			Dean & Horton, Stamford.	40.00	
			Mapes' Branch, Hartford.	38.00	
			Wilson & Burr, Middletown.	38.00	
			R. B. Bradley & Co., New Haven.	38.00	

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

Station No.	Name or Brand.	Manufacturer.	Dealer.	Dealer's cash price per ton.	Manufacturer's statement of average cash price per ton.
2019	Hill and Drill Phosphate.	Bowker Fertilizer Co., 43 Chatham St., Boston, Mass.	Dunham & Co., Cheshire.	$40.00	$36.00
			Brewster & Burnett, Norwich.	38.00	
			Southington Lumber and Feed Co., Southington.	37.50	
			R. S. Converse, Stafford.	38.00	
			Jas. Greenfield, New London.	37.50	
2020	Bowker Ammoniated Bone Phosphate.	Bowker Fertilizer Co., 43 Chatham St., Boston, Mass.	Dunham & Co., Cheshire.	35.00	32.00
			Jas. Greenfield, New London.	35.00	
			Hubbell & Bradley, Saugatuck.	32.00	
			Brewster & Burnett, Norwich.	38.00	
2044	Ammoniated Bone Superphosphate.	Preston Fertilizer Co., Greenpoint, Brooklyn, L. I.	A. L. Hodges, Roxbury Station.	33.00	----
			J. B. Merrow & Sons, Merrow Station.	34.00	
2115	Ammoniated Superphosphate.	Russell Coe, Tremley, N. J.	Wilson & Burr, Middletown.	30.00	----
2042	Fish and Potash.	G. W. Miles, Milford.	Simon Banks, Southport.	32.00	
1974	Alkaline Bone.	E. Frank Coe., 16 Burling Slip, New York.	Wheeler & Howes, Bridgeport.	35.00	32–34
			J. F. Silliman, New Canaan.	32.00	
			Allen Betts, Norwalk.	29.00	
2014	Cumberland Superphosphate.	Cumberland Bone Co., Portland, Me.	C. P. Capron, Norwich Town.	38.00	38.00
			Brainard & Childs, New London.	40.00	
			J. W. Cutler, Putnam.	38.00	
2021	Original Coe's Superphosphate of Lime.	Bradley Fertilizer Co., 27 Kilby St., Boston, Mass.	T. Pease & Sons Co., Windsor Locks.	36.00	34–35
2013	Improved Blood Guano.	Dambmann Bros. (Ed. F. Cook, Agt.), Baltimore, Md.	W. Dudley, Guilford.	35.00	30–35
			Champion & Caulkins, Lyme.	35.00	
2048	Royal Bone.	Williams & Clark Co., Hanover Square, New York City.	Hale, Day & Co., So. Manchester.	30.00	----
			L. W. Dart, Niantic.	30.00	
			Strong & Backus, Colchester.	29.00	
			A. P. Smith & Sons, Lebanon.	27.00	

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

Station No.	Name or Brand.	Manufacturer.	Dealer.	Dealer's cash price per ton.	Manufacturer's statement of average cash price per ton.
1987	Standard Superphosphate.	Standard Fertilizer Co., 118½ Milk St., Boston, Mass.	Allen Wilson, Suffield.	$38.00	----
1977	Good Luck Guano.	R. J. Ruth & Co., New York.	H. J. Mattoon, Watertown.	36.00	----
			H. L. Hall, 2d, Wallingford.	36.00	
2031	Great Planet A. Manure.	Clark's Cove Guano Co., New Bedford.	J. H. Ives, Danbury	46.00	----
			A. L. Chamberlain & Co., Fair Haven.	45.60	
2067	Cecrops or Dragon Tooth Fertilizer.	Newton & Ludlam, 182 Front St., New York.	D. N. Benton, Guilford.	41.50	----
2024	Common Sense Fertilizer, No. 2.	Common Sense Fertilizer Co., 42 Congress St., Boston, Mass.	E. Fly, Putnam.	35.00	----
			W. H. Cardwell, Norwich.	35.00	
			Jas. Greenfield, New London.	35.00	
2066	Cereal Fertilizer.	Newton & Ludlam, 182 Front St., New York.	J. E. Littlefield, Niantic.	34.00	----
			D. N. Benton, Guilford.	31.50	
2088	I. X. L. Ammoniated Superphosphate.	G. W. Miles, Agent, Milford, Conn.	John Guyer, New Haven.	33.00	$33.00
1986	Red Brand Excelsior Guano.	E. Frank Coe, 16 Burling Slip, New York.	Manufacturer.*	45.00	45.00
2075	Fish and Potash.	Orient Guano Manufacturing Co., Orient, L. I.	J. E. Dean, Winsted.	37.50	----
2033	Ammoniated Bone Superphosphate.	Russell Coe, Tremley, N. J.	Wilson & Burr, Middletown.	30.00	----
2039	I. X. L. Ammoniated Bone Superphosphate.	G. W. Miles, Milford, Conn.	W. Sardam, Canaan.	36.00	----
			Platt & Merwin, Milford.	30.00	
			J. P. Barstow, Norwich.	32.00	

* Sampled from a lot bought by a number of farmers in Middlefield.

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

Station No.	Name or Brand.	Manufacturer.	Dealer.	Dealer's cash price per ton.	Manufacturer's statement of average cash price per ton.
1970	Soluble Pacific Guano.	Glidden & Curtis, Agents, Boston, Mass.	Wm. M. Perry & Co., Stratford.	38 00	----
			H. A. Stillman, Hartford.	38.00	
			A. A. Hubbard, Canaan.	38.00	
			Balch & Platt, W. Winsted.	38.00	
			Talcott & Alvord, Torrington.	37.00	
			Hull & Sweet, Coventry.	38.00	$36.00
2043	Standard Superphosphate.	A. Mitchell, Tremley Pt., Staten Island.	J. E. Dean, Winsted.	30.00	----
2015	Orient Complete Manure.	Orient Guano Co., Orient, L. I.	M. G. Morse, Guilford.	30.00	
			G. W. Eaton, Plainville.	33.00	
1997	Economical Bone Fertilizer.	Wilkinson & Co., 239 Center St., New York.	G. H. Loomis, Chestnut Hill.	35.00	----
2053	High Grade Fish Guano and Potash.	E. Frank Coe, 16 Burling Slip, New York.	Hall, Hornbeck & Co., Falls Village.	35.00	----
2016	Economical Bone Fertilizer.	Wilkinson & Co., 239 Center St., New York.	A. L. Anderson & Son, Tolland.	32.00	----
1996	Ammoniated Superphosphate.	Wilkinson & Co., 239 Center St., New York.	Ferris & Nolan, Stamford.	38.00	----

Analyses of Nitrogenous Superphosphates and Guanos Sampled by the Station.

Station No.	Name or Brand.	Nitrogen.					Phosphoric Acid.							Potash.		Chlorine.	Cost per ton.	Valuation per Ton.	Percentage Difference between Cost and Valuation.
		Nitrogen as Nitrates.	Nitrogen as Ammonia.	Nitrogen, Organic.	Total Nitrogen Found.	Nitrogen Guaranteed.	Soluble.	Reverted.	Insoluble.	Total Found	Total Guaranteed.	Available. Found.	Available. Guaranteed.	Found.	Guaranteed.				
2010	Quinnipiac Dry Ground Fish	----	----	8.97	8.97	7.5	.80	5.50	.88	7.18	----	6.30	4.0	----	----	----	$37.00	$41.46	10.7†
1912	Sanderson's Fish Scrap	----	----	7.96	7.96	6.6	.98	3.95	1.35	6.28	6.0	4.93	----	----	----	----	35.00	36.16	3.2†
1918	Swift Sure Superphosphate	.74	----	2.45	3.19	2.5	9.06	3.45	2.27	14.78	----	12.51	9.0	4.79	4.0*	trace	38.00	37.25	2.0
2046	Fish and Potash, Plain Brand	----	.65	3.15	3.80	2.0	1.01	4.33	1.86	7.20	6.0	5.34	4.0	4.83	4.0	7.91	28.00	26.65	5.0
1957	Kelsey's Fish and Potash	----	----	3.78	3.78	2.5	1.17	1.77	.24	3.18	3.0	2.94	----	3.32	3.0	2.94	22.00	20.72	6.1
2079	Mapes' Pure Fine Bone Dissolved in Sulphuric Acid	----	----	1.89	1.89	2.1	5.76	10.88	.76	17.40	----	16.64	12.0	----	----	----	35.00	32.62	8.8
2065	Peruvian Guano, cargo Jonas	.11	2.13	1.05	3.29	3.9	4.23	9.90	8.19	22.32	22.9	14.13	----	5.01	2.6	2.25	47.00	42.77	9.8
1969	Quinnipiac Phosphate	.51	trace	2.73	3.24	2.7	7.24	4.37	1.83	13.44	----	11.61	9.0	2.61	2.0	2.61	36.00	32.65	10.2
1965	Baker's A. A. Ammoniated Superphosphate	----	2.87	.50	3.37	2.5	11.73	.44	.13	12.30	----	12.17	10.0	2.94	2.0	3.19	37.50‡	33.80	10.9
2025	Lister's Standard Superphosphate of Lime	----	1.20	.96	2.16	2.3	10.59	1.07	.70	12.36	----	11.66	10.0	1.63	1.5	1.17	32.50	27.92	16.4
1988	Farmer's New Method Fert'r	----	.14	2.29	2.43	1.7	8.36	1.68	2.56	12.60	10.0	10.04	8.0	3.32	3.0	3.02	34.00	28.77	18.2
2038	Acme Fertilizer, No. 2	----	4.94	.58	5.52	5.0	7.09	1.13	.21	8.43	8.5	8.22	8.0	6.35	5.0	4.99	45.00	37.89	18.8
2052	Fish and Potash, Triangle A Brand	----	.69	3.09	3.78	2.0	2.80	3.34	2.53	8.67	6.0	6.14	4 0	3.99	4.0	5.02	33.00	27.63	19.5
2015	Pine Island Phosphate	----	.45	1.98	2.43	2.0	5.78	4.25	1.31	11.34	----	10.03	9.0	1.94	1.0	2.99	32.00	26.57	20.4
2011	Mapes' Complete for General Use	.79	.91	1.92	3 62	3.3	5.44	4.12	3.78	13.34	10.0	9.56	----	4.87	4.0	3.21	41.00	33.88	21.0
1971	Americus Brand Ammoniated Bone Superphosp'ate	----	.79	1.87	2.66	2.0	9.20	1.71	.55	11.46	11.0	10.91	----	2.49	2.0	trace	36.00	29.67	21.3
2108	Chittenden's Ammoniated Bone Superphosphate	.08	----	2.48	2.56	1.7	7.22	3.18	1.57	11.97	9.0	10.40	7.0	1.99	2.0	2.52	34.00	27.89	21.9

* As Sulphate. † Valuation exceeds Cost. ‡ Manufacturer quotes $37, which would make the percentage difference 9.4.

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

Station No.	Name or Brand.	Nitrogen.					Phosphoric Acid.							Potash.		Chlorine.	Cost per Ton.	Valuation per Ton.	Percentage Difference between Cost and Valuation.
		Nitrogen as Nitrates.	Nitrogen as Ammonia.	Nitrogen, Organic.	Total Nitrogen Found.	Nitrogen Guaranteed.	Soluble.	Reverted.	Insoluble.	Total Found	Total Guaranteed.	Available. Found.	Available. Guaranteed.	Found.	Guaranteed.				
2028	Bowker's Fish and Potash	----	----	2.54	2.54	2.3	1.86	2.92	7.96	12.74	8.0	4.78	----	4.19	4.0	3.83	$30.00	$24.59	22.0
2111	Acme Fertilizer, No. 1	----	3.25	1.12	4.37	3.7	7.72	.31	.05	8.08	----	8.03	8.0	10.12	9.0	9.03	45.00	36.75	22.4
1972	Extra Fine Ground Bone with Potash, Circle brand	----	----	2.04	2.04	1.9	3.00	5.16	5.42	13.58	8.0	8.16	----	3.74	2.0	5.99	32.00	26.11	22.5
2095	Miles' Fish and Potash	----	.32	2.27	2.59	2.5	6.44	.68	.28	7.40	----	7.12	5.0	4.53	3.0*	3.56	30.00	24.41	22.9
1985	High Grade Ammoniated Bone Phosphate	----	.95	1.37	2.32	2.1	9.12	1.75	1.18	12.05	11.0	10.87	9.0	2.17	3.0*	.22	35.00	28.36	23.4
2037	Acme Fertilizer, No. 1	----	3.98	.67	4.65	3.7	7.36	1.06	.23	8.65	----	8.42	8.0	7.67	9.0	5.14	45.00	36.31	23.9
2008	Mapes' Complete for Light Soils	1.37	2.59	1.41	5.37	5.0	2.97	3.20	3.31	9.48	7.0	6.17	----	7.50	6.0	6.62	45.00	36.30	23.9
1968	Chittenden's Complete Fertilizer	.30	.65	2.97	3.92	3.7	4.90	4.87	4.71	14.48	8.0	9.77	6.0	5.07	6.0	2.91	45.00	36.22	24.2
2034	Darling's Animal Fertilizer	.45	.37	2.83	3.65	3.3	2.68	4.65	3.63	10.96	10.0	7.33	----	5.19	4.0	5.54	38.00	30.50	24.6
2023	Bay State Fertilizer	----	.91	1.70	2.61	2.0	8.68	2.05	1.88	12.61	10.0	10.73	8.0	2.95	2.0	.76	38.00	30.22	25.7
2047	Pacific Guano Co's Fish and Potash	----	.37	1.97	2.34	2.5	4.89	3.22	1.39	9.50	6.0	8.11	4.0	4.92	4.0	8.69	32.50	25.85	25.7
1999	Fish and Potash, Crossed Fishes Brand	----	.65	3.46	4.11	3.3	.91	4.73	1.75	7.39	5.0	5.64	3.0	5.02	3.0	6.18	36.00	28.27	27.3
1966	E. F. Coe's Ammoniated Bone Superphosphate	----	.56	1.70	2.26	2.0	8.26	2.02	1.91	12.19	11.0	10.28	9.0	1.96	3.0*	trace	35.00	27.47	27.4
2022	Chittenden's Fish and Pot'sh	----	.21	3.32	3.53	3.3	.65	5.02	3.29	8.96	6.0	5.67	----	4.82	5.0	9.22	34.50	27.00	27.7
2119	Victor Phosphate	----	----	1.07	1.07	----	7.04	1.72	1.21	9.97	----	8.76	----	2.36	----	2.49	†26.00	20.33	27.8
2074	Darling's Extra Phosphate	.41	.57	1.85	2.83	2.5	6.23	3.47	1.60	11.30	10.0	9.70	7.0	3.33	3.0	3.19	37.00	28.75	28.7

* As Sulphate. † See Explanatory note in this Bulletin.

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

Station No.	Name or Brand.	Nitrogen.					Phosphoric Acid.							Potash.		Chlorine.	Cost per Ton.	Valuation per Ton.	Percentage Difference between Cost and Valuation.
		Nitrogen as Nitrates.	Nitrogen as Ammonia.	Nitrogen, Organic.	Total Nitrogen Found.	Nitrogen Guaranteed.	Soluble.	Reverted.	Insoluble.	Total Found.	Total Guaranteed.	Available. Found.	Available. Guaranteed.	Found.	Guaranteed.				
2032	Unicorn Ammoniated Superphosphate	----	.05	2.18	2.23	2.1	6.32	3.15	2.67	12.14	10.0	9.47	8.5	2.56	2.3	1.70	$34.20	$26.49	29.1
2003	Crocker's Bone Superphosphate	----	trace	3.11	3.11	2.9	7.87	1.96	1.25	11.08	----	9.83	8.0	2.21	1.6*	2.16	37.50	29 05	29.1
2018	Pelican Bone Fertilizer	----	1.67	.69	2.36	1.9	8.60	.41	.11	9.12	----	9.01	8.0	2.88	2.0	2.29	32.50	25.16	29.2
1975	Bradley's Patent Superphosphate of Lime	.30	----	2.55	2.85	2.3	8.05	2.12	2.38	12.55	11.0	10.17	9.0	1.91	1.5	1.93	37 50	29.00	29.3
2009	Mapes' Complete Manure, A Brand	.78	.60	1.16	2.54	2.5	5.71	4.56	3.32	13.59	----	10.26	10.0	3.19	2.5	3.58	38.00	29.34	29.5
2019	Hill and Drill Phosphate	----	.23	2.33	2.56	2.5	8.45	2.23	3.19	13.87	12.0	10.68	----	1.75	2.0	2.52	38.00‡	29.23	30.0
2020	Bowker's Ammoniated Bone Phosphate	----	----	1.95	1.95	2.0	8.74	1.36	1.99	12.09	11.0	10.10	10.0	1.57	2.0	1.79	33.00§	25.36	30.1
2044	Preston's Bone Superphosphate	----	----	2.57	2.57	2.5	5.35	1.99	2.83	10.17	----	7.34	9.0	3.25	2.0	.73	33.50	25.58	30.9
2115	Russell Coe's Ammoniated Superphosphate	----	.70	1.07	1.77	2.0	6.75	2.51	.99	10.25	10.0	9.26	8.0	1.69	1.0	5.60	30.00	22.80	31.6
2042	Miles' Fish and Potash	----	----	2.23	2.23	2.5	7.56	.67	.28	8.51	----	8.23	5.0	3.51	3.0*	2.45	32.00	24.14	32.5
1974	E. Frank Coe's Alkaline Bone	----	----	1.22	1.22	1.0	7.30	2.74	2.90	12.94	----	10.04	9.0	2.04	3.0*	trace	32.00	24.04	33.1
2014	Cumberland Superphosphate	.63	.05	1.73	2.41	2.0	6.00	2.71	4.65	13.36	11.0	8.71	8.0	3.94	2.0	1.66	38.00	28.49	33.3
2021	Original Coe's Superphosphate of Lime	----	----	2.32	2.32	2.1	7.67	2.35	2.54	12.56	10.0	10.02	8.0	1.77	1.0	1.76	36.00†	26.93	33.7
2013	Improved Blood Guano	.66	.55	1.11	2.32	1.6	7.44	2.16	1.21	10.81	----	9.60	8.0	2.73	2.0	3.04	35.00	26.11	34.0
2048	Royal Bone	----	----	1.53	1.53	.3	6.33	2.12	.47	8.92	8.0	8.45	----	2.54	2.0	.36	29.00	21.63	34.0

* As Sulphate. † Manufacturer quotes $34.00, which would make the percentage difference 28.1.
‡ Manufacturer quotes $36.00, which would make the percentage difference 23.1.
§ Manufacturer quotes $32.00, which would make the percentage difference 26.1.

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

Station No.	Name or Brand.	Nitrogen.					Phosphoric Acid.							Potash.		Chlorine.	Cost per Ton.	Valuation per Ton.	Percentage Difference between Cost and Valuation.
		Nitrogen as Nitrates.	Nitrogen as Ammonia.	Nitrogen, Organic.	Total Nitrogen Found.	Nitrogen Guaranteed.	Soluble.	Reverted.	Insoluble.	Total Found.	Total Guaranteed.	Available. Found.	Available. Guaranteed.	Found.	Guaranteed.				
1987	Standard Superphosphate	----	trace	2.78	2.78	2.5*	7.20	2.24	2.50	11.94	11.0	9.44	9.0	2.47	2.0	3.57	38.00	28.21	34.7
1977	Good Luck Guano	----	.51	1.68	2.19	2.5	8.19	1.86	1 24	11.29	----	10.05	10.0	2.16	2.0	1.64	36.00	26.14	37.7
2031	Great Planet A Manure	----	1.54	1.80	3.34	3.3	5.47	2.43	1.39	9.29	8.3	7.90	7.0	9.54	9.5	6.65	46.00	33.22	38.5
2067	Cecrops or Dragon Tooth Fertilizer	----	.90	1.81	2.71	3.3	7.52	1.52	2.77	11.81	----	9.04	7.0	5.28	7.0	5.24	41.50	29.95	38.5
2024	Common Sense Fertilizer, No. 2	----	2.61	.73	3.34	2.0	.21	5.54	3.30	9.05	4.0	5.75	----	3.08	3.0	3.24	35.00	24.94	40.3
2066	Cereal Fertilizer	----	----	1.40	1.40	1.5	7.83	2.01	2.52	12.36	12.0	9.84	10.0	1.59	4.0	2.11	32.75	23.31	40.5
2088	I. X. L. Ammoniated Superphosphate	----	.23	1 83	2.06	----	7.06	1.81	.62	9.49	----	8.87	----	2.13	----	2.99	33.00	23.41	40.9
1986	Red Brand Excelsior Guano	----	trace	3.27	3.27	3.3	7.40	1.80	1.17	10.37	10.0	9.20	----	4.88	11.0*	.52	45.00	31.89	41.1
2075	Orient Fish and Potash	----	.44	2.99	3.43	3.0	3.24	.90	.32	4.46	----	4.14	5.0	9.11	14.0*	8.48	37.50	26.47	41.6
2033	Russell Coe's Ammoniated Superphosphate	----	----	.97	.97	2.0	7.09	2.71	1.83	11.63	10.0	9.80	8.0	1.11	1.0	4.77	30.00	20.85	43.9
2039	I. X. L. Ammoniated Bone Superphosphate	----	----	1.58	1.58	2.1	6.98	2.33	1.15	10.46	----	9.31	8.0	1.48	1.0*	2.52	32.00	22.13	44.6
1970	Soluble Pacific Guano	----	----	2.22	2.22	2.0	6.82	2.21	3.40	12.43	----	9.03	8.0	2.52	2.0	2.61	38.00	26.18	45.1
2043	Mitchell's Superphosphate	----	----	1.99	1.99	2.1	8.30	2.49	45	11.24	11.5	10.79	9.0	1.81	3.0	trace	38.00	25.80	47.3
2015	Orient Complete Manure	----	.14	1.45	1.59	1.7	6.45	2.23	1.10	9.78	----	8.68	8.0	1.24	2.0*	1.47	31.00	20.95	47.9
1997	Economical Bone Fertilizer	----	1.59	.49	2.08	1.3	5.87	1.94	.57	8.38	6.00	7.81	----	4.32	2.0*	9.22	35.00	23.59	48.4
2053	E. F. Coe's Fish Guano and Potash	----	----	----	2.36	3.3	3.02	2.86	2.65	8.53	----	5.88	6.0	3.60	4.0*	6.40	35.00	22.03	58.9
2016	Economical Bone Fertilizer	----	.18	1.83	2.01	1.3	3.13	.66	.82	4.61	6.00	3.79	----	6.39	2.0*	12.56	32.00	18.96	68.7
1996	Wilkinson's Superphosphate	-	.09	2.13	2.22	1.7	3.50	.39	.78	4.67	----	3.89	----	5.30	3.0	7.62	38.00	18.93	100.8

* As Sulphate.

II. Manufacturers' Samples.

The analyses, tabulated on page 51, were made on samples deposited by manufacturers at the Station this year in accordance with the law, with a statement that they fairly represented the goods on sale in the State.

Their analysis is necessary because our agents did not find those brands in the stock which they inspected.

III. Samples drawn by private individuals.

1949. Chittenden's Ammoniated Bone Phosphate, made by National Fertilizer Co., Bridgeport. Sampled and sent by C. H. Cables, Thomaston.

2040. Adams' High Grade Ammoniated Bone, made by W. P. Adams, 248 Front St., New York. Sampled and sent by request of the Station by J. B. Linsley, selling agent, Fair Haven.

Analyses and Valuations.

	1949. Found.	1949. Guaranteed.	2040. Found.	2040. Guaranteed.
Nitrogen in Nitrates	.67		----	
Nitrogen in Ammonia	.18		1.06	
Organic Nitrogen	2.92	1.7	1.60	
Total Nitrogen	3.77		2.66	2.5
Soluble Phosphoric Acid	4.41		6.97 }	10.0
Reverted Phosphoric Acid	4.99		1.56 }	
Insoluble Phosphoric Acid	4.76		.30	
Total Phosphoric Acid	14.16	9.0	8.83	
Potash	4.32	2.0	4.57	3.7
Chlorine	2.36		1.58	
Valuation per ton	$34.37		$27.48	
Cost	35.00		38.00	

Superphosphates for Comparative Field Test.

Last spring the Station was asked to sample and analyze various fertilizers which had been sent to Shaker Station, for a comparison in the field, under arrangement with Mr. R. H. VanDeusen. The analyses are here given. The Station has no connection, other than this, with the tests which have been carried out.

2087. Church's Fish and Potash, from a lot of 1000 pounds.

2083. Economical Fertilizer, No. 3, made by Economical Fertilizer Co., Butler & Breed, selling agents. Stock of 800 pounds.

Nitrogenous Superphosphates.—Manufacturer's Samples.

Station No.	Name or Brand.	Nitrogen as Nitrates.	Nitrogen as Ammonia.	Organic Nitrogen.	Total Nitrogen Found.	Total Nitrogen Guaranteed.	Phosphoric Acid. Soluble.	Phosphoric Acid. Reverted.	Phosphoric Acid. Insoluble.	Phosphoric Acid. Total Phosphoric Acid.	Phosphoric Acid. Phosphoric Acid Guaranteed.	Phosphoric Acid. Available. Found.	Phosphoric Acid. Available. Guaranteed.	Potash. Found.	Potash. Guaranteed.	Chlorine.	Valuation per Ton.
2071	Bradley's B. D. Sea Fowl Guano	.39	----	2.32	2.71	2.5	7.24	2.58	2.71	12.53	----	9.82	9.0	2.65	1.5	2.74	$28.70
2072	Bradley's Fish and Potash, Anchor Brand	----	----	3.97	3.97	3.3	2.82	2.36	1.59	6.77	----	5.18	3.0	3.88	3.0	8.85	26.20
2081	Clark's Cove Guano Co's Great Planet B. Fertilizer	----	2.59	1.99	4.58	4.9	4.43	2.34	.30	7.07	----	6.77	5.0	7.73	7.0	1.48	34.83
2073	Clark's Cove Guano Co's King Philip Alkaline Guano	----	.23	1.32	1.55	1.2	5.28	1.96	3.17	10.41	----	7.24	6.5	4.53	3.0	3.80	22.57
2070	Common Sense Fertilizer No. 22	.66	2.38	1.07	4.11	2.0	.21	7.39	3.63	11.23	9.0	7.30	----	1.78	1.0	1.75	29.30
2080	Crocker's Fertilizer and Chemical Works' Queen City Phosphate	----	----	1.64	1.64	1.7	5.53	3.47	2.12	11.12	----	9.00	8.0	1.50	1.1	1.53	22.34
2041	G. W. Miller's Flour of Bone Phosphate	.58	.09	2.49	3.16	----	.43	7.92	3.75	12.10	----	8.35	----	5.33	----	6.87	30.20
2076	C. Prentice's Phosphate	----	1.20	.92	2.12	----	5.28	5.18	4.51	14.97	----	10.46	----	2.76	----	2.72	28.70

2085. Mixture from F. Ellsworth, Hartford:

600 pounds Castor Pomace.
100 " Swift Sure Bone.
100 " Swift Sure Superphosphate.
145 " Muriate of Potash.

2054. Lister's Ammoniated Dissolved Bone.
2036. Mapes' Corn Manure.
2086. Sanderson's Formula A.
2082. Williams, Clark & Co's Americus Superphosphate.

HOME-MIXED FERTILIZERS.

The *manufacture* of superphosphate on the farm from phosphatic materials and oil of vitriol is not commonly a paying operation.

The *mixing* of fertilizers on the farm, on the other hand, has proved itself in this and other States a very profitable undertaking in the hands of intelligent farmers who are able to pay cash for the raw materials and who purchase in ton lots or more, either singly or by clubbing together. It is stated by manufacturers that most agricultural chemicals can be bought nearly as cheaply in ton lots as in 100 ton lots, so that in the purchase of stock the one who manufactures on a small scale is at no very great disadvantage. Again, while the machinery of a fertilizer factory can undoubtedly mix a large lot of goods more cheaply than hand labor could do it, yet it does not follow that in all cases it costs more to mix on the farm.

It is safe to say that often the mixing of 2 or 3 tons of chemicals on the farm costs absolutely nothing because it is done at odd times by labor which is paid for but cannot be otherwise profitably employed during the winter and early spring. Again, there is greater security against inferior forms of nitrogen or phosphoric acid and their presence can be more easily detected in raw materials than in mixed goods.

Further, the purchaser saves more or less expense incident to the purchase of mixed goods, such as expenses of traveling and local agents, risks of the business and manufacturers' profits. Finally the intelligent farmer knows best what his land and special crops require and can suit these special needs by varying the composition of the mixture.

It is not claimed that everywhere and always home-mixtures are the most economical. It is often cheaper for the purchaser to buy the best commercial mixtures, ammoniated superphosphates

FERTILIZERS FOR COMPARATIVE FIELD TEST.

Station No.	Name or Brand.	Nitrogen as Nitrates.	Nitrogen as Ammonia.	Nitrogen Organic.	Total Nitrogen.	Phosphoric Acid. Soluble.	Reverted.	Insoluble.	Total Phos. Acid.	Available Phos. Acid.	Potash. As Muriate.	As Sulphate.	Total Potash.	Chlorine.	Valuation per Ton.
2087	Church's Fish and Potash	....	.32	3.77	4.09	2.42	2.55	.51	5.48	4.97	4.05	....	4.05	6.20	$25.76
2083	Economical Fertilizer, No. 3	trace	....	.33	.33	....	.17	6.11	6.28	.17	.24	....	.24	10.18	4.07
2085	Mixed Fertilizer from F. Ellsworth, Hartford	....	....	4.49	4.49	1.54	4.78	.61	6.93	6.32	8.73	....	8.73	6.62	33.13
2054	Ammoniated Dissolved Bone Phosphate	....	1.04	1.17	2.21	10.60	1.36	.83	12.79	11.96	1.35	.19	1.54	1.02	28.60
2086	Sanderson's Formula A	1.45	.09	2.56	4.10	7.79	1.91	.31	10.01	9.70	7.87	....	7.87	7.54	36.12
2082	Americus Bone Superphosphate	....	.78	1.89	2.67	8.90	2.03	.37	11.30	10.93	.47	2.10	2.57	.36	29.57

and special manures, than to buy the chemicals and mix them, but the testimony of a yearly increasing number of farmers shows that often money may be saved by the seasonable purchase of raw materials and their use in home-mixtures. During the last year the Station has analyzed eleven home-mixed fertilizers and their analyses follow, together with details as to the materials employed. For table of analyses see page 57.

1916. Made by J. J. Webb, Hamden, from muriate of potash, sulphate of ammonia, dissolved bone black and tankage.

1976. Made by H. E. Bassett, Hamden, by the following formula:

2000	pounds	tankage	@ $26.00	per ton,	costing $26.00
1500	"	dissolved bone black	@ 25.00	"	" 18.75
400	"	muriate of potash	@ 40.00	"	" 8.00
400	"	sulphate of potash	@ 30.00	"	" 6.00
4300	"				$58.75

Cost of ingredients per ton, $27.32. No estimate given of cost of mixing. Mr. Bassett bought in New Haven at current rates and had no freight charges additional to what he would have had for commercial fertilizers.

1980. Made by C. T. Merwin, Milford, by the following formula:

2500	pounds	dissolved bone black	@ $23.00	per ton,	costing $28.75
1000	"	muriate of potash	@ 39.00	"	" 19.50
2000	"	fish scrap	@ 35.00	"	" 35.00
500	"	sulphate of ammonia	@ 67.50	"	" 16.88
6000					$100.13
		To which add freight			4.00
		Cost of mixing			3.00
					$107.13

Cost of fertilizer, mixed, $35.71 per ton.

Mr. Merwin bought his dissolved bone black, muriate of potash and sulphate of ammonia below the usual retail market rate.

1981. Made by C. T. Merwin, Milford, by the following formula:

2500	pounds	dissolved bone black	@ $23.00	per ton,	costing $28.75
1000	"	muriate of potash	@ 39.00	"	" 19.50
2000	"	tankage	@ 25.00	"	" 25.00
500	"	sulphate of ammonia	@ 67.50	"	" 16.88
6000					$90.13
		To which add freight			4.00
		Cost of mixing			3.00
					$97.13

Cost of fertilizer, mixed, $32.37.

As in the last case Mr. Merwin got his dissolved bone black, muriate of potash and sulphate of ammonia below the usual market rate.

1983. Made by J. C. Eddy, Simsbury, according to the following formula:

4000	pounds	animal dust	@ $27.00	per ton,	costing $54.00
1635	"	dissolved bone black	@ 25.00	"	" 20.44
800	"	sulphate of potash	@ 30.00	"	" 12.00
565	"	muriate of potash	@ 40.00	"	" 11.30
7000					$97.74
		To which add freight to Simsbury			10.34
		Cost of mixing			3.00
					$111.08

Cost of the mixed fertilizer, $31.75 per ton.

The goods shrunk 50 pounds in mixing from drying out and mechanical loss.

2089. Potato Fertilizer. Made by C. S. Phelps at farm of C. M. Beach, West Hartford, by the following formula:

500	pounds	double manure salt	@ $22.50	per ton,	costing $ 5.63
100	"	muriate of potash	@ 37.00	"	" 1.85
300	"	dried blood	@ 34.40	"	" 5.16
500	"	nitrate of soda	@ 47.20	"	" 11.80
600	"	dissolved So. Carolina rock,	@ 16.40	"	" 4.90
2000					$29.34
		To which add for freight and cartage			1.80
		Cost of mixing			1.50
					$32.64

Cost of the mixed fertilizer, $32.64 per ton.

The double manure salt, muriate of potash and nitrate of soda used in this and the next following fertilizer were purchased in New York, the other materials in Hartford.

2090. Corn Fertilizer. Made by C. S. Phelps at the farm of C. M. Beach, West Hartford, by the following formula:

1000	pounds	dissolved So. Carolina rock,	@ $16.40	per ton,	costing $ 8.20
150	"	dissolved bone black	@ 24.00	"	" 1.80
200	"	dried blood	@ 34.40	"	" 3.44
350	"	nitrate of soda	@ 47.20	"	" 8.26
300	"	muriate of potash	@ 37.00	"	" 5.55
2000					$27.25
		To which add for freight and cartage			1.10
		Cost of mixing			1.50
					$29.85

Cost of the mixed fertilizer, $29.85 per ton.

2094. Made by N. S. Platt, Cheshire, from the following formula:

500 pounds tankage.
700 " sulphate of potash.
800 " dissolved bone black.

Mr. Platt purchased the materials somewhat under the usual market rate, so that they cost him $27.20 per ton in Cheshire *unmixed.*

2096. Made by Lyman H. Francis, Meriden, by the following formula:

400 pounds muriate of potash.
400 " dissolved bone black.
400 " tankage.
800 " nitrate of soda.

At the regular market rates the cost would have been $43.30, unmixed. Mr. Francis purchased for $38.00.

2097. Made by N. S. Baldwin, Meriden, by the following formula:

400 pounds nitrate of soda.
800 " kainit.
800 " tankage.

At regular market rates the cost would have been $30.80. Mr. Baldwin states that he purchased for $20.50.

2151. Made by George F. Platt, Milford, by the following formula:

500	pounds sulphate of ammonia	@ $72.48	per ton, costing	$18.12
3000	" bone, blood and meat	@ 25.00	" "	37.50
2000	" dissolved bone black	@ 31.00	" "	31.00
2000	" ground bone	@ 35.00	" "	35.00
1000	" muriate of potash	@ 43.50	" "	21.75
1000	" sulphate of potash	@ 37.00	" "	18.50
9500				$161.87

The prices do not include freight, but Mr. Platt by paying cash got such discounts from dealers' rates as made the goods cost $161.53 delivered in Milford. The cost of mixing was $4.72, so that the entire cost of 4¾ tons was $166.25 or $35.00 per ton.

In almost all cases the Station has analyzed the raw materials of which the mixture was made, so that it is possible to calculate the composition of the mixture, supposing all the goods to have been uniform in quality, the weights correct and the mixture uni-

Home Mixed Fertilizers.

