CORRECTIONS.

Page 17. Eighth line from the bottom, after *than* insert $\frac{1}{12}$.
Page 36. Ninth line from top, for *10596* read *10569*.
Page 40. In the fourteenth line from the bottom, for *good* read *food*.
Page 73. The guaranteed percentage of potash in Chittenden's potato phosphate No. 10355 is *eight* per cent. not *ten* per cent. as given in the table.
Page 124. For W. F. Wackley, Middletown, read W. F. Ackley.
Page 220. In the heading and also in second line under Vinegar, for *1897* read *1898*.

STATE OF CONNECTICUT

TWENTY-SECOND ANNUAL REPORT

OF

The Connecticut Agricultural Experiment Station

FOR 1898.

Printed by Order of the General Assembly

The publications of this Station are sent free to every citizen of Connecticut who applies for them. Address, The Conn. Agricultural Experiment Station, New Haven, Conn.

HARTFORD, CONN.
PRESS OF THE CASE, LOCKWOOD & BRAINARD COMPANY.
1899.

CONNECTICUT AGRICULTURAL EXPERIMENT STATION.

OFFICERS AND STAFF FOR 1898.

CONTENTS.

ANNOUNCEMENT.

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

The Station is prepared to analyze and test fertilizers, cattle-food, seeds, milk, and other agricultural materials and products, to identify grasses, weeds, moulds, blights, mildews, useful or injurious insects, etc., and to give information on various subjects of Agricultural Science, for the use and advantage of the citizens of Connecticut.

The Station does not undertake sanitary analyses of water.

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

1. That the results are of use to the public and are free to publish.

2. That the samples are taken from stock now in the market, and in accordance with the Station "Instructions for Sampling."

3. That the samples are fully described and retail prices given on the Station "Forms for Description."

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

☞ By a recent Act of Legislature it is made the business of this Station to examine articles of food and drink on sale in Connecticut, with reference to their adulterations.

Here it may be stated that, *until further notice*, the Station will examine only such samples of food and drink as are collected by its agents or such as shall be taken under its advice, and by the methods it shall prescribe or approve.

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

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

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

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

☞ Parcels by Express, to receive attention, should be *prepaid*.

☞ Letters sent to individual officers are liable to remain unanswered in case the officer addressed is absent. All communications therefore should be directed simply to the

AGRICULTURAL EXPERIMENT STATION,
NEW HAVEN, CONN.

and all remittances should be made payable to the undersigned.

☞ Station Grounds, Laboratories, and Office are on Huntington Street, five minutes walk west from Whitney Avenue and 1⅝ miles north of City Hall.

☞ Huntington Street may be reached by Whitney Avenue Electric Cars, which leave the corner of Chapel and Church Streets five times hourly, viz.: on the striking of the clock and at intervals of twelve minutes thereafter.

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

☞ The Grass Garden, in charge of Mr. James B. Olcott, is near South Manchester, five minutes walk from the line of the Manchester Electric Cars, leaving City Hall Square, State Street, Hartford, every half hour. Conductors on this line can direct visitors to the Garden.

S. W. JOHNSON, *Director*.

REPORT OF THE BOARD OF CONTROL.

To his Excellency, George E. Lounsbury, Governor of Connecticut:

The Board of Control of the Connecticut Agricultural Experiment Station herewith submits its Report for the year ending October 31st, 1898:

THE FERTILIZER CONTROL.

During the months of April, May, and June, Mr. V. L. Churchill, sampling agent of this Station, visited one hundred and twenty-nine towns and villages of Connecticut and drew seven hundred and seventy-six samples, representing two hundred and eighty-four of the two hundred and eighty-nine brands of commercial fertilizers which have been entered at the Station for sale in this State.

Analyses of samples of all these brands have been made in the chemical laboratory by Messrs. Winton, Ogden, and Mitchell, with the assistance of Mr. Lange.

A manuscript copy of each analysis has been sent to the manufacturers and to each dealer from whom a sample of the goods analyzed was taken.

The chemists named have also analyzed two hundred and eighty-five other samples of fertilizers and manurial waste products, making the total number of fertilizer analyses five hundred and sixty-nine.

A full account of the results of this work is given in Part I of the Report of the Station Staff.

EXAMINATION OF FOOD PRODUCTS.

One thousand and forty-eight samples of food products, the larger part of them bought by our sampling agent in open market, have been examined with reference to adulterants, by Messrs. Winton, Ogden, and Mitchell. A full account of this work and its results forms Part II of the Report of the Station Staff.

Nine samples of cattle foods have also been chemically and microscopically examined.

WORK FOR THE DAIRY COMMISSIONER.

All the chemical work required by the Dairy Commissioner has been done in the laboratory of this Station, including two hundred and three examinations of molasses, four of syrup, thirty-two of vinegar, seventeen of butter and imitation butter, and four of cream. Expert evidence has also been given in court when required.

OTHER CHEMICAL WORK.

In connection with work on the availability of different kinds of fertilizer-nitrogen, the chemists have made partial analyses of two hundred and twenty-one samples of turnips, Hungarian grass, red-top, and buckwheat; also fourteen samples of soil.

Considerable work has been done in the study of certain methods of quantitative analysis, which has included fifty determinations of nitrogen, forty-four of phosphoric acid, and thirty-six of potash, as well as a large number of determinations of nicotine, the alkaloid of tobacco.

STUDY OF PROTEIDS.

Dr. Osborne, with the assistance of Mr. Campbell, has made, during the year, an investigation of the proteids of wheat germs.

He has also devoted much labor to a closer study of several of the plant proteids described in former Annual Reports of this Station, and has taken up the investigation of egg-albumin.

It has been found that all proteid preparations contain small amounts of hydrochloric and sulphuric, or other acids, chemically combined to the proteid substance. Evidence has been obtained that *edestin,* for example, forms a series of definite compounds with acids, and the properties and composition of these compounds are being studied.

Some results of this work are ready for publication.

SEED TESTING.

Three hundred and thirty-three samples, chiefly of vegetable seeds, have been tested as to their vitality and germinative power, in the interests of seedsmen and purchasers.

Mycological Work.

The investigations of Dr. Sturgis during the last Station year have included a study of three Diseases of Melons, viz.: "Wilt,"— a bacterial disease, — Black Mold, and Leaf Burn, with field experiments to test preventive measures; also field experiments on the prevention of the Mildew of Lima Beans; preliminary notes on the "Calico" and the Natural Spotting of Tobacco; and much miscellaneous work on questions referred to him by correspondents throughout the State.

On September first Dr. Sturgis went to Europe, having been given six months' leave of absence, for the purpose of further study in his special department.

Horticultural and Entomological Work.

The study of the relative availability of organic nitrogen in various forms has been continued by Dr. Jenkins and Mr. Britton, with the coöperation of the Station chemists. Sixty-two cultures of red-top grass, sixty-two of turnips, thirty of Hungarian grass, forty-eight of privet, and fourteen of buckwheat have been made for this purpose, in galvanized iron pots charged with a natural soil, to which the several forms of nitrogenous plant-food had been added.

During the winter fifty comparative cultures of tomatoes, twelve of carnations, and ten of lettuce were made, on the one hand in rich compost, and on the other in a mixture of coal ashes, peat, and varying amounts of fertilizers. These cultures were made on the benches of the forcing houses to study the fertilizer requirements of these crops which are now grown extensively under glass.

Mr. Britton has also given attention to the grafting of chestnuts to determine the proper season and the best methods of setting chestnut cions in this State. Over two hundred cions were set at different times between April 20th and June 20th, in four separate places in and about New Haven.

The observations on the growth of forest-tree seedlings have been continued in coöperation with the Division of Forestry, U. S. Department of Agriculture.

In connection with the Section of Seed and Plant Introduction of the above-mentioned Department, forty-seven imported plants are being tested as to their value for cultivation in this country.

The Entomological work of the Station, which has considerably increased of late, has been done by Mr. Britton. Besides the correspondence and determination of insect species referred to the Station by correspondents, special attention has been given to a study of the San José scale; its present distribution in this State, its spread from infected places, and the effects of kerosene and other insecticides upon the scale, and also upon the trees to which they are applied.

Several States to which Connecticut nurserymen are shipping nursery stock have passed laws forbidding entry into those States of stock from nurseries which have not been inspected within the year, and requiring with each shipment a certificate of inspection. In response to requests from our nurserymen, Mr. Britton has made eleven inspections of nurseries, and in eight cases has given the desired certificate.

The method of banding trees to keep off canker worms, and the best substances to use on the bands, has also been studied.

Field Experiments.

Under the supervision of Dr. Jenkins, the three experiments on the fertilization of peach orchards, begun in 1896, chiefly to study the effects of different amounts of potash salts and of the forms of nitrogen best adapted to the crop, have been continued, but the account of them is reserved until further data are secured.

Tobacco Experiments.

Under the direction of Dr. Jenkins, the curing of wrapper tobacco by artificial heat and the fermentation of this tobacco in bulk, instead of in case, have been studied during the year. For this purpose, a new experimental tobacco barn was built at Windsor to replace the one destroyed by fire last year.

Station Publications.

The Twenty-first report of this Station, for the year 1897, a volume of 418 pages, has been issued in an edition of 7,000 copies. These have been distributed, after satisfying our exchanges, among the farmers of this State in response to applications.

Of the Second Annual Report on Food Products, 10,000 extra copies were printed at the expense of the Station, and distributed in our cities and villages to intelligent citizens who are, presumably, interested in pure food but are not reached by the regular edition that is intended for the use of agriculturists.

Bulletin No. 125, issued in April last, sixteen pages, was entitled "Preparation and Application of Fungicides."

Bulletin No. 126, twelve pages, entitled "Insecticides; Their Preparation and Use," and Bulletin No. 127, ten pages, entitled "The Cast of Plant-Food in Connecticut, Spring Months of 1898," were issued in May, 1898.

Five thousand copies of each bulletin were printed and distributed.

Bulletins 125 and 126 are not reprinted in this Annual Report.

Correspondence.

During the year three thousand two hundred and eighty-six letters and manuscript reports of fertilizer and other analyses have been written on Station business.

Meetings of the Board.

During the year ending October 31st the Board of Control has held three meetings.

All of which is respectfully submitted.

Wm. H. Brewer, *Treasurer.*

REPORT OF THE TREASURER.

Wm. H. Brewer, in account with The Connecticut Agricultural Experiment Station for the fiscal year ending September 30, 1898.

Receipts.

Balance from 1897,	$3.14	
State Appropriation, Agriculture,	10,000.00	
State Appropriation, Food,	2,500.00	
United States Appropriation,	7,500.00	
Analysis Fees due 1897,	3,550.00	
Analysis Fees due 1898,	3,095.00	
Miscellaneous,	127.57	
		$26,775.71

Disbursements.

S. W. Johnson,	$1,250.00
E. H. Jenkins,	2,500.00
W. H. Brewer,	433.32
V. E. Cole,	766.67
W. C. Sturgis,	2,000.00
T. B. Osborne,	1,700.00
A. L. Winton,	1,700.00
A. W. Ogden,	1,600.00
G. F. Campbell,	966.67
W. L. Mitchell,	825.00
H. Lange,	714.99
J. B. Olcott,	800.00
W. E. Britton,	1,100.00
C. J. Rice,	600.00
V. L. Churchill,	600.00
Labor,	911.60
Publications,	580.93
Postage,	155.77
Stationery,	235.47
Telephone and Telegraph,	117.77
Freight and Express,	78.88
Coal,	847.80
Gas,	357.50

Water,	$147.00	
Laboratory Supplies,	1,288.71	
Agricultural and Horticultural Supplies,	72.48	
Miscellaneous Supplies,	161.40	
Fertilizers,	102.39	
Feeding Stuffs,	100.37	
Library,	764.60	
Tools and Machinery,	77.10	
Furniture and Fixtures,	57.49	
Scientific Apparatus,	72.32	
Live Stock,	40.00	
Traveling Expenses of the Board,	60.91	
Traveling Expenses of the Staff,	156.64	
Tobacco Investigation,	1,501.13	
Fertilizer Sampling,	322.98	
Food Sampling,	244.65	
Unclassified Sundries,	20.25	
Repairs,	382.77	
Betterments,	78.77	$26,494.33
Balance to New Account,		281.38
		$26,775.71

Memorandum.—The accounts of the Treasurer have been duly audited by the State Auditors of Public Accounts, and the Report of the Treasurer for the fiscal year of the United States ending June 30, 1898, was duly rendered to the United States Secretary of the Treasury and the Secretary of Agriculture in July.

In the accounts as here written the disbursements for "Fertilizers" are exclusive of those used in the special Grass and Tobacco investigations, and those for "Traveling Expenses of the Staff" are exclusive of those used in the said investigations and also those used in the sampling of Foods and Fertilizers.

WM. H. BREWER,
Treasurer.

COMMERCIAL FERTILIZERS.

During 1898 fifty-four manufacturing firms have entered for sale in this State two hundred and eighty-nine distinct brands of fertilizers, viz.:

Special manures for particular crops, . . .	106
Other nitrogenous superphosphates, . . .	114
Bone manures and "bone and potash," . . .	38
Chemicals, including fish, tankage, and castor pomace, .	31
	289

The duties of this Station regarding fertilizers are prescribed by law as follows:

THE FERTILIZER LAW OF CONNECTICUT.

The General Assembly, in 1882, passed an act concerning Commercial Fertilizers, which, as amended in 1893, is now in force.

Attention is especially called to the following requirements of the law, the full text of which is printed on pages 3 and 4.

1. In case of *all* fertilizers or manures, except stable manure and the products of local manufacturers of less value than ten dollars a 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 has provided labels or statements and has paid the fee. Sections 4005 and 4007.

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

2. The law also requires, *in the case of every commercial fertilizer*, that a *sealed sample* shall be deposited with the Director

of the Station by the MANUFACTURER OR IMPORTER, and that a *certified statement* of composition, etc., shall be filed with him. Section 4006.

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

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

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

The percentage of insoluble phosphoric acid may be stated or omitted.

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

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

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

3. It is also provided that EVERY PERSON in the State, who sells *any commercial fertilizer of whatever kind or price*, shall annually report certain facts to the Director of the Experiment Station, and on demand of the latter shall deliver a sample for analysis. Section 4008.

4. All "CHEMICALS" that are applied to land, such as Muriate of Potash, Kainite, Sulphate of Potash and Magnesia, 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 4013 of the Act.

It will be noticed that the State exacts no license tax either for making or dealing in fertilizers. For the safety of consumers and the benefit of honest manufacturers and dealers, the State requires that it be known what is offered for sale, and whether fertilizers are what they purport to be. With this object in view the law provides, in Section 4013, 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.

ACTS CONCERNING COMMERCIAL FERTILIZERS.

Chapter CCLIII of the General Statutes of Connecticut as amended by Chapter CLXXII of the Acts of the General Assembly, Session of 1893.

SECTION 4005. Every person or company who shall sell, offer, or expose for sale, in this State, any commercial fertilizer or manure except stable manure, and the products of local manufacturers of less value than ten dollars a 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 trademark 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 usually employed by the Connecticut Agricultural Experiment Station.

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

SEC. 4006. Before any commercial fertilizer is sold, offered, or exposed for sale, the manufacturer, importer, or person who causes it to be sold, or offered for sale, within this State, shall file with the Director of the Connecticut Agricultural Experiment Station two certified copies of the statement prescribed in Section 4005, and shall deposit with said director a sealed glass jar or bottle containing not less than one pound of the fertilizer, accompanied by an affidavit that it is a fair average sample thereof.

SEC. 4007. The manufacturer, importer, agent, or seller of any commercial fertilizer shall pay on or before May 1, 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 when the manufacturer or importer shall have paid the fee herein required for any person acting as agent or seller for such manufacturer or importer, such agent or seller shall not be required to pay the fee prescribed in this section.

SEC. 4008. 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 and brand of said fertilizer, with the name and address of the manufacturer, importer, or party from whom such fertilizer was obtained, and shall, on demand of the Director of the Connecticut Agricultural Experiment Station, deliver to said director a sample suitable for analysis of any such fertilizer or manure then and there sold or offered for sale by said seller or agent.

SEC. 4009. No person or party shall sell, offer, or expose for sale, in this State, 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 every parcel or lot of the same.

SEC. 4010. 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 chemicals, approved by the director of said experiment station, in such quantity as to arrest decomposition: *provided, however*, that in lieu of such treatment such manufacturers may provide a means for consuming all smoke and vapors arising from such fertilizers during the process of manufacture.

SEC. 4011. Any person violating any provisions of the foregoing sections of this chapter shall be fined one hundred dollars for the first offense, and two hundred dollars for each subsequent violation.

SEC. 4012. This chapter shall not affect parties manufacturing, importing, or purchasing fertilizers for their own private use, and not to sell in this State.

SEC. 4013. The Director of the Connecticut Agricultural Experiment Station shall pay the analysis fees received by him into the treasury of the Station, and shall cause one or more analyses of each fertilizer to be made and published annually. Said director is hereby authorized, in person or by deputy, to take samples for analysis from any lot or package of manure or fertilizer which may be in the possession of any dealer.

SEC. 4014. The Director of the Connecticut Agricultural Experiment 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.

OBSERVANCE OF THE FERTILIZER LAW.

Here follows an alphabetical list of the manufacturers who have paid analysis fees as required by the Fertilizer Law, and the names or brands of the fertilizers for which fees have been paid by them for the year ending May, 1899:

Firm.	*Brand of Fertilizer.*
Armour Fertilizer Works, Chicago, Ill.	Ammoniated Bone with Potash, Grain Grower, Bone, Blood, and Potash. All Soluble.
Baker, H. J. & Bro., 93 William St., N. Y. city.	Complete Tobacco Manure, "AA" Ammoniated Superphosphate, "Harvest Home" Fertilizer, Complete Potato Manure, Complete Manure for General Use, Standard UnXLD. Fertilizer, Vegetable, Vine, and Potato Manure, Castor Pomace.
Berkshire Mills Co., Bridgeport, Conn.	Berkshire Complete Fertilizer, Ammoniated Bone Phosphate, Ground Bone.
Boardman, F. E., Little River, Conn.	Boardman's Complete Manure for Potatoes and Vegetables.
Bowker Fertilizer Co., 43 Chatham St., Boston, Mass.	Stockbridge Special Tobacco Manure, " " Corn Manure, " " Grass Top Dressing and Forage Crop Manure, " " Potato and Vegetable Manure, Bowker's Special Fertilizer — Potato and Vegetables, " Potato Phosphate, " Hill and Drill Phosphate, " Farm and Garden, or Ammoniated Bone Fertilizer, " Fish and Potash, Square Brand, " Tobacco Starter, " Sure Crop Phosphate, " Market Garden Fertilizer, " Square Brand Bone and Potash, " Corn Phosphate, " Bone and Wood Ash Fertilizer, " Tobacco Ash Elements, " " " Fertilizer, " Middlesex Special, " Fisherman Brand Fish and Potash, " Dry Ground Fish,

Firm.	*Brand of Fertilizer.*
Bowker Fertilizer Co., 43 Chatham St., Boston, Mass.	Nitrate of Soda, Dissolved Bone Black, Muriate of Potash, Fresh Ground Bone, Tankage.
Bradley Fertilizer Co., 92 State St., Boston, Mass.	Bradley's Eclipse Phosphate, " High Grade Tobacco Manure, " Farmers' New Method Fertilizer, " Original Coe's Superphosphate, " B. D. Sea Fowl Guano, " Triangle A Fish and Potash, " Anchor Brand Fish and Potash, " Circle Brand Ground Bone with Potash, " Fine Ground Bone, " Complete Manure for Corn and Grain, " Complete Manure for Top-dressing Grass and Grain, " Complete Manure for Potatoes and Vegetables, " Potato Manure, " Superphosphate, " Corn Phosphate, " Potato Fertilizer, " Niagara Phosphate, " Tobacco Fertilizer.
Wm. E. Brightman, Tiverton, R. I.	Brightman's Fish and Potash, " Tobacco Special and Market Garden Fertilizer, " Ammoniated Bone and Potash, " Bone Meal, " Dry Ground Fish.
Buckingham, C., Southport, Conn.	XX Formula.
Burwell, E. E., New Haven, Conn.	Double Sulphate of Potash, Muriate of Potash, Blood and Meat, Dissolved Bone Black, Nitrate of Soda.
Clark's Cove Fertilizer Co., P. O. Box 1779, New York city.	Great Planet A. Manure, Bay State Fertilizer, G. G., Potato Fertilizer, King Philip Guano, Defiance Complete Manure, White Oak Pure Ground Bone.
Cleveland Dryer Co., 92 State St., Boston, Mass.	Cleveland Superphosphate, " High Grade Complete Manure, " Potato Phosphate,

Firm.	*Brand of Fertilizer.*
Cleveland Dryer Co., 92 State St., Boston, Mass.	Cleveland Fertilizer, " Pioneer Fertilizer, " Extra Fine Ground Bone.
Coe, E. Frank Co., 133–137 Front St., New York city.	E. Frank Coe's High Grade Ammoniated Bone Superphosphate, " High Grade Potato Fertilizer, " Gold Brand Excelsior Guano, " Ground Bone and Potash, " Special Tobacco Fertilizer.
Connecticut Reduction Co., Bridgeport, Conn.	Conn. Reduction Co.'s Fertilizer.
Connecticut Valley Orchard Co., Berlin, Conn.	C. V. O. Co's Phosphate.
Cooper's Glue Factory, Peter, 17 Burling slip, N. Y. city.	Bone Dust.
Crocker Fertilizer & Chemical Co., Buffalo, N. Y.	Crocker's Potato, Hop, and Tobacco Fertilizer, " Ammoniated Bone Superphosphate, " Wheat and Corn Phosphate, " New Rival Ammoniated Superphosphate, " Pure Ground Bone, " Special Potato Manure, " General Crop Phosphate, " Ground Bone Meal, " Vegetable Bone Superphosphate, " New England Tobacco and Potato Grower, " A. A. Complete Manure, " Universal Grain Grower,
Cumberland Bone-Phosphate Co., State St. and Merchants Row, Boston, Mass.	Cumberland Superphosphate, " Concentrated Phosphate, " Potato Fertilizer, " Fertilizer, " Hawkeye Fertilizer, " Extra Fine Ground Bone.
Darling Fertilizer Co., L. B., Pawtucket, R. I.	Potato and Root Brand, Animal Fertilizer, Tobacco Grower, Blood, Bone, and Potash, Dissolved Bone and Potash, G. Brand, Pure Fine Bone.
Dennis, E. C., Stafford Springs, Conn.	Ground Bone.

Firm.	*Brand of Fertilizer.*
Downs & Griffin, Derby, Conn.	Ground Bone.
F. Ellsworth, Hartford, Conn.	Shoemaker's Swift Sure Bone Meal, " " " Superphosphate.
Great Eastern Fertilizer Co., Rutland, Vermont.	Northern Corn Special, Vegetable, Vine, and Tobacco, Grass and Oats, General, Garden Special.
Hartford Fertilizer Co., Hartford, Conn.	Ground Bone.
Kelsey, E. R., Branford, Conn.	Bone, Fish, and Potash.
Lederer & Wolf, New Haven, Conn.	Pure Ground Bone.
Lister's Agricultural Chemical Works, Newark, N. J.	Success Fertilizer, Standard Pure Bone Superphosphate of Lime, Special Potato, Potato Manure, Bone and Potash.
Lowell Fertilizer Co., 44 No. Market St., Boston, Mass.	Lowell Bone Fertilizer, " Animal Fertilizer, " Potato Phosphate, " Tobacco Manure, " Ground Bone, Dissolved Bone and Potash, Market Garden, Fruit and Vine.
Luce Bros., Niantic, Conn.	Dry Ground Fish Guano, Bone, Fish, and Potash.
Ludlam, Frederick, 108 Water St., N. Y. city.	Cecrops, or Dragon's Tooth Brand, Cereal Brand.
Manchester, E. & Sons, West Winsted, Conn.	Manchester's Formula.
Mapes, F. & P. G. Co., The, 143 Liberty St., N. Y. city.	Potato Manure, Tobacco Manure (Wrapper Brand), Economical Potato Manure, Corn Manure, Complete Manure "A" Brand, Cereal Brand, Tobacco Starter, Fruit and Vine Manure, Vegetable Manure, or Complete Manure for Light Soils, Grass and Grain Spring Top Dressing, Dissolved Bone, Tobacco Ash Constituents, Seeding Down Manure.
McCormack, William, Wolcott, Conn.	Ground Bone.

Firm.	*Brand of Fertilizer.*
Miller, George W., Middlefield, Conn.	Geo. W. Miller's Unexcelled Phosphate, " Pure Ground Bone.
Milsom Rendering & Fertilizer Co., 963 William St., East Buffalo, N. Y.	Potato, Hop, and Tobacco Phosphate, Buffalo Guano, Cyclone Bone, Wheat, Oats, and Barley Phosphate, Potato Special, Corn Fertilizer, Buffalo Fertilizer, Bone Meal, Dissolved Bone and Potash, Erie King, Dissolved Bone, Vegetable Bone Fertilizer.
National Fertilizer Co., Bridgeport, Conn.	Chittenden's Complete Fertilizers, " Ammoniated Bone, " Fish and Potash, " Market Garden, " Potato Phosphate, " Fine Ground Bone.
Niagara Fertilizer Works, The, Buffalo, N. Y.	Niagara Triumph, " Wheat and Corn Producer, " Grain and Grass Grower, " Potato, Tobacco, and Hop Fertilizer.
Nuhn, Successor to Frederick, Waterbury, Conn.	Ground Bone.
Olds & Whipple, Hartford, Conn.	O. & W. Special Phosphate.
Pacific Guano Co., P. O. Box 1368, Boston, Mass.	Soluble Pacific Guano, Potato Special, Nobsque Guano, High Grade General Fertilizer, Grass and Grain Fertilizer, Fine Ground Bone.
Packers' Union Fertilizer Co., P. O. Box 1528, New York city.	Wheat, Oats, and Clover Fertilizer, Universal Fertilizer, Animal Corn Fertilizer, Potato Manure, Gardeners' Complete Manure.
Peck Bros., Northfield, Conn.	Pure Ground Bone.
Plumb & Winton Co., Bridgeport, Conn.	Ground Bone.
Preston Fertilizer Co., Greenpoint, L.I.	Potato and Onion, Potato, Potato and Corn Guano.
Quinnipiac Co., The, 92 State St., Boston, Mass.	Phosphate, Potato Manure, Potato Phosphate,

Firm.	*Brand of Fertilizer.*
Quinnipiac Co., The, 92 State St., Boston, Mass.	Market Garden Manure, Grass Fertilizer, Corn Manure, Pure Bone Meal, Fish and Potash Crossed Fishes, Climax Phosphate, Pequot Fish and Potash, Onion Manure, Muriate Potash, Sulphate Potash, Sulphate Ammonia, Nitrate Soda, Dissolved Bone Black, Dry Ground Fish.
Read Fertilizer Co., Box 3121 New York city.	Read's Standard, Bone, Fish, and Potash, Vegetable and Vine, High Grade Farmer's Friend, Leader Guano, Practical Potato Special.
Rogers & Hubbard Co., Middletown, Conn.	Hubbard's Pure Raw Knuckle Bone Flour, " Strictly Pure Fine Bone, " Fertilizer for Oats and Top-dressing, " Fertilizer for All Soils and All Crops, " Potato Phosphate, " Soluble Potato Manure, " Fairchild's Formula, Corn and General Crops, " Soluble Tobacco Manure, " Grass and Grain Fertilizer.
Rogers Mfg. Co., Rockfall, Conn.	Pure Ground Bone, High Grade Soluble Potato, Complete Potato, Complete Corn, Oats and Top Dressing, High Grade Tobacco Manure, Grass and Grain Manure, Fish and Potash.
Russia Cement Co., Gloucester, Mass.	Essex XXX Fish and Potash, " Complete Manure for Potatoes, Roots, and Vegetables, " Complete Manure for Corn, Grain, and Grass, " Potato Fertilizer, " Tobacco Fertilizer.
L. Sanderson, New Haven, Conn.	Sanderson's Formula A, " Old Reliable Superphosphate, " Potato Manure, " Special with 10% Potash Nitrate of Soda,

Firm.	*Brand of Fertilizer.*
L, Sanderson, New Haven, Conn.	Dissolved Bone Black, Blood, Bone, and Meat, Sulphate of Potash (Double), Muriate of Potash, Bone.
Standard Fertilizer Co., Farlow Building, State St., Boston, Mass.	Standard Fertilizer, " Special for Potatoes, " Guano, " Complete Manure.
Tucker, Henry F. Co., Farlow Building, State St., Boston, Mass.	Tucker's Special Potato Fertilizer, " Original Bay State Bone Superphosphate, " Bay State Special Fertilizer, " Imperial Bone Superphosphate.
Wheeler, M. E. & Co., Rutland, Vt.	M. E. Wheeler & Co.'s High Grade Corn Fertilizer, " " High Grade Potato Manure, " " Superior Truck Fertilizer, " " Havana Tobacco Grower, " " High Grade Fruit Fertilizer, " " High Grade Grass and Oats, " " High Grade Electrical Dissolved Bone, " " High Grade Pure Ground Bone.
Wilcox Fertilizer Works, Mystic, Conn.	Potato, Onion, and Tobacco Manure, Complete Bone Superphosphate, Potato Manure, High Grade Fish and Potash, Dry Ground Fish Guano.
Williams & Clark Fertilizer Co., 27 William St., N. Y. city.	Americus Ammoniated Bone Superphosphate, Americus Potato Phosphate, Corn Phosphate, Americus High Grade Special, Royal Bone Phosphate, Fine Wrapper Tobacco, Americus Pure Bone Meal, Potato Manure, Muriate of Potash, Kainit, Dissolved Bone Black, Dry Ground Fish.

SAMPLING AND COLLECTION OF FERTILIZERS.

During April, May, and June, Mr. V. L. Churchill, the sampling agent of this Station, visited one hundred and twenty-nine towns and villages of Connecticut, to draw samples of commercial fertilizers for analysis. These places were distributed as follows:—

Litchfield County,	12
Hartford County,	34
Tolland County,	12
Windham County,	12
New London County,	12
Middlesex County,	15
New Haven County,	18
Fairfield County,	14
	129

In these places 776 samples were taken, representing all but five of the brands which have been entered for sale in this State.

The brands entered for sale in this State, which the sampling agent was unable to find on sale and of which no samples were received from the manufacturers, were the following:—

H. J. Baker & Bro.'s Complete Manure, for general use.
Cleveland Dryer Co.'s Extra Fine Bone.
The E. Frank Coe Co.'s Special Tobacco Manure.
Cumberland Fertilizer Co.'s Fertilizer.
The Williams & Clark Fertilizer Co.'s Dissolved Bone Black.

It has not been possible, therefore, for the Station to make analyses of these five fertilizers.

When several samples of a single brand were drawn in different parts of the State, the analysis was performed, not on any single sample, but on a mixture made of an equal weight of each of the several samples. Thus, it is believed, the average composition of the goods is more fairly represented than by the analysis of any single sample.

The Station agent is instructed in every case to open at least three packages of each brand for sampling, and, if the number of packages is very large, to take a portion from every tenth one, by means of a sampling tube which withdraws a section or core through the entire length of the bag or barrel.

As a rule, the Station will not analyze samples taken—

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

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

ANALYSES OF FERTILIZERS.

During the year, 569 samples of commercial fertilizers and manurial waste-products have been analyzed. A classified list of them is given on page 21.

On a few of these samples, analyses were made for private parties and charged for accordingly. A few others were analyzed at the request of other experiment stations in order to compare and test analytical methods. Results of the examination of all the samples, with these exceptions, are given in detail in the following pages. When the contrary is not stated, the samples were drawn by an agent of the Station.

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 correction or protest, before the results are published.

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

EXPLANATIONS CONCERNING THE ANALYSIS OF FERTILIZERS AND THE VALUATION OF THEIR ACTIVE INGREDIENTS.*

THE ELEMENTS OF FERTILIZERS.

The three chemical elements whose compounds chiefly give value, both commercial and agricultural, to fertilizers, are Nitrogen, Phosphorus, and Potassium. The other elements found in fertilizers, viz.: Sodium, Calcium, Magnesium, Iron, Silicon, Sulphur, Chlorine, Carbon, Hydrogen, and Oxygen, which are necessary or advantageous to the growth of vegetation, are either so abundant in the soil or may be so cheaply supplied to crops, that they do not considerably affect either the value or cost of high-priced commercial fertilizers.

NITROGEN in fertilizers is, on the whole, the least abundant of their valuable elements, and is, therefore, their most costly ingredient.

Free Nitrogen is universally abundant, making up nearly four-fifths of the common air, and appears to be directly assimilable by various low vegetable organisms, and with aid of certain bacteria, by leguminous plants (the clovers, alfalfa, peas, beans, lentils, esparsette, lupins, vetches, lathyrus, peanut, yellow locust, honey locust, etc.), and by a few non-leguminous plants, carrying root nodules, viz.: the Oleasters (*Eleagnus*), the *Alders* (*Alnus*), and a single family of coniferous trees (*Podocarpus*), but not at all, according to present evidence, by the cereals or other field and garden crops.

Organic Nitrogen is the nitrogen of animal and vegetable matters which is chemically united to carbon, hydrogen, and oxygen. Some forms of organic nitrogen, as those of blood, flesh, and seeds, are highly active as fertilizers; others, as found in leather and peat, are comparatively slow in their effect on vegetation, unless these matters are chemically disintegrated. Since organic nitrogen may often readily take the form of ammonia, it has been termed *potential ammonia*.

Ammonia (NH_3) *and Nitric Acid* (N_2O_5) are results of the chemical change of *organic nitrogen* in the soil and manure heap, and contain nitrogen in its most active forms. They occur in commerce—the former in sulphate of ammonia, the latter in nitrate of soda: 17 parts of ammonia, or 66 parts of pure sulphate of ammonia, contain 14 parts of nitrogen: 85 parts of pure nitrate of soda also contain 14 parts of nitrogen.

PHOSPHORUS is, next to nitrogen, the most costly ingredient of fertilizers, wherein it exists in the form of phosphates, usually those of calcium, iron, and aluminum, or in case of "superphosphates," to some extent in the form of free phosphoric acid.

Water-soluble Phosphoric Acid is phosphoric acid (or a phosphate) that freely dissolves in water. It is the characteristic ingredient of

* Prepared and revised by the Director.

superphosphates, in which it is produced by acting on "insoluble" (or "citrate soluble") phosphates, with diluted sulphuric acid. Once well incorporated with the soil, it gradually "reverts" and becomes insoluble, or very slightly soluble, in water.

Citrate-soluble Phosphoric Acid signifies the phosphoric acid (of various phosphates) that is freely taken up by a hot strong solution of neutral ammonium citrate, which solution is, therefore, used in analysis to determine its quantity. The designation *citrate-soluble* is synonymous with the less explicit terms *reverted, reduced,* and *precipitated,* which all imply phosphoric acid that was once easily soluble in water, but from chemical change has become insoluble in that liquid.

Recent investigation tends to show that water-soluble and citrate-soluble phosphoric acid are on the whole about equally valuable as plant food, and of nearly equal commercial value. In some cases, indeed, the water-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 insoluble both in water and in hot solution of neutral ammonium citrate. The phosphoric acid of Canadian "Apatite," of South Carolina and Florida "Rock Phosphate," and of similar dense mineral phosphates, as well as that of "bone ash" and "bone black," is mostly insoluble in this sense, and in the majority of cases gives no visible good results when these substances, in the usual ground state, are applied to crops. They contain, however, a small proportion of citrate-soluble phosphoric acid, and sometimes, when they are reduced to extremely fine dust (floats) or applied in large quantities, especially on "sour soils" or in conjunction with abundance of decaying vegetable matter (humus), they operate as efficient fertilizers.

Available Phosphoric Acid is an expression properly employed in general to signify phosphoric acid in any form, or phosphates of any kind that serve to nourish vegetation. In the soil, phosphoric acid and all phosphates, whatever their solubilities as defined in the foregoing paragraphs, are more or less freely and extensively available to growing plants. Great abundance of "insoluble" phosphoric acid may serve crops equally well with great solubility of a small supply, especially when the soil and the crop carry with them conditions highly favorable to the assimilation of plant food.

In Commercial Fertilizers, "available phosphoric acid" is frequently understood to be the sum total of the "water-soluble" and the "citrate-soluble," with the exclusion of the "insoluble."

The "insoluble phosphoric acid" in a commercial fertilizer costing $20 to $50 per ton, has very little or no value to the purchaser, because the quantity of it which can commonly go upon an acre of land has no perceptible effect upon the crop, and because its presence in the fertilizer excludes an equal percentage of more needful and much more valuable ingredients.

In Raw Bone the phosphoric acid (calcium phosphate) is nearly insoluble, because of the animal matter of the bones which envelopes it; but when the animal matter decays in the soil, or when it is disintegrated by boiling or steaming, the phosphate mostly remains in an available form. The phosphoric acid of "Basic-Slag" and of "Grand Cayman's Phosphate" is in some soils as freely taken up by crops as water-soluble phosphoric acid, but in other soils is much less available than the latter.

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

POTASSIUM is the constituent of fertilizers which ranks third in costliness. In plants, soils, and fertilizers, it exists in the form of various salts, such as chloride (muriate), sulphate, carbonate, nitrate, silicate, etc. Potassium itself is scarcely known except as a chemical curiosity. *Potash* signifies the substance known in chemistry as potassium oxide (K_2O), which is reckoned as the valuable fertilizing ingredient of "potashes" and "potash salts." In these it should be freely soluble in water and is most costly in the form of sulphate, and cheapest in the form of muriate (potassium chloride). In unleached ashes of wood and of cotton-seed hulls it exists mainly as potassium carbonate.

VALUATION OF FERTILIZERS.

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

Plaster, lime, stable manure, and nearly all of the less expensive fertilizers have variable prices, which bear no close relation to their chemical composition, but guanos, superphosphates, and similar articles, for which $30 to $50 per ton are paid, depend for their trade-value exclusively on the substances, *nitrogen, phosphoric acid, and potash*, which are comparatively costly and steady in price. The trade-value per pound of these ingredients is reckoned from the current market prices of the standard articles which furnish them to commerce.

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

TRADE-VALUE OF FERTILIZER ELEMENTS FOR 1898.*

The average trade-values or retail costs in market, per pound, of the ordinarily occurring forms of nitrogen, phosphoric acid, and potash in raw materials and chemicals, as found in New England, New York, and New Jersey markets during 1897 were as follows:

* Adopted at a conference of representatives of the Connecticut, Massachusetts, New Jersey, and Rhode Island Stations held in March, 1898.

	Cents per pound.
Nitrogen in ammonia salts,	14
in nitrates,	14
Organic nitrogen, in dry and fine-ground fish, meat, and blood, and in mixed fertilizers,	14
in cotton-seed meal,	12
in fine* bone and tankage,	13½
in coarse* bone and tankage,	10
Phosphoric acid, water-soluble,	4½
citrate-soluble,†	4
of fine* ground fish, bone, and tankage,	4
of coarse* fish, bone, and tankage,	3½
of cotton-seed meal, castor pomace, and ashes,	4
of mixed fertilizers, if insoluble in ammonium citrate,†	2
Potash as high-grade sulphate and in forms free from muriate (or chlorides),	5
as muriate,	4¼

The foregoing are, as nearly as can be estimated, the prices at which, during the six months preceding March last, the respective ingredients were retailed for cash, in our large markets, in those *raw materials* which are the regular source of supply. They also correspond to the average wholesale price for the six months ending March 1st, plus about 20 per cent. in case of goods for which we have wholesale quotations. The valuations obtained by use of the above figures will be found to correspond fairly with the *average retail prices at the large markets, of standard raw materials, such as the following:*

* In this report "fine," as applied to bone and tankage, signifies smaller than $\frac{1}{50}$ inch; and "coarse," larger than $\frac{1}{50}$ inch. From 1878 on for 10 years, we distinguished five grades of bone, as to fineness. In 1888, one, in 1897 two of the coarser grades were dropped from the list. The smaller grades remain unchanged in dimensions, but "coarse" was for the first 10 years larger than $\frac{1}{6}$ inch, for the next 9 years included all larger than inch, for the next year all larger than $\frac{1}{25}$ inch, and in this year all larger than $\frac{1}{50}$ inch; the former "coarse-medium," "medium," and "fine-medium" having been successively merged in "coarse."

† Dissolved from 2 grams of the fertilizer, previously extracted with pure water, by 100 cc. 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.

Sulphate of Ammonia,	Muriate of Potash,
Nitrate of Soda,	Sulphate of Potash,
Dried Blood,	Plain Superphosphates,
Azotin,	Dry Ground Fish,
Ammonite,	Bones and Tankage,

Ground South Carolina Rock.

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

The Organic Nitrogen in these classes of goods is reckoned at the price of nitrogen in raw materials of the best quality,* 14 cents.

Insoluble Phosphoric Acid is reckoned at 2 cents per pound. Potash is rated at 4¼ cents, if sufficient chlorine is present in the fertilizer to combine with it to make muriate. If there is more Potash present than will combine with the chlorine, then this excess of Potash is reckoned at 5 cents per pound.

In most cases the valuation of the ingredients in superphosphates and specials falls below the retail price of these goods. The difference between the two figures represents the manufacturer's charges for converting raw materials into manufactured articles and selling them. The charges are for grinding and mixing, bagging or barreling, storage, and transportation, commission to agents and dealers, long credits, interest on investments, bad debts, and, finally, profits.

The majority of the manufacturers agree that the average cost of mixing, bagging, handling, and cartage ranges from $3 to $4.50 per ton.

In 1898 the average selling price of Ammoniated Superphosphates and Guanos was $29.22 per ton, the average valuation was $19.30, and the difference $9.92, an advance of 51.4 per cent. on the valuation and on the wholesale cost of the fertilizing elements in the raw materials.

* This concession gives the dishonest manufacturer the opportunity to defraud the consumer very easily and very seriously, by "working off" inferior or almost worthless leather, bat guano, and similar materials which "analyze well," containing up to 8 or 9 per cent. of nitrogen, much or all of which may be quite inert. Since the Station has had no practicable means of determining with certainty the amount of worthless nitrogen or the quality of the nitrogen in a mixed fertilizer, and since the honest manufacturers (doubtless, the greater number) use only "materials of the best quality," it would be unjust to them to assume that these fertilizers contain anything inferior. Farmers should satisfy themselves that they are dealing only with honest and with intelligent manufacturers. This can be done at little cost by such co-operation as Farmers' Clubs and Granges may practice, sending a competent and trusty agent to visit factories frequently and unexpectedly, and take samples of raw materials. Honorable manufacturers will be glad to show all their raw materials and processes to their customers, especially if such inspection is insisted on as a preliminary to business. Co-operation may thus insure satisfactory quality of goods, as well as reduced cost.

In case of special manures the average cost was $33.11, the average valuation $21.72, and the difference $11.39 or 52.4 per cent. advance on the valuation.

To obtain the Valuation of a Fertilizer we multiply the pounds per ton of nitrogen, etc., by the trade-value per pound. We thus get the values per ton of the several ingredients, and adding them together we obtain the total valuation per ton.

In case of *Ground Bone and Tankage*, the sample is sifted into the two grades just specified (see footnote, page 17), and we separately compute the nitrogen-value of each grade by multiplying the pounds of nitrogen per ton by the per cent. of each grade, taking $\frac{1}{10}$th of that product, multiplying it by the trade-value per pound of nitrogen in that grade, and taking this final product as the result in cents. Summing up the separate values of each grade thus obtained, together with the values of each grade of phosphoric acid, similarly computed, the total is the Valuation of the sample of bone.

Uses and Limitations of Fertilizer Valuation.

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

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 tolerably sure that the price is reasonable. If the selling price is twenty to twenty-five per cent. higher than the valuation, it may still be a fair price; but in proportion as the cost per ton exceeds the valuation there is reason to doubt the economy of its purchase.

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

But the valuation is not to be too literally construed, for in some cases analysis cannot discriminate positively between the active and the inert forms of nitrogen, while the mechanical condition of a fertilizer is an item whose influence cannot always be rightly expressed or appreciated.

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

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

Experience leads to the conclusion that the trade-values adopted at the beginning of the 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.

Agricultural Value of Fertilizers.

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

CLASSIFICATION OF FERTILIZERS ANALYZED.

	No. of Samples
Raw Materials.	
1. *Containing Nitrogen as the Chief Valuable Ingredient.*	
Nitrate of Soda,	14
Sulphate of Ammonia,	2
Dried Blood,	2
Cotton-Seed Meal,	34
Castor Pomace,	5
Rape-Seed Meal,	1
2. *Containing Phosphoric Acid as the Chief Valuable Ingredient.*	
Rock Phosphate,	3
Dissolved Bone Black,	8
Acid Phosphate,	10
3. *Containing Potash as the Chief Valuable Ingredient.*	
High Grade Sulphate of Potash,	5
Double Sulphate of Potash and Magnesia,	9
Muriate of Potash,	19
Kainit,	4
Carbonate of Potash,	1
Silicate of Potash,	1
Phosphate of Potash,	1
Tobacco Stems,	4
4. *Containing Nitrogen and Phosphoric Acid.*	
Bone Manures,	72
Tankage,	14
Fish,	6
Mixed Fertilizers.	
Bone and Potash,	3
Nitrogenous Superphosphates and Guanos,	133
Special Manures,	114
Home Mixtures,	24
Miscellaneous Fertilizers and Manures.	
Cotton Hull Ashes,	48
Corn Cob Ashes,	1
Wood Ashes,	20
Lime Kiln Ashes,	2
Lime,	1
Marl,	1
Plaster,	1
Bat Guano,	1
Street Sweepings,	1
Ground Weed Seed,	1
Jadoo Fiber,	1
Rotted Peat,	2
Total,	569

DESCRIPTION AND ANALYSES OF FERTILIZERS.*

The samples referred to in the following pages, unless the contrary is stated, were drawn by an agent of the Station.

I. RAW MATERIALS CHIEFLY VALUABLE FOR NITROGEN.

NITRATE OF SODA OR SODIUM NITRATE.

Nitrate of Soda is mined in Chili and purified there before shipment. It contains about 16 per cent. of nitrogen, equivalent to 97 per cent. of pure sodium nitrate. The usual guarantee is "96 per cent." of sodium nitrate, equivalent to 15.8 per cent. of nitrogen.

In rare cases cargoes have been found to contain sodium perchlorate which, even in small amount, is very injurious to vegetation.

Fourteen analyses of nitrate of soda are given in a following table. The percentage of nitrogen ranges from 15.32, equivalent to 93 per cent. of nitrate,—to 16.04. All the samples are therefore of fair to good quality.

The prices ranged from $40 to $45 per ton.

The cost of nitrogen in nitrate of soda has ranged from 12.7 to 14.7 cents per pound, the average cost being 13.5 cents, a cent less than in the previous year.

* This chapter has been prepared for publication by Dr. Jenkins. The analyses of fertilizers have all been made by Messrs. Winton, Ogden, and Mitchell, chemists of the Station, with the assistance of Mr. Lange.

ANALYSES OF NITRATE OF SODA.

Station No.	Sold by	Sampled from Stock of	Nitrogen.	Equivalent Nitrate.	Cost per ton.	Nitrogen costs cents per pound.
10377	M. L. Shoemaker & Co., Philadelphia,	Daniels Bros., Middletown,	15.72	95.42	$40.00	12.7
10304	Bowker Fertilizer Co., Boston,	W. H. Todd, North Haven,	16.04	97.36	41.00	12.7
10310	Bowker Fertilizer Co., Boston,	Fred. R. Jennings, Greenfield Hill,	15.58	94.57	40.00	12.8
10556	Bradley Fertilizer Co., Boston,	G. B. Porter, Waterbury,	15.40	93.48	40.00	13.0
10513	L. Sanderson, New Haven,	E. Manchester & Sons, West Winsted,	15.32	92.99	40.00	13.1
10256	E. E. Burwell, "	E. E. Burwell, New Haven,	15.94	96.76	42.00	13.2
10506	F. S. Bidwell, Windsor Locks,	George Rengerman, East Granby,	15.46	93.84	41.00	13.3
10444	Bowker Fertilizer Co., Boston,	Clifton Peck, Yantic,	15.60	94.69	43.00	13.8
10372	L. Sanderson, New Haven,	Dennis Fenn, Milford,	15.88	96.39	45.00	14.1
10381	Quinnipiac Company, Boston,	Olds & Whipple, Hartford,	15.80	95.91	45.00	14.2
10263	L. Sanderson, New Haven,	L. Sanderson, New Haven,	15.70	95.30	45.00	14.3
10428	L. Sanderson, "	Chas. B. Sheldon, W. Suffield,	15.14	91.90	45.00	14.7
10249	.....	S. D. Woodruff & Sons, Orange,	15.76	95.66	.....	.....
10162	L. Sanderson, New Haven,	Agricultural Station,	15.89	.....	.....	.....

SULPHATE OF AMMONIA, OR AMMONIUM SULPHATE.

This article, now made on a large scale as a by-product of gas works and coke ovens, usually contains over 20 per cent. of nitrogen, the equivalent of 94-97 per cent. of ammonium sulphate. The rest is chiefly moisture. The usual guarantee is 25 per cent. of ammonia, which is equivalent to 20.6 per cent. of nitrogen.

10380. Sold by Quinnipiac Co., Boston, Mass. Sampled from stock of Olds & Whipple, Hartford.

10658. Sold by L. Sanderson, New Haven. Sampled from stock of J. C. Eddy, Simsbury.

ANALYSES.

	10380	10658
Nitrogen,	20.94	20.94
Equivalent Ammonia,	25.43	25.43
Cost per ton,	$60.00	$65.00
Nitrogen costs cents per pound,	14.3	15.5

At these prices sulphate of ammonia is an expensive source of nitrogen as compared with nitrate of soda and the organic forms, and is not likely to be used much as a fertilizer.

DRIED BLOOD.

This consists of slaughter-house blood which has been dried by superheated steam or hot air. It is a finely pulverized, nearly odorless substance, red or nearly black in color, and rich in nitrogen that is quickly available to vegetation.

10314. Sold by the Bowker Fertilizer Co., Boston, Mass. Sampled from stock of Simeon Pease, by Fred. R. Jennings, Greenfield Hill.

10589. Sold by L. Sanderson, New Haven. Sampled by Geo. H. Bartlett, North Guilford, from stock bought by him.

ANALYSES.

	10314	10589
Nitrogen,	10.70	10.13
Phosphoric Acid,	.....	4.16
Cost per ton,	$28.00	$26.00
Nitrogen costs cents per pound,	13.1	11.4*

Of the nitrogen of **10314**, 87.3 per cent. were soluble in pepsin solution, demonstrating the absence of any such adulterant as ground leather.

*** Allowing 3½ cents per pound for the phosphoric acid.**

COTTON-SEED MEAL.

This material is of two kinds, which are known in trade respectively as undecorticated and decorticated. In their manufacture cotton seed is first ginned to remove most of the fiber, then passed through a "linter" to take off the short fiber or lint remaining, then through machines which break and separate the hulls. The hulled seed is ground and the oil expressed. The ground cake from the presses is used as a cattle food and fertilizer. The hulls are burned for fuel in the oil factory, and the ashes, which contain from 20 to 30 per cent. of potash, are also used as a fertilizer. In case of undecorticated meal, the hulls and the ground press-cake are mixed together.

The only samples received for analysis this year have represented clear, decorticated meal.

In the following table are given the percentages of nitrogen in thirty-four samples. The percentage of phosphoric acid in cotton-seed meal ranges from 2.69 to 3.44, and that of potash from 1.64 to 2.00, the average being 3.15 and 1.90, respectively. The cost per pound of nitrogen is determined in each case by deducting from the ton price $4.42—the valuation of the phosphoric acid and potash,—and dividing the remainder by the number of pounds of nitrogen in the ton of meal.

The average cost of cotton-seed meal has been about $21.50 per ton. The percentage of nitrogen has ranged from 7.04 to 7.97 and has averaged 7.44. The cost of nitrogen per pound has ranged from 10.2 to 12.4 cents, averaging 11.5 cents per pound, the cheapest form of quickly available organic nitrogen in our market.

CASTOR POMACE.

This is the ground residue of castor beans from which castor oil has been extracted. The nitrogen which it contains is quickly available to plants, but the pomace is extremely poisonous to animals, which often eat it greedily when the opportunity offers.

10384. Made by H. J. Baker & Bro., N. Y. city. Stock of Olds & Whipple, Hartford.

10846. Made by H. J. Baker & Bro., N. Y. city. Stock of J. C. Eddy, Simsbury.

10190. Made by H. J. Baker & Bro., N. Y. city. Stock of Olds & Whipple, Hartford.

Analyses of Cotton Seed Meal.