	1916 Found.	1916 Calculated.	1976 Found.	1976 Calculated.	1980 Found.	1980 Calculated.	1981 Found.	1981 Calculated.	1983 Found.	1983 Calculated.
Nitrogen as Nitrates	-----	---	-----	---	-----	---	-----	---	-----	---
Nitrogen as Ammonia	1.89	---	-----	---	1.85	---	2.08	---	-----	---
Nitrogen (organic)	2.70	---	4.35	---	2.45	---	2.92	---	3.49	---
Total Nitrogen	4.59	---	4.35	4.19	4.30	4.35	5.00	4.43	3.49	3.35
Soluble Phosphoric Acid	5.79	---	5.61	---	6.40	---	6.39	---	3.84	---
Reverted Phosphoric Acid	2.46	---	1.31	---	2.19	---	1.93	---	4.85	---
Insoluble Phosphoric Acid	.93	---	.43	---	.31	---	.44	---	1.75	---
Total Phosphoric Acid	9.18	---	7.35	7.74	8.90	8.69	8.76	8.84	10.44	10.43
Potash as Muriate	7.97	---	6.02	---	10.20	---	10.69	---	4.56	---
Potash as Sulphate	-----	---	1.62	---	-----	---	-----	---	3.44	---
Total Potash	7.97	---	7.64	7.26	10.20	8.48	10.69	8.63	8.00	7.21
Chlorine	-----	---	4.54	---	-----	---	-----	---	-----	---
Valuation per ton	$36.35	---	$33.33	---	$37.44	---	$39.96	---	$34.34	---
Cost per ton	-----	---	27.32*	---	35.71	---	32.37	---	31.75	---

	2089 Found.	2089 Calculated.	2090 Found.	2090 Calculated.	2094 Found.	2094 Calculated.	2096 Found.	2096 Calculated.	2097 Found.	2097 Calculated.	2151 Found.	2151 Calculated.
Nitrogen as Nitrates	3.93	---	2.85	---	-----	---	7.36	---	.77	---	-----	---
Nitrogen as Ammonia	-----	---	-----	---	-----	---	-----	---	-----	---	.98	---
Nitrogen (organic)	1.38	---	1.03	---	1.93	---	-----	---	3.63	---	3.57	---
Total Nitrogen	5.31	5.30	3.88	3.7	1.93	1.87	7.36	7.68	4.40	5.76	4.55	4.39
Soluble Phosphoric Acid	3.98	---	6.96	---	5.92	---	3.12	---	-----	---	3.09	---
Reverted Phosphoric Acid	.71	---	1.43	---	2.86	---	2.70	---	4.63	---	5.37	---
Insoluble Phosphoric Acid	.22	---	.48	---	1.01	---	.45	---	1.89	---	2.70	---
Total Phosphoric Acid	4.91	4.60	8.87	9.0	9.79	9.42	6.27	6.34	6.52	6.33	11.16	9.43
Potash as Muriate	4.18	---	8.14	---	1.39	---	9.28	---	5.95	---	7.40	---
Potash as Sulphate	5.51	---	-----	---	8.16	---	-----	---	-----	---	-----	---
Total Potash	9.69	9.00	8.14	7.5	9.55	9.50	9.28	10.17	5.95	4.91	7.40	8.08
Chlorine	3.15	---	-----	---	1.05	---	8.04	---	12.66	---	5.00	---
Valuation per ton	$34.59	---	$33.23	---	$31.29	---	$40.75	---	$28.30	---	$36.83	---
Cost per ton	32.64	---	29.80	---	27.20*	---	38.00*	---	-----	---	35.00	---

* Actual cost of ingredients unmixed.

form. It appears that there is in all but three cases a very satisfactory agreement between the actual and calculated quantities of nitrogen and phosphoric acid present, while the actual quantity of potash present is in all but one case larger than the calculated quantity. The discrepancies are greatest in Nos. **1981** and **2097**.

If the valuation of **1981** was based on the calculated rather than the actual composition of the sample it would be $36.23 instead of $39.96. If the valuation of **2097** were based on its calculated composition it would be a little over $30.00 and that of **2156** $34.57. In all but one case, however, valuation even if based on the calculated composition, is still not less than the cost.

The mechanical condition of the samples sent was certainly as good as that of the average commercial mixtures, hence it is fair to conclude that those who made these mixtures instead of buying commercial mixtures of average composition saved some 20–25 per cent. of their outlay, since the average retail cash price of nitrogenous superphosphates is from 20–25 per cent. higher than their valuation. In order to buy to the best advantage cash payment and orders for some considerable quantity of material are necessary. For the information of those interested is here appended a form taken with slight alterations from a circular sent to dealers in fertilizer chemicals by the Moorestown Grange in New Jersey, and which may be convenient for the use of granges and farmers' clubs in this State.

"Wanted: to buy the materials to make ——— tons *or more* of fertilizer. The materials to consist of nitrate of soda, sulphate of ammonia, acid phosphate, dissolved bone or bone black, fine ground bone, fine ground fish scrap, muriate of potash and sulphate of potash.

All materials to be in good mechanical condition; in good bags; to run even weights or be plainly marked what each bag contains *net*, and to be delivered at ——— early in March next. All materials to be guaranteed to contain certain percentages of nitrogen, potash, or available phosphoric acid, as the case may be; one-half the bill to be paid within ten days after receipt of goods; on the other half a credit of sixty days to be allowed, within which time samples will be sent to the Connecticut Experiment Station for analysis, and if there found to contain as large percentages as guaranteed the balance of bill will be paid within the sixty days, but if any are found to contain a *less* percentage than guaranteed, then a discount is to be allowed on the bill equal to the loss in money value caused by such deficiency for the first one per cent. or fraction thereof, and *twice* the loss in money value for all deficiencies in excess of one per cent., and balance of bill within the sixty days. Samples to be taken by a station agent or other disinterested party."

Special Manures.

I. *Sampled by Station Agents.*

The tables on pages 61 to 65, contain twenty analyses of this class, which were made on samples known to fairly represent the stock from which they were taken. Of some, several samples were secured, and the analysis was made on a mixture of them as already explained on page 33.

The retail cash price of Fairchild's Formula for Corn and Wheat, No. **2068,** was reduced August 1, from $46 to $44 per ton.

In April an analysis was made on a mixture of three samples of Baker's Special Potato Fertilizer. Objection was made to this analysis by the manufacturer, on the ground that it did not fairly represent the quality of this brand. This analysis is numbered **1937** in the table on page 60. To show whether this analysis was or was not fairly representative, the Station took the trouble to analyze separately every sample of this one brand which we had collected. The analyses are given in the table, page 60. Finally the five separate analyses were averaged to give the figures printed in the table on page 65—No. **2126.**

These analyses show that the first analysis made on a mixture did fairly represent the brand, they show the general uniformity in the goods, and also furnish an illustration of the desirability of analyzing mixtures of samples instead of depending on a single sample. For while an analysis of either of four samples would have given a correct statement of the character of the goods, an analysis of the fifth alone would have given a showing less correct and more favorable.

Cost and Valuation.—The average cost of the special manures sampled by the Station has been $42.52, and the average valuation $35.20. The difference, $7.32, makes the percentage difference 20.9. The corresponding difference in case of the superphosphates was 25.6. This year, as heretofore, the special manures as a class have been higher priced but more concentrated than the other nitrogenous superphosphates, and if the quality of the raw materials composing them is equally good, they have been the more economical to purchase.

Baker's Potato Fertilizer.

	A Mixture of the three following samples.	Stock of R. B. Bradley & Co.	Stock of C. O. Jeliff & Co., March 22.	Stock of Dennis Fenn.	Stock of Allen Betts.	C. O. Jeliff & Co. May 19.	Average of the five preceding.
	1937	**1989**	**1990**	**1991**	**1992**	**2063**	**2126**
Nitrogen as Ammonia	3.14	3.05	3.24	3.01	3.24	3.70	3.25
Organic Nitrogen	.59	.42	.54	.65	.61	.58	.56
Total Nitrogen	3.73	3.47	3.78	3.66	3.85	4.28	3.81
Soluble Phosphoric Acid	5.87	5.76	5.90	6.56	6.68	5.71	6.12
Reverted Phosphoric Acid	.58	.48	.85	.27	.26	.87	.55
Insoluble Phosphoric Acid	.21	.25	.27	.06	.10	.20	.18
Total Phosphoric Acid	6.66	6.49	7.02	6.89	7.04	6.78	6.84
Potash	10.24	10.20	9.81	10.57	9.13	10.17	9.98
Chlorine	4.24	3.32	3.96	5.54	5.54	6.43	4.96
Valuation per ton	$33.31	32.55	33.58	33.55	33.65	34.60	33.39

Special Manures Sampled by the Station.

Station No.	Name or Brand.	Manufacturer.	Dealer.	Dealer's cash price per ton.	Manufacturer's statement of average cash price per ton.
2068	Fairchild's Corn Formula.	The Rogers & Hubbard Co., Middletown, Conn.	Strong & Backus, Colchester.	$46.00	$46.00
2030	Complete Manure for Potatoes and Vegetables.	Bradley Fertilizer Co., 27 Kilby St., Boston, Mass.	E. S. Gillette, Easton.	----	42.00
			J. A. Lewis, Willimantic.	42.00	
			Chas. Jennings & Son, Southport.	43.00	
			J. W. Beach, Stratford.	45.00	
2050	Complete Manure for Corn and Grain.	Bradley Fertilizer Co., 27 Kilby St., Boston, Mass.	S. Stevens, Glastonbury.	42.00	42.00
1936	Quinnipiac Potato Manure.	Quinnipiac Co., New London, Conn.	E. A. Godfrey, Southport.	38.00	38.00
2056	Tobacco Manure for Use with Stems.	Mapes' Formula & Peruvian Guano Co., 158 Front St., New York.	Mapes' Branch, Hartford.	46.00	46.00
2057	Grass and Grain Spring Top Dressing.	Mapes' Formula and Peruvian Guano Co., 158 Front St., New York.	Birdsey & Foster, Meriden.	44.50	43.00
			Dean & Horton, Stamford.	44.00	
2027	Stockbridge Forage Crop Manure.	Bowker Fertilizer Co., 43 Chatham St., Boston, Mass.	Brewster & Burnett, Norwich.	42.50	40.00
			R. S. Converse, Stafford.	42.00	
			Southington Lumber and Feed Co., Southington.	41.50	
1930	Mapes' Potato Manure.	Mapes' Formula & Peruvian Guano Co., 158 Front St., New York.	R. B. Bradley & Co., New Haven.	45.00	45.00
			Mapes' Branch, Hartford.	45.00	
			W. W. Cooper, Suffield.	43.00	
2051	Bradley's Complete Top Dressing for Grass and Grain.	Bradley Fertilizer Co., 27 Kilby St., Boston, Mass.	Burtis & Mead, New Canaan.	42.00	42.00
1993	Stockbridge Potato and Vegetable Manure.	Bowker Fertilizer Co., 43 Chatham St., Boston, Mass.	T. Pease & Sons Co., Windsor Locks.	43.00	40.00
			H. K. Brainard, Thompsonville.	40.00	
2055	Mapes' Tobacco Manure (Conn. Brand).	Mapes' Formula & Peruvian Guano Co., 158 Front St., New York.	W. W. Cooper, Suffield.	46.00	46.00

SPECIAL MANURES SAMPLED BY THE STATION—*Continued.*

Station No.	Name or Brand.	Manufacturer.	Dealer.	Dealer's cash price per ton.	Manufacturer's statement of average cash price per ton.
2936	Mapes' Corn Manure.	Mapes' Formula & Peruvian Guano Co., 158 Front St., New York.	R. H. Van Deusen, Shaker Station.	$44.00	$43.00
			J. P. Barstow, Norwich.	43.00	
			J. O. Fox & Co., Putnam.	46.00	
			Southington Lumber and Feed Co., Southington.	43.00	
			Dunham & Co., Cheshire.	45.00	
			Wilson & Burr, Middletown.	43.00	
			W. W. Cooper, Suffield.	43.00	
2063	Baker's Special Potato Manure.	H. J. Baker & Bro., 215 Pearl St., New York.	C. O. Jelliff & Co., Southport.	43.00	45.00
1964	Bradley's Potato Manure.	Bradley Fertilizer Co., 27 Kilby St., Boston, Mass.	J. W. Beach, Stratford.	38.00	38 00
			Mather & Gruman, Darien.	38.00	
			Burtis & Mead, New Canaan.	40.00	
			Chas. Jennings, Southport.	38.00	
2035	Lister's Potato Manure.	Lister Agricultural and Chemical Works, Newark, N. J.	A. A. Hubbard, Canaan.	38.00	
			C. Swan, State St., Bridgeport.	45.00	----
2049	Tobacco and Onion Manure.	Williams & Clark Co., Hanover Square, New York.	A. N. Clark, Milford.	40.00	
			N. H. Smith & Co., Norwalk.	44.00	42.00
1973	Americus Special Fertilizer for Potatoes.	Williams, Clark & Co., New York.	E. M. Jennings, Southport.	42.00	
			D. B. Wilson & Co., Waterbury.	42.00	42.00
			E. M. Jennings, Southport.	42.00	
			J. Goodman, E. Litchfield.	41.50	
			Atwood & Wilson, Watertown.	45.00	

SPECIAL MANURES SAMPLED BY THE STATION—*Continued.*

Station No.	Name or Brand.	Manufacturer.	Dealer.	Dealer's cash price per ton.	Manufacturer's statement of average cash price per ton.
2001	Stockbridge Grain Manure.	Bowker Fertilizer Co., 43 Chatham St., Boston, Mass.	Hubbell & Bradley, Saugatuck.	$43.00	$40.00
			T. Pease & Sons Co., Windsor Locks.	43.00	
			Dunham & Co., Cheshire.	45.00	
			Southington Lumber and Feed Co., Southington.	41.50	
2002	Potato, Hop and Tobacco Phosphate.	Crocker Fertilizer and Chemical Co., Buffalo, N. Y.	J. S. Bragg, Canaan.	37.00	----
			J. H. Reay, Greenwich.	38.00	
			E. T. Morehouse, New Hartford.	40.00	
			J. M. Belden, New Britain.	40.00	
2126	Special Potato Manure.	H. J. Baker & Bro., 215 Pearl St., New York.	C. O. Jeliff & Co., Southport.	45.00	45.00
			Dennis Fenn, Milford.	45.00	
			R. B. Bradley & Co., New Haven.	45.00	
			C. O. Jeliff & Co., Southport.	43.00	
			Allen Betts, Norwalk.	44.00	
2064	Baker's Complete Corn Manure.	H. J. Baker & Bro., 215 Pearl St., New York.	C. O. Jeliff & Co., Southport.	45.00	45.00
			R. B. Bradley & Co., New Haven.	----	

Analyses of Special Manures Sampled by the Station.

Station No.	Name or Brand.	Nitrogen.					Phosphoric Acid.							Potash.		Chlorine.	Cost per Ton.	Valuation per Ton.	Percentage Difference between Cost and Valuation.
		Nitrogen as Nitrates.	Nitrogen as Ammonia.	Organic Nitrogen.	Total Nitrogen found.	Nitrogen Guaranteed.	Soluble.	Reverted.	Insoluble.	Total Found.	Total Guaranteed.	Available. Found.	Available. Guaranteed.	Found.	Guaranteed.				
2068	Fairchild's Corn Formula	3.81	----	1.90	5.71	----	----	----	----	13.71	----	----	----	13.28§	----	----	$46.00	$45.49	1.1
2030	Bradley's Complete Manure for Potatoes and Veg'bles	.62	1.06	2.31	3.99	3.8	9.31	1.89	.54	11.74	----	11.20	8.0	6.08	6.0	.98	42.00	38.20	9.9
2050	Bradley's Complete Manure for Corn and Grain	.79	.51	3.26	4.56	3.7	8.02	1.57	.69	10.28	10.0	9.59	9.0	7.14	5.5	4.72	42.00	37.62	11.6
1936	Quinnipiac Potato Manure	.52	.69	2.91	4.12	3.3	3.42	4.08	2.20	9.70	----	7.50	5.0	6.36	6.0	.93	38.00	33.87	12.2
2056	Mapes' Tobacco Manure for Use with Stems	.66	2.41	2.43	5.50	5.4	7.82	2.95	1.45	12.22	10.5	10.77	----	3.86	3.5	.37	46.00	40.99	12.2
2057	Mapes' Grass and Grain Top Dressing	.83	1.87	1.94	4.64	4.1	5.97	4.66	1.68	12.31	7.0	10.63	----	6.50	5.0	5.91	44.00‡	39.07	12.6
2027	Stockbridge Forage Crop	.51	2.36	2.79	5.66	5.5	5.86	1.41	1.78	9.05	6.0	7.27	5.0	2.85	2.5	1.58	41.50	34.84	19.1
1930	Mapes' Potato Manure	1.61	1.55	.69	3.85	3.7	4.89	4.50	3.68	13.07	8.0	9.39	----	7.50	6.0*	.66	45.00	37.80	19.1
2051	Bradley's Complete Top Dressing for Grass and Grain	4.15	----	.38	4.53	4.1	4.99	2.96	2.98	10.93	7.0	7.95	6.0	5.62	5.0	trace	42.00	35.00	20.0
1993	Stockbridge Potato and Vegetable Manure	----	2.45	1.03	3.48	3.3	6.93	2.72	1.64	11.29	----	9.65	8.0	5.68	7.0	6.38	40.00	33.15	20.7
2055	Mapes' Tobacco Manure [Conn. Brand]	.54	2.69	1.42	4.65	4.7	6.97	1.20	.24	8.41	7.8	8.17	----	7.53	7.8	.44	46.00	37.34	23.2
2036	Mapes' Corn Manure	1.14	1.29	1.51	3.94	3.7	5.37	3.97	3.08	12.42	10.0	9.34	----	6.77	6.0	6.26	43.00	35.60	23.6
1964	Bradley's Potato Manure	.42	----	2.68	3.10	2.7	6.04	1.71	2.22	9.97	8.0	7.75	6.0	6.16	6.0	3.76	38.00	29.81	27.5
2035	Lister's Potato Manure	.61	1.85	1.66	4.12	3.7	8.22	.41	.12	8.75	----	8.63	8.5	5.90	7.0	4.42	42.50	33.12	28.3

* As Sulphate. § As Muriate.

‡ Manufacturer quotes $43 which would make the percentage difference 10.0.

Analyses of Special Manures Sampled by the Station—*Concluded.*

Station No.	Name or Brand.	Nitrogen.					Phosphoric Acid.							Potash.		Chlorine.	Cost per Ton.	Valuation per Ton.	Percentage Difference between Cost and Valuation.
		Nitrogen as Nitrates.	Nitrogen as Ammonia.	Organic Nitrogen.	Total Nitrogen found.	Nitrogen Guaranteed.	Soluble.	Reverted.	Insoluble.	Total Found.	Total Guaranteed.	Available. Found.	Available. Guaranteed.	Found.	Guaranteed.				
2049	Williams, Clark & Co.'s Tobacco and Onion Manure.	----	1.75	2.88	4.63	4.0	3.93	1.22	.65	5.80	5.0	5.15	----	7.19	8.0	.54	$42.00	$32.45	29.4
1973	Americus Special for Potatoes	----	2.04	1.36	3.40	3.3	5.60	1.44	.33	7.37	7.0	7.04	----	8.10	8.0	trace	42.00	32.13	30.7
2001	Stockbridge Grain Manure	----	1.39	1.88	3.27	3.3	7.89	2.10	1.77	11.76	7.0	9.99	6.0	3.95	4.0	4.32	41.50†	31.63	31.2
2002	Potato, Hop and Tobacco Phosphate	----	trace	2.47	2.47	2.0	8.21	2.44	.66	11.31	----	10.65	8.0	3.96	3.5	3.64	39.00	29.22	33.4
2126	Baker's Special Potato Manure	----	3.25	.56	3.81	3.3	6.12	.55	.18	6.84	----	6.67	5.8	9.98	10.0	4.96	45.00	33.39	34.7
2064	Baker's Complete Corn Manure	----	3.58	.74	4.32	5.0	6.57	.46	.16	7.19	----	7.03	6.3	8.08	7.0	11.03	45.00	33.29	35.2

† Manufacturer quotes $40 which would make the percentage difference 26.4.

II. *Manufacturer's Sample.*

PRENTICE'S POTATO PHOSPHATE.

2077. This is the only manufacturer's sample of a special fertilizer analyzed this year. Analyses of all other special fertilizers sold in the State have been made on samples collected by agents of the Station.

	2077.
Nitrogen as Ammonia	2.22
Organic Nitrogen	.67
Soluble Phosphoric Acid	6.35
Reverted Phosphoric Acid	2.18
Insoluble Phosphoric Acid	3.05
Potash	8.78
Chlorine	8.46
Valuation per ton	$32.84

III. *Sampled by Private Individuals.*

PEACH YELLOWS CURE.

2093. Made by H. J. Baker & Bro., New York. Sampled and sent by N. S. Platt, from stock of C. S. Gillette, Cheshire.

Nitrogen	.37
Soluble Phosphoric Acid	9.92
Reverted Phosphoric Acid	1.18
Insoluble Phosphoric Acid	none.
Potash	11.68
Chlorine	11.16
Cost per ton	$38.00

BONE MANURES.

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

I. *Sampled by the Station.*

On pages 69–71 will be found 19 analyses of bone manures made on samples collected by agents of the Station.

Of these the following appear to be strictly pure ground raw bone: **1903, 1905** and **2136,** H. J. Baker's Strictly Pure Bone; and **2061,** made by the Rogers & Hubbard Co.; and **2060,** made by the Crocker Fertilizer Co.

The following are tolerably clean cooked bone: **1904** and **2133,** Quinnipiac Co.'s; **1907,** Darling's; **1933,** Meyer's; **1958,** Chittenden's; **1961,** Bradley's, and **2125,** Armour's. **1967** is bone from which the nitrogen has been largely extracted in the process of glue manufacture. Sanderson's Bone, **1894** and **2120** is apparently a mixture of bone and tankage. Lister's Bone, **1934,** and Coe's Bone, **1906** and **2004,** are mixtures of tankage, bone and salts.

In Bulletin No. 91, issued in April last, it was stated that Swift Sure Bone, **1908,** and Americus Pure Bone, **1927,** were mixtures of bone and tankage. An inspection of the samples and the fact that they contain a larger percentage of nitrogen than other grades of pure bone usually contain,—6.57 and 4.44 per cent.—while the per cent. of phosphoric acid is rather low for a pure bone—19.44 and 18.24—led us to this conclusion. The manufacturers have since informed us that the goods are not mixtures of bone and tankage.

The Swift Sure Bone is stated to consist of bone from which all adhering meat is removed and which is dried and deprived of all grease by a process which leaves the material dry, brittle and very porous. The Americus Pure Bone is stated to be made from green butcher's bones which are put in steam-tight tanks and subjected to pressure which removes the grease. The entire product remaining in the tank is dried and ground.

The system of valuation of bone, which depends on the mechanical condition of the sample as well as on its chemical analysis, has already been explained on page 29.

Leaving out of account the two samples of E. F. Coe's bone, **1906** and **2004,** and Lister's bone, **1934,** which contain a considerable quantity of alkaline salts, the average cost per ton of the fifteen samples, whose cost and valuation are both given, is $35.00, and the average valuation is $40.41. Since bone is a raw material and not a mixed fertilizer its valuation should agree pretty closely with its average market price.

The figures indicate that the Station schedule of valuations is too high as far as it applies to bone manures.

There are three analyses of H. J. Baker's Bone in the table. Two were made in the spring, and the third, **2136,** in the fall, from a stock of 70 tons. Competition being at this time and place very active, the price was cut to $32.00, the regular price being $35.00. A second analysis of Quinnipiac Bone, **2133,** was made from stock sampled last spring, at the request of the manufacturers who believed the first analysis, **1904,** did not fairly represent the quality of the goods.

II. *Sampled by manufacturers and private individuals.*

On page 72 are four analyses of samples of bone furnished by manufacturers in compliance with the terms of the fertilizer law.

Peck's Pure Ground Bone.

2114. Made by Peck Brothers, Northfield. Sampled by Apothecaries Hall Co., Waterbury, from their stock.

Mechanical Analysis.

Fine, smaller than $\frac{1}{50}$ inch	10
Fine medium, smaller than $\frac{1}{25}$ "	15
Medium, smaller than $\frac{1}{12}$ "	38
Coarse medium, smaller than $\frac{1}{6}$ "	35
Coarse, larger than $\frac{1}{6}$ "	2
	100

Analysis and Valuation.

Nitrogen	4.41
Phosphoric acid	21.62
Cost per ton	$32.00*
Valuation per ton	$31.95

* Cash at mill.

In bulletin No. 88, July, 1886, the price of Peck Brothers' Pure Bone at the dealer's store was given as $35.00, and in a foot note, the price at mill was given, $33.00. In the annual report for 1886 the quotation *at mill* was omitted by an oversight.

Bone Manures.—Sampled by Station.

Station No.	Name or Brand.	Manufacturer.	Dealer.	Cost Per Ton.
1967	Peter Cooper's Pure Bone Dust.	Peter Cooper's Glue Factory, 16 Burling Slip, New York City.	W. B. Meeker, Southport. Wilson & Burr, Middletown.	$28.00 28.00
2136	Baker's Strictly Pure Ground Bone.	H. J. Baker & Bro., 215 Pearl St., New York City.	C. O. Jelliff & Co., Southport.	32.00
2125	Armour's Bone.	Armour Glue Works, 205 La Salle St., Chicago, Ill.	R. A. Moore, Berlin.	32.00
1903	Baker's Strictly Pure Ground Bone.	H. J. Baker & Bro., 215 Pearl St., New York City.	C. O. Jelliff & Co., Southport.	35.00
2133	Quinnipiac Bone Meal.	Quinnipiac Co., New London, Conn.	R. B. Bradley & Co., New Haven. W. F. Benedict, Stepney Depot. Olds & Whipple, Hartford. Chandler & Morse, Putnam. E. A. Godfrey, Westport.	36.00 37.00 34.00 34.00
1961	Bradley's Fine Bone.	Bradley Fertilizer Co., 27 Kilby St., Boston, Mass.	Chas. Jennings & Son, Southport.	35.00
2120	Fine Ground Bone.	L. Sanderson, Long Wharf, New Haven.	Robt. Aitken, Shaker Station.	35.00
1894	Ground Bone.	L. Sanderson, Long Wharf, New Haven.	Manufacturer.	35.00
1904	Quinnipiac Bone Meal.	Quinnipiac Co., New London.	E. A. Godfrey, Southport. R. B. Bradley, New Haven.	36.00
1908	Swift Sure Bone Meal.	M. L. Shoemaker & Co., Philadelphia.	F. Ellsworth, Hartford.	40.00

Bone Manures.—Sampled by Station.

Station No.	Name or Brand.	Manufacturer.	Dealer.	Cost per ton.
2060	Ground Bone.	Crocker Fertilizer & Chemical Works, Buffalo, N. Y.	J. E. Leonard, Jewett City. G. S. Bragg, Canaan.	$40.00 38.00
2061	Pure Ground Bone, A. X. Brand.	Rogers & Hubbard Co , Middletown.	Wilson & Burr, Middletown.	32.00*
1933	Pure Ground Bone.	C. Meyer, Jr., Maspeth, L. I.	G. F. Platt, Milford.†	35.00‡
1905	Baker's Strictly Pure Bone. "A"	H. J. Baker & Bro., 215 Pearl Street, New York.	C. O. Jeliff & Co., Southport.	35.00
1927	Americus Brand Pure Bone Meal.	Williams & Clark Co., Hanover Square, New York City.	R. B. Bradley & Co., New Haven.	36.00§
1906	E. F. Coe's Ground Bone.	E. F. Coe, 16 Burling Slip, New York.	Simon Banks, Southport.	28.00
2004	E. F. Coe's Ground Bone.	E. F. Coe, 16 Burling Slip, New York.	J. F. Silliman, New Canaan. Wheeler & Howes, Bridgeport. D. P. Penfield, Danbury.	35.00 32.00 35.00
1934	Lister's Celebrated Ground Bone.	Lister Fertilizer and Chemical Works, Newark, N. J.	A. N. Clark, Milford.	28.00
1907	Darling's Fine Ground Bone.	L. B. Darling Fert. Co., Pawtucket, R. I.	R. B. Bradley & Co., New Haven.	
1958	Chittenden's Ground Bone or Fine Animal Bone.	National Fertilizer Co., Bridgeport.	Mattabesett Grange, Middletown.	

* Sold by manufacturer for $30 *cash* f. o. b. Middletown. † From stock purchased for his own use. ‡ *At Milford.*
§ Manufacturer's price.

Analyses of Bone Manures.—Sampled by Station.

Station No.	Name or Brand.	Chemical Analysis.		Mechanical Analysis.					Cost per ton.	Valuation per ton.	Percentage difference between cost and valuation.
				Finer than				Coarser than $\frac{1}{6}$ inch.			
		Nitrogen.	Phos. Acid.	$\frac{1}{50}$ inch.	$\frac{1}{25}$ inch.	$\frac{1}{12}$ inch.	$\frac{1}{6}$ inch.				Valuation exceeds cost.
1967	Peter Cooper's Pure Bone Dust	1.34	31.35	44	18	22	16	--	$28.00	$40.69	31.1
2136*	H. J. Baker's Strictly Pure Bone	3.89	23.38	73	27	--	--	--	32.00‡	43.49	26.4
2125	Armour's Bone	3.31	26.56	51	21	23	5	--	32.00	42.34	24.4
1903*	H. J. Baker's Strictly Pure Ground Bone	3.80	22.78	81	19	--	--	--	35.00	42.90	18.4
2133†	Quinnipiac Bone Meal	2.82	26.00	67	19	13	1	0	36.00	42.38	15.5
1961	Bradley's Fine Bone	3.38	23.88	67	19	14	--	--	35.00	41.37	15.4
2120	Sanderson's Fine Ground Bone	3.94	22.07	60	40	--	--	--	35.00	41.09	14.9
1894	Sanderson's Ground Bone	3.86	21.78	65	35	--	--	--	35.00	40.78	14.1
1904†	Quinnipiac Bone Meal	2.59	25.54	65	19	16	--	--	36.00	40.91	12.0
1908	Shoemaker's Swift Sure Bone Meal	6.57	19.44	65	25	10	--	--	40.00	45.31	11.7
2060	Crocker Fertilizer and Chemical Works, Ground Bone	3.79	24 65	56	24	20	--	--	38.00	42.51	10.6
2061	Rogers & Hubbard Pure Ground Bone, Grade AX Brand	3.79	22.01	28	26	26	20	--	32.00	34.78	8.0
1933	C. Meyer's Pure Ground Bone	3.49	19.47	60	40	--	--	--	35.00	36.31	3.6
1905*	H. J. Baker's "A" Strictly Pure Bone	3.44	18.81	67	32	1	--	--	35.00	35.59	1.6
1927	Americus Brand Pure Bone Meal	4.44	18.24	58	22	16	4	--	36.00	36.17	.5
											Cost exceeds valuation.
1906	E. F. Coe's Ground Bone	2.73	14.85§	54	19	15	8	4	28.00	27.98	.1
2004	E. F. Coe's Ground Bone	3.16	14.24‖	64	18	10	8	--	32–35	29.88	12.1
1934	Lister's Celebrated Ground Bone	2.90	12.82	38	20	20	22	--	28.00	22.54	24.2
1907	Darling's Fine Ground Bone	3.00	24.51	79	19	2	--	--	----	42.51	----
1958	Chittenden's Fine Animal Bone	3.55	23.72	43	24	21	12	--	----	38.28	----

* Compare the three analyses **1903, 1905** and **2136** in this table. † Compare the two analyses **2133** and **1904** in this table.
‡ Regular price $35.00. § Also contains 2.46 per cent. of potash. ‖ Also contains 2.80 per cent. of potash.

Analyses of Manufacturers' Samples of Bone Manures.

Station No.	Name or Brand.	Chemical Analysis. Nitrogen.	Chemical Analysis. Phos. Acid.	Mechanical Analysis. Finer than 1/50 inch.	Finer than 1/25 inch.	Finer than 1/12 inch.	Finer than 1/6 inch.	Coarser than 1/6 inch.	Valuation per Ton.
2123	L. M. Meyer's Bone Manure	4.20	20.83	53	23	18	6	--	*$37.99
2127	G. W. Miller's Pure Ground Bone	3.93	22.52	23	14	26	37	--	†33.35
2078	C. Prentice's Bone	4.09	22.04	39	35	17	9	--	38.14
2153	The Rogers & Hubbard Co's Pure Raw Knuckle Bone Flour	3.82	25.61	76	21	3	--	--	46.28

* Cost $37 f. o. b. Middletown. † Cost $32 per ton.

Bone and Potash.

Two samples of bone containing potash, No. **1906** and **2004**, have been classed with the bone manures already discussed, because sold as "bone."

2154. Fairchild's Formula Bone and Potash made by the Rogers & Hubbard Co., Middletown. Sampled by the manufacturer.

Mechanical Analysis.

Fine, smaller than	1/50 inch	36
Fine medium, smaller than	1/25 "	17
Medium, smaller than	1/12 "	33
Coarse medium, smaller than	1/6 "	14
		100

Chemical Analysis and Valuation.

Nitrogen	2.60 per cent.
Phosphoric Acid	16.25 "
Potash	17.70 "
Valuation	$40.75
Cost	35.00

Tankage.

This material consists of various kinds of offal but chiefly of cooked bone and meat which collects on the bottom of the tanks in which grease is separated from the waste of slaughter-houses and meat markets. As the analyses show it varies greatly in composition. On the valuation of Tankage see page 91.

1960. No. 1, sold by National Fertilizer Co., Bridgeport, to the Meriden Grange.

1959. No. 2, sold by National Fertilizer Co., to the Meriden Grange.

1889. Western Tankage from stock of L. Sanderson, New Haven.

1891. New York Tankage from stock of L. Sanderson, New Haven.

2122. Sold by L. Sanderson, New Haven, to Robert Aitkin, Shaker Station.

1946. Made by Sperry & Barnes, New Haven. From lot bought by G. F. Platt, Milford.

1948. Made by Sperry & Barnes. From lot bought by H. E. Bassett, New Haven.

MECHANICAL ANALYSES.

	1960	1959	1889	1891	2122	1946	1948
Fine, smaller than $\frac{1}{50}$ inch	46	54	65	75	72	46	54
Fine medium, smaller than $\frac{1}{25}$ inch	29	23	22	14	15	19	21
Medium, smaller than $\frac{1}{12}$ inch	20	17	12	9	11	14	13
Coarse medium, smaller than $\frac{1}{6}$ inch	5	6	1	2	2	10	6
Coarse, larger than $\frac{1}{6}$ inch	0	0	0	0	0	11	6
	100	100	100	100	100	100	100

CHEMICAL ANALYSES AND VALUATIONS.

	1960	1959	1889	1891	2122	1946	1948
Nitrogen	7.51	6.52	7.46	5.38	5.53	8.20	8.99
Phosphoric acid	9.02	15.60	12.44	19.24	18.83	5.98	4.76
Cost per ton	$		38.00	38.00	35.00	25.00	26.00
Valuation per ton	$32.62	38.40	38.60	41.87	41.47	29.18	31.39

ANIMAL DUST.

Sampled by private individuals.

1984. Finest Animal Dust. Sampled by S. T. Stockwell, Simsbury.

1982. Animal Dust. Sampled by J. C. Eddy, Simsbury. Both made by the L. B. Darling Fertilizer Co., Pawtucket R. I., and bought direct from the company.

MECHANICAL ANALYSES.

	1984	1982
Fine, smaller than $\frac{1}{50}$ inch	41	31
Fine medium, smaller than $\frac{1}{25}$ "	18	14
Medium, smaller than $\frac{1}{12}$ "	24	32
Coarse medium, smaller than $\frac{1}{6}$ "	17	23
	100	100

ANALYSES AND VALUATIONS.

	1984	1982
Nitrogen	6.01	5.72
Phosphoric acid	10.96	12.59
Cost per ton	$27.00	27.00
Valuation per ton	$29.19	28.85

DRIED BLOOD.

Pure dried blood, prepared at large slaughter houses by drying the blood with superheated steam, contains from 10 to 15 per cent. of nitrogen, depending on the degree of dryness. It contains besides the animal tissue of which the nitrogen forms a part, a small fraction of a per cent. each of phosphoric acid and potash, and from 8 to 15 or more per cent. of water. It is sold usually on a guarantee of so many "units of ammonia." For explanation of this term, see page 87. "Blood and Meat," "Blood and Bone," etc., as their names imply, are different things, being mixtures of various kinds of slaughter-house offal containing less nitrogen and often considerable quantities of phosphoric acid from bones.

2007. Stock of C. M. Beach, West Hartford. Last years' stock used in home mixtures described further on.

2124. Made by Armour & Co., Chicago, Ill. Stock of R. A. Moore, Berlin.

2149. Sold by Bradley Fertilizer Co., Boston, Mass. Stock of A. A. Hubbard, Canaan.

1914. Stock of L. Sanderson, New Haven.

ANALYSES.

	2007	2124	2149	1914
Nitrogen	9.15	13.04	11.21	12.65
Cost per ton	$34.40*	38.00	38.00	43.00
	cts.	cts.	cts.	cts.
Nitrogen costs per pound	18.8	14.6	16.9	17.0

* Including freight to farm.