Station No.	Dealer.	Sampled by	Nitrogen.	Cost per ton.	Nitrogen costs cents per pound.
10191	McBride & Co., Memphis, Tenn.,	S. A. Kent, Suffield, Conn.,	7.81	$20.40	10.2
10216	American Cotton Oil Co., New York City,	Edward O. Marsh, New Milford,	7.76	20.50	10.4
10194	W. W. Cooper, Suffield,	C. D. Woodworth, Thompsonville,	7.97	21.50	10.7
10495	Morton Bancroft, Springfield, Mass.,	Henry Derwig, Warehouse Point,	7.56	21.00	11.0
10272	Chapin & Co., Boston,	E. Manchester & Sons, West Winsted,	7.37	20.75	11.0
10357	J. E. Perkins, Suffield,	F. B. Hatheway, Windsor Locks,	7.57	21.25	11.1
10498	W. W. Cooper, Suffield,	Station Agent,	7.60	21.50	11.2
10499	H. K. Brainard, Thompsonville,	Station Agent,	7.61	21.50	11.2
10429	W. W. Cooper, Suffield,	Chas. B. Sheldon, West Suffield,	7.40	21.00	11.2
10298	C. H. Dexter & Son, Windsor Locks,	E. S. Seymour, Windsor Locks,	7.50	21.50	11.4
10370	Bowkers Branch, Hartford,	H. W. Alford, Poquonock	7.38	21.25	11.4
10323	Olds & Whipple, "	Pitcher & Phillips, Thompsonville,	7.58	21.75	11.4
10279	W. W. Cooper, Suffield,	S. O. Ranney, Windsor Locks,	7.22	21.00	11.5
10361	Arthur Sikes, Mapleton,	D. I. King, Windsor Locks,	7.18	21.00	11.5
10500	H. K. Brainard, Thompsonville,	Station Agent,	7.42	21.50	11.5
10215	Ernest N. Austin, Suffield,	H. H. Austin, Suffield,	7.42	21.50	11.5
10308	American Cotton Oil Company,	W. H. Olcott, So. Manchester,	7.55	22.00	11.6
10571	....	P. P. Hickey, Burnside,	7.43	21.75	11.7
10479	Olds & Whipple, Hartford,	Stanton F. Brown, Poquonock,	7.73	22.50	11.7
10234	Arthur Sikes, Suffield,	G. A. Douglass, Thompsonville,	7.34	21.50	11.7
10724	C. M. Cox & Co., Boston, Mass.,	C. J. Dewey, Buckland,	7.20	21.50	11.7
10570	American Cotton Oil Company,	N. T. Case, Tariffville,	7.42	22.00	11.9
10409	C. H. Dexter & Son, Windsor Locks,	Fred. Thrall, Poquonock,	7.10	21.50	12.0
10408	Olds & Whipple, Hartford,	John Du Bon, "	7.10	21.50	12.0
10822	Olds & Whipple, Hartford,	T. P. Kinney, Windsor,	7.29	22.00	12.0
10432	C. F. Tallard & Son, Broad Brook,	C. D. Cannon, Windsor Locks,	7.04	21.50	12.1
10297	Olds & Whipple, Hartford,	Clark Bros., Poquonock,	7.49	22.50	12.1
10278		W. H. Prout, Suffield,	7.54	22.75	12.2
10288	Olds & Whipple, Hartford,	A. E. Holcomb, Poquonock,	7.23	22.50	12.4
10436	Olds & Whipple, Hartford,	A. H. Brown, "	7.30	22.50	12.4
10120	....	A. E. Plant, Branford,	7.66	.....	....
10179	C. A. Pease & Co., Hartford,	C. A. Pease & Co., Hartford,	7.48	.....	....
10549	Charles M. Cox & Co., Boston, Mass.,	Chas. M. Cox & Co., Boston, Mass.,	7.34	.....	....
10163	L. Sanderson, New Haven,	Agricultural Station,	7.40	.....	....

10189. Made by H. J. Baker & Bro., N. Y. city. Sampled from stock of Olds & Whipple, Hartford, by E. P. Brewer, Silver Lane.

10845. Sold by the Bowker Fertilizer Co., Boston, Mass. Stock of Newell St. John, Simsbury.

Analyses.

	10384	10846	10190	10189	10845
Nitrogen,	5.70	5.50	5.34	5.02	4.60
Phosphoric Acid,	1.60	....	1.64	1.43	....
Potash,	0.95	....	0.77	0.91	....
Cost per ton,	$19.00	$19.00	$19.00	$19.00	$19.00
Nitrogen costs cents per pound,	14.7	15.3	15.9	16.8	18.3

The percentage of nitrogen in these samples of castor pomace has a rather wide range, 4.60 to 5.70, and the cost of nitrogen per pound is much higher than in cotton seed meal. Many tobacco-growers, however, use castor pomace, believing that it imparts a desirable quality to the wrapper leaf, which is not obtained by cotton-seed meal. The experiments made by this Station for five successive years failed to show any advantage from the use of castor pomace in place of cotton seed meal as a tobacco fertilizer.

RAPE-SEED MEAL.

10220. A sample of this material, made by the Oil Seeds Pressing Co., 15-25 Whitehall street, New York city, and used by J. A. DuBon, Poquonock, in an experiment to test its value as a tobacco fertilizer, contained:

Nitrogen,	5.40	per cent.
Phosphoric Acid,	2.16	"
Potash,	.99	"

In composition it is not unlike castor pomace. As a tobacco fertilizer it did not prove satisfactory in 1898.

II. RAW MATERIALS OF HIGH GRADE CONTAINING PHOSPHORIC ACID AS THE CHIEF VALUABLE INGREDIENT.

DISSOLVED BONE BLACK.

Bone black, made by subjecting bone to a red heat without access of air, is used in sugar refineries to decolorize sugar solutions. The waste bone black, dried and treated with oil of vitriol, makes a " superphosphate " of high grade which does not cake together on standing, but remains as a fine powder suitable for application to the land.

In the following table are given analyses of seven samples of this material.

The cost of available phosphoric acid in dissolved bone black has ranged from 6.0 to 6.9 cents per pound, the average in the seven samples being 6.5 cents.

DISSOLVED ROCK PHOSPHATE OR ACID ROCK.

This material, made by treating various mineral phosphates with oil of vitriol, is the most common source of the phosphoric acid of factory-mixed fertilizers.

In the following table are given ten analyses of dissolved rock phosphate. The composition of the samples is by no means uniform.

The cost of available phosphoric acid ranges from 3.1 to 7.4 cents per pound, the average of six samples being 3.9 cents.

10741 is " Electrical Dissolved Bone," sold by M. E. Wheeler & Co. It is simply dissolved mineral phosphate, sold for about double the price of the other samples.

ANALYSES OF DISSOLVED BONE BLACK AND (☞) DISSOLVED ROCK PHOSPHATE.

Station No.	Sold by	Sampled from Stock of	Phosphoric Acid. Soluble.	Reverted.	Insoluble.	Total.	Cost per ton.	"Available" Phosphoric Acid costs cents per pound.
	Dissolved Bone Black.							
10721	Quinnipiac Co., Boston,	O. S. Olmsted, Melrose,	12.90	3.41	.74	17.05	$20 00	6.0
10588	Bowker Fertilizer Co., Boston,	A. L. Hitchcock, Plainville,	13.92	2.12	.18	16.22	19.50	6.1
10260	E. E. Burwell, New Haven,	E. E. Burwell, New Haven,	11.97	5.04	.45	17.46	22.00	6.4
10274	L. Sanderson, "	E. Manchester & Sons, W. Winsted,	16.00	.37	.15	16.52	22.00	6.7
10262	" " "	L. Sanderson, New Haven,	15.54	.60	.11	16.25	22.00	6.8
10427	" " "	Chas. B. Sheldon, West Suffield,	15.39	.86	.16	16.41	22.00	6.8
10373	" " "	Dennis Fenn, Milford,	15.79	....	.51	16.30	22.00	6.9
	Dissolved Rock Phosphate.							
10643	Geo. F. Taylor's Sons, N. Y. city,	H. C. C. Miles, Milford,	12.93	2.02	.26	15.21	10.25	3.4
10386	M. L. Shoemaker & Co., Phila.,	Daniels Bros., Middletown,	10.59	2.98	1.83	15.40	11.00	3.8
10385	Bowker Fertilizer Co , Boston,	W. B. Miller, Middlefield,	9.34	3.32	1.78	14.44	11.00	4.1
10458	" " "	Clifton Peck, Yantic,	9.63	4.10	1.48	15.21	12.00	4.2
10554	Bradley " " "	G. B. Porter, Waterbury,	8.67	3.37	2.05	14.09	12.00	4.6
10741	M. E. Wheeler & Co., Rutland, Vt.,	D. G. Chesebro, Center Groton,	8.98	4.90	1.16	15.04	21.00	7.4
10202	Berkshire Mills Co., Bridgeport,	S. E. Curtis, Stratford,	9.22	7.87	.47	17.56	11.00	3.1
10250		S. D. Woodruff & Sons, Orange,	12.46	1.42	.83	14.71	....	...
10714	Milsom Rendering & Fertilizer Co., East Buffalo, N. Y.,	Manufacturer,	10.19	3.09	.17	13.45	....	...
10276	Quinnipiac Co., Boston,	C. Buckingham, Southport,	10.42	3.70	1.62	15.74	....	...

III. RAW MATERIALS OF HIGH GRADE CONTAINING POTASH.

HIGH GRADE SULPHATE OF POTASH.

This chemical should contain over 90 per cent. of pure potassium sulphate (sulphate of potash) or about fifty per cent. of potassium oxide, the same quantity as is supplied by muriate, and should be nearly free from chlorine.

In the table, on pages 32 and 33, are given five analyses of high grade sulphate, all of them of fair quality.

DOUBLE SULPHATE OF POTASH AND MAGNESIA.

This material is usually sold as "sulphate of potash" or "manure salt," on a guarantee of "48-50 per cent. sulphate," which is equivalent to 25.9-27.0 per cent. of potassium oxide. Besides some 46-50 per cent. of potassium sulphate, it contains over 30 per cent. of magnesium sulphate, chlorine equivalent to 3 per cent. of common salt, a little sodium and calcium sulphates, with varying quantities of moisture.

The analyses of eight samples of this material appear in the table on pages 32 and 33. Two of them, Nos. **10294** and **10343**, contain considerably less potash than this material is usually guaranteed to contain, and in two others, **10235** and **10733**, the percentage of potash is rather low.

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 potassium oxide.

The percentages of potash in the seventeen samples whose analyses appear in the table, pages 32 and 33, range from 53.67 to 48.77, and average 51.1 per cent.

KAINIT.

Kainit is less uniform in composition than the other potash salts. It contains from 11 to 15 per cent. of potash, more than that quantity of soda, and rather less magnesia. These "bases" are combined with chlorine and sulphuric acid. Unless "calcined" it contains more water than occurs in sulphate or in 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 is not properly called or claimed to be a sulphate of potash, since it contains more than enough chlorine to combine with all the potash present, and there are sound reasons for believing that its potash exists largely as muriate and to a much less extent as sulphate. Its action and effects are unquestionably those of a muriate rather than of a sulphate.

Four analyses of kainit appear in the table, pages 32 and 33. The percentage of potash ranges from 11.14 to 13.80.

In 1898, the cost of potash in the samples of high grade sulphate of potash analyzed at this station, five in number, ranged from 4.6 cents to 5.1 cents per pound, and averaged 4.8.

The cost of potash in the "low grade" or double sulphate of potash and magnesia ranged from 4.9 to 6.8 cents per pound and averaged (8 samples) 5.8 cents, a cent more per pound than in the high grade sulphate.

In eleven samples of muriate of potash, the cost per pound of potash ranged from 3.8 to 4.5 cents per pound, and averaged 4.2 cents, this being the cheapest source of water-soluble potash in the market.

The cost of potash in Kainit ranged from 5.1 cents to 6.3 cents per pound.

ANALYSES OF (☞) POTASH SALTS.

Station No.	Sold by	Sampled from Stock of.	Per cent. Potash.	Equivalent Sulphate of Potash.	Equivalent Muriate of Potash.	Cost per ton.	Potash costs cents per pound.
	High Grade Sulphate of Potash.						
10426	L. Sanderson, New Haven,........	Chas. B. Sheldon, W. Suffield,...	49.39	91.37	......	$45.00	4.6
10512	L. Sanderson, New Haven,........	E. Manchester & Sons, W. Winsted,	48.48	89.69	......	45.00	4.6
10553	Bradley Fertilizer Co., Boston,......	G. B. Porter, Waterbury,.........	49.83	92.19	......	47.00	4.7
10313	Bowker Fertilizer Co., Boston,......	F. R. Jennings, Greenfield Hill,..	48.35	89.45	......	47.00	4.9
10345	Bowker Fertilizer Co., Boston,......	Bowker's Branch, Hartford,......	47.90	88.62	......	49.00	5.1
	Double Sulphate of Potash and Magnesia.						
10293	Bradley Fertilizer Co., Boston,......	James P. O'Connor, Wethersfield,	26.62	49.25	......	26.00	4.9
10259	E. E. Burwell, New Haven,........	E. E. Burwell, New Haven,......	26.14	48.36	......	28.00	5.4
10261	L. Sanderson, New Haven,.........	L. Sanderson, New Haven,......	25.78	47.69	......	28.00	5.4
10235	Ernest N. Austin, Suffield,........	H. H. Austin, Suffield,.........	23.96	44.33	......	28.00	5.8
10379	Quinnipiac Co., Boston,...........	Olds & Whipple, Hartford,.......	27.12	50.17	......	32.00	5.9
10294	Bowker Fertilizer Co., Boston,.....	James P. O'Connor, Wethersfield,	22.22	41.11	......	26.00	5.9
10343	Bowker Fertilizer Co., Boston,.....	Bowker's Branch, Hartford,......	23.03	42.61	......	30.00	6.5
10733	Bowker Fertilizer Co., Boston,......	H. K. Brainard, Thompsonville,..	24.16	44.70	......	33.00	6.8
	Muriate of Potash.						
10555	Bradley Fertilizer Co., Boston,......	G. B. Porter, Waterbury,........	52.14	......	82.38	40.00	3.8
10257	E. E. Burwell, New Haven,........	E. E. Burwell, New Haven,......	53.00	......	83.74	41.50	3.9
10312	Bowker Fertilizer Co., Boston,......	F. R. Jennings, Greenfield Hill,..	49.68	......	78.49	40.00	4.0
10659	Williams & Clark Fertilizer Co., New York,..........................	J. G. Schwink, Meriden,........	50.40	......	79.63	42 00	4.1
10442	L. Sanderson, New Haven,........	E. C. Warner, Fair Haven,.......	50.22	......	79.35	42 00	4.2
10305	Rogers & Hubbard Co., Middletown,.	H. W. Andrews, Wallingford,....	50.96	......	80.52	42.50	4.2
10371	L. Sanderson, New Haven,.........	D. Fenn & Son, Milford,........	50.14	......	79.22	42 00	4.2
10266	L. Sanderson, New Haven,.........	L. Sanderson, New Haven,......	49.39	......	78.04	42.50	4.3
10344	Bowker Fertilizer Co., Boston,......	Bowker's Branch, Hartford,......	50.15	......	79.24	43 00	4.3
10378	Quinnipiac Co., Boston,...........	Olds & Whipple, Hartford,......	50.97	......	80.53	45.00	4.4
10552	Great Eastern Fertilizer Co., Rutland, Vt.,..........................	Wm. M. Tyler, Waterbury,......	50.50	......	79.79	45.00	4.5
10203	Berkshire Mills Co., Bridgeport,.....	S. E. Curtis, Stratford,.........	53.59	......	84 67	......	....
10443	Bowker Fertilizer Co., Boston,......	Clifton Peck, Yantic,...........	50.98	......	80.55	......	....
10242	....	S. D. Woodruff & Sons, Orange,...	48.77	......	77.06	......	....
10248	....	" " "	53.12	......	83.93	......	....
10273	....	E. Manchester & Sons, W. Winsted,	53.67	......	84.80	......	....
10603	Geo. F. Taylor's Sons, N. York City,	H. C. C. Miles, Milford,........	51.91	......	82.02	40.40	3.9
	Kainit.						
10433	....	D. Fenn, Milford,.............	13.80	25.53	......	14.00	5.1
10734	Bowker Fertilizer Co., Boston,.....	H. K. Brainard, Thompsonville,..	12.14	22.46	......	14.00	5.8
10657	Williams & Clark Fertilizer Co., New York,..........................	J. G. Schwink, Meriden,........	11.74	21.72	......	14.00	5.9
10346	Bowker Fertilizer Co., Boston,......	Bowker's Branch, Hartford,......	11.14	20.61	......	14.00	6.3

HIGH GRADE SCOTCH MURIATE OF POTASH.

This material has a coarser grain than the German muriate. A sample, **10755**, sent by Chas. H. Weekes, 54 Maiden Lane, New York, contained 61.58 per cent. of potash soluble in water, which is about the quantity guaranteed by the manufacturers. Mr. Weekes states that it is sold at a somewhat lower price than the German muriate.

CARBONATE OF POTASH.

10296. A white, dry powder containing many small lumps, sold by the cask at $110.00 per ton. Sampled by Clark Bros., Poquonock. It is used by the Clark Bros. as a potash fertilizer for tobacco, being applied to the land, in solution, from a watering cart. The results are stated by the Clark Brothers to have been most satisfactory, both as regards yield of crop and quality of leaf.

The sample contained 64.55 per cent. of water-soluble potash, equivalent to 94.70 per cent. of carbonate of potash. Actual potash in this material cost 8.5 cents per pound, more than in any commonly used tobacco fertilizer.

SILICATE OF POTASH.

10481. A sample of silicate of potash, mixed with a little peat, which was given to the Station by the German Potash Syndicate for experimental use as a tobacco fertilizer, contained 19.40 per cent. of water-soluble potash and 21.50 per cent. of total potash.

PHOSPHATE OF POTASH.

A sample, **10482**, analyzed for the Storrs Station, contained 51.60 per cent. of potash and 41.23 per cent. of phosphoric acid, both soluble in water.

TOBACCO STEMS.

These consist, not of the stalks, but of the midribs of the leaves, stripped off in cigar factories. They are much used on tobacco lands, and, being free from weed seeds, make an excellent fertilizer and mulch for lawns, applied late in the fall.

10383. Broken tobacco stems. Bought of the P. J. Sorg Co., Middletown, Ohio. **10463.** Ground stems, and **10496**, unground stems; the three samples taken from stock of Olds & Whipple, Hartford.

ANALYSES.

	10383	10463	10496
Nitrogen,	1.55	1.05	1.07
Phosphoric Acid,	.47	.49	1.15
Potash,	4.96	5.60	5.32
Cost per ton,	$15.00	$18.00	$11.50

If we allow 14 and 4 cents per pound for nitrogen and phosphoric acid respectively, the cost of potash per pound, in the three samples, will be 10.4, 13.1, and 7.1 cents. It is evident that if the value of stems as a fertilizer rests wholly in their content of nitrogen, phosphoric acid, and potash they are uneconomical to buy at present prices.

But, like stable manure, they are also valuable for the organic, humus-forming material in them.

IV. RAW MATERIALS CONTAINING NITROGEN AND PHOSPHORIC ACID.

BONE MANURES.

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

The method adopted for the valuation of bone manures, which takes account of their mechanical condition as well as chemical composition, is explained on page 19.

1. *Bone Manures Sampled by Station Agents.*

In the following table are given analyses of forty-four samples of bone drawn by the Station agents. See pages 38 and 39.

The average cost per ton has been $29.49; the average valuation $25,55, showing that the Station schedule of valuations for bone has been lower than is justified by the average selling price of bone.

Analyses Requiring Special Notice.

The Bradley Fertilizer Co. was dissatisfied with the results of analysis No. **10394**, pp. 38 and 39, and asked that other samples be drawn and analyzed. Another sample, **10537**, pp. 38 and 39 was accordingly analyzed, which gave higher percentages of both nitrogen and phosphoric acid. Both analyses appear in the table.

The Lowell Fertilizer Co. was dissatisfied with analysis No. **10596**, pp. 38 and 39, stating that this brand usually contained from 2.27 to 2.69 per cent. of nitrogen, while our analysis showed only 2.03 per cent.

Nitrogen was then determined in each of the three samples, with the following results: 2.10, 1.96, 1.86; average, 1.97 per cent.; found in the mixture of the three, 2.03 per cent.

Two samples were then drawn from the stock of the Standard Feed Co., in Bridgeport, **10753** and **10754**; analyses, pp. 38 and 39.

The former was from bags, labeled and tagged, and contained 2.02 per cent. of nitrogen; the latter, from unlabeled bags, said by the manufacturer to be poultry bone, contained 2.25 per cent.

The Lowell Fertilizer Co. next asked that further samples be drawn from a number of places, by representatives of the Station and the Company, which was accordingly done.

The six samples, thus drawn, **10825** to **10830**, both inclusive, are given in the table, and all the analyses of this brand are tabulated below for ready comparison.

Analyses of the Lowell Fertilizer Company's Ground Bone.

MECHANICAL ANALYSES.

	10569	10753	10754	10825	10826	10827	10828	10829	10830
Smaller than $\frac{1}{50}$ inch,	60	68	63	66	65	67	68	60	63
Larger than $\frac{1}{50}$ inch,	40	32	37	34	35	33	32	40	37
Total, . .	100	100	100	100	100	100	100	100	100

CHEMICAL ANALYSES AND VALUATIONS.

	10569	10753	10754	10825	10826	10827	10828	10829	10830
Nitrogen, ...	2.03	2.02	2.25	1.87	1.90	2.17	1.61	2.23	2.10
Phosphoric acid, . . .	29.31	29.44	28.68	29.07	29.18	28.45	29.58	28.29	29.16
Cost per ton, ...	$30.00	28.00	28.00	30.00	30.00	30.00	30.00	30.00	30.00
Valuation per ton, . . .	$27.26	27.61	27.40	26.87	27.02	27.21	26.71	26.90	27.41

An inspection of all these analyses shows a tolerably uniform composition, the average of all the percentages of nitrogen being 2.02 per cent., nearly identical with the percentage reported in the first analysis.

Bone Manures Sampled by Manufacturers and by Purchasers.

In the table on pp. 40 and 41 are given analyses of sixteen samples of bone, which were sent by purchasers, and of one sample deposited by a manufacturer representing a brand which was not found in market by our sampling agent.

The Station is responsible for the correct subdivision and analysis of the small samples placed in its possession, but not for the accuracy with which those samples represent the several articles specified,—though it requires that a certificate be filed by the person drawing the sample, stating that it has been fairly drawn according to the printed directions furnished by the Station.

BONE MANURES. SAMPLED BY (☞) STATION AGENT. ANALYSES.

Station No.	Name or Brand.	Manufacturer.	Dealer.	Dealers' cash price per ton.	Valuation per ton.	Percentage difference between cost and valuation.	Chemical Analysis. Nitrogen.	Chemical Analysis. Phos. Acid.	Mechanical Analysis. Finer than 1/50 inch.	Mechanical Analysis. Coarser than 1/50 inch.
10544	Ground Bone.	E. C. Dennis, Stafford Springs.	Manufacturer.	$22.00	$24.08	*8.6	4.29	21.16	13	87
10240	Preston's Ground Bone.	Preston Fert. Co., Greenpoint, L. I.	O. G. Beard, Shelton.	25.00	26.38	*5.2	2.56	27.30	47	53
10281	Ground Bone.	Berkshire Mills Co., Bridgeport.	Manufacturer.	28.00	27.60	1.4	2.93	26.76	63	37
10753	Ground Bone.	Lowell Fertilizer Co., Boston.	Standard Feed Co., Bridgeport.	28.00	27.61	1.4	2 02	29 44	68	32
10754	Ground Bone.	Lowell Fertilizer Co., Boston.	Standard Feed Co, Bridgeport.	28.00	27.40	2.2	2 25	28.68	63	37
10255	Armour's Bone Meal.	Armour Fertilizer Works, Chicago.	C. J. Benham, New Haven.	27.00	26.07	3.5	2.85	25.11	62	38
10546	Ground Bone Meal.	Crocker Fertilizer Co., Buffalo, N.Y.	H. C. Porter, Hebron. H. C. Aborn, Ellington.	28.00 30.00 29.00	27.89	4.0	2.93	26.74	70	30
10541	Pure Ground Bone.	G. W. Miller, Middlefield.	Manufacturer.	26.00	24.44	6.4	4.08	21.82	20	80
10723	Bone Meal.	Milsom Rend. & Fert Co., E. Buffalo.	W. T. Anderson & Son, Tolland.	28.00	26.22	6.8	3.25	24 43	55	45
10543	Fine Ground Bone.	L. B. Darling Fertilizer Co., Pawtucket.	F. L. Hitchcock, Watertown. A. I. Kinney, Terryville.	30.00 30.00	27.45	9.3	3.27	25.32	66	34
10830	Lowell Ground Bone.	Lowell Fertilizer Co., Boston, Mass.	S. R. Dean, Seymour.	30.00	27.41	9 4	2.10	29.16	63	37
10430	Fine Ground Bone.	L. Sanderson, New Haven.	Manufacturer.	30.00	27.39	9.5	4.18	22.23	67	33
10569	Ground Bone.	Lowell Fertilizer Co., Boston.	Bugbee Bros., Willimantic. J. P. Barstow, Norwich. A. A. Snow, Clinton.	30.00 32.00 30.00	27.26	10.0	2.03	29.31	61	39
10827	Lowell Ground Bone.	Lowell Fertilizer Co., Boston.	C. W. Lines, New Britain.	30.00	27.21	10.3	2.17	28.45	67	33
10307	Pure Raw Bone Meal.	Listers Agricultural Chem. Works, Newark, N. J.	M. D. Stanley, New Britain. A. N. Clark, Milford.	27.00 28.00 27.50	24.89	10.5	2.88	24.75	40	60
10264	Fine Ground Bone.	L. Sanderson, New Haven.	Manufacturer.	30.00	27.03	10.9	4.23	21.70	66	34
10826	Lowell Ground Bone.	Lowell Fertilizer Co., Boston.	D. N. Clark, Shelton.	30.00	27.02	11.0	1.90	29.18	65	35
10395	Hubbard's Pure Raw Knuckle Bone Flour.	Rogers & Hubbard Co., Middletown.	H. W. Andrews, Wallingford. W. C. Bulkley, Forestville. City Coal & Wood Co., N. Brit'n	32.50 32.00 35.50	28.72	11.4	3.86	25.36	62	38
10829	Lowell Ground Bone.	Lowell Fertilizer Co., Boston.	Bugbee Bros., Willimantic.	30.00	26.90	11.5	2.23	28.29	60	40
10825	Lowell Ground Bone.	Lowell Fertilizer Co., Boston.	C. N. Jones, Wallingford.	30.00	26.87	11.6	1.87	29 07	66	34
10828	Lowell Ground Bone.	Lowell Fertilizer Co., Boston.	S. A. Billings, Meriden.	30.00	26.71	12.3	1.61	29.58	68	32
10303	Ground Bone.	Hartford Fertilizer Co., Hartford.	S A. Billings, Meriden.	29.00	25.83	12.3	2.78	24.92	63	37
10389	Ground Bone.	Wm. McCormack, Wolcott.	Manufacturer.	28.00	24.81	12.9	4.28	22.46	10	90
10282	Chittenden's Ground Bone.	National Fertilizer Co., Bridgeport.	Manufacturer.	25.00	22.05	13.4	3.26	20.60	25	75
10393	Fresh Ground Bone.	Bowker Fertilizer Co., Boston.	W. O. Goodsell, Bristol. C. T. Leonard, Norwalk.	30.00 32.00	26.44	13.4	2.76	26.00	60	40
10397	Pure Ground Bone.	Peck Bros., Northfield.	W. H. Scott, Pequabuck. Apothecaries' Hall, Waterbury.	28.00 32.00	24.38	14.8	4.17	21.33	22	78
10545	Hubbard's Strictly Pure Fine Bone.	Rogers & Hubbard Co., Middletown.	Manufacturer. John Bransfield, Portland.	30.00 30.00	26.09	15.0	3.98	22.76	43	57
10277	Ground Bone.	Plumb & Winton Co., Bridgeport.	Manufacturer.	28.00	24.35	15.0	4.16	19.43	50	50
10740	Self-Recommending Fertilizer.	Successor to F. Nuhn, Waterbury.	Manufacturer.	30.00	26.06	15.1	4.13	20.52	69	31
10404	Pure Ground Bone.	Rogers Mfg. Co., Rockfall.	Manufacturer. John Bransfield, Portland.	30.00 30.00	25.89	15.9	4.45	20.88	45	55
10398	Swift Sure Bone Meal.	M. L. Shoemaker, Philadelphia.	Olds & Whipple, Hartford.	37.00	31.46	17.6	5.26	24.01	68	32
10306	Bone Meal.	M. E. Wheeler, Rutland, Vt.	J. F. Blakeslee, North Haven.	32.00	27.03	18.4	2.44	28.63	46	54
10540	Bone Meal.	W. E. Brightman, Tiverton, R. I.	Wm. Crane, Broad Brook.	28.00	23.24	20.5	3.31	20 07	59	41
10399	Pure Bone Dust.	P. Cooper's Glue Factory, N. York.	Apothecaries' Hall, Waterbury.	30.00	24.71	21.4	1.61	27 90	50	50
10539	Pure Ground Bone.	Lederer & Wolf, New Haven.	Edward White, Rockville.	30.00	24.50	22.4	2.48	25.01	48	52
10283	Ground Bone.	Downs & Griffin, Derby.	Manufacturer.	30.00	24.41	22.9	1.90	25.97	62	38
10388	Americus Pure Bone Meal.	Williams & Clark, New York.	Gault Bros., Westport.	30.00	23.71	26.5	2.72	22.20	66	34
10396	Bone Meal.	Quinnipiac Co., Boston.	Gault Bros., Westport. H. S. Coe, Harwinton.	30.00 32 00 31.00	24.47	26.7	3.07	22.18	64	36
10542	Cyclone Pure Bone Meal.	Milsom Rend. & Fert. Co., E. Buffalo.	G. W. Barnes, Poquonock.	35.00	26.54	31.9	3.70	23.14	60	40
10537	Fine Ground Bone.	Bradley Fertilizer Co., Boston.	P. Schwartz, Chesterfield.	32.00	23.84	34.2	2 90	22.13	60	40
10394	Fine Ground Bone.	Bradley Fertilizer Co., Boston.	S. A. Billings, Meriden. C. O. Jelliff, Southport.	33 00 29.00 32.00	23.07	38.7	2 62	21.59	68	32
10548	White Oak Pure Ground Bone.	Clark's Cove Fertz. Co., New York.	J. R. Ballard, Thompson.	30.00	21.42	40.0	3.06	18.43	60	40
10722	Extra Fine Ground Bone.	Cumberland Bone Phos. Co., Boston.	L. J. Storrs, Mansfield Center.	32.00	19.39	65.0	2.40	17.78	62	38
10547	Fine Ground Bone.	Pacific Guano Co., Boston.	Jas. W. Nichols, Danielson.	30.00	18.12	65.6	1.98	17 37	64	36

* Valuation exceeds cost.

BONE MANURES, SAMPLED BY MANUFACTURERS (☞) OR BY PURCHASERS. ANALYSES.

Station No.	Name or Brand.	Manufacturer or Dealer.	Sampled by	Dealers' cash price per ton.	Valuation per ton.	Chemical Analysis.		Mechanical Analysis.	
						Nitrogen.	Phos. Acid.	Fine, smaller than 1/50 inch.	Coarse, larger than 1/50 inch.
10715	Pure Ground Bone.	Crocker Fertilizer Co., Buffalo, N. Y.	Manufacturer.	....	$27.96	3.88	26.12	36	6
10132	Bone.	Mr. Davis, Rocky Hill, Conn.	Butler & Jewell, Cromwell.	....	20.05	3 62	18.18	2	9
10148	Bone.		C. M. Jarvis, Berlin, Conn.	$13.50*	21.14	3.50	20.16	1	99
10156	Bone.	Swift & Co., Chicago, Ill.	C. M. Jarvis, Berlin, Conn.	24.50*	26.87	4.00	24.66	31	69
10178	Pure Raw Bone.	The Scientific Fertilizer Co., Pittsburg, Pa.	H. B. Buell, Eastford.	29.00	26.56	3.72	23.63	52	48
10192	Nuhn's Self-recommending Fertilizer, made in summer, 1897.	Successor to F. Nuhn, Waterbury.	A. H. Coe, Waterbury.	....	27.38	4.79	20.92	58	42
10193	Nuhn's Self-recommending Fertilizer, made in winter, 1897–'98.	Successor to F. Nuhn, Waterbury.	A. H. Coe, Waterbury.	....	26.99	4.32	22.04	56	44
10226	Bone Fertilizer.	Plumb & Winton Co., Bridgeport.	F. L. Staples, Plattsville.	....	25.63	3.96	22.20	43	57
10238	Raw Wet Butchers' Bone.		C. M. Jarvis, Berlin.	....	......	2.87	18.71	.....	..
10275	Fine Ground Bone.	Bradley Fertilizer Co., Boston.	M. C. Knapp, Danbury.	31.00	22.34	3.04	19.96	55	45
10295	Fine Ground Bone.	Bowker Fertilizer Co., Boston.	J. P. O'Connor, Wethersfield	27.00	25.81	2.68	25.89	52	48
10309	Fresh Ground Bone.	Bowker Fertilizer Co, Boston.	W. H. Olcott, Manchester.	28 00	26.83	3.08	26.15	49	51
10461	Pure Ground Bone.	National Fertilizer Co, Bridgeport.	E. C. Warner, Fair Haven.	25 00	21.66	3.24	18.86	47	53
10478	Fresh Ground Bone.	Bowker Fertilizer Co., Boston.	N. S. Gallup, Ledyard.	28.00	23.98	2.94	21.63	70	30
10508	Darling's Ground Bone.	W. W. Cooper, Suffield.	Jos. Frohlinger, Jr., Suffield.	30.00	25.39	2.70	24.05	73	27
10644	Ground Raw Bone.	George F. Taylor's Sons, New York City.	H. C. C. Miles, Milford.	22.00	27.57	3.34	24.88	72	28
10840	Strictly Pure Raw Bone.	M. E. Wheeler & Co., Rutland, Vt.	G. H. Pearson, Bethel.	32.00	26.95	2.42	27.30	70	30

AN EXPERIMENT IN TREATING RAW BONE WITH SULPHURIC ACID.

Mr. C. M. Jarvis of East Berlin had a quantity of raw, wet butcher's bone cut up for poultry good. This treatment left it still very coarse for use as a fertilizer, and being very damp, and full of grease, milling it was out of the question. It has been proposed to treat raw bone with oil of vitriol in quantity only sufficient to convert the phosphoric acid into the dibasic combination ("reverted" phosphoric acid), an operation which is said to greatly increase its availability. This plan was tried with a small lot of this coarse, wet bone, hoping by the means to improve its mechanical condition as well as the availability of the phosphoric acid. Accurate sampling of the treated and untreated bone were, under the circumstances, not possible, but the analyses may serve to show the general effect of the treatment.

Forty pounds of concentrated oil of vitriol, 66°B, were poured into an oil cask over 265 pounds of the raw, wet bone above described, which contained

Nitrogen,	2.87
Water-soluble Phosphoric Acid,	.31
Citrate-soluble " "	10.85
Insoluble " "	8.05
Total " "	19.21
Water,	25.23
Grease,	21.54

The whole mass became hot and boiled, the sulphuric acid drawing water from the bone. It was stirred and mixed as thoroughly as was possible and allowed to stand for some days, when it was weighed, and a sample sent to the Station for analysis.

* Car lot, f. o. b. E. Berlin.

There resulted 270 pounds of a mixture, No. 10237, containing

Nitrogen,	3.50	per cent.
Water-soluble Phosphoric Acid,	2.85	"
Citrate-soluble Phosphoric Acid,	12.88	"
Insoluble Phosphoric Acid,	3.22	"
Total Phosphoric Acid,	18.95	"

Reckoning the number of pounds of nitrogen and phosphoric acid from these percentages, we have the following comparison:

	The raw bone contained	The acidified bone contained
Nitrogen,	7.6 pounds.	9.5 pounds.
Water-soluble Phosphoric Acid,	.8 "	7.7 "
Citrate-soluble Phosphoric Acid,	27.4 "	34.8 "
Insoluble Phosphoric Acid,	21.3 "	8.7 "
Total Phosphoric Acid,	49.5 "	51.2 "

It is probable that the raw bone did not contain as much citrate-soluble phosphoric acid as the analysis shows, for in order to bring the sample into condition for analysis it was necessary to dry a weighed portion and partially extract the grease. The analysis was made on this dried material and reckoned back to the fresh material. But this fresh bone would have certainly been less soluble in citrate solution than it was after drying and extraction.

The number of pounds of nitrogen and of total phosphoric acid should have been the same in the raw and in the dissolved bone, and the discrepancy is to be explained by the impossibility, under the circumstances, of getting a perfectly representative sample.

The results, however, show that more than half of the "insoluble" phosphoric acid of the raw bone was converted into soluble forms, the whole mass was dried, both by evaporation due to the great heat evolved (305 pounds of bone and acid lost 35 pounds during treatment) and by the "fixation" of water by calcium sulphate formed by the reaction of sulphuric acid and lime. Besides this, the material was made finer in its mechanical condition and further putrefaction was checked.

This method, which may be recommended for bone which has been cut or crushed into small pieces, is not applicable, probably, to coarse, raw bones, which offer a comparatively small surface to the action of oil of vitriol.

TANKAGE.

After boiling or steaming meat scrap, bone, and other slaughter-house waste, fat rises to the surface and is removed, the soup is run off, and the settlings are dried and sold as tankage. As analyses show, tankage has a very variable composition. In general, it contains more nitrogen and less phosphoric acid than bone.

In the table, pages 44 and 45, are given thirteen analyses of this material, five drawn by a Station agent and eight by purchasers.

These analyses show the usual differences in chemical composition.

Some question having been raised as to the quality of Tankage No. 10311, the pepsin-solubility of its nitrogen was determined and found to be 63.6 per cent., thus demonstrating the absence of any considerable amount of agriculturally inferior nitrogenous matter.

TANKAGE. (☞)

Station No.	Name or Brand.	Dealer.
	Sampled by Station Agent.	*Dealer.*
10258	Blood and Meat.	E. E. Burwell, New Haven.
10459	Tankage.	Clifton Peck, Yantic.*
10267	Blood, Bone, and Meat.	L. Sanderson, New Haven.
10265	Pulverized Bone and Meat.	L. Sanderson, New Haven.
10246	Tankage.	S. D. Woodruff & Sons, Orange.*
	Sampled by Purchaser.	
10181	Tankage.	
10311	Tankage.	Bowker Fertilizer Co., Boston, Mass.
10243	Tankage.	
10153	Tankage.	Sperry & Barnes, New Haven.
10227	Tankage.	Plumb & Winton Co., Bridgeport.
10374	Bone Tankage.	Plumb & Winton Co., Bridgeport.
10204	Tankage.	Berkshire Mills Co., Bridgeport.
10511	Tankage.	Berkshire Mills Co., Bridgeport.

DRY GROUND FISH.

This residue from the manufacture of fish oil is often sprinkled with diluted oil of vitriol, to hinder decay during drying, whereby the fish bones are softened and to some extent dissolved.

Six analyses of this article are given in the table below.

With a single exception, the nitrogen found in these samples is well above the seller's guarantee.

DRY GROUND FISH. (☞)

Station No.	Manufacturer or Wholesale Dealer.	Sampled from Stock of	Dealer's Cash Price per Ton.
10719	Wm. E. Brightman, Tiverton, R. I.	William Crane, Broad Brook,	$28.00
10720	Williams & Clark, New York, .	Daniels Mills Co., Hartford,	29 00
10716	Quinnipiac Co., Boston, . .	Olds & Whipple, Hartford,	30.00
10558	Wilcox Fertilizer Works, Mystic,	Manufacturer, . . .	30.00
		C. M. Smith, East Hartford,	31.00
10717	Luce Bros , Niantic, . .	W. C. Reynolds, E. Haddam,	32.00
10718	Bowker Fertilizer Co., Boston, .	E. F. Miller, Ellington, .	28.00

* Purchaser only.

ANALYSES AND VALUATIONS.

Sampled from Stock of	Dealer's cash price per ton.	Valuation per ton.	Percentage diff. between Cost and Valuation.	Chemical Analysis. Nitrogen.	Chemical Analysis. Phosphoric Acid.	Mechanical Analysis. Fine, smaller than 1/50 inch.	Mechanical Analysis. Coarse, larger than 1/50 inch.
E. E. Burwell, New Haven.	$29.00	$26.29	10.3	9.86	4.04	51	49
Clifton Peck, Yantic.	24.00	19.72	21.7	5.38	8.44	66	34
L. Sanderson, New Haven.	30.00	23.77	26 2	5.68	12.51	70	30
L. Sanderson, New Haven.	34 00	26.34	29.1	4.90	18.55	67	33
S. D. Woodruff & Sons, Orange.	......	23.41	....	5.53	14.60	40	60
C. M. Jarvis, Berlin.	12.50‡	22.62	44.7†	7.38	9.34	19	81
Fred R. Jennings, Greenfield Hill.	13.00	16.43	20.9†	5.12	4.99	66	34
J. G. Schwink, Jr., Meriden.	20.00	25.16	20 5†	7.51	9.75	53	47
F. T. Bradley, Saybrook.	21.00	23.36	10.1†	8.33	4.06	62	38
F. L. Staples, Plattsville.	25 00	22.91	9.1	5.40	13.16	57	43
D. Fenn & Son, Milford.	25.00	22.24	12.4	4.90	13.48	63	37
S. E. Curtis, Stratford.	......	24.03	...	6.15	13.07	46	54
E. Manchester & Sons, West Winsted.	......	26.80	....	9.46	4.77	64	36

MIXED FERTILIZERS.

BONE AND POTASH AND BONE AND WOOD ASHES.

10582. Bone and wood ash fertilizer, made by Bowker Fertilizer Co., Boston, Mass. Stock of S. E. Brown, Collinsville, and A. L. Hitchcock, Plainville.

10704. Ground bone and potash, made by The E. F. Coe

ANALYSES AND VALUATIONS.

Valuation per Ton.	Percentage Difference between Cost and Valuation.	Nitrogen. Nitrogen as Ammonia.	Nitrogen. Nitrogen, Organic.	Nitrogen. Tot. Nitrogen. Found.	Nitrogen. Tot. Nitrogen. Guaranteed.	Phosphoric Acid. Soluble.	Phosphoric Acid. Reverted.	Phosphoric Acid. Insoluble.	Phosphoric Acid. Total. Found.	Phosphoric Acid. Total. Guaranteed.	Phosphoric Acid. Available. Found.	Phosphoric Acid. Available. Guaranteed.
$29.64	5.5†	.22	8.42	8.64	*7.4*	.59	5.21	1.84	7.64	*7.0*	5.80	..
30.51	4.9†	.32	8.74	9.06	*7.4*	.94	4.56	1.61	7.11	*7.0*	5.50	..
30.55	1.8†	.30	8.90	9 20	*7.1*	.70	4.36	1.67	6.73	*7.0*	5.06	..
} 30.22	0.7†	.20	8.72	8.92	*8.5*	.61	4.83	2.07	7.51	*6.0*	5.44	..
29.83	7.3	1.50	6.86	8.36	*8.2*	.93	6.48	1.00	8.41	...	7.41	..
20.47	36.8	.34	5.36	5.70	*6.6*	1.22	3.62	1.28	6.12	*6.0*	4.84	..

‡ Car lot price.
† Valuation exceeds cost.

Fertilizer Co., New York city. Stock of Gault Bros., Westport.

10705. Bone and potash, made by Lister's Agricultural Chemical Works, Newark, N. J. Stock of A. W. Hutchinson, Gilead, and W. B. Martin, Rockville.

ANALYSES AND VALUATIONS.

	10582	10704	10705
Nitrogen of Nitrates,	0.73	....	....
Nitrogen, organic,	1.24	2.05	....
Nitrogen, total,	1.97	2.05	....
Soluble Phosphoric Acid,	....	....	5.28
Reverted Phosphoric Acid,	8.11	....	3.01
Insoluble Phosphoric Acid,	4.95	....	0.58
Total Phosphoric Acid,	13.06	17.31	8.87
Potash as Muriate,	1.13	2.55	5.23
Potash as Sulphate,	1.27	....	....
Potash total,	2.40	2.55	5.23
Cost per ton,	$25.10	28.00	24.00
Valuation per ton,	$16.07	20.09	11.84

The potash in sample **10582** is stated to be from wood ashes. The sample contained some chlorine, and a corresponding quantity of potash has therefore been reckoned as muriate, following the practice noted on page 18. The potash is probably present chiefly in the form of carbonate.

Sample **10705** does not contain bone, but is a mixture of dissolved phosphate and potash salts.

NITROGENOUS SUPERPHOSPHATES AND GUANOS.

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

1. *Samples drawn by Station Agents.*

In the tables on pages 50 to 61 are given analyses of 119 samples belonging to this class, arranged according to the percentage differences between their cost prices and valuations.

GUARANTEES.

Of the one hundred and nineteen analyses of nitrogenous superphosphates given in the tables, twenty-three are below the manufacturer's minimum guarantee, in respect of one ingredient, and three in respect of two ingredients

The number which failed to come up to the guarantee is relatively about the same as in the previous year.

There are only seven failures to meet the guarantee on nitrogen, the most costly ingredient, and eight failures in phosphoric acid; but in five of these the failure is in total phosphoric acid, while the "available" phosphoric acid is well above the guarantee. There are sixteen failures to meet the guaranteed percentage of potash. The larger number of these are probably explained by the difficulty of securing uniform mixture of the potash salts and the use of the foreign analyses of potash salts in calculating formulas for mixtures. These analyses do not always fairly represent the goods, after the vicissitudes of ocean freighting, lightering, and storage.

Usually the deficiency of one ingredient in the mixture has been made up by a surplus of another, indicating that the lack of agreement between actual and guaranteed composition was caused by defects in mixing or by a mechanical separation of the ingredients after mixing.

COST AND VALUATION.

Cost.

The method used to ascertain the retail cost price of the superphosphates is as follows:

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

From the data thus obtained the average prices are computed.

Valuation.

The valuation has been computed in all cases in the usual manner as explained on page 18.

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

This information enables the purchaser to estimate the comparative value of different brands and to determine whether it is better economy to buy the commercial mixed fertilizers of which so many are now offered for sale, or to purchase and mix for himself the raw materials.

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

In case a fertilizer has sold at two or more different prices, the *manufacturer's price*, when known, has been used in calculating percentage difference.

Otherwise an *average, or nearly average price*, forms the basis of comparison between cost and valuation. The price thus employed is printed in heavy-faced type.

The average cost of the nitrogenous superphosphates is $29.22. The average valuation is $19.30, and the percentage difference 51.4.

Last year the corresponding figures were:

Average cost $30.44, average valuation $20.75, percentage difference 46.9.

These valuations, it must be remembered, are based on the assumption that the nitrogen, phosphoric acid, and potash in each fertilizer are of good quality and readily available to farm crops. Chemical examination shows conclusively whether this is true in respect of potash and phosphoric acid, but gives little or no clue as to the availability of the organic nitrogen of mixed goods. This Station has been for some years, and is still, engaged in a study of methods for determining approximately the relative availability of nitrogen.

Since various inferior or agriculturally worthless forms of nitrogen are in the market and are known to be used in compounding fertilizers, and cannot as yet be detected with certainty by analysis, the only security of purchasers of mixed fertilizers is in dealing with firms which have the highest reputation and are able to satisfy their customers that they use the best raw materials, and in avoiding " cheap " goods offered by irresponsible parties.

Analyses Requiring Special Notice.

10407. E. Frank Coe's Long Islander Market Garden Special, page 50, is not on sale by agents in this State, but is sold direct from the factory to farmers in certain districts.

The manufacturer states that the analysis given on pp. 50 and 51 does not fairly represent the average quality of this brand, which should never show less than 9.5 per cent. of available phosphoric acid.

10390. Fairchild's Formula for Corn and General Crops, made by the Rogers & Hubbard Co., Middletown. The analysis, page 50, was made on a mixture of two samples. The one from stock of Mr. Kilbourne, we were informed, after making the analysis, represented stock carried over from last year.

10559. Fish and Potash, made by The Rogers Manufacturing Co., is below the guarantee in nitrogen, page 54. At the request of the manufacturers, another sample was drawn, **10735**, page 52, which contained a much higher percentage of nitrogen.

10419. Farmers' New Method, made by The Bradley Fertilizer Co., Boston, Mass., page 54. The percentage of potash being below the guarantee, other samples were drawn at the request of the manufacturer, and analysis **10729**, page 54, was made on a mixture of them. This contained the guaranteed amount of potash.

10685. Gold Brand Excelsior Guano, made by The E. Frank Coe Co., New York city. Sampled from stock of Edgar Brewer & Son, Hockanum. See pp. 60 and 61. The manufacturer stated that this sample did not fairly represent the average quality of the brand, which should contain about 6.3 per cent. of potash, and requested that other samples be drawn. Accordingly a sample was drawn from stock of L. C. Grant, Talcottville, the only dealer who had any of the goods on hand in July.

The analysis **10772**, pp. 56 and 57, show 5.02 per cent. of potash, while the first analysis showed but 4.73 per cent.

Inferior Forms of Nitrogen.

The analysis **10445**, given in the tables, p. 60, is of a Fertilizer, made by the Connecticut Reduction Co., of Bridgeport. This fertilizer is stated to be made in part, at least, of city garbage. The tests made on other samples, which are described on page 62, make it quite probable that the nitrogen of this material is of very inferior value as plant food. For this reason no " valuation " is given.

NITROGENOUS SUPERPHOSPHATES AND GUANOS, SAMPLED BY THE STATION.

Station No.	Name of Brand.	Manufacturer.	Dealer.	Dealer's cash price per ton.
10340	Buckingham XX Formula.	C. Buckingham, Southport.	Manufacturer.	$30.00
10684	Fertilizer.	Conn Valley Orchard Co., Berlin.	Manufacturer.	25.00
10626	Manchester's Formula.	E. Manchester & Sons, West Winsted.	R. D. Wilson, Winsted. Manufacturer.	29.00 29.00
10708	Harvest Home Fertilizer.	H. J. Baker & Bro., N Y	W F. Andross, E. Hartf'd.	25.00
10407	Long Islander Market Garden Special.*	E. Frank Coe, New York.	G. S. Jennings, Southport	28.00
10602	Complete Fertilizer for Potatoes and Gen'l Crops	F. E. Boardman, Little River.	Manufacturer.	28.00
10742	Bone, Fish, and Potash.	E R Kelsey, Branford.	Loomis Bros., Granby.	24.00
10650	Complete Manure.	Standard Fert Co., Boston	E. M Olmsted, Chester.	28.00
10391	Pure Fine Bone Dissolved in Sulphuric Acid.	Mapes F. & P. G. Co, New York.	Mapes Branch, Hartford. C W. Atwood, Watertown.	29.00 31.00 30.00
10390	Fairchild's Formula for Corn and Gen'l Crops.*	The Rogers & Hubbard Co., Middletown, Conn	City Coal & Wood Co., New Britain. A. E. Kilbourne, E. Hartford.	44.00 .....
10646	Hubbard's All Crops, All Soils.	The Rogers & Hubbard Co., Middletown	John Bransfield, Portland J. P. Barstow, Norwich.	28.00 28.00
10695	Unexcelled Phosphate.	G. W. Miller, Middlefield.	Manufacturer.	30.00
10452	Ammoniated Bone with Potash.	Armour Fertilizer Works, Chicago.	C. J. Benham, N. Haven Wilson & Burr, Middletown.	25.00 28.00 26.50
10474	Bone, Fish, and Potash.	Luce Bros., Niantic.	Cromwell Co-operative Store, Cromwell. Manufacturer. F. A. Beckwith, Niantic. P. Schwartz, Chesterfield.	29.00 24.00 25 00 25.00
10743	Fisherman's Brand Fish and Potash.	Bowker Fertilizer Co., Boston.	F. T. Bradley, Saybrook. G. F. Walters, Guilford. Bowker's Branch, Hartford W. H. Todd, No. Haven	25.00 24.00 26.00 18.00
10460	Middlesex Special.	Bowker Fert. Co., Boston.	W. H. Baldwin, Meriden.	25.00
10653	Bay State Special.	H. F. Tucker & Co., Boston	Alfred Sneider, Rockville	32.00
10447	Market Garden.	Bowker Fertilizer Co., Boston.	W H. Todd, No. Haven Peck Bros, West Cheshire	32 00 36.00 33.00
10519	All Soluble.	Armour Fertilizer Works, Chicago.	Adams & Canfield, Winnipauk. E. W. Buck, Willimantic.	30.00 33.00 31.50
10667	Pequot Fish and Potash.	Quinnipiac Co, Boston.	A. J. Martin, Wallingford	22.00
10617	Animal Fertilizer.	L. B. Darling Fertilizer Co., Pawtucket, R. I.	A. I. Kinney, Terryville. Hotchkiss & Templeton, Waterbury,	30.00 34.00 32.00
10614	Blood, Bone, and Potash.	L. B. Darling Fertilizer Co., Pawtucket, R. I.	Loomis Bros., Granby Hotchkiss & Templeton, Waterbury.	35.00 37.00 36.00
10581	Complete Fertilizer.	Berkshire Mills Co., Bridgeport.	Johnson Bros., Jewett City A. C. Taintor, Colchester. Manufacturer.	31.00 35.00 32.00
10641	G. G. Bay State Fertilizer.	Clark's Cove Fert. Co., N.Y.	H. E. Daniels, N. London.	24.00

* See page 49.

ANALYSES—*Continued.*

Valuation per ton.	Percentage difference between cost and valuation.	Nitrogen: Nitrogen as Nitrates.	Nitrogen: Nitrogen as Ammonia.	Nitrogen: Nitrogen Organic.	Nitrogen: Total Nitrogen: Found.	Nitrogen: Total Nitrogen: Guaranteed.	Phosphoric Acid: Soluble.	Phosphoric Acid: Reverted.	Phosphoric Acid: Insoluble.	Phosphoric Acid: Total: Found.	Phosphoric Acid: Total: Guaranteed.	Phosphoric Acid: Available: Found.	Phosphoric Acid: Available: Guaranteed.	Potash: Found: As Muriate.	Potash: Found: Total.	Potash: Guaranteed.
$28.87	3.9	1.25	....	3.17	4.42	*4.1*	6.05	3.74	1.42	11.21	*10.0*	9.79	*5.0*	0.55	7.81	*6.0*
23.39	6.9	1.29	....	2.94	4.23	*4.1*	6.21	3.29	2.30	11.80	..	9.50	*9.0*	3.14	3.14	*3.0*
26.26	10.4	0.70	....	3.47	4.17	*3.5*	6.30	1.42	0.24	7.96	*7.5*	7.72	....	3.92	8.40	*8.0*
22.22	12.5	4.21	....	1.22	5.43	*1.0*	4.30	1.86	1.22	7.38	*9.0*	6.16	*8.0*	2.35	2.35	*2.0*
24.11	16.1	..	0.90	2.55	3.45	*3.5*	7.10	1.42	1.66	10.18	*11.0*	8.52	*9.0*	0.52	6.34	*6.0*
23.92	17.1	...	...	3.00	3.00	*2.5*	6.22	1.83	0.28	8.33	...	8.05	*7.0*	9.82	9.82	*10.0*
20.18	18.9	....	0.54	3.18	3.72	*3.3*	2.94	2.63	0.67	6.24	*4.0*	5.57	....	0.59	4.84	*4.0*
22.98	21.8	1.26	....	2.06	3.32	*3.3*	4.38	3.81	1.40	9.59	*9.0*	8.19	*8.0*	7.50	7.50	*7.0*
23.99	25.0	...	....	2.91	2.91	*2.1*	3.68	13.63	4.08	21.39	*12.0*	17.31	..	.....	......	...
34.90	26.1	3.37	...	2.25	5.62	*5.5*	....	....	....	13.34	*12.0*	.....	....	12.41	12.41	*12.5*
21.81	28.4	0.92	....	1.94	2.86	*2.3*	7.33	4.48	1.89	13.70	*12.0*	11.81	*10.0*	3.59	3.59	*3.0*
23.16	29.5	....	....	2.71	2.71	*2.0*	4.82	3.97	1.64	10.43	*10.5*	8.79	....	8.69	8.69	*9.0*
20.45	29.6	....	....	3.00	3.00	*2.5*	2.02	6.15	3.79	11.96	*8.0*	8.17	*6.0*	0.55	3.87	*3.0*
18.46	30.0	....	1.00	2.31	3.31	*3.0*	2.06	3.06	0.70	5.82	*4.0*	5.12	....	1.47	4.83	*4.0*
18.32	31.0	....	0.14	2.50	2.64	*2.3*	3.61	2.41	3.37	9.39	*6.0*	6.02	*4.0*	5.18	5.18	*5.0*
19.05	31.2	....	...	2.41	2.41	*2.1*	4.85	2.95	1.60	9.40	*8.0*	7.80	...	5.80	5.80	*6.0*
24.09	32.8	0.89	..	2.55	3.44	*3.3*	2.88	6.14	2.35	11.37	*9.0*	9.02	*8.0*	7.29	7.29	*7.0*
24.74	33.4	0.64	....	2.28	2.92	*2.3*	4.99	1.87	1.15	8.01	*8.0*	6.86	*6.0*	12.06	12.06	*10.0*
23.59	33.5	....	0.62	2.87	3.49	*2.9*	3.52	5.94	1.50	10.96	*10.0*	9.46	*8.0*	0.29	5.33	*4.0*
16.26	35.3	....	0.32	2.57	2.89	*2.1*	1.73	4.14	3.33	9.20	*7.0*	5.87	*6.0*	2.30	2.30	*2.0*
23.26	37.6	0.32	....	3.72	4.04	*3.3*	4.16	5.37	0.96	10.49	*10.0*	9.53	*6.0*	4.22	4.22	*4.0*
26.09	38.0	0.63	0.28	3.13	4.04	*4.5*	4.74	5.18	0.52	10.44	*9.0*	9.92	*7.0*	7.40	7.40	*7.0*
23.13	38.3	0.67	0.12	2.11	2.90	*2.5*	5.73	4.73	1.22	11.68	*10.0*	10.46	*8.0*	6.72	6.72	*6.0*
17.20	39.5	....	..	2.22	2.22	*1.9*	6.05	3.89	1.47	11.41	*10.0*	9.94	*8.5*	2.15	2.15	*2.0*

NITROGENOUS SUPERPHOSPHATES AND GUANOS, SAMPLED BY THE STATION.

ANALYSES—*Continued.*

Station No.	Name of Brand.	Manufacturer.	Dealer.	Dealer's cash price per ton.	Valuation per ton.	Percentage difference between cost and valuation.	Nitrogen.					Phosphoric Acid.							Potash.		
							Nitrogen as Nitrates.	Nitrogen as Ammonia.	Nitrogen Organic.	Total Nitrogen. Found.	Total Nitrogen. Guaranteed.	Soluble.	Reverted.	Insoluble.	Total. Found.	Total. Guaranteed.	Available. Found.	Available. Guaranteed.	Found. As Muriate.	Found. Total.	Guaranteed.
10679	Concentrated Phosphate.	Cumberland Bone Phosphate Co., Boston.	Kahn Bros., Yantic.	$34.00	$24.32	39.8	0.89	...	2.51	3.40	*3.3*	2.88	6.69	2.20	11.77	*11.0*	9.57	*8.0*	7.25	7.25	*7.0*
10706	Old Reliable Superphosphate.	L. Sanderson, New Haven.	R. M. Goodale, Durham. A. B. Morse & Son, Guilford.	30.00 28.00 29.00	20.67	40.3	0.20	0.16	2.32	2.68	*2.0*	3.94	6.84	3.16	13.94	*10.0*	10.78	*7.0*	3.44	3.44	*2.0*
10697	Cecrops.	Fred'k Ludlam, N. York.	S. A. Smith, Clintonville.	34.00	24.21	40.4	1.29	....	2.18	3.47	*3.0*	6.98	2.48	1.00	10.46	....	9.46	*7.0*	7.17	7.17	*7.0*
10472	Complete Manure for Light Soils.	Mapes F. & P. G. Co., New York.	Mapes Branch, Hartford. J. P. Barstow, Norwich.	39.00 40.00	27.71	40.7	0.68	1.10	3.74	5.52	*4.9*	2.24	4.38	1.80	8.42	*8.0*	6.62	*6.0*	7.23	7.23	*6.0*
10712	Anchor Brand Fish and Potash.	Bradley Fertilizer Co., Boston.	Manufacturer.	27.00	19.09	41.4	....	...	3.60	3.60	*3.3*	2.91	3.37	1.46	7.74	*5.0*	6.28	*3.0*	3.13	3.58	*3.0*
10628	Ammoniated Bone Superphosphate.	Crocker Fertilizer Co., Buffalo, N. Y.	Latimer & Williams, So. Coventry. Smith & Sons, West Cornwall.	31.00 25.00 28.00	19.70	42.1	....	....	3.17	3.17	*2.9*	7.01	3.96	0.70	11.67	....	10.97	*10.0*	1.25	1.25	*1.1*
10608	Market Garden Manure.	Lowell Fertilizer Co., Boston.	W. D. Penfield, Cobalt. N. N. King, Thompsonville. J. F. Sheridan & Bro., Manchester.	40.00 38.00 40.00 39.00	27.31	42.8	....	0.84	4.06	4.90	*4.1*	6.29	0.98	0.35	7.62	*8.0*	7.27	*7.0*	0.49	7.08	*6.0*
10423	Market Garden Manure.	Quinnipiac Co., Boston.	C. Buckingham, Southport. Gault Bros., Westport.	33.00 36.00 34.50	24.14	42.9	0.68	1.04	1.74	3.46	*3.3*	4.58	4.93	1.80	11.31	*9.0*	9.51	*8.0*	6.83	6.83	*7.0*
10663	High Grade Farm's Friend	Read Fertilizer Co., N. Y.	B. H. Saunder, Collinsville.	36.00	25.18	43.0	...	0.42	3.02	3.44	*3.3*	4.16	2.16	1.00	7.32	*6.0*	6.32	....	11.38	11.38	*10.0*
10449	Gardeners' Complete Manure.	Packer's Union Fertilizer Co., New York.	A. S. Bennett, Cheshire. Walter Gildersleeve, Gildersleeve.	35.00 40.00	24.46	43.1	....	....	2.74	2.74	*2.5*	6.75	2.08	1.07	9.90	....	8.83	*8.0*	1.27	8.81	*10.0*
10707	Swift Sure Superphosphate for General Use.	M. L. Shoemaker & Co., Philadelphia.	J. P. Barstow, Norwich. Daniels Bros., Middletown. W. W. Cooper, Suffield. Olds & Whipple, Hartford.	36.00 35.00 35.00 35.00	24 44	43.2	0.89	...	1.97	2.86	*2.5*	9.38	3.15	1.90	14.43	....	12.53	....	0.09	4.90	*4.0*
10689	High Grade Complete Manure.	Cleveland Dryer Co., Boston.	C. E. Main, Plainfield.	34.00	23.67	43.6	1.24	....	2.18	3.42	*3.3*	4.53	4.10	1.44	10.07	*9.0*	8.63	*8.0*	7.54	7.54	*7.0*
10735	Fish and Potash.*	Rogers Mfg. Co., Rockfall, Conn.,	Manufacturer.	28.00	19.48	43.7	..	0.38	2.84	3.22	*3.3*	1.97	4.64	2.64	9.25	*6.0*	6.61	....	4.62	4.62	*3.8*
10568	High Grade Fish and Potash.	Wilcox Fertilizer Works, Mystic.	W. A. Howard, Woodstock. Manufacturer. I. W. Dennison, Mystic.	29.00 30.00 27.00	20.07	44.5	....	0.40	3.32	3.72	*3.3*	3.54	2.42	0.65	6.61	*6.0*	5.96	*6.0*	5.01	5.01	*4.0*
10732	Market Garden Manure.	Quinnipiac Co., Boston.	Osborn & Co., Branford. O. S. Olmsted, Melrose.	35.00 34.00 34.50	23.77	45.1	1.68	....	1.78	3.46	*3.3*	3.66	5.01	1.88	10.55	*10.0*	8.67	*8.0*	7.49	7.49	*7.0*
10699	Animal Fertilizer, G. Brand	L. B. Darling Fertilizer Co., Pawtucket.	Hotchkiss & Templeton, Waterbury.	32.00	21.95	45.8	....	0.22	3.00	3.22	*2.0*	3.42	6.87	1.35	11.64	*7.0*	10.29	*5.0*	4.48	4.48	*4.0*
10670	High Grade Gen. Fertiz'r.	Pacific Guano Co., Boston.	J. A. Nichols, Danielson.	34.00	23.27	46.1	1.88	....	1.56	3.44	*3.3*	4.39	4.12	1.51	10.02	*9.0*	8.51	....	7.25	7.25	*7.0*
10484	Essex XXX Fish and Potash.	Russia Cement Co., Gloucester, Mass.	C. N. Jones, Wallingford. L. A. Carrier, Berlin.	28.00 30.00 29.00	19.77	46.7	....	...	2.68	2.68	*2.1*	6.16	4.34	3.55	14.05	*12.0*	10.50	....	2.16	2.16	*2.3*
10620	Vegetable Bone Fertilizer.	Milsom Rend. and Fertilizer Co., East Buffalo, N. Y.	D. E. Doolittle, West Cheshire. G. W. Barnes, Poquonock.	36.00 32.00 34.00	23.09	47.2	....	....	3.86	3.86	*4.1*	6.86	1.69	1.20	9.75	*9.0*	8.55	*8.0*	5.03	5.03	*5.0*
10579	Standard U. X. D. Fertil'r.	H. J. Baker & Bro., N. Y.	I. J. Scoville, Plainville.	25.00	16 97	47.3	0.26	0.98	1.01	2.25	*1.9*	5.10	3.73	1.98	10.81	*9.0*	8.83	*8.0*	2.78	2.78	*2.3*
10616	Dissolved Bone and Potash.	L. B. Darling Fertilizer Co., Pawtucket.	Hotchkiss & Templeton, Waterbury. F. L. Hitchcock, Watertown.	36.00 38.00 37.00	25 04	47.8	0.06	0.26	2.10	2.42	*1.5*	5.55	7.61	0.90	14.06	*13.0*	13.16	*11.0*	8.02	8.02	*7.0*

* See page 49.

NITROGENOUS SUPERPHOSPHATES AND GUANOS, SAMPLED BY THE STATION.

Station No.	Name of Brand.	Manufacturer.	Dealer.	Dealer's cash price per ton.
10483	Formula A.	L. Sanderson, New Haven.	F. O. Ives, W. Cheshire. R. M. Goodale, Durham. A. B. Morse & Son, Guilf'd.	35.00 35.00 33.00
10583	Fish and Potash, Square Brand.	Bowker Fertilizer Co., Boston.	E. F. Miller, Ellington.	27.00
10392	Circle Brand Ground Bone with Potash.	Bradley Fertilizer Co., Boston.	C. O. Jelliff, Southport.	28.00
10660	Great Planet A.	Clark's Cove Fertilizer Co., New York.	Wells & Dean, Bloomfield.	37.00
10354	Fish and Potash.	National Fertilizer Co., Bridgeport.	G. A. & H. B. Williams, East Hartford. Manufacturer.	30.00 ......
10473	Standard Pure Bone Superphosphate.	Lister's Agricult'l Chemical Works, Newark, N. J.	A. N. Clark, Milford. A. W. Hutchinson, Gilead.	28.00 28.00
10700	Garden Special Fertilizer.	Great Eastern Fertilizer Co., Rutland, Vt.	Silas Finch, Greenwich.	34.00
10655	Superior Truck Fertilizer.	M. E. Wheeler & Co., Rutland, Vt.	I. J. Scoville, Plainville.	36.00
10559	Fish and Potash.*	Rogers Manufacturing Co., Rockfall, Conn.	Manufacturer. W. T. Andross, E. Hartf'd.	28.00 30.00
10425	Complete Fertilizer.	National Fertilizer Co., Bridgeport.	G. A. & H. B. Williams, East Hartford. J. F. Buckhout, Greenw'ch. A. G. Beach, Seymour. Manufacturer.	38.00 38.00 37.00 35.00
10683	Vegetable Bone Superphosphate.	Crocker Fertilizer Co., Buffalo, N. Y.	The Meeker Coal Co., Norwalk.	41.00
10729	New Method Fertilizer.*	Bradley Fertilizer Co., Boston.	H. S. Harvey, Windham Center. Sanford & Hawley, Unionville. Wilson & Burr, Middlet'n.	28.00 26.00 30.00
10493	Success Fertilizer.	Lister's Agricult'l Chemical Works, Newark, N. J.	M. D. Stanley, N. Britain. A. W. Hutchinson, Gilead.	25.00 26.00
10751	Special Manure, 10 per cent. Potash.	L. Sanderson, New Haven.	A. B. Morse & Son, Guilford.	33.00 35.00
10578	Ammoniated Bone Phosphate.	Berkshire Mills Co., Bridgeport.	Johnson Bros., Jewett City. T. H. Eldridge, Norwich. Manufacturer.	28.00 28.00 28.00
10565	Complete Bone Superphosphate.	Wilcox Fertilizer Works, Mystic.	W. A. Howard, Woodst'k. Manufacturer. F. A. Rathbun, Hebron.	29.00 30.00 32.00
10682	A. A. Complete Manure.	Crocker Fertilizer Co., Buffalo, N. Y.	C. F. Tallard & Son, Broad Brook.	35.00
10356	Chittenden's Market Garden.	National Fertilizer Co., Bridgeport.	Manufacturer.	32.00
10419	Farmers' New Method.*	Bradley Fertilizer Co., Boston.	D. L. Clark, Milford. W. H. Scott, Pequabuck.	28.00 29.00 28.50
10488	Dissolved Bone and Potash.	Milsom Rend. and Fertilizer Co., East Buffalo, N. Y.	D. E. Doolittle, West Cheshire. Chas. H. Davis, Guilford.	17.50 18.00

* See page 49.

ANALYSES.—*Continued.*

Valuation per ton.	Percentage difference between cost and valuation.	Nitrogen: Nitrogen as Nitrates.	Nitrogen: Nitrogen as Ammonia.	Nitrogen: Nitrogen Organic.	Nitrogen: Total Nitrogen: Found.	Nitrogen: Total Nitrogen: Guaranteed.	Phosphoric Acid: Soluble.	Phosphoric Acid: Reverted.	Phosphoric Acid: Insoluble.	Phosphoric Acid: Total: Found.	Phosphoric Acid: Total: Guaranteed.	Phosphoric Acid: Available: Found.	Phosphoric Acid: Available: Guaranteed.	Potash: Found: As Muriate.	Potash: Found: Total.	Potash: Guaranteed.
$23.28	50.3	0.46	0.66	1.98	3.10	*3.0*	5.17	4.77	2.12	12.06	*10.0*	9.94	*8.0*	6.32	6.32	*6.0*
17.93	50.6	...	0.33	2.59	2.92	*2.3*	3.23	3.47	1.60	8.30	*8.0*	6.70	....	4.04	4.04	*4.0*
18.39	52.3	....	....	2.62	2.62	*1.9*	1.94	6.78	4.32	13.04	*10.0*	8.72	*6.0*	2.53	2.53	*2.0*
24.26	52.5	0.77	0.52	2.31	3.60	*3.3*	3.62	5.37	2.40	11.39	*9.0*	8.99	*8.0*	6.84	6.84	*7.0*
19.66	52.6	....	...	3.07	3.07	*3.0*	3.86	2.52	2.82	9.20	*6.0*	6.38	...	0.45	4.51	*4.0*
18.13	54.4	....	....	2.32	2.32	*2.4*	8.93	1.86	1.30	12.09	*12.0*	10.79	*10.0*	1.86	1.86	*1.5*
22.02	54.4	....	....	3.22	3.22	*3.3*	4.96	2.15	0.90	8.01	....	7.11	*6.0*	7.60	7.60	*8.0*
23.24	54.9	...	0.17	3.15	3.32	*3.5*	5.90	1.55	0.89	8.34	....	7.45	*7.0*	8.27	8.27	*8.0*
18.00	55.6	...	0.23	2.58	2.81	*3.3*	1.28	3.89	4.58	9.75	*6.0*	5.17	....	4.77	4.77	*3.8*
23.73	55.9	...	1.52	2.05	3.57	*3.3*	4.29	5.42	0.92	10.63	*10.0*	9.71	*8.0*	6.07	6.07	*6.0*
26.05	57.4	...	2.22	2.90	5.12	*5.0*	5.41	2.01	0.31	7.73	....	7.42	*6.0*	6.01	6.01	*6.0*
17.75	57.7	....	....	2.21	2.21	*1.7*	5.66	3.86	1.92	11.44	*10.0*	9.52	*8.0*	3.07	3.07	*3.0*
15.83	57.9	....	....	1.58	1.58	*1.7*	7.81	2.53	1.06	11.40	*11.5*	10.34	*9.5*	1.80	2.21	*2.0*
22.06	58.6	0.69	0.10	1.71	2.50	*2.5*	2.86	3.97	2.65	9.48	*8.0*	6.83	*6.0*	9.87	9.87	*10.0*
17.58	59.3	....	....	2.07	2.07	*1.7*	4.53	4.80	3.35	12.68	*10.0*	9.33	*8.0*	0.47	2.59	*2.0*
18.75	60.0	....	....	2.72	2.72	*2.0*	2.37	5.31	3.90	11.58	*9.0*	7.68	*8.0*	3.75	3.75	*3.0*
21.84	60.3	...	0.27	3.10	3.37	*3.3*	4.97	2.24	1.04	8.25	....	7.21	*8.0*	6.73	6.73	*7.5*
19.95	60.4	...	1.13	1.35	2.48	*2.5*	3.89	4.56	1.57	10.02	*9.0*	8.45	*7.0*	6.15	6.15	*6.0*
17.71	60.9	....	....	2.16	2.16	*1.7*	5.94	3.86	2.15	11.95	*10.0*	9.80	*8.0*	2.77	2.77	*3.0*
10.81	61.9	....	....	....	....	....	7.14	3.56	0.20	10.90	*11.0*	10.70	*9.0*	1.71	1.71	*1.7*

NITROGENOUS SUPERPHOSPHATES AND GUANOS, SAMPLED BY THE STATION.

ANALYSES.—*Continued.*

Station No.	Name of Brand.	Manufacturer.	Dealer.	Dealer's cash price per ton.	Valuation per ton.	Percentage difference between cost and valuation.	Nitrogen: Nitrogen as Nitrates.	Nitrogen: Nitrogen as Ammonia.	Nitrogen: Nitrogen Organic.	Nitrogen: Total Nitrogen, Found.	Nitrogen: Total Nitrogen, Guaranteed.	Phosphoric Acid: Soluble.	Phosphoric Acid: Reverted.	Phosphoric Acid: Insoluble.	Phosphoric Acid: Total, Found.	Phosphoric Acid: Total, Guaranteed.	Phosphoric Acid: Available, Found.	Phosphoric Acid: Available, Guaranteed.	Potash: Found, As Muriate.	Potash: Found, Total.	Potash: Guaranteed.
10448	High Grade Ammoniated Bone Superphosphate.	E. Frank Coe Co., New York.	E. Brewer & Son, Hockanum. J. R. Babcock, Mystic. J. P. Barstow, Norwich.	...... $29.00 32 00 30 00	$18.51	62.1	....	0.46	2.00	2.46	*2.0*	7.31	2.09	2.00	11.40	*11.0*	9.40	*9.0*	0.39	2.63	*1.9*
10638	Americus Ammoniated Bone Superphosphate.	Williams & Clark, New York.	D. B. Wilson, Waterbury. A. B. Garfield, E. Canaan.	30.00 33.00 31 50	19.38	62.5	0.28	0.20	2.40	2.88	*2.5*	6.48	3.58	2.40	12.46	*10.0*	10.06	*9.0*	2.02	2.02	*2.0*
10353	Complete Manure. A Brand.	Mapes F. & P. G. Co., New York.	Birdsey & Foster, Meriden. Mapes Branch, Hartford.	34.00 33.00	20.20	63.4	0.30	0.26	2.40	2.96	*2.5*	3.54	6.06	3.23	12.83	*12.0*	9.60	*10.0*	3.11	3.11	*2.5*
10678	Superphosphate.	Cumberland Bone Phosphate Co., Boston.	Kahn Bros., Yantic.	28.00	17.12	63.5	0.20	....	2.08	2.28	*2.1*	5.57	3.98	2.05	11.60	*10.0*	9.55	*8.0*	2.08	2.08	*2.0*
10418	Cereal Brand.	Mapes F. & P. G. Co., New York.	A. N. Clark, Milford. Mapes Branch, Hartford. D. B. Wilson, Waterbury.	28.00 26.00 32.00 27.00	16.41	64.5	...	....	2.12	2.12	*1.7*	4.93	3.52	0.77	9.22	*8.0*	8.45	*6.0*	3.41	3.41	*3.0*
10534	Animal Fertilizer.	Lowell Fertilizer Co., Boston.	G. G. Avery, New London. W. D. Penfield, Cobalt. S. H. Bowen, Brooklyn. J. F. Sheridan & Bro., Manchester.	33.00 33.00 33.00 33.00	20.06	64.5	...	0.16	2.46	2.62	*2.5*	6.00	4.24	0.89	11.13	*10.0*	10.24	*9.0*	4.20	4.20	*4.0*
10772	Gold Brand Guano.*	E. Frank Coe Co., New York.	L. C. Grant, Talcottville.	35.00	21.24	64.8	....	0.88	1.80	2.68	*2.0*	6.69	2.13	2.68	11.50	*9.0*	8.82	*8.0*	0.45	5.02	*6.0*
10420	Special Phosphate.	Olds & Whipple, Hartford.	Manufacturer.	34.00	20.61	65.0	....	0.63	2.37	3.00	*2.5*	6.88	3.53	2.14	12.55	*10.0*	10.41	*9.0*	0.67	2.44	*2.0*
10593	Ammoniated Bone and Potash.	Wm. E. Brightman, Tiverton, R. I.	Wm. Crane, Broad Brook.	30.00	18.05	66.2	0.23	....	2.03	2.26	*2.1*	6.06	3.63	2.02	11.71	*9.0*	9.69	*8.0*	3.07	3.07	*3.0*
10347	Patent Superphosphate.	Bradley Fertilizer Co., Boston.	Wheeler & Howe, Bridgep't D. L. Clark, Milford. E. E. Scoville, Stamford.	33.00 30.00 34.00 32.00	19.24	66.3	0.12	0.10	2.48	2.70	*2.5*	7.02	3.84	1.42	12.28	*11.0*	10.86	*9.0*	2.06	2.06	*2.0*
10521	A. A. Ammoniated Superphosphate.	H. J. Baker & Bro., New York.	Edward White, Rockville. W. F. Andross, E. Hartf'd. Saxton & Strong, Bristol.	32.00 35.00 34.00	20.38	66.8	0.58	0.92	1.38	2.88	*2.5*	8.98	1.74	1.11	11.83	*11.0*	10.72	*10.0*	2.96	2.96	*2.0*
10349	Hill and Drill Phosphate.	Bowker Fertilizer Co., Boston.	C. W. Michaels, Yalesville. Peck Bros., West Cheshire.	32.00 34.00	19.14	67.2	0.12	..	2.66	2.78	*2.3*	8.06	2.18	1.25	11.49	*12.0*	10.24	*9.0*	2.22	2.22	*2.0*
10524	King Philip Alkaline Guano.	Clark's Cove Fertilizer Co., New York.	J. M. Burk, So. Manchester H. E. Daniels, N. London	24.00 24.00	14.29	67.9	...	...	1.32	1.32	*1.0*	6.40	2.58	2.01	10.99	*9.0*	8.98	*8.0*	2.32	2.32	*2.0*
10337	High Grade Universal Fertilizer.	Packer's Union Fertilizer Co., New York.	C. O. Jelliff, Southport. J. H. Ray & Son, Greenwich.	25.00 28.00 26.50	15.73	68.5	....	..	1.12	1.12	*0.8*	6.64	2.15	0.80	9.59	....	8.79	*8.0*	5.37	5.37	*5.0*
10422	Quinnipiac Phosphate.	Quinnipiac Co., Boston.	Gault Bros., Westport. H. S. Coe, Harwinton. Olds & Whipple, Hartford	32.00 33.00 35.00 33.00	19.41	70.0	0.30	0.36	2.18	2.84	*2.5*	6.08	4.10	2.13	12.31	*10.0*	10.18	*9.0*	2.26	2.26	*3.5*
10668	Crossed Fishes Brand Fish and Potash.	Quinnipiac Fertilizer Co., Boston.	Olds & Whipple, Hartford.	32.00	18.81	70.1	....	0.26	3.24	3.50	*3.3*	1.55	3.20	4.10	8.85	*5.0*	4.75	*3.0*	4.01	4.01	*3.0*
10686	Superphosphate.	Cleveland Dryer Co., Boston.	C. E. Main, Plainfield.	30.00	17.57	70.7	trace	..	2.35	2.35	*2.0*	6.00	3.78	1.54	11.32	....	9.78	*9.0*	2.29	2.29	*2.0*
10618	Fish, Bone, and Potash.	Read Fertilizer Co., New York.	J. M. White, Bristol, E. E. Pitney, Ellington.	30.00 28.00 29.00	16.91	71.5	....	....	2.88	2.88	*2.5*	3.01	2.42	0.97	6.40	*5.0*	5.43	*4.0*	4.48	4.48	*4.0*
10533	Soluble Pacific Guano.	Pacific Guano Co., Boston.	J. A. Nichols, Danielson. John Bransfield, Portland. Saxton & Strong, Bristol.	30.00 30.00 33.00 31.00	18.04	71.8	0.09	0.16	2.24	2.49	*2.3*	5.81	3.94	2.07	11.82	*10.5*	9.75	....	2.21	2.21	*2.0*

* See page 49.

Nitrogenous Superphosphates and Guanos, Sampled by the Station.

Station No.	Name of Brand.	Manufacturer.	Dealer.	Dealer's cash price per ton.
10424	Ammoniated Bone Phosphate.	National Fertilizer Co., Bridgeport.	G. A. & H. B. Williams East Hartford. Ansonia Flour and Grain Co., Ansonia. Manufacturer.	$30.00 32.00 28.00 **30.00**
10401	Square Brand Bone and Potash.	Bowker Fertilizer Co., Boston.	C. T. Leonard, Norwalk. E. W. S. Pickett, Fairfield Bowker's Branch, Hartf'd.	25.00 28.00 27.00 **26.50**
10528	Guano for All Crops.	Standard Fertilizer Co., Boston.	F. J. Newton, Branford. W. E. Truesdell, Burnside.	26.00 24.00 **25 00**
10599	Original Coe's Superphosphate.	Bradley Fertilizer Co., Boston.	Wilson & Burr, Middletown.	**30.00**
10627	Dissoived Bone and Potash.	Lowell Fertilizer Co., Boston.	F. A Chamberlain, Unionville. N. N. King, Thomps'nv'l J. W. Beard, Plainville. G. M. Bradley, Danbury.	...... 28.00 30.00 31.00 **29 00**
10691	Buffalo Fertilizer.	Milsom Rend. and Fertilizer Co., East Buffalo, N. Y.	I. J. Scoville, Plainville.	**26.50**
10654	Original Bay State.	H. F. Tucker Co., Boston	W. R. Amadon, Staffordville.	**30.00**
10640	Defiance Phosphate.	Clark's Cove Fertilizer Co., New York.	H. E. Daniels, New London.	**22 00**
10596	Eclipse Phosphate.	Bradley Fertilizer Co , Boston.	C. F. Tallard & Son, Broad Brook. W. W. Sheldon, So. Woodstock	29.00 27.00 **28.00**
10526	Imperial Bone Superphosphate for All Crops.	H. F. Tucker Co., Boston.	F. H. Rolf, Guilford. E. A. Buck & Co., Willimantic.	**28.00** 28.00
10692	Buffalo Guano.	Milsom Rend. and Fertilizer Co., East Buffalo, N. Y.	Chas. H. Davis, Guilford.	**25.00**
10523	B. D. Sea Fowl Guano.	Bradley Fertilizer Co., Boston.	F. S. Bidwell, Windsor Locks. W. W. Cooper, Suffield.	**30.00** 30.00
10492	New Rival Ammoniated Superphosphate.	Crocker Fertilizer Co., Buffalo, N. Y.	Clark & Bradley, North Westchester. W. Gildersleeve, Gildersleeve.	24.00 35.00 **28.00**
10467	Sure Crop Phosphate.	Bowker Fertilizer Co., Boston.	Hubbell & Bradley, Saugatuck. C. T. Leonard, Norwalk. H. E. Daniels, N. London.	28.00 24.00 **26.00**
10591	Brightman's Fish and Potash.	Wm. E. Brightman, Tiverton, R. I.	Wm. Crane, Broad Brook	**28.00**
10350	Bowker's Ammoniated Dissolved Bone, or Farm and Garden Phosphate.	Bowker Fertilizer Co., Boston.	E. B. Clark Co., Milford. C. T Leonard, Norwalk. Linsley & Lightbourn, New Haven.	26.00 38.00 35.00 **30.00**

Analyses—*Continued.*

Valuation per ton.	Percentage difference between cost and valuation.	Nitrogen. Nitrogen as Nitrates.	Nitrogen as Ammonia.	Nitrogen Organic.	Total Nitrogen. Found.	Total Nitrogen. Guaranteed.	Phosphoric Acid. Soluble.	Reverted.	Insoluble.	Total. Found.	Total. Guaranteed.	Available. Found.	Available. Guaranteed.	Potash. Found. As Muriate.	Found. Total.	Guaranteed.
$17.44	72.0	....	....	2.22	2.22	*1.6*	2.08	8.28	1.45	11.81	*9.0*	10.36	*7.0*	2.53	2.53	*2.0*
15.37	72.4	....	....	1.95	1.95	*1.5*	2.82	4.72	4.23	11.77	*12.0*	7.54	*6.0*	2.24	2.24	*2.0*
14.49	72.5	....	....	1.40	1.40	*1.0*	7.12	2.15	1.49	10.76	*10.0*	9.27	*8.0*	2.16	2.16	*2.0*
17.37	72.7	....	....	2.32	2.32	*2.1*	5.98	4.21	1.87	12.06	*10.0*	10.19	*8.0*	1.61	1.61	*1.0*
16.75	73.1	....	....	2.05	2.05	*1.7*	7.39	2.45	1.35	11.19	*10.0*	9.84	*9.0*	2.19	2.19	*1.0*
15.28	73.4	....	....	2.10	2.10	*1.9*	5.89	2.02	2.66	10.57	*9.0*	7.91	*8.0*	1.67	1.67	*1.5*
17.25	73.9	0.20	....	2.02	2.22	*2.1*	6.10	3.74	1.98	11.82	*11.0*	9.84	*9.0*	2.12	2.12	*2.0*
12.54	75.4	....	....	1.04	1.04	*0.8*	6.27	3.01	1.45	10.73	*9.0*	9.28	*7.0*	1.17	1.17	*1.0*
15.82	77.0	0.14	....	1.58	1.72	*1.0*	6.58	3.70	1.80	12.08	*12.0*	10.28	*10.0*	1.69	1.69	*1.5*
15.76	77.7	....	...	1.86	1.86	*1.3*	5.55	3.61	1.84	11.00	*11.0*	9.16	*9.0*	2.26	2.26	*1.9*
13.98	78.8	....	....	0.85	0.85	*0.8*	6.26	2.54	0.78	9.58	*9.0*	8.80	*8.0*	4.27	4.27	*4.0*
16.42	82.7	....	....	2.09	2.09	*2.0*	6.59	3.22	2.10	11.91	*10.0*	9.81	*8.0*	1.43	1.43	*1.5*
15.24	83.7	....	....	1.52	1.52	*1.2*	7.78	2.87	0.72	11.37	....	10.65	*10.0*	1.64	1.64	*1.6*
14.15	83.7	0.14	....	1.02	1.16	*0.8*	7.47	3.24	1.92	12.63	*10.0*	10.71	*8.0*	1.00	1.00	*1.0*
15.15	84.8	....	0.23	2.32	2.55	*2.1*	2.34	3.68	2.35	8.37	*7.5*	6.02	*6.0*	2.38	2.38	*2.0*
16.17	85.5	0.14	....	1.78	1.92	*1.5*	6.50	2.77	2.29	11.56	*10.0*	9.27	*8.0*	2.17	2.17	*2.0*

Nitrogenous Superphosphates and Guanos, Sampled by the Station.

Station No.	Name of Brand.	Manufacturer.	Dealer.	Dealer's cash price per ton.
10696	Cereal Brand.	Frederick Ludlam, New York.	J. M. Beckwith, Chesterfield.	$26.00
10687	Fertilizer for All Crops.	Cleveland Dryer Co., Boston.	C. E. Main, Plainfield.	27.00
10671	Triumph.	Niagara Fertilizer Co., Buffalo, N. Y.	C. A. Ahlquist, Portland.	35.00
10652	Standard Fertilizer.	Standard Fertilizer Co., Boston.	W. E. Truesdell & Co., Burnside.	32.00
10471	General Crop Phosphate.	Crocker Fertilizer Co., Buffalo, N. Y.	Clark & Bradley, North Westchester. Henry Davis, Durham Center. The Meeker Coal Co., Norwalk.	20.00 20.00 25.00 22.00
10637	Royal Bone Phosphate.	Williams & Clark, New York.	D. S. Buell, Madison. S. E. Brown, Collinsville.	27.00 28.00 27.50
10662	Leader Guano.	Read Fertilizer Co., New York.	J. R. Babcock, Mystic.	24.50
10530	Climax Phosphate.	Quinnipiac Co., Boston.	Bailey & Markham, Cobalt. C. A. Young, Danielson. W. C. Pease, Somers. O. S. Olmsted, Melrose.	35.00 28.00 29.00 26.00
10619	Standard Superphosphate.	Read Fertilizer Co., New York.	J. W. Palmer, Stamford. J. R. Babcock, Mystic. J. N. Clark, Columbia.	32.00 27.00 28.00 29.00
10598	Niagara Phosphate.	Bradley Fertilizer Co., Boston.	Sanford & Hawley, Unionville. Wilson & Burr, Middletown. P. Schwartz, Chesterfield. H. S. Harvey, Windham Center.	25.00 25.00 25.00 21.00
10669	Nobsque Guano.	Pacific Guano Co., Boston	James A. Nichols, Danielson.	28.00
10609	General Fertilizer.	Great Eastern Fertilizer Co., Rutland, Vt.	Silas Finch, Greenwich. Elmer Keeler, Danbury.	29.00 30.00 29.50
10688	Pioneer.	Cleveland Dryer Co., Boston.	C. E. Main, Plainfield.	24.00
10680	Hawkeye Fertilizer.	Cumberland Bone Phosphate Co., Boston.	Geo. C. Dean, Plainfield.	27.00
10693	Erie King.	Milsom Rend. and Fertilizer Co., East Buffalo, N. Y.	D. E. Doolittle, West Cheshire.	24.00
10685	Gold Brand Excelsior Guano.*	E. Frank Coe Co., New York.	Edgar Brewer & Son, Hockanum.	......
10445	Fertilizer.	Connecticut Reduction Co., Bridgeport.	Manufacturer. W. H. Tinkham, Milford. D. B. Wilson, Waterbury.	18.00 16.00 15.00
10315	Fertilizer.	L. Sanderson, New Haven.	F. S. Hopson, Stratford.	......

* See page 49.

Analyses—*Continued.*

Station No.	Valuation per ton.	Percentage difference between cost and valuation.	Nitrogen. N trogen as Nitrates.	Nitrogen. Nitrogen as Ammonia.	Nitrogen. Nitrogen Organic.	Nitrogen. Total Nitrogen. Found.	Nitrogen. Total Nitrogen. Guaranteed.	Phosphoric Acid. Soluble.	Phosphoric Acid. Reverted.	Phosphoric Acid. Insoluble.	Phosphoric Acid. Total. Found.	Phosphoric Acid. Total. Guaranteed.	Phosphoric Acid. Available. Found.	Phosphoric Acid. Available. Guaranteed.	Potash. Found. As Muriate.	Potash. Found. Total.	Potash. Guaranteed.
10696	$13.98	86.0	0.20	....	0.98	1.18	0.8	7.25	3.31	1.93	12.49	10.0	10.56	....	0.91	0.91	1.0
10687	14.35	88.2	....	....	1.29	1.29	1.0	7.30	1.99	1.37	10.66	9.0	9.29	8.0	2.39	2.39	2.0
10671	18.57	88.5	....	....	2.88	2.88	2.5	6.40	2.20	2.77	11.37	...	8.60	8.0	2.21	2.21	2.2
10652	16.89	89.5	0.26	....	1.92	2.18	2.0	5.79	3.70	2.11	11.60	10.0	9.49	8.0	2.14	2.14	2.0
10471	11.43	92.5	....	....	1.26	1.26	0.8	4.09	3.65	1.20	8.94	....	7.74	7.0	0.96	0.96	1.0
10637	14.21	93.5	....	....	1.32	1.32	1.0	5.39	3.57	1.95	10.91	8.0	8.96	7.0	2.37	2.37	2.0
10662	12.65	93.7	....	....	1.34	1.34	0.8	5.11	2.58	0.82	8.51	8.0	7.69	7.0	2.25	2.25	2.0
10530	14.29	95.9	....	....	1.27	1.27	1.0	7.05	2.20	1.62	10.87	9.0	9.25	8.0	2.32	2.32	2.0
10619	14.57	99.0	....	....	1.15	1.15	0.8	6.29	2.32	0.92	9.53	9.0	8.61	8.0	4.07	4.07	4.0
10598	12.32	102.9	....	....	1.25	1.25	0.8	4.19	3.75	2.19	10.13	8.0	7.94	7.0	1.38	1.38	1.0
10669	13.57	106.3	....	....	1.18	1.18	1.2	6.69	2.11	1.33	10.13	9.0	8.80	8.0	2.39	2.39	2.0
10609	14.29	106.4	....	....	1.10	1.10	0.8	6.42	1.92	0.79	9.13	....	8.34	8.0	4.20	4.20	4.0
10688	11.42	110.2	....	....	0.98	0.98	0.8	3.15	5.01	2.14	10.30	9.0	8.16	7.0	1.14	1.14	1.0
10680	12.39	117.9	....	....	1.17	1.17	0.8	4.67	3.62	2.52	10.81	9.0	8.29	7.0	1.18	1.18	1.0
10693	10.70	124.3	....	....	0.90	0.90	0.8	5.22	2.19	0.69	8.10	9.0	7.41	7.0	1.71	1.71	2.0
10685	21.03	....	....	0.85	1.81	2.66	2.0	6.80	2.22	2.48	11.50	9.0	9.02	8.0	0.27	4.73	6.0
10445	....	....	....	....	2.70	2.70	3.5	none	2.73	1.44	4.17	...	2.73	3.5	0.40	0.40	3.1
10315	27.57	....	0.77	....	3.09	3.86	4.0	5.30	4.39	1.41	11.10	....	9.69	9.0	9.50	9.50	8.0

2 and 3. Sampled by Manufacturers and Purchasers.

In the table below is given one analysis of a nitrogenous superphosphate, sampled by a manufacturer, and nine analyses of samples sent to the Station by purchasers.

10462. Fish, Bone, and Potash. Mr. E. R. Kelsey wrote that the sample represents goods made early in the year. The manufacturer afterwards had his stock of potash salts analyzed at the Station, and, finding the percentage of potash lower than represented in the German analysis, on which he had based his formula, worked over his stock, adding more potash to it.

10245 and 10217. Made by the Connecticut Reduction Co. or Bridgeport Utilization Co., represent garbage fertilizers to which reference has been already made, page 49.

The solubility of the nitrogen in pepsin solution, a reagent which, in a general way, measures the availability of the nitrogen, was found to be very low, 17.0 and 18.1 per cent., respectively.

It is, therefore, probable that the nitrogen of the material is of very inferior value as plant food. Consequently, no valua-

tion is assigned to these goods, and the facts regarding them were published promptly in Bulletin 127.

Nitrogen solubility was also determined in 10289, Fairfield formula, made by the Bowker Fertilizer Co., and was found satisfactory, 74.2 per cent.

The last two samples, 10360 and 10366, were sent to ascertain whether the percentage of nitrogen was in both cases as guaranteed.

SPECIAL MANURES.

Here are included such mixed fertilizers, chiefly nitrogenous superphosphates, as are claimed by their manufacturers to be specially adapted to the needs of particular crops.

1. Samples drawn by Station Agents.

In the tables on pages 66 to 79 are given analyses of one hundred and eleven samples drawn by the Station agents and representing one hundred and seven brands.

NITROGENOUS SUPERPHOSPHATES, SAMPLED BY MANUFACTURERS (☞) AND PURCHASERS. ANALYSES AND VALUATIONS.

Station No.	Name of Brand.	Manufacturer.	Sampled by	Valuation per ton.
10713	Bone, Blood, and Potash.	Armour Fertilizer Co., Chicago.	Manufacturer.	$28.98
10289	Bowker's Fairfield Formula.	Bowker Fertilizer Co., Boston.	Simeon Pease, Greenfield Hill.	27.92
10538	Red Brand Excelsior Guano.	E. Frank Coe Co., New York.	Sidney B. Smith, East Haven.	24.78
10462	Fish, Bone, and Potash.	E. R. Kelsey, Short Beach.	E. C. Warner. Fair Haven.	18.98
10369	Conn. Valley Orchard Co.'s Fertilizer.	Quinnipiac Co., Boston.	Earl Cooley, Berlin.	23.85
10363	Scientific Economy Fertilizer.	The Scientific Fertilizer Co., Pittsburgh, Pa.	R. K. Woodward, Amenia Union, N. Y.	17.81
10245	Fertilizer.	Connecticut Reduction Co., Bridgeport.	S. E. Frisbie, Milford.	......
10217	Fertilizer.	Bridgeport Utilization Co., Bridgeport.	Joseph Lee, Southport.	.... .
10366	Berkshire Complete Fertilizer.	Berkshire Mills Co., Bridgeport.	M. A. Fitzgerald, Stratford.	.... .
10365	Berkshire Complete Fertilizer.	Berkshire Mills Co., Bridgeport.	M. A. Fitzgerald, Stratford.	.... .

Station No.	Nitrogen.					Phosphoric Acid.							Potash.		
				Total Nitrogen.					Total.		Available.		Found.		
	Nitrogen as Nitrates.	Nitrogen as Ammonia.	Nitrogen Organic.	Found.	Guaranteed.	Soluble.	Reverted.	Insoluble.	Found.	Guaranteed.	Found.	Guaranteed.	As Muriate.	Total.	Guaranteed.
10713	0.77	....	3.91	4.68	*4.1*	7.04	2.50	1.40	10.94	*10.0*	9.54	*8.0*	0.26	7.17	*7.0*
10289	0.90	0.10	3.10	4.10	*4.0*	5.65	2.79	.80	9.24	......	8.44	*8.0*	10.56	10.56	*8.0*
10538	....	1.00	2.59	3.59	*3.5*	7.01	1.35	1.43	9.79	*10.0*	8.36	*9.0*	.61	6.86	*6.0*
10462	...	0.88	2.81	3.69	*3.3*	2.54	2.99	.69	6.22	......	5.53	*4.0*	.49	3.76	....
10369	1.56	....	2.63	4.19	*4.1*	6.70	2.97	2 32	11.99	......	9.67	*9.0*	3.64	3.64	*3.0*
10363	....	....	2.44	2.44	*2.1*	4.18	4.06	1.20	9.44	*9.0*	8.24	*7.5*	.....	3.49	*4.0*
10245	....	....	2.65	2.65	*2.6*	None.	2.53	1.23	3.76	......	2.53	*4.5*	0.37	0.37	*3.1*
10217	....	....	....	3.35	*2.6*	None.	2.00	1.65	3.65	......	2.00	*4 5*	.....	0.34	*3.1*
10366	....	....	....	3.10	*2.5*	.....	....	....	.....	......	....	.....	....	.....	....
10365	....	....	....	3.44	*3.3*	.....	....	....	.....	......	....	.....	....	.....	...

GUARANTEES.

Of the one hundred and eleven samples analyzed, thirty-three do not fulfill the manufacturer's minimum guarantee in respect of one ingredient, and six are each deficient in respect of two ingredients. The causes of these deficiencies have in part been mentioned on page 47.

Thirteen were deficient in nitrogen, twenty-two in potash, and ten in phosphoric acid. In eight of the ten cases, however, the available phosphoric acid was as guaranteed, the deficiency being only in the insoluble part of the phosphoric acid.

COST AND VALUATION.

The average cost per ton of the one hundred and eleven samples examined was $33.11, the valuation $21.72, and the percentage difference 52.4.

In 1897 the corresponding figures were: Average cost, $34.34; average valuation, $24.28; percentage difference, 41.4.

Analyses requiring Special Notice.

No. 10585, pp. 70 and 71. Stockbridge Top Dressing, made by the Bowker Fertilizer Co., Boston, Mass. The manufacturer called attention to the fact that the nitrogen found, 3.93 per cent., was nearly one per cent. under the guarantee, and, in view of the discrepancy, asked that another sample be drawn. This was done, and the analysis, No. 10728, pp. 70 and 71, made on another sample shows 5.67 per cent. of nitrogen, but only 4.36 per cent. of potash, being less than the guarantee, 6.0 per cent., and less than was found in the first sample, 6.47 per cent. The reason for these variations does not appear.

10664, pp. 76 and 77. Vegetable and Vine Manure. Made by the Read Fertilizer Co., N. Y. city. The manufacturer stated that as the percentage of potash, 6.90, was considerably under the guarantee, 8.0 per cent., he believed that the sample did not fairly represent the goods, and asked that another sample be drawn and analyzed. This was done, and the results are given in No. 10752, pages 74 and 75. The percentage of potash found in this sample was much nearer, though not up to the maker's guarantee.

A similar request was made regarding No. 10694, pp. 78 and 79. Wheat, Oats, and Barley Phosphate. Made by the Milsom Rendering and Fertilizer Co., East Buffalo, N. Y. Another analysis, 10773, made on a different sample, gave essentially the same percentage of potash as the first analysis.

10417, pp. 78 and 79. Wheat and Corn Producer. Made by the Niagara Fertilizer Works, Buffalo, N. Y. The manufacturer stated that this analysis did not fairly represent the general quality of this brand, which contained more potash than was found in our analysis.

A second analysis, made on another sample, 10730, showed composition very similar to the first.

10402. Wilson's Corn and Grain Fertilizer, pp. 68 and 69. Made for D. B. Wilson & Co., Waterbury, by the Bowker Fertilizer Co., Boston. But a small quantity of this fertilizer was shipped into the state and was subsequently withdrawn.

SPECIAL MANURES SAMPLED BY THE STATION.

Station No.	Name of Brand.	Manufacturer.	Dealer.	Dealer's cash price per ton.
10710	Seeding Down Manure.	Mapes F. & P. G. Co., N. Y.	Manufacturer.	$35.00
10405	High Grade Grass and Grain Fertilizer.	Rogers Mfg. Co., Rockfall.	Manufacturer.	37.00
10736	High Grade Grass and Grain.	Rogers Mfg. Co., Rockfall.	Manufacturer.	37.00
10403	Hubbard's Grass and Grain Fertilizer.	Rogers & Hubbard Co., Middletown.	H. W. Andrews, Wallingford.	38.00
			City Coal & Wood Co., New Britain.	37.00
				37.50
10701	Tobacco Grower.	L. B. Darling Fertilizer Co., Pawtucket, R. I.	J. B. Pease, Melrose.	38.00
10647	Oats and Top Dressing.	Rogers Mfg. Co., Rockfall.	Manufacturer	42.00
10656	Americus Fine Wrapper Tobacco Grower.	Williams & Clark, New York.	J. Barnard, Simsbury.	40.00
10331	Hubbard's Soluble Tobacco Manure.	Rogers & Hubbard Co., Middletown.	H. W. Andrews, Wallingford.	42.00
			C. L. Luce, New Britain.	40.00
10332	Armour's Grain Grower.	Armour Fertilizer Works, Chicago.	C. J. Benham, New Haven.	25.00
			Adams & Canfield, Winnipauk.	21.00
				23 00
10400	Hubbard's Oats and Top Dressing.	Rogers & Hubbard Co., Middletown.	City Coal & Wood Co., New Britain.	48.00
			H. W. Andrews, Wallingford.	49.00
			W. C. Bulkley, Forestville.	47.00
10649	Special Tobacco Manure.	Russia Cement Co., Gloucester, Mass.	J. B. Parker, Poquonock.	43.00
10525	Tobacco Ash Elements.	Bowker Fertilizer Co., Boston.	H. K. Brainard, Thompsonville	32.00
			G. M. Risley, Windsor.	30.00
			Bowker's Branch, Hartford.	32.00
10586	Tobacco Ash Fertilizer.	Bowker Fertilizer Co., Boston.	G. M. Risley, Windsor.	40.00
			Bowker's Branch, Hartford.	42.00
				41.00
10241	Preston's Potato Phosphate.	Preston Fertilizer Co., Greenpoint, L. I.	O. G. Beard,* Shelton.	31.00
10486	Essex Complete Manure for Corn, Grain, and Grass.	Russia Cement Co., Gloucester, Mass.	T. Anderson & Co., Cromwell.	38.00
			C. N. Jones, Wallingford.	38.00
			E. N. Pierce & Co., Plainville.	38.00
10485	Complete Manure for Potatoes, Roots, and Vegetables.	Russia Cement Co., Gloucester, Mass.	R. M. Burnham, East Windsor Hill.	39.00
			L. A. Carrier, Berlin.	40.00
			C. N. Jones, Wallingford.	38.00
10631	Hubbard's Potato Phosphate.	Rogers & Hubbard Co., Middletown.	H. W. Andrews, Wallingford.	30.00
			J. P. Barstow, Norwich.	30.00
			Manufacturer.	30.00
10625	Tobacco Manure, Wrapper Brand.	Mapes F. & P. G. Co, New York.	Mapes Branch, Hartford.	44.00
			D. W. Barnes, Windsor.	46.00

*Consumer, not a dealer.