TALLOW SCRAP.

A sample of wet meat **1902**, from a rendering establishment, brought to the station by Mr. J. H. Dickerman of Mt. Carmel, contained—

Water	66.00 per cent.
Nitrogen	3.07 "
Phosphoric acid	1.18 "

The material could only be well used for composting, being too coarse for direct application to the land.

Castor Pomace.

This is the ground residue or cake of castor beans from which castor oil has been extracted by pressure.

2059. Made by H. J. Baker & Bro., New York. Stock of W. W. Clark, Simsbury.

1995. Made by Collier White Lead and Oil Co., St. Louis, Mo. Stock of F. Ellsworth, Hartford.

1994. Made by St. Louis Lead and Oil Co., St. Louis, Mo. Stock of Olds & Whipple, Hartford.

Analyses and Valuations.

	2059	1995	1994
Nitrogen	5.86	5.70	5.77
Phosphoric Acid	1.99	1.70	1.87
Potash	1.07	1.02	1.00
Cost per ton	$19–20	$20.00	$19.00
Valuation per ton	$24.21	$23.20	$23.67

These three samples from different manufacturers show a close agreement in composition. For valuation, nitrogen has been reckoned at 17½ cents, phosphoric acid at 7 cents (as in fine bone and in fish scrap) and potash at 4¼ cents per pound. If these valuations are given to the phosphoric acid and potash, then the actual average cost of nitrogen in these samples is 14.1 cents per pound, which shows that the pomace has been this year the cheapest form of readily available nitrogen in the Connecticut market.

Nitrate of Soda.

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

1915. Stock of L. Sanderson, New Haven.

1956. Sold by National Fertilizer Co., Bridgeport, to Mattabesett Grange, Middletown.

2145. Sold by the Quinnipiac Co., New London. Stock of Wilson & Burr, Middletown.

2146. Sold by Mapes Branch, Hartford.

Analyses.

	1915	1956	2145	2146
Water	1.45	2.20	1.40	1.00
Salt	.39	.84	1.25	1.09
Sulphate of Soda	.27	.30	.25	.53
Nitrate of Soda	97.89	96.66	97.10	97.38
	100.00	100.00	100.00	100.00
Nitrogen	16.12	15.92	15.99	16.04
Cost per ton	$55.00		52.50	60.00
Nitrogen costs per pound, cts.	17.0		16.4	18.7

Sulphate of Ammonia.

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

1940. Made by C. Meyer Jr., Maspeth, L. I. Stock of G. F. Platt, Milford.

1911. Stock of L. Sanderson, New Haven.

2144. Stock of Mapes Branch, Hartford.

Analyses.

	1940	1911	2144
Nitrogen	20.37	20.37	19.93
Equivalent Ammonia	24.74	24.74	24.20
Cost per ton	$72.48*	70.00	73.00
	cts.	cts.	cts.
Nitrogen costs per pound	18.3	17.1	18.3

* Including freight from N. Y.

Double Sulphate of Potash and Magnesia.

This article is usually sold as "sulphate of potash" on a guarantee of "48–50 per cent. sulphate" which is equivalent to 25.9–27 per cent. of actual potash. It contains, besides some 46–50 per cent. of sulphate of potash, over 30 per cent. of sulphate of magnesia,* chlorine equivalent to 3 per cent. of common salt, besides sulphates of soda and lime, with varying quantities of moisture.

1892. Stock of L. Sanderson, New Haven.

1945. Sold by C. Meyer, Jr., Maspeth, L. I. Stock of G. F. Platt, Milford.

1951. Sold by National Fertilizer Co., Bridgeport, to Mattabesett Grange, Middletown.

1952. Sold by National Fertilizer Co., Bridgeport, to Meriden Grange.

2137. Sold by Williams, Clark & Co., New York. Stock of E. M. Jennings, Southport.

2138. Sold by Williams, Clark & Co., New York. Stock of Strong & Backus, Colchester.

ANALYSES.

	1892	1945	1951	1952	2137	2138
Potash	27.17	25.03	26.34	26.82	26.34	26.08
Equivalent Sulphate of Potash	50.2	46.3	48.7	49.6	48.7	48.2
Chlorine	----	1.88	1.80	1.80	----	----
Cost per ton	$30.00	37.00*	----	----	----	35.00
Potash costs per pound, cts.	5.5	7.3	----	----	----	6.7

* $35.00 f. o. b. in N. Y.

MURIATE OF POTASH.

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

1928. Sold by H. J. Baker & Bro., New York. Stock of R. B. Bradley & Co., New Haven. Dealer declined to quote retail price.

2140. Sold by H. J. Baker & Bro., New York. Stock of C. O. Jeliff & Co., Southport.

1943. Sold by H. J. Baker & Bro., New York. Stock of Dennis Fenn, Milford.

2141. Sold by the Mapes Branch, Hartford.

1944. Sold by C. Meyer, Jr., Maspeth, Long Island. Stock of G. F. Platt, Milford.

* Epsom salt is crystallized hydrated sulphate of magnesia, with 51 per cent. water of crystallization.

2062. Sold by Quinnipiac Fertilizer Co., New London. Stock of Wilson & Burr, Middletown.

1890. Sold by L. Sanderson, New Haven. Sampled in February.

2121. Sold by L. Sanderson. Sampled in September.

1953. Sold by National Fertilizer Co. Stock of Mattabesett Grange, Middletown.

2139. Sold by Williams, Clark & Co., New York. Stock of E. M. Jennings, Southport.

ANALYSES.

	1928	2140	1943	2141	1944	2062	1890	2121	1953	2139
Potash	51.17	51.67	50.40	53.73	51.77	48.85	50.88	51.33	52.95	51.27
Equivalent Muriate of Potash	80.8	81.9	79.7	84.9	82.0	77.2	80.6	81.4	83.9	80.9
Cost per ton, $		42.00	45.00	45.00	43.50	42.50	42.50	41.00	----	----
Potash costs per pound, cts.		4.1	4.4	4.2	4.2	4.4	4.2	4.0	----	----

Muriate of potash is generally sold in the same packages in which it is received from Germany, or is merely rebagged by importers without manipulation. The differences in composition are due in part to variations in the freshly manufactured article, and in part to accidents in shipment.

KAINIT.

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

1929. Sold by H. J. Baker & Bro., New York. Stock of C. O. Jeliff & Co., Southport.

2147. Sold by Quinnipiac Co., New London. Stock of E. A. Godfrey, Southport.

1913. Stock of L. Sanderson, New Haven.

1955. Sold by National Fertilizer Co., Bridgeport, to Meriden Grange.

2148. Sold by Williams, Clark & Co., New York. Stock of E. M. Jennings, Southport.

ANALYSES OF KAINIT.

	1929	2147	1913	1955	2148
Potash	12.41	12.82	12.26	12.42	13.07
Cost per ton	$13.00	12.00	11.50	----	----
Potash costs per pound, cts.	5.2	4.7	4.7	----	----

COTTON HULL ASHES.

1924. From stock of W. W. Cooper and E. A. Russell, Suffield. Sampled by Station Agent.

1896. Sampled and sent by Dwight S. Fuller, Suffield. Received by him from Mr. Charles, New Orleans, La.

1899. From Stock of F. C. Harmon. Sampled and sent by Edmund Halladay, Suffield.

1926. Mixture of three samples from stock of J. Fröhlinger, E. A. Russell and F. E. Granger, all of Suffield. These lots were all bought of F. C. Harmon, Suffield.

1950. From stock of Olds & Whipple, Hartford. Sampled and sent by C. H. Cables, Thomaston.

1962. From stock of Olds & Whipple, Hartford. Sampled and sent by L. G. Goodrich, Simsbury.

1979. From stock of R. A. Parker, Warehouse Point. Sampled and sent by John Mason, Warehouse Point.

1923. From stock of R. E. Pinney, Suffield. Sampled and sent by C. D. Woodworth, Thompsonville.

1925. Mixture of two samples. One from stock of R. E. Pinney, the other from stock sold by him to E. A. Russell, Suffield. Sampled by Station Agent.

1963. From stock bought by H. B. Wakeman, Greens Farms, of American Oil Co., of New York. Sampled and sent by Station Agent.

COTTON HULL ASHES—ANALYSES AND VALUATION.

	1924	1896	1899	1926	1950	1962	1979	1923	1925	1963
Soluble Phosphoric Acid	1.72	1.57	.91	.51	1.65	.64	.40	.75	2.08	1.44
Reverted Phosphoric Acid	6.44	7.63	4.00	5.15	7.06	6.78	6.78	5.67	6.90	6.33
Insoluble Phosphoric Acid	.74	1.42	.09	.96	2.40	1.42	1.77	1.51	1.85	.59
Potash Soluble in Water	12.54	18.97	32.79	28.58	21.54	27.72	21.43	20.91	21.36	26.73
Cost per ton	$35.00	35.00	33.00	33.00	35.00	----	35.00	35.00	35.00	30.00
Valuation per ton	26.50	35.39	43.57	40.36	37.88	42.25	35.09	33.30	37.92	41.44

Soluble phosphoric acid in the ashes is valued at 8 cents per pound, reverted at 7½ cents and insoluble at 2 cents per pound. The potash being free from chlorides is valued at 5½ cents. As in past years the ashes vary greatly in composition, but are an excellent source of potash, especially for tobacco growers. The ashes sold by the American Oil Co. and by R. E. Pinney are in good condition mechanically, being free from the large hard lumps which are common in crude cotton hull ashes.

CAYUGA LAND PLASTER.

1947. Made by Cayuga Plaster Co., Union Springs, New York. Sampled by H. J. Mattoon, Watertown., from stock sold by him. Cost $7.00 per ton.

Pure Hydrated Sulphate of Lime	66.50
Sand and Insoluble Matters	6.27
Other Matters, chiefly Carbonate of Lime	27.23
	100.00

The sample has about the average composition of Cayuga Plaster, which usually differs from Nova Scotia Plaster chiefly in containing a larger quantity of carbonates.

UNLEACHED HARDWOOD ASHES.

1910. Sold by Charles Stevens, Napanee, Canada. Stock of T. R. Dawley, Griswold.

2084. Sold by Charles Stevens. Sampled from stock at Shaker Station.

2135. Sold by Charles Stevens, Napanee, Canada. From stock bought by Augustus Meeker, Southport, and sampled and sent by him.

1897. Sold by James Hartness, Detroit, Mich. Sampled by W. H. Burr, Westport.

2134. Sold by E. M. Jennings, Southport. Sampled and sent by Augustus Meeker, Southport.

2152. Sold by Irwin Jennings. Sampled and sent by E. O. Wakeman, Westport.

	1910	2084	2135	1897	2134	2152
Water	11.99	---	---	10.84	---	---
Phosphoric acid	1.61	1.38	1.56	1.66	1.44	---
Potash soluble in water	7.67	5.58	7.01	5.34	4.96	.98
Sand and soil	9.05	---	---	15.40	---	4.95
Cost per ton	$12.00	15.00*	11.50*	11.00	11.50*	

Lime Kiln Ashes.

2012. Made in New York State. From E. M. Jennings, Southport.

Phosphoric acid	1.66
Potash	1.24
Sand and soil	5.40
Coal, etc.	2.80
Water	22.45

* In car lots.

Corn Cob Ashes.

1886. Sampled and sent by W. W. Pease, Thompsonville.

Potash soluble in water	12.87
Phosphoric acid	2.26
Sand, soil and coal	34.65

Cost $25 per ton.

The agricultural value of ashes generally depends not merely on the quantity of potash and phosphoric acid they contain, but also consists in their favorable effect on the mechanical condition of the soil, and especially in their serving to supply lime to the soil and to the crop, in the form of carbonate.

Analysis of Tobacco Stalks, No. 1895.

On the 17th of February, Mr. Byron Loomis brought to this Station a sample of Tobacco Stalks, in regard to which he stated as follows:—The stalks are from Havana Seed Tobacco raised in Suffield, planted in rows $3\frac{1}{2}$ feet apart, the plants 18–20 inches apart in the row. The sample represents 50 average stalks after they have been cured, and weighs 20 pounds. From Mr. Loomis's statement it appears that there were between 7100 and 7900 stalks to the acre or 7500 on the average, and accordingly their weight at the date would be about 3000 pounds or $1\frac{1}{2}$ tons to the acre. The analysis follows, and for comparison is also given an analysis of stalks of Connecticut Leaf, Havana Seed, Tobacco, which were supplied to the Station by Mr. H. H. Austin, of Suffield. The analysis, with a different water content is found on page 105 of the Report for 1884. Mr. Austin's sample was much drier than Mr. Loomis's sample, containing only 45.90 per cent. of water. The analysis is here reckoned to 67.00 per cent. of water for comparison. Mr. Austin also estimates the weight of the [drier] stalks at 4000 pounds per acre. These differences in estimated total yield and in the water-content of the stalks account largely for the difference in the yield of plant food per acre as calculated from the analysis.

	Mr. Loomis's Sample.	Mr. Austin's Sample.
Water	66.99	67.00
Organic and Volatile Matter	29.96	30.06
Containing Nitrogen	[.69]	[.13]
Ash or Mineral Matter	3.05	2.94
	100.00	100.00

The mineral matter contains:

Potash	1.37	1.60
Soda	.02	.01
Lime	.29	.30
Magnesia	.15	.19
Oxide of Iron	.04	--
Phosphoric acid	.18	.22
Sulphuric acid	.16	.23
Chlorine	.34	.33
Sand and Silica	.58	.13
	3.13	3.01
Deduct oxygen equivalent to chlorine	.08	.07
	3.05	2.94

From the data given by Mr. Loomis the amount of plant food contained in the stalks, furnished by him is calculated as follows, for the produce of an acre:

Nitrogen	20.6	pounds.
Phosphoric acid	5.4	"
Potash	41.0	"
Soda	.5	"
Lime	7.8	"
Magnesia	4.4	"
Sulphuric acid	4.7	"
Chlorine	10.3	"

The stalks therefore contain about as much nitrogen and potash as would be furnished by an application of 70 pounds of muriate of potash and 300 pounds of cotton seed meal per acre. The latter would, however, contain nearly twice as much phosphoric acid.

MUCK FROM FLORIDA.

The two following analyses were made in the interest of citizens of Connecticut, who are engaged in orange culture in Florida. Under date of July 14, Mr. Cyrus Pickett of New Haven, writes in regard to the samples: "No. 1 consists of rotted leaves and plants in what are called "Bays," that cover millions of acres in Florida. No. 4 is from "Ponds" that are really a kind of muck or peat beds into which you can press a pole ten or fifteen feet sometimes.

"Is it true that there are acids in them that do as much hurt to orange trees as the valuable elements do good?"

The results of analysis were as follows:

2104. Muck from "Bays" in Florida, No. 1.

2107. Muck from "Ponds" in Florida, No. 4.

Station No.	**2104**	**2107**
Water	13.90	6.19
Organic and volatile matter*	70.82	37.50
Ash	15.28	56.31
	100.00	100.00
* Containing nitrogen	1.67	1.26
The ash is made up of:		
Sand and soil	12.75	54.20
Iron Oxide	trace	trace
Lime	.38	.18
Magnesia	.68	.49
Phosphoric acid	.18	.19
Other matters not separately determined	2.29	1.25
	16.28	56.31

2104 has a faintly acid reaction. No soluble iron salts.

2107 has a faintly acid reaction. There is a bare trace of soluble iron salts.

To Mr. Pickett was written substantially as follows:

"The analyses represent the peat in a comparatively dry condition. No. 1 is much richer in vegetable matter than No. 4, has therefore more nitrogen and is probably the more valuable agriculturally. On the dry sandy lands near the deposits these mucks will prove a valuable amendment, making the soil more retentive of moisture and at the same time richer in plant food. The peat should be thrown out to dry some time before it is to be used so as to give it time to weather and become crumbly and mellow. If horse manure, urine or old fashioned guano are at your disposal, composting the peat with either of these things will much improve it. At present the nitrogen in the peat is no doubt mostly in an inert form and composting will make it more readily available."

It may be added that the "injurious acids" of peat or swamp muck commonly consist of acid salts of iron or alumina which are rendered harmless by exposure to air and rain and by composting with animal manures or with lime.

REVIEW OF THE FERTILIZER MARKET

FOR THE YEAR ENDING DEC. 1, 1887.

NITROGEN.

Organic Nitrogen.

The nitrogen of *Dried Blood* was quoted *at wholesale* in the New York market in December, 1886, at about 13.3 cents per pound. It rose to 13.6 cents in April, which was the highest figure for the year, declined to 13.1 cents in June, 12.6 cents in August and 12.1 cents in September.

The *wholesale* quotation of nitrogen in *azotin* has ruled somewhat higher, 14.5 cents in December of last year, 14.1 in April, 13.4 in August and 12.3 in October.

The wholesale cost of organic nitrogen the year through has been considerably under 14 cents per pound.

The *retail price* of the nitrogen of dried blood in three samples form the Connecticut market has been from 14.6 to 17 cents per pound. It is sold in New Haven at 17 cents per pound at this time (Dec. 1). Castor Pomace has been freely sold in the State this season at prices which make its nitrogen cost a trifle over 14 cents.

Nitric Nitrogen.

The *wholesale* price in the New York market of nitrogen in *Nitrate of Soda* was 13.1 cents per pound in December of last year., It rose in February to 13.6, in March to 14.3, and in April to 14.9. It then gradually declined to 11.8 cents in August, rallied in the next two months to 13.0 and is now quoted at 12.7.

Its *retail* price in this State has been from 16.4 to 18.7 cents per pound. It is offered freely at 17 cents.

Ammonic Nitrogen.

The *wholesale* price in New York of nitrogen in *Sulphate of Ammonia* has been quite constant, fluctuating between 14.5 and 14.9 cents during the entire year, the average price being about 14.6 cents.

The *retail* cost in this State has been from 17.1 to 18.3 cents.

Phosphatic Materials.

Refuse Bone Black stood at $18.50 per ton wholesale till September when it fell to $17.75.

Ground Bone at the same time fell from $29.50 to $28.50.

Ground Charleston Rock, f.o.b., N. Y., fell in September from $8.25 to $7.50 and in October to $6.25.

Sulphuric Acid, 66° fell in May from 1·17½ cts. per pound wholesale to 1.07½.

Potash.

In Muriate of Potash.

Potash *at wholesale* in this form was quoted at the beginning of the year at 3.41 cents per pound. It rose in April to 3.56, declined in June to 3.41 again and in September to 3.36. Its *retail* price in the State has been from 4 to 4.4 cents per pound during the year.

In Double Sulphate of Potash and Magnesia.

Potash *at wholesale* in this form has sold at from 4.05 to 4.15 cents per pound in New York.

Its *retail* price in the State has been from 5.5 to 7.3 cents per pound. Apparently it is not retailed at nearly so close a margin as the muriate.

In Kainit.

The *wholesale* price of Kainit has been from $7.37 to $7.87 per ton. Assuming that Kainit averages 12.4 per cent. of potash the *wholesale* cost of actual potash in kainit has been from 3.0 to 3.17 cents per pound. The *retail* cost in the State has been from 4.7 to 5.2 cents per pound. Kainit at present prices is a less economical source of potash than muriate and so far as its potash goes is in no way superior to the muriate.

In general there has been no striking change in the wholesale fertilizer market during the year in the quotations of potash and phosphoric acid.

Nitrogenous matters, except sulphate of ammonia, have been noticeably cheaper than in the previous year.

The market quotations given above are taken from the "Oil, Paint and Drug Reporter," published in New York. The weekly quotations for each month are averaged and this average is taken as the quotation for the month.

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

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

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

Blood, azotin and ammonite are quoted at so much "per unit of ammonia." To reduce ammonia to nitrogen, multiply the per cent. of ammonia by the decimal .824 (or multiply the percentage of ammonia by 14 and divide that product by 17). A "unit of ammonia" is one per cent., or 20 pounds per ton. To illustrate: if a lot of tankage has 7.0 per cent. of nitrogen, equivalent to 8.5 per cent. of ammonia, it is said to contain 8½ units of ammonia, and if it is quoted at \$2.25 per unit, a ton of it will cost $8\frac{1}{2}\times 2.25$ =\$19.13.

The term "ammonia" is *properly* used only in those cases where the nitrogen actually exists in the form of ammonia, but it is a usage of the trade to reckon all nitrogen, in whatever form it occurs, as ammonia.

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

Ammonia at	\$3.80	per unit is	equivalent to	nitrogen at	23.0	cts.	per lb.
"	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	"	"
"	1.90	"	"	"	11.6	"	"
"	1.80	"	"	"	11.0	"	"

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	$4\frac{3}{4}$	cents per lb.	Nitrogen	costs	23.1	cents per lb.
"	$4\frac{5}{8}$	"	"	"	22.5	"
"	$4\frac{1}{2}$	"	"	"	21.9	"
"	$4\frac{3}{8}$	"	"	"	21.3	"
"	$4\frac{1}{4}$	"	"	"	20.7	"
"	$4\frac{1}{8}$	"	"	"	20.1	"
"	4	"	"	"	19.5	"
"	$3\frac{7}{8}$	"	"	"	18.9	"
"	$3\frac{3}{4}$	"	"	"	18 3	"
"	$3\frac{5}{8}$	"	"	"	17.6	"
"	$3\frac{1}{2}$	"	"	"	17.0	"
"	$3\frac{3}{8}$	"	"	"	16.4	"

At	$3\frac{1}{4}$	cents per lb.	Nitrogen	costs	15.8	cents per lb.
"	$3\frac{1}{8}$	"	"	"	15.2	"
"	3	"	"	"	14.6	"
"	$2\frac{7}{8}$	"	"	"	14.0	"
"	$2\frac{3}{4}$	"	"	"	13.4	"

Commercial Nitrate of Soda averages 95 per cent. of the pure salt or 15.6 per cent. of nitrogen.

If quoted at	$3\frac{3}{8}$	cents per lb.	Nitrogen	costs	21.5	cents per lb.
"	$3\frac{1}{4}$	"	"	"	20.8	"
"	$3\frac{1}{8}$	"	"	"	19.9	"
"	3	"	"	"	19.2	"
"	$2\frac{7}{8}$	"	"	"	18.3	"
"	$2\frac{3}{4}$	"	"	"	17.6	"
"	$2\frac{5}{8}$	"	"	"	16.9	"
"	$2\frac{1}{2}$	"	"	"	16.0	"
"	$2\frac{3}{8}$	"	"	"	15.2	"
"	$2\frac{1}{4}$	"	"	"	14.4	"
"	$2\frac{1}{8}$	"	"	"	13.6	"
"	2	"	"	"	12.8	"
"	$1\frac{7}{8}$	"	"	"	12.0	"
"	$1\frac{3}{4}$	"	"	"	11.2	"

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

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

The Double Sulphate of Potash and Magnesia usually has about $26\frac{1}{2}$ per cent. of actual potash.

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

The following table shows the fluctuations in the wholesale prices of a number of fertilizing materials in the New York market, since April, 1884. The price given for each month is the average of the four weekly quotations in that month. Sulphate of ammonia is assumed to contain 20.5 per cent. and nitrate of soda 15.6 per cent. nitrogen, and muriate of potash $50\frac{1}{2}$ per cent. of actual potash or 80 per cent. of the pure salt.

		Cost of Nitrogen at Wholesale in				Cost of Potash at Wholesale in
		Blood. cts. per lb.	Azotin or Ammonite. cts. per lb.	Nitrate of Soda. cts. per lb.	Sulphate of Ammonia. cts. per lb.	Muriate of Potash. cts. per lb.
1884.	April	13.6	13.6	14.0	14.6	3.38
	May	14.0	13.9	14.4	15.3	3.44
	June	13.9	13.5	13.8	14.6	3.36
	July	13.2	13.5	14.2	14.9	3.37
	August	13.6	13.3	14.3	14.7	3.36
	September	12.8	13.3	14.4	14.4	3.28
	October	12.9	13.2	14.3	14.8	3.38
	November	12.4	12.6	14.4	15.2	3.26
	December	12.1	12.8	14.4	15.2	3.32
1885.	January	12.3	13.0	14.1	15.2	3.32
	February	12.6	13.4	14.4	15.2	3.36
	March	13.4	13.7	13.2	15.2	3.58
	April	13.6	13.7	13.2	15.2	3.51
	May	14.3	13.7	14.1	15.2	3.54
	June	13.9	13.7	14.0	15.2	3.36
	July	13.6	13.6	14.0	15.0	3.31
	August	13.8	13.6	15.0	14.9	3.34
	September	13.4	13.5	15.6	14.8	3.36
	October	13.4	13.5	16.0	14.8	3.36
	November	13.8	13.5	15.6	14.8	3.38
	December	14.1	13.9	16.0	14.9	3.39
1886.	January	14.0	14.2	15.6	15.1	3.38
	February	14.2	14.3	15.2	15.2	3.46
	March	14.9	14.7	16.0	15.8	3.64
	April	14.9	15.7	16.1	16.4	3.56
	May	14.6	15.4	16.4	15.8	3.41
	June	13.9	14.7	15.6	14.6	3.32
	July	14.2	14.4	14.9	14.6	3.31
	August	14.1	14.4	14.0	14.5	3.31
	September	14.1	14.4	13.7	14.4	3.40
	October	14.4	14.4	13.2	14.6	3.41
	November	14.0	14.4	12.7	14.7	3.41
	December	13.3	14.5	13.1	14.7	3.41
1887.	January	13.3	14.5	13.0	14.6	3.41
	February	13.5	14.5	13.6	14.6	3.41
	March	13.4	14.5	14.3	14.5	3.51
	April	13.6	14.1	14.9	14.5	3.56
	May	13.4	14.0	14.7	14.5	3.48
	June	13.1	14.0	14.0	14.5	3.41
	July	13.1	14.0	12.0	14.5	3.41
	August	12.6	13.4	11.8	14.5	3.40
	September	12.1	12.5	12.2	14.7	3.36
	October	12.1	12.3	13.0	14.9	3.36
	November	11.8	12.2	12.7	14.7	3.41

On the Valuation of Tankage.

Tankage has been valued like bone, with due regard to its mechanical as well as its chemical analysis, as explained on page 29, on the assumption that both the fine and coarse particles have the same composition. A possible objection to this method is that the nitrogenous matter of tankage may be much finer than the bone fragments which have been largely freed from their nitrogenous constituents by boiling. If so, then the system undervalues the nitrogen and overvalues phosphoric acid, making the total valuation lower than it should be. To test the matter, two samples of tankage, one of eastern, the other of western manufacture, were separated by sieves into the several grades as practiced in the mechanical analysis of bone, nitrogen and phosphoric acid were separately determined in each portion, and the valuation of each grade was reckoned by the schedule as on page 27. The total valuation thus obtained, free from the objection cited above, could then be compared with the valuation made in the usual way. The results are tabulated on the following page and are so nearly identical as to show that the method of valuation commonly used for bone is equally applicable to tankage.

ANSWERS TO CORRESPONDENTS CONCERNING FERTILIZERS.

Preparation of Bone Superphosphate.

In answer to repeated inquiries from various sources, the methods of "dissolving" ground bone, i. e. of preparing a bone superphosphate by help of sulphuric acid—useful where soluble phosphoric acid and nitrogen are desired—is here reproduced from the Report of this Station for 1881.

"Most of the ground bone that comes into market contains a considerable proportion of coarse fragments which may remain in the soil for years before they become of avail to plants. The finest parts of ground bone are, on the other hand, adapted to feed crops at once. If ground bone be treated directly with sulphuric acid, the fine parts are promptly decomposed, but the coarse portions are but little acted on unless a large amount of acid and much time are consumed. Dr. Alexander Müller has proposed the following very rational method of treating ground bone, which is perhaps the best adapted for domestic use of any of the processes involving the use of oil of vitriol.

TANKAGE.

	Mechanical Analyses. 1889 Western Tankage.	Mechanical Analyses. 1891 New York Tankage.	Chemical Analyses. 1889 Western Tankage. Nitrogen.	Chemical Analyses. 1889 Western Tankage. Phos. Acid.	Chemical Analyses. 1891 New York Tankage. Nitrogen.	Chemical Analyses. 1891 New York Tankage. Phos. Acid.
Fine, smaller than $\frac{1}{50}$ inch	67	73	7.04	13.01	5.54	18.74
Fine-medium, " $\frac{1}{25}$ "	20	13	7.90	11.19	5.57	18.04
Medium, " $\frac{1}{12}$ "	12	10	8.22	10.56	4.05	23.54
Coarse-Medium, " $\frac{1}{6}$ "	1	4	9.07	----	2.17	31.91
	100	100				

The Valuations per ton were:—	1889 Western Tankage.	1891 New York Tankage.
By the usual method	$38.60	$41.87
By the special method above described	38.28	41.44

Take 100 lbs. of ground bone such as contains 20 to 50 per cent., more or less, of material coarser than $\frac{1}{4}$ inch, 25 lbs. of oil of vitriol of 66°, the strongest commercial acid, and six quarts of water.

Separate the bone by sifting into two, or if the proportion of coarse bone is large, into three parts, using sieves of $\frac{1}{16}$ inch and $\frac{1}{8}$ inch mesh.

Mix the coarser part of the bone in a cast-iron or lead-lined vessel or in the half of an oil barrel with the oil of vitriol. When the bone is thoroughly wet with the strong acid, add the water, stirring and mixing well. The addition of the water to the acid develops a large amount of heat which favors the action. Let stand, with occasional stirring, for twenty-four hours, or until the coarsest fragments of bone are quite soft; then, if three grades of bone are used, work in the next coarser portion of bone, and let stand another day or two until the acid has softened all the coarse bone, or has spent its action; and finally, dry off the mass by mixing well with the finest bone. In carrying out this process, the quantity of oil of vitriol can be varied somewhat—increased a few pounds if the bone has a large proportion of coarse fragments, or diminished if it is fine.

Stöckhardt gives a somewhat different procedure, viz: "From a mixture of sifted wood or coal ashes and earth thrown upon a barn or shed floor, form a circular wall so as to enclose a pit capable of containing one hundred weight of ground bone; the surrounding wall of ashes may be rendered so firm as not to yield by being trodden down or beaten firm with a board.

Sift off the finer part of the bone and set it aside. Throw the coarser part into the cavity, and sprinkle it during continued stirring with three quarts of water until the whole is uniformly moistened; add gradually eleven pounds of oil of vitriol of 66°, the agitation with the shovel being continued. A brisk effervescence of the mass will ensue (from decomposition of the carbonate of lime in the bones), which will not, however, rise above the margin of the pit if the acid is poured on in separate small quantities. After twenty-four hours, sprinkle again with three quarts of water, add the same quantity of sulphuric acid as before, with the same brisk shoveling of the mass, and leave the substances to act for another twenty-four hours upon each other. Then intermix the fine bone previously sifted off, and finally shovel the ashes and earth of the pit into the decomposed bone until they are all uniformly mixed together."

Treating Bones with Acid.

"Will you inform me if there is any fertilizing property in sulphuric acid or is it only used to cut bone, in the manufacture of superphosphate? I inclose formula for making phosphate that I have taken from my scrap book and ask your opinion of it."

To these questions was replied substantially:

Sulphuric acid is a plant-food but is not generally deficient in our soils. It can be most economically supplied in land plaster which is the sulphate of lime. You ask an opinion as to the inclosed formula. *Fine* bone dust needs no "cutting" with acid to make it readily available for crops. If you do cut it with acid it will usually be necessary to add a drier like the dry loam or wood dirt of your formula, else the mass will be smeary or pasty. If you want a more quickly acting phosphate it would probably be cheaper to buy plain bone-black superphosphate [at $28.00 a ton] and mix one or two hundred pounds to the ton with your bone meal rather than experiment with sulphuric acid which is a somewhat dangerous thing for one unskilled in its use to handle.

The cost of hauling of 1600 pounds of loam from and to the fields will go far towards the purchase of a small proportion of superphosphate.

The best methods of "cutting" bones with sulphuric acid are given on a previous page.

Dissolving Bone, Composting Offal, etc.

A correspondent inquires in substance as follows:

1. Is the phosphoric acid of steamed bones available?

2. What quantity of acid is it best to use to cut steamed bones?

3. Is it necessary to treat fish with acid in order to make a good fertilizer of them?

4. What is the value of nitrate of potash as a fertilizer?

5. Having refuse meat and offal from a slaughter at my disposal what quantity of muck must I use with it to make compost equal to horse manure and how shall I manage the composting?

Answer.

"1. Doubtless all the phosphoric acid of steamed bone is readily available, not so quickly as that of bones "dissolved" in acid, but quickly enough for all practical purposes, especially if the

steaming has been done under high pressure so that the bones are easily crushed to powder.

2. The amount of acid advantageous to use for raw bones you will find stated on page 93 of this Report—Dr. Alexander Müller's method. Steamed bones, if they require acid to subdivide them may be treated in the same manner.

3. It is not needful to treat fish with acid at all in order to make a good fertilizer. To prevent the loss of ammonia, and to suppress stink and destroy flies and maggots it pays to sprinkle the fresh fish-scrap with a few per cent. of diluted oil of vitriol. That makes the bones so friable that they crush easily to powder and mostly converts them into superphosphate.

4. Nitrate of potash is excellent as a fertilizer but costs too much. It is cheaper to use nitrate of soda and muriate of potash together.

5. It is not easy to say how much muck to one of meat will make a compost just equal to horse-manure. I should use muck or leaf mold as dry as possible and use with the meat muck enough to take up the water and leave a nearly dry mass. If needful to make it dry I would add sifted dry coal ashes or wood ashes and I would mix in a good sprinkling of plaster or sulphate of potash. The mixture thus made should be protected from wet and allowed to heat moderately. Then to regulate the heating and prevent loss it should be trodden or stamped down. If that does not suffice, it should be sprinkled with water till moist and packed or stamped more, or the proportion of muck should be increased. These directions are very general but if you will set up several trial heaps, noting carefully what quantities of materials you use and observing that the mixtures should decompose and heat within a reasonable time but should suffer no loss of ammonia [perceptible to the smell] you will soon understand the matter. The Station will assist you by analyses of materials and products on condition that results may be published for the benefit of the public."

Copperas as a Fertilizer.

A correspondent writes:—

"The Journal of the Chemical Society states that copperas is a valuable dressing for many crops; that one-eighth of an acre with fourteen pounds applied yielded 5278 pounds of potatoes, an increase of 400 pounds over a similar plot not so treated; also recommends it for other crops—hay was doubled in quantity by its use—and so forth.

I would like to ask you what fertilizing material it contains and whether the statement seems reasonable enough to warrant making the experiment. I think it will cost about three cents per pound by the barrel. I expect to use some this year to protect grape-vines from rot and mildew. As it has a sterilizing effect on fungi I should infer that it might act injuriously on the growth of agricultural plants."

Answer.—The statement by A. B. Griffiths in the Journal of the Chemical Society to which you refer gives account of some remarkable results from the use of copperas (protosulphate of iron) on various crops. He found that there was less increase of yield in case of the cereals than with root crops. But he claims that copperas prevents or hinders mildew on wheat and that in very weak solution (one part by weight in one thousand of water), it destroys the spores of mildew; which is remarkable because most spores are very retentive of life. On mossy land Griffiths observed that it destroyed moss and increased the grass crop. All this seems to have been accomplished with very moderate applications, only one-half a cwt. (fifty-six pounds) per acre. Sir J. B. Lawes is quoted as saying that in his experience 1½ cwt. was rather too much to apply per acre. Griffiths' explanation of the favorable effect of copperas is that it increases the chlorophyl in the leaves, of which iron is an essential constituent, and so increases the power of the plant for assimilation. He finds a larger percentage of fiber, of carbhydrates and of nitrogen, in crops raised with an application of copperas than in those produced on the same kind of soil without it, which facts he cites as sustaining his hypothesis. But since the soil itself with which he experimented contained 3·95 per cent. of sesquioxide of iron, it is difficult to believe that it could not furnish as much assimilable iron as his application of fifty-six pounds per acre of copperas. The iron of the soil is, however, in all ordinary cases very slowly and slightly soluble; in some soils a supply of freely soluble iron may be of great advantage to crops. It was demonstrated that the observed increase of crop was not due to a supply of sulphuric acid by the copperas because kainit and superphosphates containing abundance of sulphuric acid, proved to have less effect.

The results are scarcely to be explained by the indirect action

of the salt in making plant-food soluble in the soil-water, for kainit, which would be supposed to exert such effect, did not give nearly so large a yield as the copperas. It is probable that in the soil on which Griffiths operated there were certain fungi or bacteria which had an unfavorable effect on crop-production and that copperas was beneficial chiefly or wholly on account of its property of destroying or sterilizing these organisms. Kellner in experiments on small plots of ground in Japan with from 50 to 600 pounds of copperas to the acre found no good effect and no injury from its use. König, in Germany, observed an increase of crop in some trials made in this way.