ANALYSES AND VALUATIONS.

Valuation per ton.	Percentage difference between cost and valuation.	Nitrogen. Nitrogen as Nitrates.	Nitrogen. Nitrogen as Ammonia.	Nitrogen. Nitrogen Organic.	Nitrogen. Total Nitrogen. Found.	Nitrogen. Total Nitrogen. Guaranteed.	Phosphoric Acid. Soluble.	Phosphoric Acid. Reverted.	Phosphoric Acid. Insoluble.	Phosphoric Acid. Total. Found.	Phosphoric Acid. Total. Guaranteed.	Phosphoric Acid. Available. Found.	Phosphoric Acid. Available. Guaranteed.	Potash. Found. As Muriate.	Potash. Found. Total.	Potash. Guaranteed.
$30.48	14.8	1.69	...	1.09	2.78	*2.5*	....	....	....	17.65	*18.0*	....	....	11.09	11.09	*10.0*
31 56	17.2	0.36	0.13	2.38	2.87	*3.0*	....	....	....	15.22	*16.0*	....	....	14.64	14.64	*12.5*
31 14	18.8	0.06	0.10	2.56	2.72	*3.0*	....	....	....	17.45	*16.0*	....	....	13.14	13.14	*12.5*
30 91	21.3	....	....	3.04	3.04	*2.5*	....	....	....	18.37	*16.5*	....	....	11.96	11.96	*12.5*
31.14	22.0	....	2.23	2.79	5.02	*4.9*	3.82	3.74	1.08	8.64	*8.0*	7.56	*7.0*	0.33	10.28	*10.0*
33.31	26.1	4.76	0.14	1.72	6.62	*6.3*	1.87	6.08	0.66	8.61	*9.0*	7.95	....	10.49	10.49	*7.5*
31.58	26.7	0.86	1.83	2.89	5.58	*5.8*	4.35	1.52	1.68	7.55	*6.0*	5.87	*5.0*	0.76	10.43	*10.0*
31.52	26.9	1.31	....	3.54	4.85	*5.0*	1.76	7.65	1.20	10.61	*10.0*	9.41	*7.0*	0.99	10.17	*10.0*
17.97	27.9	....	....	2.36	2.36	*1.6*	4.34	5.16	3.18	12.68	*10.0*	9.50	*8.0*	1.33	2.25	*2.0*
37.52	27.9	7.73	....	1.55	9.28	*8.8*	....	....	....	8.47	*7.9*	....	....	8.48	8.48	*8.4*
33.29	29.2	....	1.37	3.68	5.05	*4.5*	4.70	3.12	1.12	8.94	*8.0*	7.82	....	0.67	12.07	*12.0*
24.73	29.4	....	....	....	....	....	0.08	8.43	3.71	12.22	....	8.51	*6.0*	1.26	16.63	*15.0*
31.61	29.7	2.96	....	0.55	3.51	*3.0*	....	8.67	4.20	12.87	....	8.67	*5.0*	1.36	13.95	*13.0*
23 73	30.6	0.34	..	1.81	2.15	*1.6*	4.50	4.65	1.99	11.14	....	9.15	*7.0*	9.62	10.66	*10.0*
29.05	30.8	0.91	....	3.38	4.29	*3.7*	4.69	4.86	1.85	11.40	*9.5*	9.55	....	9.85	9.85	*9.5*
29.77	31.00	0.24	0.72	3.34	4.30	*3.7*	4.94	4.54	1.69	11.17	*9.0*	9.48	....	0.80	9.14	*8.5*
22.75	31.9	0.68	....	1.96	2.64	*2.0*	7.70	3.90	2.08	13.68	*10.0*	11.60	*9.0*	5.42	5.42	*5.0*
33.36	31.9	3.07	1.67	1.72	6.46	*6.2*	0.26	5.06	0.42	5.74	*4.5*	5.32	....	0.81	11.55	*10.5*

SPECIAL MANURES SAMPLED BY THE STATION.

Station No.	Name of Brand.	Manufacturer.	Dealer.	Dealer's cash price per ton.
10567	Potato, Onion, and Tobacco Manure.	Wilcox Fertilizer Works, Mystic.	W. A. Howard, Woodstock. F. A. Rathbun, Hebron. J. W. Dennison, Mystic. Manufacturer. C. M. Smith, E. Hartford.	$34.00 37.00 31.00 35.00 35.00
10624	Tobacco Ash Constituents.	Mapes F. & P. G. Co., New York.	Mapes Branch, Hartford. F. S. Bidwell, Windsor Locks. W. W. Cooper, Suffield.	30.00 31.00 30.00
10611	Potato and Root Crop Manure.	L. B. Darling Fertilizer Co., Pawtucket, R. I.	A. I. Kinney, Terryville. Hotchkiss & Templeton, Waterbury.	34.00 36.00 35.00
10560	Complete for Potatoes and Vegetables.	Rogers Mfg. Co., Rockfall.	Manufacturer. A. J. Palmer, Branford.	30.00 28.00
10610	Potato Manure.	Lister's Agricultural Chemical Works, Newark, N. J.	Strong & Tanner, Winsted. Daniels Bros., Middletown. A. N. Clark, Milford.	35.00 30.00 34.00 33 00
10329	Hubbard's Soluble Potato Manure.	Rogers & Hubbard Co., Middletown.	H. W. Andrews, Wallingford. City Coal & Wood Co., New Britain. C. L. Luce, New Britain. J. F. Close, Round Hill.	38.00 37.00 36.00 38.00
10632	High Grade Soluble Tobacco Manure.	Rogers Mfg. Co., Rockfall.	Manufacturer. W. F. Andross, East Hartford.	42.00 40.00
10338	Swift's Lowell Potato Phosphate.	Lowell Fertilizer Co., Boston.	J. C. Lincoln, Berlin. C. W. Lines, New Britain.	30.00 32.00 31.00
10580	Complete Potato Manure.	H. J. Baker & Bro., New York.	Edward White, Rockville. J. W. Ives, Danbury.	38.00 35.00 36 50
10633	High Grade Soluble Potato and General Crops.	Rogers Mfg. Co., Rockfall.	Manufacturer. F. S. Bidwell, Windsor Locks.	38.00 39.00
10402	*Wilson's Corn and Grain Fertilizer.	Bowker Fertilizer Co., Boston, Mass.	D. B. Wilson, Waterbury.	25.00
10595	High Grade Tobacco Manure.	Bradley Fertilizer Co., Boston.	H. C. Aborn, Ellington. D. T. Dyer, Collinsville.	44.00 46.00 45.00
10351	Grass and Grain Spring Top Dressing.	Mapes F. & P. G. Co., New York.	Birdsey & Foster, Meriden Mapes Branch, Hartford.	39.00 38.00
10469	Stockbridge Potato and Vegetable.	Bowker Fertilizer Co, Boston.	E. B. Clark & Co., Milford.	36.00
10330	Economical Potato Manure.	Mapes F. & P. G. Co., New York.	Birdsey & Foster, Meriden. Southington Lumber & Feed Co., Southington.	34.00 33.00 33.50
10634	Special Potato Fertilizer.	H. F. Tucker Co., Boston.	E. A. Buck, Willimantic. Alfred Sneider, Rockville.	31.00 27.00 29.00
10335	Potato Manure.	Mapes F. & P. G. Co., New York.	Birdsey & Foster, Meriden. A. N. Clark, Milford.	38.00 38.00

*See page 65.

ANALYSES AND VALUATIONS.— *Continued.*

Valuation per ton.	Percentage difference between cost and valuation.	Nitrogen: Nitrogen as Nitrates.	Nitrogen: Nitrogen as Ammonia.	Nitrogen: Nitrogen Organic.	Nitrogen: Total Nitrogen: Found.	Nitrogen: Total Nitrogen: Guaranteed.	Phosphoric Acid: Soluble.	Phosphoric Acid: Reverted.	Phosphoric Acid: Insoluble.	Phosphoric Acid: Total: Found.	Phosphoric Acid: Total: Guaranteed.	Phosphoric Acid: Available: Found.	Phosphoric Acid: Available: Guaranteed.	Potash: Found: As Muriate.	Potash: Found: Total.	Potash: Guaranteed.
$25.55	33.1	0.81	....	3.16	3.97	*3.3*	3.98	4.17	1.51	9.66	*8.0*	8.15	*7.0*	0.07	7.08	*6.0*
22.29	34.6	....	....	0.64	0.64	*0.5*	....	4.43	1.89	6.32	*5.7*	4.43	....	0.92	16.34	*15.0*
25.91	35.1	0.63	0.23	3.32	4.18	*2.8*	3.76	6.22	1.18	11.16	*10.0*	9.98	*9.0*	5.44	6.32	*7.0*
22.09	35.8	0.90	....	1.56	2.46	*2.3*	6.30	6.04	1.86	14.20	*10.0*	12.34	....	4.87	4.87	*5.0*
24.22	36.2	....	1.24	2.32	3.56	*3.7*	6.72	1.88	0.96	9.56	*8.5*	8.60	*7.5*	7.43	7.43	*7.0*
27.14	36.3	1.34	....	3.67	5.01	*5.0*	1.78	6.66	1.54	9.98	*10.0*	8.44	*7.0*	1.00	5.98	*5.0*
30.75	36.6	1.42	....	3.02	4.44	*5.0*	1.76	6.74	1.13	9.63	*8.0*	8.50	....	0.77	11.29	*11.0*
22.64	36.9	....	....	2.89	2.89	*2.5*	6.30	2.66	0.35	9.31	*9.0*	8.96	*8.0*	0.14	6.63	*6.0*
26.56	37.4	0.52	1.83	1.44	3.79	*3.3*	5.92	.96	0.74	7.62	*6.8*	6.88	*5.7*	9.98	11.16	*10.0*
27.34	39.0	0.88	....	2.63	3.51	*3.5*	2.19	7.11	2.09	11.39	*9.0*	9.30	....	0.89	9.32	*8.8*
16.71	40.9	0.18	....	1.66	1.84	*1.5*	6.50	2.79	1.94	11.23	*9.0*	9.29	*8.0*	3.21	3.21	*3.0*
31.80	41.5	....	4.05	1.82	5.87	*5.8*	2.93	3.03	1.51	7.47	*6.0*	5.96	*5.0*	1.36	9.90	*10.0*
26.73	42.2	1.23	1.47	2.62	5.32	*4.9*	2.48	3.84	0.70	7.02	*6.0*	6.32	*5.0*	7.64	7.64	*7.0*
25.24	42.6	1.50	....	2.13	3.63	*3.2*	3.38	3.42	1.98	8.78	*7.0*	6.80	*5.0*	10.36	10.36	*10.0*
23.48	42.7	1.16	0.28	2.14	3.58	*3.3*	2.37	4.48	0.99	7.84	*6.0*	6.85	*4.0*	2.09	7.89	*8.0*
20.22	43.4	0.28	....	2.48	2.76	*2.5*	3.54	3.55	1.98	9.07	*10.0*	7.09	*8.0*	6.74	6.74	*6.0*
26.32	44.4	0.90	2.78	0.32	4.00	*3.7*	3.73	4.93	1.29	9.95	*8.0*	8.66	*8.0*	0.80	7.60	*6.0*

SPECIAL MANURES SAMPLED BY THE STATION.

ANALYSES AND VALUATIONS.— *Continued.*

Station No.	Name of Brand.	Manufacturer.	Dealer.	Dealer's cash price per ton.	Valuation per ton.	Percentage difference between cost and valuation.	Nitrogen: Nitrogen as Nitrates.	Nitrogen: Nitrogen as Ammonia.	Nitrogen: Nitrogen Organic.	Nitrogen: Total Nitrogen. Found.	Nitrogen: Total Nitrogen. Guaranteed.	Phosphoric Acid: Soluble.	Phosphoric Acid: Reverted.	Phosphoric Acid: Insoluble.	Phosphoric Acid: Total. Found.	Phosphoric Acid: Total. Guaranteed.	Phosphoric Acid: Available. Found.	Phosphoric Acid: Available. Guaranteed.	Potash: Found. As Muriate.	Potash: Found. Total.	Potash: Guaranteed.
10491	N. E Potato and Tobacco Grower.	Crocker Fertilizer Co, Buffalo, N. Y.	Clark & Bradley, North Westchester. Walter Gildersleeve, Gildersleeve. The Meeker Coal Co., Norwalk.	$30.00 40.00 34.00 32.00	$21.99	45.5	....	....	3.50	3.50	*3.3*	3.71	3.27	2.14	9.12	....	6.98	*6.0*	0.53	5.45	*5.4*
10698	Tobacco Manure.	Lowell Fertilizer Co., Boston.	J. D. Beasley, Ellington.	40 00	27.42	45.9	....	0.18	4.66	4.84	*4.9*	4.82	1.32	0.37	6.51	....	6.14	*6.0*	0.69	8.42	*8.0*
10592	Special Tobacco and Market Garden.	Wm. E. Brightman, Tiverton, R. I.	William Crane, Broad Brook.	35.00	23.97	46.0	0.84	....	2.67	3.51	*3.3*	3.08	6.13	1.87	11.08	*9.0*	9.21	*8.0*	6.93	6.93	*7.0*
10648	Complete Corn Manure.	Rogers Mfg. Co., Rockfall.	Manufacturer.	35.00	23.86	46.7	1.45	....	2.01	3.46	*3.6*	3.07	5.54	2.53	11.14	*8.0*	8.61	....	7.36	7.36	*7.0*
10623	Tobacco Starter.	Mapes F. & P. G. Co., New York.	Mapes Branch, Hartford. D. W. Barnes, Windsor.	33.00 35.00	22.37	47.5	1.54	0.48	1.18	3.20	*2.5*	4.35	7.40	1.57	13.32	*12.0*	11.75	*8.0*	0.69	3.36	*2.5*
10607	Fruit and Vine.	Lowell Fertilizer Co., Boston.	W. D. Penfield, Cobalt. N. N. King, Thompsonville.	37.00 35.00 36.00	24.24	48.5	....	....	3.89	3.89	*3.3*	5.73	1.62	0.76	8.11	*9.0*	7.35	*8.0*	0.88	6.72	*6.0*
10728	*Stockbridge Top Dressing.	Bowker Fertilizer Co., Boston.	C. W. Michaels & Co., Yalesville.	38.00	25.37	49.8	2.84	....	2.83	5.67	*4.8*	2.34	4.18	2.06	8.58	*6.0*	6.52	*4.0*	3.73	4.36	*6.0*
10348	Complete Manure for Potatoes and Vegetables.	Bradley Fertilizer Co., Boston.	D. L. Clark, Milford. Lockwood & Hotchkiss, Ansonia.	36.00 35.00 35.50	23.68	49.9	0.78	0.44	2.08	3.30	*3.3*	6.27	3.01	1.12	10.40	*9.0*	9.28	*8.0*	7.17	7.17	*7.0*
10475	Fruit and Vine Manure.	Mapes F. & P. G. Co., New York.	Mapes Branch, Hartford. J. H. Barker, Branford. J. P. Barstow, Norwich.	37.00 39.00 40.00	24.68	49.9	0.50	....	1.87	2.37	*1.7*	2.32	4.16	1.52	8.00	*7.0*	6.48	*5.0*	1.09	12.27	*10.0*
10352	Corn Manure.	Mapes F. & P. G. Co., New York.	A. N. Clark, Milford. Mapes Branch, Hartford.	36.00 34.00	22.65	50.1	0.18	0.84	1.86	2.88	*2.5*	5.52	4.89	0.68	11.09	*10.0*	10.41	*8.0*	6.43	6.43	*6.0*
10639	Potato and Corn Guano.	Preston Fertilizer Co., Greenpoint, L. I.	Bronson Bros. & Co., Winchester Center. T. B. Wickwire, Berlin.	30.00 30.00	19.97	50.2	0.26	....	1.02	1.28	*1.6*	6.86	5.81	1.39	14.06	....	12.67	*8.0*	5.94	5.94	*3.0*
10566	Potato Manure.	Wilcox Fertilizer Works, Mystic.	Manufacturer. F. A. Rathbun, Hebron. W. A. Howard, Woodstock.	30.00 32.00 29.00	19.92	50.6	....	0.44	2.34	2.78	*2.0*	2.26	5.34	3.38	10.98	*8.0*	7.60	*7.0*	4.81	5.21	*4.0*
10600	Stockbridge Tobacco Manure.	Bowker Fertilizer Co., Boston.	H. K. Brainard, Thompsonville.	48.00	31.82	50.8	3.05	....	2.81	5.86	*5.8*	....	4.83	3.98	8.81	*6.0*	4.83	*4.0*	0.60	10.66	*10.0*
10585	*Stockbridge Top Dressing.	Bowker Fertilizer Co., Boston.	W. O. Goodsell, Bristol.	37.00	24.52	50.9	2.35	....	1.58	3.93	*4.8*	4.37	4.14	1.83	10.34	*6.0*	8.51	*4.0*	3.00	6.47	*6.0*
10661	Potato and Onion Fertilizer.	Preston Fertilizer Co., Greenpoint, L. I.	T. B. Wickwire, Berlin.	34.00	22.44	51.5	0.20	....	2.71	2.91	*2.3*	1.63	6.96	4.56	13.15	....	8.59	*6.0*	6.43	6.43	*6.0*
10466	Potato Fertilizer.	Cumberland Bone Phosphate Co., Boston.	Kahn Bros., Yantic. A. J. Palmer, Branford.	28.00 27.00 27.50	18.05	52.4	0.21	....	2.04	2.25	*2.0*	7.02	2.44	1.84	11.30	*11.0*	9.46	*6.0*	3.27	3.27	*3.0*
10666	Onion Manure.	Quinnipiac Fertilizer Co., Boston.	W. C. Pease, Somers.	36.00	23.59	52.6	1.88	....	1.56	3.44	*3.3*	4.37	4.37	1.43	10.17	*9.0*	8.74	*8.0*	7.45	7.45	*7.0*
10487	Essex Potato Fertilizer.	Russia Cement Co., Gloucester, Mass.	C. N. Jones, Wallingford. L. A. Carrier, Berlin. Southington Lumber & Feed Co., Southington. J. M. White, Bristol. F. L. Hitchcock, Watertown. T. Anderson & Co., Cromwell.	33.00 34.00 32.00 35.00 35.00 35.00	22.26	52.7	0.38	....	2.38	2.76	*2.3*	6.02	3.08	2.22	11.32	*9.0*	9.10	....	0.46	5.91	*5.0*

* See page 64.

Special Manures Sampled by the Station.

Analyses and Valuations.— *Continued.*

Station No.	Name of Brand.	Manufacturer.	Dealer.	Dealer's cash price per ton.	Valuation per ton.	Percentage difference between cost and valuation.	Nitrogen: Nitrogen as Nitrates.	Nitrogen: Nitrogen as Ammonia.	Nitrogen: Nitrogen Organic.	Nitrogen: Total Nitrogen, Found.	Nitrogen: Total Nitrogen, Guaranteed.	Phosphoric Acid: Soluble.	Phosphoric Acid: Reverted.	Phosphoric Acid: Insoluble.	Phosphoric Acid: Total, Found.	Phosphoric Acid: Total, Guaranteed.	Phosphoric Acid: Available, Found.	Phosphoric Acid: Available, Guaranteed.	Potash: Found, As Muriate.	Potash: Found, Total.	Potash: Guaranteed.
10584	Stockbridge Corn.	Bowker Fertilizer Co., Boston.	Sanford & Hawley, Unionville. Jacob Blakeslee, Watertown. C. T. Leonard, Norwalk.	$37.00 **38.00** 39.00	$24.78	53.3	0.75	....	2.72	3.47	*3.0*	7.01	2.45	1.25	10.71	*10.0*	9.46	....	7.58	7.58	*6.0*
10681	Special Potato Manure.	Crocker Fertilizer Co., Buffalo, N. Y.	F. M. Loomis, North Granby.	**36 00**	23.46	53.5	...	1.86	2.08	3.94	*3.7*	7.10	1.87	0.19	9.16	....	8.97	*8.0*	5.25	5.25	*5.0*
10597	Tobacco Fertilizer.	Bradley Fertilizer Co., Boston.	D. T. Dyer, Collinsville. C. K. & H. T. Hale, Gildersleeve.	37.00 38.00 **37 50**	24.41	53.6	0.95	.40	2.33	3.68	*3.4*	4.26	4.96	1.50	10.72	*10.0*	9.22	*8.0*	6.94	6.94	*4.0*
10564	High Grade Special.	Williams & Clark, New York.	G. H Sloan, Windsorville. John Bransfield, Portland. Gault Bros., Westport.	...... 38.00 36.00 **37.00**	23.89	54.9	1.10	.26	2.13	3.49	*3.3*	3.01	6.00	1.83	10.84	*9.0*	9.01	*8.0*	7.18	7.18	*7.0*
10520	Tobacco Starter.	Bowker Fertilizer Co., Boston.	W. C. Pease, Somers. Bowker's Branch, Hartford. E. F. Miller, Ellington.	36.00 **35.00** 33.00	22.26	57.2	0.38	....	2.40	2.78	*2.3*	9.34	1.86	1.41	12.61	*12.0*	11.20	*8.0*	0.41	4.15	*3.0*
10612	Potato Phosphate.	Cleveland Dryer Co., Boston.	A. H. Bates, Windham Center. C. E. Main, Plainfield.	26.00 30.00 **28.00**	17.76	57.7	0.23	....	1.98	2.21	*2.1*	6.75	2.82	1.55	11.12	....	9.57	*8.0*	3.13	3.13	*3.0*
10606	Special Potato Fertilizer.	Lister's Agricultural Chemical Works, Newark, N. J.	A. W. Hutchinson, Gilead J. C. Leonard & Son, Jewett City. W. B. Martin, Rockville.	**27.00** 26.00 27.00	16.95	59.3	....	....	1.96	1.96	*1.7*	6.06	3.37	1.34	10.77	*9.0*	9.43	*8.0*	3.00	3.22	*3.0*
10451	Complete Manure for Top Dressing Grass and Grain.	Bradley Fertilizer Co., Boston.	W. H. Scott, Pequabuck. C. K. & H. T. Hale, Gildersleeve.	36.00 35 00 **35.50**	22.25	59.6	5.26	....	....	5.26	*4.3*	2.88	3.72	1.05	7.65	*6.0*	6.60	*5.0*	0.56	2.66	*2.5*
10336	Lowell Bone Fertilizer for Corn and Grain.	Lowell Fertilizer Co., Boston.	J. C. Lincoln, Berlin. C. W. Lines, New Britain.	25.00 28.00 **26 50**	16.40	61.6	....	....	1.96	1.96	*1.7*	6.64	1.93	1.27	9.84	*9.0*	8.57	*8.0*	3.39	3.39	*3.0*
10562	High Grade Fruit Fertilizer.	M. E. Wheeler & Co., Rutland, Vt.	J. F. Blakeslee, North Haven. L. B. Morgan, Plainfield.	28.00 24.00 **26.00**	16.04	62.1	....	....	....	....	....	8.26	2.54	0.70	11.50	*12.0*	10.80	*10.0*	6.94	7.34	*8 0*
10635	Americus Potato Manure.	Williams & Clark, New York.	R. B. Ritter, Brooklyn. E. F. Strong, Colchester. John Bransfield, Portland.	...... 27.00 30.00 **28.50**	17.46	63.2	0.26	....	1.92	2.18	*2.0*	5.89	3.39	1.80	11.08	*9.0*	9.28	*8.0*	3.14	3.14	*3.0*
10355	Chittenden's Potato Phosphate.	National Fertilizer Co., Bridgeport.	Manufacturer. G. A. & H. B. Williams, East Hartford. J. F. Buckhout, Greenwich. A. G. Beach, Seymour.	...... **32.00** 31.00 34.00	19.56	63.6	....	0.56	1.54	2.10	*2.0*	3.55	2.95	0.80	7.30	*8.0*	6.50	*6.0*	3.88	8.38	*10.0*
10615	Vegetable, Vine, and Tobacco.	Great Eastern Fertilizer Co., Rutland, Vt.	H. S. Harvey, Windham Center. W. M. Tyler, Waterbury. Silas Finch, Greenwich.	30.00 **32.00** 32.00	19.54	63.8	....	..	2.23	2.23	*2.0*	6.59	2.17	1.10	9.86	....	8.76	*8.0*	6.11	6.11	*6.0*
10333	Vegetable, Vine, and Potato Manure.	H. J. Baker & Bro., New York.	Lockwood & Palmer, Stamford. The Meeker Coal Co., Norwalk.	35.00 34.00 **34.50**	21.04	64.0	...	0.78	1.10	1.88	*1.7*	5.54	0.84	0.44	6.82	*6.5*	6.38	*5.5*	11.69	11.69	*12.0*
10470	Bowker's Potato and Vegetable.	Bowker Fertilizer Co, Boston.	C T. Leonard, Norwalk. Bowker's Branch, Hartford.	36 00 35.00 **32.00**	19 43	64.7	0.26	...	2.58	2.84	*2.3*	6.58	1.90	1.20	9.68	*10.0*	8.48	*8.0*	4.25	4.25	*4.0*

SPECIAL MANURES SAMPLED BY THE STATION.

Station No.	Name of Brand.	Manufacturer.	Dealer.	Dealer's cash price per ton.
10711	Complete Tobacco Manure.	H. J. Baker & Bro., New York.	Wm. Stevenson, South Glastonbury.	$42.00
10587	Corn Phosphate.	Bowker Fertilizer Co., Boston.	H. E. Daniels, New London.	26.00
10709	Americus Corn Phosphate.	Williams & Clark, New York.	C. F. Boswell, Preston.	28.00
10622	Animal Corn Fertilizer.	Packer's Union Fertilizer Co., New York.	Rockville Milling Co., Rockville.	29.00
			T. A. Tillinghast, Brooklyn.	28.00
			A. S. Bennett, Cheshire.	32.00
				30.00
10752	*Vegetable and Vine.	Read Fertilizer Co., New York.	J. L. Rice, Beacon Falls	31.00
			N. L. Parmalee, Killingworth.	32.00
				31.50
10563	Havana Tobacco Grower.	M. E. Wheeler & Co., Rutland, Vt.	John Bransfield, Portland.	38.00
			E. E. Pitney, Ellington.	37.00
				37.50
10601	Complete Manure for Corn and Grain.	Bradley Fertilizer Co., Boston.	C. M. Beach, New Milford.	**38.00**
10450	Potato Fertilizer.	Bradley Fertilizer Co., Boston.	D. L. Clark, Milford.	29.00
			Wilson & Burr, Middletown.	32.00
				30.00
10532	Potato Special.	Pacific Guano Co., Boston.	Carlos Bradley & Son, Ellington.	28.00
			John Bransfield, Portland.	**30.00**
			Jas. A. Nichols, Danielson.	32.00
10339	High Grade Potato Manure.	Packer's Union Fertilizer Co., New York.	H. L. Hall, Wallingford.	**35.00**
			A. S. Bennett, Cheshire.	32.00
				33.50
10731	Potato Manure.	Bradley Fertilizer Co., Boston.	C. K. & H. T. Hale, Gildersleeve.	33.00
			H. S. Harvey, Windham Center.	31.00
				32.00
10613	Ammoniated Wheat and Corn Phosphate.	Crocker Fertilizer & Chemical Co., Buffalo, N. Y.	H. F. Cady, Stafford.	31.00
			C. F. Tallard & Son, Broad Brook.	**29.00**
			H. Davis, Durham Center.	26.00
10849	Potato Manure.	Bradley Fertilizer Co., Boston.	Wheeler & Howe, Bridgeport.	33.00
			D. L. Clark, Milford.	30.00
			E. E. Scoville, Stamford.	34.00
				32.00
10621	Potato Phosphate.	Quinnipiac Co., Boston.	H. S. Coe, Harwinton.	**31.00**
			C. A. Young, Danielson.	30.00
10535	Northern Corn Special.	Great Eastern Fertilizer Co., Rutland, Vt.	J. N. Saunders, North Stamford.	35.00
			C. A. Sanderson, Moosup.	30.00
				32.50
10629	Corn Fertilizer.	Milsom Rend. & Fertilizer Co., E. Buffalo, N. Y.	Charles H. Davis, Guilford.	**28 50**
			I. J. Scoville, Plainville.	30.00
10594	Fish and Potash, Triangle A Brand.	Bradley Fertilizer Co., Boston.	C. F. Tallard & Son, Broad Brook.	**29.00**

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ANALYSES AND VALUATIONS.— *Continued.*

Valuation per ton.	Percentage difference between cost and valuation.	Nitrogen. Nitrogen as Nitrates.	Nitrogen as Ammonia.	Nitrogen Organic.	Total Nitrogen. Found.	Total Nitrogen. Guaranteed.	Phosphoric Acid. Soluble.	Reverted.	Insoluble.	Total. Found.	Total. Guaranteed.	Available. Found.	Available. Guaranteed.	Potash. Found. As Muriate.	Found. Total.	Guaranteed.
$25.45	65.0	0.43	1.82	2.59	4.84	*4.5*	5.63	0.59	0 32	6.54	....	6.22	*4.0*	7.42	7.42	*10.0*
15.70	65.6	0.12	....	1.70	1.82	*1.5*	5.97	2.95	2.33	11.25	*11.0*	8.92	*8.0*	2.32	2.32	*2.0*
16.91	65.6	....	....	2.15	2.15	*2.1*	5.36	4.26	2.47	12.09	*10.0*	9.62	*9.0*	1.96	1.96	*1.5*
18.09	65.8	....	0.29	2.57	2.86	*2.5*	6.37	2.53	1.18	10.08	...	8.90	*8.0*	2.19	2.19	*2.0*
18.89	66.8	0.04	....	1.90	1.94	*1.7*	5.50	2.21	0.96	8.67	*7.0*	7.71	*6.0*	7.50	7.50	*8.0*
22.45	67.0	...	....	3.08	3.08	*2.9*	5.54	2.32	1.22	9.08	....	7.86	*6.0*	7.63	7.63	*7.0*
22.72	67.3	....	0.75	2.61	3.36	*3.3*	5.20	6.82	1.85	13.87	*13.0*	12.02	*12.0*	2.86	2.86	*3.0*
17.88	67.8	....	....	2.17	2.17	*2.1*	5.20	4.18	2.75	12.13	*11.0*	9.38	*9.0*	3.15	3.15	*3.3*
17.86	68.0	0.18	....	1.98	2.16	*2.1*	6.08	3.53	2.17	11.78	*9.0*	9.61	*8.0*	3.16	3.16	*3.0*
19.94	68.0	....	....	2.29	2.29	*2.1*	7.02	1.94	1.06	10.02	....	8.96	*8.0*	6.16	6.16	*6.0*
19.02	68.2	....	0.22	2.52	2.74	*2.5*	3.79	3.15	2.68	9.62	*8.0*	6.94	*6.0*	5.11	5.11	*5.0*
17.22	68.4	....	....	2.28	2.28	*2.0*	7.49	3.10	0.60	11.19	....	10.59	*10.0*	1.62	1.62	*1.6*
18.83	69.9	....	0.20	2.42	2.62	*2.5*	3.47	3.38	2.71	9.56	*9.0*	6.85	*6.0*	5.10	5.10	*5.0*
18.15	70.8	....	....	2.26	2.26	*3.1*	4.86	5.12	2.16	12.14	*9.0*	9.98	*8.0*	2.93	2.93	*3.0*
18.96	71.4	...	0.28	2.82	3.10	*3.0*	6.93	2.10	1.15	10.18	....	9.03	*8.0*	2.23	2.23	*2.0*
16.51	72.6	....	....	2.26	2.26	*2.5*	6.40	2.43	1.84	10.67	*9.0*	8.83	*8.0*	2.05	2.05	*2.0*
16.77	72.9	...	0.32	2.14	2.46	*2.0*	2.72	3.19	1.92	7.83	*6.0*	5.91	....	4.84	4.84	*4.0*

SPECIAL MANURES SAMPLED BY THE STATION.

Station No.	Name of Brand.	Manufacturer.	Dealer.	Dealer's cash price per ton.
10421	Potato Manure.	Quinnipiac Co., Boston.	C. Buckingham, Southport. Adams & Canfield, Winnipauk. Olds & Whipple, Hartford.	$30.00 32.00 34.00
10489	Special Potato Fertilizer.	Milsom Rendering & Fertilizer Co., East Buffalo, N. Y.	Charles H. Davis, Guilford. D. E. Doolittle, West Cheshire.	31.00 32.00
10494	Potato, Hop, and Tobacco Phosphate.	Crocker Fertilizer Co., Buffalo, N. Y.	Haley & Chesebro, Stonington. H. C. Porter, Hebron.	31.00 33.00 32.00
10518	High Grade Special Potato.	E. Frank Coe Co., New York.	H. B. Sherwood, Southport. J. O. Fox, Putnam.	...... 38 00
10636	Potato Phosphate.	Williams & Clark, New York.	D. B. Wilson, Waterbury. T. B. Atwater, Plantsville	30.00 35.00 32.50
10527	Corn Fertilizer.	M. E. Wheeler & Co., Rutland, Vt.	J. F. Blakeslee, North Haven. C. I. Harvey & Son, Middletown. C. K. Ranney, Cromwell. G. C. Ingham, Saybrook. Dwight Gallup, Old Mystic. L. B. Morgan, Plainfield.	30.00 28.00 28.50 30.00 28.00 25.00
10773	*Wheat, Oats, and Barley.	Milsom Rend. & Fertilizer Co., E. Buffalo, N. Y.	J. A. Loomis, Manchester	25.00
10517	Potato Fertilizer.	Clark's Cove Fertilizer Co., New York.	F. A. Hunt, Columbia. J. M. Burke, Manchester. J. R. Ballard, Thompson	30.00 32.00 32.00 31.50
10664	*Vegetable and Vine.	Read Fertilizer Co., New York.	J. N. Clark, Columbia.	32 00
10531	Grass and Grain Fertilizer.	Pacific Guano Co., Boston.	Jas. A. Nichols, Danielson. Carlos Bradley & Son, Ellington.	26.00 24.00 25.00
10651	Special for Potatoes.	Standard Fertilizer Co., Boston.	W. E. Truesdell & Co., Burnside.	32.00
10529	Corn Manure.	Quinnipiac Co., Boston.	S. V. Osborn & Co., Branford. C. A. Young, Danielson. W. C. Pease, Somers.	30.00 29.00 30.00
10476	Universal Grain Grower.	Crocker Fertilizer & Chemical Co., Buffalo, N. Y.	Clark & Bradley, North Westchester. Henry Davis, Durham Center.	22.00 22.00
10702	Wheat, Oats, and Clover Fertilizer.	Packers' Union Fertilizer Co., New York.	A. S. Bennett, Cheshire. Rockville Milling Co., Rockville. H. L. Hall, Wallingford.	22.00 24.00 22.00
10468	Potato and Vegetable Phosphate.	Bowker Fertilizer Co., Boston.	D. B. Wilson, Waterbury. J. C. Lincoln, Berlin. Linsley & Lightbourn, New Haven.	30.00 30.00 35.00

* See page 64.

ANALYSES AND VALUATIONS.— *Continued.*

Valuation per ton.	Percentage difference between cost and valuation.	Nitrogen: Nitrogen as Nitrates.	Nitrogen: Nitrogen as Ammonia.	Nitrogen: Nitrogen Organic.	Total Nitrogen: Found.	Total Nitrogen: Guaranteed.	Phosphoric Acid: Soluble.	Phosphoric Acid: Reverted.	Phosphoric Acid: Insoluble.	Phosphoric Acid, Total: Found.	Phosphoric Acid, Total: Guaranteed.	Phosphoric Acid, Available: Found.	Phosphoric Acid, Available: Guaranteed.	Potash, Found: As Muriate.	Potash, Found: Total.	Potash: Guaranteed.
$18.46	73.3	0.53	....	2.15	2.68	*2.5*	1.07	5.91	2.14	9.12	*7.0*	6.98	*6.0*	5.30	5.30	*5.0*
17.84	73.8	....	...	1.50	1.50	*1.6*	5.49	2.36	0.96	8.81	*10.0*	7.85	*8.0*	7.56	7.56	*8.0*
18.37	74.2	....	....	2.24	2.24	*2.0*	5.66	4.15	1.49	11.30	...	9.81	*10.0*	3.63	3.63	*3.3*
21.72	75.0	....	0.89	1.74	2.63	*2.4*	6.32	2.03	2.64	10.99	*9.0*	8.35	*7.0*	.24	6.03	*6.5*
18.45	76.1	0.68	....	1.99	2.67	*2.5*	.75	6.31	1.91	8.97	*7.0*	7.06	*6.0*	4.85	5.35	*5.0*
16.09	77.1	....	....	2.04	2.04	*1.6*	6.67	2.41	1.08	10.16	....	9.08	*8.0*	2.37	2.37	*2.0*
14.05	77.9	....	....	1.40	1.40	*1.2*	5.68	3.03	2.56	11.27	*9.0*	8.71	*8.0*	.50	1.65	*2.0*
17.68	78.2	....	....	2.10	2.10	*2.1*	6.72	2.89	1.74	11.35	*9.0*	9.61	*8.0*	3.22	3.22	*3.0*
17.69	80.9	....	....	1.84	1.84	*1.7*	5.78	1.54	0.60	7.92	*7.0*	7.32	*6.0*	6.90	6.90	*8.0*
13.60	83.8	....	...	1.21	1.21	*0.8*	6.66	2.70	1.68	11.04	*8.0*	9.36	*7.0*	1.64	1.64	*1.0*
17.29	85.1	....	....	2.02	2.02	*2.0*	4.83	4.55	2.57	11.95	*9.0*	9.38	*8.0*	3.07	3.07	*3.0*
16.17	85.5	....	....	2.12	2.12	*2.1*	7.55	2.26	1.01	10.82	*10.0*	9.81	*9.0*	1.43	1.43	*1.5*
11.82	86.1	....	....	0.92	0.92	*0.8*	4.45	2.99	0.90	8.34	...	7.44	*7.0*	2.92	2.92	*2.7*
11.82	86.1	....	....	....	....	....	7.04	4.38	1.00	12.42	....	11.42	*11.0*	1.86	1.86	*2.0*
16.12	86.1	0.21	....	1.67	1.88	*1.5*	6.34	2.76	3.00	12.10	*10.0*	9.10	*8.0*	2.08	2.08	*2.0*

SPECIAL MANURES SAMPLED BY THE STATION.

Station No.	Name of Brand.	Manufacturer.	Dealer.	Dealer's cash price per ton.
10561	Potato Manure.	M. E. Wheeler & Co., Rutland, Vt.	G. C. Ingham, Saybrook.	$34.00
			John Bransfield, Portland.	34.00
			C. K. Ranney, Cromwell.	31.00
			F. E. Larrabee, Marion.	**33.00**
			J. F. Blakeslee, North Haven.	32.00
10522	Corn Phosphate.	Bradley Fertilizer Co., Boston.	W. W. Sheldon, South Woodstock.	30.00
			Quinnebaug Store, Danielson.	33.00
			W. H. Scott, Pequabuck.	29.00
				31.00
10453	Potato, Hop, and Tobacco Fertilizer.	Niagara Fertilizer Co., Buffalo, N. Y.	Wm. Higgins, New London.	**30.00**
			W. R. Atwell, Durham.	30.00
10490	Potato, Hop, and Tobacco Phosphate.	Milsom Rend. & Fertilizer Co., E. Buffalo, N. Y.	D. E. Doolittle, West Cheshire.	**30.00**
			Chas. H. Davis, Guilford.	29.50
10665	Grass Fertilizer.	Quinnipiac Co., Boston.	Bailey & Markham, Cobalt.	**35.00**
10690	Grain and Grass Grower.	Niagara Fertilizer Works, Buffalo, N. Y.	Wm. Higgins, New London.	**23.00**
10703	Grass and Oats Fertilizer.	M. E. Wheeler & Co., Rutland, Vt.	G. C. Ingham, Saybrook.	**24.00**
10630	Practical Potato Special.	Read Fertilizer Co., New York.	Pascoe Bros., Winsted.	**28.00**
			J. R. Babcock, Mystic.	28.00
			J. W. Palmer, Stamford.	32.00
10730	*Wheat and Corn Producer.	Niagara Fertilizer Co., Buffalo, N. Y.	J. W. Cutler, Putnam.	**28.00**
10694	†Wheat, Oats, and Barley Phosphate.	Milsom Rend. & Fertilizer Co., E. Buffalo, N. Y.	D. E. Doolittle, West Cheshire.	**26.00**
10417	*Wheat and Corn Producer.	Niagara Fertilizer Co., Buffalo, N. Y.	Wm Higgins, New London.	26.00
			W. R. Atwell, Durham.	30.00
			C. A. Ahlquist, Portland.	30.00
				29.00
10536	Grass and Oats Phosphate.	Great Eastern Fertilizer Co., Rutland, Vt.	C. A. Sanderson, Moosup.	**25.00**
			H. S. Harvey, Windham Center.	21.00
			J. N. Saunders, North Stamford.	28.00

* See page 65. † See page 64.

ANALYSES AND VALUATIONS.— *Continued.*

Valuation per ton.	Percentage difference between cost and valuation.	Nitrogen. Nitrogen as Nitrates.	Nitrogen. Nitrogen as Ammonia.	Nitrogen. Nitrogen Organic.	Nitrogen. Total Nitrogen. Found.	Nitrogen. Total Nitrogen. Guaranteed.	Phosphoric Acid. Soluble.	Phosphoric Acid. Reverted.	Phosphoric Acid. Insoluble.	Phosphoric Acid. Total. Found.	Phosphoric Acid. Total. Guaranteed.	Phosphoric Acid. Available. Found.	Phosphoric Acid. Available. Guaranteed.	Potash. Found. As Muriate.	Potash. Found. Total.	Potash. Guaranteed.
$17.61	87.4	....	....	2.33	2.33	*2.0*	6.62	2.15	1.13	9.90	....	8.77	*8.0*	3.48	3.48	*3.8*
16.49	88.0	....	....	2.14	2.14	*2.1*	6.53	3.28	1.91	11.72	*10.0*	9.81	*9.0*	1.46	1.46	*1.5*
15.91	88.6	....	....	2.02	2.02	*1.6*	5.95	2.97	0.70	9.62	*8.0*	8.92	....	2.62	2.62	*2.7*
15.86	89.2	....	....	1.88	1.88	*2.1*	5.42	2.36	1.10	8.88	*9.0*	7.78	*8.0*	3.99	3.99	*4.0*
18.49	89.3	....	4.05	0.02	4.07	*3.9*	3.92	1.53	0.84	6.29	*6.0*	5.45	*5.0*	2.35	2.35	*2.0*
11.80	94.9	....	....	1 36	1.36	*0.8*	3.54	4.23	1.24	9.01	....	7.77	*7.0*	1.08	1.08	*1.0*
12.25	95.9	....	....	....	....	....	7.26	4.49	1.07	12.82	....	11.75	*11.0*	2.00	2.00	*3.0*
13.83	102.5	....	....	1.06	1.06	*0.8*	2.85	1.98	0.65	5.48	*5.0*	4 83	*4.0*	7.59	7.59	*8.0*
13.61	105.7	....	....	1.48	1.48	*1.8*	5.36	3 34	0.55	9.35	....	8.70	*8.0*	2.02	2.02	*2.2*
12.13	114.3	....	....	1.28	1.28	*1.2*	4.93	2.35	1.96	9.24	*9.0*	7.28	*8.0*	1.70	1.70	*2.0*
13.46	115.4	...	....	1.50	1.50	*1.2*	5.44	2.96	0.64	9.04	*8.0*	8.40	....	2.03	2.03	*2.1*
11.58	115 9	....	....	....	....	....	7.41	3.62	0.97	12.00	....	11.03	*11.0*	1.91	1.91	*2.0*

2 and 3. Special Manures Sampled by Manufacturers and Purchasers.

The three samples described below were sent for analysis by purchasers.

10364. Scientific Potato Fertilizer. Made by the Scientific Fertilizer Co., Pittsburg, Pa. Sampled and sent by R. K. Woodward, Amenia Union, N. Y.

10406. Special Soluble Potato and Onion Manure. Made by J. G. Downward & Co., Coatesville, Pa. Sampled and sent by J. H. Thomas, Southport.

10725. Mapes Tobacco Starter. Made by the Mapes Formula and Peruvian Guano Co., N. Y. Sampled and sent by C. J. Dewey, Buckland.

ANALYSES.

	10364	10406	10725
Nitrogen of nitrates	....	0.62	1.83
" ammonia	....	1.00	0.20
" organic	2.98	1.99	1.09
Total Nitrogen found	2.98	3.61	3.12
" *guaranteed*	*3.0*	*4.0*	*2.5*
Soluble Phosphoric Acid	3.82	5.14	4.26
Reverted " "	4.66	2.87	6.60
Insoluble " "	1.78	1.25	1.87
Total Phosphoric Acid found	10.26	9.26	12.73
" " *guaranteed*	*9.0*	*8.0*	*12.0*
Potash as muriate	0.44	5.46	0.52
" sulphate	5.29	....	2.79
Total Potash found	5.73	5.46	3.31
" *guaranteed*	*6.0*	*6.0*	*2.5*
Cost per ton	$23.00	$28.00	$35.00
Valuation per ton	....	22.05	21.46

The organic nitrogen of the Special Soluble Potato and Onion Manure, **10406,** made by J. G. Downward & Co., is soluble in acid pepsin solution to the extent of 75.9 per cent., indicating that it is readily available to plants.

Inferior Forms of Nitrogen.

The nitrogen of the Scientific Potato Fertilizer, **10364,** is apparently of quite inferior agricultural value, as only 33.5 per cent. of it is soluble in acid pepsin solution. For this reason no valuation is attached, as a valuation presupposes that the nitrogen of the fertilizer is derived from animal and vegetable matters which are quickly and fully available.

HOME MIXTURES.

In the following table are analyses of twenty-four mixtures made by the persons named, for their own use. With the analyses are given the formulas by which they were compounded.

The cost price named does not include the cost of mixing, usually estimated at from one to two dollars per ton. If two dollars per ton were added to the cost of these mixtures, for mixing, their average cost per ton would be $27.94, their average valuation $25.05, and the percentage difference between cost and valuation, 11.5. The economy of home mixing as compared with buying factory-mixed goods is discussed on page 99.

HOME MIXTURES, FORMULAS (☞)

Station No.	Made by	Formulas, Pounds Per Ton of Mixture.													
		Nitrate of Soda.	Sulphate of Ammonia.	Cotton Seed Meal.	Dry Ground Fish.	Ground Bone.	Dissolved Bones.	Tankage.	Dissolved Bone Black.	Acid Phosphate.	Muriate Potash.	Sulphate Potash, High Grade.	Sulphate Potash, Low Grade.	Wood Ashes.	Kainit.
10416	F. T. Bradley, Saybrook.	...	...	...	...	...	...	1700	...	...	300	...	...	...	...
10375	D. Fenn, Milford.	198	...	...	...	...	...	790	790	...	222	...	...	...	...
10726	C. J. Dewey, Buckland.	125	...	...	...	...	...	750	750	...	200	...	200	...	...
10497	P. K. Hoadley, No. Guilford.	100	300	...	...	800	...	...	...	300	500	...	...	...	...
10387	W. B. Miller, Middlefield.	...	...	...	...	...	...	...	...	...	...	...	...	...	...
10516	E. E. Burwell, New Haven.	...	...	...	...	...	...	...	...	...	...	...	...	...	...
10515	E. E. Burwell, New Haven.	...	...	...	...	...	...	...	...	...	...	...	...	...	...
10247	S. D. Woodruff & Sons, Orange.	100	...	...	...	...	...	800	...	800	300	...	...	...	...
10575	L. Sanderson, for N. D. Platt.	200	...	...	...	300	...	700	700	..	100	...	...	...	...
10576	L. Sanderson, for N. D. Platt.	200	..	...	...	300	...	700	700	.	100	...	...	...	...
10577	L. Sanderson, for N. D. Platt.	100	66	...	...	167	...	667	667	...	166	...	167	...	...
10465	F. B. Northam, Cobalt.	300	...	...	...	...	...	*400	...	700	...	400	...	...	...
10455	Clifton Peck, Yantic.	...	...	...	...	...	...	1266	...	200	534	...	...	...	...
10456	Clifton Peck, Yantic.	552	...	...	...	...	...	207	...	1241	...	...	...	...	...
10454	Clifton Peck, Yantic.	210	...	...	...	...	...	737	...	737	316	...	...	...	...
10457	Clifton Peck, Yantic.	200	...	...	...	...	...	800	...	800	200	...	...	...	...
10501	C. B. Pomeroy, Jr., Willimantic.	...	...	1000	...	...	...	...	...	700	300	...	...	...	...
10434	L. Sanderson, for George F. Platt & Son.	200	...	...	...	200	...	800	800	...	...	...	...	...	...
10435	L. Sanderson, for George F. Platt & Son.	200	...	...	...	200	...	700	700	...	200	...	...	...	...
10290	J. P. O'Connor, Wethersfield.	300	...	...	250	200	...	...	600	...	...	...	600	50	...
8996	E. E. Burwell, New Haven.	150	75	...	...	...	1265	...	...	...	...	510	...	...	...
10551	A. C. Lake, Bethlehem.	150	...	...	...	900	...	...	...	500	275	175	...	...	...
10550	A. C. Lake, Bethlehem.	140	...	...	...	...	...	785	...	700	200	175	...	...	...
10557	W. C. Pease, Somers.	857	...	...	...	572	...	...	...	...	...	...	...	...	571

* Also 200 pounds dried blood.

MISCELLANEOUS FERTILIZERS AND MANURES.

COTTON HULL ASHES.

In the tables on pages 84 and 85 are given analyses of 47 samples of this material which is extensively used as a source of potash for fertilizing tobacco lands in this State.

These analyses show the usual wide range of composition, especially as regards potash, the ingredient for which the ashes are bought.

ANALYSES AND VALUATIONS.

Analyses.										Cost (Unmixed) and Valuation.	
Nitrogen as Nitrates.	Nitrogen as Ammonia.	Nitrogen, Organic.	Total Nitrogen.	Soluble Phosphoric Acid.	Reverted Phosphoric Acid.	Insoluble Phosphoric Acid.	Total Phosphoric Acid.	Potash.	Cost Per Ton.	Valuation Per Ton.
.....	......	5.24	5.24	......	......	......	3.79	7.31	....	....
1.40	......	2.23	3.63	6.98	4.04	.93	11.95	5.90	$30.00	$24.78
1.09	......	2.55	3.64	5.65	3.48	1.60	10.73	7.66	33.00	24.99
.67	2.89	.90	4.46	1.34	7.72	.56	9.62	12.46	32.75	30.55
1.72	....	2.30	4.02	3.25	2.56	1.05	6.86	7.07	....	22.32
.38	......	4.02	4.40	4.67	2.75	.36	7.78	3.13	23.75	21.45
.35	1.18	1.94	3.47	5.01	2.26	.55	7.82	8.68	29.45	24.48
.92	.....	2.22	3.14	5.65	3.94	1.63	11.22	8.53	25.00	24.75
.96	......	2.80	3.76	4.90	8.93	2.76	16.59	1.88	26.50	24.59
.93	......	2.77	3.70	5.84	7.88	2.78	16.50	2.27	26.50	24.78
.61	.36	3.30	4.27	4.77	4.39	1.68	10.84	5.98	28.00	25.42
2.38	......	2.26	4.64	2.56	2.28	1.25	6.09	9.65	....	26.24
.....	......	3.60	3.60	.74	3.02	2.02	5.78	13.83	29.00	31.73
3.72	......	.74	4.46	6.67	2.88	1.07	10.62	....	23.00	20.47
1.35	......	2.49	3.84	3.33	3.83	1.68	8.84	7.14	25.00	23.28
1.20	.....	2.43	3.63	3.74	3.48	2.12	9.34	4.68	25.00	20.90
.....	......	3.83	3.83	3.46	2.13	.99	6.58	8.81	22.60	23.42
1.80	......	1.92	3.72	8.98	3.21	.92	13.11	....	26.00	21.08
1.36	......	3.45	4.81	4.74	4.62	1.39	10.75	6.96	28.00	27.65
3.04	.....	1.68	4.72	3.42	2.94	.91	7.27	7.70	24.98	25.88
1.38	.25	2.54	4.17	3.46	12.53	1.20	17.19	9.50	45.00	34.43
.81	......	1.52	2.33	4.32	6.57	4.82	15.71	10.66	28.50	26.99
1.02	......	2.44	3.46	5.07	2.60	.70	8.37	9.62	24.66	24.92
4.11	......	1.02	5.13	......	......	......	6.36	3.90	28.00	20.99

The highest percentage of potash was 31.09, the lowest, 15.08, while the average percentage was 23.3, slightly higher than the average in the previous year (22.4).