I know of but one experiment in this country with copperas, made by G. H. Whitcher at the New Hampshire Agricultural College Farm, and reported in "Agricultural Science." To one quarter of an acre of land was applied broad-cast, 70 pounds of dissolved bone black, 30 of muriate of potash and 10 of sulphate of ammonia, and in the hill 35 pounds of dissolved bone black, 15 of muriate of potash and 8 of copperas. To another adjoining quarter-acre plot were added the same fertilizers in the same way but omitting the copperas. Both plots were planted to maize. That which had copperas produced a rank growth of dark green color. The harvest was as follows:

	Sound Corn.	Soft Corn.	Stover.
One-fourth acre with chemical manures and copperas,	820	110	1000
One-fourth acre with chemical manures without copperas,	670	170	970
Gain or loss.	+ 150	— 60	+ 30

Thirty-two pounds of copperas per acre increased the yield of corn 600 pounds, or 22 per cent.

In Europe many trials with sulphate of iron, sulphate of soda, sulphate of magnesia, common salt, chloride of calcium, chloride of magnesium and various other saline compounds were on record thirty or forty years ago and instances were not wanting in which crops improved in appearance and increased in quantity by such applications.

Trials with copperas being inexpensive, are well worth making, though to judge from past experience this substance will not be found generally helpful. It will be injurious to agricultural plants when applied in too large quantities; even in small quantity it may prove a damage on "sour," that is, close-textured and wet land. It might be found of advantage, if any where, on rich garden land that has had abundance of stable manure applied for many years.

Superphosphate from Bone.

A correspondent asks:

1. What quantity of acid is necessary to dissolve 100 pounds of bone?

2. What strength of acid is most suitable?

3. What will be the percentage composition of a superphosphate made from bone?

4. What will be the mechanical condition of the superphosphate?

Answer was made as follows:—

1. As to proportion of sulphuric acid to bone. This may properly vary somewhat since commercial "bone" itself is not constant in composition. Its phosphoric acid varies from 19 to 30 per cent. and its nitrogen from 6 to 2·5 per cent., usually the more phosphoric acid, the less nitrogen; and *vice versa.* The age of the bone [or of the animal] the time it has been weathered, boiled or dried, the amount of meat, tendon, marrow and sand adhering to it, all influence its composition.

Some twenty-five years ago Prof. J. T. Way, then chemist to the Royal Agricultural Society of England, stated that 100 pounds of average bone require 29 pounds of strong oil of vitriol [66° acid] to render the phosphoric acid all soluble, but as the organic tissue of the bone absorbs the sulphuric acid, sponge fashion, some excess of oil of vitriol, 35 to 40 pounds per 100 of bone, must be used for complete conversion of the phosphoric acid into a form soluble in water.

2. The strength of sulphuric acid to be used.

If oil of vitriol of 66° be used, it should be diluted with about one-half its weight of water. A corresponding quantity of "chamber acid" may be used.

3. Way states that 100 pounds of bone and 29 pounds of 66° acid should give a product of which 100 pounds contain,

Water	10	
Animal matter	27	with 1·25 nitrogen.
Hydrated sulphate of lime	39·	
Superphosphate of lime	24	with 17 soluble phosphoric acid.

In practice, however, all the phosphoric acid is not made soluble.

4. Pure bone-superphosphate will be an unmanageable paste if enough sulphuric acid be used to make nearly all its phosphoric acid soluble. There is agriculturally no gain in making all the phosphoric acid of bones soluble in water. Fine bone is of itself a quick fertilizer requiring no treatment with oil of vitriol, so that the most economical result is attained by acting on the coarser parts of ground bone with sulphuric acid, and using the fine bone as a dryer.

An account of the method of dissolving bone is given on page 93.

Value of Waste Lye from Soap Works.

To an inquiry on this subject, referred to the Station, reply was made as follows, after obtaining and analyzing a sample.

The analysis of the waste lye is as follows:—

Nitrogen	·04
Potash	·03
Soda	5·34
Water	88·79
Carbonic Acid, with small amounts of Chlorine, Sulphuric Acid and undetermined matters, by difference	5·80
	100·00

The analysis fully confirms the view that the waste of soap works is now-a-days essentially destitute of plant-food. This sample contains soda corresponding to 12·3 per cent. of sodium carbonate. Since in the analysis, soda and carbonic acid, etc., amount to but 11·1 per cent. there is evidently a small amount of caustic soda remaining in the lye. Speaking in general terms, carbonate of soda cannot be recommended as an application to land. There are indeed cases where it may do good, as experience has shown. Soil that is rich in vegetable matter, either that of drained swamp-land, or of fields and gardens that have been heavily dressed with stable manure, may be benefited and are least likely to be harmed, by its use. Its action on such soils is indirectly to feed the crops by favoring the conversion of the inert nitrogen of the vegetable matter into soluble and available forms. If applied directly to the land, the lye should be diluted with 10 to 20 times its bulk of water. The best use to make of this lye would be in composting and rotting swamp-muck or coarse vegetable refuse.

ANALYSES OF FEEDING STUFFS.

In former reports extended explanations concerning the Analysis, Valuation and Economical Use of Feeding Stuffs have been given. It is not thought necessary to repeat them here since copies of Reports containing them can be supplied to any who desire such explanations.

Twenty-two Samples of Feeding Stuffs * have been analyzed during the year 1887. Those which have general interest are here noticed.

HAY.

CCXLVIII. Rather coarse Clover Hay, baled. Bought in New Haven.

CCXLIX. Hay from mixed grasses, chiefly blue-grass (*Poa pratensis*) and fine bent (*Agrostis vulgaris*), cut on the Station land early when the blue-grass was in bloom.

ANALYSES.

	Baled Clover Hay. CCXLVIII.	Hay of Mixed Grasses. CCXLIX.
Water	15.11	20.25
Ash	3.17	4.68
Albuminoids	6.44	9.21
Fiber	29.77	22.92
Nitrogen-free Extract	4373	40.58
Fat (Ether Extract)	1.78	2.36
	100.00	100.00

SOME CONNECTICUT GRASSES.

In regard to these grasses Mr. J. B. Olcott of South Manchester kindly furnishes the following notes:

"The grasses whose analyses follow, with the exception of *Sorghum halapense*, Johnson grass,† are native grasses, growing with and without cultivation in our most productive meadows, as well as in neglected places, since the first settlement of the country. Farm testimony is abundant, but varying as to their value. Except that the foliage of several is injured by autumn frosts, their hardiness is unquestioned and even made a demerit by those

* Exclusive of potatoes.

† And perhaps of *Festuca ovina*.

who do not value *very* permanent meadow, wherein these deep-rooted and lasting grasses distinguish themselves. *Andropogon provincialis* (forked Andropogon, blue-stem of the west), has many strong friends, and this together with *Panicum virgatum* (black-bent), and *Chrysopogon nutans* (broad bent), must be considered worthy of close attention by investors in really permanent forage. Their seeding qualities and other practical points are not well known and cannot be ascertained in a single year's study. In the famous 'Hartford Meadows,' including the Windsors and Glastonbury, these, with other tall grasses in varying proportions, covering a finer growth of *Poa pratensis*, exist in park-like expanses of hundreds of acres, offering conclusive testimony of their worth to the State, and tempting investigation as to their more general value and uses.

Glyceria nervata prefers wet land (as the before-mentioned grasses do not), and makes seed freely. Of the lesser *Andropogons, scoparius*, prominent on Wallingford plains, is far better than bushes for forage. *Virginicus* is less prevalent than the other and less frequent in very dry land."

CCLXIII, *Glyceria nervata*, nerved meadow grass, cut in bloom in a wet spot by the road side in New Haven.

CCLXV, *Festuca ovina* (?), sheep's fescue, cut in bloom under evergreen trees in a door yard in New Haven.

CCLXVI, *Panicum virgatum*, black-bent.

CCLXVII, *Andropogon provincialis*, blue-bent.

CCLXVIII, *Chrysopogon nutans*.

The last three samples were cut Sept. 9, in East Hartford meadows and brought to the station the same day by Mr. J. B. Olcott, who used all care that they should not dry out before their arrival. They represent rowen headed, but cut before bloom.

CCLXIX, *Andropogon scoparius*, broom grass, and

CCLXX, *Andropogon Virginicus*; both cut by Mr. Olcott on his own land, Sept. 9, 1887, in condition like his other specimens but from poorer land owing to the vicinity of trees.

CCLXXI, *Panicum crus-galli var. hispidum*, barn yard grass.

This was raised from seed—gathered the year before from a dumping ground in New Haven—planted in the Station Forage Garden. The seed was drilled in, Sept. 25, 1886, and did not come up that fall. The drill was replanted March 21, 1887. May 15 it came up, apparently from both fall and spring planting. Being a hot-weather grass it did not make great progress till July when it grew rapidly and stood five feet high and over, Sept. 5, when this sample was cut for analysis. The seed had formed but was not ripe. The seed was ready to gather the last week in Sept. The stalks at that time were greedily eaten clean by cows. This grass seems to be a surface feeder and filled the soil so completely with fine fibers that a hoe could scarcely be worked within a foot of the stalks. The seed of this grass is common enough in untidy potato fields in the fall and springing the next year is frequently cut for hay. Its qualities to be considered for that use are, quick and rank growth during July and August, besides being shallow-rooted and an annual and hence not troublesome in the following season if cut before seeding. It dries slowly and we do not recommend it for general use but regard it worthy of further trials here.

CCLXXVII, *Panicum agrostoides*, red top panic, cut at same place and time as CCLXX; common in the wetter portions of Hartford meadows.

CCLXXVIII, *Sorghum halapense*, Johnson grass. Cut in the Station Forage Garden, Sept. 5, 1887. The seeds had formed but were not ripe. This grass grew very thriftily but rusted badly about the time of blossoming. Sown in the late summer it is completely winter-killed and probably cannot survive the winter in this latitude.

As a standard of comparison the following table includes analyses of the dry substance of timothy hay—average of 53 analyses and of good meadow hay from mixed meadow grasses—average of 9 analyses.

A single analysis does not settle the value of a forage plant. Differences of soil, climate and season have a great effect on the chemical composition and feeding value of forage but these analyses are here given as a single contribution to our knowledge of their composition.

ANALYSES OF GRASSES.

Freshly Cut.

	Glyceria nervata. CCLXIII.	Festuca ovina (?) CCLXV.	Panicum virgatum. CCLXVI.	Andropogon provincialis. CCLXVII.	Chrysopogon nutans. CCLXVIII.	Andropogon scoparius. CCLXIX.	Andropogon Virginicus. CCLXX.	Panicum crus-galli var. hispidum. CCLXXI.	Panicum agrostoides. CCLXXVII.	Sorghum halapense. CCLXXVIII	Timothy Hay. 53 analyses	Hay from mixed meadow grasses. 9 analyses.
Water	74.88	71.85	65.16	73.09	67.01	57.08	64.50	80.52	65.01	68.62	----	----
Ash †	1.83	1.85	1.94	1.58	2.86	1.72	1.24	1.43	3.55	1.74	----	----
Albuminoids *	2.64	2.91	3.67	2.15	2.42	1.74	2.20	1.42	2.42	2.89	----	----
Fiber	8.41	9.98	10.40	8.51	9.96	16.21	13.03	6.75	10.44	9.37	----	----
Nitrogen-free Extract	11.75	12.68	17.99	14.05	17.00	22.64	18.30	9.54	17.93	16.44	----	----
Fat	.49	.73	.84	.62	.75	.61	.73	.34	.65	.94	----	----
	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	----	----
Nitrogen	.42	.46	.58	.34	.38	.28	.35	.23	.38	.46	----	----
Phosphoric Acid	----	----	.15	.09	.19	.13	.13	.09	----	----	----	----
Potash	----	----	.20	.18	.36	.29	.28	.47	----	----	----	----
Water-free.												
Ash†	7.29	6.57	5.57	5.87	8.67	4.01	3.49	7.34	10.14	5.54	**4.58‡**	**5.57‡**
Albuminoids *	10.39	10.25	10.53	8.18	7.35	4.06	6.21	7.32	6.94	9.20	**6.74**	**7.38**
Fiber	33.53	35.46	29.84	31.50	30.35	37.75	36.66	34.65	29.83	29.87	**33.82**	**36.79**
Nitrogen-free Extract	46.83	45.15	51.64	52.16	51.34	52.74	51.57	48.94	51.24	52.41	**52.50**	**47.85**
Fat	1.96	2.57	2.42	2.29	2.29	1.44	2.07	1.75	1.85	2.98	**2.36**	**2.41**
	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	**100.00**	**100.00**
Nitrogen	1.68	1.63	1.67	1.26	1.15	.65	.98	1.18	1.11	1.47	----	----
Phosphoric Acid	----	----	.43	.34	.57	.30	.37	.46	----	----	----	----
Potash	----	----	.57	.67	1.09	.68	.79	2.41	----	----	----	----

* The total nitrogen is here reckoned as albuminoids, by multiplying it by 6¼. On p. 104 it will be seen that in eight of the samples but from 68 to 88 per cent. of the nitrogen probably existed in the form of albuminoids, 12 to 32 per cent. occurring, for the most part, doubtless, in the state of "amides."

† Free from carbonic acid, water, and char.

‡ Probably crude ash.

As a further contribution to the knowledge of these grasses the mineral matter in them, "Ash," of the previous table, has been analyzed by Dr. Osborne. The results are as follows:*

COMPOSITION OF THE ASH OF GRASSES.

	Panicum virgatum. CCLXVI.	Andropogon provincialis. CCLXVII.	Chrysopogon nutans. CCLXVIII.	Andropogon scoparius. CCLXIX.	Andropogon Virginicus. CCLXX.	Panicum crus-galli, var. hispidum. CCLXXI.
Potash	10.53	11.13	12.29	17.01	23.61	33.47
Soda	1.99	.73	.87	.57	1.01	2.35
Lime	11.09	9.91	5.65	7.65	6.00	8.49
Magnesia	10.31	7.38	4.13	5.75	7.49	11.29
Oxide of Iron	.35	.25	.12	.46	.39	.85
Sulphuric Acid	4.74	2.66	1.28	2.51	2.64	11.48
Phosphoric Acid	7.62	5.55	6.35	7.82	11.23	6.53
Chlorine	.55	.78	.72	2.40	3.34	1.26
Silica and adher'g Sand	52.94	61.77	68.75	56.37	45.04	24.56
	100.12	100.17	100.16	100.54	100.75	100.28
Deduct Oxygen equivalent to Chlorine	.12	.17	.16	.54	.75	.28
	100.00	100.00	100.00	100.00	100.00	100.00

The "albuminoid" nitrogen, determined by Stutzer's method (Jour. für Landwirthschaft, 1881, p. 476. Report of this Station for 1885, p. 40), was as follows, in the air-dry substance.

	Panicum virgatum. CCLXVI.	Andropogon provincialis. CCLXVII.	Chrysopogon nutans. CCLXVIII.	Andropogon scoparius. CCLXIX.	Andropogon Virginicus. CCLXX.	Panicum crus-galli. CCLXXI.	Panicum agrostoides. CCLXXVII.	Sorghum halapense. CCLXXVIII.
Total Nitrogen	1.53	1.17	1.08	.77	.91	1.10	1.02	1.35
"Albuminoid" Nitrogen	1.16	.87	.87	.60	.71	.75	.87	1.19
Per cent. of "Albuminoid" Nitrogen (Total Nitrogen=100.)	75.8	74.3	80.6	77.9	78.0	68.2	85.3	88.1

CONCENTRATED FOODS.

CCL. Beans. These were bought of a seedsman, being old stock and worthless for seed, but good feed for sheep.

CCLIX. Chicago gluten meal. Sold by Holmes and Keeler,

* The analyses were made on the crude ash which contained some carbon. This was determined by drying silica and carbon together at 100° C., weighing and then igniting. Operating in this way the mixture of carbon and silica cannot be perfectly dried and for that reason the analyses came somewhat high, about 101 per cent. They are here reckoned free from carbonic acid, water and carbon.

Norwalk. Cost $21.00 per ton. Sent by D. H. Van Hoosear, Wilton.

DCLXII. "Corn-Germ Feed" from an Indianapolis Hominy Mill. Cost about $1.00 per 100 lbs. Sent by F. W. Holmes, Salisbury.

CCLX. Spring Wheat Bran and CCLXI. Winter Wheat Bran. Sent by S. D. Newell, Bristol.

ANALYSES.

	Beans. CCL.	Gluten Meal. CCLIX.	Corn Germ Feed. CCLXII.	Spring Wheat Bran. CCLX.	Winter Wheat Bran. CCLXI.
Water	15.00	8.23	12.18	10.90	11.13
Ash	3.10	1.27	2.54		
Albuminoids	20.37	27.38	10.87	15.19	14.06
Fiber	3.20	1.46	8.30		
Nitrogen-free extract	56.71	55.98	56.87		
Fat	1.62	5.68	9.24	4.85	4.47
	100.00	100.00	100.00		

Analyses of maize kernel and cob and of maize stalks will be found on pages 119 and 120 in the discussion of a field experiment and they need not be repeated here.

"IMPERIAL GRANUM."

CCLXXIX. as described by the proprietor, "Imperial Granum, The Great Medicinal Food. This justly celebrated dietetic preparation is in composition principally the gluten derived by chemical process from very superior growths of wheat. A solid extract. The invention of an eminent French chemist. It has acquired the reputation of being an incomparable aliment for the growth and protection of infants and children. The salvator for invalids and the aged," etc., etc.

ANALYSIS.

	Imperial Granum.	Wheat flour Average of 25 analyses.
Water	11.10	12.56
Ash	.33	.56
Albuminoids, including "gluten"	10.13	11.28
Fiber	.10	.27
Nitrogen-free extract	77.58	74.13
Fat	.82	1.20
	100.00	100.00
Cost per pound	$1.00.	$0.025—0.05

The "Imperial Granum" contains 77.24 per cent. of wheat-starch with possibly some dextrin. The quantity of dextrin and dextrose is not more than 1.8 per cent. The only wide difference between the figures given above for "Granum" and wheat flour is in the *cost per pound*. The "Granum" cannot be distinguished in chemical composition and properties from wheat flour slightly browned, which cooked as a porridge has long been used and prized as a food for infants and invalids.

It does not consist principally of the gluten of wheat, and is in no respect superior as food to good wheat flour.

"Anti-fermentine."

CCXLV. Made by W. W. Chase, Newburgh, N. Y. Sent by C. E. Sperry, Bolton. It is described by the manufacturer as follows: "Anti-fermentine is a simple, harmless preparation, free from taste, smell and color that has the property of stopping and preventing fermentation. * * * It is especially useful for preserving fruits of all kinds without cooking, retaining the natural fresh appearance and taste of the fruit. The question is sometimes asked: Is it injurious? To allay all doubts on that score we would say that we have consulted many of our most eminent chemists and physicians, and all unite in pronouncing the use of Anti-fermentine as a preservative a perfectly safe and harmless preparation, being composed of pure table salt and salicylic acid."

The composition of the article was as follows:—

Chlorine	19.87	
Equivalent salt		32.75 per cent.
Nitric acid	18.59	
Equivalent saltpeter		34.80 "
Salicylic acid (by difference)		32.45 "
		100.00

The mixture consists accordingly of about equal weights of saltpeter, salt and salicylic acid. A single package contains about 50 grams or less than 2 ounces and costs 60 cents.

Potatoes.

A number of analyses of potatoes have been made at the request of Mr. Theron E. Platt of Newtown, who has made a specialty of growing potatoes and testing new varieties. The analyses with a single exception were made on samples kindly supplied by Mr. Platt. For table of analyses see page 108.

CCLXI. Home Comfort. First quality.
A. Variety unknown. Bought in New Haven.
CCXLVI. White Flower. Raised with 200 pounds sulphate of potash to the acre.
CCXLVII. White Flower. Raised with 200 pounds muriate of potash to the acre.
CCLXII. Early Telephone. First quality.
CCLX. Rosy Morn. First quality.
CCLXIII. Queen of the Valley. Second quality.
CCLIX. White Star. Second quality.

Methods of Analysis.

Specific gravity was determined by weighing the potatoes and also the water which they displaced when put into a jar previously filled with water.

Water. The potatoes after weighing were cut into thin slices, partly dried, ground and again weighed. A portion was further pulverized so as to pass through fine bolting cloth and on this material all subsequent determinations were made. Water was determined by drying at 120° C. in a stream of dry hydrogen.

Starch was determined by Sachsse's method with separation of cellulose, as described on page 132.

Total Nitrogen, by Kjeldahl's method.

Albuminoid Nitrogen was determined by Stutzer's method (Jour. für Landwirthschaft 1881, p. 476. Report of this Station for 1885, p. 40).

Amide Nitrogen, more properly nitrogen of the amides and amido-acids, asparagine etc.—was determined by Sachsse's method (Versuchs-St. XVI. p. 61.)

ANALYSES OF POTATOES.

Station No.	Variety.	Specific Gravity.	Water.	Starch.	Ash.	Other matters, by difference.	Nitrogen. Total.	Nitrogen. Albuminoid.	Nitrogen. Amide.	Nitrogen. In other forms.
CCLXI	Home Comfort, 1st quality	1.099	75.58	19.39	1.09	3.94	.24	.17	.04	.03
(A)	From New Haven market	1.099	76.23	19.06	----	----	.37	--	--	--
CCXLVI	White Flower, with sulphate	1.091	76.77	18.38	.93	3.92	.38	.21	.10	.07
CCLXVII	White Flower, with muriate	1.082	77.39	17.99	.98	3.64	.35	.19	.08	.18
CCLXII	Early Telephone, 1st quality	1.087	78.08	17.17	.96	3.79	.39	.21	.09	.09
CCLX	Rosy Morn, 1st quality	1.082	79.25	16.53	.85	3.37	.32	.18	.07	.07
CCLXIII	Queen of the Valley, 2d quality	1.072	79.86	15.69	.84	3.61	.39	.23	.09	.07
CCLIX	White Star, 2d quality	1.076	80.99	14.50	1.13	4.38	.32	.16	.08	.08

The following percentage statement gives a better idea of the relative quantities of the different forms of nitrogenous matter in these potatoes than the table of analyses presents.

VARIETY.	Per cent. of the Total Nitrogen present in		
	Albuminoids.	Amides.	Other forms.
Home Comfort	71.2	17.6	11.2
White Flower (sulphate)	55.5	27.4	17.1
White Flower (muriate)	54.5	23.8	21.7
Early Telephone	53.5	23.3	23.2
Rosy Morn	54.0	21.6	24.4
Queen of the Valley	59.2	23.5	17.3
White Star	51.9	23.3	18.8

CORRESPONDENCE RELATING TO FEEDING STUFFS.

Fern and Bog Hay.

Referring to an analysis of the buckhorn fern, *Osmunda regalis*, published in our last report, Joshua Lyon, Esq., of Greenwich, writes as follows:

"In the report of the Experiment Station just received I read: 'As far as chemical analysis can indicate, the fern is equal to good meadow hay in composition; but it should be remembered that chemical analysis alone does not positively determine the feeding value.' My experience in regard to its feeding value, not from a scientific point of view but from actual results, is as follows. I have two pieces of ground, one upland, the other lowland. The upland hay consisted of timothy, red-top, etc., and was cut in good season about the 10th of July, and got in in good condition. The swamp hay was cut in the middle of August and a portion of it got wet. It consisted of ferns, bog hay, red-top and some willows [which last the cows did not eat however]. The yield of milk from 48 cows on the good hay was about 160 quarts per day while from the bog hay, fern, etc., it was about 180 quarts per day. The other feed, bran 4 pounds, meal 6 pounds per day was the same in both cases."

Undecorticated Cotton Seed Meal as a Cattle Food.

A sample of this article sent to the Station with the inquiry whether it was sufficiently decorticated to be a safe food, was submitted to Mr. J. J. Webb of Hamden and after receiving his opinion the following answer was sent:—

"The cotton seed meal received from you was submitted to Mr. Webb who has had considerable experience in feeding cotton seed meal to milk cows. He says in regard to it, 'I can see no reason on account of its not being thoroughly decorticated why it should not be a safe food. I fed undecorticated meal for some three winters and discovered no ill effects from it on my cows. Since then I have fed thoroughly decorticated meal and abortions taking place, I was led to suspect that the cotton seed meal was the cause.' It is a fact that many English stock-feeders prefer the undecorticated to the decorticated meal, and claim it is far less likely to cloy the cattle. This may be due to the fact that undecorticated meal is a less concentrated feed than the other or there may be something in the hulls which either medicinally or mechanically helps the digestion."

FIELD EXPERIMENT WITH PHOSPHATES.

Last spring it was proposed to make field experiments to test the relative value of certain phosphates for the corn crop. The land owned by the Station is unsuitable for this purpose because phosphates do not sensibly increase its productiveness, as has been demonstrated by four years' experience. Some years ago Mr. Charles Fairchild of Middletown and Mr. W. I. Bartholomew of Putnam, both proved by a series of field experiments, proposed by Prof. Atwater of Wesleyan University and carried out by them with great skill and care, that their land was strikingly benefited by phosphates, and on this account each of these gentlemen was asked to undertake for the Station the care of an experiment. Mr. Fairchild assented at once and the details of the plan were being arranged when they were interrupted by his sudden death—which was a serious loss to the farming interest of this State.

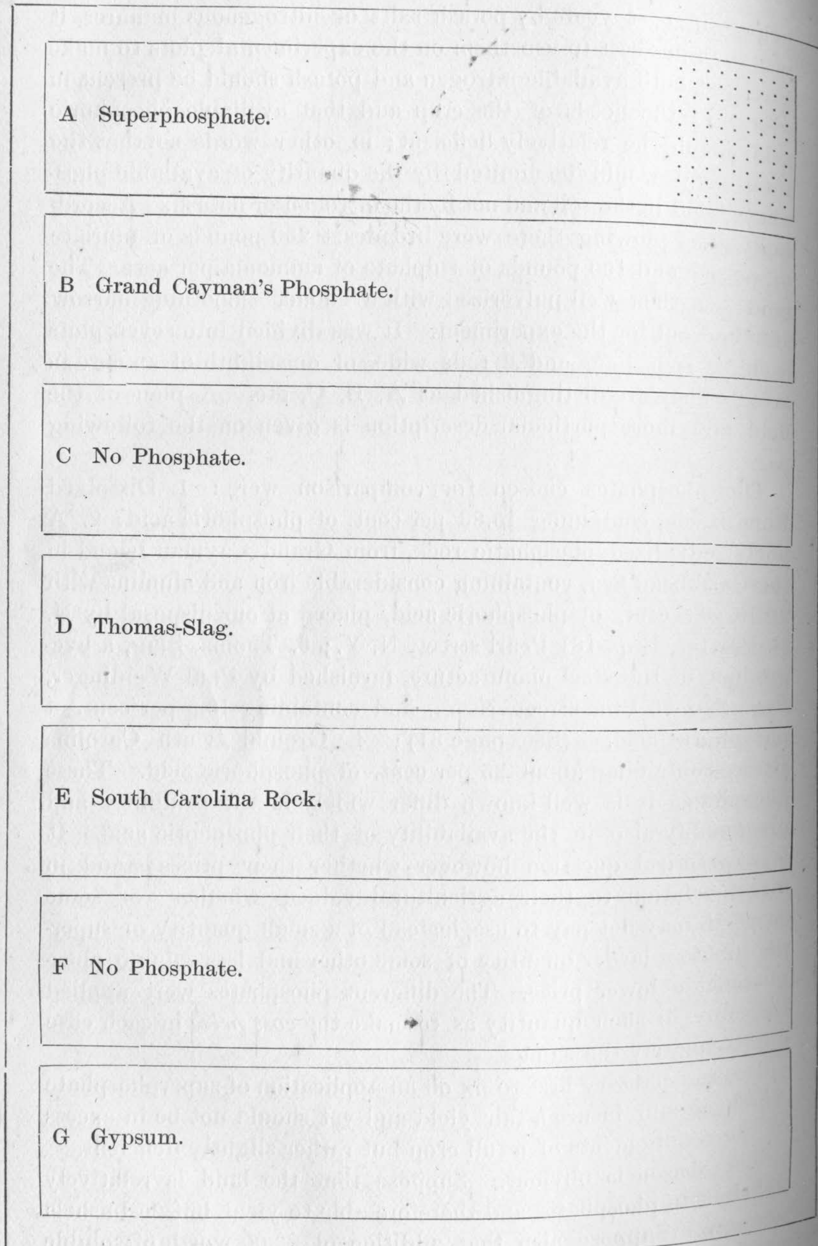
Our first letter to Mr. Bartholomew was lost in the mail which occasioned delay, but having finally secured his coöperation the Station was able to get the fertilizers delivered in time for planting on the 24th of May.

The land used for the experiment was high, gently sloping to the southwest. The soil was a dark loam, moist, with clayey sub-soil. The fall before, it had been sown to rye which was badly winter-killed. Though land in the same field had not been helped in past years by potash salts or nitrogenous manures, it was thought best to use them on the experimental plots to make sure that both available nitrogen and potash should be present in excess of the needs of the crop and that available phosphoric acid should be relatively deficient; in other words so that the total yield would be limited by the quantity of available phosphoric acid in the soil and not by the nitrogen or potash. Accordingly after plowing there were broadcast 200 pounds of muriate of potash and 100 pounds of sulphate of ammonia per acre. The land was then well pulverized with a Thomas smoothing harrow and laid out for the experiment. It was divided into seven plots each 10 rods long and 2 rods wide, or one-eighth of an acre in area. They are distinguished as A, B, C, etc. A plan of the field and more particular description is given on the following page.

The phosphates chosen for comparison were: 1. Dissolved Bone Black, containing 15.83 per cent. of phosphoric acid; 2. A finely pulverized phosphatic rock, from Grand Cayman Island in the Caribbean Sea, containing considerable iron and alumina with 29.49 per cent. of phosphoric acid, placed at our disposal by N. B. Powter, Esq., 181 Pearl street, N. Y.; 3. Thomas-Slag, a bye-product of the steel manufacture, furnished by Paul Weidinger, Esq., No. 76 Pine street, N. Y., and containing 19.5 per cent. of phosphoric acid. (See page 31); 4. Ground South Carolina Rock, containing about 25 per cent. of phosphoric acid. These phosphates it is well known differ widely in the solubility and presumably also in the availability of their phosphoric acid. It is a practical question however whether their prices stand in direct relation to their agricultural value; whether for some crops it may not pay to use, instead of a small quantity of superphosphate a larger quantity of some other and less soluble phosphate at a lower price. The different phosphates were applied therefore in such quantity as to make the *cost price* in each case approximately the same.

It was necessary first to fix on an application of superphosphate which should insure a fair yield and yet should not be in excess of the requirements of a full crop but rather slightly deficient.

The reason is obvious. Suppose that the land is relatively deficient in phosphates and therefore able to yield but 25 bushels per acre. Suppose also that addition of $3.00 worth of soluble phosphoric acid (superphosphate) would remedy the deficiency



The plots are 2 rods wide and 10 rods long and contain one-eighth of an acre each. The hills of corn are one-fifth of a rod apart each way and the outside hills are one-tenth of a rod from the edge of the plot. Between the plots are spaces one-fifth of a rod wide and in the middle of each space is a single row of potatoes. The whole ground under experiment is surrounded by a double row of potatoes.

and make the crop 50 bushels. Now if $2.50 worth of soluble phosphoric acid is added, this will nearly but not fully meet the requirements of the crop, giving a yield of perhaps 45 bushels and if various phosphates be compared together, those nearly or fully able to feed the crop, will show an increased yield, up to 50 bushels.

If on the other hand $3.50 worth of superphosphate were used, the yield would still be 50 bushels, while other phosphates, though able to feed a larger crop, and more economical, could not show a better effect. Neglect to sufficiently regard this point often leads to quite false conclusions from the results of field experiments.

Experiments made by Mr. Bartholomew in past years* with 51, 25½ and 17 pounds of phosphoric acid per acre on land in the same field, had yielded 2900 pounds, 2650 pounds, and 2330 pounds of sound field-cured ears respectively. It was fair to suppose then that 40 pounds of phosphoric acid especially in connection with a full supply of potash and nitrogen would not be in excess of the needs of the crop. Therefore this quantity was taken as the standard and a quantity of superphosphate was used on one-eighth of an acre plot which would furnish one-eighth of 40 or 5 pounds of phosphoric acid. The plots were arranged as follows:

	Costing	Containing Phosphoric acid.	Ton price.
Plot A had 32 lbs. Dissolved Bone Black,	42 cts.	5.1 lbs.	$26.00
" B " 56 " Grand Cayman's Phosphate,	"	16.5 "	15.00†
" C " No phosphate.			
" D " 67½ " Thomas-Slag,	"	13.2 "	12.50†
" E " 70 " Ground So. Carolina Rock,	"	17.5 "	12.00
" F " No phosphate.			
" G " 16.9 " Gypsum.			

Contiguous to these plots there was another, H, which received the same quantities of nitrogen and potash as A, but twice as much superphosphate. Another plot was measured off at harvest in Mr. Bartholomew's large field, containing one-eighth of an acre and 500 hills. This land was inverted sod and had received 15 loads of stable manure to the acre and bone dust in the hill besides. It was selected because it appeared to be the heaviest corn in the field. This was called plot X.

It was designed that Plots C and F with no phosphates should show the natural capacity of the land to supply phosphoric acid to

* Report of Connecticut Board of Agriculture, 1877, pages 357 and 358.

† f. o. b. New York.

the crop. To Plot G was applied a quantity of plaster containing as much sulphuric acid as existed in the superphosphate on Plot A. All the fertilizers were carefully weighed out and bagged at the Station and shipped by freight to Mr. Bartholomew. The phosphates were applied in the hill and the corn was planted on May 24th. The week following, after a gentle rain, dried blood was broadcast at the rate of 100 pounds per acre. It had been delayed on the road and did not come in time to be spread with the other fertilizers. The corn was planted in hills about 3 feet and 3 inches apart each way, making 10 rows or 500 hills in each plot. The seed was Rhode Island White Cap, a flint corn with small ears eight rowed and plump. Two ears on a stalk are rare. It came up well and was thinned at hoeing time to five stalks to a hill. One month after planting the stand on Plot A was decidedly taller and heavier than on the other plots which appeared nearly uniform in these respects. On the 10th of August the following notes were made by Dr. Jenkins who then examined the field.

"Plot A looks nearly as well as other parts of the field which have had 15 loads of stable manure to the acre and bone dust in the hill. It is decidedly the best of the plots in appearance. The corn is more mature, all the anthers have fallen and some tassels are already crisp. The tassels are well developed, having 8–15 side branches.

B and D look about alike. Not as large stalks as A. Anthers still hanging, and tassels not as large as on A.

C is very poor. The corn is not as tall as on those just named, the silk is green, pollen not all fallen, and tassels very imperfectly developed, consisting of a single upright stalk and only one, two or three side branches.

E looks rather better than C and F but not as well as the rest.

G looks perhaps a little better than C and F. There have lately been very severe rains which washed and somewhat gullied the field which slopes gently from A to G, and G *may* have been benefited by this wash, though I doubt it. The whole piece is very accurately laid out, the hills are regular, each of five stalks, very few defective hills."

The year was rather more than commonly good for raising corn, through August and early September particularly, and plots B and D improved very much in appearance. The corn was cut and stacked on the 20th of September and on the 13th

and 14th of October it was husked by Mr. Bartholomew's workmen and weighed by Dr. Jenkins.

A weighed portion of the corn on the cob was taken to the Station in order to determine the relation of kernel to cob as well as the dry weight of each. The weights of the field-cured crop are as follows:

WEIGHTS IN POUNDS OF THE FIELD-CURED CROPS.

Plot	Sound Corn on the Cob.	Soft, Immature Corn on the Cob.	Corn Stalks, Leaves & Husks.	Total Weight.
A, Superphosphate ------	479	108	472	1059
B, Grand Cayman's ------	469	102	559	1130
C, No Phosphate -------	319½	178	465½	963
D, Thomas-Slag ---------	463½	90½	494	1048
E, So. Carolina Rock ----	394	105½	459½	959
F, No Phosphate --------	343½	140	459½	943
G, Plaster --------------	376	113	456	945
H, Superphosphate, double quantity ----------	----	----	----	1045½
X, ------------------	462	65	545	1072

In examining the results it will be noticed:

1st. A fair yield was got on the plots A, B, D, H and X, which had received applications of phosphates. The highest yield, on Plot A, is 479 pounds of sound corn on the cob, or 3832 pounds per acre. Allowing one-sixth for cob,* we have 3194 lbs. of shelled corn, or 57 bushels per acre of field-cured corn, if we reckon 56 pounds to the bushel. Field-cured corn, however, will weigh more than 56 pounds per bushel. From the number of baskets of ears at harvest Mr. Bartholomew reckoned the yield at from 45 to 50 bushels of shelled corn per acre.

2d. It also appears that the land was suited to the experiment because in each case the crop was notably increased by the use of phosphate.

3d. Before comparing the effects of the different phosphates it is necessary to inquire whether on Plot A phosphoric acid was applied in excess of the requirements of the crop,—whether there was more phosphoric acid in the soil than the crop could use. If so, then a close comparison cannot be made between the superphosphate and the other phosphates.

It is seen that the total yield on plot H, with a double quantity of superphosphate, is 1045½ pounds, rather less than on plots

* The quantity found by actual trial.

A, B and D. The weight of sound corn on X also is rather less than on plots A, B and D, and the total weight of crop is less than on B. It seems clear then, that the yield on A was about all that could be got out of the land this year, and with this variety of seed, and that the quantity of superphosphate was either sufficient for the crop production or was in excess of it.

It should be said that the corn at harvest time *looked* a little heavier and ranker on plot X than on A, and that A *looked* better than B or D, but this appearance was not borne out by the weighing. The considerations already referred to in regard to the effects of phosphates in past years, the slightly higher yield of sound ears on A, together with the general appearance of the crop, leads us to conclude that phosphoric acid on A was not in any considerable excess, but was used in just about the maximum quantity for profit.

4th. Proceeding to a discussion of the results, it appears that the total crop on the plots which had no phosphate was nearly alike and averaged 953 pounds. There was a wider difference in the yield of sound corn (24 pounds.) This was in part due to the difficulty on these plots, not experienced on the others, of making a fair separation of "sound" ears and soft and immature ears. Most of the corn was inferior, but the average yield was 331½ pounds of sound ears. If we call the yield on the no-phosphate plots 100, the yields on the other plots will be as follows:

	Total Crop.	Sound Ears.
No-phosphate	100	100
A, Superphosphate	111	144
B, Grand Cayman's	119	141
D, Thomas-Slag	110	140
E, So. Carolina	101	118
G, Plaster	99	113
H, Double quantity superphosphate	109	—
X, Stable manure and bone dust	112	139

If we deduct from A the increased yield of ears due to gypsum (13) which is shown by G, the comparative yield of sound ears in A is 131.

The difference in total crop is not striking though there is a decided gain over the no-phosphate plots. Where phosphates were used the largest gain was in the weight of the sound ears.

South Carolina Rock showed itself decidedly inferior to the other phosphates, but the Thomas-Slag and the Grand Cayman's Phosphate produced very nearly the same effect on the crop as was produced by a quantity of superphosphate equivalent to them in cost. This is a point which is of great importance and deserving of further study. A single series of experiments is by no means decisive. The season was particularly good for corn raising and this fact probably was to the advantage of plots B, D and E, as compared with A, because A grew fastest and matured soonest, and in event of a cold August or an early frost, would probably have yielded much better than the others. The general effect of phosphates is to hasten ripening, and the more available they are, the greater will be this effect. This season, however, was so favorable that both the Thomas-Slag and the Grand Cayman's Phosphate yielded all the phosphoric acid which the crop required.

There is another consideration which is in favor of these undissolved phosphates. In the following table is given: 1st, The total quantity of phosphoric acid applied in each case reckoned on an acre; 2d, The quantity removed by the crops harvested, as determined by analysis, and 3d, The quantity still remaining in the soil.

Plot.	Applied. Lbs.	Removed by crop. Lbs.	Remaining in the soil. Lbs.
A	40.6	23.9	16.7
B	132.2	24.5	107.7
D	105.3	23.0	82.3
E	140.0	21.1	118.9

There is every reason to suppose that a part, at least, of the phosphoric left in the soil is as available as that which was removed by the crop and will come to use another year.

This subject is worth further consideration and experiment.

In conclusion, our thanks are due to Mr. Bartholomew for his accuracy, care and skillful management of the experiment which could not have been more successfully carried out at the Station and under our constant supervision.

CONTRIBUTIONS TO THE CHEMICAL STATISTICS OF THE INDIAN CORN CROP.

In case of most cultivated field and garden plants, data are at hand from which can be calculated with fair accuracy the quantities of vegetable substance of the various kinds which are produced upon an acre, as well as the amounts of ash-ingredients and nitrogen withdrawn from the soil by the crop.

The numerous analyses which supply these data have mostly been made in Germany and Austria where maize is not cultivated except in the southern districts of those countries and there more as forage than for the seed grain.

As a consequence very few statistical analyses of the mature maize plant in all its harvested parts are on record and therefore the opportunity furnished by the field trials just described was taken advantage of to enlarge our knowledge in this respect.

Dr. Jenkins carefully sampled the field-cured crop on Plot X, and full analyses of the several kinds of agricultural material thus secured, are here placed on record.

The Sound corn and cob from one-eighth of an acre weighed 462 pounds. A fair sample weighing 10,200 grams (about 22½ pounds) was air-dried in the laboratory and shelled. The shelled corn weighed 6,215 grams and the cob 1,005 grams. The ratio of cob to corn is 1 : 6·18.

The Soft and immature corn and cob ("nubbins") from one-eighth of an acre weighed 65 pounds. A fair sample, weighing 4,235 grams (about 9⅓ pounds) was air-dried and shelled. The shelled corn weighed 2,500 grams and the cob 530 grams. The ratio of cob to corn is 1 : 4·72.

The field-cured Stalks (including leaves and husks) from one-eighth of an acre weighed 545 pounds. The stalks from six stacks or shooks were cut into two-inch pieces in a feed cutter, thoroughly mixed and 9,300 grams (20½ pounds) of the mixture were dried in the laboratory at a gentle heat. After coarse grinding a sub-sample of 685 grams was finely ground and allowed to stand for 24 hours exposed to the air. It then weighed 734 grams and was preserved in a tight bottle for analysis.

The samples thus prepared were analyzed with the results that follow:—

The statements giving the per cents of the several ingredients or classes of ingredients that commonly serve as the basis of computing food-values are termed *proximate analyses*. Besides these, are also given detailed *ash-analyses*.

Proximate Analyses of the Different Parts of the Maize Crop, Air-dry. Per cent.

	Sound Corn. (In the ear.) Kernel.	Sound Corn. (In the ear.) Cob.	Soft Corn. (In the ear.) Kernel.	Soft Corn. (In the ear.) Cob.	Stalks.
Water	8.71	7.28	9.43	7.50	8.40
Ash*	1.23	1.39	1.32	2.00	6.26
Albuminoids†	11.06	2.00	10.44	2.81	6.93
Fiber	1.07	33.24	1.32	31.93	29.75
Nitrogen-free Extract‡	72.28	55.49	72.50	55.20	47.08
Fat (Ether Extract)	5.65	.60	4.99	.56	1.58
	100.00	100.00	100.00	100.00	100.00

It is noticeable, in contrasting the sound with the soft corn, that while the per cent. of albuminoids in the kernels of the former is somewhat greater than in those of the latter, in the cob the relation is reversed. A similar compensation is seen in case of fiber; the soft kernels contain relatively more than the sound, but the soft cobs less. These differences stand connected with the maturing process. The sound, i. e., ripe corn is, pound for pound of dry matter, somewhat more nutritious than the soft. The soft corn in air-drying also retains a little more water than the sound.

Composition of the Different Parts of the Maize Crop, Field Cured. Per cent.

	Sound Corn. Kernel and Cob.	Soft Corn. Kernel and Cob.	Stalks.
Water	35.25	34.99	48.65
Ash	.89	1.03	3.50
Albuminoids	6.93	6.51	3.89
Fiber	3.93	4.77	16.69
Nitrogen-free Extract	49.50	49.69	26.41
Fat (Ether Extract)	3.50	3.01	.88
	100.00	100.00	100.00

* Free from charcoal, carbonic acid and water.

† More correctly nitrogen reckoned as albuminoids. Amide-nitrogen, etc., are included.

‡ Starch, sugar, gum, and similar carbhydrates reckoned by difference.

This statement is derived from the foregoing analyses by calculation, the ascertained loss of water in passing from the field-dry to the air-dry (or more correctly house-dry) state and the proportions of kernel to cob, being important factors in the reckoning.

The sound corn and soft corn in the ear, field-cured, have very nearly the same per cent. of water. The soft corn has almost half a per cent. less of albuminoids as well as of fat than exists in the sound corn, and eight-tenths of a per cent. more fiber. This inferiority is in part due to the greater proportion of cob to kernel in the soft corn.

Composition of the Ash of the Different Parts of the Maize Crop. Per cent.

	Kernels, of Sound Corn.	Kernels, of Soft Corn.	Cob, of Sound Corn.	Cob, of Soft Corn.	Stalks.
Potash (K_2O)	30.84	30.82	61.16	58.49	39.28
Soda (Na_2O)	.68	.72	.75	.97	.81
Lime (CaO)	.61	.78	1.44	2.02	8.02
Magnesia (MgO)	15.11	14.30	2.28	3.31	3.43
Oxide of Iron (Fe_2O_3)	trace	trace	.10	.14	.83
Sulphuric Acid (SO_3)	.78	1.68	2.59	3.70	3.18
Phosphoric Acid (P_2O_5)	48.64	47.71	4.73	6.22	4.75
Chlorine	.14	.28	4.74	6.32	8.38
Silica and Sand (by difference)	3.23	3.77	23.30	20.10	33.21
	100.03	100.06	101.09	101.27	101.89
Deduct Oxygen equivalent to Chlorine,	.03	.06	1.09	1.27	1.89
	100.00	100.00	100.00	100.00	100.00
Per cent. of Ash	1.23	1.32	1.39	2.00	6.26

Of the total quantity of ash in the cob, nearly or quite three-fifths consists of actual potash. In the cob the potash is probably chiefly combined with organic acids and in the ash remains as carbonate. These facts justify the common impression that cob-ashes are particularly valuable for soap-making or for fertilizing purposes.

The ash of the stalks has a higher per cent. of potash than the kernel. The per cent. of phosphoric acid in the stalks is small, about like that of the cob.

Nearly half the ash of the kernel consists of phosphoric acid, which is mostly combined with potash and magnesia, so that we may say the ash of the seeds of maize, as of other cereal grains, is nine-tenths or more phosphates of potash and magnesia.

Composition of the Field-Cured Maize Crop. Pounds per Acre.

	Sound Corn. Kernel.	Sound Corn. Cob.	Soft Corn. Kernel.	Soft Corn. Cob.	Stalks.	Total.
Water	1303		182		2119	3604
Ash	27.7	5.1	4.1	1.3	153.1	191.2
Albuminoids*	249.0	7.3	32.1	1.8	169.7	459.9
Fiber	24.1	121.1	4.1	20.8	727.7	897.6
Nitrogen-free Extract	1627.3	202.1	222.4	35.9	1151.9	3239.6
Fat (Ether Extract)	127.2	2.2	15.3	.4	38.7	183.7
Total	3696		520		4360	8576.0

From this statement it appears that more than a third of the most valuable food-ingredient of the crop, namely the albuminoids, was contained in the stalks; about the same relative amount of the nitrogen-free extract and about one-fifth of the fat was also found in the stalks.

The food-value of maize stalks is generally recognized, though they are often used carelessly, being thrown into the barnyard to be picked over by the cattle and then worked into the manure. As far as the chemical composition of their dry matter goes they compare very favorably with timothy or meadow hay, as the following statement shows:

Composition of the Dry Matter of Field-Cured Corn-Stalks, Timothy Hay and Meadow Hay of Average Quality.

	Corn Stalks.	Timothy.	Meadow Hay.
Ash	6.83	4.58	5.57
Albuminoids	7.57	6.74	7.38
Fiber	32.47	33.82	36.79
Nitrogen-free Extract	51.40	52.50	47.85
Fat	1.73	2.36	2.41
	100.00	100.00	100.00

* More properly nitrogenous matters reckoned as albuminoids.

ASH-INGREDIENTS AND NITROGEN IN THE MAIZE CROP. (Pounds per acre.)

	Sound Corn. Kernel.	Sound Corn. Cob.	Soft Corn. Kernel.	Soft Corn. Cob.	Stalks.	Total.
Potash	8.5	3.2	1.3	.8	60.2	74.0
Soda	.2	trace	trace	trace	1.2	1.4
Lime	.2	.1	trace	trace	12.3	12.6
Magnesia	4.2	.1	.6	trace	5.3	10.2
Oxide of iron	trace	trace	trace	trace	1.3	1.3
Sulphuric Acid	.2	.1	.1	.1	4.9	5.4
Phosphoric Acid	13.5	.2	1.9	.1	7.3	23.0
Chlorine	trace	.2	trace	.1	12.8	13.1
Silica and Sand	.9	1.2	.2	.2	50.9	53.4
	27.7	5.1	4.1	1.3	156.2	194.4
Deduct oxygen equivalent to chlorine	----	----	----	----	3.1	3.2
Total	27.7	5.1	4.1	1.3	153.1	191.2
Nitrogen	39.8	1.2	5.1	.3	27.2	73.6

From this table it appears that more than four-fifths of the potash taken from the land by this corn crop, one-third of the phosphoric acid and more than one-third of the nitrogen were contained in the stalks.

The demand of this crop upon the soil for nitrogen and potash removed in the harvest was the same—74 lbs. per acre. The amount of phosphoric acid carried off was but 23 lbs.

It will be interesting here to compare these figures with the results of a similar investigation made at the New Jersey station in 1883.* In this experiment a variety of Dent corn was planted in hills 3½ feet apart each way on land heavily manured. It yielded 68.3 bushels of shelled corn and 2.2 tons of dried stalks per acre. The total yields per acre were as follows:

	Kernels.		Cobs.		Stalks.		Total.		Entire crop reckoned on 1000 lbs. of dry substance.	
	N. J.	Ct.	N. J.	Ct.	N. J.	Ct.	N. J.	Ct.	N. J.	Ct.
Ash	55.4	31.8	12.6	6.4	193.9	153.1	261.9	191.3	34.5	38.5
Albuminoids	328.9	281.1	18.4	9.1	165.3	169.7	512.6	459.9	67.4	92.5
Fiber	69.2	28.2	269.2	141.9	1313.0	727.7	1651.4	897.8	217.2	180.6
Nitrogen-free Extract	2602.7	1849.7	483.6	238.0	1895.3	1151.9	4981.6	3239.6	655.3	651.5
Fat	149.5	142.5	2.8	2.6	42.8	38.7	195.1	183.8	25.6	36.9
	3824.0	2333.3	950.0	398.0	4041.0	436.0	7602.6	4972.4	1000.0	1000.0
Nitrogen	52.7	43.9	2.9	1.5	26.3	27.2	81.9	72.6	10.8	14.6
Phos. Acid	27.2	15.4	2.6	.3	15.0	7.3	44.8	23.0	5.9	4.6
Potash	15.3	9.8	4.8	4.0	33.1	60.2	53.2	74.0	7.0	14.9

*Report of the New Jersey Agricultural Experiment Station, 1884, p. 127.

In 1000 lbs. of dry matter the Connecticut crop contained considerably more albuminoids and fat and correspondingly less fiber than the New Jersey crop, the proportion of non-nitrogenous extract (i. e., starch, sugar and the like), being nearly the same in both. It is remarkable that the Connecticut crop contained more than twice the proportion of potash that existed in the New Jersey crop. These striking differences as well as the widely unlike total yield of grain and stalks, stand related, no doubt, largely to difference in the varieties of the corn that were the subjects of trial, and in a less degree to difference of climate and season as well as to quality of soil and quantity of fertilizers.

Indian corn exhibits a very great diversity of development according to external conditions and the large dent varieties may be expected to differ greatly from the smaller flint sorts in their requirements as they do in their dimensions of stalk and ear.

The differences in percentage composition of the kernel, however, will be comparatively slight.

Investigations at the New Jersey Experiment Station have shown:

1st. That a larger quantity of digestible food may be obtained from an acre of field corn than from an acre of fodder corn, *if the stalks are fed without waste.*

2d. That the digestible carbhydrates (digestible fibre and nitrogen-free extract together) of corn meal and corn stalks when fed to cows do not differ in their effect on the quantity of milk produced.

3d. That the substitution of corn ensilage for corn meal and corn stalks does not affect the flow of milk.

4th. It was demonstrated that corn stalks, cut and finely shredded, were eaten as clean and were as valuable feed as hay.

RELATIVE FEEDING-VALUE OF THE LEAVES, HUSKS AND STRIPPED STALKS.

No data were gathered on this point for the flint corn raised by Mr. Bartholomew. Later in the season we obtained from Mr. J. J. Webb, of Hamden, a sample of the stover which he was then feeding. The variety was "White Edge Dent." This stover is stacked near his barns in stacks 15 feet in diameter, and 12 to 15 feet high. These apparently suffer damage from the weather only to a depth of a very few inches. As needed, the stover or fodder corn is taken to the barn. The sample which we took, though not sensibly damp, contained, as the analysis shows, more water by 20 per cent. than field-cured stover usually contains. It had, however, a bright, fresh color and no trace of musty or moldy smell. The leaves and husks were separated completely, and the stripped stalks were cut in two at the sixth joint from the butt, so that the two pieces were about equal in length.

The weights of the several parts in the fresh state, the weights of their dry matter and the percentage of the total dry matter which each part contained, are as follows:

	Fresh (ounces.)	Dry Matter (ounces.)	Per cent.
Leaves	153.0	85.6	32.
Husks	124.1	59.6	22.
Upper half of stalks	57.3	31.1	12.
Lower " "	267.6	91.1	34.
	602.0	267.4	100.

The analyses of these parts, both in their fresh and water-free condition, are given below.

ANALYSES OF DIFFERENT PARTS OF STOVER, FIELD-CURED.

	Leaves.	Husks.	Upper half of stalks.	Lower half of stalks.
Water	44.02	52.00	45.67	65.94
Ash *	5.04	2.07	2.46	1.22
Albuminoids	4.91	2.71	1.88	1.10
Fiber	17.98	16.79	22.57	15.03
Nitrogen-free Extract	27.28	25.82	26.76	16.23
Fat	.77	.61	.66	.48
	100.00	100.00	100.00	100.00

ANALYSES OF DIFFERENT PARTS OF STOVER, WATER-FREE.

	Leaves.	Husks.	Upper half of stalks.	Lower half of stalks.
Ash *	9.00	4.30	4.52	3.60
Albuminoids	8.77	5.66	3.45	3.24
Fiber	32.09	34.98	41.54	44.19
Nitrogen-free Extract	48.76	53.78	49.28	47.55
Fat	1.38	1.28	1.21	1.42
	100.00	100.00	100.00	100.00

The following table calculated from the foregoing shows the quantity of each nutrient in each part of 1000 pounds of *dry* (water-free) stover:

* Free from char, water and carbonic acid.

	Leaves.	Husks.	Upper part of stalks.	Lower part of stalks.	Total.
Ash	28.8	9.6	5.3	12.3	56.0
Albuminoids	28.1	12.6	4.0	11.0	55.7
Fiber	102.7	78.0	48.4	150.5	379.6
Nitrogen-free Extract	156.1	119.7	57.3	162.1	495.2
Fat	4.4	2.8	1.4	4.9	13.5
	320.1	222.7	116.4	340.8	1000.0

In this experiment with stover from Dent corn it appeared:

1st. About one-third of the dry matter of the stover was in the leaves, one-third in the lower half of the stalks and one-third in the husks and upper half of the stalks.

2d. The leaves, as was to have been expected, were far richer in mineral matter and albuminoids than any other part and had less fiber. The husks in chemical composition stood next in value to the leaves. The upper part of the stripped stalks did not differ greatly in composition from the lower part.

3d. One-fifth of the albuminoids, one-third of the nitrogen-free extract (starch, gum, etc.), and ether extract (fat), and between one-third and one-half of the fiber of the stover were in the lower half of the stalks.

There is no reason to believe that there is any great difference in the digestibility of the different parts of stover, but to make the stalks acceptable to cattle they must be cut, crushed or shredded. On some farms it will pay to do this, on others perhaps not. The observations above cited may be serviceable in helping to a decision in particular cases. Mr. Webb cuts his fodder and field-corn in inch pieces with an ensilage cutter, and his cattle eat it, leaving only very little.

ON THE

DETERMINATION OF NITROGEN IN FERTILIZERS CONTAINING NITRATES BY JODLBAUER'S MODIFICATION OF THE KJELDAHL METHOD.

By E. H. Farrington, M.S.

The Kjeldahl method has proved itself a very convenient and accurate method of determining nitrogen in fertilizers and agricultural products which are free from nitrates.

Jodlbauer (Chem. Centralb. **17**, 433 and Fres. Zeitschr. **26**, 1887, 92) has proposed a modification of the method which renders it applicable to substances containing nitrates as well as to pure nitrates. This modification is essentially as follows:

.2–.5 grm. of a pure nitrate, or a corresponding quantity of a substance containing nitrates is introduced into a flask with 20 cc. concentrated sulphuric acid and 2.5 cc. of phenol-sulphonic acid,—prepared by dissolving 50 grams of crystallized phenol in enough concentrated sulphuric acid to make the volume 100 cc.—and 2–3 grams of zinc dust and 5 drops of platinum chloride solution which contains .04 grams platinum in 1 cc. are also added. After 4 hours boiling in the usual way the liquid is colorless and ready for further treatment according to Kjeldahl's method. By adding to 200 grams phosphoric anhydride enough oil of vitriol to make the volume 1000 cc. and using 20 cc. of this acid instead of pure sulphuric acid, the time required for boiling is reduced one-half but the glass flasks are rapidly attacked.

Stutzer and Reitmair (Rep. Anal. Chem., **7**, 4–6) find that Jodlbauer's method fails to yield accurate results if the acid acts on compact masses of the substance. They obtain good results by proceeding as follows: One gram of substance is introduced into the flask with 25 cc. of water which is evaporated in an air bath and leaves the nitrates more uniformly distributed. 50 cc. of sulphuric acid containing 20 grams of phenol per liter are added and allowed to stand a few minutes. 2–3 grams of zinc dust are then added and one or two drops of mercury and the process is conducted from this point as usual.

In experiments with these methods at this Station it appeared that the digestion in the cold after adding the phenol-sulphonic acid, suggested by Stutzer and Reitmair, was very important.

Better results too were obtained, in the case of fertilizers, with the ordinary commercial 66° acid than with the so-called "chemically pure" acid or with an acid made still stronger by addition of fuming sulphuric acid. An objection to the use of "chemi-

Station No.	Condition of the Nitrogen.			Total Nitrogen found.		Differences.	
	As Nitrates.	As Ammonia.	Organic Nitrogen.	By Dumas' method.	By modified Kjeldahl-Jodlbauer's method.	Minus.	Plus.
1812	3.38	----	----	3.38	3.40	--	.02
1872	3.24	----	----	3.24	3.27	--	.03
1873	3.06	----	----	3.06	3.04	.02	--
1874	.82	1.06	.58	2.56	2.49	.07	--
1918	.74	----	2.45	3.21	3.16	.05	--
1930	1.61	1.55	.69	3.92	3.78	.14	--
1936	.52	.69	2.91	4.23	4.06	.17	--
1949	.67	.18	2.92	3.79	3.74	.05	--
1964	.42	----	2.68	3.06	3.12	--	.06
1968	.30	.65	2.97	3.97	4.06	--	.09
1969	.51	----	2.73	3.16	3.27	--	.11
1975	.30	----	2.55	2.85	2.89	--	.04
2008	1.37	2.59	1.41	5.43	5.32	.11	--
2009	.78	.60	1.16	2.58	2.50	.08	--
2011	.79	.91	1.92	3.58	3.65	--	.07
2013	.66	.55	1.11	2.32	2.15	.17	--
2014	.63	.05	1.73	2.48	2.34	.14	--
2027	.51	2.36	2.79	5.68	5.65	.03	--
2030	.62	1.06	2.31	3.98	4.00	--	02
2034	.45	.37	2.83	3.69	3.66	.03	--
2035	.61	1.85	1.66	4.08	4.16	--	.08
2036	1.14	1.29	1.51	3.95	3.93	.02	--
2041	.58	.09	2.49	3.16	3.01	.15	-
2050	.79	.51	3.26	4.47	4.26	.21	-
2051	4.15	----	.38	4.56	4.49	.07	--
2055	.54	2.69	1.42	4.48	4.65	--	.17
2056	.66	2.41	2.43	5.44	5.46	--	.02
2057	.83	1.87	1.94	4.61	4.66	--	.05
2068	3.81	----	1.90	5.76	5.65	.11	--
2070	.66	2.38	1.07	4.11	3.98	--	.13
2071	.39	----	2.32	2.72	2.69	--	.03
2074	.41	.57	1.85	2.83	2.82	.01	--
2089	3.93	----	1.38	5.34	5.28	.06	--
2090	2.85	----	1.03	3.89	3.87	.02	--

cally pure" acid of the trade lies in the fact that it usually contains so much sulphate of ammonia as to make the required correction too large to be satisfactory.

Thus 50 cc. of "chemically pure" acid contained .017 grams nitrogen.
50 cc. of fuming sulphuric " " .004 "
50 cc. of commercial, impure, 66° acid contained .0029 grams nitrogen.

I have found the following precautions and slight modifications to give very satisfactory results in fertilizer analysis.

1 gram of the fertilizer is digested in a flask with 50 cc. of a solution of 50 grams of crystallized phenol in one liter of commercial oil of vitriol of 66° B. This mixture is allowed to stand in the cold for half an hour with frequent shaking. To it are then added 2–3 grams of zinc dust, and .7 gram mercuric oxide. The contents of the flask are then heated gradually and boiled till colorless and subsequently treated according to Kjeldahl's directions.

In the preceding table are given all the results obtained by this method in comparison with results obtained by combustion of the same substances with copper oxide in the way described in the Reports of this Station for 1878 and 1879. The combustions with copper oxide were made by Mr. Winton, the determinations by the Kjeldahl–Jodlbauer method by myself.

An inspection of these results shows that in 68 per cent. of the cases, the difference between the two methods was not over 0.1 per cent. and in 88 per cent. of the cases not over .15 per cent. The greatest difference, No. 2050, was .21 per cent.

The plus differences are 14 in number, the minus differences 20. The average of the former is .066, of the latter .085. It is evident then that the two methods are about equally accurate.

NOTES ON THE DETERMINATION OF STARCH.

By A. L. Winton, Jr., Ph.B.

The determination of pure anhydrous starch in different varieties of commercial starch may be satisfactorily accomplished by heating the substance with dilute hydrochloric acid according to Sachsse's method, determining the dextrose thus formed by Allihn's method, and from the dextrose found, reckoning the starch.

It is claimed that direct heating of the substance with acid is not admissible in the case of potatoes, grains and other agricultural products, partly because cellulose also is in a measure converted into dextrose by acids and partly because the acid dissolves certain ash ingredients which would be afterwards precipitated by alkaline copper solution.

Several methods for separating the starch from such substances have been devised and it was with the view of learning how they compared with each other as regards accuracy and convenience that the following investigations were undertaken.

Allihn's Method for Determination of Dextrose.*

Since in all the methods for estimation of starch which I have tested with the exception of Asboth's the starch is converted into dextrose, it is of first importance that the method used for determining dextrose should be trustworthy and properly executed.

Allihn's directions are briefly as follows:

For preparing alkaline copper solutions, two solutions are made up.

Solution No. I. contains 173 grms. Rochelle salts and 125 grms. Caustic potash dissolved in water and made up to 500 cc.

No. II. contains 34.69 grms. crystallized copper sulphate dissolved in water and also made up to 500 cc.

60 cc. of alkaline copper solution prepared immediately before using by mixing 30 cc. No. I. and 30 cc. No. II. are heated just to boiling in a beaker of 300 cc. capacity over a lamp. To the boiling liquid 25 cc. of dextrose solution (containing not more than .25 grms. dextrose) are added and the heating further continued until boiling begins again. After the reduced copper suboxide has settled it is collected on a weighed asbestus filter, washed with cold water (at first by decantation) finally with alcohol and ether and dried at 100° C. The copper suboxide is reduced to metallic copper by heating to redness in a stream of dry hydrogen, and to prevent oxidation is cooled in the same gas. From Allihn's table the weight of dextrose, corresponding to the weight of copper, is found.

For an asbestus filter a Gooch crucible with a thick layer of asbestus may be used, although in my experience the filtering tubes described by Allihn are more convenient and retain the finely divided precipitate better. These are easily made from a piece of hard glass tubing 4 inches long and $\frac{2}{3}$ of an inch in diameter by drawing out one end to a small opening and slightly expanding the other. In the narrow portion of the tube a small platinum cone is fitted and a layer of asbestus $\frac{1}{2}$ inch deep is packed in with the aid of a suction pump and a glass rod.

* Jour. für Prak. Chem., **22**, 52. Fres. Zeit. für Anal. Chem., **22**, 448.

For reducing the copper suboxide the tube is attached by means of a perforated cork to the apparatus which provides a stream of dry hydrogen and after air has been expelled it is carefully ignited in a free flame and cooled before turning off the hydrogen.

In using the method, the following precautions are essential:

I. The solutions for preparing alkaline copper solution must be freshly made and never mixed until immediately before using.

II. After adding the dextrose solution the liquid is simply heated to boiling and *not longer*. 4 minutes boiling brings the result one per cent. or more high.

III. As soon as the precipitate has settled it is collected without further delay on the weighed filter.

IV. Care must be taken that the filter completely retains the precipitate. It is a good practice to let the washings stand for sometime so that if any of the copper suboxide has run through it may subside. In suspension it is hardly visible.

The above method gave me perfectly accurate results with pure, anhydrous dextrose and was used in all the determinations of dextrose which were made in the following investigation.

Action of Dilute Sulphuric Acid on Dextrose.

Since the methods of determining starch involve a treatment with dilute sulphuric or hydrochloric acid it is important to know whether the dextrose formed in the process is itself subsequently changed by the acid.

The experiments of both Allihn and Salomon seem to show that sulphuric acid is poorly adapted for the conversion of starch into dextrose.

The former in an elaborate series of experiments using .1, .2, .5, and 1 per cent. sulphuric acid, and heating under pressure at temperatures from 100° C. to 114° C. was not able under the most favorable circumstances to obtain more than 95 per cent. of the starch in the form of sugar.

Salomon finds the chief difficulty to be in the change into "humus-like" substances which dextrose undergoes on protracted heating with sulphuric acid. Owing to the formation of such substances the solution gradually darkens in color.

50 cc. of a solution of dextrose which contained 4.678 grms. of the pure dry substance after boiling 4 hours with 20 cc. of 5 per cent. sulphuric acid was found by him to contain but 4.446 grms. of dextrose, in other words but 95 per cent. of the original quantity. 5 per cent. sulphuric acid is, however, twice the strength of the acid ordinarily used for this purpose.

Prof. R. H. Chittenden (of Yale Univ.) has found that dextrose is not altered on boiling two hours with 2 per cent. sulphuric acid, still a modification of his method described further on in which the starch was first treated with saliva until the solution gave no reaction with iodine solution, then boiled two hours with 2 per cent. sulphuric acid, gave results which were 1 per cent. low.

Action of Dilute Hydrochloric Acid on Dextrose.

Four portions of pure anhydrous dextrose of about 2.5 grms. each were digested with 2 per cent. hydrochloric acid exactly as prescribed by Sachsse's method to be described further on (page 132) except that the time of heating was varied. After cooling, the acid was nearly neutralized with sodium hydrate, and dextrose determined by Allihn's method.

The following are the results:

	Time of Heating.	Per cent. of Dextrose.	Color of Solution.
I.	1 hour	100.24	Colorless.
II.	3 hours	100.22	Light straw.
III.	11 hours	96.85	Dark yellow.
IV.	17 hours	94.59	Dark brown.

The solutions which after one hour's heating still remained colorless and after three hours were but slightly tinged with yellow, on further heating soon began to darken in color.

No. I. and II. show that after three hours heating the dextrose remained practically unchanged, whilst on the other hand III. heated 11 hours was found to have lost 3.15 per cent., IV. heated 17 hours 5.46 per cent. of the original quantity of dextrose. From these experiments we conclude that the action of 2 per cent. hydrochloric acid on the dextrose as employed in Sachsse's method is not sufficient to appreciably affect the results. Heating longer than three hours brings the results low.

In order to have for experiment starch of known composition a quantity was prepared from potatoes and after being allowed to dry in the air was carefully bottled and used in all the following experiments. In this sample, water, ash, fiber and starch were determined by the methods used by Allihn* and Salomon† as follows:—

* Jour. f. Prak. Chem. 22-79. † Jour. f. Prak. Chem. 28-84.

Water: Two grams were dried to a constant weight at 120° C. in a stream of hydrogen.

Ash: The burning to ash was carried on in a muffle furnace at a heat below redness.

Fiber: The flocks which remained undissolved after converting the starch into sugar were filtered on a weighed filter, dried at 100° C. and weighed.

Starch: By Sachsse's method to be described immediately.

RESULTS OF ANALYSES OF POTATO STARCH.

	I.	II.	III.	Average.
Water	15.16	15.18	----	15.17
Ash	.63	.61	----	.62
Fiber	.01	.03	---	.02
Starch	84.55	84.37	84.69	84.54
				100.35

The most approved methods of determining Starch were next tested as follows:—

SACHSSE'S METHOD FOR DETERMINATION OF STARCH.

[Chem. Centralbl. 1877, p. 732.]

3 grms. of the air-dry substance are heated in a boiling water bath for 3 hours with 200 cc. water and 20 cc. of a 25 per cent. hydrochloric acid (Sp. gr. 1.125).

The flask is provided with a condenser consisting simply of a long tube ½ inch in diameter attached by means of a perforated rubber stopper. After cooling, enough sodium hydrate solution of known strength is added to nearly (but not quite) neutralize the acid and the liquid is made up to 250 cc. (or some other convenient volume) and an aliquot portion of 25 cc. used for estimating dextrose by Allihn's method already described.

The weight of dextrose multiplied by .9 gives the weight of starch, considering its formula to be $C_6 H_{10} O_5$. In the sample referred to, this method gave 84.54 per cent. of starch.

PROF. CHITTENDEN'S METHOD OF DETERMINING STARCH WITH USE OF SALIVA.

The details of this method which have been furnished us by Prof. Chittenden are as follows:—

3 grms. of the finely powdered substance are made into a paste of even thickness, with 400 cc. of boiling water. After cooling to 40° C. 15 cc. of filtered and neutralized saliva are added and the temperature kept at 40°* until a drop of the liquid gives no coloration with iodine solution.

For neutralizing the saliva .2 per cent. hydrochloric acid is added drop by drop until the reaction with delicate litmus paper is neutral (the diastatic action of normally alkaline saliva is increased by neutralizing it). An excess of acid must be avoided since .003 per cent. hydrochloric acid almost completely checks the action of the ferment.†

The soluble dextrine and maltose into which the starch has been completely changed, are separated from the insoluble matter by filtering.

The filtrate after concentration to 200 cc. is treated with hydrochloric acid precisely as in Sachsse's method and dextrose is determined by Allihn's method.

The following results on the potato starch of my preparation were obtained by this method.

	I.	II.	Average.
	84.45	84.85	84.65
By Sachsse's method	----	----	84.54

The advantage which saliva as a ferment in starch analysis has over the malt extract usually employed, is that it does not, like the latter, contain soluble carbhydrates which become converted during the process into dextrose.

When, however, a large number of determinations are to be made and it is impossible for the chemist to supply a sufficient quantity of saliva, malt extract must be used. In this case a blank analysis with the malt extract is made by the same process as the others and a correction made.

Malt extract is best prepared by treating 50 grms. of malt with 1000 cc. of water for 3 hours at 40° C. About 25 cc. of this extract are equivalent to 15 cc. of neutralized saliva.

The digestion of the substance in which starch is to be determined with this ferment solution is carried on at 50°–55° C.

To further illustrate the importance of limiting the heating with dilute hydrochloric acid to three hours, three portions of starch were treated by Chittenden's method exactly as described above except that the heating with acid was continued 17 hours.

* Studies from the Laboratory of Physiolog. Chem. Sheffield Scientific School, for the year 1884–1885, 121.

† Chittenden, l. c., p. 1.

The results were 3 per cent. low.

	I.	II.	III.	Average.
	81.15	81.88	80.93	81.32
By Sachsse's method	----	----	----	84.54

In the following trials a 2 per cent. sulphuric acid was substituted for a 2 per cent. hydrochloric acid. The solutions of starch in saliva were boiled gently over a Bunsen burner for 2 hours.

Although the color of the solution was quite dark the results are but 1 per cent. low.