Allowing 4½, 4, and 2 cents per pound respectively for water-soluble, citrate soluble and insoluble phosphoric acid, the water-soluble potash has cost from 4.8 to 10.7 cents per pound, or 7.1 cents per pound on the average.

The average cost of potash per pound would have been considerably higher but for the fact that in most cases the ashes were bought of responsible dealers who gave a guarantee of the per cent. of potash, and when the ashes were shown by the

Station analysis to fall short of this guarantee, the dealers made a reduction of price. In making contracts the percentage of "water-soluble potash" should be guaranteed, not simply of "potash" without qualification. This Station bases its valuation on the water-soluble form only. Ashes contain more or less potash in form of silicates, which are quite insoluble and inferior or inert as plant food. Thus, in sample No. 10480 there was 19.58 per cent. of water-soluble potash, while the

COTTON HULL ASHES.

Station No.	Dealer or Purchaser.	Supplied by
10147	J. W. Walker & Co., Houston, Tex.,...	C. D. Burbank, Thompsonville,
10268	W. S. Pinney, Suffield,	W. H. Prout, Suffield,
10360	W. S. Pinney, Suffield,	D. I. King, Windsor Locks,
10219	Olds & Whipple, Hartford,	Olin Wheeler, Buckland,
10821	Olds & Whipple, Hartford,	S. E. Wilcox, Hartford,
10358	Chas. L. Spencer, Suffield,	F. B. Hathaway, Windsor Locks,
10218	Olds & Whipple, Hartford,	....
10573	Olds & Whipple, Hartford,	P. P. Hickey, Burnside,
10410	Olds & Whipple, Hartford,	John DuBon, Poquonock,
10291	Chas. L. Spencer, Suffield,	E. S. Seymour, Windsor Locks,
10504	....	Geo. C. Eno, Simsbury,
10480	....	John A. DuBon, Poquonock,
10111	Olds & Whipple, Hartford,	Frank S. Taylor, Hartford,
10182	Edmund Halladay, Suffield,	Edmund Halladay, Suffield,
10183	Edmund Halladay, Suffield,	Edmund Halladay, Suffield,
10382	Olds & Whipple, Hartford,	Station Agent,
10114	Olds & Whipple, Hartford,	Olin Wheeler, Buckland,
10180	Olds & Whipple, Hartford,	T. P. Kinney, Windsor,
10196	Olds & Whipple, Hartford,	F. L. Chandler, South Woodstock,
10112	Olds & Whipple, Hartford,	Olin Wheeler, Buckland,
10113	Olds & Whipple, Hartford,	Olin Wheeler, Buckland,
10321	....	Clinton Spencer, Suffield,
10320	W. W. Cooper, Suffield,	C. F. Tilden, Thompsonville,
10280	C. L. Spencer, Suffield,	S. O. Ranney, Windsor Locks,
10184	Olds & Whipple, Hartford,	A. E. Holcomb, Poquonock
10221	Chas. L. Spencer, Suffield,	F. L. Woodworth, Thompsonville,
10195	W. S. Pinney, Suffield,	C. D. Woodworth, Thompsonville,
10151	W. S. Pinney, Suffield,	G. H. Harman, Suffield,
10368	Edmund Halladay, Suffield,	Edmund Halladay, Suffield,
10507	Olds & Whipple, Hartford,	Geo. Rengermann, East Granby,
10572	R. W. Cowles, Tariffville,	N. T. Case, Tariffville,
10324	W. S. Pinney, Suffield,	Pitcher & Phillips, Thompsonville,
10233	W. S. Pinney, Suffield,	G. A. Douglass, Thompsonville,
10431	Olds & Whipple, Hartford,	C. D. Cannon, Windsor Locks,
10110	Olds & Whipple, Hartford,	Frank S. Taylor, Hartford,
10505	Clinton Spencer, Suffield,	E. A. Pomeroy, Suffield,
10319	Edmund Halladay, Suffield,	Arthur H. Humason, Suffield,

total potash was 21.86 per cent. Sample No. **10321**, contained 17.90 per cent. of water-soluble potash, but the total per cent. of potash was 20.80.

CORN-COB ASHES.

8999. Sent by J. A. DuBon. Sample from Chas. G. Eno, Osborn, Kansas. The ashes are stated to be procurable in some quantity in Kansas and neighboring states.

ANALYSES.

Station No.	Soluble Phosphoric Acid.	Reverted Phosphoric Acid.	Insoluble Phosphoric Acid.	Total Phosphoric Acid.	Potash Soluble in Water.	Cost per Ton.	Valuation per Ton.	Potash Costs cents per pound.
10147	.14	4.48	.74	5.36	29.24	$32.00	$23.25	4.8
10268	1.73	8.48	.50	10.71	27.32	40.00	35.86	5.8
10360	1.68	8.38	.49	10.55	26.88	40.00	35.29	5.9
10219	2.85	6.75	.94	10.54	31.09	45.00	39.43	5.9
10821	.54	7 83	.87	9.24	23.89	40.00	30.99	6.1
10358	1.30	7.20	.63	9.13	26.86	40.00	34.04	6.1
10218	2.14	11.77	.49	14.40	25.14	43.00	36.69	6.2
10573	2.53	6.89	.72	10.14	29.76	45.00	37.84	6.2
10410	.83	6 66	.72	8.21	19.98	31.50	26.35	6.3
10291	2.40	8.90	.97	12.27	23.92	40.00	33.59	6.3
10504	2.13	6 79	.65	9.57	29.88	45.00	37.49	6.3
10480	1.30	6.39	.75	8.44	19.58	31.50	26.16	6.4
10111	.53	11 01	.89	12.43	23.22	40.00	32.87	6.5
10182	.66	6.06	1.16	7.88	24.08	38.00	29.98	6.7
10183	1.44	6.17	1.51	9.12	22.82	38.00	29.66	6.8
10382	1.54	7.55	.89	9.98	23.64	40.00	31.43	6.8
10114	.76	9.43	2.35	12.54	25.00	43.00	34.16	6.8
10180	.21	6.88	1.02	8.11	23.42	38.50	29.52	6.9
10196	.69	7.04	.50	8.23	26.50	43.00	32.95	6.9
10112	.40	8.42	.53	9.35	26.88	45.00	34.19	7.0
10113	.35	8.61	.63	9.59	24.54	43.00	32.00	7.2
10321	.46	3.83	1.33	5.62	17.90	30.00	21.90	7.3
10320	.69	6.55	.81	8.05	23.08	40.00	29.26	7.3
10280	2.00	9.34	1.06	12.40	20.30	40.00	29.99	7.4
10184	.08	6.18	1.12	7.38	21.80	38.00	27.26	7.5
10221	.69	6.99	1.06	8.74	22.24	40.00	28.87	7.5
10195	.50	7.19	1.03	8.72	22.32	40.00	28.93	7.5
10151	.54	7.47	1.09	9.10	20.30	38.00	27.21	7.6
10368	.40	4.82	.78	6.00	22.58	39.00	27.11	7.6
10507	trace	5.27	.51	6.78	24.90	43.00	30.12	7.6
10572	1.38	6 87	.92	9.17	24.46	42.00	29 57	7.8
10324	.48	7 45	1.05	8.98	20.64	40.00	27.45	8.0
10233	.35	7.73	1.09	9.17	20.56	40.00	27.50	8.0
10431	.21	7.39	.79	8.39	20.76	40.00	27.18	8.1
10110	none	3.95	1.87	5.82	12.30	25.00	16.21	8.5
10505	.24	3.77	1.11	5.12	19.46	40.00	23.14	9 3
10319	.78	5.90	.94	7.62	15.08	38.00	20.88	10.7

ANALYSIS.

Water-soluble phosphoric acid,	2.37 per cent.
Citrate " " "	.97 "
Insoluble " "	.67 "
Potash soluble in water,	21.13 "

These ashes contain about the same percentage of potash as cotton-hull ashes, but less than half as much phosphoric acid.

WOOD ASHES.

In the table, pages 88 and 89, are given nineteen analyses of wood ashes.

10130 is a sample from the Coe Brass Co. of Torrington. These ashes cost 15 cents per bushel of 45 pounds, from which is calculated the ton price, $6.67.

The three samples sent by W. H. Olcott of So. Manchester represent ashes from heaps which have been leached by exposure to the weather.

The samples show the usual range of composition. Nearly a quarter of the weight of sample **10244** consists of sand and soil, "gathered" with the ashes, which explains the low percentage of potash. The low percentages of potash in samples **10509** and **10642** are explained in the same way.

Samples **10604, 10605, 10510,** and **10727** represent ashes of low grade and probably partly leached.

The average composition of unleached (and unsanded) ashes for the last four years has been:

	1895. 16 Samples.	1896. 22 Samples.	1897. 21 Samples.	1898. 9 Samples.
Potash, soluble in water,	4⅓	5½	5½	5½
Phosphoric Acid,	1½	1½	1⅕	1½
Lime,	34	32½	32½	36½
Sand and soil,	12¼	11	10½	5
Charcoal,	2	2½	2	1⅓
Cost per ton,	$10.75	$10.36	$10.30	$9.45*

Ashes are sometimes sold with a guarantee of 5.0 per cent. of "potash." This Station, as a rule, determines only the potash soluble in water; for the reason that only potash which is freely soluble can be regarded as immediately available to vegetation. Green sand marl, felspar, and glass all may contain considerable quantities of "potash," but in forms which yield it up to the roots of plants extremely slowly.

* Excluding one exceptionally low price, the average is $9.82.

The lime contained in ashes is often their most valuable ingredient for agricultural purposes. A ton of unleached wood ashes, calculated from the average of the analyses given above contains 732 pounds of lime, 111 pounds of potash, and 30 pounds of phosphoric acid, costing $9.82. Allowing 5 cents per pound each for potash and phosphoric acid, the pure lime (calcium oxide), in the nine samples, has cost thirty-eight cents for 100 pounds.

LIME-KILN ASHES.

The two samples, whose analyses appear in the table, p. 88, contained 31.38 and 40.48 per cent. of lime, respectively, with 1.06 and 0.99 per cent. of potash. Reckoned on the same basis as in the unleached ashes, pure lime in the one of these samples whose price is given, cost forty-eight cents per 100 pounds, ten cents more per hundred than in wood ashes.

OYSTER-SHELL LIME.

A single sample of this material is included in the table, page 88. The pure lime contained in it costs 81 cents per 100 pounds. The price quoted is at the rate charged for single barrel lots of 250 pounds.

Sources, Analyses, and Cost of Wood Ashes and of Lime-kiln Ashes.

Station No.	Dealer or Purchaser.	Sampled or sent by	Potash Soluble in Water.	Phosphoric Acid.	Lime, Calcium Oxide.	Carbonic Acid.	Sand and Soil.	Charcoal.	Cost per ton.
	Wood Ashes.								
10362	Allison Co., Fulton St., New York City,	Ernest N. Austin, Suffield,	4.41	1.26	28.45	17.31	7.06	0.88	$9.50
10292	Bowker Fertilizer Co., Boston, per A. G. Smith, Wethersfield,	Jas. P. O'Connor, Wethersfield,	6.60	1.18	31.99	17.61	3.49	0.98	10.00
10107	F. R. Lalor, Dunville, Ont.,	John E. Frisbie, Southington,	5.22	1.28	46.51	22.54	3.40	0.64	10.50
10244	F. R. Lalor, Dunville, Ont.,	T. D. Barclay, Kent,	2.99	1.46	28.90	16.38	23.17	2.76	10.00
10284	F. R. Lalor, Dunville, Ont.,	G. A. Isbell, 708 Chapel St., N. Haven,	5.70	1.30	39.79	19.44	3.86	1.12	9.50
10604	F. R. Lalor, Dunville, Ont.,	H. C. C. Miles, Milford,	3.17	1.13	34.65	20.78	3.39	1.30	10.00
10605	F. R. Lalor, Dunville, Ont.,	Geo. F. Platt & Son, Milford,	2.84	1.13	37.14	23.38	3.34	1.67	10.00
10318	George Munroe, Oswego, N. Y.,	Earl Cooley, Berlin,	7.13	1.66	35.76	21.27	6.39	1.31	10.00
10342	George Munroe, Oswego, N. Y.,	Geo. W. Spicer, Deep River,	5.35	1.41	34.46	21.09	6.20	1.25	10.00
10839	George Munroe, Oswego, N. Y.,	Horace Hurlbutt, Weston,	5.02	1.32	34.35	20 67	4.60	1.52	9.50
10130	Coe Brass Co., Torrington,	Wm. J. Barber, Harwinton,	4.56	2.44	37.95	28.24	2 60	3.10	6.67
10509	T. Potts, Brantford, Ont.,	J. H. Hale, So. Glastonbury,	2.99	1.25	23.54	14 29	19.60	3.27	8.00
10642	Thomas Potts, Brantford, Ont.,	J. H. Hale, So. Glastonbury,	3.16	1.60	27.74	18.10	20.49	3.54	8.00
10004	Local Sawmill,	W. H. Olcott, So. Manchester,	0.85	0.79	14.43	8.18	*36.50	5.26	....
10108	Local Sawmill,	W. H. Olcott, So. Manchester,	0.42	....	19.20	12.19	26.03	1.11	....
10152	Local Sawmill,	W. H. Olcott, So. Manchester,	1.68	1.15	25.41	14.37	38.66	3.91	....
10002	....	Thomas L. Craik, Greenfield Hill,	5.85	1.51	40.14	22.29	7.39	1.07	9.50
10510	....	A. E. Hollister, Glastonbury,	3.07	0.75	47.20	26.56	1.78	0.49	....
10727	Mr. Smith Wethersfield,	Thomas H. L. Tallcott, Glastonbury,	3.36	0.88	47.55	25.17	2.12	0.95	11.00
	Lime-kiln Ashes.								
10376	East Canaan,	Daniels Bros., Middletown,	1.06	0.90	31.38	23.29	1.64	5.21	....
10848	A. S. Farnham & Bros., Cheshire, Mass.,	John W. Palmer, Stamford,	0.99	0.60	40.48	18.71	2.39	3.02	5.50
	Oyster-shell Lime.								
10359	Edward Austen, Suffield,	F. B. Hathaway, Windsor Locks,	....	....	61.64	8 89	6.28	...	10.00

* Water, 26.93.

Land Plaster.

A sample, 10477, sent by A. H. Clark, Poquonock, drawn from stock of Olds & Whipple, Hartford, contained:

Water,	6.29 per cent.
Insoluble in acid, sand, etc.,	0.74 "
Calcium sulphate, hydrated (gypsum),	78.46 "
Calcium carbonate and other matters, by difference,	14.51 "
Total,	100.00

The cost is $10 per ton.

This has the composition of Cayuga or Onondaga plaster. Nova Scotia plaster contains but little, if any, carbonate of lime.

Bat Guano.

10188. This material, sent by Olin Wheeler, Buckland, is found in caves where bats resort in large numbers. The sample had the following composition:

	Bat Guano. 10188
Nitrogen as nitrates,	1.50
" Ammonia,	.58
" Organic,	2.87
Total Nitrogen found,	4.95
" guaranteed,	...

	Bat Guano.
Phosphoric Acid, soluble,	.45
" reverted,	5.98
" insoluble,	4.93
Phosphoric Acid, total,	11.36
Potash as muriate,	.49
" sulphate,	.26
Total Potash found,	.75
Chlorine,	.20

The organic nitrogen of bat guano comes almost entirely from the chitinous wing-cases of insects and is known to be very inert as a fertilizer. It is almost entirely insoluble in pepsin solution.

Street Sweepings.

10129. A sample sent by P. P. Hickey, Burnside, is stated to consist of the sweepings from asphalt pavements in Hartford, offered as a manure.

The analysis is as follows:

Water,	14.48
Organic and Volatile matters,	10.70
Sand and Soil,	66.60
Other Mineral Matter,	8.22
	100.00
In the Organic Matter, Nitrogen,	0.19
In the Mineral Matter, Phosphoric Acid,	0.15
Potash,	0 07

Ground Weed Seed.

10154. A sample sent by A. N. Farnham, New Haven, contained:

Nitrogen,	2.72
Phosphoric Acid,	1.16
Potash,	0.87

This material is stated to be the ground residue left from the cleaning of grain, and it was proposed to use it in the compost heap.

Rotted Peat.

8997 and **8998.** Samples taken from a peat swamp in East Haven by E. E. Burwell of New Haven. The first represents the upper layer, taken between one foot and two and a half feet from the surface. The second was taken between two and four feet down.

Analyses.

	8997	8998
Water,	35.54	34.18
*Organic Matter,	53.05	58.87
Mineral Matter, soluble in Acid,	7.01	6.55
" insoluble in Acid (sand and soil),	4.40	0.40
	100.00	100.00

* Containing Nitrogen, 1.85 1.41

The lower layer contains less sand and more organic matter (humus), but this has less nitrogen in it than the surface layer.

Jadoo Fiber.

10003. Bought for experiment of the American Jadoo Fiber Co., Philadelphia. Cost, delivered, $1.10 for a package containing 24 pounds of the material.

This is claimed to be "a new growing substance for plants of all kinds," made by boiling peat moss or other suitable fibrous or spongy material with a fertilizing composition, straining and partially fermenting the product. Its manufacture is covered by patent.

The sample bought of the company had the following composition:

Water,	71.57	per cent.
Organic Matter,	25.82	"
Sand and Soil,	0.59	"
Soluble Mineral Matter,	2.02	
	100 00	

The material contained 0.29 per cent. of nitrogen, 0.18 per cent. of phosphoric acid, and .09 per cent. of potash.

REVIEW OF THE FERTILIZER MARKET,

FOR THE YEAR ENDING OCTOBER 31, 1898.

BY E. H. JENKINS.

NITROGEN.

Nitric Nitrogen.

The *wholesale* New York quotation of nitrogen in this form in November, 1897, was 10.1 cents per pound. It rose at first gradually, and then sharply on account of the demand for the gunpowder manufacture and increased freight risks caused by the war, and was quoted in May, 1898, at 17.1 cents. It fell quickly thereafter to 9.1 cents in September, and rose in October to 9.6 cents per pound.

The average of the monthly quotations for a number of years — from November 1st to November 1st has been as follows:

Year, . . .	1898	1897	1896	1895	1894	1893	1892	1891
Average quotation, Cents pr. lb., *wholesale*,	11.0	11.4	11.1	11.4	13.0	12.7	12.1	12.9

The *retail* price of nitrogen in nitrate in this state at freight centers, as shown on page 22, has been about 13.5 cents per pound.

Ammonic Nitrogen.

The *wholesale* New York quotations of nitrogen in form of sulphate of ammonia have ranged during the year between 10.9 cents and 12.6 cents per pound. The average of the monthly quotations has been 11.9 cents.

The corresponding averages of previous years have been:

Year, ...	1898	1897	1896	1895	1894	1893	1892
Average quotation, *wholesale*, cents per pound, .	11.9	10.5	11.1	14.3	17.3	15.7	14.5

There is but little demand for sulphate of ammonia in the Connecticut retail market, and at *retail*, nitrogen in this form, as is seen on page 24, costs considerably more than nitrate, from 14.3 to 15.5 cents per pound.

Organic Nitrogen.

The *wholesale* New York quotations of nitrogen in the forms of red blood, black or low grade blood, and concentrated tankage for each month in the year are shown in the table on page 98. The fluctuations have not been large.

The nitrogen of red blood has cost at wholesale — the average of twelve months' quotations — 0.3 cent per pound more in 1898 than in 1897, that of black blood 0.2 cent more, and that of concentrated tankage 1.7 cents more.

These forms of organic nitrogen do not meet with much sale in our retail market.

Low grade tankage, fish, bone, and especially cotton-seed meal are the forms most used by those who mix their own fertilizers or apply fertilizers to their land unmixed.

Cotton-seed meal, as shown on page 25, has been the cheapest form of quickly-available organic nitrogen in our market.

PHOSPHATIC MATERIALS.

Rough bone, which was quoted at $17.50 per ton wholesale in the winter months of 1898, rose to $19 in June, at which price it has been quoted till November.

Bone meal was quoted November 1, 1898, at $21.50 per ton, a dollar more than in November of 1897.

Sulphuric acid, 66°B. rose from .97½ in November, 1897, to 1.47½ in May, 1898, and has been quoted at that figure till the time of this writing, November, 1898.

Available phosphoric acid, in form of dissolved South Carolina phosphate, quoted at 2.53 cents per pound wholesale in November, 1897, fell in April, 1898, to 2.36 cents, but has risen since then to 3.13 cents per pound.

The figures given on page 28 show that available phosphoric acid *in form of dissolved bone black* has cost *at retail* in this state from 6.0 to 6.9 cents per pound, while *in form of dissolved rock phosphate* it has cost from 3.1 to 4.6 cents per pound.

Potash.

Muriate of Potash.

The average monthly *wholesale* quotations of potash in this form have been 3.64 cents per pound, through the year, being fixed, like those of the other German potash salts, by the German Kali Works.

The retail price in Connecticut, as shown on page 31, has ranged from 3.8 to 4.5 cents per pound.

The Double Sulphate of Potash and Magnesia.

The average monthly wholesale quotation of potash in this form has been 4.09 cents per pound uniformly through the year.

The retail price of potash in this form in Connecticut, as appears on page 31, has ranged from 4.9 to 6.8 cents per pound.

High Grade Sulphate of Potash.

The average monthly wholesale quotation of potash in this form has been 4.10 cents per pound, uniformly through the year.

The retail price in Connecticut, as appears on page 31, has ranged from 4.6 to 5.1 cents per pound.

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

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

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

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

Blood, azotin, and concentrated tankage 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 per cent. of ammonia by 14 and divide that product by 17.) A "unit of ammonia" is one per cent., or 20 pounds per

ton. To illustrate: if a lot of tankage has 7.0 per cent. of nitrogen, equivalent to 8.5 per cent. of ammonia, it is said to contain $8\frac{1}{2}$ units of ammonia, and if quoted at $2.25 per unit, a ton of it will cost $8\frac{1}{2} \times 2.25 = \$19.13$.

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

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

Ammonia at	$3.00	per unit is	equivalent to	nitrogen at	18.2	cts. per lb.
"	2.90	"	"	"	17.6	"
"	2.80	"	"	"	17.0	"
"	2.70	"	"	"	16.4	"
"	2.60	"	"	"	15.8	"
"	2.50	"	"	"	15.2	"
"	2.40	"	"	"	14.6	"
"	2.30	"	"	"	14.0	"
"	2.20	"	"	"	13.4	"
"	2.10	"	"	"	12.8	"
"	2.00	"	"	"	12.2	"
"	1.90	"	"	"	11.6	"
"	1.80	"	"	"	11.0	"
"	1.70	"	"	"	10.3	"
"	1.60	"	"	"	9.7	"
"	1.50	"	"	"	9.1	"

Commercial sulphate of ammonia contains about 20.8 per cent. of nitrogen, though it varies somewhat in quality. With that per cent. of nitrogen (equivalent to 25.25 per cent. of ammonia).

If quoted at	2.6	cents per pound,	Nitrogen	costs	12.5	cents per pound.
"	2.5	"	"	"	12.0	"
"	2.4	"	"	"	11.5	"
"	2.3	"	"	"	11.1	"
"	2.2	"	"	"	10.6	"
"	2.1	"	"	"	10.1	"
"	2.0	"	"	"	9.6	"

Commercial nitrate of soda averages 95 per cent. of pure sodium nitrate, or 16 per cent. of nitrogen.

If quoted at 2.5	cents per pound,	Nitrogen	costs	15.6	cents per pound.
" 2.4	"	"	"	15.0	"
" 2.3	"	"	"	14.4	"
" 2.2	"	"	"	13.8	"
" 2.1	"	"	"	13.2	"
" 2.0	"	"	"	12.5	"
" 1.9	"	"	"	11.9	"
" 1.8	"	"	"	11.3	"
" 1.7	"	"	"	10.6	"
" 1.6	"	"	"	10.0	"
" 1.5	"	"	"	9 4	"

Commercial Muriate of Potash usually contains 50½ per cent. of "actual potash," or potassium oxide.

If quoted at 2.20	cents per pound,	Potassium Oxide	costs	4.35	cents per lb.
" 2.15	"	"	"	4.25	"
" 2.10	"	"	"	4.15	"
" 2.05	"	"	"	4.06	"
" 2.00	"	"	"	3.96	"
" 1.95	"	"	"	3.86	"
" 1.90	"	"	"	3.76	"
" 1.85	"	"	"	3.66	"
" 1.80	"	"	"	3.56	"
" 1.75	"	"	"	3.46	"
" 1.70	"	"	"	3.36	"

High Grade Sulphate of Potash, as it is found in the Connecticut market, contains about 49.2 per cent. of actual potash.

If quoted at 2.50	cents per pound,	Potassium Oxide	costs	5.1	cents per lb.
" 2.45	"	"	"	5.0	"
" 2.40	"	"	"	4.9	"
" 2.35	"	"	"	4.8	"
" 2.30	"	"	"	4.7	"
" 2.25	"	"	"	4.6	"
" 2.20	"	"	"	4.5	"
" 2.15	"	"	"	4.4	"
" 2.10	"	"	"	4.3	"
" 2.05	"	"	"	4.2	"
" 2.00	"	"	"	4.1	"

The Double Sulphate of Potash and Magnesia has about 26½ per cent. of potassium oxide.

If quoted at 1.00	cents per pound,	Potassium Oxide	costs	3.77	cents per lb.
" 1.05	"	"	"	3.96	"
" 1.10	"	"	"	4.15	"
" 1.15	"	"	"	4.34	"
" 1.20	"	"	"	4.53	"
" 1.25	"	"	"	4.72	"
" 1.30	"	"	"	4.90	"

The following table shows the fluctuations in the wholesale prices of a number of fertilizing materials in the New York market, since November, 1894. The price given for each month is the average of the four weekly quotations for that month. Sulphate of ammonia is assumed to contain 20.8 per cent. and nitrate of soda 16.0 per cent. of nitrogen, muriate of potash 50½ per cent., high grade sulphate 49.2 per cent., and double manure salt 26.5 per cent. of actual potash.

WHOLESALE PRICES OF FERTILIZING MATERIALS.

	Cost of Nitrogen at wholesale in						Cost of Potash at wholesale in			
	Dried Blood.									
	Red. Cents per pound.	Black or low grade. Cents per pound.	Azotin or Ammonite. Cents per pound.	Concentrated Tankage. Cents per pound.	Nitrate of Soda. Cents per pound.	Sulphate of Ammonia. Cents per pound.	Muriate of Potash. Cents per pound.	Double Manure Salt. Cents per pound.	High Grade Sulphate of Potash. Cents per pound.	Available Phosphoric Acid in Dissolved South Carolina Rock. Cents per pound.
November,	14.1	13.1	14.0	12.3	13.2	16.4	4.13	5.04	4.85	3.00
December,	13.5	12.4	13.1	12.3	12.9	16.0	4.13	5.04	4.85	3.10
1895. January,	12.7	12.2	13.0	12.3	12.1	15.0	3.54	4.24	4.13	3.50
February,	11.9	11.2	....	12.3	11.4	15.0	3.54	4.24	4.13	3.37
March,	12.1	10.5	....	12.3	10.4	15.0	3.59	4.32	4.20	3.37
April,	11.7	10.6	....	12.3	10.3	15.0	3 59	4 32	4 20	3.37
May,	12.1	10.8	....	12.3	10.5	14.3	3.59	4.32	4.20	3.37
June,	11.7	10.9	....	12.3	11.0	13.6	3.59	4.32	4.20	3.37
July,	11.6	10.7	....	12.3	10.9	13.4	3.60	4.32	4.20	3.37
August,	11.5	10.2	....	12.3	10.8	13.1	3.60	4.32	4.20	3.37
September,	11.8	10.2	....	12.3	11.3	13.0	3 60	4.32	4.20	3.23
October,	11.8	10.2	....	12.3	11.7	12.2	3.60	4.32	4.20	2.62
November,	11.7	9.9	...	12.3	11.6	12.0	3.60	4.32	4.34	2.62
December,	11.7	9.8	...	12.3	11.1	12.0	3.60	4.32	4.34	2.62
1896. January,	11.0	9.8	....	12.3	10.8	11.6	3.60	4.32	4.34	2.62
February,	10.8	9.8	....	12.3	10.7	11.3	3.55	3.99	4.13	2.62
March,	10.8	9.8	....	12.3	10.7	11.5	3.53	3.87	4.05	2.73
April,	10.8	9.8	....	12.3	10.7	11.1	3.60	3.94	4.10	2.73
May,	10.7	9.9	....	12.3	10.9	10.8	3 60	3.94	4.10	2.73
June,	10.5	9.8	....	12.3	10.8	10.8	3.60	3.94	4.10	2.73
July,	10.5	9.8	....	12.6	10.8	10.8	3.60	3.94	4.10	2.73
August,	10.5	9.8	....	11.4	10.8	10.7	3.60	3.94	4.10	2.73
September,	10.2	9.1	....	9.5	10.8	10.5	3.60	3.94	4.10	2.73
October,	10.3	9.0	....	9.5	11.3	10.5	3.60	3.94	4.10	2.73
November,	11.0	10.1	....	9.4	11.6	10.8	3.59	3 94	4.10	2.73
December,	11.2	10.8	...	9.5	12.1	10.4	3.59	3 94	4.10	2.73
1897. January,	10.7	10.1	....	9.4	12.1	11.0	3.59	3.94	4.10	2.73
February,	10 6	10.0	....	9.4	11.9	11.0	3.59	3.94	4.10	2.73
March,	10.5	10.1	...	9.4	11.9	10.9	3.59	3.94	4.10	2.73
April,	10.5	9.9	....	9.4	12.3	10.8	3.60	3.97	4.10	2.68
May,	10.3	9.7	...	9.9	11.5	10.7	3.64	4.09	4.10	2.53
June,	10.1	9.7	....	9 9	11.0	10.3	3.64	4.09	4.10	2.53
July,	10.7	10.1	....	9.9	10.6	10.2	3.64	4.09	4.10	2.53
August,	11.1	10.5	....	10.1	10.5	9.7	3.64	4.09	4.10	2.53
September,	11.8	11.3	....	11.5	10.5	10.4	3.64	4.09	4.10	2.53
October,	12.0	11.8	....	11.7	10.5	10.5	3.64	4.09	4.10	2.53
November,	11.9	10.3	....	11.7	10.1	10.9	3.64	4.09	4.10	2.53
December,	11.7	10.5	....	11.7	10.3	11.3	3.64	4.09	4.10	2.55
1898. January,	11.7	10.5	....	11.7	11.3	11.5	3.64	4.09	4.10	2.53
February,	11.6	10.4	....	11.6	10.3	12.4	3.64	4.09	4.10	2.48
March,	10.0	10.2	....	11.4	11.1	12.1	3.64	4.09	4.10	2.36
April,	10.8	10.5	....	11.5	11.9	11.4	3.64	4.09	4.10	2.36
May,	10.9	10.6	....	11.7	17.1	11.5	3.64	4.09	4.10	2.50
June,	11.1	10.8	....	11.7	11.5	12.1	3.64	4.09	4.10	2.56
July,	10.8	10.3	....	11.7	9.9	12.1	3.64	4.09	4.10	3.13
August,	10.8	10.5	....	11.7	9.2	12.3	3.64	4.09	4.10	3.13
September,	10.8	10.5	....	11.7	9.1	12.6	3.64	4.09	4.10	3.13
October,	10.8	10.5	....	11.7	9.6	12.3	3.64	4.09	4.10	3.13

ON THE PURCHASE OF FERTILIZERS.

BY E. H. JENKINS.

The only rational way to buy fertilizers — or anything else — is for purchasers to *make their own schedule of valuation* immediately before purchasing, thus getting figures which are strictly correct for their special circumstances, and which enable them to compare accurately the different forms of plant food offered to them, with reference to their cost.

To illustrate: In the schedule of "trade values" given on page 17, soluble phosphoric acid is priced at 4½ cents, and reverted phosphoric acid at 4 cents — figures justified by the *average* prices of plain superphosphates for the half-year previous to making the schedule. But by getting quotations from a number of dealers and paying cash, certain farmers have, during the spring of 1898, bought available phosphoric acid in this form for 3.1 cents per pound. On the other hand, others have paid 6.8 cents per pound for it, in form of dissolved bone black.

There is no known difference between the two forms in respect to their value as plant food, and the buyer has paid in the one case more than twice as much for the same quantity of plant food as in the other.

If available phosphoric acid in form of unmixed goods costs 6 cents per pound, it may be cheaper for the buyer to get a factory mixture containing nitrogen, phosphoric acid, and potash. If he can get available phosphoric acid for three cents a pound it may pay him to do his own mixing, or better, perhaps, apply the chemicals unmixed.

The farmer goes into the market to buy plant food in forms which have a suitable mechanical condition and are available to crops, at as low a price as he can.

The mixed fertilizer has no special virtue in it because of its being a mixture. Whether the forms which contain the plant food are mixed before application or not is a circumstance which affects the cost of application or the cost of the ingredients, but does not affect the availability to crops of the plant food itself. Where fertilizers are applied broadcast it may often be cheaper to apply each raw material separately than to buy them all in a ready-made mixture, or to prepare a mixture on the farm.

No general rule can be given, but the farmers in any community can yearly determine these things for themselves, by jointly securing quotations for mixed fertilizers and fertilizer chemicals from a number of manufacturers *before the spring work begins*, and by buying together.

There is no apparent reason why members of granges or other associations in one neighborhood should not more generally combine and secure from a number of manufacturers bids for a considerable number of tons, or of car lots even, of a fertilizer having a given guaranteed composition, made from certain specified raw materials, with a rebate provided for any failure to meet the guarantee, and at a specified cash price. This practice, which is quite common in other states and which has been adopted to a limited extent in Connecticut, with great advantage to the farmer, deserves more attention by those who prefer to buy mixed goods rather than raw materials.

At present in many of our towns a large number of brands, made by different firms, are sold in small lots to the members of the neighborhood at prices which are from 50 to 100 per cent. above the *cash ton price* of the real plant food contained in them.

If it is granted that this number of fertilizer agents is necessary, that each of the brands sold has a special merit for some particular crop, and if — as is too often the case — the seller must wait six or nine months for his pay, these prices are, perhaps, justified.

It is, however, quite certain that one, two, or three brands, at most, of concentrated mixed fertilizers containing the best forms of plant food — none of them so-called "cheap" fertilizers — would perfectly satisfy the agricultural needs of that community.

It is also certain that if this supply was made by one firm rather than by half a dozen different ones, the work of manufacture and sale could be more cheaply done.

Further, it is certain that if a number of firms made bids for doing the work, a still further reduction of cost to the farmer could be made; and, finally, if purchasers would not call on dealers or manufacturers to do a banking business for them, as well as a fertilizer business, by carrying their notes for three, six, or nine months, the cost of mixed fertilizers to the farmers

of this State would be considerably lessened and the profit of their use correspondingly increased.

The present condition of the trade is illustrated by the following facts:

In one town in this State there are forty farmers, each of whom uses a ton or more of commercial fertilizers, and in the aggregate between 300 to 400 tons are sold. There are eight distinct firms having selling agents there, but the number of brands sold is not known.

In another town there are about seventy farmers who use commercial fertilizers. There are three resident agents, and the goods made by eleven other manufacturers are also sold; the number of brands is considerably larger.

Another correspondent writes: "I know of only one agent in town. He only sells to accommodate his neighbors and to obtain what he uses at somewhere near reasonable cost. He pays cash and waits two years for his pay. He is a fool and he knows it. He is I."

THIRD

REPORT ON FOOD PRODUCTS.

To His Excellency, GEORGE E. LOUNSBURY, *Governor of Connecticut:*

As required by law, I herewith present the third annual report of this Station on Adulterated Food Products.

Very respectfully yours,

S. W. JOHNSON, *Director.*

THE CONNECTICUT FOOD LAW.

CHAPTER CCXXXV.

PUBLIC ACTS, JANUARY SESSION, 1895.

An Act regulating the Manufacture and Sale of Food Products.

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

SECTION 1. It shall be unlawful for any person, persons, or corporation within this State to manufacture for sale, offer, or expose for sale, have in his or their possession for sale, or to sell, any article of food which is adulterated or misbranded within the meaning of this act.

SEC. 2. The term food, as used in this act, shall include every article used for food or drink by man, horses, or cattle. The term misbranded, as used in this act, shall include every article of food and every article which enters into the composition of food, the package or label of which shall bear any statement purporting to name any ingredient or substance as not being contained in such article, which statement shall be untrue in any particular; or any statement purporting to name the substance or substances of which such article is made, which statement shall not give fully the names of all substances contained in such article in any measurable quantity.

SEC. 3. For the purposes of this act, an article shall be deemed adulterated:

First, if any substance or substances be mixed or packed with it so as to reduce or lower or injuriously affect its quality or strength;

Second, if any inferior substance or substances be substituted wholly or in part for the article;

Third, if any valuable constituent of the article has been wholly or in part abstracted;

Fourth, if it be an imitation of or sold under the name of another article;

Fifth, if it is colored, coated, polished, or powdered whereby damage is concealed, or if it is made to appear better or of greater value than it is;

Sixth, if it contains poisonous ingredients which may render such article injurious to the health of a party consuming it, or if it contain any antiseptic or preservative not evident and not known to the purchaser or consumer;

Seventh, if it consists, in whole or in part, of a diseased, filthy, decomposed, or putrid substance, either animal or vegetable, unfit for food, whether manufactured or not, or if it is in any part the product of a diseased animal, or of any animal that has died otherwise than by slaughter;

Provided, that an article of food product shall not be deemed adulterated or misbranded within the meaning of this act in the following cases.

(*a*) In the case of mixtures or compounds which may be now or from time to time hereafter known as articles of food under their own distinctive names, and not included in definition fourth of this section;

(*b*) In the case of articles labeled, branded, or tagged, so as plainly or correctly to show that they are mixtures, compounds, combinations, or blends;

(*c*) When any matter or ingredient is added to a food because the same is required for the protection or preparation thereof as an article of commerce in a fit state for carriage or consumption and not fraudulently to increase the bulk, weight, or measure of the food, or to conceal the inferior quality thereof;

(*d*) When a food is unavoidably mixed with some extraneous matter in the process of collection or preparation.

SEC. 4. The Connecticut Agricultural Experiment Station shall make analyses of food products on sale in Connecticut suspected of being adulterated, at such times and places and to such extent as it may determine, and may appoint such agent or agents as it deems necessary, who shall have free access, at all reasonable hours, for the purpose of examining into any place wherein it is suspected any article of food adulterated with any deleterious or foreign ingredient or ingredients exists, and such agent or agents upon tendering the market price of said article may take from any person, firm, or corporation samples of any article suspected of being adulterated as aforesaid, and the said station may adopt or fix standards of purity, quality, or strength when such standards are not specified or fixed by statute.

SEC. 5. Whenever said station shall find by its analysis that adulterated food products have been on sale in the State, it shall forthwith transmit the facts so found to a grand juror or prosecuting attorney of the town in which said adulterated food product was found.

SEC. 6. The said station shall make an annual report to the governor upon adulterated food products, in addition to the reports required by law, which shall not exceed one hundred and fifty pages, and said report may be included in the report which said station is already authorized by law to make, and such annual reports shall be submitted to the general assembly at its regular session.

SEC. 7. To carry out the provisions of this act, the additional sum of twenty-five hundred dollars is hereby annually appropriated to said Connecticut Agricultural Experiment Station, which sum shall be paid in equal quarterly installments to the treasurer of the board of control of said station, upon the order of the comptroller, who is hereby directed to draw his order for the same.

SEC. 8. Any person who, either by himself, his agent, or attorney, with the intent that the same may be sold as unadulterated, adulterates any food products for man, or horses, or cattle, or, knowing that the same has been adulterated, offers for sale or sells the same as unadulterated, or without disclosing or informing the purchaser that the same has been adulterated, shall be fined not more than five hundred dollars, or imprisoned not more than one year.

SEC. 9. No action shall be maintained in any court in this State on account of any sale or other contract made in violation of this act.

SEC. 10. All acts and parts of acts inconsistent herewith are hereby repealed.

Approved, June 26, 1895.

DUTIES OF THE STATION UNDER THE FOOD LAW.

The fourth, fifth, and sixth sections of the foregoing act lay certain duties upon this Station as follows:

1st. To make analyses of food products suspected of being adulterated.

2d. Whenever it shall find by its analysis that adulterated food products have been on sale, it shall forthwith transmit the facts so found to a prosecuting officer in the town where the adulterated food was found.

3d. The Station shall make an annual report.

The law also provides that the Station may adopt or fix standards of purity, quality, or strength, when such standards are not specified or fixed by statute.

SAMPLES COLLECTED BY THE STATION.

During the year beginning August 1, 1897, authorized agents of this Station visited twenty-eight towns and villages of this State and purchased samples of food products for examination at this Station.

These places were distributed as follows :

	No. of Places.
Litchfield County,	1
Hartford "	4
Windham "	3
Tolland "	0
New London "	4
Middlesex "	2
New Haven "	8
Fairfield "	6
	28

By this means there have been bought and examined 887 samples of the following names or kinds :

		No. of Samples.
Jelly,		70
Jam,		62
Tea,		89
Coffee,		73
Ginger,		91
Spices in boxes,	Pepper,	38
	Mustard,	26
	Red Pepper,	14
	Nutmeg,	6
	Cinnamon,	26
	Allspice,	21
	Cloves,	20
Tapioca, Sago, etc.,		4
Malt liquor,		47
Sausage,		19
Honey,		37
Maple syrup,		3
Milk,		109
Cream,		32
Canned soup,		32
Canned vegetables,		65
Chili sauce,		1
Mince meat,		9
Total,		894

In studying the chemical composition and microscopical characters of genuine spices from different localities, there have also been analyzed the following number of samples, most of them drawn from original packages in the possession of importers :

	No. of Samples.
Black pepper,	14
Pepper by-products and adulterants,	6
White pepper,	10
Cayenne pepper,	8
Ginger,	18
Ginger by-products,	3
Cloves,	8
Clove stems,	2
Ceylon cinnamon,	6
Cassia,	23
Cassia buds,	2
Allspice,	3
Nutmegs,	6
Mace,	7
Miscellaneous spice adulterants,	10
Total,	126

It has been our aim to collect as large a number of brands as possible of each of the food products examined, without trying to select the cheaper kinds, which are presumably more likely to be adulterated.

In every case where certain proof of adulteration was found, the facts, as required by the law, have been forthwith transmitted to a grand juror or other prosecuting officer of the town or borough where the adulterated food products were sold.

SAMPLES COLLECTED BY THE STATE DAIRY COMMISSIONER.

The office of Dairy Commissioner was established by an act of the General Assembly, approved April 3, 1886. By this and supplementary acts the commissioner is charged with the enforcement of laws regulating the sale of three articles, viz., butter, vinegar, and molasses.

From the beginning this station has done gratuitously all the chemical work desired by the commissioners, and has given expert testimony in court as required.

During the twelve months covered by this report there have been examined for the present commissioner, Hon. J. B. Noble, two hundred and three samples of molasses, thirty-two samples of vinegar, and seventeen samples of butter and imitation butter, making a total of two hundred and fifty-two.

It thus appears that, exclusive of cattle feeds, the station has examined during the past year twelve hundred and sixty-five samples of food products.

The results appear in detail in the following papers.

JELLIES.

By A. L. Winton, A. W. Ogden, and W. L. Mitchell.

Pure fruit jelly is a clear, gelatinous product made entirely from the fruit specified and cane sugar. Jellies which are offered for sale containing any other ingredients than these should be distinctly labeled as imitations or compounds in order to meet the requirements of the pure food law.

ADULTERANTS.

These may be classified as follows:

1. *Gelatinous Materials.*— Such as starch paste, gelatine, agar-agar, and apple jelly. Agar-agar is a general name for the gelatinous materials prepared in Japan, India, and other Eastern countries from sea-mosses. Like starch paste, it has little taste or color, and serves merely to stiffen the artificial jellies in which it is used. Apple jelly has a yellow color and a fruity flavor. By the admixture of dye stuffs and flavoring extracts it is readily transformed into counterfeit "currant jelly," "raspberry jelly," etc.

2. "*Sweeteners.*"— Glucose or corn syrup is commonly used because of its cheapness. It is much less sweet than cane sugar but is equally harmless. Saccharine, a sweetener prepared by chemical process from coal-tar, is now extensively advertised in the trade journals for use in food preparations. Although it costs about $15 per pound it can be profitably used in place of cane sugar, since it is about 500 times as sweet. Saccharine has no nutritive properties and in this respect differs from both cane sugar and glucose.

3. *Coloring Matters.*— Coal-tar, or "aniline," dyes (ma-

genta, tropeolin, Bordeaux B, etc.), cochineal, and possibly some vegetable dyes, are used in jellies. Some of the coal-tar colors have been shown to retard, in a marked degree, the process of digestion, and none of them, with our present knowledge, can be regarded as a fit ingredient for food. But, whether injurious or not, dyes serve to make jellies "appear better or of greater value" than they really are and therefore, according to the pure food law, are adulterants.

4. *Fruit Flavors.*— Artificial extracts, or fruit ethers, for flavoring jellies as well as soda water syrups and candies, are prepared by mixing ethers and other chemicals in various proportions. Although these mixtures are claimed to be chemically identical with the true fruit flavors, it usually requires a lively imagination to detect a resemblance, either in taste or odor.

5. *Acids.*— The acidity of jellies prepared from starch paste, agar-agar, and gelatine is secured by the addition of citric, tartaric, or other acids. Apple jelly is of course acid without any such admixture.

6. *Chemical Preservatives*— Salicylic acid is the common preservative for jellies. Possibly benzoic and sulphurous acids are also used.

EXAMINATION OF SAMPLES OF JELLY FROM THE CONNECTICUT MARKET.

Seventy samples have been examined which may be grouped as follows:

	Sold in bulk.	Sold in labeled packages.	Total.
Jellies not found adulterated,....	—	20	20
Adulterated jellies,............	10	33	43
Jellies marked "compound," etc.,	—	7	7
			70

Methods of Examination.

Water. Into a flat-bottomed aluminum dish, 8 cm. in diameter, containing a glass stirring rod, both of which have been weighed together, are brought two grams of the jelly, ten grams of ignited sand and 50 cc. of water. The dish is then placed on the water bath and its contents stirred until the jelly has completely dissolved. The solution is evaporated to dryness, being stirred when the mass begins to stiffen to break up the lumps and mix the sand. The dish and contents are then heated in a drying cell at 100° C. till the weight is constant.

By this method the drying is completed in nearly every case within fifteen hours, whereas in trials made without sand or without preliminary solution in water the jelly continued to lose in weight appreciably even after drying several days.

Ash is determined by burning below redness.

Nitrogen is determined by the Kjeldahl method.

Polarization, for the detection of glucose, is done as described on page 158.

Detection of Dyes.— A portion of the jelly is boiled with from one to three parts of water (according to the thickness of the jelly) until the lumps have disappeared. About 25 cc. of this jelly solution are made strongly alkaline with ammonia and shaken for some minutes with colorless amyl alcohol. Another portion is mixed with a few drops of hydrochloric acid and shaken in like manner with amyl alcohol. The clear alcohol layer is separated in both cases and examined for dyes.

If fuchsine is the only dye present the alcohol separated from the alkaline solution is colorless but acquires a magenta color on acidifying with acetic acid, addition of strong hydrochloric acid changes the color to yellow. If no appreciable amount of color is extracted from either the alkaline or the acid solution, further search for dyes is abandoned, but if in either case the alcohol extract is orange or red, or if addition of acetic acid develops a color, dyeing tests with wool are made.

The presence of a coal tar dye should not be affirmed until the color has been fixed on wool and the wool has been washed in boiling water, dried and tested according to the scheme of Witt and Weingaertner.*

In carrying out the dyeing tests the amyl alcohol solution is first evaporated to small volume in the presence of a thread of wool. If this treatment does not fix the color on the wool, water is added and the evaporation repeated. Some coal-tar colors are more readily taken up by wool from an aqueous than an alcoholic solution. The dye extracted from one sample examined did not dye wool at all until the amyl alcohol had been entirely removed by evaporation and the residue had been taken up in water.

A colored amyl alcohol does not prove the presence of a coal-tar color, as we have found that red coloring matters are extracted by this solvent from acid solutions of pure raspberry and grape jellies. These solutions, however, do not dye wool when treated as above described.

When the acid amyl alcohol extract has an orange color and coal-tar dyes are not found, test is made for cochineal by the uranium acetate method.† Cazeneuve's scheme for the detection of dyes‡ and the mercuric acetate methods of testing for acid fuchsine,§ which are so often employed in the examination of wines, are not satisfactory in the case of jellies because filtration is difficult and the reactions often indecisive.

* Girard et Dupré, Analyse des Matières Alimentaires et Recherche de leurs Falsification, pp. 583–593.

† Ibid, p. 580. ‡ Ibid, p. 174. § Ibid, p. 169.

Particulars with regard to the kinds of jelly, the manufacturers, dealers, prices and (in the case of the adulterated and compound jellies) the materials, other than fruit and cane sugar detected, will be found in Tables I, II, and III. The results of the chemical analyses (which are of interest chiefly to food analysts) are given in Table IV.

Most of the pure jellies were made in the household, and all the adulterated samples were factory products. The adulterants detected were, starch paste, other gelatinous matter (probably apple jelly), glucose, magenta and other coal-tar dyes, cochineal and salicylic acid. Artificial fruit ethers were evidently present in many of the samples, but no tests other than taste and smell were applied. Gelatine was not in any case detected.

Some of the spurious jellies contained only one adulterant while in others not less than five adulterants were present.

Samples Nos. 9202 to 9206 inclusive are interesting frauds. Each was put up in a tumbler which was covered with a pasteboard cap labeled: "Pure fruit jellies, W. P. & Co.,* Ayer, Mass." The fruits from which they were supposed to be prepared, as given on other labels were orange, raspberry, strawberry, currant, and grape. These jellies were found to consist of starch paste sweetened with glucose, artificially flavored, colored (in all cases but one) with coal-tar dye and preserved with salicylic acid.

The prices of some of the adulterated jellies should be noted.

Samples Nos. 7898, 7899, 7900, and 9087 sold for 25 cents per jar or pail, containing in each case five pounds of jelly. The pure jellies, on the other hand, cost on the average 25 cents per half pound glass. Disregarding the value of the packages, the four imitations cost only one-tenth as much per pound as the genuine jellies.

* In a monogram. The label on a sample of jam bore the same monogram with the firm name, "Whitcher, Pillman & Co."

TABLE I.—JELLIES NOT FOUND ADULTERATED.

Station No.	Brand.		Dealer.	Pounds of jelly in glass, jar, or pail.	Price. Cents.
	Apple.				
9245	Superior Apple Jelly, J. A. Thompson & Son, Melrose, Conn.,	*Hartford.*	Wm. C. Smith & Co., 119 Pearl St.,	5	60
	Barberry.				
9393	Barberry Jelly, Home Made, Mrs. S. C. Stone, New Haven,	*New Haven.*	Gilbert & Thompson, 918 Chapel St.,	⅔	35
	Crab Apple.				
9387	Crab Apple Jelly, Home Made, Mrs. S. C. Stone, New Haven,	*New Haven.*	Gilbert & Thompson, 918 Chapel St.,	⅔	35
9226	Pure Crab Apple Jelly, F. R. Adams & Co., Boston,		Johnson & Bro., 411 State St.,	½	25
	Currant.				
9362	Currant Jelly, made at the Station,				
9066	Red Currant Jelly, Austin Nichols & Co., N. Y.,	*Greenwich.*	Avery & Wilson,	⅔	25
9240	Currant Jelly, Francis H. Leggett & Co., N. Y.,	*Hartford.*	H. J. Case & Co., 433 Main St.,	½	25
9389	Currant Jelly, Home Made, Mrs. S. C. Stone, New Haven,	*New Haven.*	Gilbert & Thompson, 918 Chapel St.,	⅔	35
9227	Pure Red Currant Jelly, F. R. Adams & Co., Boston,		Johnson & Bro., 411 State St.,	½	25
9195	Pure Red Currant Jelly, Curtice Bros., Rochester, N. Y.,		Harry Leigh, 354 State St.,	½	25
9385	Currant Jelly, Home Made,		Woman's Exchange, 151 Orange St.,	½	35
9082	Red Currant Jelly, Gordon & Dilworth, N. Y.,	*Stamford.*	Fitch A. Hoyt, Atlantic Square,	½	30
	Grape.				
9386	Wild Grape Jelly, Home Made, Mrs. S. C. Stone, New Haven,	*New Haven.*	Gilbert & Thompson, 918 Chapel St.,	⅔	35
9384	Grape Jelly, Home Made,	*New Haven.*	Woman's Exchange, 151 Orange St.,	½	25
	Pineapple.				
9388	Pineapple Jelly, Home Made, Mrs. S. C. Stone, New Haven,	*New Haven.*	Gilbert & Thompson, 918 Chapel St.,	⅔	35
	Plum.				
9390	Plum Jelly, Home Made, Mrs. S. C. Stone, New Haven,	*New Haven.*	Gilbert & Thompson, 918 Chapel St.,	⅔	35
	Quince.				
9392	Quince Jelly, Home Made, Mrs. S. C. Stone, New Haven,	*New Haven.*	Gilbert & Thompson, 918 Chapel St.,	⅔	35
9311	Pure Fruit Jellies for Family Use, Quince, Steele Bros., New Britain,	*Norwich.*	Welcome A. Smith, 137 Main St.,	½	15
9313	Home Made Quince Jelly, R.,		A. T. Otis, 261 Main St.,	½	20
	Raspberry.				
9044	Raspberry Jelly, Home Made, Mrs. S. C. Stone, New Haven,	*Bridgeport.*	R. T. Whiting, 345 Main St.,	⅔	35
	Strawberry.				
9391	Strawberry Jelly, Home Made, Mrs. S. C. Stone, New Haven,	*New Haven.*	Gilbert & Thompson, 918 Chapel St.,	⅔	35

TABLE II. ADULTERATED JELLIES. (NOT MADE ENTIRELY FROM THE FRUIT SPECIFIED AND CANE SUGAR).