	I.	II.	III.	Average.
	83.48	83.61	83.56	83.55
By Sachsse's method	----	----	----	84.54

Märcker's Earlier Method for Determination of Starch in Potatoes.

[Land. Versuchs. St. **25**–107.]

This method was used by Märcker in the analysis of a large number of samples of potatoes. From the results thus obtained he has prepared his tables for the rough estimation of the starch content of potatoes from the specific gravity of the tuber. This method has been extensively employed for the determination of starch in grains and feeding stuffs.

3 grms. of the finely pulverized air-dry potatoes are heated with 50 cc. of water for 4 hours at 135°–140° C. under pressure (3–4 atmospheres). After cooling to 90° the starch which has been converted into the soluble modification is separated from the insoluble matter by filtering with the aid of suction.

The filtrate is made up to 200 cc. and treated with hydrochloric acid as in Sachsse's method. After neutralizing the acid with sodium hydrate, 7–8 cc. of basic lead acetate are added to precipitate pectin substances, and the liquid is made up to 500 cc. and filtered through a dry filter. 200 cc. of the filtrate are made up to 250 cc. with 1 per cent. sulphuric acid and after the precipitated lead sulphate has settled, once more filtered through a dry filter and dextrose determined in 25 cc. of the filtrate.

For converting the starch into the soluble modification we have heated the substance, contained in a brass vessel, covered with a tightly fitting lid together with 50 cc. of water in a Müncke's steam digester.

In using this apparatus care must be taken not to allow the pressure to fall off after digestion so rapidly as to occasion mechanical loss from the violent boiling of the contents of the vessels.

Solution of basic lead acetate is prepared by boiling 155 grms. of lead acetate and 109 grms. litharge with 400 cc. of water and making the filtrate up to 500 cc.

Results obtained on the nearly pure potato starch agree with those by preceding methods.

	I.	II.	Average.
By Märcker's method	84.50	84.77	84.63
By Chittenden's method			84.65
By Sachsse's method	----	----	84.54

Märcker's Later Method for Determination of Starch in Grains and Potatoes.

[Chem. Zeit. ix, 319.]

[Reprinted Fres. Zeitschr. **24**, 617.]

3 grms. of the finely ground substance are heated with 50 cc. of water to 90° C. and after cooling to 65° mixed with 5 cc. cold malt-extract (50 grms. of malt extracted with 1000 cc. water). After digesting ½ hour (at 65° or better at 55°), 10 cc. of 1 per cent. tartaric acid solution are added and the mixture heated under a pressure of 3 to 4 atmospheres for ½ hour as has been described. When cooled to 65°, 5 cc. malt extract are again added and after ½ hour the insoluble portion is removed by filtration. The filtrate is heated on a boiling water bath 2½ hours with 15 cc. of 25 per cent. hydrochloric acid, and enough water to make a volume of 200 cc.

The acid is then nearly neutralized with sodium hydrate and dextrose is determined by Allihn's method. Märcker states that by this method a complete solution of the starch is effected without any appreciable decomposition of the dextrose.

In order to verify this statement and also to study the solvent action of tartaric acid under pressure, 4 portions of potato starch of 2.5 grms. each were weighed out into brass vessels.

I. and II. were treated exactly as has been described with ferment solution and tartaric acid except for reasons before stated 5 cc. of neutralized saliva were substituted for 5 cc. of malt extract.

III. was digested directly with 55 cc. of water and 10 cc. 1 per cent. tartaric acid. The treatment was the same as for I. and II. except that addition of ferment solution was omitted.

IV. was simply heated under pressure for ½ hour with 65 cc. of water.

All four were heated (without filtering) with hydrochloric acid as directed, neutralized with sodium hydrate, made up to 250 cc. and dextrose determined in 25 cc. From the dextrose the percentage of starch was computed.

I.	84.86
II.	84.47
III.	84.67
IV.	84.81

These results indicate that the conversion into dextrose was in each case complete.

After digestion with saliva in I. and II. the starch was only partially in solution, although the diastatic action of 5 cc. of saliva is greater than of 5 cc. of malt extract. The quantity of anhydrous starch in 2.5 grms. of potato starch is about the same as in 3 grms. of air-dry potatoes.

The object of this first digestion with ferment solution recommended by Märcker is apparently not to effect complete solution of the starch, but to remove the larger part of it so that tartaric acid may act more readily on that which may be enveloped in vegetable tissue.

In III. heated under pressure ½ hour with tartaric acid the solution of the starch was complete, whilst IV. heated in the same way with water alone was still milky from undissolved starch.

The addition of .1 grm. of tartaric acid shortens the time of heating necessary for effecting a complete solution of the starch.

The results obtained on pure potato starch by both of Märcker's methods and by Chittenden's method agree with those by direct conversion with acid according to Sachsse's method, and with the result got by difference where water, ash and cellulose were determined.

In each case the starch was brought into solution before the digestion with acid so that if insoluble matter had been present it could have been separated and in each case also the total amount of starch used was obtained finally in the form of dextrose.

Comparison of these Methods on Potatoes.

It seemed next desirable for the sake of comparative results to estimate the starch in a sample of potatoes by each of these methods. For this purpose a number of sound potatoes were cleaned, weighed, cut into thin slices and dried in a current of warm air. They were then ground rather coarsely, taking care to avoid loss, and after standing exposed to the air several days were again weighed and a subsample was taken and reduced to a fine meal, all of which passed through a bolting cloth.

This air-dry substance amounted to 24.5 per cent. of the fresh sample.

Duplicate portions of three grams of this air-dry potato-meal were treated as follows:

1. By Märcker's earlier method.
2. Same as 1, except that "pectin substances," etc., were not removed by precipitation with basic lead acetate.
3. By Märcker's later method.
4. By Chittenden's method.
5. By Sachsse's method without separating cellulose, which was filtered out in 1, 2, 3 and 4.

The solutions of dextrose were in each case made up to 250 c. c., and 25 c.c. was used for the determination.

Per cent. of Starch found in Air-dry Sample.

	I.	II.	Average.
1	67.05	66.52	66.78
2	68.60	67.98	68.29
3	69.78, 69.30	69.46	69.51
4	69.30	68.76	69.03
5	71.60	71.64	71.62

It is evident from 1 and 2 that basic lead acetate removes substances which reduce alkaline copper solution; in 2, 3, 4 and 5, however, this was purposely omitted, as probably the error in each case would be the same and would not alter the value of the results for comparison.

The results in 5, where the material was digested directly with hydrochloric acid without previous separation of cellulose, etc., are considerably higher than any of the others. These higher results were at first supposed to be due to the partial conversion of cellulose into dextrose by heating with hydrochloric acid. In order to ascertain whether this supposition was correct, the residues which had been separated in 2, 3 and 4, of which those from 2 and 4 had been dried at 100° and weighed, were soaked in water until soft, then ground to a pulp, and finally digested with two per cent. hydrochloric acid for three hours, neutralized, made up to 250 c.c. and the copper reduced by 25 c.c. was determined.

	Residues from Märcker's earlier method yielded—		Residues from Märcker's later method yielded—	
	Copper.	Equivalent to per cent. of Starch.	Copper.	Equivalent to per cent. of Starch.
Graham flour	.0015	----	.0000	----
Maize	.0010	----	.0017	----
Rice	.0002	----	.0008	----
Potatoes, 1st sample	.0010	----	.0022	----
	.0017	----		----
Potatoes, 2d sample	.0010		.0019	
	.0000	----	.0022	----
Beans	.0060	.92	.0073	1.11
Pepper	.0087	1.33	.0130	1.98

These results indicate that in determining starch, no appreciable error is introduced by omitting the separation of cellulose and other insoluble matters before digestion with hydrochloric acid in the case of graham flour, maize meal, rice and potatoes. In the case of beans and pepper there is a considerable quantity of some copper-reducing material produced by the action of acid on the insoluble matters. Whether this is due to hydration of cellulose does not appear. But in those materials in which *accurate* starch determinations are most desirable the insoluble matters yielded only a minute quantity of reducing substance when heated with acid.

As further evidence, a third sample of potatoes from an entirely different source was put through the process for separating cellulose according to Märcker's earlier method, and the residue digested with acid as before. In this case 12 grams of the air-dry substance was used, so that the 25 c. c. of the solution corresponded to 1.2 grams, or four times what had been used in preceding cases. The weight of reduced copper was but .0016 grams.

We therefore conclude that the simplest and in other respects the most satisfactory method for estimating starch in potatoes and cereal grains, is to digest the air-dry sample directly with a two per cent. hydrochloric acid and proceed in other respects as has been described.

Notes on Asboth's Method of Determining Starch.

[Repert. Anal. Chemie. No. 20. Translation in Analyst, xii, 138.]

Asboth has shown that baryta starch $[C_6H_{10}O_5]_4BaO$, first prepared by Zulkowsky by the action of baryta water on soluble starch, is also formed and precipitated when baryta water is added to starch which is simply suspended in water in the form of paste.

On this reaction he bases a volumetric method for the determination of starch in cereals which is here copied from the Analyst, vol. xii, page 140.

Estimation of Starch.

"Weigh out about three grams of the flour and rub well in a mortar with cold water; but in the case of hard substances like maize, rice, peas, boiling water must be used. Pour off into a 250 c. c. flask, and rub residue again and again with small quantities of water, until the bulk of the starch is removed; finally introduce residue also into the flask. Add water up to about 100 c. c., and heat in water-bath for half an hour, with occasional stirring. After cooling, add 50 c. c. of standard baryta water; cork the flask, and shake well for two minutes. To completely separate the baryta starch, add proof spirit up to the mark. After ten minutes pipette off 50 c. c., but if a flocculent precipitate refuses to settle, filter a portion of the fluid through glass-wool contained in a tube." "Titrate the excess of BaO with decinormal hydrochloric acid, using phenolphthaleine as an indicator. The interval during the settling of the precipitate I utilized in standardizing the baryta water."

"I use 10 c. c. baryta water, and add 50 c. c. of thoroughly boiled distilled water before checking it." "The difference in BaO between the two determinations was first multiplied by 5, then by 4.235 = amount of starch."

"An analysis can be finished in about an hour and a half. I must call attention to the fact that if the liquid is not frequently shaken during the heating, there will be a tendency to form lumps of starch paste which are but imperfectly acted on by baryta water."

I have tried this method on the pure potato starch previously described with the following results:

	Asboth's Method.	Sachsse's Method.
Pure Starch	82.83, 83.02, 83.79	84.54

With pure starch the titration was quite sharp, the color changing with a single drop of acid, but with potatoes, however, the point of neutrality can only be approximately determined, so that although duplicate results made by the same chemist at the same time may agree, it is extremely difficult to decide whether the point of absolute neutrality has been reached or not.

A little difference of opinion on this point would alter the results one or two per cent. Even with pure starch, where the titration was comparatively easy, it is much more difficult to get sharp results than by gravimetric methods. We have also made determinations of starch by Asboth's method in the [air-dry] potatoes sent by Mr. Platt as follows:

	Asboth's Method.			Sachsse's Method.
CCXLVI	70.14	70.87		73.81
CCXLVII	74.00	73.60		73.60
CCLIX	72.08	71.69		69.96
CCLX	70.00	70.22		72.40
CCLXI	69.88	70.66		72.07
CCLXII	62.11	63.19	63.62	70.60
CCLXIII	62.97	62.29		70.68

ANALYSES OF PARIS GREEN, AND REMARKS ON THE USE OF INSECTICIDES.

Paris Green is now used in large quantities to destroy the potato beetle, and also to protect fruit trees from the codling moth and certain other insect pests. It is a compound of arsenious acid (white arsenic), acetic acid and copper, and owes its poisonous properties to the arsenic in it.

Formerly four or five brands of this article were in the market, "Strictly Pure" being what the name implied, the others consisting of varying proportions of Paris Green and some make-weight.

We have been unable this year to find any other brand than "Strictly Pure" in our market, and are told that no other brand is now manufactured. The following analyses were made by Dr. Osborne, to determine whether the "Strictly Pure" Paris Green in market is what its name indicates:

A. Made by C. T. Raynolds & Co., New York. Bought of W. A. Spalding, New Haven.

B. Made by Raynolds & Co. Bought of R. Wells & Co., New Haven.

C. Bought of Cowles & Leete, New Haven.

D. From a package with Schieffelin's label. Bought of J. H. Klock & Co., New Haven.

E. Bought of F. S. Platt, New Haven.

F. Bought of Davenport & Burt, Putnam.

Analyses.

	A	B	C	D	E	F
Water	1.09	1.01	1.05	.96	1.22	.94
Copper oxide	30.90	30.94	30.77	30.87	30.54	31.05
Arsenious oxide	57.22	57.10	57.23	57.04	56.97	57.18
Acetic acid by difference	10.79	10.95	10.95	11.13	11.27	10.83
	100.00	100.00	100.00	100.00	100.00	100.00

The samples cost uniformly 35 cents a pound, except D, for which 40 cents was asked.

Paris Green is manufactured in this country by several companies who have formed an association to control the production and price. Their prices for next season they have not yet made public but they have already guaranteed that prices will be lower than last year. At present Paris Green can be bought at retail for 35 cents per pound, and in large lots at 28 to 30 cents, but not under that. Dealers cannot buy it of the manufacturers in 500 lb. lots for less than 18 cents.

At present London Purple is a much cheaper insecticide than Paris Green. It should contain nearly as much arsenic, and costs less than half as much. Still another insecticide which could be obtained much more cheaply than either of those named is "White Arsenic," which consists wholly of arsenious acid, and therefore has from 1.7 to 2 times as much poison in it pound for pound as either Paris Green or London Purple. A common price for it at the apothecaries, is 25 cents a pound. But it sells at wholesale for 3 cents, and reliable druggists say that it would sell for 6 or 8 cents retail if there was any demand for it. A very serious objection to the use of "White Arsenic," however, is its pure white color, which makes it resemble saleratus, soda, salt, and other things used in cooking. Neither London Purple or Paris Green could be so mistaken. If "White Arsenic" is bought, it should *never* be taken from the shop until mixed with lampblack or pulverized charcoal. One-fifth of an ounce of either is sufficient to blacken a pound of arsenic.

Prof. A. J. Cook, of the Michigan Agricultural College, in a letter on the subject, says:

"The danger, through carelessness, from the use of Paris Green or London Purple is almost as nothing compared with that of White Arsenic. I have thoroughly experimented with both the latter, and find not a trace of them in the foliage of potatoes, nor in the tubers, when every advantage was given for such absorption. I have done the same with apples. No trace of the poison is found on or in the fruit. White arsenic is easily mixed, is very effective, and as far as I have tried it, does no more harm to vegetation. But I do not think it cheaper than London Purple, and no better. I have found this year that one-half pound of London Purple to 100 gallons of water is enough.

The mixture above referred to is designed for spraying fruit trees.

One pound of Paris Green mixed with 100 pounds of plaster is sufficiently strong to use on potatoes. It has been repeatedly noticed that a large quantity of the poison is less efficacious than a small one, perhaps because the beetle avoids a mass of it, while the barest trace is as deadly as any larger quantity. Many prefer to use the poison in water, because there is less danger of inhaling it. In that case a heaping spoonful in a pail of water is enough.

THE METHODS OF MECHANICAL SOIL-ANALYSIS.

By Thomas B. Osborne, Ph.D.

In the report for 1886 were given the first results of an investigation of the methods of mechanical soil-analysis. The method of Knop as modified by Moore and that of Hilgard, as well as one developed in the Station laboratory were there discussed and compared. Since then the investigation has been extended to Schöne's method, and to the process of Schlösing which combines chemical and mechanical treatment.

These methods comprise all hitherto proposed that now appear to be worthy of investigation, the others such as Schulze's, Nöbel's, Müller's, Kühn's, Masure's and others, either employ conical elutriating vessels, which as Hilgard has pointed out and this investigation fully confirms, give wholly incorrect results, or they are methods depending on subsidence through a given height of water for a definite length of time, a principle which experience has shown is not adapted to yield results of value with any certainty whatever.

Schöne's Method.

The apparatus used, obtained from Müncke, of Berlin, was similar to that described and figured by Schöne (Zeitschrift f. Analytische Chemie, 7, 1868, p. 29), with the addition, suggested by Orth, of a second elutriating tube having a diameter one-half that of the Schöne tube.* Water was supplied to the apparatus under a constant pressure by means of a Mariotte's bottle.

Schöne's elutriator has been so frequently described that any further reference to its construction is unnecessary. The hydraulic values of the different currents used were not directly determined but the flow of water was so regulated as to carry off only such particles as had diameters equal to or less than the upper limit of the grade to be separated. It was thus easy to obtain results strictly comparable with those given by the other methods used.

In the first trial made, the soils were subjected to no preparatory treatment beyond simple sifting. The samples were neither boiled with water nor acted on by hydrochloric acid nor by alkali-solutions.

Schöne, in his original paper, following Schübler and Schulze, prescribes boiling as a needful preliminary in all cases. Clayey soils containing much humus he says should be boiled an hour with water containing in solution 1–2 per cent. of alkali hydroxide. Sandy soils he directs to free from organic matters by ignition and calcareous earth he recommends to treat with cold dilute hydrochloric acid to remove carbonate of lime.

As serious objections may be urged against all these last mentioned modes of preparation, it was determined to make some trials on the simply sifted earth, in order to gain an idea of the extent to which the soil could be differentiated without their aid, the results of applying the method of Beaker elutriation being employed as standards of comparison.

Twenty grams of the air-dry soil were sifted under water through a quarter-millimeter sieve. The fine material which after passing the sieve remained suspended in the water was poured into the Schöne tube, the coarser portion being rinsed into the Orth tube. The water current was then regulated so that the largest particles of quartz carried off had an average diameter of $.01^{mm}$.

* Die Agronomische Bodenuntersuchungen und Kartirung, von Dr. Max Fesca, Berlin, 1879, pp. 19, and 143, also Albert Orth, Ueber Mechanische und Chemische Bodenanalyse. Bericht d. D. Ch. Gesellschaft, xv, p. 3026.

When the current ceased to remove any appreciable quantity of the soil its velocity was increased so that the largest quartz grains passing over had a diameter of .05mm. These portions were collected in separate vessels.

As Hilgard noticed in the case of Schulze's elutriator, secondary currents formed during the process of elutriation which descended along the walls of the conical part of the Schöne tube and for some distance along the sides of its cylindrical portion. The result of these currents was to produce globular aggregates of small particles which fell to the bottom of the tube. These flocculæ could be to some extent broken up by turning on from time to time for a few seconds a rapid current of water, but a very considerable proportion of them remained unbroken to the end of the elutriation and were only moved forward when the current was increased so as to carry off the coarsest grade.

Soil from Garden of the Experiment Station.—Not Boiled.

Analyses with the Schöne-Orth Elutriator.

	A.	B.
Above .25mm	48.82	48.82
.25–.05mm	27.36	29.94
.05–.01mm	8.63	6.07
.01– 0mm	7.36	7.31
Clay (by difference)*	1.00	1.03
Loss on ignition	6.83	6.83
	100.00	100.00

The coarser products obtained in these analyses, under the microscope were seen to contain material finer than properly belonged to them. The various sediments of A were therefore subjected to systematic beaker elutriation and the finer material thus readily separated was in each case weighed and its quantity added or subtracted as required to make the obvious corrections. The following figures show the outcome of this correction compared with the original analysis and with the results of direct beaker elutriations.

* "Clay," as given in this and in the other analyses by the Schöne and Beaker methods instanced in this paper, is, in accordance with Hilgard's conventional method, that part of the grade having diameters of from .01–0mm which remains suspended after 24 hours' sedimentation from water having a depth of 200mm.

Neither Schöne nor the various experimenters who have employed his method in analysis of soils appear to have undertaken to subdivide the grade .01–0mm.

Soil from Garden of the Experiment Station.—Not Boiled.

	A. Schöne-Orth Elutriation.	A-1. A. Corrected by Beaker Method.	Average of 3 Direct Beaker Elutriations.*
Above .25mm	48.82	48.82	48.82
.25–.05mm	27.36	23.72	22.37
.05–.01mm	8.63	12.08	13.70
.01– 0mm	7.36	7.55	7.20
Clay (by difference)	1.00	1.00	1.08
Loss on ignition	6.83	6.83	6.83
	100.00	100.00	100.00

The agreement between the results by direct beaker elutriation and the corrected Schöne-Orth elutriation is perhaps quite as close as could be expected. The uncorrected S.-O. elutriation materially differs from the direct beaker analysis in the 2d and 3d grades only and by five per cent. in each case.

The sample of Prairie soil whose analyses by other methods were reported last year was next examined. Fifteen grams were carefully worked with a rubber pestle to disintegrate as far as practicable all the lumps and separate the loosely adhering particles. The sample was then elutriated in the manner just described. The following figures show the results thus obtained as well as those yielded by the beaker method, as given in the Report of this Station for 1886, p. 157.

Prairie Soil from Mercer County, Ill.—Not Boiled.

	C. Schöne-Orth Elutriation.	No. 33. Beaker Method.
Above .25mm	.76	.62
.25–.05mm	11.25	2.42
.05–.01mm	52.65	43.58
.01– 0mm	14.84	31.58
Clay	4.44	5.81
Loss on ignition	14.49	14.49
	98.43	98.50

Here the differences between the results of the two methods are such as to show positively that the Schöne process is worthless, when applied to an unboiled soil of this character. This prairie earth is difficult to elutriate with a current of water because of its large content of very finely divided organic matter.

A sample of brick clay elutriated as in the above analyses gave the following results:

* Report of Conn. Ag. Exp. Station for 1886, p. 148.

BRICK CLAY FROM NORTH HAVEN, CONN.*

	D. Schöne-Orth Elutriation.	No. 50. Beaker Method.
Above .25mm	1.02	1.02
.25–.05mm	3.91	.76
.05–.01mm	29.63	20.95
.01– 0mm	58.58	71.01
Loss on ignition	6.60	6.60
	99.74	100.34

We note that in this ancient drift deposit which has never been cultivated and contains no visible organic debris the Schöne elutriation totally fails to make even a rough separation of the several grades of fine matter from the unboiled soil. This failure is doubtless partly due to the fact that the current of water cannot fully disintegrate the clay, but it is also due in part to the coalescence of once separated particles as they encounter each other in the elutriating process. The coarser products of elutriation contained large numbers of fine particles which under the microscope were seen adhering to one another in groups of from four or five up to twenty or thirty. During the analysis these flocculæ could be seen at all times in the process of formation in the elutriator, and when once formed, as Hilgard has shown, they adhere together with great persistence.

THE BERLIN-SCHÖNE METHOD.

In his original paper as printed 20 years ago in *Fresenius' Zeitschrift*, Schöne gave no definite instructions with regard to the proper duration of boiling as preliminary to the elutriating process, nor have any further communications from him on the subject appeared in the current literature. In the mean time his apparatus as modified by Orth has been adopted and extensively employed in the *Laboratorium für Bodenkunde*, of the Royal Prussian Geological *Landesanstalt* at Berlin. The elutriations by the Schöne apparatus that remain to be described in this paper were made as nearly as possible in accordance with the instructions that have emanated from the Berlin *Bodenlaboratorium* and are as follows:†

* Not the sample analyses of which were given in Report of this Station for 1886.

† Untersuchungen des Bodens der Umgegend von Berlin, von Dr. Ernst Laufer und Dr. Felix Wahnschaffe, Berlin, 1881, pp. 14–24; also Dr. Max Fesca, Agr. Bodenuntersuchungen, p. 143. Dr. Wahnschaffe's lately published work, "Bodenuntersuchungen" had not been received when this paper went to the printer.

500 grams of the soil are sifted upon circular holes 2mm diameter. Of the earth passing the sieve 30 to 100 grams are boiled in water with constant stirring for from one-half to one hour or longer, according to the character of the soil. The finer the texture of the soil the smaller the quantity taken and the longer the time of boiling. Treatment with acids or alkalies is not practiced.

The finer portion of the soil remaining suspended in the water after boiling is poured into the Schöne tube, the remaining coarse part is rinsed into the Orth tube. The clay, together with the finest sand, is collected in a separate vessel, the water in which it is suspended is evaporated off and the residue after drying in the air is weighed. The rest of the operation is carried out as previously described except that the products of elutriation are not ignited but weighed air-dry, in order that they may be further examined chemically if desired. By proceeding in this manner the following results were obtained:

SOIL FROM THE GARDEN OF THE EXPERIMENT STATION, boiled 45 minutes.
Separations by the Berlin-Schöne Method.

	Air dried.	Ignited.
Above .05mm	72.63	71.76
.05–.01mm	14.17	12.53
.01–0	12.97	9.38
Loss on ignition	----	6.83
	99.77	99.50

For the sake of comparing the mechanical separations attainable by this procedure with those yielded by other methods, the air-dry products were ignited and again weighed and our further statements have reference chiefly to the latter.

By subtracting from the ignited portion above .05mm, 49.37 per cent. the amount of this soil that remained upon a .25mm sieve, the fraction between .25mm and .05mm is found and the separations in this analysis may be compared with those previously obtained by the Beaker Method as follows:—

SOIL FROM GARDEN OF EXPERIMENT STATION.

	E. Berlin-Schöne Boiled 45 min.	Beaker Method. Boiled 23 hours av. of 4 analyses.	No. 29. Pestled, not boiled.	Not boiled nor pestled, av. of 3 analyses.
Above .25mm	49.37	47.77	48.82	48.82
.25–.05mm	21.39	20.75	22.44	22.37
.05–.01mm	12.53	11.18	12.55	13.70
.01–0 clay included	9.38	13.47	9.36	8.28
Loss on ignition	6.83	6.83	6.83	6.83
	99.50	100.00	100.00	100.00

Separations thus accomplished by the Berlin-Schöne method, show a very remarkable quantitative agreement with those made by the beaker method but the coincidence is more apparent than real, for on subjecting the two coarser products to beaker elutriation they were each found to contain a not inconsiderable amount of material belonging to the finer grades. The boiling for only a short time had, apparently, given the sample a composition quite different from that obtained on elutriating the unboiled soil but had not reduced it to the condition of those samples which were boiled for 23 hours. See analyses A and B, p. 146.

The following figures show the weights and per cents. of material removed by beaker elutriations from the 2d and 3d products of the foregoing analysis:

	Wt. of fractions in grams.	Wt. of substance removed.	Per cent. removed.
Air Dried.			
.25mm to .05mm	22.31	2.84	12.76
.05mm –.01mm	14.17	1.19	8.37
Ignited.			
.25mm –.05mm	21.39	2.37	11.07
.05mm –.01mm	12.53	.81	6.48

The above figures supply the data for calculating a corrected Berlin-Schöne analysis which is here compared with the uncorrected analysis and with results of a beaker elutriation made directly on a sample of the same soil boiled for the same time, viz: three quarters of an hour.

Soil from Garden of Experiment Station, boiled 45 minutes.

	E. Berlin-Schöne Method.	E. 1. E. Corrected by the Beaker Method.	No. 49. Beaker Method.
Above .25mm	49.37	49.37	49.52
.25–.05mm	21.39	19.02	19.50
.05–.01mm	12.53	14.09	13.11
.01–.0	9.38	10.19	11.04
Loss on ignition	6.83	6.83	6.83
	99.50	99.50	100.00

In case of heavy loams the inability of the Berlin–Schöne method to effect even a roughly approximate separation of the several grades becomes very conspicuous, as is evident from the following figures:

Clay Loam, Deer River, Lewis Co., N. Y.

	Boiled One Hour. Berlin-Schöne. F.	Boiled One Hour. Beaker. No. 51.	Not Boiled. Beaker. No. 30.	Not Boiled. Beaker. No. 31.
Above .25	22.39	20.26	20.92	19.91
.25–.05	26.72	18.96	17.96	18.41
.05–.01	21.75	23.70	25.26	26.94
.01–.0	21.45 (.01–.0 and Clay)	23.32	23.05	22.00
Clay		5.10*	3.55*	4.75†
Loss by Ignition	7.99	7.99	7.99	7.99
	100.30	99.33	98.73	100.00

The beaker analyses, Nos. 30 and 31, were made on this soil a year ago (report of this Station, 1886, p. 155), and are adduced for comparison with the recent analysis, No. 51. The soil here under consideration presents peculiar difficulties from the fact that it contains long-weathered fragments of clay-slate and of limestone and sandstone shales which break up on agitation, as in boiling or by pestling, into sand-grains of various grades, and into clay, so that any means which may be employed to disintegrate the existing clay, and detach it from the coarser matters, must pulverize the latter to some extent, and thus alter the mechanical composition of the soil. In my former paper, the effects of long boiling alone, and of boiling and churn-elutriation together, in reducing the coarser and increasing the finer sediments, are set forth. Here it will be seen on comparing the beaker analyses, that boiling for one hour seems to have had little effect on the two coarser grades of this loam, but has apparently diminished the 3d grade by about 2.4 per cent., and increased the 4th and 5th by nearly the same amount. But the beaker method, for the reason above stated, cannot be expected to give such closely corresponding results on this soil as to demonstrate by a single comparison the effect of boiling for one hour.

Comparing now the two analyses made on samples of the soil similarly prepared by boiling for one hour, we notice that the first two grades in the Schöne elutriation are 9.9 per cent. higher than by the beaker process, and the three finer grades are correspondingly lower.

The last elutriation, G, attempted by this method, was on a sample of the same brick clay, whose analysis, made with the unboiled earth, has been given already. For convenience of comparison the former analysis, D, is here copied, and the results of a correction of G, by the beaker method, are also stated.

* Determined directly. † Clay and loss by difference.

BRICK CLAY, FROM NORTH HAVEN, CONN.

	Berlin-Schöne Elutriation. D. Not Boiled.	G. Boiled One Hour.	G 1. G, Corrected by Beaker Elutriation.	No. 50. Direct Beaker Elutriation.
Above .25	1.02	1.02	1.02	1.02
.25–.05	3.91	4.58	.68	.76
.05–.01	29.63	29.94	22.90	20.95
.01–.0 } Clay	58.58	57.14	68.08	71.01
Loss by Ignition	6.60	6.60	6.60	6.60
	99.74	99.28	99.28	100.34

The two analyses, D and G, agree very closely, the boiling of this clay for one hour in case of G, has had but little effect over the *preliminary* pestling applied to D, in increasing the per cent. of the finest at the expense of the coarser grades.

The composition of the several sediments from the Schöne–Orth apparatus in analysis G, as found by subjecting them separately to beaker elutriation is stated in the subjoined table. The up-and-down columns under G give the Schöne–Orth elutriation products and their sub-divisions effected by the beaker process. The cross-page figures under G, when added together, give the corrected analysis G 1.

NORTH HAVEN BRICK CLAY. BOILED ONE HOUR.

	G. Berlin-Schöne Method. Above .05	.05–.01.	.01–.0.	Loss on Ignition.	Total.	G 1. G, Corrected by Beaker Elutriation.
Siftings	1.02					1.02
.25–.05	.68					.68
.05–.01	2.07	20.83				22.90
.01–.0	.89	6.13	57.14			64.16
Clay	.94	2.98				3.92
Loss by Ignition				6.60		6.60
Totals G	5.60	29.94	57.14	6.60	99.28	G. 1. 99.28

SCHLŒSING'S METHOD.

According to Grandeau (Traité d'analyse des Matières Agricoles, 1887, p. 137), Schlœsing's method, "has the great advantage over all the other mechanical methods yet proposed, of making known the exact content of clay and sand in the soil. The very fine sand which closely resembles clay in its physical properties, and yet in chemical character is so entirely different is not here, as in all the mechanical analyses, confounded with the clay." By this method humus and carbonates are also determined.

In the analyses thus far given in this paper, the term "clay" has been applied to that portion of the soil which remained in suspension after allowing the water in which it had been diffused, the height of which was 200^{mm}, to stand at rest for 24 hours (Hilgard's Conventional Method). By this means a product is obtained which consists of the greater part of the *true clay* contained in the soil, together with a considerable amount of very fine sand. The importance of separating this very fine sand from the true clay is obvious, for the chemical properties of the two are very unlike, and their influence on the physical character of the soil is different.

By *true clay* is here meant that material, mostly derived from the decomposition of feldspars and similar silicates, which is capable of uniting with a very considerable amount of water, and thus assuming a gelatinous condition in which it exerts a powerful binding action upon the particles of sand in the soil. To some extent, probably, this action is also exerted by iron and alumina hydroxides, as well as by colloid organic bodies. A relatively small amount of such clay is able to modify greatly the physical properties of a large amount of fine sand with which it is admixed, and to influence the agricultural character of the soil to a very marked degree.

Therefore, in view of the claims made for Schlœsing's method, the clay obtained by his process was carefully examined for sand.

Grandeau claims for Schlœsing's method more than Schlœsing himself. The latter in his *Contribution a l'Etude de la Chemie Agricole, Encyclopedie Chimique*, t. x., 1885, p. 86, remarks, "We have reckoned as clay all those elements which remain in suspension in water after a repose of 24 hours. In reality these elements contain a notable proportion of very fine sand which will be deposited in the course of time. In order that the liquid may be entirely rid of this sand it is necessary to wait several weeks or even months. Such a prolongation of the analysis is evidently inadmissible. I have proposed a rest of 24 hours, for the deposition of clay.

This is a conventional time, but this convention is justified by the fact that the sediment which we call clay presents, when it has a suitable degree of humidity, a cohesion and a plasticity in all respects analogous to that of the natural clays."

The method as described by Grandeau is briefly as follows:

1. Thorough mechanical subdivision of the sample by working under water with the fingers.

2. Further disintegration of the sample by solution of the lime salts in weak hydrochloric acid.

3. The solution of humus in dilute caustic potash or ammonia.

4. The separation of the humus and clay from the sand by means of repeated (up to 5 or 6) subsidences of 24 hours duration.

5. Separation of the clay and humus by precipitation of the clay by potassium chloride.

6. Determination of the amount of humus by precipitating its ammonia solution by acetic acid and lead acetate.

7. Separating the sand into several grades by sifting or levigation.

The directions in Grandeau's *Traité d'analyse des matières Agricoles*, p. 138, were carefully followed* and the results of the analyses are believed to show correctly how far the claims made by Grandeau for this method admit of vindication.

A calcareous brick clay and a prairie soil, rich in organic matter, were selected as suitable material for testing the method.

BRICK CLAY. NORTH HAVEN, CONN.

H.

Schlœsing's Method.

Carbonate of lime	4.20
Sand	64.91
Clay	22.65
Humus	None
Loss on ignition	6.60
	98.36

Before weighing "sand" in the above analysis obtained by following Grandeau's directions it was further examined as follows: In order to remove any still adhering clay it was pestled, suspended in water and allowed to settle for 24 hours when the

* See also Contributions a l'Etude de la Chimie Agricole Par Th. Schlœsing, pp. 80–87, where a method for the "physical analysis" of soils is described, differing in various points from Grandeau's statements.

water and suspended soil were poured off. The sediment thus obtained was repeatedly treated in the same manner until it subsided leaving the water perfectly clear. The clay and fine sand thus removed were suspended in water and allowed to stand for several days. The supernatant liquid was poured off and the sediment thoroughly pestled and treated in the same manner as the "sand" had been. This process was repeated until the clay-water deposited no particles of sand having a diameter greater than ·002mm, and all the sand which had been deposited from the clay-water subsided leaving the water perfectly clear.

The sand and clay thus obtained were ignited and weighed and their sum represented the "sand" obtained according to Grandeau's directions.

This "clay" obtained according to Schlœsing's method was worked over in the same manner, in order to remove from it as far as possible the fine sand which the microscope showed it to contain. From this "clay" there was thus separated 8·99 per cent. of fine sand.

The following statement of the analysis shows the result of the foregoing treatment.

H corrected.

Carbonate of lime		4.20
Sand	Sand	63.31
	Clay	1.60
Clay	Sand	8.99
	Clay	13.66
Humus		None
Loss on ignition		6.60
		98.36

The clay thus separated still appeared to contain some very fine sand (below ·002mm diameter) from which it could not be freed by mechanical means.

This analysis is, in most respects, not comparable with those made on the same material by other methods, but as the corrected Berlin-Schöne elutriation, G. 1, made on a sample boiled one hour, gave but 3.92 per cent. of clay, it would appear that, of the 15.22 per cent. of clay here found, a considerable proportion must have resulted from the breaking up of concreted material by the treatment with hydrochloric acid.

With the prairie soil Schlœsing's method yielded the following results.

PRAIRIE SOIL. MERCER CO., ILL.

J.

Schlœsing's Method.

Carbonate of lime	.88
Sand	82.86
Clay	7.86
Humus	1.57
Loss at 150° C.	4.42
	97.59

The clay in this case contained very little sand which could be separated from it and in this respect the determination was satisfactory. The sand was elutriated by the beaker method and yielded a considerable amount of "clay" as determined according to Hilgard's conventional process. The complete elutriation of this sand may be compared with a similar elutriation of the same soil without previous treatment with acid and shows that the textural character of this soil is considerably changed by the action of dilute acids.