Station No.	BRAND.	DEALER.	Pounds of jelly in glass, jar, or pail.	Price. Cents.	Gelatinous matter.	Sugar.	Coloring matter.	Preservative.
	Apple.							
9218	Extra Quality Apple Jelly. Made from select fruit,	*New Haven.*— New Haven Public Market, 390 State St.,	⅓	5	....	Glucose,		
	Crab Apple.							
9237	Superior Crab Apple Jelly, American Preservers Co.,	*Hartford.*— Barrows & Thalheimer, 525 Main St.,	⅓	10	Starch paste,	Glucose,	....	Salicylic acid.
	Currant.							
9015	Currant Jelly. Sold in bulk,	*Bridgeport.*— Centennial Tea Co., 856 Main St.,	1	5	Starch paste,	Glucose,	Red coal-tar dye.	
9023	Economy Currant Jelly, The W. Va. Preserving Co., Wheeling,	Coe & White, 560 Main St.,	½	10	....	Glucose,	....	Salicylic acid.
9030	Currant Jelly. Sold in bulk,	David O'Donnell, 628 Main St.,	1	5	Starch paste,	Glucose,	Magenta.	
9013	do. do.	John T. Sullivan, 222 E. Main St.,	1	5	Probably apple,	Glucose,	Red coal-tar dye.	
9029	do. do.	R. Wundrack, 575 Main St.,	1	7	Starch paste,	Glucose,	Red coal-tar dye.	
9248	do. do.	*Meriden.*— Block & Behrens, 74 E. Main St.,	1	5	Starch paste,	Glucose,	Magenta.	
9338	do. do.	*Middletown.*— A. M. Bidwell, 344 Main St.,	1	10	Starch paste,	Glucose,	Magenta.	
9340	Excelsior Currant Jelly, New York,	W. K. Spencer, 98 Main St.,	½	15	Starch paste,	Glucose,	....	Salicylic acid.
9205	Currant Jelly, Pure Fruit Jellies, W. P. & Co., Ayer, Mass.,	*New Haven.*— S. S. Adams, 412 State St.,	½	10	Starch paste,	Glucose,	Red coal-tar dye,	Salicylic acid.
9223	Currant Jelly. Sold in bulk,	do. do.	1	5	Starch paste,	Glucose,	Magenta.	
7898	Currant Jelly, The W. Va. Preserving Co, Wheeling,	Coe & Jenks, 422 State St.,	5	25	Probably apple,	Glucose,	Magenta.	
9186	Currant Jelly, Columbia Preserving Co., Boston,	Harry Leigh, 354 State St.,	⅔	10	Probably apple,	Glucose,	Magenta.	
9216	Extra Quality Currant Jelly. Made from select fruit,	New Haven Public Market, 390 State St.,	⅓	5	Starch paste,	Glucose,	Magenta.	
9301	Currant Jelly. Sold in bulk,	*Norwich.*— George Lepau, 252 Franklin St.,	1	5	Starch paste,	Glucose,	Red coal-tar dye.	
9327	Fine Fruit Jellies, Currant, Oliver Day & Co., Boston,	*Putnam.*— W. J. Bartlett,	⅔	10	....	Glucose,	Red coal-tar dye.	
9080	Currant Jelly. Sold in bulk,	*Stamford.*— Fitch A. Hoyt,	1	6	Starch paste,	Glucose,	Red coal-tar dye.	
9073	do. do.	T. F. Maher, 7 Pacific St.,	1	8	Starch paste,	Glucose,	Orange coal-tar dye.	
9087	Currant Jelly, Orange Preserving Co., N. Y.,	W. W. Edwards, 99 Main St.,	5	23	Probably apple,	Glucose,		
	Grape.							
9092	Grape Jelly,	*Hartford.*— J. C. & Co., Hill Grocery, 558 Asylum St.,	¼	10	Starch paste,	Glucose,		
9206	Grape Jelly, Pure Fruit Jellies, W. P. & Co., Ayer, Mass.,	*New Haven.*— S. S. Adams, 412 State St.,	½	10	Starch paste,	Glucose,	Red coal-tar dye,	Salicylic acid.
9185	Grape Jelly, Columbia Preserving Co., Boston,	Harry Leigh, 354 State St.,	⅔	10	Probably apple,	Glucose,	Magenta.	
	Guava.							
9234	Guava Jelly, E. T. Cowdrey & Co., Boston,	*Putnam.*— A. C. Stetson,	½	20	....	Glucose,		
	Orange.							
9203	Orange, Pure Fruit Jellies, W. P. & Co., Ayer, Mass.,	*New Haven.*— S. S. Adams, 412 State St.,	½	10	Starch paste,	Glucose,	....	Salicylic acid.
	Peach.							
9255	Peach Jelly, Eagle Preserving Co., New York,	*Meriden.*— L. C. Brown, 4 E. Main St.,	½	10	Starch paste,	Glucose,		
9215	Extra Quality Peach Jelly. Made from select fruit,	*New Haven.*— New Haven Public Market, 390 State St.,	⅓	5	Starch paste,	Glucose,		

TABLE II. ADULTERATED JELLIES. (NOT MADE ENTIRELY FROM THE FRUIT SPECIFIED AND CANE SUGAR.)—*Continued.*

Station No.	BRAND.	DEALER.	Pounds of jelly in glass, jar, or pail.	Price. Cents.	Gelatinous matter.	Sugar.	Coloring matter.	Preservative.
	Pineapple.							
9280	Pineapple Jelly, Philip T. Ritter Conserve Co., Phila., . . .	*New London.*— Daboll & Freeman, 148 State St., . .	2/3	20	....	Glucose.		
9326	Pineapple Jelly, Berry Preserving Co., Boston, ...	*Putnam.*— W. H. Mansfield, ...	2/3	25	....	Glucose.		
	Quince.							
9194	Curtice Pure Quince Jelly, Curtice Brothers, Rochester, N. Y., . .	*New Haven.*— Harry Leigh, 354 State St., . . .	1/2	25	Quince,	Cane sugar,	Cochineal.	
	Raspberry.							
9022	Raspberry Jelly, The Ayer Preserving Co., Ayer, Mass., . .	*Bridgeport.*— Bridgeport Public Market, 39 Bank St., .	5	25	Probably apple,	Glucose,	Red coal-tar dye.	
9204	Raspberry Jelly, Pure Fruit Jellies, W. P. & Co., Ayer, Mass., . .	*New Haven.*— S. S. Adams, 412 State St., . . .	1/2	10	Starch paste,	Glucose,	Red coal-tar dye,	Salicylic acid.
7899	Raspberry Jelly, The W. Va. Preserving Co., Wheeling, . . .	Coe & Jenks, 422 State St., . . .	5	25	Probably apple,	Glucose,	Magenta.	
9308	Raspberry Jelly, ...	*Norwich.*— H. I. Palmer, 231 Main St., .	1/2	15	Starch paste,	Glucose,	Red coal-tar dye.	
9070	Crystal Jelly, Raspberry, Extra Quality, New York, . . .	*Stamford.*— Geo. A. Ferris, 184 Main St., . . .	1/2	10	Probably apple,	Glucose,	....	Salicylic acid.
	Strawberry.							
9241	Strawberry Jelly, ...	*Hartford.*— H. J. Case & Co., 433 Main St., . .	1/2	10	....	Glucose,	Coal-tar dye.	
9258	Strawberry Jelly, Eagle Preserving Co., 110 Hudson St., N. Y., . .	*Meriden.*— H. F. Rudolf, 14 Pratt St., . . .	5	30	Probably apple,	Glucose,		
9352	Strawberry Jelly, Pure Fruit Jellies, W. P. & Co., Ayer, Mass., . .	*Middletown.*— G. E. Burr, 136 Main St., . . .	1/2	15	Starch paste,	Glucose,	Red coal-tar dye.	
9202	Strawberry Jelly, Pure Fruit Jellies, W. P. & Co., Ayer, Mass , . .	*New Haven.*— S. S. Adams, 412 State St., . . .	1/2	10	Starch paste,	Glucose,	Red coal-tar dye,	Salicylic acid.
7900	Strawberry Jelly, The W. Va. Preserving Co., Wheeling, . . .	Coe & Jenks, 422 State St., . . .	5	25	Probably apple,	Glucose,	Magenta.	
9187	Strawberry Jelly, Columbia Preserving Co., Boston, Mass., . .	Harry Leigh, 354 State St., . . .	2/3	10	Probably apple,	Glucose,	Magenta.	
9217	Extra Quality, Strawberry Jelly. Made from select fruit, . . .	New Haven Public Market, 390 State St.,	1/3	5	Starch paste,	Glucose,	Magenta.	
9401	Strawberry Jelly, Whitcher, Pillman & Co., Ayer, Mass., . . .	N. A. Fullerton, 926 Chapel St., . .	1/2	10	Probably apple,	Glucose	Red coal-tar dye,	Salicylic acid.

TABLE III. COMPOUND JELLIES.

9260	Fine Fruit Jellies, Currant, Compound, American Preserving Co., Phila.,	*Meriden.*— F. W. Miner, 213 Pratt St., .	2/3	10	Starch paste,	Glucose,	Red coal-tar dye,	Salicylic acid.
9344	Currant Flavor, Pomona Jellies, made from the juice of fruit and refined sugar, ...	*Middletown.*— S. T. Camp, 234 Main St., .	1/2	18	Starch paste,	Cane sugar,	Red coal-tar dye.	
9348	Peach Flavored Jelly, Williams Bros. & Charbonneau, Detroit, Mich., .	Cottage Market, cor. Main and Washington Streets, ...	1/2	10	Starch paste,	Glucose,		
9314	Clifford's Fruit Flavor Jellies, Strawberry, ...	*Norwich.*— T. A. Stoddard, 100 Franklin St.,	1/3	10	Probably apple,	Glucose,	Orange coal-tar dye.	
9315	Clifford's Fruit Flavor Jellies, Currant, ...	do. do.	1/3	10	Starch paste,	Glucose,		
9335	Crystal Currant Jelly, Compound, .	*Putnam.*— A. C. Stetson, ...	5	30	Probably apple,	Glucose,		
9321	Currant Flavored Jelly, Williams Bros. and Charbonneau, Detroit, Mich., ...	Edward Mullan, ...	2/3	15	Starch paste,	Glucose,		

TABLE IV. ANALYSES OF JELLIES.

Station No.		Water.	Ash.	Nitrogen.	Polarization. Sugar Degrees. Direct. Reading.	Direct. Temp. C.	After Inversion. Reading.	After Inversion. Temp. C.	After Inversion. Reading at 86° C.
	Jellies not found adulterated.								
9245	Apple, . . .	28.82	0.53	0.05	—34.6	21	—46.4	22	—16.0
9393	Barberry, . .	35.41	.25	.08	—10.0	25	—21.2	24	0.4
9387	Crab apple, . .	37.26	.53	.08	19.0	22	—19.0	23	— 0.2
9226	" . .	24.88	.21	.05	39.8	24	—22.0	24	— 1.0
9362	Currant, . . .	26.81	.33	.04	—20.0	24	—22.4	22	0.0
9066	" . . .	30.18	.32	.04	— 4.5	23	—22.0	21	0.0
9240	" . . .	43.11	.75	.05	— 1.6	25	—17.6	24	— 0.2
9389	" . . .	37.34	.33	.10	25.0	23	—19.2	23	0.4
9227	" . . .	27.61	.54	.06	— 6.7	23	—23.1	22	0.0
9195	" . . .	38.01	.79	.06	— 7.6	23	—20.4	25	— 0.6
9385	" . . .	34.21	.29	.08	10.0	26	—19.6	25	2.2
9082	" . . .	30.90	.65	.07	— 6.6	24	—20.0	24	0.0
9386	Grape, . . .	36.04	.10	.05	27.4	22	—19.6	22	0.6
9384	" . . .	29.20	.44	.07	41.6	23	—22.4	22	1.0
9388	Pineapple, . .	31.84	.26	.07	35.2	22	—22.0	24	— 0.4
9390	Plum, . . .	36.29	.32	.08	24.0	24	—20.0	22	1.0
9392	Quince, . . .	40.46	.16	.05	14.0	25	—18.6	23	— 0.4
9311	" . . .	32.15	.12	.04	9.6	26	—19.6	24	0.0
9313	" . . .	34.77	.28	.03	14.4	25	—19.6	23	0.0
9044	Raspberry, . .	24.38	.47	.11	19.3	21	—25.1	22	— 0.1
9391	Strawberry, . .	36.98	.20	.06	24.6	24	—19.2	24	1.6
	Adulterated Jellies.								
9218	Apple, . . .	29.69	.39	.04	64.0	24	44.2	24	51.0
9237	Crab apple, . .	38.07	.52	.05	106.4	30	103.2	25	98.4
9015	Currant, . . .	32.71	.68	.07	120.6	23	119.2	23	107.6
9023	" . . .	31.62	.62	.05	77.8	26	75.6	23	76.4
9030	" . . .	37.07	.63	.05	106.6	23	103.0	25	
9013	" . . .	39.76	.85	.07	88.2	23	86.6	24	
9029	" . . .	30.76	.82	.05	118.6	22	116.2	23	
9248	" . . .	38.92	.63	.05	107.6	27	105.4	25	102.4
9338	" . . .	40.32	.40	.06	116.2	25	114.2	23	108.2
9340	" . . .	38.78	.52	.04	82.4	25	81.0	25	79.2
9205	" . . .	38.78	.21	.05	104.8	25	93.0	25	91.4
9223	" . . .	37.33	.45	.05	116.4	26	116.4	25	112.4
7898	" . . .	32.63	.72	.05	115.3	22	103.7	21	103.7
9186	" . . .	37.88	.65	.08	66.2	25	64.6	24	69.8
9216	" . . .	38.47	.28	.05	49.8	26	31.8	27	39.4
9301	" . . .	40.50	.70	.06	97.2	26	96.0	24	91.2
9327	" . . .	39.36	.57	.06	85.4	25	67.0	25	71.4
9080	" . . .	38.66	.67	.05	97.4	26	95.4	24	94.4
9073	" . . .	29.70	.72	.05	115.6	24	114.0	23	
9087	" . . .	30.25	.69	.06	123.0	21	120.6	21	
9092	Grape, . . .	35.38	.48	.04	86.4	25	85.4	24	83.8
9206	" . . .	39.38	....	.05	110.0	26	95.6	22	96.0
9185	" . . .	35.16	.54	.05	72.8	25	69.8	23	75.0

TABLE IV. ANALYSES OF JELLIES.—*Continued.*

Station No.		Water.	Ash.	Nitrogen.	Polarization. Sugar Degrees. Direct. Reading.	Direct. Temp. C.	After Inversion. Reading.	After Inversion. Temp. C.	After Inversion. Reading at 86° C.
	Adulterated Jellies.—Continued.								
9334	Guava, . . .	17.02	0.49	0.04	78.4	25	30.0	25	44.4
9203	Orange, . . .	37.60	.13	.04	118.4	25	105.4	24	104.4
9255	Peach, . . .	34.97	.50	.05	95.2	27	81.4	25	81.4
9215	" . . .	33.10	.60	.03	58.4	25	41.2	24	59.8
9280	Pineapple, . .	33.09	.32	.05	68.0	24	35.4	25	42.4
9326	" . . .	33.43	.73	.03	98.8	25	70.2	24	75.4
9194	Quince, . . .	31.68	.34	.03	21.4	22	— 1.2	24	7.0
9022	Raspberry, . .	36.71	.55	.05	106.0	22	103.2	25	
9204	" . . .	37.94	...	.07	110.0	24	95.2	24	94.4
7899	" . . .	31.37	.73	.05	122.5	23	118.5	23	
9308	" . . .	44.03	.51	.03	96.4	26	94.4	24	90.4
9070	" . . .	30.74	.43	.05	115.4	26	112.6	23	111.4
9241	Strawberry, . .	38.70	.69	.05	104.2	25	101.6	24	98.4
9258	" . . .	34.12	.57	.05	107.9	21	103.9	26	
9352	" . . .	30.31	.61	.07	99.4	25	88.8	23	91.4
9202	" . . .	36.31	....	.05	107.6	27	94.8	23	94.4
7900	" . . .	32.65	.73	.05	115.7	23	112.8	23	
9187	" . . .	35.15	.75	.07	70.4	25	64.4	24	69.4
9217	" . . .	36.41	.38	.04	57.2	25	29.2	25	38.6
9401	" . . .	38.76	.16	.05	102.0	25	94.0	25	90.0
	Compound Jellies.								
9260	. . . . .	22.79	.34	.05	85.4	25	64.4	25	72.0
9344	. . . . .	24.52	.18	.03	51.2	26	—22.8	24	0.0
9348	. . . . .	37.00	.52	.06	104.6	25	102.4	25	100.4
9314	. . . . .	37.32	.77	.03	53.8	25	52.4	24	58.4
9315	. . . . .	37.53	.50	.03	55.4	27	54.4	25	59.4
9335	. . . . .	30.57	.54	.05	121.1	23	118.7	24	
9321	. . . . .	32.97	.59	.06	115.4	25	114.6	23	110.0

PRESERVES, JAMS, MARMALADES, AND APPLE BUTTER.

By A. L. Winton, A. W. Ogden, and W. L. Mitchell.

Pure preserves, jams, and marmalades are products obtained by boiling down fruit with enough cane sugar to prevent fermentation. Unlike jellies, they contain the fruit pulp, and in the case of berries, currants, and some stone fruits, the seeds and skins. The presence of any other material than the fruit specified and *cane* sugar should be regarded as an adulteration, except in cases where the package is distinctly labeled so as to show that it is a "mixture, compound, combination, or blend."

Pure apple butter is a sauce made from apples, cane sugar, and spices. It should not contain glucose or chemical preservative.

Adulterants. — The materials mentioned in the chapter on jellies, page 108, are also used in the fruit products here considered. According to Blyth, jams may be readily adulterated with turnip pulp or other cheap vegetable tissue. It is stated that an artificial raspberry jam has been made in this country, in which herds-grass seed took the place of the fruit seeds. We have not, however, been able to detect foreign seeds in any of the samples examined at this station.

Examination of Samples from the Connecticut Market.

Eleven samples of pure preserves made at this station from fruit and cane sugar, and 51 samples of preserves, jams, marmalades, and apple butter bought by station agents from grocers in various parts of the state, have been examined by the methods described on page 109.

The samples prepared at the station were as follows:

No. 9405. — Blackberry jam.
9394. — Cherry jam.
9404. — Currant jam.
9399. — Orange marmalade.
9395. — Peach jam.
No. 9397. — Pineapple jam.
9396. — Plum jam.
9403 and 9364. — Quince jam.
9400. — Raspberry jam.
9398. — Strawberry jam.

The results of the analyses of these samples are given in Table VI, and may serve as standards of composition of pure fruit products.

The samples bought in the Connecticut market may be classified as follows:

Preserves, Jams, and Marmalades:	
Not found adulterated, ...	3
Adulterated (not made entirely from fruit and cane sugar), ...	44
Labeled "compound,"	2
Apple Butter:	
Not found adulterated, ...	1
Adulterated (not made entirely from apples, cane sugar, and spice), ...	1
Total, ...	51

Preserves, Jams, and Marmalades. — Of the 49 samples bought by station agents, only three were not found to contain other ingredients than fruit and cane sugar. The three were the following:

No. 9010. — Red Currant Jam. Specially prepared for R. C. Williams & Co., New York, by Charles Southwell & Co., London, Eng. Twenty cents per half-pound jar.

No. 9009. — Raspberry Jam. Specially prepared for R. C. Williams & Co., New York, by Charles Southwell & Co., London, Eng. Twenty cents per half-pound jar.

Nos. 9010 and 9009 were bought of George E. Cleaveland, 200 State Street, Bridgeport.

No. 9383. — Strawberry Jam. Home made. Bought at Woman's Exchange, 151 Orange Street, New Haven. Twenty cents per half-pound glass.

All the remaining 46 samples contained glucose; 27 were preserved with salicylic acid, eight were colored with coal-tar dyes, and four were colored with cochineal. The names of the manufacturers and dealers, the prices paid per jar, and the adulterants detected in the samples not labeled "compound" are given in Table V. The jars, unless otherwise noted, contained from one-half to two-thirds of a pound of the material.

TABLE V.—ADULTERATED PRESERVES, JAMS, AND MARMALADES (NOT MADE ENTIRELY FROM FRUIT AND CANE SUGAR).

Station No.	Brand.	Dealer.	Price per jar or tin, cents.
	Blackberry.		
9032	Campbell's Blackberry Jam, Jos. Campbell Preserve Co., Camden, N. J.,	*Bridgeport.*— E. L. Sullivan, 436 E. Main st.,	18
7892	Superior Preserved Blackberries, Max Ams, New York,	*New Haven.*— D. S. Cooper Co., 470 State st.,	18
	Cherry.		
9190	Fresh Fruit, Red Cherry Jam, Curtice Bros. Co., Rochester, N. Y.,	*New Haven.*— Harry Leigh, 354 State st.,	15
	Currant and Raspberry.		
9243	Currant and Raspberry,	*Hartford.*— Joseph Hagerty, 75 Front st.,	10
9189	Fresh Fruit, Raspberry and Currant Jam, Curtice Brothers Co.,	*New Haven.*— Harry Leigh, 354 State st.,	15
	Damson.		
9196	Damson Jam, Pure Preserved Fruits, F. P. Adams & Co., Boston,	*New Haven.*— S. S. Adams, 412 State st.,	15
9278	Damson Jam, Alexander Cairns, Paisley, Scotland,	*New London.*— Daboll & Freeman, 148 State st.,	28
9075	Damson Jam, Crescent Preserve Co., Camden, N. J.,	*Stamford.*— T. F. Maher, 7 Pacific st.,	10
	Gooseberry.		
9275	Cairn's Finest Scotch Preserves, Gooseberry Jam, Paisley, Scotland,	*New London.*— Keefe & Davis, 125 Bank st.,	20
	Grape.		
7889	Superior Preserved Grapes, Max Ams, New York,	*New Haven.*— D. S. Cooper Co., 470 State st.,	18
	Orange.		
9192	Fresh Fruit Orange Marmalade, Curtice Bros. Co., Rochester, N.Y.,	*New Haven.*— Harry Leigh, 354 State st.,	15
	Peach.		
9036	Fresh Fruit Jam, Peach, W. H. Clark Co., Rochester, N. Y.,	*Bridgeport.*— Logan Bros., 863 Main st.,	15
9014	Peach Jam. Sold in bulk,	J. B. Sullivan, 222 E. Main st.,	8
9054	Fresh Fruit Peach Jam, Curtice Brothers Co ,	*Greenwich.*— J. L. Mahoney,	8
7888	Superior Preserved Peaches, Max Ams, New York,	*New Haven.*— D. S. Cooper Co., 470 State st.,	18
9289	McMechen's Old Virginia Peach Jam, Wheeling, W. Va.,	*New London.*— A. E. Foster, 120 Main st.,	18
9316	Peach Jam, Mrs. Hopkins' Delicious Jams, The E. G. Dailey Co., Detroit, Mich.,	*Putnam.*— J. E. Sullivan,	20
	Pineapple.		
9198	Grated Pineapple, F. P. Adams & Co., Boston,	*New Haven.*— S. S. Adams, 412 State st.,	15
9200	Pineapple Jam, F. P. Adams & Co., Boston,	S. S. Adams, 412 State st.,	15
7890	Superior Preserved Pineapples, Max Ams, New York,	D. S. Cooper Co., 470 State st.,	18
9193	Fresh Fruit Pineapple Marmalade, Curtice Bros Co., Rochester, N.Y.,	Harry Leigh, 354 State st.	15

TABLE V.—ADULTERATED PRESERVES, JAMS, AND MARMALADES (NOT MADE ENTIRELY FROM FRUIT AND CANE SUGAR).—*Continued.*

Station No.	Brand.	Sugar.	Coloring Matter.	Preservative.
	Blackberry.			
9032	Campbell's Blackberry Jam, Jos Campbell Preserve Co., Camden, N. J.,	Glucose	Red coal-tar dye	
7892	Superior Preserved Blackberries, Max Ams, New York,	Glucose	Red coal-tar dye	
	Cherry.			
9190	Fresh Fruit, Red Cherry Jam, Curtice Bros. Co., Rochester, N. Y.,	Glucose	Cochineal	Salicylic acid
	Currant and Raspberry.			
9243	Currant and Raspberry,	Glucose		
9189	Fresh Fruit, Raspberry and Currant Jam, Curtice Brothers Co.,	Glucose	....	Salicylic acid
	Damson.			
9196	Damson Jam, Pure Preserved Fruits, F. P. Adams & Co., Boston,	Glucose	....	Salicylic acid
9278	Damson Jam, Alexander Cairns, Paisley, Scotland,	Glucose		
9075	Damson Jam, Crescent Preserve Co., Camden, N. J.,	Glucose		
	Gooseberry.			
9275	Cairn's Finest Scotch Preserves, Gooseberry Jam, Paisley, Scotland,	Glucose		
	Grape.			
7889	Superior Preserved Grapes, Max Ams, New York,	Glucose		
	Orange.			
9192	Fresh Fruit Orange Marmalade, Curtice Bros. Co., Rochester, N.Y.,	Glucose	....	Salicylic acid
	Peach.			
9036	Fresh Fruit Jam, Peach, W. H. Clark Co., Rochester, N. Y.,	Glucose		
9014	Peach Jam. Sold in bulk,	Glucose	....	Salicylic acid
9054	Fresh Fruit Peach Jam, Curtice Brothers Co.,	Glucose	....	Salicylic acid
7888	Superior Preserved Peaches, Max Ams, New York,	Glucose	....	Salicylic acid
9289	McMechen's Old Virginia Peach Jam, Wheeling, W. Va.,	Glucose	....	Salicylic acid
9316	Peach Jam, Mrs Hopkins' Delicious Jams, The E. G. Dailey Co., Detroit, Mich.,	Glucose		
	Pineapple.			
9198	Grated Pineapple, F. P. Adams & Co., Boston,	Glucose	....	Salicylic acid
9200	Pineapple Jam, F. P. Adams & Co., Boston,	Glucose	....	Salicylic acid
7890	Superior Preserved Pineapples, Max Ams, New York,	Glucose	....	Salicylic acid
9193	Fresh Fruit Pineapple Marmalade, Curtice Bros. Co., Rochester, N.Y.,	Glucose	....	Salicylic acid

TABLE V.—ADULTERATED PRESERVES, JAMS, AND MARMALADES (NOT MADE ENTIRELY FROM FRUIT AND CANE SUGAR).—*Continued.*

Station No.	Brand.	Dealer.	Price per jar or tin, cents.
	Quince.		
9042	Fort Henry Preserves, Quince, The W. Va. Pres'g Co., Wheeling,	*Bridgeport.*— C. H. Stevens, 398 E. Main st.,	12
9031	Campbell's Quince Jam, Jos. Campbell Preserve Co., Camden, N. J.,	E. L. Sullivan, 436 E. Main st.,	18
7891	Superior Preserved Quinces, Max Ams, New York,	*New Haven.*— D. S. Cooper Co., 470 State st.,	18
9188	Fresh Fruit Quince Jam, Curtice Bros. Co., Rochester, N. Y.,	Harry Leigh, 354 State st.,	15
	Raspberry.		
9263	Raspberries,	*Meriden.*— C. F. Fox, 90 W. Main st.,	12
9350	Fruit Jams, Raspberry, The E. G. Dailey Co., Detroit, Mich.,	*Middletown.*— W. F. Mackley, Main st.,	15
9343	Pillman's Pure Preserved Fruits, Wild Raspberry, Whitcher, Pillman & Co., Ayer, Mass.,	J. B. Patterson, 110 Main st.,	15
9197	Wild Raspberries, F. P. Adams & Co., Boston,	*New Haven.*— S. S. Adams, 412 State st.,	15
7893	Superior Preserved Raspberries, Max Ams, New York,	D. S. Cooper Co., 470 State st.,	18
9224	Thomas Wood's Kentish Farm House Jams, Raspberry, Swanley, Eng.,	Johnson Bros., 411 State st.,	18
9408	Home-made Preserves, Raspberry, H. A. Johnson & Co., Boston,	D. M. Welch & Son, 28 Cong. av.,	50*
9290	Anderson's Raspberry Jam, Anderson Preserving Co., Camden, N. J.,	*New London.*— A. E. Foster, 120 Main st.,	12
	Strawberry.		
9037	Fresh Fruit Jam, Strawberry, W. H. Clark & Co., Rochester, N. Y.,	*Bridgeport.*— Logan Bros., 863 Main st.,	15
9053	Strawberry Jam, Crescent Preserve Co., Camden, N. J.,	*Greenwich.*— J. L. Mahoney,	8
9091	Health Brand Jams, Strawberry, Lewis DeGroff & Son, N. Y.,	*Hartford.*— J. F. Morrissey, 84 Albany ave.,	18
9356	Strawberry, Los Angeles Brand, E. M. Potts & Co.,	*Middletown.*— D. I. Chapman, 146 Main st.,	25
9199	Wild Strawberries, F. P. Adams & Co., Boston,	*New Haven.*— S. S. Adams, 412 State st.,	15
9191	Fresh Fruit Strawberry Jam, Curtice Bros. Co., Rochester, N. Y.,	Harry Leigh, 354 State st.,	15
9225	Thomas Wood's Kentish Farm House Jams, Strawberry, Swanley, Eng.,	Johnson Bros., 411 State st.,	18
9279	Strawberry Jam, Batty & Co., London,	*New London.*— Daboll & Freeman, 148 State st.,	28
9319	Strawberry, Daniels, Cornell & Co., Worcester, Mass.,	*Putnam.*— J. E. Sullivan,	10
9079	Strawberry Jam, Williams Bros. & Charbonneau, Detroit, Mich.,	*Stamford.*— Geo. A. Ferris, 184 Main st.,	20
	Tomato.		
9355	Fresh Fruit Jam, Tomatoes, Flaccus Bros., Wheeling, W. Va.,	*Middletown.*— D. I. Chapman, 146 Main st.,	18

* 5 pound jar.

TABLE V.—ADULTERATED PRESERVES, JAMS, AND MARMALADES (NOT MADE ENTIRELY FROM FRUIT AND CANE SUGAR).—*Continued.*

Station No.	Brand.	Sugar.	Coloring Matter.	Preservative.
	Quince.			
9042	Fort Henry Preserves, Quince, The W. Va. Pres'g Co., Wheeling,	Glucose		
9031	Campbell's Quince Jam, Jos. Campbell Preserve Co., Camden, N. J.,	Glucose	Red coal-tar dye	
7891	Superior Preserved Quinces, Max Ams, New York,	Glucose	....	Salicylic acid
9188	Fresh Fruit Quince Jam, Curtice Bros. Co., Rochester, N. Y.,	Glucose	Cochineal	Salicylic acid
	Raspberry.			
9263	Raspberries,	Glucose		
9350	Fruit Jams, Raspberry, The E. G. Dailey Co., Detroit, Mich.,	Glucose		
9343	Pillman's Pure Preserved Fruits, Wild Raspberry, Whitcher, Pillman & Co., Ayer, Mass.,	Glucose	Red coal-tar dye	Salicylic acid
9197	Wild Raspberries, F. P. Adams & Co., Boston,	Glucose	....	Salicylic acid
7893	Superior Preserved Raspberries, Max Ams, New York,	Glucose	Red coal-tar dye	Salicylic acid
9224	Thomas Wood's Kentish Farm House Jams, Raspberry, Swanley, Eng.,	Glucose		
9408	Home-made Preserves, Raspberry, H. A. Johnson & Co., Boston,	Glucose	Red coal-tar dye	Salicylic acid
9290	Anderson's Raspberry Jam, Anderson Perserving Co., Camden, N. J.,	Glucose		
	Strawberry.			
9037	Fresh Fruit Jam, Strawberry, W. H. Clark & Co., Rochester, N. Y.,	Glucose	....	Salicylic acid
9053	Strawberry Jam, Crescent Preserve Co., Camden, N. J.,	Glucose		
9091	Health Brand Jams, Strawberry, Lewis DeGroff & Son, N. Y.,	Glucose	....	Salicylic acid
9356	Strawberry, Los Angeles Brand, E. M. Potts & Co.,	Glucose	Cochineal	Salicylic acid
9199	Wild Strawberries, F. P. Adams & Co., Boston,	Glucose	....	Salicylic acid
9191	Fresh Fruit Strawberry Jam, Curtice Bros. Co., Rochester, N. Y.,	Glucose	Cochineal	Salicylic acid
9225	Thomas Wood's Kentish Farm House Jams, Strawberry, Swanley, Eng.,	Glucose		
9279	Strawberry Jam, Batty & Co., London,	Glucose		
9319	Strawberry, Daniels, Cornell & Co., Worcester, Mass.,	Glucose	....	Salicylic acid
9079	Strawberry Jam, Williams Bros. & Charbonneau, Detroit, Mich.,	Glucose		
	Tomato.			
9355	Fresh Fruit Jam, Tomatoes, Flaccus Bros., Wheeling, W. Va.,	Cane sugar	....	Salicylic acid

Two pails of preserves made by the Central Preserving Co., 201 State Street, Boston; one (No. 9407) labeled "Raspberry Jam, Compound," the other (No. 9406), "Strawberry Preserve Compound," were bought of D. M. Welch & Son, 28 Congress Avenue, New Haven. Each of the pails contained about five pounds of the preserve, and cost 35 cents.

The following statement of composition was attached to each package:

COMPOUND PRESERVES MADE FROM

Fresh Fruit,	.250
Corn Syrup,	.300
Gran. Sugar,	.250
Fruit Juice,	.200
	1.000

In addition to the materials above mentioned, both samples were found to contain a red coal-tar dye and salicylic acid.

Apple Butter.— Two samples were examined:

No. 9299. Heinz's Apple Butter, H. J. Heinz Co., Pittsburg. Dealer, A. T. Otis, 261 Main Street, Norwich. Price, 25 cts. per 2-pound pail. Contained neither glucose nor salicylic acid.

No. 9300. Apple Butter, West Virginia Preserving Co., Wheeling, W. Va. Dealer, J. A. Stoddard, 100 Franklin St., Norwich. Price, 25 cts. per 2-pound jar. This sample was sweetened with glucose and preserved with salicylic acid.

TABLE VI. ANALYSES OF PRESERVES, JAMS, MARMALADES, AND APPLE BUTTER.

Station No.		Water.	Ash.	Nitrogen.	Polarization. Direct. Reading.	Direct. Temp. c.	After Inversion. Reading.	After Inversion. Temp. c.	After Inversion. Reading at 86° c.
	Preserves, Jams, and Marmalades, not found adulterated.								
9405	Blackberry,	26.41	.60	.19	−4.6	26	−20.0	23	1.0
9394	Cherry,	25.21	.38	.10	4.0	25	−20.0	25	1.2
9404	Currant,	27.38	.45	.20	−6.6	25	−21.8	23	0.8
9010	do	27.15	.50	.12	−16.5	26	−23.3	23	−2.2
9399	Orange,	34.57	.52	.10	4.2	25	−16.2	26	1.0
9395	Peach,	33.73	.41	.06	19.8	26	−19.6	21	0.4
9397	Pineapple,	29.82	.38	.10	21.4	25	−20.4	24	0.5
9396	Plum,*	31.66	.39	.12	6.4	25	−16.2	25	3.0
9403	Quince,	26.85	.23	.05	32.6	26	−21.8	23	0.3
9364	do	17.74	.20	.04	8.2	23	−23.6	23	0.0
9400	Raspberry,	27.99	.33	.15	35.6	25	−19.4	25	0.8
9009	do	26.46	.34	.16	4.8	25	−20.2	24	0.0
9398	Strawberry,	26.50	.65	.18	20.0	22	−22.4	23	−0.2
9383	do	24.90	.73	.16	−15.0	23	−20 0	22	1.4
	Adulterated Preserves, Jams, and Marmalades.								
9032	Blackberry,	30.71	.42	.08	78.0	24	48.0	24	55.0
7892	do	32.50	.59	.11	86.0	25	74.6	24	75.0
9190	Red Cherry,	31.44	.58	.06	38.0	27	19.8	22	31.0
9243	Currant & raspberry,	28.05	.58	.06	110.6	26	108.0	24	98.6
9189	do	35.68	.41	.12	40.8	26	20.0	23	31.4
9196	Damson,†	33.91	.50	.10	22.6	26	7.8	25	21.4
9278	do‡	31.36	.33	.05	12.8	24	1.0	22	16.0
9075	do	33.70	.62	.08	100.8	24	94.0	25	91.0
9275	Gooseberry,	34.37	.50	.08	21.6	25	8.0	23	21.0
7889	Grape,	31.76	.57	.06	72.8	25	72.0	22	66.8
9192	Orange,	25.12	.27	.05	48.8	25	21.0	23	26.8
9036	Peach,	37.72	.48	.06	61.2	26	28.6	24	37.2
9014	do	30.30	.64	.16	92.5	24	76.1	23	76.1
9054	do	34.91	.38	.07	42.4	23	16.8	22	29.2
7888	do	44.44	.29	.08	43.2	26	9.6	22	21.0

* Pits and skins constituting 9.8 per cent. of the original jam were rejected.
† " " " 10.6 " " " " "
‡ " " " 14.7 " " " " "

TABLE VI. ANALYSES OF PRESERVES, JAMS, MARMALADES, AND APPLE BUTTER.— *Continued.*

Station No.		Water.	Ash.	Nitrogen.	Polarization. Direct. Reading.	Direct. Temp. c.	After Inversion. Reading.	After Inversion. Temp. c.	After Inversion. Reading at 86° c.
9289	Peach (*Cont.*),	20.88	.31	.08	60.0	25	47.0	23	57.0
9316	do	31.04	.46	.06	79.2	26	59.0	25	63.6
9198	Pineapple,	23.99	.19	.07	73.4	24	39.4	23	50.0
9200	do	23.89	.20	.06	82.6	25	46.6	22	56.2
7890	do	50.44	.19	.05	36.6	27	12.0	22	20.6
9193	do	31.61	.29	.03	53.2	28	18.0	26	32.0
9042	Quince,	36.94	.63	.04	89.0	24	82.0	24	82.6
9031	do	32.71	.29	.04	74.0	24	43.0	22	50.4
7891	do	41.87	.22	.05	32.4	24	10.4	21	23.0
9188	do	37.92	.36	.05	37.0	26	18.8	24	30.0
9263	Raspberry,	34.43	.50	.07	97.0	27	86.4	25	84.0
9350	do	37.27	.62	.15	68.4	25	62.0	23	65.0
9343	do	24.75	.48	.10	74.8	27	66.6	25	70.0
9197	do	26.01	.38	.09	52.0	26	42.4	25	51.2
7893	do	27.06	.48	.07	89.0	26	77.4	23	80.0
9224	do	26.41	.47	.16	45.6	26	9.6	25	22.8
9408	do	31.90	.58	.10	97.8	26	92.0	23	88.4
9290	do	31.14	.50	.07	14.8	23	7.0	21	22.4
9037	Strawberry,	34.60	.42	.09	50.6	25	36.4	20	45.4
9053	do	25.25	.74	.07	88.4	24	84.0	25	84.0
9091	do	26.21	.67	.08	77.0	27	66.0	22	71.2
9356	do	24.00	.68	.11	57.0	25	18.8	23	33.8
9199	do	26.56	.55	.08	61.2	26	37.8	24	47.0
9191	do	30.05	.41	.09	38.8	25	15.8	23	30.4
9225	do	21.09	.46	.12	60.0	26	20.0	26	35.0
9279	do	22.58	.40	.07	37.8	25	2.6	22	20.0
9319	do	23.91	.57	.09	110.4	25	106.2	24	105.0
9079	do	34.75	.35	.07	64.0	27	56.4	22	60.0
9355	Tomato,	37.18	.53	.18	11.6	26	−19.0	22	0.0
	Compounds.								
9407	Raspberry,	31.12	.24	.10	83.5	26	64.0	23	67.4
9406	Strawberry,	35.68	.71	.06	80.4	26	62.4	25	66.0
9299	Apple Butter,	53.21	.47	.08	−14.0	23	−15.2	23	−1.4
9300	do	49.96	.76	.08	41.0	23	39.2	22	42.0

TEA.

BY A. L. WINTON, A. W. OGDEN, AND W. L. MITCHELL.

Tea is prepared from the leaves of a shrubby plant, *Camellia Thea*, Link, of which there are two quite distinct varieties, considered by some botanists to be separate species. Botanically, the plant is closely related to the camellias of the conservatories.

It is stated that the tea plant has been cultivated in China for at least a thousand years, and in Japan since the beginning of the thirteenth century. It has been introduced into India, Ceylon, Java, Brazil, and some other countries during the present century. China and Japan are still the leading tea producing countries, although teas from India and Ceylon are now coming into extensive use.

Both green and black tea are products of the same plant, the difference in color and flavor being due to the method of preparation. To prepare "green tea" the leaves are dried by artificial heat immediately after picking, thus preserving the chlorophyl, or green coloring matter. When a "black tea" is desired, the leaves are subjected, before drying, to a fermentation, which changes their color to black and develops the characteristic flavor.

The alkaloid of tea, formerly known as "thein," has been shown to be identical with that of coffee, "caffein," and to this principle are attributed the stimulating properties of both beverages.

The imports of tea into the United States for the year ending June 30, 1896, amounted to 93,891,407 pounds, having an import cargo value at 14 cents per pound, of $12,688,739.61.

ADULTERATION OF TEA.

The foreign materials with which tea has been most often adulterated fall into the following classes :

Mineral Make-Weights.—Such as soapstone, gypsum, iron dust, sand, etc.

Lie Tea.—The trade name of an adulterant consisting of tea dust and other matters made into lumps with starch paste and colored. The lumps go to pieces on treatment with hot water.

Exhausted Leaves.— Tea leaves which have been used for the preparation of the beverage are said to be collected from door to door in China and also in England, and after being dried and restored, as far as possible, to their original appearance are employed for purposes of adulteration.

Foreign Leaves.— Leaves of various plants, as, for example, the beach, willow, elm, rose, wistaria, etc., have frequently been prepared in imitation of tea and mixed with the genuine leaf. This form of adulteration is usually evident to any careful observer, after spreading out the leaves, which have been rendered pliable by treatment with boiling water.

Astringents.— Catechu and some other materials, rich in tannin, were at one time used to give tea artificial strength.

Facing.— Nearly all the green tea and much of the black tea brought into the United States has been "faced" or coated, to impart a gloss and an attractive color. Among the materials employed in facing green tea are Prussian blue, indigo, turmeric, soapstone, and gypsum. Black tea is frequently coated with plumbago or black lead.

As these materials in the quantities employed may not be injurious to health and usually do not perceptibly increase the weight of the tea, it is a disputed question whether they should be regarded as adulterants. Facing is, however, a senseless custom, and when it is generally understood that it increases the cost of production without in any way adding to the value of the tea for the preparation of the beverage, the practice will doubtless be abandoned.

TEA LEGISLATION.

The U. S. Tea Adulteration Act of 1883.— *Battershall states that "the enactment of this law was largely due to the exertions of prominent tea merchants whose business interests were seriously affected by the sale (principally in trade auctions) of the debased or spurious article."

The law prohibited the importation of tea adulterated with spurious or exhausted leaf, or with so great an admixture of chemicals, or other deleterious substances, as to make it unfit for use. It provided that for each consignment of tea the importer should give a bond to the collector of the port that it

* Food Adulteration and Its Detection, p. 19.

should not be removed from warehouse until released by the custom house officials. Whenever the tea was found, on examination, to come within the prohibitions of the act, the importer was required to give a bond to ship it outside the limits of the country within six months. If this was not done at the expiration of the time specified the tea was destroyed.

As a result of the rigid enforcement of this law, the quality of the tea imported has considerably improved.

The U. S. Act of 1897 to Prevent the Importation of Impure and Unwholesome Tea.— The act of 1883 was repealed in 1897 and a more comprehensive law enacted, which makes it unlawful to import not only adulterated tea, but any that is inferior in purity, quality, or fitness for consumption.

Under this law the secretary of the treasury is required to appoint each year a board of seven tea experts, whose duty it is to fix standards for all the kinds of tea imported and procure samples of standard tea for deposit at the custom houses at New York, Chicago, and San Francisco, and for distribution among tea importers. All tea imported must be compared with these standards by the proper officials, and if found inferior, must be either exported out of the country within six months or destroyed.

Japanese Tea Adulteration Law.— In 1884, the Japanese Government passed a law making it a criminal offense to adulterate tea. Facing is not, however, prohibited as it is claimed that it is justified by the demands of foreign trade.

EXAMINATION OF SAMPLES FROM THE CONNECTICUT MARKET.

During the month of October, 1897, agents of the station purchased, in various parts of the State, 26 samples of green tea, 53 of black tea, and 10 of mixed tea, all of which have been examined. The results of the examinations, with such particulars as could be obtained regarding the kinds of tea, the names and addresses of dealers, and the prices paid per pound, are given in following tables.

METHODS OF EXAMINATION.

Foreign Leaves.— A sample of the tea is boiled with water, and the shape venation, dentation, and microscopic characters of the moist leaves are noted.

Water is determined by drying two grams to constant weight at 100° C.

Total Ash is determined by incinerating two grams by the usual method.

Ash Insoluble in Water.— The ash prepared as above is boiled with 50 cc. of water and the insoluble portion collected on a Gooch crucible, washed with hot water, dried and ignited.

Ash Soluble in Water is obtained by subtracting the percentage of water-insoluble from the percentage of total ash.

Hot Water Extract.— Two grams of the unground tea are boiled with 200 cc. of water for a half hour, care being taken to replace the water lost by evaporation. The leaves are collected on a tared filter, washed thoroughly with boiling water, dried at 100° C. and weighed.

The sum of the percentages of insoluble leaf and of water, subtracted from 100 per cent., gives the percentage of hot water extract.

The percentages of total and water-insoluble ash show whether or not the tea contains an undue amount of sand or mineral make-weights, and the percentages of hot water extract and water-soluble ash indicate whether or not there is any considerable amount of exhausted leaves. The ocular examination with and without the microscope detects any admixture of foreign leaves.

DISCUSSION OF ANALYSES.

The results of the analyses of tea are given in the table on pages 136 and 137.

The average percentages found in these analyses are as follows:

	No. of Analyses.	Water.	Total Ash.	Water-soluble Ash.	Water-insoluble Ash.	Hot water Extract.
Green tea,	26	5.18	7.16	3.61	3.54	37.41
Black "	53	5.94	6.27	3.58	2.69	36.23
Mixed "	10	6.16	6.72	3.72	3.00	34.35

The range in the percentage amount of ash and of extract, as determined by our analyses, is as follows:

	Green Tea.	Black Tea.
Total Ash,	6.13 to 8.39	5.57 to 7.42
Soluble Ash,	2.80 to 4.01	2.87 to 4.75
Insoluble Ash,	2.25 to 5.59	1.94 to 3.82
Extract,	30.82 to 40.08	28.48 to 44.92

From the analyses of tea made elsewhere and the standard adopted in other countries, it would appear that genuine tea should contain not more than 8 per cent. of total ash nor less than 3 per cent. of soluble ash nor less than 30 per cent. of extract.

Of the samples examined at this Station during the past twelve months, four (all of them green teas) contained more than eight per cent. of ash. This may indicate the presence of some adhering dirt or facing, but in no case was the percentage high enough to show that mineral make-weights had been added.

TABLE VII. TEA NOT FOUND ADULTERATED.

Station No.	Brand.	Dealer.	Price per pound.
7784	*Green Tea*, ...	*Bridgeport*. The Carten Tea Co., 529 Main St.,	$0.40
7790	"	E. H. Davis, 60 Courtland St.,	.52
7795	"	C. H. Stevens, 398 E. Main St.,	.26
7778	"	Union Pacific Tea Co., 416 Main St.,	.26
9159	"	*Danbury*. Atlantic & Pacific Tea Co., 163 Main St.,	.28
7773	"	*Derby*. Grand Union Tea Co., 237 Main St.,	.40
7934	"	*Hartford*. Grand Union Tea Co., 249 Main St.,	.36
7951	"	Leroy Bros., 691 Main St.,	.40
7932	"	*Meriden*. Grant's Tea Store, State and Main Sts.,	.30
7930	"	Morton Tea Co., 200 W. Main St.,	.40
9133	"	*Middletown*. A. B. Atkins, South Farms,	.52
9179	"	*Naugatuck*. F. K. Grant, 2 Church St.,	.32
7834	"	*New Haven*. Atlantic & Pac. Tea Co., 386 State St.,	.26
7807	"	Geo. M. Clark, 987 State St.,	.40
7826	"	C. F. Curtiss, 958 State St.,	.36
7918	"	Gilbert & Thompson, 918 Chapel St.,	.80
7912	" Young Hyson, .	" " " "	1.10
7840	"	N. England Tea Co., 35 Congress Av.,	.30
7845	"	R. M. Stevens, 255 " "	.20
7828	" Gunpowder, .	Union Pacific Tea Co., 779 Chapel St.,	.26
7973	"	*New London*. Keefe & Davis, 125 Bank St.,	.26
9120	"	*Putnam*. Chas. W. Bradway, 80 School St.,	.26
9117	"	J. E. Sullivan, 100 Elm St.,	.26
7764	"	*Waterbury*. J. A. Edmundson, 415 S. Main St.,	.40
7748	"	E. J. Upson, 841 N. Main St.,	.40
7968	"	*Willimantic*. H. C. Hall, 17 Union St.,	.32
7765	*Black Tea*, ...	*Ansonia*. G. E. May & Son, High and Maple Sts.,	.28
7768	"	D. M. Welch & Son, 186 Main St.,	.36
7786	"	*Bridgeport*. Centennial Tea Co., 856 Main St.,	.26
7793	"	J. J. Linehan, 139 Myrtle Ave.,	.26
7780	"	N. England Tea Co., 124 Fairf'd Ave.,	.32
9170	"	*Danbury*. W. Chambers, 6 West St.,	.40
9162	"	Union Pacific Tea Co., 253 Main St.,	.28
7771	"	*Derby*. E. J. Malumphy, 40 Elizabeth St.,	.40
7952	"	*Hartford*. Atlantic & Pacific Tea Co., 427 Main St.,	.40
7937	"	Buckley & Reardon, 169 Main St.,	.52
7944	"	Union Pacific Tea Co., 174 Asylum St.,	.40
7928	"	*Meriden*. J. Keating & Co., 285 W. Main St.,	.36
9135	"	*Middletown*. O. H. Cone, 262 Main St.,	.36
9131	"	New England Tea Co., 442 Main St.,	.36
9126	"	W. K. Spencer, 98 Main St.,	.20
9171	"	*Naugatuck*. The Peoples Grocery, Maple and Main Sts.,	.28
7813	" Lipton's,	*New Haven*. Geo. J. Burt, 894 State St.,	.50
7856	"	I. B. Chandler, 101 Dixwell Ave.,	.40
7808	"	A. Duhan, 1134 State St.,	.40
7838	"	U. L. Frank Tea Co., 26 Cong. Ave.,	.30
7919	" Best Eng. Breakfast,	Gilbert & Thompson, 918 Chapel St.,	1.10
7917	" Formosa Oolong, .	" " "	.80
7916	" Oolong, . .	" " "	.50
7915	" Formosa Oolong, .	" " "	1.00

TABLE VII.—CONTINUED. TEA NOT FOUND ADULTERATED.