PRAIRIE SOIL, MERCER CO., ILL.

	J. Schloesing's Method.	XIV. Beaker Method.		Schloesing's Sand. Dried at 150° C.	Schloesing's Sand. Ignited.	Original Soil. Ignited.
Carbonate of Lime,	.88					
Humus,	1.57					
Loss at 150° C.,	4.42					
Sand,	82.86	Above .25mm		.12	.10	.92
		.25–.05		3.58	3.55	2.89
		.05–.01		42.69	41.87	42.86
		.01–.0	.01-0	23.66	20.47	31.44
			Clay*	12.81	10.14	
Clay,	7.86					7.40†
Loss on ignition,						14.49
	97.59					100.00

The figures indicate that the treatment with acid has disintegrated the particles of less than .01mm diameter so that one-third of this portion would appear as clay, according to the Hilgard method of estimating clay, which we have usually employed.

As to humus it may be noted that the loss in the analysis by Schloesing's method, viz: 2.41 per cent., plus loss at 150°—4.42 per cent. plus humus found—1.57, plus carbon dioxide ($\frac{44}{56}$ of .88=).69, amounts to 9.09 per cent., while the loss on ignition which represents humus, carbon dioxide (?) and water is 14.49 per cent. The 5.40 per cent. difference must evidently be, for the most part, humus which has escaped estimation by the Schloesing method, having been distributed among the sand and clay.

* Determined by 24 hours subsidence. Chiefly fine sand.

† By difference.

Schloesing, in the *Encyclopédie Chimique*, directs to calcine the sand and thus to determine as "organic *debris*" the relatively bulky vegetable matters separated by sifting or found in the coarse sand. The humus in the clay is not determined nor taken account of in the method of "physical analysis" there described.

The humus determined in analysis J, is in fact humic acid, or that part of the dead vegetable matter, which, in the soil, exists chemically united to earthy and metallic bases in forms that are highly insoluble in water but are decomposed by hydrochloric acid.

The mechanical disintegration that has resulted from the chemical action of hydrochloric acid followed by that of an alkali, in case of this soil has been due to decomposition not only of carbonates, but also and perhaps in a greater degree, to that of humates.

THE MECHANICAL DETERMINATION OF CLAY.

Schloesing's method for the separation of clay is essentially one of subsidence for 24 hours from a solution of 200 to 250cc volume, but of no specified height. Hilgard's conventional method requires the same time and a height of solution of 200mm.

Such methods of separation assume, first, that most of the sand and second, that little of the clay shall settle within the fixed time. That both of these assumptions are fallacious, the following experiments show. The "clay" obtained by 24 hours subsidence from 30 grams of brick clay was suspended in four liters of distilled water and allowed to settle out completely, which required several days. The water was then decanted off so as to remove all soluble matters, the jar again filled with distilled water and the clay and fine sand allowed to settle again for several days. The upper three-quarters of the liquid were then decanted and made up to a volume of four liters, and this was allowed to stand several days when a considerable sediment had formed. A decantation was again made as before. The operations were repeated until the clay water had been so far freed from the clay as to become opalescent; then it first ceased to deposit any appreciable sediment. A microscopic examination of the several sediments thus collected showed them all to contain particles of sand. It appears, therefore, that only after the liquid containing the clay has become opalescent does it cease to deposit fine particles of sand as well as clay.

Furthermore, the character of the true clay itself is so changed under certain conditions that it loses the property of remaining in prolonged suspension in water.

A sample of clay which had been freed from particles of sand exceeding .005^{mm} diameter was suspended in water and precipitated from it by freezing. It was then washed by decantation with alcohol and dried in the air. A portion of this clay was shaken up with water and allowed to stand a few hours, during which time the greater part of it had settled. After decanting off the water and suspended clay and repeating this process a few times a very considerable part of the clay was left which would subside completely through 100^{mm} in a few hours. After standing under water for several months, only a small part of the clay had regained the quality of prolonged suspension. It was found, however, that if this clay were pestled this quality of prolonged suspension was restored to it to a very considerable degree.

It is evident, therefore, that conventional methods depending on simple subsidence can give no accurate results because the very varying amounts of finest sand and clay in different soils will yield very variable mixtures of the two when subjected to any simple course of treatment by elutriation and subsidence.

The method of persistent pestling and repeated subsidences and decantations continued until no further separation can be effected, although extremely tedious, is the only one which has as yet yielded even approximately good separations on any of the clayey soils I have hitherto examined.

A single subsidence of the clay water for 24 hours will free it from all particles of sand having a diameter greater than .005^{mm}, but in many cases a considerable amount of finer sand will remain in suspension for many hours or days.

On the other hand, the sediment formed during the twenty-four hours subsidence will not be free from clay, as may be easily seen by suspending it in water a second time and allowing it to stand again for twenty-four hours. Both Hilgard and Schloesing direct attention to these defects, but assume that they do not usually influence the results to a sufficient extent to deprive them of value. In many cases this is undoubtedly true, as for example, in such soils as that from the Garden of the Experiment Station

in which there is but little clay and fine sand, but in soils of the opposite character as in the North Haven brick clay where exact separations are most desirable, a very considerable error is thus inevitably encountered.

Effect of Boiling on the Texture of Clayey Soils.

Most investigators who have worked upon mechanical soil-analysis advise boiling with water in order to detach "clay" and "sand" from each other and make good separation of the several mechanical elements practicable or possible. In general, however, the instructions as to the time and manner of boiling are rather indefinite, and no proper research as to the effects of this treatment has been undertaken.

The practice of Prof. Hilgard, to boil 24 hours or even longer in case of adhesive clays, would appear to be objectionable in view of the dehydration and change of physical properties known to occur in case of many hydroxides, especially those of iron and aluminum, which occur or may occur in the soil. It is a familiar fact to the chemical student that the hydroxides above named and many other amorphous substances when precipitated from cold solutions are more bulky and less easily washed upon a filter than when thrown down hot. It is also well known that their properties are considerably changed by warming or boiling with water, and St. Gilles,* Davies† and Rodman‡ have shown that heating with water to boiling for some hours or days gradually converts the bulky brown-red ferric hydroxide, which when precipitated cold and air-dried for 18 days Carnelley and Walker§ found to contain 38 per cent. of water, into a much denser bright-red substance containing but two per cent. of water. St. Gilles has also observed the partial dehydration of aluminum hydroxide (from $Al_2O_3 . 5H_2O$ to $Al_2O_3, 2H_2O$) by prolonged boiling.

The hydrates of silica and the highly hydrated silicates are most probably affected in a similar manner, and if such be the case, boiling would evidently change the constitution of clay in a very essential degree.

The following experiments were undertaken to throw light upon this question:

10 grams of North Haven Brick Clay were boiled continuously for nine days in a glass flask of 1 liter capacity, with about 700^{cc} of distilled water and reflux condenser.

* J. pr. Chem., lxvi, 141.
† Chem. Soc. J. [2], iv, 66.
‡ Am. J. Sci., xliv, 1867, p. 222.
§ Chem. Soc. J., Jan. 1888, pp. 76.

15 grams were boiled in the same manner for eight and one half days. When the boiling was concluded the soil was found to have assumed a granular condition, the clay and fine sand being collected into a mass of small grains resembling coarse sand which settled rapidly. One portion thus boiled was elutriated by the Beaker method, the other by Hilgard's. The pestle was not used on either of those portions as it was desired to determine simply the effect of prolonged boiling. The separations thus accomplished are here compared with the elutriations of the same soil boiled 23 hours and of the pestled but unboiled soil.

BRICK CLAY, NORTH HAVEN.

Effect of long Boiling (in glass).

	Hilgard Elutriation.		Beaker Elutriation.	
		Not pestled.		Pestled.
	Boiled 23 hrs. XII.	Boiled 9 days. XVI.	Boiled 8½ days. No. 40.	Not boiled. No. 27.
Sifted	3.36	3.24	3.63	3.49
.25–.05	1.21	1.11	1.91	1.29
.05–.01	28.27	33.04	33.61	27.02
.01–0	56.29	48.85	54.78	52.21
Clay	4.92	3.05	1.97	10.15
Loss on ignition	5.95	5.95	5.95	5.95
	100.00	95.24	101.85	100.11

Here it is observed that the 8–9 day's boiling diminished the clay as determined by Hilgard's conventional method by 7–8 per cent., increasing the "dust" by 2–3 per cent. and the "silt" by about 6 per cent.

Under the microscope small, rounded, opaque, brown granules were seen in large numbers, which when pressed under the cover-glass broke up into a multitude of very fine particles.

Unfortunately the sample was exhausted by these analyses and the experiment could not be repeated so as to correct the considerable error indicated by the loss in XVI.

From these experiments it would appear to be conclusively proved that too long boiling precipitates clay and thereby defeats the very object of the operation.

In these experiments the time of boiling was prolonged in order to bring out unmistakably the effects of this operation. If ebullition for 8 or 9 days reduces "clay" from 10 to 2–3 per cent., increasing the .05–.01^{mm} grades by 6 per cent., it is evident that boiling for one day or a shorter time becomes a questionable treatment. In the analyses made by the use of Hilgard's churn

elutriator, published in my former paper, it is easy to trace the effect of boiling. This very Brick Clay boiled for 23 hours is shown by analysis XII above quoted, either to have come short of sufficient disintegration in the .05–0 sediments, or if sufficiently disintegrated, to have suffered subsequent precipitation of half of the clay with those sediments.

The comparative analyses of Prairie Soil given in my former paper lead to the same alternative. The Hilgard elutriation, after 23 hours boiling, XIV (Report of this Station for 1886, p. 157) yielded less of clay by 2 per cent., less of .01–0^{mm} by nearly 5 per cent., and more of the two coarser grades by 7 per cent. than the Beaker elutriation on unboiled soil.

Whether this precipitation on boiling is simply due to dehydration by heat or is partly or wholly attributable to the action of salts extracted from the clay or from the glass of the vessel, further experiments in metallic vessels, which are already in progress, may decide.

When the clay has once been converted into the "granular" condition considerable difficulty is experienced in restoring it to the state in which it is capable of prolonged suspension in water.

The results of the studies herewith reported may be summed up as follows :—

1. The Berlin-Schöne method of elutriation gives fairly correct separations with sandy soils containing little clay or matters finer than .01^{mm}, but on fine-textured soils, as loams rich in humus and clays, it gives results which are grossly inaccurate, the error on single grades amounting to 8–14 per cent.

2. In respect to rapidity, economy of time and ease of operating, the Schöne elutriation has no advantage over the Beaker method.

3. Schlöesing's method on its mechanical side makes no satisfactory separations, and the chemical treatment it employs is liable seriously to alter the texture of the soil.

4. The determination of "clay" by a single subsidence from any conventional volume or depth of water, or for any conventional time, is not a process certain to effect even a roughly approximate separation of the finest quartz grains from true clay.

5. Boiling with water must be rejected as a treatment preliminary to mechanical analysis, because it not only abrades and reduces the coarser sediments, but dehydrates and coagulates the true clay and thus essentially alters the texture and grain of the soil.

In a paper "On the Methods of Mechanical Soil Analysis," published in the "Proceedings of the Eighth Annual Meeting of the Society for the Promotion of Agricultural Science, 1887, pp. 48-50, Prof. E. W. Hilgard states his objections to "the subsidence method or 'beaker elutriation,'" and explains the reasons which formerly induced him "to reject this same method." Prof. Hilgard further says. "After obtaining an insight into the grave difficulties involved in the hydraulic process my first thought was to avoid them by using the obvious and simple method of subsidence, and I thus went very fully over the ground covered by Dr. Osborne's work," and again, "So far the only difference between Dr. Osborne's plan and mine is that he proposes to treat, also, the larger sized sediments (>·28^{mm} hyd. value) by the subsidence method.

But Prof. Hilgard has overlooked the fact that the older "subsidence methods" differ essentially from the process which I have proposed to distinguish as "beaker-elutriation" in one very important and characteristic particular.

Prof. Hilgard says that his objection to the "subsidence method" is "simply that life seems to me too short to be occupied in painfully watching the second-hand of the watch up to the decisive moment when a short paroxysm of precipitate activity ensues, to be again succeeded by a period of enforced idleness and patience-trying watchfulness."

In my first paper (Report of this Station for 1886, p. 142), I stated nearly at the outset that "it shortly became evident that nothing is to be gained by limiting sedimentation arbitrarily to any particular intervals of time and space," and I would repeat that my process does not, as Prof. Hilgard appears to suppose, require any "close observance of the times corresponding to grain sizes," but that the eye and the micrometer alone decide the results of separations and indicate the times and the number of the subsidences, which are simply repeated until a desired result is attained and all with as much freedom to the operator as is permissible in carrying on hydraulic elutriation, or the ordinary work of the laboratory. In fact, if I am able to judge impartially, the actual consumption of time and nerve in hydraulic elutriation, including the preliminary boiling, the handling of large volumes of distilled water, and of clay-water, and the use and care of delicate apparatus, is no less than in beaker elutriation.

THE STATION FORAGE GARDEN.

How to improve Connecticut grass-lands so as to make them more productive and also more permanent (wherever that is desirable), are questions of the first importance. To answer these questions we need for one thing, to know more about the hardy grasses and forage-plants which grow in our state with less care than others and no expense for seeding; their habits of growth, seed production, fitness for meadow and pasture on different soils, feeding value, rooting peculiarities, growth with other varieties, possible improvement by cultivation or by selection of seed, the effect of different fertilizers, etc. We need, also, to secure a more general and a closer observation of the appearance and behavior of all our useful grasses, so that they may be known by botanists as well as by farmers, at sight, through the spring, summer and fall. We need to have names for them which shall pass current every where, free from all confusion; because without names there can be no discussion of grass away from the grasses themselves. Only by a general improvement in these respects can the literature of our agricultural grasses become satisfactory or as widely useful as the welfare of the State demands.

Botanists at present have for their ready information books and collections of carefully dried plants usually gathered when in flower or fruit, each labeled with its scientific name. To identify a specimen botanists require to see it either in flower or fruit. Agricultural botany needs to go further than this; to read the sod like a book and identify with certainty the common grasses at all stages of growth from spring to fall. The botanist's herbarium is not enough for this. We must have the planted as well as printed page. There are needed for reference, as keys to our door-yards and farms, collections of growing grasses, to show as the season advances, their foliage, flowers, seed and general appearance. These when properly labeled, will enable a good observer without any special knowledge of botany to name almost any grass which grows in this State. Such a collection has been gathered at this Station during the last eighteen months to serve as a starting point, we hope, for other collections throughout the

State. Many of the difficulties in the way of starting, especially in procuring seeds and plants, have been overcome here and need not be encountered by others. It is hoped that many farmers will join the Station in its closer study of forage plants. To learn the names of a considerable collection in the home garden or at large on the farm can scarcely tax the memory more than a teacher is taxed in learning the names of scholars the first week of school.

The Station was fortunate at the outset in having the services of Mr. James B. Olcott, of South Manchester. The success of the undertaking has been largely due to Mr. Olcott's special knowledge, to his energy and persistence in securing specimens of seed and growing plants, and to his advice and personal services in the garden itself.

Seeds of grasses for the garden have been collected where possible, in and about New Haven by ourselves. Messrs. Vilmorin, Andrieux & Co., of Paris, Peter Henderson & Co., of New York, and R. D. Hawley, of Hartford, kindly supplied us with seeds ordered from them, without charge. From J. J. Wolfenden of New Berne, N. C., we received a package of seeds of the Cow Pea. A collection of sods of western grasses was kindly sent to us by A. Gilchrist, Esq., of Cheyenne, Wyoming. Prof. E. M. Shelton of the Kansas Agricultural College, and Carlos Reese, Esq., of Marion, Ala., both favored us with seed and sod or roots of Texas blue-glass [*Poa arachnifera*]. To the New York Experiment Station we are also indebted for a gift of seed. To Dr. Vasey, Botanist of the U. S. Department of Agriculture, our special thanks are due for both seeds and sods of a number of western and Mexican grasses from the Department gardens as well as for frequent favors in identifying species.

The U. S. Department of Agriculture also supplied us with seeds of a considerable number of forage plants, most of which proved very satisfactory.

Seeds of the grasses were planted in drills, seven feet long and from 18 to 24 inches apart, and were usually covered half an inch deep and the earth was moderately compacted over them. Those which it seemed desirable to have also in sward, were sown in plats 7 feet long by 5 feet wide, raked in and rolled with a light roller.

If the weather was dry after planting they were lightly mulched with corn stalks, salt marsh hay or tobacco stems. The tenderer

grasses were also mulched lightly late in the winter when the snow was going, to prevent the tearing of their roots by the frequent thawing and freezing. In November of 1886, 45 sods collected by Mr. Olcott, in the neighborbood of Hartford, all of them correctly labeled, were received for the garden. These, with one or two exceptions, did not suffer by transplanting but furnished more satisfactory specimens the following summer than any from the fall sowing of seeds. Others have from time to time sent in sods and seeds to be tested in the garden. During the Spring of 1887, Mr. Olcott, at our request, visited Rhode Island and made a study of "Rhode Island Bent" both in the seed pastures and meadows and in the seed market, sending specimens of the trade seed and of the sods from many different places, for observation in our forage garden. He subsequently made a partial survey of this State with the same objects in view. A paper by Mr. Olcott, on Fine *versus* Coarse Agrostis, will be found in the following pages.

By constant care each drill and plat has been kept entirely clean of all weeds or grasses other than the one specially planted. A special set of thrust and bayonet hoes made for us by the Collins Co. from Mr. Olcott's models, has alone made this possible with the limited time that could be given to the garden. Our experience proves that for the greatest convenience in weeding, the drills should have been one foot shorter and the plats one or two feet narrower.

The total number of sods now in the garden, many of them duplicates of the same species, is 650, of drills there are 163 and of plats 56.

The garden contains 81 out of the 120 species of grasses which grow without care in this State, and besides, some thirty species of grasses which do not occur wild in this State. Besides grasses, there are grown clovers, vetches and lupines as well as some of the more interesting sedges, which furnish a part of our hay and grazing. All these kinds of plants are proper subjects of recognition and study, whether they prove useful or not. Thus far the work in the forage garden has been chiefly devoted to securing specimens of grasses and seed true to name. Certain experiments have been commenced but results are not yet ready for discussion.

We only note here one or two observations made incidentally in our collection of specimens and seed. Attention is also called in this connection to the analyses of certain grasses given on page 100. To ascertain the present state of the seed market in Fine Bent, Rhode Island Bent seed was ordered by us from 10 of the prominent seedsmen in New York, Philadelphia and Boston. Six lots only were obtained, four of the firms not being able to supply it. These lots were sown in plats rather late in the season and blossomed very sparingly. It was evident however that only two of them contained any considerable quantity of "Fine Bent," the others were chiefly "Coarse Bent"—the ordinary trade red-top.

Of the samples of wheat sent by the U. S. Department of Agriculture, those bearing the following labels did well.

Martins' Amber.
Four-rowed Sheriff.
Diehl's Mediterranean.
McGee White.
Raub's Black Prolific.
German Emperor.
Fulcaster.

The last two varieties made the heaviest growth. Genoese and White Crimean winter-killed badly.

Indian and Extra Early Oakley sprouted very feebly.

A sample bought for *Festuca pratensis*, Meadow Fescue, proved to be *Lolium perenne*, or English Rye Grass with perhaps a little Italian Rye Grass.

A sample of *Anthoxanthum odoratum*, or Sweet Vernal grass proved to be Var. *Puelii* which is an annual plant much inferior to the perennial Sweet Vernal. It is extensively sold for the more valuable variety.

A sample of "Superior Rhode Island Bent" proved to be chiefly tall Red-top, not Rhode Island Bent, or fine Red-Top at all. The same was true of a sample of trade "*Agrostis canina*."

A sample bought for *Avena elatior* or tall Oat grass, proved to be a mixture of *Bromus secalinus* or Cheat or Chess, *Dactylis glomerata* or Orchard grass, much *Lolium perenne* or English Rye grass and some *Avena elatior*.

A sample bought for *Poa annua* or Annual Spear grass proved to be another *Poa*, which has not yet been identified.

Another sample bought for Sweet Vernal grass contained a large quantity of seed of a handsome, but agriculturally worthless, annual grass, *Apera spica-venti*.

A sample of "Hard Fescue," *Festuca duriuscula*, proved to be about half Hard Fescue and half Sheep's Fescue.

The Southern Cow Pea has grown very vigorously in the garden, furnishing a large amount of forage and ripening its seed before frost.

It is noteworthy that *Phalaris arundinacea* or Reed Canary-grass, the *Glycerias* and certain sedges, notably *Carex vulgaris*, which are wet-land or marsh grasses, made excellent growth in our garden soil. It may be that these and other grasses if freed from competition with other plants or from the grazing of cattle would thrive as well in dry as in wet places.

From these notes it is evident that the trade in pure seed is not in a satisfactory state and that fresh seed true to name for a garden like ours must be collected by those in charge, for it cannot be bought with any certainty as to quality. This fact was fully appreciated at the outset and we have only bought seed when it was impossible to get it otherwise. We have now gathered from our own garden, as the list on page 173 shows, small quantities of seed from many species of grass which is true to name. The Station will be glad to receive from any source seeds or sods of grasses not in this list, and to exchange for them any sod or seed which it has in surplus. To the extent of its ability it will aid any institution which has such work in prospect. It will also continue to receive from citizens of Connecticut plants for identification as explained in Bulletin No. 91.

The Station is also always prepared to examine for farmers seeds of grasses or of vegetables with reference to their purity and vitality as explained in the Report for 1883, page 105.

How the practical information which the Station garden offers can best be distributed through the state is an important question. Personal visits to the garden will certainly be profitable alike to the visitor and to those in charge of it, favoring an exchange of knowledge on the subject. The Station can supply to a limited number of Granges, Farmers' Clubs or Schools small collections of named grass-seeds for planting if they are desired. Should sufficient interest be awakened it could perhaps arrange to send by mail whole plants for inspection and study as they come into bloom through the season. The recommendation of the Dairymen's Association made at its recent meeting that Agricultural Societies offer small premiums for the best collections of named grasses is a step in the right direction.

The following pages of explanations are here repeated, with some minor changes, from Bulletin No. 93 of this Station.

On the Classification and Naming of Plants.

To aid in understanding the plan by which men of science have classified and named grasses and other plants, the following explanations are offered.

It is evident at the outset that in order to describe a plant exactly words must be used which have as far as possible a strictly definite and unmistakable meaning. Botanists acting on this principle have adopted certain words which they employ in their classification of plants. Such words are *variety*, *species*, *genus*, and *family*. In the following pages we have endeavored to give the sense in which the botanist uses some of the more important of these terms, believing that the farmer also will find great benefit in their scientific use.

A Species is intended to include all individual plants which are very closely alike in form, structure and manner of growth, and which steadily reproduce plants which are like the parents in all these particulars. For instance there is a species called the white oak (*Quercus alba*). The leaves of every white oak tree have a general oblong or egg shape, but are cut into 3 to 9 oblong or linear lobes, having no pointed tips, smooth, of a bright green color above and pale below. All white oaks bear their acorns in the fall, on wood of the same year's growth, the cups of these acorns are rough, hemispherical, and much shorter than the acorns themselves, which are oblong. No other oak but the white oak has all these peculiarities of structure and growth. The white oak cannot be confounded by any one who knows these facts, with the red oak, or the shrub oak, or the swamp white oak which are three distinct species. Moreover from the acorns of the white oak only a white oak will grow, never a swamp white oak, shrub oak or red oak. The white oaks are related by a kind of common origin which the other oaks do not have in common with them. Another distinguishing mark of a species is the power of continued reproduction between individuals belonging to it. All white oaks cross-fertilize, i. e., the pollen from one white oak tree will fertilize the pistillate flower of any other white oak tree, whereas it would not fertilize the pistillate flower of another perfectly distinct species of oak. Among grasses, Hungarian grass (*Setaria Italica*) is one species and the yellow fox-

tail (*Setaria glauca*) is another and related species. The differences between these two [species differences or *specific* differences] are well known to many farmers.

Varieties.—Individuals of the same species while very closely alike differ from each other more or less. Circumstances of soil, climate, etc., increase these differences and varieties originate when such differences assume a *comparative permanence and fixity.* But as external conditions cause variations away from any particular representative of a species, so they may cause variation back again to the original, and although variation may take a seemingly wide range, its bounds are fixed and do not touch specific characters. Among plants varieties may often be perpetuated by the seed. This is true of our cereals and leguminous crops, which reproduce their kind with striking regularity. The Tom Thumb, Marrowfat and Champion of England peas, for instance, are all varieties of one species which are reproduced true to the seed. In case of certain other plants, particularly those in which there is abundant chance for a mixing of pollen, favorite varieties cannot be, or are not, certainly reproduced unalterably by the seed.

Red-top [*Agrostis vulgaris*] has two agricultural varieties as distinct as the Tom Thumb and the Champion of England Pea: Tall Red-top which grows 24–30 inches high, blooms a week later than the other variety and has a coarser foliage; Fine Red-top or, Rhode Island Bent, which grows 12–15 inches high, blooms earlier and has a much finer foliage. Both are reproduced true from seed. We also find forms intermediate between these two which evidently belong to the same species although they cannot always be classed with one variety rather than the other.

Genus.—All the different species of oaks have a general family resemblance noticeable by any one, and certain common characters, chiefly in their flower and fruit, which distinguish them from all other trees. This group of closely allied species makes a *genus* [plural, *genera*]. So we have the oak genus [*Quercus*] including the white oak, the chestnut oak, red oak, etc. In like manner we have the Red-top genus [*Agrostis*], which includes our common varieties of Red-top, already spoken of, besides fiorin [*Agrostis alba*], about which English grass books say so much, Brown Bent or Dog's Bent [*Agrostis canina*], and the Thin grass [*Agrostis perennans*], which grows in shady places, etc. The Timothy genus [*Phleum*] includes both our eastern

Timothy [*Phleum pratense*], or English grass and the Mountain Timothy of the west [*Phleum alpinum*].

Families.—The genera themselves are grouped into families. Thus the oaks, chestnuts, beeches, hazels and hornbeams, all belong in one family, the *Cupuliferæ* or cup bearers, so called because each fruit, a nut, is borne in a cup-shaped receptacle. So too the genera *Agrostis* and *Phleum*, and all other grasses belong in the one family of *Gramineæ*, whose aspect and characters are well known.

Names of Grasses.

In order to speak or write intelligibly of plants it is necessary to have a name for each which shall be commonly and perfectly understood and which shall apply to one species and only one. Following the method first proposed by Linnæus, "the father of botany," it was long ago agreed to give to each species of plants two names, one, the first, being the name of its genus, the second the species name; and in order that the same name might be used by botanists of all lands the Latin form was used, that being the nearest approach to a universal language. The name is given by the botanist who first identifies or classifies the plant and his name or initials are often put after the name which he gives. *Quercus*, as we have already seen, is the name of the oak genus, as distinguished from the hickory or chestnut genus, *alba* is the species or specific name and distinguishes the white oak from the red oak, live oak, post oak, etc. While the name white oak is recognized only where the English language is spoken and even there is liable to be confounded with the swamp white oak, which is a very distinct species, the name *Quercus alba* is understood by botanists all over the world. But it sometimes happens that after a plant supposed to be new has been named, it appears that it had been previously described and differently named by some one else. In such cases, to avoid all confusion, the invariable rule is to use the name first given.

These then are the names found in our standard botanical books. The objection to their common use is that they are in a strange language and sometimes long. They are hardly stranger, however, than "nitrogen," "available phosphoric acid," and "actual potash" were to most farmers a few years ago. The advantage of these names is that they avoid confusion and make intelligible our discussion of botanical matters. To illustrate: "Poverty grass" is a common grass, frequently spoken of among farmers, but this name is commonly applied to at least two very distinct species, viz: *Danthonia spicata*, which grows only in a very poor soil and is of no value as forage, and *Andropogon scoparius*, which also grows on poor sandy soil, but in some places makes valuable feed. This last is also called "broom sedge," whereas it is a grass and not at all a sedge. "Blue Stem" and "Blue Bent" are names of one of our best native grasses, *Andropogon provincialis;* "Blue Joint," which is dangerously like "Blue Stem," is the name of a grass very different from the last, viz: *Deyeuxia Canadensis.* "Wood grass" is applied to *Chrysopogon nutans*, a coarse but good forage grass, and to *Muhlenbergia Mexicana*, which is totally different in appearance and value. Now "Poverty grass," "Blue Stem," "Blue Bent" and "Wood grass," are indefinite terms, but *Danthonia spicata*, *Andropogon provincialis*, *Muhlenbergia Mexicana*, etc., can never be confused, since these names are used by all botanists and in their writings the peculiarities of these grasses are accurately and fully described. In the list of names of grasses on page 174 of this Report will be found both the botanical and colloquial names of the commonest grasses, which will illustrate these points and will also explain the meaning of some botanical names.

We believe that a better knowledge of our Connecticut grasses, of their habits of growth and forage value, is one great need of our agriculture. But the first step toward getting and spreading that knowledge must be to have names for the more useful ones, which shall be so definite that no one will misunderstand them, and which shall not be so difficult or uncouth that intelligent men will not use them. At present we have no such names *in common use* among us. There are not more than three or four grasses in this State whose common English names are generally used throughout the State without confusing synonyms which are also applied to other grasses. These are Timothy, Red-top, June-grass and Orchard-grass. Even Red-top applies to two grasses agriculturally distinct, and June-grass is a name quite generally used without the knowledge that it is the same as Kentucky Blue-grass. Yet there are at least eleven important meadow grasses which are mowed in large quantity every year in the State, and at least six others which are common and valuable pasture grasses, to say nothing of a number of less common but very useful ones and of the sedges, some of which are valuable. We have then on the one hand Latin botanical names which are tolerably free from confusion, and on the other hand common English names which are very much confused and indefinite. The former are not familiar and are, perhaps, harder to learn than the latter. The question is, can they and will they be learned by intelligent farmers? If not, can English names be agreed upon for all our common grasses which shall be as definite and free from confusion as the botanical names, and can they be brought into common use? A revision of the grass nomenclature now in common use, like the revision of pomological names which is at present going on, is very desirable. Till it is accomplished, the Station, to be accurate and clear, can only use the botanical names, supplying where possible the best common names, as on page 174 of this Report.

The following list includes all grasses which have grown in the Station Forage-garden during the present season. The annual grasses of course, at this time, are dead, and have been sown again for next year. An asterisk (*) before the name of a grass denotes that we have at our disposal, for exchange, a few young plants or sods; a dagger (†) in the same position denotes that we have seed for exchange. The quantity which we propose to exchange will be but quite small, in most cases only sufficient for a drill seven or eight feet long; enough, however, to show the characters of the grass, and to yield seed next year for a larger sowing, if that is desired. The seed we believe to be sound, strictly pure and true to name, most of it gathered in this garden and by our own hands.

GRASSES IN THE GARDEN OF THE STATION.

Agropyrum caninum. [Triticum caninum of Gray's botany.]

divergens.

† glaucum.

† repens. [Triticum repens of Gray's botany.]

† tenerum.

Agrostis exarata.

*† perennans.

† scabra.

*† vulgaris, var. major.

*† vulgaris, var. minor.

*† var. alba?

*†Alopecurus pratensis.

†Andropogon dissitiflorus. [A. Virginicus of Gray's botany.]

† provincialis, [A. furcatus of Gray's botany.]

*† scoparius.

†Anthoxanthum odoratum.

† var. Puelii.

†Apera spica-venti.

†Aristida purpurascens.

purpurea.

*†Arrhenatherum avenaceum.

*†Asprella hystrix. [Gymnostichum hystrix, of Gray's botany.]

*†Avena flavescens.

†Boutiloua olygostachya.

*†Bromus brizaeformis.

† ciliatus.

*inermis.

*pratensis.

*† Schraederi.

*† secalinus.

† segetum.

*† tectorum.

[Carex stricta.]

[tentaculata.]

*[vulgaris.]

†Cenchrus tribuloides.

†Chrysopogon nutans, [Sorghum nutans of Gray's botany.]

†Cinna arundinacea.

Cynosurus cristatus.

[Cyperus Michauxianus.]

*†Dactylis glomerata.

*†Danthonia spicata.

Deschampsia caespitosa.

† flexuosa.

† pulchella?

†Deyeuxia Canadensis. [Calamagrostis Canadensis of Gray's botany.]

Diplachne fascicularis, [Leptochloa fascicularis of Gray's botany.]

Eatonia obtusata.

Eleusine Indica.

Elymus Canadensis.

*† Virginicus.

†Eragrostis capillaris.

*† pectinacea.

† pilosa.

† poeoides, var. megastachya.

Erianthus Ravennae.

Eulalia Japonica.

var. variegata.

*Festuca duriuscula.

† pratensis.

heterophylla.

nutans.

*ovina.

*var. tenuifolia.

var. rubra.

† tenella.

†Glyceria aquatica. var. Americana.

† Canadensis.

nervata.

†Holcus lanatus.

Hordeum jubatum.

Leersia oryzoides.

Virginicus.

*†Lolium perenne.
*† var. Italicum.
* var. tenue.
Muhlenbergia capillaris.
† diffusa.
*† Mexicana.
Willdenovii.
†Panicum agrostoides.
† capillare.
clandestinum.
† crus-galli.
† var. hispidum.
dichotomum.
filiforme.
glabrum.
† latifolium.
† miliaceum.
proliferum.
† sanguinale.
† virgatum.
Paspalum setaceum.
*Phalaris arundinacea.
*†Phleum pratense.
Phragmites communis.
Poa annua.
* arachnifera.
*† compressa.
Nevadensis.
* pratensis.
*† serotina.
trivialis.
Reana luxurians.
†Setaria glauca.
† verticillata.
† viridis.
Sorghum halapense.
Spartina cynosuroides.
Sporobolus depauperatus.
† heterolepis.
Stipa pennata.
spartea.
*†Triodia seslerioides. [*Tricuspis seslerioides, of Gray's botany.*]
*Vilfa vaginaeflora.
aspera.

Since these botanical names are not familiar to many, there follow here by way of explanation, the botanical names of the more common agricultural grasses, their pronunciation indicated by accents, and their derivation given as far as that is possible. With each are given, in lighter type, the colloquial or provincial names by which they are sometimes known. As yet we have no really common names.

BOTANICAL AND COLLOQUIAL NAMES OF GRASSES.

Agropyrum répens, formerly called *Triticum repens*, [*Agropyrus* = field wheat, *repens* = creeping.] Couch-, Quitch-, or Quick-grass, Quack, Twitch- or Dog's-grass, Dutch-grass, Durfa, Devil's-grass. Grows through potato tubers!

Agróstis scábra, [*scabra* = rough.] Hair-grass.

Agróstis vulgáris. [*Agrostis* = a field, the place of growth, *vulgaris* = common or ordinary; i. e. common field grass.] Red-top, Fine-top, Furze-top, Burden-grass (from its fleece-like burden rolling from the scythe) Bent, Fine Bent, English grass, Rhode Island Bent. These names all apply in different sections to a variety that is twelve to fifteen inches high and blooms a little earlier than another taller variety, which is Tall Red-top. Tall Red-top grows twenty-four to thirty inches high, and is much sown with timothy and clover in short rotation.

The seed of this is now chiefly grown far west. That of the other for lawns should be saved from clean turf in the east as of well-swarded sheep pastures, with no mixture of other grasses.

Alopecúrus praténsis. [*Alopecurus* = a fox tail, *pratensis* = of the meadow.] Meadow Fox tail, "Mountain Timothy" of Montana. Blooms earlier, taller, and with a shorter head than Timothy, moreover the leaves and stems are of a darker and richer green.

Andropógon provinciális. [*Andropogon* = bearded man, the staminate or male flowers often being bearded, *provincialis* = of a province.] Thatch, Finger-spiked Broom-grass, Blue Stem, Blue Bent of Connecticut River meadows.

Andropógon scopárius. [*scoparius*, Latin = sweeping.] Wood-grass. Broom-grass, Broom sedge. The grass of the Wallingford plains.

Andropógon dissitiflórus. Broom sedge. Not a sedge but a grass.

The Andropogons start late in spring and stop growing with cool weather.

Anthoxánthum odorátum. [*Anthoxanthum* = flower of flowers, *odoratum* = odorous.] Sweet Vernal-grass, Sweet-scented Spring-grass. Has bitter foliage but scents the hay.

Arrhenathèrum avenàceum. [*Arrhenatherum* = awned stamen, *avenaceum* = like oats.] Tall Oat-grass. The foliage has a distinctly bitter taste. Early and hardy.

Chrysopógon nútans. [*Chrysopogon* = golden bearded, *nutans* = nodding.] *Sorghum nutans.* Indian-grass, Wood-grass. Starts late in spring and stops growing with cool weather.

Cínna arundinácea. [*Cinna*, name unexplained, *arundinacea* = reed-like.] Wood Reed-grass.

Dáctylis glomeráta. [*Dactylis* = finger's breadth, alluding to the size of the clusters, *glomerata* = crowded together, in allusion to the flower clusters.] Orchard-grass, Cock's-foot-grass, Rough Cock's-foot-grass. Young stems flat at base in fall and spring, and so quite distinct from Timothy. Almost evergreen.

Danthónia spicáta. [*Danthonia*, from Danthoine, a French botanist, *spicata* = spiked.] Poverty-grass. Oat-grass. Spiked wild Oat-grass. White Top.

Deyeúxia Canadénsis. Blue Joint, Small Reed-grass. Grows in wet places and makes good hay.

Festúca ovína. [*Festuca*, the old Latin name for it, *ovina* = belonging to sheep.] Sheep's Fescue. Makes the finest, close sward alone and without manure on suitable soils. Seed in market seems to grow plants which are seedy and bunchy. Remedy may be a return to old pasture seed.

Festúca praténsis. [*pratensis* = of the meadow.] Meadow Fescue. In Conn. we have very little or none of this species growing tall enough to answer the descriptions of *elatior* by English writers. Excellent for rich permanent meadow or pasture.

Glycéria Canadénsis. [*Glyceria* = sweet, in allusion to taste of the grain, *Canadensis* = Canadian.] Rattlesnake-grass, Tall Quaking-grass. Grows in wet places. Cattle eat it greedily.

Glycéria nerváta. [*nervata* = nerved.] Nerved Meadow-grass, Nerved Manna-grass, Fowl Meadow-grass. This name is properly applied only to *Poa serotina.* Makes good hay on wet land.

Glycéria aquática. [*aquatica* = aquatic.] Reed Meadow-grass, White Spear-grass. A wet meadow grass. Quite sweet at base of stalk.

Hólcus lanátus. [*Holcus* = attractive, *lanatus* = wooly.] Velvet-grass, Meadow Soft-grass, Velvet Mesquite-grass. Called "Calf-Kill" in Rhode Island from the rather dry and wooly, innutritious character of the forage, probably.

Leérsia oryzoídes. [*Leersia*, named for Leers, a German botanist, *oryzoides* = like rice.] Rice Cut-grass. Grows in wet places and in rich flowed land gives heavy crops. Fodder value not well known. Rough as a cow's tongue.

Muhlenbérgia Mexicána. [*Muhlenbergia*, named for Muhlenberg, an American botanist, *Mexicana* = Mexican.] Drop seed. Wood-grass.

Muhlenbérgia diffúsa. [*diffusa* = spreading, diffuse.] Drop-seed. Nimble Will.

Pánicum sanguinále. [*Panicum*, an ancient Latin name for millet supposed to come from the word meaning bread, *sanguinale* = bloody.] Common Crab or Finger-grass. A very common annual weed under the lawn-mower.

Pánicum agrostoídes. [*Agrostoides* = like an *agrostis*.] Red-top Panic.

Pánicum virgátum. [*virgatum* = made of twigs or osiers.] Tall Panic-grass, Switch-grass, Long-panicled Panic-grass, Black Bent of Connecticut River meadows. This species like *Andropogon provincialis* and *Chrysopogon nutans* has its foliage injured by frost.

These Panicums like the Andropogons are warm weather grasses.

Phléum praténse. [*Phleum*, an ancient Greek name, *pratense* = of the meadow.] Timothy, Herd's grass in New England and New York.

Póa ánnua. [*Poa*, ancient name for grass or fodder, *annua* = annual.] Low Spear-grass, Annual Spear-grass, Annual Meadow-grass, Goose-grass. Good for rich lawns.

Póa compréssa. [*compressa* = pressed together, flat.] Old English Blue-grass, Wire-grass, Flat-stalked Meadow-grass. Will grow in very dry places, sterile railway banks, etc. Endures the closest grazing.

Póa serótina. [*serotina* = late ripe or backward.] Fowl Meadow-grass, Late Flowering Meadow-grass, False Red-top. Fine hay on wet land.

Póa praténsis. [*pratensis* = of the meadow.] Green or common Meadow-grass, June-grass, Kentucky Blue-grass, Spear-grass. Smooth-stalked Meadow-grass. Excellent for parks and cemeteries. Seed-stalk frequently blasted early in the season. Very common all over Connecticut.

Póa triviális. [*trivialis* = common-place.] Rough-stalked Meadow-grass, Common Meadow-grass. It is scarce and uncommon in meadows except they are old, rich and moist or shaded. Loudon says this, with *P. annua*, are almost the only grasses that will grow in shaded and enclosed places in towns. *Festuca ovina* may have been in Loudon's mind when he wrote "almost."

Zizánia aquática. [*Zizanion* was the Greek name of some wild grain, *aquatica* = aquatic.] Wild Rice, Canada Rice, Indian Rice, Water Oats. Annually reproduces itself, six to ten feet in height, from under water in spring. Blades broad and green as small corn. Seed must be watched for as it falls daily in ripening.

FINE *versus* COARSE AGROSTIS.

By James B. Olcott.

We have been told by botanists that Fine *Agrostis*, Dwarf Red-top, Fine Bent, Furze-top, Burden-grass, and R. I. Bent—all names for the same thing, perhaps—are not to be distinguished, structurally, from Tall Red-top or *Agrostis vulgaris*. This point of *structure* we leave to those who are regulating our botanic system.

But whoever is habitually using and recognizing these forms of Red-top, in farm and garden practice, will deny the identity of the varieties in question. Except that we are inveterate mixers of grass-seeds (though few of us care for grass, only to get enough of it), we should never think of classing them together in any farm catalogue. Because they are no more alike as used by wise farmers and gardeners, than a pony is like a cart-horse.

When seeding plow-lots for a crop or two of hay, we should feel cheated, if a seedsman were to sell us, inadvertently, the smaller, to mix with Timothy, instead of the larger variety of *Agrostis*. On the other hand, when tired of plowing a field, and wishing to seed it so it will run from a meadow into a permanent "butter pasture," perhaps, or a green home-lot, with a fine close sward at bottom, we take much pains to get seed of the smaller grass. Sod of the larger one never tempted spade to lift it, but turf of fine *Agrostis* is a beautiful possession.

Hence—for seeding door-yards, or lawns, where *Agrostis* is preferred, and the best effects desired, the dwarf ones are so much finer in their leaves, stems and roots, that the coarse varieties will never be used in nice gardening for any such permanent purpose. We don't put carpet wools into broadcloth. This is not a treatise upon lawn-making, but parenthetically it may be said here that seedsmen's mixtures, composed of all they recommend for lawns, seem best devised to render uniform, fine texture impossible. We have creeping *Agrostis*, both coarse and fine, in old and well established varieties, preferring, so far as we know, decidedly wet land or wet seasons, and suffering on dry land in dry seasons. The fine one is of value in lawn-making, but to sow it, mixed, on very dry places, would be unskillful, wasteful, contrary to nature, which fitted it to endure wet, and to art which must mind all these particulars to produce a perfect lawn from seed. When farmers learn to grow, dealers learn to sell, gardeners learn to use, and consumers learn to appreciate pure seed, the art of lawn-making and all grass growing will be established on firm foundations. Mixed seeds for the lawn are like mixed colors for the artist, fibers for the factory, and drugs for the chemist—only valuable for purposes to which they exactly apply.

Agrostis, moreover, means *a field*, or *of the field*. This shows the old botanists knew what they were about. Few, if any of this species, bear shade or the drip of trees very well. The place in the door-yard for the *Agrostis*, then, is in the open, trodden, sunny parts of the ground, and plenty of pure seed must be used, where the land is foul with weeds (as it should not be) to produce fair results. Since clean, fine seed is so scarce—at present, indeed, well nigh impossible to find—impure seed has its value for pastures and meadows.

With seed of one coarse *Agrostis* the market is better supplied than ever before in the world. It makes seed freely at the west, and our stock in trade is drawn by train loads from clean fresh lands within two hundred miles of St. Louis. Its pressure on the market is such that it threatens to become more common than the old "common" grazier's Red-top.

Both forms of *Agrostis* are common in Connecticut, and often found growing side by side, one nearly twice as high as the other. Where much plowing is done, the larger variety is apt to prevail. The seed of it, being cheaper, and making tall, coarse hay, is often the only *Agrostis* sown. Where farm animals are brought home nights, from good old pastures, long free from the plow, the seed of dwarf Red-top is frequently scattered widely by cattle, or farm manure, and only for special purposes needs to be bought.

There are thousands of acres of rough pasture sward in every county of the State, largely composed of this old English "Fine Bent." Sheep, if well managed, improve a dwarf *Agrostis* sod, while eating most other kinds of grass out. The connection between fine mutton and Fine Bent seed-growing is natural and practically absolute. Since flocks have disappeared, the fine grass has been overgrown by coarser ones, or with weeds and bushes. Formerly hundreds of bushels of fine *Agrostis* seed were saved from sheep pastures in this State. Now we learn of none being grown for market.

Rhode Island—as nearly as diligent inquiry last spring could determine—is the only source of genuine "Bent" in American trade. Scattering districts and islands, where sheep and pains-taking family industries remain together, still produce a scant supply of this valuable seed; though, to say the least, it is sometimes none too clean; but for this fault there are plenty of excuses. From personal examination of the seed-producing districts, we have reason to believe that the product of pure seed—never very large—is now decreasing.

There are reasons for this which should be made public: *First*, botanists have not, generally, recognized the agricultural differences between coarse and fine *Agrostis*. *Second*, there were no positive safeguards against error, either in farm literature, history or tradition. Indeed, much of our literature is misleading. *Third*, buyers, in many cases, have not understood what they needed. *Fourth*, seedsmen, pressed by demand and pinched by supply, grew desperate or unscrupulous, when armed by botanic authority. *Fifth*, growers and land-owners, during the change or decline of eastern agriculture, became careless or helpless in this matter. These conditions, along with general laxity, indifference, pre-occupation and lack of accurate information in things graministic, combined, gradually to bring the much cheaper seed of coarse Red-top, mixed or unmixed, willfully or ignorantly, largely into use in place of the scarcer dwarf *Agrostis*. Many young farmers and gardeners do not recognize the latter, growing at their feet. Unless we have a change for the better in public comprehension, the production of Fine Bent seed for market is on its last legs.

Experiments in growing dwarf *Agrostis* at the far west, have not been successful. Timely rains, as well as close pasturage, and a good soil are required to produce a sod of fine *Agrostis* in several years time. It is a peculiarly wholesome and necessary industry, most in accordance with the genius and circumstances of the east, that is in danger of extinction.

The botanic situation was complicated, some ten or twelve years ago, by the well-meaning efforts of a Providence merchant—assisted by a botanist—to stem the tide of adulteration. This injured his own business and that of seed growers in the Narragansett country, who relied for a living on their sales of fine *Agrostis* seed under the trade name of Rhode Island Bent.

COMPLIANCE WITH THE FERTILIZER LAW ON THE PART OF DEALERS.

DEALERS who have complied with the fertilizer law by furnishing the Director of the Station with the information required in the 4th section:

Alford, G. H., Winsted.
Apothecaries Hall Co., Waterbury.
Balch & Platt, West Winsted.
Barstow, J. P. & Co., Norwich.
Benton, C. E., Sharon.
Birdsey & Foster, Meriden.
Blakeslee, Jacob, Watertown.
Brainard, H. K., Thompsonville.
Brownell, E. C., Moodus.
Butler, John L., Torrington.
Bun, Fred. P. & Co., Middletown.
Carman, J. B., So. Coventry.
Chandler & Morse, Putnam.
Chamberlain, A. L. & Co., New Haven.
Chamberlin, Lewis, North Coventry.
Converse, R. S, Stafford Springs.
Cutler, J. W., Putnam.
Dakin, C. B. & Co., Sharon.
Dean, Jas. E., Winsted.
Dickerman, Elam J., Mount Carmel.
Dyen, M. S., Canton.
Eddy, Sam'l, Canaan.
Ellsworth, F., Hartford.
Emmons, S. H., Moodus.
Leonard, J. E., Jewett City.
Gifford, H. M., East Woodstock.
Godfrey, E. A., Westport.
Goodman, John, East Litchfield.
Grant, Geo. W., Wapping.
Greenwood Co., New Hartford.
Griffiths, Silas, Sterling.
Gillette, C. S., Cheshire.
Hall, Henry L., 2d, Wallingford.
Hall, L. A. & Co., So. Coventry.
Hall, S. J., Meriden.
Hopson, Geo., Kent.
Hubbard, A. A., Canaan.
Hull & Sweet, So. Coventry.
James, C. D., Danielsonville.
Jones, H. L, New Hartford.
Kingsbury, Andrew, Coventry.
Knight, F. M., Thompson.
Lewis, J. A., Willimantic.
Littlefield, Jno. E., Niantic.
Lincoln & Boss, Willimantic.
Martin Bros., Wallingford.
Martin, C. F., Elliott.
Martin, F. W., Chaplin.
Mansfield, D. B., Harwinton.
Merrow, J. B. & Sons, Merrow.
Morgan, Daniel, Poquonnock Bridge.
Peck Bros., Northfield.
Phelps, J. P. & L. C., Hamden.
Platt & Merwin, Milford.
Pratt, C. M., Westbrook.
Roberts, A. F., Lakeville.
Russell, A. S. & Co., Meriden.
Sardam, Wm., Canaan Valley.
Smith, B. E., East Granby.
Smith, C. S., Kent.
Southington Lumber & Feed Co., Southington.
Still, Andrew J., Southport.
Stillman, H. A., Hartford.
Talcott & Alvord, Torrington.
Tucker, R. H., Saybrook.
Ure, Andrew, Hamden.
Walker & Nutting, Waterbury.
Warner, D. B. & Son, East Haddam.
Wilson, Allen, Suffield.
Wilson & Burr, Middletown.
Wilson, D. B. & Co., Waterbury.

The above should have had place on page 19 of this report, but was overlooked.

FERTILIZER SALES IN CONNECTICUT IN 1887.

In November last a circular was addressed to each manufacturer of fertilizers whose goods were legally sold in this state, asking for a statement of his total sales in Connecticut of the different classes of commercial fertilizers for the year ending Nov. 1, 1887. This request was made with the promise that the statement should be regarded as strictly confidential, and that only the aggregage sales in the state by all manufacturers should be published. Twenty-nine firms complied with this request, one firm declined to comply and thirteen took no notice of the circular. The aggregate amounts reported by twenty-nine firms are as follows:

Kainit	177
Muriate of potash	183
Sulphate of potash	30
Sulphate of ammonia	40
Nitrate of soda	69
Blood, Ammonite and Fish	157
Other nitrogenous matters	1,052
Bone	1,331
Plain superphosphate	195
Ammoniated superphosphates without potash	53
"Complete" manures	8,000
Total	11,287

If the sales of the fourteen other firms were on the average as large, the total sales would be about 16,700 tons. We believe the total sales were above rather than below these figures. A moderate estimate of the cost to purchasers of this quantity of fertilizers is $500,000.

THE COMPOSITION OF AMERICAN FEEDING STUFFS.

BY DR. E. H. JENKINS.

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

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

Composition of American Feeding Stuffs.

Name.	Analyses.	Total Dry Matter. Min.	Max.	Aver.	Albuminoids or Protein. Min.	Max.	Aver.	Crude Fat. Min.	Max.	Aver.	Nitrogen-free Extract. Min.	Max.	Aver.	Fiber. Min.	Max.	Aver.	Ash.
GREEN FODDER.																	
Maize Fodder	48	7.1	30.9	19.02	.6	3.0	1.63	.1	.9	.41	3.2	19.7	10.62	1.9	11.4	5.23	1.13
Maize Fodder, ensilaged	57	13.0	28.4	19.48	.7	2.8	1.49	.2	1.8	.68	5.1	18.3	10.26	3.0	10.0	5.68	1.31
Sorghum	7	13.6	28.4	21.66	.9	1.4	1.10	.2	.5	.36	5.3	27.0	13.08	4.7	8.5	6.25	.87
Sorghum, ensilaged	5	22.0	28.1	24.17	.6	.9	.75	.1	.4	.28	13.8	19.0	15.82	5.9	6.8	6.28	1.04
Rye Fodder	6	21.9	25.3	24.72	2.3	3.0	2.61	.2	.7	.56	4.9	12.4	6.94	4.9	14.9	12.73	1.88
Rye Fodder, ensilaged	1	----	----	19.25	----	----	2.42	----	----	.27	----	----	9.18	----	----	5.76	1.62
Oat Fodder	2	21.4	28.8	25.10	1.5	2.0	1.77	.4	.7	.57	10.8	14.6	12.70	7.1	9.5	8.27	1.79
Clover	1	----	----	26.67	----	----	4.09	----	----	.69	----	----	11.61	----	----	8.12	2.16
Clover, ensilaged	3	21.5	27.4	23.73	3.0	3.8	3.34	.9	1.1	1.02	8.1	11.4	10.21	5.1	8.6	6.66	2.50
Cow-pea vines, green and succulent	2	14.0	17.9	15.93	3.0	3.3	3.12	.6	.6	.60	5.3	8.5	6.90	2.9	4.1	3.48	1.83
Beet leaves	1	----	----	11.16	----	----	2.74	----	----	.60	----	----	2.49	----	----	2.50	2.83
Carrot leaves	1	----	----	16.70	----	----	4.26	----	----	.86	----	----	5.99	----	----	2.25	3.34
Cabbage ensilage	1	----	----	12.39	----	----	1.19	----	----	.93	----	----	4.52	----	----	1.59	4.16
HAY AND DRY COARSE FODDER.																	
Clover hay	33	78.2	93.9	88.63	8.9	20.8	12.55	1.5	4.3	2.44	35.0	49.0	40.55	15.6	35.7	26 86	6.23
Hay containing much clover	10	85.5	89.8	86.68	6.3	14.4	10.33	1.5	3.1	2.52	31.8	45.2	40.46	19.7	35.1	28.07	5.30
White clover hay	2	91.4	92.9	92.12	14.1	20.0	17.03	2.1	5.8	3.95	38.2	40.6	39.38	20.3	27.3	23.75	8.00
Alsike clover hay	4	91.6	94.8	92.63	11.4	16.1	13.50	1.6	4.2	2.35	36.5	43.5	40.86	27.7	29.5	28.61	7.31
Lucerne hay	3	92.5	94 4	93.52	15.0	18.6	17.04	1.8	2.4	2.05	35.5	39.2	37.12	26.2	33.0	30.21	7.10
Timothy hay (*Phleum pratense*)	53	84.5	92.9	89.76	4.2	9.6	6.06	1.0	3.4	2.12	39.2	58.5	47.10	22.7	38.5	30.37	4.11
Red top hay (*Agrostis vulgaris*)	1	----	----	90.16	----	----	7.25	----	----	1.95	----	----	46.52	----	----	27.45	6.99
Timothy and Red top	10	85.7	91.8	87 64	4.8	9.0	6.52	1.5	2.7	2.00	38.5	48.9	44.15	24.7	38.4	30.17	4.80
Orchard grass hay (*Dactylis glomerata*)	4	88.2	93.5	91.87	3.6	8.2	6.33	1.4	2.4	1.93	33.5	48.6	44 45	29.7	38.3	33.81	5.35
Hungarian grass hay	13	91.0	95.2	92.85	5.0	12.3	7.22	1.5	3.5	2.14	44.4	53.0	49.41	23.6	31.3	28.25	5.83
Barley hay (seed in milk)	1	----	----	89.75	----	----	9.21	----	----	2.47	----	----	47.49	----	----	26.14	4.44

Composition of American Feeding Stuffs—*Continued.*

Name.	Analyses.	Total Dry Matter. Min.	Max.	Aver.	Albuminoids or Protein. Min.	Max.	Aver.	Crude Fat. Min.	Max.	Aver.	Nitrogen-free Extract. Min.	Max.	Aver.	Fiber. Min.	Max.	Aver.	Ash.
HAY.—*continued.*																	
Oat hay	3	86.3	91.3	89.32	7.8	9.9	8.53	2.1	3.1	2.52	36.2	48.0	41.93	25.1	33.6	29.92	6.42
High meadow hay	2	88.7	89.4	89.02	6 8	8.3	7.57	2.0	2.5	2 25	46.9	47.5	47.19	24.3	25.2	25 78	6.23
Hay from mixed meadow grasses	9	81.0	87.0	84 52	4.9	7 9	6.24	1.4	2.7	2.05	34.4	47.3	40.43	23.7	35.9	31.09	4.71
Low meadow hay	10	85.5	93.6	89.50	4.6	10.4	7.70	.7	3.6	2.20	39.8	55.2	43.60	21.4	40.0	30.20	5.80
Hay from salt marsh grasses	13	81.4	92.8	89.89	4.0	7.8	5.69	1.6	3.1	2.31	34.1	54.3	44 10	25.1	37.9	30.51	7.28
Baled hay, "extra fine"	1	----	----	84.05	----	----	6.20	----	----	2.19	----	----	45·13	----	----	26.60	3.93
Maize fodder, field cured	4	60.6	77.1	65.02	3.8	4.6	4.23	.6	1.6	1.08	30.5	40.8	33.79	18.7	24.7	21.27	4.65
Maize stover, field cured	9	63.5	83.8	77.17	3.8	8.3	5.38	1.1	1.9	1.45	35.8	46.2	40.30	19.1	29.5	25.18	4.86
Maize stover, dried	11	87.0	92.4	90.43	3.4	8.5	5.02	.8	1.5	1.10	45.3	52.9	49.17	26.6	33.6	29.92	5.23
Buckwheat straw	3	89.6	91.0	90.09	3.3	7.8	5.15	.7	1.7	1.26	32.1	38.9	35.16	37.2	46.8	42.98	5.54
Oat Straw	12	87.5	93.5	91.26	2.3	6.9	3.82	1.0	3.2	2.22	26.4	51.4	38.89	29.5	56.0	41.52	4.81
Rye straw	8	87.5	93.7	92.24	2.2	6.9	3.46	1.0	2.7	1.40	35.7	52.9	38.35	34.2	43.3	45.25	3.78
Wheat straw	6	82.1	93.5	91.22	2.9	5.0	3.45	.8	1.8	1.29	31.0	50.6	37.33	34.3	42.7	44.99	4.16
Cow-pea vines	6	86.0	90.7	85.95	13.6	19.8	15.68	1.1	4.1	2.87	34.9	46.4	42.17	17.2	23.7	19.80	8.41
ROOTS, BULBS, TUBERS AND OTHER VEGETABLES AND FRUIT.																	
Beets, red	2	10.5	12.3	11.43	1.5	1.7	1.60	.2	.2	.18	7.2	7.6	7.40	.6	1.7	.12	1.08
Beets, sugar	8	9.2	16.4	13.03	1.7	2.9	2.01	.1	.2	.10	5.7	12.0	9 15	.7	1.1	.87	.90
Mangolds	6	5.6	11.7	8.68	1.0	1.9	1.52	----	.5	.16	2.4	8.4	5.00	.8	1.0	.84	1.16
Ruta bagas	1	----	----	12.92	----	----	1.15	----	----	.09	----	----	9.11	----	----	1.16	1.41
Turnips	2	7.6	8.2	7.92	.8	1.3	1.02	.1	.2	.18	5.8	4.2	5.03	.8	1.2	1.01	.68
Carrots	6	8.9	13.5	11.70	.9	2.0	1.16	.2	.7	.42	5.1	10.4	7.68	1.0	2.3	1.38	1.06
Onions	6	6.5	18.4	12.45	.8	2.3	1.41	.2	.4	.26	3.8	14.1	9.53	.6	.8	.69	.56
Potatoes	7	19.4	24.1	21.90	1.1	3.0	2.19	----	.2	.10	15.3	20.0	18.19	.3	.9	.54	.88
Sweet potatoes	5	26.6	34.0	29.37	.5	3.6	1.55	.3	.6	.38	18.0	29.7	25.09	.6	2.5	1.36	.99

Composition of American Feeding Stuffs—*Continued.*

Name.	Analyses.	Total Dry Matter.			Albuminoids or Protein.			Crude Fat.			Nitrogen-free Extract.			Fibre.			Ash.
		Min.	Max.	Aver.	Min.	Max.	Aver.	Min.	Max.	Aver.	Min.	Max.	Aver.	Min.	Max.	Aver.	
Roots, Bulbs, Etc.—*continued.*																	
Cabbage	2	6.5	10.2	*8.28*	1.8	2.0	*1.95*	.2	.5	*.33*	2.0	3.5	*2.75*	1.4	3.0	*2.21*	1.04
Squash	2	4.8	5.4	*5.12*	.6	.6	*.66*	.2	.3	*.28*	2.9	3.5	*3.24*	.5	.5	*.54*	.40
Pumpkin	1	----	----	*7.73*	----	----	*1.11*	----	----	*.16*	----	----	*4.34*	----	----	*1.49*	.63
Apples	5	15.9	22.7	*18.22*	.2	1.2	*.69*	.3	.6	*.41*	12.6	20.0	*15.31*	.9	2.9	*1.49*	.32
Grain and other Seeds.																	
Barley	9	87.4	92.7	*89.08*	8.6	15.7	*12.39*	1.5	3.1	*1.86*	66.7	73.9	*69.88*	1.2	4.1	*2.57*	2.38
Buckwheat	8	85.1	89.1	*87.40*	8.6	11.1	*10.00*	2.2	2.4	*2.25*	62.6	65.4	*64.50*	7.8	9.4	*8.70*	2.00
Oats (raised in Conn.)	7	86.5	90.7	*89.06*	8.0	10.1	*9.32*	4.7	5.8	*5.29*	59.0	63.2	*61.55*	8.9	12.9	*9.95*	2.95
Oats	25	86.5	91.1	*89.06*	8.0	14.4	*11.38*	3.4	5.8	*4.81*	50.8	66.9	*60.05*	1.5	19.4	*9.85*	2.97
Rye	6	86.8	91.3	*88.40*	9.5	12.1	*10.60*	1.4	2.1	*1.70*	70.7	73.9	*72.60*	1.4	2.1	*1.60*	1.90
Wheat, winter	242	83.8	92.9	*89.48*	8.3	16.6	*11.73*	1.3	3.9	*2.11*	68.1	76.6	*72.01*	.4	2.9	*1.77*	1.86
" spring	13	86.6	91.9	*89.63*	8.1	15.4	*12.51*	1.8	2.5	*2.20*	66.1	78.6	*71.19*	1.3	2.3	*1.82*	1.91
" unclassified	55	87.6	90.9	*89.31*	9.8	14.7	*11.96*	1.6	2.8	*2.10*	68.5	74.7	*71.50*	1.2	3.1	*1.92*	1.83
" Average of all Analyses	310	83.8	92.9	*89.46*	8.1	16.6	*11.80*	1.3	3.9	*2.11*	66.1	78.7	*71.89*	.4	3.1	*1.80*	1.86
Maize, dent	80	85.9	93.7	*89.91*	7.5	12.1	*10.33*	3.8	6.9	*5.10*	66.2	75.7	*70.66*	1.2	4.8	*2.28*	1.54
" flint	70	80.4	93.4	*88.93*	7.0	13.7	*10.57*	3.4	7.1	*4.96*	65.0	74.6	*70.31*	.7	2.9	*1.65*	1.44
" sweet	26	89.1	94.0	*91.18*	9.5	15.3	*11.62*	3.8	11.9	*8.14*	61.8	72.4	*66.70*	1.5	5.2	*2.80*	1.92
" "Western Corn"	3	79.3	83.6	*80.90*	7.8	8.6	*8.30*	3.6	3.9	*3.70*	64.9	68.2	*66.00*	1.7	1.8	*1.75*	1.20
" Average of all Analyses	192	79.3	94.0	*89.49*	7.0	15.3	*10.55*	3.4	11.9	*5.45*	61.8	75.7	*69.85*	.7	5.2	*2.09*	1.54
Sorghum Seed	9	83.2	90.7	*87.48*	7.6	11.2	*8.88*	2.1	4.6	*3.65*	66.8	73.6	*71.26*	1.4	3.2	*1.88*	1.80
Cotton Seed, hulls and kernels	1	----	----	*92.28*	----	----	*15.72*	----	----	*18.56*	----	----	*29.09*	----	----	*25.73*	3.16
Cow Pea	5	79.2	89.9	*85.21*	19.3	23.0	*20.77*	1.3	1.6	*1.43*	48.1	61.9	*55.75*	3.3	5.0	*4.06*	3.20
Soy Bean	4	86.9	93.9	*91.53*	34.6	40.2	*37.22*	12.3	19.0	*16.52*	26.2	30.5	*28.21*	3.7	5.0	*5.12*	4.46

Composition of American Feeding Stuffs—*Continued.*

Name.	Analyses.	Total Dry Matter.			Albuminoids or Protein.			Crude Fat.			Nitrogen-free Extract.			Fiber.			Ash.
		Min.	Max.	Aver.	Min.	Max.	Aver.	Min.	Max.	Aver.	Min.	Max.	Aver.	Min.	Max.	Aver.	
Flour and Meal.																	
Barley Meal	3	83.8	86.0	*84.90*	8.8	13.9	*11.80*	.7	2.2	*1.70*	----	----	*70.90*	----	----	*.10*	.50
Buckwheat Flour	4	82.4	87.2	*85.46*	4.2	8.1	*6.89*	.7	1.8	*1.44*	71.1	79.4	*75.79*	.2	.5	*.34*	1.00
Oat Meal	6	91.1	93.8	*92.15*	12.9	16.2	*14.66*	6.1	8.8	*7.06*	66.6	68.9	*67.57*	.6	1.2	*.86*	2.00
Rye Flour	4	86.4	87.7	*86.90*	6.0	7.1	*6.65*	.8	.9	*.84*	77.6	79.1	*78.28*	.4	.5	*.41*	.72
Wheat Flour, from Winter Wheat*	1	----	----	*87.04*	----	----	*8.56*	----	----	*1.19*	----	----	*76.59*	----	----	*.17*	.53
" from Spring Wheat†	6	86.5	89.7	*87.68*	8.6	14.1	*10.68*	.6	2.0	*1.11*	68.3	78.1	*75.00*	----	1.2	*.22*	.64
" Unclassified	21	86.4	88.8	*87.52*	9.7	13.3	*11.25*	.8	1.9	*1.16*	69.5	76.9	*74.33*	.1	1.0	*.25*	.53
" Average of all varieties	25	86.4	89.7	*87.44*	8.6	14.1	*11.28*	.6	2.0	*1.20*	68.3	78.1	*74.13*	.0	1.2	*.27*	.56
Graham Flour	3	86.3	87.9	*86.90*	11.3	12.4	*11.70*	1.5	1.9	*1.70*	69.8	70.0	*69.80*	1.8	2.1	*1.90*	1.80
Maize Meal	56	74.5	92.0	*84.15*	7.1	10.3	*9.16*	2.2	5.1	*3.81*	57.0	74.0	*67.84*	.5	2.8	*1.80*	1.46
Hominy	2	86.4	86.6	*86.50*	8.1	8.4	*8.25*	.4	.5	*.44*	77.1	77.2	*77.12*	.3	.3	*.32*	.38
Sorghum Meal, mostly decorticated	1	----	----	*86.84*	----	----	*8.25*	----	----	*3.85*	----	----	*71.27*	----	----	*1.88*	1.59
Pea Meal	2	87.0	91.2	*89.54*	19.1	21.4	*10.23*	.9	1.5	*1.19*	50.2	52.0	*51.09*	11.1	17.7	*14.33*	2.64
By Products and Refuse.																	
Apple Pomace	7	22.1	27.4	*22.94*	1.0	1.7	*1.40*	.6	2.0	*1.36*	12.6	17.6	*15.63*	2.0	5.9	*4.01*	.54
Brewers' Grains, wet from brewery	15	20.6	31.4	*24.99*	4.3	7.7	*5.57*	.8	2.9	*1.68*	10.1	15.7	*12.86*	3.0	5.6	*3.87*	1.01
" " "dried"	3	88.1	93.8	*91.81*	19.2	20.2	*19.89*	4.2	6.5	*5.56*	46.1	56.8	*51.75*	10.2	11.6	*11.01*	3.58
" " kiln-dried	1	----	----	*97.43*	----	----	*20.30*	----	----	*6.40*	----	----	*54.89*	----	----	*11.79*	3.97
" " from Silo	3	26.1	33.2	*30.18*	5.8	7.1	*6.64*	1.8	2.5	*2.11*	13.6	16.8	*15.58*	3.9	5.4	*4.64*	1.21
Brewers's Swill	1	----	----	*5.70*	----	----	*1.90*	----	----	*.80*	----	----	*2.00*	----	----	*.70*	.30
Malt Sprouts	3	88.0	92.7	*89.72*	21.0	25.9	*22.95*	1.1	2.9	*1.79*	45.4	50.3	*48.60*	9.3	11.9	*10.72*	5.67
Cotton Seed Meal	29	81.5	94.2	*91.68*	23.3	50.8	*42.39*	10.2	18.0	*13.37*	12.7	38.6	*22.97*	2.7	11.7	*5.69*	7.26

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

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

COMPOSITION OF AMERICAN FEEDING STUFFS—*Continued.*

Name.	Analyses.	Total Dry Matter.			Albuminoids or Protein.			Crude Fat.			Nitrogen-free Extract.			Fiber.			Ash.
		Min.	Max.	Aver.	Min.	Max.	Aver.	Min.	Max.	Aver.	Min.	Max.	Aver.	Min.	Max.	Aver.	
BY PRODUCTS AND REFUSE—*continued.*																	
Linseed Meal, Old Process	12	87.4	93.9	*90.97*	27.7	38.2	*32.33*	5.1	11.6	*8.24*	30.8	41.9	*35.22*	7.1	13.3	*9.31*	5.87
" New Process	12	86.6	93.2	*89.25*	27.1	37.1	*32.85*	1.3	4.4	*3.08*	35.2	48.0	*38.29*	7.6	14.0	*9.46*	5.57
" Oil not removed	1	----	----	*91.67*	----	----	*22.97*	----	----	*30.26*	----	----	*25.48*	----	----	*9.60*	3.36
Palm Nut Meal	3	89.1	93.8	*91.71*	13.5	16.0	*14.39*	6.4	18.7	*13.30*	33.8	41.6	*38.88*	18.7	23.9	*21.40*	3.74
Rye Bran	6	86.3	91.8	*88.51*	11.5	16.8	*15.28*	1.8	4.9	*2.46*	59.8	67.6	*63.66*	2.5	4.1	*3.52*	3.59
Wheat Bran	63	84.2	91.8	*87.72*	7.5	16.9	*15.07*	1.5	5.9	*3.78*	50.0	67.6	*54.26*	2.4	17.8	*8.71*	5.70
" Middlings	27	84.0	91.5	*88.00*	10.1	19.2	*15.17*	1.3	12.7	*4.01*	53.0	70.9	*60.99*	2.1	5.9	*4.57*	3.26
" Shorts	8	84 5	89.0	*87.26*	11.1	16.1	*13.83*	2.5	5.3	*4.14*	53.3	67.0	*57.59*	5.8	10.5	*7.45*	4.25
"Hominy Chops," "Hominy Feed," "Baltimore Meal," "White Meal"	11	86.5	91.9	*88.86*	7.9	11.2	*9.85*	4.6	11.2	*8.43*	61.0	71.1	*64.49*	2.5	4.8	*3.59*	2.50
Gluten Meal	11	88.3	92.7	*90.61*	25.0	35.0	*29.58*	4.2	8.7	*6.31*	44.7	58.5	*52.64*	.7	3.8	*1.34*	.74
Maize Cob	13	85.6	92.8	*90.67*	1.2	3.7	*2.50*	.1	.9	*.45*	45.3	66.4	*55.99*	28.2	38.2	*30.36*	1.33
"Starch Feed," refuse from starch manufacture	8	27.8	37.7	*34.34*	3.6	7.7	*5.73*	1.3	4.3	*3.02*	18.7	28.9	*22.21*	1.6	4.3	*3.17*	.21
"Sugar Feed," kiln-dried, refuse from glucose manufacture	2	89.6	93.4	*91.50*	13.1	13.5	*13.30*	5.9	11.2	*8.60*	54.9	61.4	*58.10*	8.4	10.7	*9.50*	2.00
Sorghum Bagasse	4	11.3	16.6	*14.50*	.6	.7	*.65*	----	----	----	----	----	*10.20*	2.8	3.3	*3.10*	.60

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ERRATUM.

Page 31, 13th line from bottom, for 122 read 115.