Station No.	Brand.	Dealer.	Price per pound.
	Black Tea—Continued.		
7914	“ Formosa Oolong,	*New Haven.* Gilbert & Thompson, 918 Chapel St.,	$0.70
7913	“ English Breakfast,	“ “ “	.80
7833	“	Gilson Tea Co., 422 State St.,	.26
7811	“	Geo. Hugo, 1316 State St.,	.36
7848	“	J. C. Kelly, 360 Dixwell Ave.,	.26
7819	“	Kohn Bros., 55 George St.,	.26
7847	“ Cooper, Cooper & Co. India and Ceylon,	Malley, Neely & Co., 922 Chapel St.	.50
7816	“	New Haven Grocery Co., 382 State St.,	.40
7817	“	Russell Bros., 418 State St.,	.20
7842	“	Russian Tea House, 167 Cong. Ave.,	.26
7850	“ Wood's Formosa,	H. A. Smith, 7 Shelton Ave.,	.60
7802	“	Jeremiah Sullivan, 114 Nash St.,	.36
7837	“	Edgar Thomas, 859 Chapel St.,	.30
7979	“	*New London.* J. G. Arnold, 137 Shaw St.,	.40
7983	“	Grand Union Tea Co., 88 State St.,	.40
7981	“	A. M. Stacy, 123 State St.,	.26
7997	“	*Norwich.* J. D. D. Cranston, 176 W. Main St.,	.38
9102	“	Hong Kong Tea Co., 210 Main St.,	.24
7991	“ English Breakfast,	J. B. Murphy, 4 W. Main St.,	.40
7993	“	Stanton & Tyler, 58 Main St.,	.20
9121	“ Formosa Oolong,	*Putnam.* W. H. Mansfield, 47 Elm St.,	.60
9114	“	Union Pacific Tea Co., 79 Water St.,	.32
9139	“	*Stamford.* New York Grocery Co., 208 Main St.,	.26
9149	“	B. Polkin, 60 Pacific St.,	.40
7752	“	*Waterbury.* Dillon's Cash Grocery, 45 E. Main St.,	.26
7760	“ Columbia, Russian,	Waterbury Cheap Grocery, 171 S. Main St.,	.56
7741	“	Waterbury Grocery Co., 165 Bank St.,	.26
7956	“	*Willimantic.* Grand Union Tea Co., 725 Main St.,	.40
7965	“	Perkins & Blish, 66 Church St.,	.36
7769	*Mixed Tea,*	*Ansonia.* Union Pacific Tea Co., 204 Main St.,	.40
9158	“	*Danbury.* W. W. Edwards, 147 Main St.,	.26
7920	“	*Meriden.* Fred H. Lewis, 98 W. Main St.,	.36
7854	“	*New Haven.* Paul L. Baer, 181 Dixwell Ave.,	.30
7814	“	S. S. Adams, Court and State Sts.,	.26
9154	“	*S. Norwalk.* F. D. Lawton & Co., 22 S. Main St.,	.40
9144	“	*Stamford.* New Cash Store, 47 Canal St.,	.28
7759	“	*Waterbury.* W. Dixon & Sanson, 328 Washington Ave.,	.36
7756	“	Jas. F. Phelan, 41 E. Main St.,	.24
7761	“	*Willimantic.* W. A. Royle, 919 Main St.,	.26

A little less than three per cent. of soluble ash was found in two samples, and a little less than thirty per cent. of extract in four samples, but no one sample was deficient in both soluble ash and extract, and there is, therefore, no clear evidence of the presence of exhausted leaves.

Probably thirty per cent. of extract is too high a standard for all teas, especially as Battershall* states that low grade, but pure, Congou tea may contain as little as twenty-five per cent. Furthermore, some allowance should be made for the method of determination employed—whether the ground or unground leaf is extracted, or whether the extract is weighed or obtained by difference, etc.

In only one sample, No. 9139, were foreign leaves detected, and in that sample the quantity was small and probably due to accident.

The chemical analyses of all the samples gave no evidence of the presence of either mineral make-weights or exhausted leaves.

Nearly all, if not all, the green teas were "faced," but this is not prohibited by the United States law to which reference has been made.

It appears that none of the samples examined has been found adulterated otherwise than by facing. This is especially gratifying when it is considered that the teas examined were, for the most, part, of the cheapest grades.

In 1887, Spencer,† after examining sixty-three samples purchased in Washington, D. C., arrived at the conclusion "that there are few, if any, spurious teas on the market." He further states: "With the strict enforcement of the United States adulteration act the consumer is reasonably well protected so far as securing the genuine leaf is concerned, but, of course, has no protection from the sale of inferior teas."

Now that the law of 1897 is in force, the public has a right to expect that not only the adulterated but also the very inferior teas will be kept out of the country.

* Food Adulteration and Its Detection, p. 25.
† U. S. Dept. Agr. Div. Chem., Bull. 13, p. 898.

TABLE VIII.—ANALYSES OF TEA.

Station No.	Brand.	Water.	Ash. Total.	Ash. Soluble in water.	Ash. Insoluble in water.	Hot water extract.
7784	*Green Tea*,	4.81	8.11	3.67	4.47	36.71
7790	"	4.13	7.20	3.62	3.58	39.47
7795	"	6.25	7.66	3.62	4.04	35.32
7778	"	4.94	8.18	3.03	5.15	31.72
9159	"	5.46	6.56	3.56	3.00	38.81
7773	"	5.89	6.72	3.53	3.19	36.55
7934	"	5.46	7.23	3.45	3.78	38.81
7951	"	5.37	6.98	3.75	3.23	39.06
7932	"	4.06	7.62	3.56	4.06	40.00
7930	"	4.21	7.38	3.62	3.76	38.48
9133	"	3.92	6.78	3.63	3.15	39.54
9179	"	5.62	7.09	3.42	2.67	36.34
7834	"	4.99	6.76	3.83	2.93	39.45
7807	"	4.40	6.96	3.76	3.20	37.89
7826	"	4.90	6.77	3.69	3.08	40.08
7918	"	5.80	6.13	3.53	2.60	39.67
7912	"	5.77	6.24	3.99	2.25	39.30
7840	"	3.89	6.96	3.77	3.19	39.34
7845	"	6.24	7.08	3.74	3.34	36.76
7828	"	5.87	8.39	2.80	5.59	30.82
7973	"	6.18	6.19	3.48	2.71	32.83
9120	"	6.82	7.72	3.36	4.36	35.60
9117	"	4.97	7.31	3.48	3.83	35.31
7764	"	4.23	6.97	3.61	3.36	39.65
7748	"	6.00	8.06	4.01	4.05	35.96
7968	"	4.42	7.20	3.79	3.41	39.23
7765	*Black Tea*,	5.86	6.30	3.59	2.71	34.96
7768	"	4.89	6.32	3.71	2.61	36.05
7786	"	5.64	6.27	3.47	2.80	38.54
7793	"	6.59	5.95	3.50	2.45	41.43
7780	"	6.55	6.77	3.17	3.60	34.47
7771	"	5.57	6.23	3.33	2.90	28.48
9170	"	5.85	6.62	3.53	3.09	36.54
9162	"	6.52	7.42	3.60	3.82	29.90
7952	"	5.32	6.17	3.52	2.65	36.69
7937	"	5.31	6.18	3.66	2.52	37.79
7944	"	6.23	6.35	3.87	2.48	39.11
7928	"	5.48	6.71	3.70	3.01	37.42
9135	"	6.01	6.42	3.51	2.91	36.04
9131	"	6.02	6.12	3.46	2.66	35.96
9126	"	5.89	5.99	3.04	2.95	35.49
9171	"	5.64	6.06	3.49	2.57	40.76
7813	"	6.93	5.68	3.58	2.10	36.62
7856	"	5.74	5.88	3.56	2.32	41.23
7808	"	6.07	6.27	3.53	2.74	38.34
7838	"	5.85	6.86	3.76	3.10	33.21
7919	"	6.85	5.79	3.85	1.94	33.75
7917	"	5.95	6.42	3.64	2.78	37.05

TABLE VIII.—ANALYSES OF TEA.—*Continued.*

Station No.	Brand.	Water.	Ash. Total.	Ash. Soluble in water.	Ash. Insoluble in water.	Hot water extract.
7916	*Black Tea—Continued*,	5.41	6.39	3.62	2.77	40.34
7915	"	5.80	5.83	3.48	2.35	42.68
7914	"	5.81	6.14	3.62	2.52	41.17
7913	"	6.92	6.05	3.90	2.15	32.54
7833	"	6.01	5.99	3.36	2.63	33.49
7811	"	6.12	5.75	3.23	2.52	38.94
7848	"	6.32	6.15	3.41	2.74	34.99
7819	"	6.60	6.39	3.75	2.64	31.24
7847	"	6.13	5.63	3.55	2.08	38.10
7816	"	5.18	6.89	3.94	2.95	44.92
7817	"	5.33	6.23	3.10	3.13	35.19
7842	"	6.57	6.63	3.83	2.80	29.43
7850	"	5.52	6.14	3.69	2.45	38.18
7802	"	5.66	6.16	3.55	2.61	39.50
7837	"	6.09	6.14	3.35	2.79	33.39
7979	"	6.40	5.92	3.93	1.99	32.13
7983	"	5.12	7.33	4.75	2.58	34.89
7981	"	6.27	6.61	3.51	3.10	37.32
7997	"	5.51	5.98	3.69	2.29	38.82
9102	"	6.10	6.22	3.03	3.19	34.00
7991	"	6.29	5.67	3.68	1.99	38.82
7993	"	6.01	6.25	3.70	2.55	39.09
9121	"	5.33	5.87	3.62	2.25	39.96
9114	"	6.00	5.99	2.87	3.12	32.92
9139	"	6.06	6.39	3.14	3.25	34.61
9149	"	7.14	6.56	3.73	2.83	31.10
7752	"	5.62	6.83	3.91	2.92	33.40
7760	"	6.51	5.57	3.26	2.31	29.66
7741	"	4.73	6.77	3.43	3.34	36.62
7956	"	5.18	6.32	3.89	2.43	36.66
7965	"	6.54	7.09	4.53	2.56	36.48
7769	*Mixed Tea (Green and Black)*,	5.75	6.66	3.66	3.00	33.98
9158	"	6.14	6.45	3.29	3.16	33.31
7920	"	6.40	6.00	3.62	2.38	35.86
7854	"	5.96	6.65	3.43	3.22	37.18
7814	"	6.45	5.90	3.49	2.41	36.02
9154	"	6.13	6.56	3.48	3.08	36.07
9144	"	6.38	7.15	4.37	2.78	31.23
7759	"	5.81	7.55	4.42	3.13	36.27
7756	"	5.77	6.96	3.63	3.33	31.94
7961	"	6.78	7.31	3.78	3.53	31.67

COFFEE, COFFEE COMPOUNDS, AND COFFEE SUBSTITUTES.

By A. L. Winton.

Seventy-three samples were examined, as follows:

		Unground.	Ground.	Total.
Coffee,	Not found adulterated,	21	13	34
	Adulterated,	2	9	11
Coffee compounds,		2	20	22
Coffee substitutes,		0	6	6
				73

Coffee.

Descriptions of the samples not found adulterated are given in Table IX and of the adulterated samples in Table X. The proportion of samples found adulterated to the whole number examined during the present year has been much less than during the two preceding years, as shown by the following figures:

Percentage of Samples Found Adulterated.

	Unground.	Ground.	Total.
1896,	25.0	89.2	63.3
1897,	7.7	86.6	57.7
1898,	8.7	40.9	24.4

This improvement is believed to be due to the operation of the pure food law. Mixtures of coffee with peas, chicory, and other materials are still on the market, but they are now sold more generally under distinctive names in labeled packages.

In quoting the statements found on the packages we must not be understood as thereby, in any instance, vouching for their truth.

Table IX.—Coffee not Found Adulterated.

Station No.	Brand.	Dealer.	Price per ½ pound, cts.
	Unground Coffee.		
9160	Sold in bulk,	*Danbury.* Atlantic & Pac. Tea Co., 163 Main St.,	10
9169	" "	W. Chambers, 6 White St.,	13
9161	" "	Union Pacific Tea Co., 253 Main St.,	9
7946	Mocha & Java Coffee, American Mills, New York,	*Hartford.* J. C. & Co., 558 Asylum St.,	25*
7935	Sold in bulk,	Grand Union Tea Co, 249 Main St.,	12
7799	" "	*Meriden.* Centennial Tea Co., 41 E. Main St.,	13
7925	" "	Russell Bros., 2 Colony St..	13
7927	" "	Pierce & Hupfer, 111 Britannia St.,	13
9136	" "	*Middletown.* O. H. Cone, 262 Main St.,	13
9130	" "	New Eng. Tea Co., 442 Main St.,	13
9127	" "	W. K. Spencer, 98 Main St.,	10
9174	" "	*Naugatuck.* Charlie Ark & Co., Maple St.,	14
7832	Old Government Java & Mocha 400 Coffee, Isaac Newton, New York,	*New Haven.* Gilson Tea Co, 405 State St.,	35*
7985	Sold in bulk,	*New London.* H. Levin, 38 Bradley St.,	10
7982	" "	A. M. Stacy, 123 State St.,	10
7996	" "	*Norwich.* W. A. Church, 18 Market St.,	13
9116	" "	*Putnam.* George Farley, 20 Providence St.,	18
9112	" "	Union Pacific Tea Co., 79 Water St.,	11
9138	Fifth Ave. Mocha & Java, O'Donohue Coffee Co., New York,	*Stamford.* H. S. Daskam, 59 Atlantic St.,	35*
9140	Sold in bulk,	New York Grocery Co., 208 Main St.,	13
9150	" "	B. Polkin, 60 Pacific St.,	13
	Ground Coffee.		
7785	Sold in bulk,	*Bridgeport.* Centennial Tea Co., 856 Main St.,	10
7777	" "	Union Pacific Tea Co., 416 Main St.,	8
7947	Flag Brand Mocha & Java, W. H. Raymond Grocery Co., Boston,	*Hartford.* George F. Kellogg, 123 Ann St.,	35*
7986	Crown Royal Mocha & Java, G. W. Whitford, Providence,	*New London.* T. W. Potter, 72 State St.,	35*
9107	Red Label Java & Mocha, Winslow, Rand & Watson, Boston,	*Norwich.* A. T. Otis, 261 Main St.,	35*
7815	Sold in bulk,	*New Haven.* S. S. Adams, 412 State St.,	8
7827	" "	C. F. Curtis, 958 State St.,	13
7839	" "	Unite L. Frank Tea Co., 26 Congress Ave.,	9
7852	" "	C. Kipp, 290 Dixwell Ave.,	13
7843	" "	Russian Tea House, 167 Congress Ave.,	8
7801	Rex Mocha & Java, Lincoln, Seyms & Co., Hartford,	J. Sullivan, 114 Nash St.,	30*
7836	Sold in bulk,	Thomas, 859 Chapel St.,	14
7824	" "	R. Zeidler, 768 Grand Ave.,	13

* Per pound package.

TABLE X.—ADULTERATED COFFEE.

Station No.	DEALER.	Price per ½ pound, cts.	ADULTERANTS.
	Unground Coffee.		
9145	*Stamford.* New Cash Store, 47 Canal St.,	11	29% imitation coffee,[1] 26% peas, 9% chicory.
9142	W. W. Waterbury, 207 Main St.,	11	24% imitation coffee,[1] 26% peas, 6% chicory.
	Ground Coffee.		
7779	*Bridgeport.* New England Tea Co., 124 Fairfield Ave.,	13	Peas, chicory, and wheat or rye.
7821	*New Haven.* Kohn Bros., 55 George St.,	13	Chicory, and wheat or rye.
7841	New England Tea Co., 35 Congress Ave.,	13	Peas, chicory.
7829	Union Pacific Tea Co., 779 Chapel St.,	13	Chicory, and wheat or rye.
7974	*New London.* J. E. St. John, 265 Bank St.,	13	Hulled peas, chicory.
7751	*Waterbury.* C. A. Bailey, 834 N. Main St.,	13	Peas, chicory.
7746	H. W. Foote, 447 W. Main St.,	10	Peas, chicory.
7744	New York & China Tea Co., 181 So. Main St.,	13	Chicory, pea-hull pellets.[2]
7755	J. F. Phelan, 41 E. Main St.,	13	Chicory, pea-hull pellets[2]

[1] Brown lumps made from wheat middlings to resemble coarsely crushed roasted coffee.
[2] Made of pea hulls and middlings, resembling roasted coffee.

COFFEE COMPOUNDS.

The pure food law provides that a food product shall not be deemed adulterated "in the case of articles labeled, branded, or tagged so as plainly or correctly to show that they are mixtures, compounds, combinations, or blends." It thus appears that a mixture of coffee with other materials, which if sold under the name of coffee would be regarded as adulterated, is a legitimate article of trade when sold in a package bearing a *correct* statement of its character. In labeling such packages, however, various subterfuges are resorted to for the purpose of deceiving the purchaser.

The word "compound" or a statement of composition may appear on the label, but in such small letters or in such an obscure position as to easily escape the notice of the purchaser, or the wording may be such as to convey the impression that the preparation is a compound of coffees rather than of coffee with other materials.

Plates I and II show photographic reproductions of three labels which illustrate these statements.

Some of the preparations described in the following paragraphs were properly labeled, but several instances of deception, if not of violation of the law, may be noted.*

The seven samples named below, representing four brands, contained

Coffee, Peas, and Chicory:

7772, 9123, and 7957. These three samples were purchased at stores of the Grand Union Tea Co., in Derby, Middletown, and Willimantic. In each case the bag was marked at the time of purchase with the words "Royal Compound." The price paid was 13 cents per half pound.

9173. "Boardman & Son's Compound Prime Old Java Coffee, 304 Asylum St., Hartford." "Compound" was in much smaller letters than the rest of the label. Bought of The People's Grocery, Naugatuck. Price, 25 cents per pound package. (See plate I.)

7809. "Imperial Compound Java and Mocha Coffee. Is made from coffees selected especially for their strength, flavor, and superior drinking qualities. Capitol Mills, Hartford, Conn." Bought of Aug. Reisinger, 1267 State St., New Haven. Price, 25 cents per pound can.

7823. "Welcome Coffee Compound. Bryan, Miner & Read, New Haven." Bought of D. M. Welch & Son, 28 Congress Ave., New Haven. Price, 25 cents per pound package; bar of soap given away with the package.

7750. "Good Luck Coffee. O. H. Blanchard, Hartford, Conn. This coffee is compounded from the very best stock, and is as wholesome as the bread we eat. It is double the strength of pure, imported goods, and will make more cups of rich, delicious drink than any other coffees." Bought of E. J. Upson, 841 Main St., Waterbury. Price, 25 cents per pound package; with glass tumbler.

The following sample contained

Coffee, Peas, Chicory, and Wheat or Rye:

7954. "Compound" [stamped on bag]. Bought of J. H. McGuire, 16 Church St., Hartford. Price, 13 cents per half pound.

* For description of other brands, see Rep. 1896, p. 57.

The two following samples were mixtures of

*Coffee, Peas, Chicory, and Imitation Coffee :**

9181. "Red D Prepared Coffee, John C. Turnbull, New York. Red D Prepared Coffee is crushed and packed immediately after roasting, thus preserving the full aroma and flavor, making a rich cup of coffee." Bought of W. F. Brennan, Naugatuck. Price, 25 cents per pound package. Cup and saucer given away with each pound.

7818. "Combination" [stamped on bag]. Bought of Russell Bros., 418 State St., New Haven. Price, 10 cents per half pound.

The following were mixtures of

*Coffee, Peas, Chicory, and Imitation Coffee :**

9180. "Old Reliable Coffee. The Nutmeg Coffee and Spice Mills, Hartford. A compound of delicious drinking coffees and guaranteed to please those who like a full, heavy-bodied cup of Coffee." Bought of W. J. Kelly, Naugatuck. Price, 25 cents perpound can. (See plate I.)

7994. "Stanton's Vegetable Compound Coffee. Stanton & Tyler, Norwich. We do not claim for this wholly the title of coffee, but a compound prepared from fresh, sweet, and nutritious cereals and pure Santos coffee, which is very rich and aromatic." Bought of Stanton & Tyler, Norwich. Price, 20 cents per pound package.

The following brand was composed of

Coffee, Chicory, and Pellets:†

7835. "The Great Atlantic & Pacific Tea Co.'s Granulated 8 o'Clock Breakfast Coffee Mixture. 45% choicest coffee, 30% choicest English chicory, 25% cereals." Bought at their store, 386 State St., New Haven. Price, 13 cents per half pound.

The following brand contained

Coffee, Peas, Chicory, and Pellets :†

7962. "Crown Jewel Java Coffee. Packed by Grand Central Tea Importing Co., New York. Made of pure coffee and cereals." Bought of W. A. Royle, 919 Main St., Willimantic. Price, 22 cents per pound package. (See plate II.)

* Brown lumps, made from wheat middlings to resemble coarsely crushed roasted coffee.
† Made from pea-hulls and middlings.

PLATE II. LABEL ON PACKAGE OF A COFFEE COMPOUND.

PLATE I. LABELS ON PACKAGES OF COFFEE COMPOUNDS.

The two brands named below are coffees of low grade, roasted and unground, containing a very little sugar:

7831. "Arbuckle's Ariosa Coffee. New York and Pittsburg. Ariosa is a compound made from coffee, sugar, and eggs. The coffees are selected especially for their strength, flavor, and superior drinking qualities, are pure, sound coffees, and absolutely free from all the poisonous coloring substances which are now so largely used to improve the appearance of coffee. Coffee when roasted is porous, and, unless prevented, loses its best qualities and absorbs others that are injurious to it. By our process of *hermetically sealing* the pores of roasted coffee, we secure a three-fold object: 1st, the retention of the full strength and aroma for any length of time; 2d, the prevention through absorption of any injurious flavors; 3d, the saving to the consumer of the additional expense of eggs incurred when any other coffee is used. ARIOSA is self-settling. Choicest eggs and pure granulated sugar are the only articles used in HERMETICALLY SEALING ARBUCKLE'S ARIOSA COFFEE. Formula: Coffee, .99278; eggs, .00361; sugar, .00361." Bought of Coe & Jenks, 422 State St., New Haven. Price, 15 cents per pound package.

7804. "Lion Fancy Roasted Coffee, Woolson Spice Co., Toledo, Ohio. This package contains only the genuine coffee berry. It is sealed with pure reclarified sugar for the purpose of preserving its strength and purity." Bought of Philip Hugo, 28 Edwards St., New Haven. Price, 15 cents per pound package.

COFFEE SUBSTITUTES.

Various preparations of wheat, rye, barley, peas, etc., containing no real coffee, are sold under special names for those who for any reason prefer them to genuine coffee.

Four such coffee substitutes were examined in 1896, and are described in the report for that year, page 61. The following additional brands were purchased during the month of Oct., 1897:

Two of these consisted of

Whole Barley Kernels, roasted.

7782. "Fischer Mills Fresh Roasted Malt Coffee. B. Fischer & Co., N. Y." Bought of I. P. Prescott, Water and State Sts., Bridgeport. Price, 15 cents per package.

7887. "Kneipp Malt Coffee. Kneipp Malt Food Co., New York and Chicago." Bought at Food Exposition, New Haven, Oct., 1897. Price, 15 cents per package.

The following two samples were prepared from

Roasted Cereals.

7844. "Grain–O. A table beverage which the children may drink without injury as well as the adult. Prepared by the Genesee Pure Food Co., LeRoy, N. Y." Bought of R. M. Stevens, 255 Congress Ave., New Haven. Price, 15 cents per package.

7846. "Postum Cereal, A Toothsome, Healthful Beverage. Postum Cereal Co., Lim. Battle Creek, Mich." Bought of H. M. Tower, 379 Congress Ave., New Haven. Price, 25 cents per package.

The following sample consisted of small brown lumps made from

Pea Hulls with a Paste of Wheat Flour or Middlings.

7933. "Wheat Coffee." Bought of Grant's Tea Store, State and Main Sts., Meriden. Price, 10 cents per pound.

One sample consisted of

Roasted and partially Ground Wheat.

7886. "Old Grist Mill Entire Wheat Coffee. Potter & Wrightington, Agents, Boston." Bought at Food Exposition New Haven, Oct., 1897. Price, 20 cents per package.

(The Old Grist Mill Entire Wheat Coffee examined in 1896 contained not only wheat but also peas and real coffee. See Report, 1896, p. 60.)

GINGER.

By A. L. Winton and W. L. Mitchell.

Ginger is the root or more correctly speaking, the underground stem of a perennial herbaceous plant, *Zingiber officinale*, Rosc., which is cultivated in India, its native country, and also in Jamaica, Cochin China, Africa, and Australia.

Ginger root is used in a "recent" or undried state for the preparation of preserves and confectionery, but most of it is dried in the countries where it is produced and shipped in this form.

Jamaica ginger, which is considered the finest on the market, is scraped before drying to remove the outer coatings, and frequently it is "bleached" or coated with chalk as a protection against the drug-store beetle and other destructive insects. In other countries the root is usually dried without removing the epidermis, although occasionally it is scraped, bleached, or otherwise prepared in imitation of the higher priced Jamaica variety.

At the time when the samples described in this chapter were purchased (Oct., 1897), the following wholesale prices were quoted:

Jamaica, bleached, 19 cents per pound.
Jamaica, scraped, 18 cents per pound.
Cochin, 5¼ to 7¼ cents per pound.
African, 4½ cents per pound.
Calcutta, 4 cents per pound.

The unground ginger imported into the United States for the year ending July 30, 1896, amounted to 4,827,703 pounds, and was valued by the custom house officials at 5 cents per pound, making a total wholesale value of $226,251.56.

Adulteration of Ginger.—Rice middlings, wheat flour, corn meal, mustard husks, turmeric, sawdust, gypsum, and chalk are frequently mixed with ground ginger. Exhausted ginger, the dried residues from the ginger ale and extract factories, is extensively used as an adulterant in England and to some extent in this country.

Examination of Samples.

Ninety-one samples purchased by agents of the station have been examined by the methods described on page 186, and may be grouped as follows:

	In labeled packages.	In bulk.	Total.
Not found adulterated,	19	48	67
Adulterated,	4	20	24
Total,	23	68	91
Per cent. of samples adulterated,	17.4	29.4	26.4

In Table XI are given the names and addresses of the dealers from whom the samples not found adulterated were purchased, the prices paid, and also, in the case of samples bought in labeled packages, the names of the brands and of the manufacturers. The adulterated samples are described in like manner in Table XII, and in addition the foreign materials detected in each case are given.

The chemical analyses of the samples will be found in Table XIV.

The adulterant most commonly found in the ground ginger bought in Connecticut was rice middlings, a by-product consisting of the inner seed-coats of the grain with more or less starchy matter. It was present in 20 out of 24 adulterated samples, and in 16 of these it was the only adulterant detected.

Three samples contained gypsum: No. 9235, 19.47 per cent.; No. 7980, 8.35 per cent.; and No. 7747, 8.35 per cent. The other foreign materials detected were wheat middlings, sawdust, corn meal, mustard husks, and turmeric. Samples Nos. 7740 and 7960 contained turmeric, but were believed to be otherwise pure.

Although all the samples were examined by the best approved methods for the detection of exhausted ginger, there was no evidence in any case that this adulterant was present.

TABLE XI. GINGER NOT FOUND ADULTERATED.

Station No.	Brand.	Dealer.	Price per ¼ pound, cents.
7766	Sold in bulk, ...	*Ansonia.* G. E. May & Son, High and Maple Sts.,	8
9414	Pure ginger. Stickney & Poor,	D. M. Welch & Son, Main St.,	10
7788	Sold in bulk, ...	*Bridgeport.* China & Japan Tea Co., 820 Main St.,	10
7789	Slade's Absolutely Pure Ginger. D. & L. Slade Co., Boston, .	E. H. Davis, 60 Courtland St.,	10
7775	Genuine Borneo Ginger. Bennett, Simpson & Co., London,	Lee & Ketcham, 20 Fairfield Ave.,	10
7776	Sold in bulk, ...	Union Pacific Tea Co., 416 Main St.,	7
7796	" "	C. H. Stevens, 398 E. Main St.,	8
9168	" "	*Danbury.* W. C. Chambers, 6 West St.,	10
9165	" "	McGraw & Baldwin, 93 White St.,	8
7774	" "	*Derby.* J. McEnerney, 75 Elizabeth St.,	8
7486	" "	*Hartford.* Allen Bros., 132 Main St.,	10
7936	" "	Buckley & Reardon, 169 Main St.,	7
7494	" "	Cady & Lombard, 69 Albany Ave.,	10
7492	" "	Empire Cash Grocery, 94 Albany Ave.,	8
7941	Red Shield Ginger. Jas. G. Powers & Co., N. Y., . .	Joseph Hagerty, 75 Front St.,	10
9410	Pure Jamaica Ginger. Hills & Co., ...	Hills & Co., 368 Asylum St.,	10
7499	Sold in bulk, ...	E. M. Palmer, 124 Albany Ave.,	10
7489	" "	Chas. A. Post, 709 Main St.,	10
7472	" "	C. H. Russell, 383 Main St.,	5
7479	" "	A. H. Tillinghast, 91 Main St.,	10
7943	Pure Ginger. Union Spice Co.,	Union Pacific Tea Co., 174 Asylum St.,	10
7800	Blue Ribbon Pure African Ginger. Austin Nichols & Co., N. Y.,	*Meriden.* H. E. Bushnell, 79 W. Main St.,	10
7931	Sold in bulk, ...	Grant's Tea Store, State and Main Sts.,	5
7929	" "	Morton Tea Co., 200 W. Main St.,	10
7926	" "	Pierce & Hupfer, 111 Britannia St.,	10
9134	Pure Ginger. E. J. Gillies & Co, N Y., ...	*Middletown.* O. H. Cone, 262 Main St.,	10
9122	Sold in bulk, ...	Grand Union Tea Co., 272 Main St.,	10
9129	" "	N. England Tea Co., 442 Main St.,	10
9124	" "	J. B. Patterson, 110 Main St.,	7
9178	" "	*Naugatuck.* F. K. Grant, 2 Church St.,	8
9177	Pure Ginger, Capital Mills. Lincoln, Seyms & Co., Hartford,	The Grant Grocery Co., Maple St.,	10
9172	Sold in bulk, ...	The People's Grocery, Main and Maple Sts.,	10
7972	" "	*New London.* Keefe & Davis, 125 Bank St.,	8
7988	" "	Kellogg & Avery, 27 Truman St.,	7
7978	Ginger. Wm. Boardman & Son, Hartford, ...	Albert Peck, Howard St.,	10
7976	Sold in bulk, ...	Thomas & Gumble, 437 Bank St.,	10
9230	Pure Ginger. Equitable Mills. F. R. Farrington & Co., N. Y. and Boston, . . .	*New Haven.* S. S. Adams, 412 State St.,	5
7737	Sold in bulk, ...	Daniel Dore, 579 Grand Ave.,	5
7738	" "	Mrs. Foley & Co., 763 Grand Ave.,	9
7739	" "	N. A. Fullerton, 926 Chapel St.,	10

TABLE XI. GINGER NOT FOUND ADULTERATED. — CONTINUED.

Station No.	Brand.		Dealer.	Price per ¼ pound, cents.
7730	Pure African Ginger. Howard & Co., N. Y.,	*New Haven.*	Mrs. M. L. Gerner, 860 State St.,	10
7729	Sold in bulk,		" " "	10
7728	Absolutely Pure Ginger. The F. C. Bushnell Co, N. Haven,		Gibbons Bros., 824 State St.,	10
7632	Sold in bulk,		L. Goldbaum, 177 Congress Ave.,	8
7736	" "		N. Haven Prov. Co., 398 Grand Ave.,	8
7461	" "		A. B. Stevens, 61 Broadway,	10
7733	" "		L. C. Strickland, 99 Grand Ave.,	10
7725	Pure Ginger. Crescent Mills, J. P. Auger, New Haven,		Wm. Tansey, 29 Williams St.,	10
7447	Sold in bulk,		H. M. Tower, 379 Congress Ave.,	7
7726	" "		W. E. Waterbury, 774 State St.,	5
7734	Absolutely Pure Ginger. D. M. Welch & Son,		D. M. Welch & Son, 8 Grand Ave.,	8
7454	Sold in bulk,		" " 28 Congress Ave.,	5
7995	" "	*Norwich.*	W. A. Church, 18 Market St.,	10
7990	" "		J. P. Murphy, 4 W. Main St.,	10
9119	" "	*Putnam.*	C. W. Bradway, 80 School St.,	8
9111	Pure Ginger. A. C. Stetson,		A. C. Stetson, Water St.,	10
9113	Sold in bulk,		Union Pacific Tea Co., 79 Water St.,	8
9137	" "	*Stamford.*	H. S. Daskam, 59 Atlantic St.,	8
9156	" "	*S. Norwalk.*	G. E. Friedrick, 20 Railroad Sq.,	8
9153	" "		F. D. Lawton & Co., 22 S. Main St.,	8
9152	" "		C. E. Seymour, 33 Washington St.,	10
7754	" "	*Waterbury.*	Dillon's Cash Store, 45 E. Main St.,	10
7763	Ginger. Helmet XXX Brand. E. R. Durkee & Co., N. Y.,		J. A. Edmundson, 415 S. Main St.,	10
7757	Sold in bulk,		T. P. Kelley, 38 S. Riverside St.,	10
7966	" "	*Willimantic.*	H. C. Hall, 17 Union St.,	10
7969	Pure Ginger. The E. S. Kibbe Co., Hartford,		H. Levins, 493 Main St.,	10
9409	Pure African Ginger. Bugbee & Brownell, Providence,		Burt Thompson, Main St.,	10

TABLE XII. ADULTERATED GINGER.

Station No.	Brand.	Dealer.	Price per ¼ pound, cents.	Adulterated.
		Ansonia:		
7767	Sold in bulk,	D. M. Welch & Son, 186 Main St.,	8	Rice middl'gs, corn meal, turmeric.
		Bridgeport:		
7792	" "	Peoples Groc. & Prov. Co., 124 Rail'd Av.,	5	Rice middlings, turmeric.
7781	" "	I. P. Prescott, Water and State Sts.,	9	Rice middlings.
9033	Pure Ginger. Wm. A. Leggett & Co., N. Y.,	E. L. Sullivan, 436 E. Main St.,	8	Rice middlings, turmeric.
		Danbury:		
9157	Sold in bulk,	W. W. Edwards, 147 Main St.,	8	Rice middlings.
		Hartford:		
9235	" "	Barrows & Thalheimer, 525 Main St.,	10	Sawdust, wheat midd'ngs, turmeric, 19.47% gypsum.*
7953	" "	J. H. McGuire, Standard House, 16 Church St.,	10	Rice middlings, turmeric.
7939	" "	M. J. Warren, Sheldon and Front Sts.,	10	Rice middlings, turmeric.
		Meriden:		
7798	" "	Centennial Tea Co., 41 E. Main St.,	8	Rice middlings.
		New Haven:		
7732	" "	C. F. Curtiss, 973 State St.,	10	Rice middlings.
7735	" "	W. S. Graves, 341 Grand Ave.,	10	Rice middlings, mustard husks, turmeric.
7633	" "	P. R. Lyons, 413 Congress Ave.,	8	Rice middlings, turmeric.
7465	" "	John T. Pohlman, 140 Dixwell Ave.,	8	Rice middlings.
		New London:		
7984	" "	H. Levin, 38 Bradley St.,	5	Rice middlings.
7980	Pure Ginger. E. P. Hornick, N. Y.,	A. M. Stacy, 123 State St.,	10	8.35 per cent. gypsum.*
		Norwich:		
7998	Ginger. The Challenge Mills, N. Y.,	E. F. Burlingame, 128 W. Main St.,	10	Rice middlings, turmeric.
9104	Sold in bulk,	A. B. Peckham, 147 Franklin St.,	8	Rice middlings.
		Putnam:		
9115	" "	Geo. Farley, 20 Providence St.,	10	Rice middlings.
		Stamford:		
9143	" "	New Cash Store, 47 Canal St.,	5	Rice middlings, turmeric.
9148	" "	B. Polkin, 60 Pacific St.,	6	Wheat, rice middlings.
9147	Ginger. Square Deal Pure Spices,	I. N. Waterbury, 142 Pacific St.,	7	Rice middlings.
		Waterbury:		
7747	Sold in bulk,	Kinney & Balfe, 674 N. Main St.,	10	Rice middlings, 8.35 per cent. of gypsum.*
7740	" "	Waterbury Grocery Co., 165 Bank St.,	10	Turmeric.
		Willimantic:		
7960	" "	W. A. Royle, 919 Main St.,	8	Turmeric.

* $CaSO_4 + 2H_2O$ calculated from CaO.

Discussion of the Analyses.

The following maxima and minima results show the range in composition of samples of pure ginger-root and also of pure and adulterated ground ginger found in the market The analyses of two samples of exhausted ginger are given with these for comparison.

Table XIII.—Analyses of Ginger, Pure and Adulterated. Range of Composition.

		Ash.				Ether extract.			
		Total.	Soluble in water.	Insoluble in HCl.	Lime.	Volatile.	Non-volatile.	Alcohol extract.	Cold water extract.
Whole Ginger, 13 samples, not coated with chalk.*	Max.	7.55	4.09	2.29	0.71	3.09	5.42	6.58	17.55
	Min.	3.61	2.17	0.05	0.20	1.61	3.37	4.36	12.04
Whole Ginger, 5 samples, coated with chalk.*	Max.	9.35	2.95	1.28	3.53	1.49	4.02	5.37	16.10
	Min.	4.34	1.73	0.02	1.07	0.96	2.82	3.63	10.92
Ground Ginger, 67 samples, not found adulterated.	Max.	9.80	4.10	4.30	0.62	2.37	5.99	7.27	15.72
	Min.	4.32	2.30	....	....	0.70	3.02	3.29	11.30
Ground Ginger, 24 samples, adulterated.	Max.	19.26	6.25	3.55	6.34	1.83	8.49	9.88	19.13
	Min.	3.77	1.56	....	....	0.26	1.27	3.50	11.06
Exhausted Ginger, No. 9727.*		2.12	0.59	0.18	....	1.61	3.86	4.88	6.15
Exhausted Ginger, No. 9368.*		5.05	3.55	1.50	....	0.13	0.54	1.52	16.42

Young† found in 7 samples of pure ginger from 3.40 to 8 00 per cent. of ash and Richardson,‡ in 6 samples, 3.39 to 7.02 per cent. In the analyses of 104 samples, as collated by Allen, the maximum percentage of ash was 10.65.

The Bavarian chemists consider as adulterated all ginger containing over 8 per cent. of ash and 3 per cent. of sand. In the *Codex alimentarius austriacus* it is stated that genuine ginger should not have more than 8 per cent. or less than 1.5 per cent. of ash.

High percentages of ash usually indicate the presence of either sand or of a lime salt. Sand (ash insoluble in HCl) is usually an accidental impurity; sulphate of lime, except when present in small amounts, must, however, be regarded as an adulterant.

"Limed" ginger has been found to contain 1.0 to 3 5 per cent. of lime as carbonate.

Eleven of the samples of ground ginger, containing from 8 to 9.80 per cent. of ash and from 2.50 to 4.30 per cent. of sand, although inexcusably dirty, are classed with those not found adulterated. Samples Nos. 9235, 7980, and 7747 contain not only high percentages of ash, but from 2.72 to 5.55 per cent. of lime as sulphate, and they are without doubt adulterated.

* See page 192.

† Analyst, *9*, 214.

‡ U. S. Dept. Agr. Div. Chem., Bull., *10*, 216.

Table XIV. Analyses of Ground Ginger from the Conn. Market.

Station No.		Moisture.	Ash.			Lime (CaO.)	Ether extract.		Alcohol extract.	Cold water extract.
			Total.	Soluble in water.	Insoluble in HCl.		Volatile.	Non-volatile.		
7766	Not found Adulterated.	9.40	7.25	2.82			1.18	3.58	4.83	13.99
9414		9.86	9.17	4.00	3.25	0.32	1.57	3.81	4.87	13.64
7788		9.40	5.89	2.86			1.84	4.53	6.00	13.04
7789		9.54	7.09	3.21			2.01	3.63	5.32	12.78
7775		10.60	4.37	2.56			1.09	4.07	4.91	13.82
7776		8.90	8.00	3.48	2.55	0.60	1.83	3.97	5.49	12.10
7796		9.36	6.50	3.10			1.92	4.15	5.30	12.51
9168		9.58	7.47	3.08			1.24	3.82	5.16	12.81
9165		9.35	4.88	2.52			1.15	3.54	4.99	13.55
7774		9.59	7.17	2.96			0.93	3.60	4.80	11.70
7486		9.11	5.65	3.31			1.52	4.25	5.27	12.60
7936		8.63	7.68	3.06			1.63	4.41	5.17	13.83
7494		9.47	8.25	3.36	2.50	0.46	0.98	3.81	4.96	13.17
7492		8.83	4.89	2.83			1.87	5.62	6.72	13.75
7941		7.79	7.58	3.25			1.88	4.37	5.24	13.50
9410		8.77	4.32	2.84			1.73	5.06	5.28	15.72
7499		9.44	6.05	2.79			1.40	4.44	5.64	11.76
7489		8.45	5.11	2.85			2.06	5.99	7.17	11.30
7472		8.55	5.16	2.92			1.12	3.89	5.68	12.13
7479		8.30	7.95	3.26			1.26	3.45	5.70	13.12
7943		8.67	7.76	3.56			2.06	3.76	4.89	13.55
7800		9.24	6.64	2.76			1.40	4.18	4.77	12.87
7931		9.58	6.31	2.50			1.16	4.68	5.00	12.81
7929		9.21	6.91	3.16			1.72	4.32	5.07	12.58
7926		10.16	7.88	3.51			1.42	3.51	4.65	13.40
9134		9.03	5.07	2.74			2.28	5.17	6.49	13.91
9122		10.08	4.71	2.42			2.03	4.96	6.45	13.19
9129		8.15	5.47	3.03			2.37	4.70	6.44	13.99
9124		9.07	6.84	2.78			1.21	3.88	5.01	12 72
9178		9.08	7.63	3.39			1.18	3.58	5.03	12.07
9177		8.10	7.40	3.38			1.49	4.49	5.88	12.92
9172		9.29	8.47	3.16	3.34	0.32	1.40	4.15	5.43	12.51
7972		8.78	7.29	3.22			2.01	3.56	5.36	13.41
7988		8.81	9.80	3.63	4.30	0.36	1.35	4.04	6.06	13.95
7978		9.69	7.21	3.40			1.31	4.29	5.88	13.23
7976		7.62	7.86	3.64			1.52	4.20	5.43	14.39
9230		8.38	9.54	3.74	4.12	0.54	0.92	3.85	5.10	11.91
7737		9.73	6.33	2.90			1.79	4.10	5.56	12.70
7738		9.68	7.71	3.66			1.35	3.93	4.92	13.19
7739		9.73	8.19	3.44	3.10	0.24	1.74	3.75	5.20	12.42
7730		8.31	6.86	3.26			1.95	5.36	7.27	13.93
7729		9.57	7.96	3.42			1.36	4.01	5.25	12.55
7728		10.42	7.80	2.91			1.01	3.74	4.67	11.70
7632		8.55	7.01	3.53			1.31	3.02	4.27	12.77
7736		8.97	6.95	3.06			1.47	3.88	5.22	13.14
7461		8.31	7.61	3.25			1.03	4.90	3.29	11.96
7733		9.77	6.31	2.76			1.69	3.92	5.48	12.64

TABLE XIV.— CONTINUED.

Station No.		Moisture.	Ash. Total.	Ash. Soluble in water.	Ash. Insoluble in HCl.	Lime (CaO.)	Ether extract. Volatile.	Ether extract. Non-volatile.	Alcohol extract.	Cold water extract.
7725	Not found Adulterated.	9.91	7.88	4.10			2.05	5.12	5.87	14.92
7447		9.21	8.39	3.45	3.18	0.60	0.70	4.08	5.58	12.39
7726		9.78	5.19	2.30			1.48	4.49	5.66	12.84
7734		9.52	7.16	2.95			1.61	3.87	5.42	11.58
7454		8.41	7.02	3.01			1.03	3.64	5.18	13.93
7995		9.73	5.34	2.98			1.00	3.24	4.45	13.27
7990		9.82	7.33	3.24			1.25	4.03	5.28	12.51
9119		8.93	8.89	3.26	3.41	0.32	1.53	3.93	5.38	12.73
9111		9.44	7.01	2.53			1.53	4.36	6.35	12.32
9113		9.50	7.14	3.10			1.65	4.16	5.56	12.88
9137		8.68	4.67	2.51			1.78	4.76	5.90	13.43
9156		8.21	7.71	3.63			1.16	3.88	5.74	12.20
9153		9.04	5.98	2.73			1.60	4.56	5.79	12.84
9152		9.29	5.81	3.53			1.59	3.89	5.45	13.60
7754		8.75	5.83	2.99			2.22	4.64	5.98	14.00
7763		9.14	7.75	3.49			1.80	4.47	5.77	11.60
7757		9.33	8.25	3.58	2.59	0.62	1.25	3.75	4.89	12.58
7966		8.61	9.24	3.24	3.64	0.44	1.89	3.43	5.11	12.14
7969		9.55	4.83	2.64			1.70	4.03	5.42	12.66
9409		9.05	5.82	3.01			1.22	3.37	6.84	
7767	Adulterated.	8.87	4.58	2.22			1.03	6.49	7.71	11.62
7792		9.31	7.18	2.98			1.37	4.80	6.37	13.10
7781		9.01	5.55	3.17			1.54	5.11	5.95	13.06
9033		7.88	5.82	2.85			1.61	4.35	6.26	11.30
9157		9.15	5.59	2.19			1.67	4.51	6.08	12.34
9235		8.55	19.26	5.57	1.27	*6.34	1.46	3.70	6.28	19.13
7953		8.53	5.85	2.38			1.15	4.15	5.47	11.53
7939		7.29	7.82	2.99	3.09	0.42	1.83	6.47	9.40	14.02
7798		7.00	10.23	3 21	2.92	0.64	1.32	8.49	9.88	18.41
7732		9.45	5.63	2.18			0.76	3 54	5.08	12.23
7735		7.84	5.77	2.26			1.24	4.02	5.71	13.04
7633		8.31	5.55	2.34			1.59	5.97	7.78	15.00
7465		8.12	5.61	2.18			1.39	6.56	8.43	15.42
7984		10.09	5.16	2.41			0.50	5.51	7.35	14.68
7980		9.11	10.37	6.25	.64	†2.72	1.33	4.44	5.67	16.09
7998		8.55	8.00	3.09	2.57	0.16	0.31	6.92	9.25	15.02
9104		8.82	5.19	2.15			1.80	6 44	8.21	12.34
9115		8.54	6.82	2.41			0.56	7.13	9.11	14.42
9143		9.31	7.62	2.48			0.61	3.28	4.65	11.06
9148		8.79	3.77	1.56			0.26	1.27	3.50	20.18
9147		8.58	9.35	4.12	3.55	0.36	0.98	4.15	5.18	12.88
7747		9.47	12.31	6.07	1.98	‡2.72	1.69	3.61	5.42	15.89
7740		9.13	4.70	2.77			1.35	3.46	4.68	13.53
7960		9.50	6.78	2.95			1.41	3.71	5.79	12.79

* SO_3 9.25. † SO_3 3.60. ‡ SO_3 3.56.

SALICYLIC ACID IN MALT LIQUORS.

By A. L. Winton.

Forty samples of lager beer and seven of ale, all of which were purchased in New Haven, have been tested for salicylic acid.

The results may be summarized as follows:

	In Labeled Bottles.	In Rubber Stoppered Bottles, Not Labeled.	Drawn from the Wood.	Total.
Lager Beer—				
Salicylic acid, not found,	19	8	2	29
Salicylic acid, found,	3	8	0	11
Total, ...				40
Ale—				
Salicylic acid, not found,	3	1	2	6
Salicylic acid, found,	0	1	0	1
Total, ...				7

The method used for detecting salicylic acid was as follows:

Method of Testing for Salicylic Acid.— Twenty-five to fifty cc. of the liquor to be tested are acidified with sulphuric acid and the mixture thoroughly shaken in a tube of suitable size with an equal bulk of ether. The ethereal solution is carefully decanted into a flat porcelain dish and the ether evaporated at a gentle heat. The residue is dissolved in absolute alcohol and tested with ferric chloride solution.

Descriptions of the samples of beer and ale not found to contain salicylic acid are given in Tables XV and XVI, and of those found to contain this preservative in Table XVII.

The sample of ale found to contain salicylic acid was bought of W. J. Boettger, 215 Shelton Avenue, and was stated by the dealer to have been brewed by Feigenspan.

TABLE XV. LAGER BEER NOT FOUND TO CONTAIN SALICYLIC ACID.

Station No.	Brand.	Dealer.
	In Labeled Bottles.	
7690	Rochester Brewing Co.'s Bohemian,	Free & Waag, 725 State St.
7691	Rochester Brewing Co.'s Premier,	Free & Waag, 725 State St.
7692	Rochester Brewing Co.'s Standard,	Free & Waag, 725 State St.
7693	Rochester Brewing Co.'s Extra Dark Bavarian,	Free & Waag, 725 State St.
7586	Gabriel Sedlmayr München, Versandt Bier,	Edw. E. Hall & Son, 770 Chapel St.
7591	The Bergner & Engel Co , Phila., Tannhaeuser Bier,	Edw. E. Hall & Son, 770 Chapel St.
7590	Beadleston & Woerz, Imperial German Brew,	Edw. E. Hall & Son, 770 Chapel St.
7588	Beadleston & Woerz, Imperial Beer, Gold Label,	Edw. E. Hall & Son, 770 Chapel St.
7589	Rochester Brewing Co., Extra Dark Bavarian,	Edw. E. Hall & Son, 770 Chapel St
7587	Jos. Schlitz Brewing Co , Celebrated Milwaukee Beer,	Edw. E. Hall & Son, 770 Chapel St.
7594	Pabst Bohemian, Milwaukee,	Edw. E. Hall & Son, 770 Chapel St.
7593	Bürgerbräu, Würzburg, Bavaria (Dark),	Edw. E. Hall & Son, 770 Chapel St.
7596	Brauerei zum Augustiner, München,	W. H. Jensen, 47 Church St.
7685	Jos. Schlitz Brewing Co.'s Celebrated Milwaukee Lager Beer,	Hugh J. Reynolds, 152 Crown St.
7686	Jos. Schlitz Brewing Co.'s Extra Pale Milwaukee Beer,	Hugh J. Reynolds, 152 Crown St.
7687	Jos. Schlitz Brewing Co.'s Münchener,	Hugh J. Reynolds, 152 Crown St.
7600	Pschorr-Bräu, München,	Hugh J. Reynolds, 152 Crown St.
7688	Aktien-Brauerei zum Löwenbräu München, Export Bier,	Chas. Scholl, 156 Crown St.
7703	Chr. Feigenspan's Export Beer, Newark,	C. Shanley, 245 Congress Ave.
	*In Rubber Stoppered Bottles, Not Labeled.**	
7689	J. Ruppert's,*	J. P. Baldwin, 450 State St.
7705	Ulmer,*	W. J. Boettger, 215 Shelton Ave.
7704	The Springfield Brewing Co.,*	J. P. Carney, 169 Meadow St.
7702	Weibel's,*	Jos. Fappiano.
7697	Weidemann's,*	Fontaine & Heidrich, 231 Cong Av.
7599	Toledo,*	W. Ihne, 66 Crown St.
7716	Quinnipiac,*	Quinnipiac Brewing Co.
7709	F. & M. Schaefer, N. Y., Culmbacher,*	Geo. Stalze, 905 State St.
	Drawn from the Wood.	
7717	Narragansett,*	W. Scanlon, 142 Ashmun St.
7723	Rochester,*	J. P. Donnelly, 174 Ashmun St.

* The brand or maker's name was given by the dealer.

TABLE XVI. ALE NOT FOUND TO CONTAIN SALICYLIC ACID.

Station No.	Brand.	Dealer.
	In Labeled Bottles.	
7707	Bass & Co.'s White Label,	John C. Doody, 239 Water St.
7696	Bass & Co.'s Pale Ale,	Wm. Henchy, 254 Congress Ave.
7715	Quinnipiac Brewing Co., Pale Ale,	Quinnipiac Brewing Co.
	In Rubber Stoppered Bottles, Not Labeled.	
7714	Quinnipiac Brewing Co., Still Ale,*	Quinnipiac Brewing Co.
	Drawn from the Wood.	
7713	Ballentine's Ale, Newark,*	Patrick Lee, 166 Ashmun St.
7712	H. Clausen & Son Ale, New York,*	R. E. Wartmann, 134 Starr St.

* As stated by the dealer.

TABLE XVII. BEER FOUND TO CONTAIN SALICYLIC ACID.

Station No.	Brand.	Dealer.
	In Labeled Bottles.	
7694	Rochester Brewing Co., Rienzi,	Free & Waag, 725 State St.
7598	Springfield, Mass., Brewing Co., Gold Medal Tivoli,	Gilbert & Thompson, 918 Chapel St.
7592	Rochester Export Lager Bier,	Edw. E. Hall & Son, 770 Chapel St.
	In Rubber Stoppered Bottles, Not Labeled.	
7701	Fresenius Standard Lager Beer,*	Thos. A. Kean, 285 Water St.
7698	Fresenius Lager Beer,*	Jos. A. Miller, 404 Congress Ave.
7595	Narragansett Lager Beer,*	Chas. Scholl, 156 Crown St.
7700	Feigenspan's Lager Beer,*	Otto A. Scholz, 45 Bristol St.
7711	Liebmann's Lager Beer,*	Geo. W. Shea, 143 Newhall St.
7708	F. & M. Schaefer, N. Y., Wiener Beer,*	Geo. Stelzle, 908 State St.
7710	F. & M. Schaefer, N. Y., Lager Beer,*	Geo. Stelzle, 908 State St.
7699	Bachmann's Lager Beer,*	Aug. Wilhelm, 88 Ashmun St.

* Statement of dealer.

SAUSAGE.

By A. L. Winton and W. L. Mitchell.

In the report for 1897, page 41, will be found descriptions of forty-two samples of sausage purchased during the months of October, November, and December, 1896. Twenty-seven of these samples were found to contain borax.

Nineteen samples, purchased December 8 to 17, 1897, have been examined, not only for borax but also for starch, the principal ingredient of various preparations of Indian corn, potatoes, and wheat, which are used in sausage as absorbents. As it is said that these starchy materials serve not merely to absorb the juices of the meat but also water, which is added as a "filling," the percentage of water in each sample was determined. (See Table XVIII.)

Fourteen of the samples contained borax and ten of them starch, which, in eight cases, was derived from Indian corn, in one from both Indian corn and potatoes, and in one from wheat. The average percentage of water in the samples containing starchy material was 42.40, in the other samples 40.13. This difference is too small to fully warrant the conclusion that the starchy material had been added for the purpose of holding water as a make-weight.

Table XVIII. Sausage.

Station No.	Brand.	Dealer.	Price per Pound, Cts.	Preservative.	Water.	Starch.
		Bridgeport:				
9018	World's Food Fair Bag Sausage, North Pack. & Prov. Co., Boston,	Bridgeport Pub. Market, 39 Bank St.,	12½	Borax	40.70	.....
9019	Peerless P'k Sausage, Jersey City,*	Bridgeport Pub. Market, 39 Bank St.,	12	Borax	44.07	Corn
9021	Plumb & Winton Co.'s Sausage,*	B. Liebscher, 652 Main St.,	10	.....	34.95	.....
9020	Sperry & Barnes' Sausage,*	Village Market, Main St.,	10	Borax	43.77	Corn
		Greenwich:				
9234	Made by dealer,*	H. B. Marshall & Co.,	14	.....	41.46	.....
		Hartford:				
9089	Hunt's Sausage Meat, A. C. Hunt & Co., Springfield, Mass.,	City Market, 487 Main St.,	10	Borax	36.42	Corn
9088	Springfield Sausage,*	A. C. Hart & Co., Albany Ave.,	10	Borax	37.88	Corn
		Meriden:				
9246	Meriden Provision Co.'s Home Made Sausage,	A. W. Gardner, 43 E. Main St.,	10	Borax	44.41	.....
9247	Made by dealer,*	C. F. Fox, 90 W. Main St.,	12	Borax	48.68	Corn & potato
		Middletown:				
9270	Sperry & Barnes' Sausage,*	Bacon & Co., 480 Main St.,	10	.....	31.41	Wheat
9269	Made by dealer,*	Wm. Jamieson, 290 Main St.,	10	.....	36.64	.....
		New Haven:				
9213	Armour's Sausage,*	N. Haven Pub. Market, 390 State St.,	8	Borax	42.88	.....
9210	Boston Sausage,*	N. Haven Pub. Market, 390 State St.,	9	Borax	45.84	Corn
9214	Handy's Sausage,*	N. Haven Pub. Market, 390 State St.,	10	Borax	43.74	Corn
9212	Merwin's Sausage,*	N. Haven Pub. Market, 390 State St.,	10	Borax	39.38	.....
9211	Peerless Sausage,*	N. Haven Pub. Market, 390 State St,	12	Borax	47.50	Corn
		New London:				
9266	The G. H. Hammond Co.'s Coin Special Breakfast Sausage,	Market, 20 Main St.,	12	Borax	45.73	Corn
9268	Small Sausage, North Star Brand,	Market, 46 Main St.,	15	Borax	44.51	.....
		Norwich:				
9267	Made by dealer,*	Gardner & Reynolds, 4 Market St.,	10	.....	36.39	.....

* Statement of dealer.

EXAMINATION OF HONEY.

By A. W. Ogden.

Thirty-seven samples of strained honey have been examined. Of these, five are probably pure; twenty-two may be genuine, though they seem to be made by bees fed somewhat with cane sugar, or to have had invert sugar added to them; two unquestionably contain cane sugar added as an adulterant, and *eight* are adulterated with glucose syrup.

The details regarding these samples appear in Tables XIX and XX.

METHOD OF ANALYSIS. — One-half the normal quantity for polariscopic test* is dissolved in water and clarified when necessary with 1[cc] each of alum cream and basic lead acetate solution. After making up the volume to 100[cc] and filtering, the solution is polarized in a 200[mm] tube. 50[cc] of the solution are treated with 5[cc] of strong hydrochloric acid, heated at 68° to 70° C. for ten minutes and polarized a second time, after inversion.

The results in the table are calculated in all cases to the normal quantity.

TABLE XIX. — STRAINED HONEYS.

Station No.	Label.	Manufacturer or Producer.	Dealer.	Price per Package.	Polarization. Direct. Degrees.	Direct. Temperature C.	After Inversion. Degrees.	After Inversion. Temperature C.
	Probably Pure.							
9046	Choice Honey,	C. A. Stanton, Newington, Conn.	*Bridgeport.* — Bridgeport Public Market,	.20	—0.1	24.0	—15.7	21.7
9067	One Pound Pure Honey,	Said to be native.	*Greenwich.* — Avery & Wilson,	.25	—4.3	23.7	—11.8	23.7
9063	Pure Extracted Honey. From the apiary of	W. E. Close, Stanwich, Conn.	L. Timmons,	.25	—0.5	22.3	—17.9	23.0
9345	Pure Extracted Honey. From the apairy of	Geo. J. Francis, Durham, Conn.	*Middletown.* — A. M. Bidwell,	.30	—9.7	26.0	—12.4	25.4
9068	2 lbs. Pure Machine Extracted Honey. From the apiary of	Irving M. June, Riverbank, Conn.	*Stamford.* — W. W. Waterbury,	.32	—8.7	22.4	—14.0	21.5
	Possibly from Bees fed with Sugar, or with Invert Sugar added.							
9025	Pure Honey,	Wm. T. Gregory, Cranbury, Conn.	*Bridgeport.* — Coe & White, 560 Main St.,	.15	—10.9	22.0	—15.1	23.0
9035	Strained Honey,	F. H. Leggett & Co., New York.	Logan Bros., 863 Main St.,	.20	—12.7	25.5	—20.4	24.3
9041	Pure White Clover Honey,	W. J. Lamb.	C. H. Stevens, 398 East Main St.,	.20	—16.7	23.0	—19.5	22.2
9043	Busy Bee Brand, Pure Strained Honey,	Hudson Mfg. Co , 61 Hudson St., N. Y.	R. T. Whiting, 345 Main St.,	.25	—16.3	22.0	—16.8	22.0
9380	Pure Honey, gathered from White Clover,	F. H. Strever, Pine Plains, N. Y.	*Canaan.* — Jackson & Eggleston,	.25	—10.3	24.3	—16.1	24.7
9051	Health Brand, Pure Strained Honey.	Lewis DeGroff & Son, New York.	*Greenwich.* — Knapp & Studwell,	.20	—15.7	22.0	—19.3	22.0
9055	Pure Strained Honey. Guaranteed Free from adulteration,	Falcon Packing Co., New York.	J. L. Mahoney,	.20	—14.5	23.0	—17.9	23.0
9100	Pure Strained Honey,	F. C. Gould, East Hartford, Conn.	*Hartford.*— Barrows & Thalhiemer, 525 Main,	.15	—16.7	23.0	—22.3	23.0
9238	Strained Honey,	F. H. Leggett & Co., New York.	H. J. Case & Co., 433 Main St.,	.25	—12.5	23.2	—18.4	22.6
9253	Pure Honey. With a bee as trade-mark,	None given.	*Meriden.* — L. C Brown, 4 West Main St.,	.18	—15.7	25.3	—19.0	25.3
9262	½ lb. Pure Honey (blown in glass),	None given.	Kimball & Hugins, 31 East Main St.,	.15	—16.3	24.0	—19.9	22.2
9250	Pure White Clover Honey,	Brownell & Field Co., Providence, R. I.	N.Y. Butter & Grocery House, 2 Colony,	.15	—16.3	23.0	—21.9	23.5
9249	Choice Honey, Warranted,	None given.	J. J. Pagnam, 35 West Main St.,	.15	—10.3	23.0	—14.4	23.3
9336	None. Piece of comb in it,	None given.	*Middletown.* — C. A. Allison, 31 Main St.,	.20	—17.1	23.0	—21.7	22.0
9349	Strictly Pure Honey,	Whitcher, Pillman & Co., Ayer, Mass.	Cottage Market, Main St ,	.10	—18.9	21.5	—22.8	20.3
9341	Pure Extracted Honey. From the apiary of	Geo. J. Francis, Durham, Conn.	W. K. Spencer, Main St.,	.35	—10.1	25.4	—12.9	25.2
9339	Pure Extracted Honey, Eagle Brand,	None given.	W. K. Spencer, Main St.,	.20	—14.7	22.0	—18.8	21.0
9281	Chas. McCulloch & Co., Wholesale Commission, Albany,	E. E. Harris, North Petersburg, N. Y.	*New London.* — Daboll & Freeman,	.20	—11.7	25.8	—14.6	25.1
9287	None. In pint Mason jar,	None given.	T. W. Potter, 72 State St.,	.28	—16.5	22.0	—20.1	22.6
9307	Fancy California Honey,	C. T. Joslyn Co., Malden, Mass.	*Norwich.* — H. I. Palmer, Main St.,	.20	—11.5	25.0	—17.5	25.0
9291	None. Piece of comb in it,	None given.	G. A. Ray, 47 Shetucket St.,	.18	—18.8	24.5	—21.9	24.0
9309	Pure Honeysuckle Honey,	W. J. Lamb.	J. A. Stoddard, 100 Franklin St.,	.25	—14.3	25.2	—19.5	20.3

* 13.024 grams.

TABLE XX.

Station No.	Label.	Manufacturer or Producer.
	Contain Cane Sugar.	
9047	Echo Brand Clover Honey, Guaranteed Pure,	Aero Distilled Water Co., Bridgeport.
9045	Echo Brand Clover Honey, Absolutely Pure,	Aero Distilled Water Co., Bridgeport.
	Consist of or Contain Glucose Syrup.	
9024	* Choice Comb Honey,	Wm. Thompson, Wayne Co., N. Y.
9040	* Choice Comb Honey,	Wm. Thompson, Wayne Co., N. Y.
9026	No Label. Said to be	Deforth Bros., 41 First Ave., New York.
9277	Pure Strained Honey, F. H. Leggett & Co., Prop.,	Crystal Conserve Co., New York.
9288	White Clover Honey,	West Virginia Preserving Co., Wheeling.
9072	* Choice Extracted Honey,	Thomas Waters, Worcester, N. Y.
9074	White Clover Honey,	West Virginia Preserving Co.
9077	Extra Quality Pansy Brand Honey,	Not given.

* We have added a little crystal syrup with our honey to prevent granulation, which we guarantee perfectly pure and wholesome.

EXAMINATION OF MAPLE SYRUP.

By A. W. Ogden.

Three samples of maple syrup have been examined, and all were found to be free from adulteration with glucose. The samples were the following:

7884. "Vermont Maple Syrup, Vermont Maple Sugar and Syrup Co., New Haven, Conn." Bought of P. Jente & Bro., 107 Broadway, New Haven.

9606. Warranted Pure Vermont Maple Syrup. Stoddard, Gilbert & Co., New Haven, Conn.

9607. Gold Leaf Brand Pure Vermont Maple Syrup. Huntington Maple Syrup and Sugar Co., Maple Groves, Huntington, Vt.

MILK EXAMINED FOR NEW HAVEN MILKMEN.

By A. W. Ogden and W. L. Mitchell.

A New Haven city ordinance, passed in 1897, establishing a milk standard, was the means of awakening unusual interest among milk producers and dealers in the composition of the

STRAINED HONEYS.

Dealer.	Price per Package.	Polarization. Direct. Degrees.	Direct. Temperature C.	After Inversion. Degrees.	After Inversion. Temperature C.	Per cent. Sucrose by Polarization.
Bridgeport. — Bridgeport Public Market,	.25	30.9	22.5	—19.5	22.5	38.0
Centennial Tea Co.,	.15	22.3	21.3	—20.6	22.0	32.6
Bridgeport. — D. O'Donnell, 628 Main St.,	.10	82.9	24.6	78.4	23.5	....
The Village Market, Main St.,	.10	106.7	23.5	102.3	23.5	....
R. Wundrack, 575 Main St.,	.12	107.7	24.0	104.2	25.3	....
New London. — Keefe & Davis, 125 Bank St.,	.20	66.5	25.0	63.0	21.5	....
T. W. Potter, 72 State St.,	.10	125.5	22.0	121.3	21.5	....
Stamford. — W. W. Edwards, 99 Main St.,	.15	88.1	25.4	83.9	24.2	....
J. F. Maher, 7 Pacific St.,	.12	126.5	24.0	123.3	24.0	....
N. Y. Grocery Co., Main St.,	.10	127.1	24.0	123.8	24.0	....

milk which they sold, and since that time ninety-six samples have been sent to the Station for examination by dealers.

The Station has no guarantee that the samples were properly drawn, but as they were submitted for the private information of the senders, it is not likely that they were intentionally unfair samples.

The results of the examinations may be summarized as follows:

Month.	Total Solids. Per Cent. No. Samples.	Average.	Highest.	Lowest.	Butter Fat. Per Cent. No. Samples.	Average.	Highest.	Lowest.
1897 December,	11	13.24	14.73	12.41	15	4.34	5.20	3.80
1898 January,	13	13.11	14.32	12.06	21	4.19	5.35	3.20
February,	6	12.59	13.13	11.88	12	4.27	7.30	3.50
March,	6	13.68	14.31	12.66	9	4.49	5.20	3.40
April,	7	13.25	14.43	12.93	8	4.79	4.85	3.85
May,	8	12.98	14.03	11.55	13	4.70	5.35	3.60
June,	1	12.06	....	.....	7	4.16	4.60	3.90
July,	..	.....	.....	.....	6	4.45	5.10	3.80
August,	..	.....	.....	.....	..	....	....	....
September,	1	13 60	....	.....	4	4.59	5.00	4.00
Total and Average,	53	12.90	14.73	11.55	95	4.40	7.30	3.20

MILK DELIVERED AT A PUBLIC INSTITUTION.

By A. W. Ogden and W. L. Mitchell.

The contents of six forty-quart cans were carefully sampled by an agent of the Station as they were delivered at 5 A. M. by the milkman to the institution. The milk in the several cans contained the following percentages of fat: 5.30, 4.90, 3.75, 4.15, 4.60, and 3.50. The milk was, therefore, of good quality, though the contents of two cans fell below the seller's guarantee of four per cent. of butter fat. It is evident that the whole quantity of milk delivered, if mixed, would contain over four per cent. (about 4.36 per cent.).

From these cans milk is poured off for kitchen uses, and also for the table use of the inmates.

The milk sent up for table use in different parts of the institution, on the day when the milk supply was examined, contained the following percentages of fat: 4.2, 3.2, 3.6, 3.45, 3.5, 3.9, and 3.8.

It would appear that rather less butter fat is in the milk served at meals than is in the milk as it is delivered. Those in charge are instructed to stir the milk thoroughly each time before pouring from the can, but evidently a perfect mixture is not obtained.

CREAM.

By A. W. Ogden and W. L. Mitchell.

Seven samples of cream, sent to the Station for examination by private individuals, contained on the average 21.41 per cent. of butter fat, the percentages ranging from 18.9 to 26.75.

Two samples of concentrated cream contained 33.75 and 37.75 per cent. of butter fat respectively.

Fourteen samples of fresh cream not found to contain borax, were bought by the Station agent of the following dealers:

Station No.		
9163	*Danbury*,........	East Canaan Creamery, 47 White St.
7938	*Hartford*,........	Allen Bros., Main and Sheldon Sts.
7945		J. P. Guilfoil Co., 193 Asylum St.
7948		G. F. Kellogg, 123 Ann St.
7921	*Meriden*,........	D. Higgins, 17 Butler St.
9175	*Naugatuck*,.....	The Grant Grocery Co.
7731	*New Haven*,.....	S. J. Burt, 894 State St.
7855		J. T. Pohlman, 140 Dixwell Ave.
7724		A. Tenant, 751 State St.
7727		W. E. Waterbury, 774 State St.
7987	*New London*,....	T. W. Potter, 72 State St.
7975		Thomas & Gumble, 437 Bank St.
9101	*Norwich*,.........	W. A. Smith, 137 Main St.
7964	*Willimantic*,....	Purinton & Reade, 717 Main St.

Four samples of fresh cream contained borax. These were the following:

7761, 7762. Two samples labeled on paper cap: "Goshen Farm Co. Pure Cream, Goshen, Conn." Dealers, Simon Bohl, 88 S. Main St., and the Waterbury Grocery Co., 165 Bank St., Waterbury. Price, 10 cents per half pint.

7849. Dealer, J. C. Kelley, Dixwell and Munson Sts., New Haven. Price, 10 cents per half pint.

7851. Dealer, C. Kipp, Dixwell Ave. and Henry St., New Haven.

The following brands of canned cream were found to contain neither borax, salicylic acid, nor benzoic acid:

7924. "Butler's Brand Condensed Cream." Dealer, Russell Bros., 2 Colony St., Meriden. Price, 10 cents per can.

7857. "Borden's Peerless Brand Evaporated Cream." Dealer, I. B. Chandler, 101 Dixwell Ave., New Haven. Price, 12 cents per can.

9106. "St. Charles Evaporated Cream." Dealer, H. D. Avery, 202 Franklin St., Norwich. Price, 15 cents per can.

9110. "Imperial Brand Cream, Anglo-Swiss Condensed Milk Co." Dealer, A. C. Stetson, Putnam. Price, 20 cents per can.

7967. "Highland Brand Evaporated Cream, Helvetia Milk Condensing Co." Dealer, H. C. Hall, Willimantic. Price, 15 cents per can.

CANNED SOUPS.

Thirty-two samples of canned soups were examined by Messrs. Winton, Ogden, and Mitchell to detect any chemical preservative, and in all cases with negative results.

The samples were as follows:

7923. Anderson's Concentrated Tomato Soup. Anderson

Preserving Co., Camden, N. J. Dealer, Russell Bros., 2 Colony St., Meriden. Price, 10 cents per can.

7908, 7909, 7910. French Soups. Franco-American Food Co., New York. Dealer, P. Jente & Bro., 107 Broadway, New Haven. Price, 35 cts. per quart can.

7903 to 7907. White Label Soups. Armour Packing Co., Kansas City. Dealer, P. Jente & Bro., 107 Broadway, New Haven. Price, 23 cents per quart can.

7860 to 7871. French Soups. Franco-American Food Co., New York. Dealer, E. E. Hall & Son, 770 Chapel St., New Haven. Price, 20 cents per pint, and 32 cents per quart cans.

7872 to 7882. Huckins' Soups. J. H. W. Huckins & Co., Boston. Dealer, S. W. Hurlburt, 1074 Chapel St., New Haven. Price, 25 cents per quart can.

CHILI SAUCE.

9375. "Heinz's Chili Sauce. Keystone Brand. H. S. Heinz, Pittsburg." Dealers, S. L. Parsons & Son, Canaan. Price, 25 cents per bottle. Contained *eosine* (a dye much used in red ink) and *salicylic acid.*

CANNED VEGETABLES.

Twenty-three samples of canned peas, twenty-five of corn, seven of string beans, three of lima beans, and seven of succotash (lima beans and corn) were examined by Messrs. Winton, Ogden, and Mitchell, for preservatives. Sulphurous acid was present in small amount in some of the samples of canned corn, but other than this, no preservative was detected.

MINCE MEAT.

Nine samples of mince meat were examined by Messrs. Winton, Ogden, and Mitchell, to detect the presence of salicylic

and boric acids, but in every case with negative results. The samples were as follows:

TABLE XXI.—MINCE MEAT NOT FOUND TO CONTAIN SALICYLIC OR BORIC ACIDS.

Station No.	Brand.	Dealer.		Price per package.
9167	Health Brand Mince Meat, Lewis DeGroff, New York, . .	*Danbury.*	Mastin & Co., 54 White St.	10
7858	Columbia Condensed Mince Meat, Gutchess Bros., Port Byron, N. Y., .	*New Haven.*	C. T. Downes & Sons, 1 Broadway, .	9
7805	The Old Homestead Condensed Mince Meat, Libby, McNeill & Libby, Chicago, ...		Philip Hugo, 28 Edwards St.,	10
7911	None Such New England Mince Meat, Merrell-Soule Co., Syracuse, N.Y.,		P. Jente & Bro., 107 Broadway,	9
7820	Condensed Mince Meat, Armour & Co., Chicago, . . .		Kohn Bros., 55 George St.,	10
7822	New England Condensed Mince Meat, T. E. Dougherty, Chicago,		D. M. Welch & Son, 28 Congress Ave.,	10
7758	The Superb Mince Meat, Hudson Valley Preserving Co., Glens Falls, N. Y., ...	*Waterbury.*	Dixon & Sanson, 328 Washington St.,	10
7749	Imperial Condensed Mince Meat, Gutchess Bros., Port Byron, N. Y.,		E. J. Upson, 841 N. Main St.,	10
7370	The Unequalled Mince Meat, E. Harrison, Glens Falls, N. Y.,	*Willimantic.*	Burt Thompson, 798 Main St.,	10

GROUND SPICES IN SEALED AND LABELED PACKAGES.

By A. L. Winton and W. L. Mitchell.

Of 332 samples of spices sold *in bulk* which have been examined at this Station during the past three years, 127, or 38.3 per cent. of the whole number, have been found adulterated. If samples of mustard colored with turmeric are included, the number of adulterated samples will be increased to 138, or 41.5 per cent. of the whole number examined.

As the purchaser has no ready means of distinguishing between the pure and the adulterated, his only safe course is to buy spices in *sealed packages, bearing the name of a reliable house whose goods have not been found adulterated.*

In Table XXII are given the results obtained in the examination of all the brands of mustard, black pepper, white pepper, cayenne pepper, cloves, allspice, cinnamon, and nutmeg which have been found on sale in this State in sealed and labeled packages. With the exception of 19 samples of black pepper collected in 1896, all of these samples have been collected and examined within the year covered by this report.

Results of examination of 25 samples of ginger sold in sealed and labeled packages will be found in Tables XI, XII, and XIV, pages 147–150.

The samples noticed in this report are the following:

Mustard,	26 samples.
Black pepper,	44 "
White pepper,	13 "
Cayenne pepper,	14 "
Cloves,	20 "
Allspice,	21 "
Cinnamon,	26 "
Nutmeg,	6 "
Total,	170 "

The methods of chemical analysis employed are described on pages 186 to 191.

A summary of the samples of ground spices examined at this Station during the past three years is as follows:

Summary of Examination of Spices.

1896–1899.

	Number of Samples Examined.	Number of Samples found Adulterated or "Compounded."	Per cent. of Samples Adulterated or "Compounded."
In bulk,	332	138	41.5
In labeled packages,	242	57	23.5

TABLE XXII — SPICES BOUGHT IN SEALED AND LABELED PACKAGES.

Station No.	Brand.	Dealer.	Price per pack.—cts.	Ounces in package.	A . Total.	Ether extract. Volatile.	Ether extract. Non-volatile.	Reducing matters by direct inversion calculated as starch.	"Starch" by diastase method.	Crude fiber.	Nitrogen × 6¼.	Remarks.
	Mustard.											
9295	Anco Spice Mills, N. Y., Perfectly Pure Mustard,	*Norwich.* A. Wilson, 58 Franklin St.,	12	4	6.76	0.61	21.10	5.22	1.92	1.67	39.56	Colored with turmeric.
9745	Augur, John P., New Haven, Crescent Mills, Pure Mustard,	*New Haven.* J. G. & J. W. Pohlman, 140 Dixwell Ave.,	10	4	6.26	0.33	19.17	5.18	2.08	2.15	39.75	Not found adulterated.
9746	Bailey, C. A., Strictly Pure Mustard,	C. A. Bailey, 171 Dix'll Ave.,	10	4	5.85	0.05	19.24	4.14	0.51	2.59	41.06	do
9490	Bennett, Simpson & Peek, London, Double Strength Mustard,	*Waterbury.* The Hewitt Grocery Co., 20 N. Main St.,	15	4	6.21	1.33	18.04	3.78	0.84	2.58	40.93	do
9742	Born Bros., Erfurt, Germany, Born's Mustard,	*New Haven.* Greater N. Y. Del. & Prov. Co., 84 Cong. Ave.,	15	4	4.81	1.90	21.98	1.85	0.28	1.95	40.63	do
9431	Bushnell Co., The F. C., Absolutely Pure Mustard,	I. B. Chandler, 101 Dix'll Ave.,	9	4	6.88	0.00	21.53	4.77	0.96	3.41	38.63	do
9251	Butler, James, New York, Strictly Pure Mustard,	*Meriden.* N. Y. Butter & Grocery House, 2 Colony St.,	10	4	4.60	0.54	10.34	33.71	30.26	1.97	23.63	Wheat flour about 40%.§
9476	Colburn Co., The A., Phila., Colburn's Mustard,*	*Hartford.* Boston Grocery Co., Main St.,	12	4	5.20	0.19	18.66	18.50	15.52	1.80	32.44	Wheat flour about 20%,§ turmeric.
9427	J. Colman's Mustard, England,†	*New Haven.* G. J. Burt, 894 State St.,	18	4	3.83	0.00	35.16	10.17	7.54	1.78	30.00	Wheat flour about 9%.§
9318	Daniels, Cornell & Co., Strictly Pure Mustard,	*Putnam.* J. E. Sullivan.	20	8	5.54	0.38	17.95	6.12	1.74	4.87	39.25	Not found adulterated.
9508	Dean & Son, N.Y., Ardenter Mustard,	*Groton.* H. E. Marquardt.	10	4	5.16	0.38	20.89	3.65	0.67	1.76	42.13	do
9744	Durkee & Co., E. R., N. Y. Gauntlet Brand Mustard Flour,	*New Haven.* C. Kipp, 290 Dixwell Ave.,	10	4	5.23	0.34	21.26	3.11	0.84	1.61	42.13	Colored with turmeric.
9740	Farrington & Co., F. R., N. Y. & Boston, Imperial Mustard,	F. W. Miner, 61 Broadway,	10	4	5.69	0.56	20.27	4.19	0.57	2.02	39.88	Not found adulterated.
9271	Gillies & Co., Edwin J., N. Y. Mustard, Absolutely Pure,	*New London.* A. E. Foster, 120 Main St.,	10	4	14.05	0.28	21.32	4.18	1.41	2.68	35.37	Sand 7.24%.
9477	Hills & Co., Gold Seal Mustard,	*Hartford.* Hills & Co., 372 Asylum St.,	15	4	5.09	0.26	17.42	4.86	1.57	2.59	43.56	Not found adulterated.
9480	Keen's Mustard, Double Superfine, London,‡	Hills & Co., 372 Asylum St.,	15	4	3.92	0.00	34.65	8.87	7.03	1.85	31.00	Wheat flour about 8%.§
9743	Leggett & Co., Francis H., N. Y., Best Mustard,	*New Haven.* C. T. Downes & Son, 1 Broadway,	10	4	5.61	0.27	27.64	2.97	0.28	1.58	36.63	Not found adulterated.
9506	Lincoln, Seyms & Co., Hartford,	*Portland.* P. Sullivan,	12	4	7.35	0.86	26.18	4.23	1.12	2.26	35.63	do
9452	Slade Co., D. & L., Boston, Oxford Mustard, Absolutely Pure,	*New Britain.* Sovereign Trading Co., 282 Main St.,	20	4	6.92	0.81	17.50	5.27	1.12	2.70	38.69	do
9468	Stickney & Poor, Boston, Absolutely Pure Mustard,	*Forestville.* J. M. Todd,	10	4	5.58	0.51	20.37	4.77	1.18	3.17	39.81	do
9739	Stoddard, Gilbert & Co., New Haven, Pure Mustard,	*New Haven.* N. Francesconie, Congress Ave.,	10	4	6.95	0.53	18.58	4.59	1.24	2.45	39.31	do
9493	Sultana Spice Mills, A. & P. Mustard,	*Waterbury.* Atlantic & Pacific Tea Co., 31 E. Main St.,	10	2½	6.58	0.26	17.14	5.54	1.80	3.35	40.49	do
9470	Union Spice Co., New York, Celebrated Mustard,	*Hartford.* Union Pacific Tea Co., 174 Asylum St.,	10	2½	7.44	0.00	16.00	7.79	1.74	6.15	36.75	Colored with turmeric.
9459	Upson Bros., Absolutely Pure Mustard,	*Southington.* Upson Bros.,	15	4	5.36	0.00	28.10	3.55	0.67	2.54	37.13	Not found adulterated.
9741	Welch & Son, D. M., Absolutely Pure Mustard,	*New Haven.* D. M. Welch & Sons, Congress Ave.,	7	2½	5.92	1.07	20.47	4.05	1.74	1.98	39.25	do
9738	Genuine English Mustard,	B. Carari & Co., 123 Congress Ave.,	10	4	6.05	0.67	18.44	4.55	0.95	2.48	39.44	do

* "The finest compound for family or medicinal use."
† "Warranted to be the finest Mustard Compound."
‡ "This is an admixture in which no injurious ingredient is used."

§ Calculated from the percentage of starch (by the diastase method) assuming that mustard contains 1 per cent. and wheat flour 70 per cent. of starch.

TABLE XXII — SPICES BOUGHT IN SEALED AND LABELED PACKAGES — *Continued.*

Station No.	Brand.	Dealer.	Price per package.	Ounces in package.	Ash. Total.	Ash. Insoluble in HCl. (Sand).	Ether extract—non-volatile.	Crude fiber.	Remarks.
	Black Pepper.								
5590	Adams & Howe, N. Y., Pure Pepper.	*Danbury.* 79 White St.,	10	4	5.93	..	8.34	14.48	Not found adulterated.
9467	Allyn & Blanchard Co., Hartf'd, Pepper.	*Southington.* Finch & Laity,	10	2½	6.26	....	7.93	15.52	do
5573	Augur, John P., New Haven, Crescent Mills, Pure Pepper.	*Waterbury.* Foote & Westwood, W. Main St.,	10	4	3.90	...	7.65	10.90	do
5574	Austin, Nichols & Co., N. Y., Blue Ribbon Pure Black Pepper.	*Putnam.* George Farley,	10	4	4.60	...	8.15	12.72	do
5595	Barnum & Reed, Strictly Pure Pepper.	*Danbury.* Barnum & Reed, 307 Main St.,	12	4	4.68	....	6.62	13.53	do
5596	Battey & Son, L., Strictly Pure Pepper.	*Moosup.* L. Battey & Son,	8	4	3.94	....	7.09	13.70	do
5569	Bennett, Simpson & Co., London, Genuine Malabar Black Pepper.	*Waterbury.* Waterbury Grocery Co., 163 Bank St.,	10	4	4.65	....	8.09	12.84	do
5071	Bennett, Sloan & Co., N. Y., Pure Pepper.	*New Haven.* Geo. M. Coombs, 195 Whalley Ave.,	..	.	4.96	....	7.02	14.30	do
5567	Blanchard, O. H., Pepper.	*Willimantic.* H. Dillon,	10	4	4.71	....	7.26	13.10	do
5570	Boardman & Sons, Hartford, Pure Pepper.	*New Britain.* J. Kerrin, 62 North St.,	10	4	4.10	....	7.84	12.86	do
5577	Bryan, Miner & Read, New Haven, Ground Black Pepper, warranted pure.	*Derby.* P. McEnerney, Main St.,	10	4	4.17	....	7.30	12.70	do
5581	Bryan, Miner & Read, New Haven, Pure Black Pepper.	*Willimantic.* Holden Arnold,	10	4	5.23	....	7.81	15.41	do
9520	Bugbee & Brownell, Providence, Pure Black Pepper.	*Norwich.* A. T. Otis, 261 Main St.,	10	4	3.91	....	7.77	7.64	do
9425	Bushnell Co., The F. C., New Haven, Absolutely Pure Pepper.	*New Haven.* F. E. Hull, 399 Grand Ave.,	10	4	5.25	....	7.52	13.98	do
9252	Butler, James, N.Y., Compound Pepper	*Meriden.* N. Y. Butter & Grocery House, 2 Colony St.,	15	8	4.65	....	5.68	16.25	Contains buckwheat and wheat products.
9415	Clark, Chapin & Bushnell, N. Y., Diamond Absolutely Pure Pepper.	*Ansonia.* W. H. Bronson, 234 Main St.,	10	4	4.26	....	8.98	10.08	Not found adulterated.
9433	Colburn Co., The A., Phila., Choicest Shot Pepper.	*New Haven.* G. J. Burt, 894 State St.,	15	*3½	7.61	....	7.07	14.51	do
9509	Daniels, Cornell & Co., New London, Strictly Pure Pepper.	*Groton.* G. S. Avery,	10	4	8.30	1.09	5.89	22.16	Contains dirt or pepper shells.
9086	De Groff, Lewis, N.Y., Best Pepper.	*Stamford.* H. Sawyer Daskam,	10	4	6.54	....	9.37	16.76	Not found adulterated.
5583	Durkee & Co., E. R., N. Y., XXX Pepper.	*Meriden.* Thomas Nolan, 250 Pratt St.,	10	4	5.75	....	7.62	12.84	do
9320	Exley, Watkins & Co., Wheeling, W. Va.	*Putnam.* Edward Mullan,	10	*2	5.86	....	7.35	16.44	do
9233	Farrington & Co., F. R., N. Y. & Boston, Pure Black Pepper.	*New Haven.* S. S. Adams, 412 State St.,	5	4	6.67	....	6.54	15.31	do
9273	Gillies & Co, Edwin J., N. Y., Absolutely Pure Pepper.	*New London.* A. E. Foster, 120 Main St.,	10	4	11.38	5.21	7.84	16.27	Contains dirt or pepper shells.
9802	Hall & Son, E. E., Singapore Black Pepper.	*New Haven.* E. E. Hall & Son,	..	.	......	...	....	.....	Not found adulterated.
9482	Hills & Co., Gold Seal Pepper.	*Hartford.* Hills & Co, 372 Asylum St.,	20	*2	4.49	....	7.12	11.52	do
9282	Hornick, E. P., N. Y., Pure Pepper.	*New London.* Wm. A. Holt, 50 Main St.,	10	4	4.84	....	8.05	12.68	do

* In glass pepper-shaker.

TABLE XXII — SPICES BOUGHT IN SEALED AND LABELED PACKAGES — *Continued.*

Station No.	Brand.	Dealer.	Price per package.	Ounces in package.	Ash. Total.	Ash. Insoluble in HCl. (Sand).	Ether extract—non-volatile.	Crude fiber.	Remarks.
	Black Pepper — Continued.								
9803	Justice Mills, Absolutely Pure Black Pepper.	*New Haven.* Harry Leigh, 354 State St.,	8	8	.....	.....	.....	.....	Not found adulterated.
9510	Leggett & Co., Francis H., N. Y., Best Black Pepper.	*Madison.* F. C. Dowd,	10	4	5.16	....	6.91	11.76	do
5576	Lincoln, Seyms & Co., Hartford, Pepper.	*Waterbury.* E. F. Platt, 37 E. Main St.,	10	4	4.82	....	7.11	12.85	do
5597	Lyon, C. H., Strictly Pure Pepper.	*New London.* C. H. Lyon, 42 Coit St.,	10	4	3.97	....	6.76	12.23	do
5591	Mansfield & Co., W. H., Pure Black Pepper.	*Putnam.* W. H. Mansfield & Co.,	10	4	4.46	....	7.96	12.73	do
5599	Palmiter, R. R., Excelsior Mills, Strictly Pure Pepper.	*Derby.* George M. Spring, 214 Main St.,	12	4	5.87	....	8.06	12.60	do
9285	Potter-Parlin Co., The, N. Y., Strictly Pure Pepper.	*New London.* T. W. Potter, 72 State St.,	10	*3½	7.47	....	7.54	14.91	do
5585	Powers & Co., Jas. G., N. Y., Red Shield Pepper.	*Norwich.* G. A. Ray,	9	4	5.88	....	8.33	14.50	do
5568	Slade Co., D. & L., Boston, Absolutely Pure Pepper.	*Willimantic.* Holden Arnold,	10	4	4.21	....	7.66	12.48	do
9450	Sovereign Trading Co., Pure Black Pepper.	*New Britain.* Sovereign Trading Co., 282 Main St.,	10	4	5.55	....	6.81	12.63	do
9207	Square Deal Mills, N. Y., Pure Pepper.	*New Haven.* S. S. Adams, 412 State St.,	10	4½	6.96	....	7.58	14.25	do
9259	Stickney & Poor, Boston, Absolutely Pure Pepper.	*Meriden.* F. W. Miner, 213 Pratt St.,	10	2½	4.50	....	7.64	10.94	do
9084	Stiff & Co., Wm. J., N. Y., Knickerbocker Pure Pepper.	*Stamford.* H. Sawyer Daskam,	12	*2½	6.76	....	9.81	17.99	do
9423	Sultana Spice Mills, A. & P. Pepper.	*New Haven.* Atlantic & Pacific Tea Co., 386 State St.,	10	2½	9.65	2.26	8.20	16.12	Contains dirt or pepper shells.
5593	Swain, Earle & Co., Boston, Pure Pepper.	*Preston.* James M. Young,	10	4	4.22	....	7.32	12.80	Not found adulterated.
9447	Tropical Mills, Boston, Select Compounded Pepper.	*Wallingford.* Laden Bros.,	10	3	6.46	...	5.20	17.40	Contains charred matter, mustard hulls, and some corn product.
9330	Union Pacific Tea Co., N. Y., Pure Sovereign Black Pepper.	*Putnam.* The U. P. Tea Co.,	20	8	9.37	2.93	6.59	16.69	Contains dirt or pepper shells.
9461	Upson Bros., Absolutely Pure Black Pepper.	*Southington.* Upson Bros.,	10	4	5.09	....	6.76	11.93	Not found adulterated.
	White Pepper.								
9420	Augur, John P., New Haven, Crescent Mills, White Pepper, warranted pure.	*New Haven.* Conrad Rausch, Foster & Avon Sts.,	10	4	2.25	...	6.12	3.23	Adulterated with a wheat product.
9219	Bennett, Simpson & Co., London, Genuine Tellicherry White Pepper.	Johnson & Bro., 411 State St.,	15	4	1.18	....	7.46	2.46	Not found adulterated.
9517	Bugbee & Brownell, Providence, Pure White Pepper.	*Norwich.* H. I. Palmer, 231 Union St.,	12	4	1.39	....	7.88	6.49	do
9228	Farrington & Co., F. R., N. Y. & Boston, Pure White Pepper.	*New Haven.* S. S. Adams, 412 State St.,	5	4	4.01	...	6.19	3.60	do
9481	Hills & Co., Gold Seal White Pepper.	*Hartford.* Hills & Co., 372 Asylum St.,	20	2*	3.43	....	6.80	4.07	do

* In glass pepper-shaker.

TABLE XXII — SPICES BOUGHT IN

Station No.	Brand.	Dealer.
	White Pepper — Continued.	
9475	Leggett & Co., Francis H., N. Y., Best White Pepper.	*Hartford.* Guilfoil Grocery Co., 184 Asylum St.,
9297	Leggett & Co., Francis H., N. Y., White Pepper.	*Norwich.* W. A. Church, 18 Market St.,
9061	Montanye & Co., W. H., N. Y., Positively Pure Pepper.	*Greenwich.* J. L. Mahoney,
9507	Powers & Co., Jas. S., N. Y., Red Shield White Pepper.	*New London.* Ed. Keefe, 495 Bank St.,
9524	Slade Co., D. & L., Boston, Absolutely Pure White Pepper.	*New Haven.* Philip Hugo, 26 Edward St.,
9293	Smith, Welcome A., The Finest White Pepper.	*Norwich.* Welcome A. Smith, 137 Main St.,
9471	Union Spice Co., N. Y., Celebrated White Pepper.	*Hartford.* Un. Pacific Tea Co., 174 Asylum St.,
9458	Upson Bros., Absolutely Pure White Pepper.	*Southington.* Upson Bros.,
	Cayenne Pepper.	
9464	Allyn & Blanchard Co., Hartford, Strictly Pure Cayenne.	*Southington.* Finch & Laity.
9312	Austin, Nichols & Co., New York, Hungarian Paprica, Sweet Pepper.	*Norwich.* A.T. Otis, 261 Main St.
9504	Bryan, Miner & Read, New Haven, Pure Cayenne.	*Portland.* C. A. Ahlquist.
9518	Bugbee & Brownell, Providence, Pure Cayenne Pepper.	*Norwich.* A.T. Otis, 261 Main St.
9512	Ellis, S. N., New London, Pequot Brand Cayenne Pepper.	*Groton.* H. E. Marquiat.
9274	Gillies Mills, N. Y., Absolutely Pure Cayenne Pepper.	*New London.* A. E. Foster, 120 Main St.
9478	Hills & Co., Gold Seal Cayenne.	*Hartford.* Hills & Co., 372 Asylum St.
9342	Lincoln, Seyms & Co., Hartford, Pure Cayenne.	*Middletown.* J. B. Patterson, 110 Main St.
9058	Montanye & Co., W. H., New York, Pure Cayenne.	*Greenwich.* J. L. Mahoney.
9421	Slade Co., D. & L., Boston, Absolutely Pure Cayenne.	*New Haven.* Conrad Rausch, Foster & Avon Sts.
9351	Stickney & Poor's Absolutely Pure Cayenne.	*Middletown.* G. E. Burr, 136 Main St.
9412	Stickney & Poor's Pure Cayenne.	*Ansonia.* D. M. Welch & Son, Main St.
9417	Thompson's Pure Cayenne.	W. H. Bronson, 234 Main St.
9489	Manufacturer not given, Ground Cayenne.	*Waterbury.* The Hewitt Grocery Co., 20 N. Main St.

SEALED AND LABELED PACKAGES.

Station No.	Price per package.	Ounces in package.	Ash. Total.	Ash. Insoluble in HCl.(Sand).	Ether extract—non-volatile.	Crude fiber.	Remarks.
9475	13	4	1.16	....	7.77	0.53	Not found adulterated.
9297	20	5*	2.51	....	8.27	4.40	do
9061	10	4	3.22	....	6.78	3.77	do
9507	10	4	2.15	....	4.07	4.24	do
9524	15	2½	1.52	....	6.65	3.50	do
9293	15	4	1.09	....	7.53	0.70	do
9471	10	3	2.77	....	6.36	3.84	do
9458	15	4	1.08	....	7.63	0.43	do
9464	10	3	7.18	....	18.09	....	Not found adulterated.
9312	20	5*	6.76	....	15.59	....	do.
9504	12	4	7.62	....	16.05	....	do.
9518	.12	4	5.88	....	17.53	..	do.
9512	10	4	7.00	....	19.02	....	do.
9274	10	4	6.02	....	19.14	....	do.
9478	15	4	8.34	....	15.82	....	do.
9342	10	1½	6.12	....	18.18	....	do.
9058	15	4	7.15	....	16.86	....	do.
9421	10	3	6.41	....	17.48	....	do.
9351	10	2*	6.56	....	17.45	....	do.
9412	10	1½	7.14	....	17.15	....	do.
9417	8	1½	6.54	....	17.52	....	do.
9489	10	1½	5.99	....	18.44	....	do.

* In glass pepper-shaker.

TABLE XXII — SPICES BOUGHT IN SEALED AND LABELED PACKAGES.

Station No.	Brand.	Dealer.	Station No.	Price per package, cents.	Ounces in package.	Ash. Total.	Ash. Insoluble in HCl. (Sand).	Ether extract. Volatile.	Ether extract. Non-volatile.	Remarks.
	Cloves.									
9463	Allyn & Blanchard Co., Hartford, Strictly Pure Cloves.	*Southington.* Finch & Laity.	9463	10	3	7.23	....	13.82	7.19	Not found adulterated.
9455	Austin, Nichols & Co., New York, Blue Ribbon Pure Penang Cloves.	*New Britain.* Boston Branch Grocery, 238 Main St.	9455	10	4	7.92	....	12.58	5.78	do.
9221	Bennett, Simpson & Co., London, Genuine Amboyna Cloves.	*New Haven.* Johnson & Bro., 411 State St.	9221	10	4	6.52	....	17.27	6.30	do.
9498	Bransfield, John, Strictly Pure Cloves.	*Portland.* John Bransfield.	9448	10	4	5.88	....	14.01	6.49	Adulterated with wheat product.
9496	Bushnell Co., The F. C., New Haven, Absolutely Pure Cloves.	*Waterbury.* Thos. Gray, 26 N. Main St.	9496	10	4	7.31	...	13.03	6.12	Not found adulterated.
9183	Clark, Holly & Ketchum, New York, Reliable Cloves.	*New Haven.* Coe & Jenks, 422 State St.	9183	15	4	5.99	....	16.77	6.31	do.
9434	Colburn Co., The A., Philadelphia, Choicest Amboyna Cloves.	G. J. Burt, 894 State St.	9434	15	3½*	8.80	1.25	9.25	7.90	Contains clove stems.
9429	Durkee & Co., E. R., New York, XXX Cloves.	do.	9429	10	2½	7.44	....	11.32	4.87	Not found adulterated.
9232	Farrington & Co., F. R., New York and Boston, Pure Cloves.	S. S. Adams, 412 State St.	9232	5	4	7.82	....	8.91	6.97	Contains clove stems.
9495	Gray, Thomas, Strictly Pure Cloves.	*Waterbury.* Thos. Gray, 26 N. Main St.	9495	10	4	8.32	1.07	9.76	6.08	do.
9483	Hills & Co., Gold Seal Cloves.	*Hartford.* Hills & Co., 372 Asylum St.	9483	20	2*	6.54	....	16.03	5.86	Not found adulterated.
9062	Leggett & Co., Wm. A., Pure Cloves.	*Greenwich.* L. Timmons.	9062	10	4	4.76	....	1.43	4.49	Adulterated with allspice.
9505	Lincoln, Seyms & Co., Hartford, Pure Cloves.	*Portland.* C. A. Ahlquist.	9505	15	4	9.42	2.06	6 19	6.38	Contains clove stems.
9059	Montayne & Co., W. H., New York, Pure Cloves.	*Greenwich.* J. L. Mahoney.	9059	10	4	6.59	....	18.25	5.61	Not found adulterated.
9526	Slade Co., D. & L., Boston, Absolutely Pure Cloves.	*New Haven.* I. B. Chandler, 101 Dixwell ave.	9526	9	4	7.47	...	11.03	5.78	do.
7451	Sovereign Trading Co., Pure Cloves.	*New Britain.* Sovereign Trading Co., 282 Main St.	7451	10	4	7.43	....	14.71	6.68	do.
9469	Stickney & Poor, Boston, Absolutely Pure Cloves.	*Forestville.* J. N. Todd.	9469	10	4	7.19	....	14.19	6.11	do.
9492	Sultana Spice Mills, A. & P., Cloves.	*Waterbury.* Atlantic & Pacific Tea Co., 31 E. Main St.	9492	10	2½	6.39	....	11.95	5.21	do.
9472	Union Spice Co., New York, Celebrated Compound Cloves.	*Hartford.* Union Pacific Tea Co., 174 Asylum St.	9472	10	3	7.00	....	7.25	5.21	Contains ground cocoanut shells & starchy matter.
9460	Upson Bros., Absolutely Pure Cloves.	*Southington.* Upson Bros.	9460	14	4	6.90	....	16.57	5.84	Not found adulterated.
	Allpsice.									
9466	Allyn & Blanchard Co., Hartford, Strictly Pure Allspice.	*Southington.* Finch & Laity.	9466	10	3	5.14	....	1.47	5.50	do.
9209	Augur & Tuttle, New Haven, Crescent Mills Pure Allspice.	*New Haven.* S. S. Adams, 412 State St.	9209	10	4	9.20	1.09	1.49	3.85	Adulterated with ground cocoanut shells.
9220	Austin, Nichols & Co., New York, Blue Ribbon Pure Allspice.	Johnson & Bro., 411 State St.	9220	10	4	5.56	....	2.49	4.15	Not found adulterated.

* In glass pepper-shaker.

TABLE XXII—SPICES BOUGHT IN SEALED AND LABELED PACKAGES—*Continued.*

Station No.	Brand.	Dealer.	Price per package, cents.	Ounces in package.	Ash. Total.	Ash. Insoluble in HCl. (Sand).	Ether extract. Volatile.	Ether extract. Non-volatile.	Remarks.
	Allspice — Continued.								
9516	Bennett, Simpson & Co., London, Genuine Pimento or Allspice.	*Norwich.* H. I. Palmer, 231 Union St.	15	4	4.54	....	2.16	6.22	Not found adulterated.
9016	Birdsey, C. K., Bridgeport, Allspice.	*Bridgeport.* Centennial Tea Co., 856 Main St.	10	4	4.11	....	2.75	3.02	Adulterated with ground cocoanut shells.
9499	Bransfield, John, Strictly Pure Allspice.	*Portland.* John Bransfield.	10	4	4.74	...	2.55	5.00	Not found adulterated.
9435	Colburn Co., The A., Philadelphia, Choicest Jamaica Allspice.	*New Haven.* G. J. Burt, 894 State St.	15*	3½	6.31	.40	2.93	5.66	do.
9428	Durkee & Co., E. R., Allspice.	do.	10	2½	7.51	.95	1.34	3.79	do.
9231	Farrington & Co., F. R , New York and Boston, Pure Allspice.	S. S. Adams, 412 State St.	5	4	5.96	...	3.50	3.48	do.
9479	Hills & Co., Gold Seal Allspice.	*Hartford.* Hills & Co., 372 Asylum St.	12	4	4.75	...	3.35	3.91	do.
9491	Howard & Co., New York, Pure Jamaica Allspice.	*Waterbury.* The Hewitt Grocery Co., 20 N. Main St.	15	4	4.59	....	1.40	6.27	do.
9502	Kibbe & Co., E. S., Hartford, Pure Allspice.	*Portland.* C. A. Ahlquist.	12	4	5.18	....	1.77	5.77	do.
9515	Pinckney & Co., H. F. A., London. Allspice.	*Norwich.* W. A. Church, 20 Market St.	15	4	5.71	....	1.67	4.92	do.
9446	Slade Co., D. & L., Boston, Absolutely Pure Allspice	*Wallingford.* Laden Bros.	10	4	4.34	....	1.35	4.20	do.
9448	Sovereign Trading Co., Pure Allspice.	*New Britain.* Sovereign Trading Co., 282 Main St.	10	4	4.98	....	2.84	3.22	do.
9208	Square Deal Pure Spices, Allspice.	*New Haven.* S. S. Adams, 412 State St.	10	4½	9.34	1.52	2.17	3.57	Adulterated with clove stems.
9426	Stickney & Poor's Pure Allspice.	D. M. Welch & Son, 8 Grand Ave.	10	2½	4.96	....	3.39	3.68	Not found adulterated.
9424	Sultana Spice Mills, A. & P., Allspice.	Atlantic & Pacific Tea Co., 386 State St.	10	2½	5.05	...	2.22	4.07	do.
9333	Tiger Mills, New York, Pure Allspice.	*Putnam.* A. C. Stetson.	18	8	4.52	....	2.49	3.78	do.
9473	Union Spice Co., New York, Celebrated Allspice.	*Hartford.* Union Pacific Tea Co., 174 Asylum St.	10	3	9.62	2.95	3.94	3.17	Too much sand.
9462	Upson Bros., Absolutely Pure Allspice.	*Southington.* Upson Bros.	10	4	5.74	....	2.06	3.36	Not found adulterated.

* In glass pepper-shaker.

TABLE XXII.—SPICES BOUGHT IN SEALED AND LABELED PACKAGES—*Continued.*

Station No.	Brand.	Dealer.	Price per package, cents.	Ounces in package.	Ash. Total.	Ash. Insoluble in HCl. (Sand).	Remarks.
	Cinnamon.						
9465	Allyn & Blanchard Co., Hartford, Strictly Pure Cinnamon.	*Southington.* Finch & Laity.	10	3	4.79	....	Not found adulterated.
9419	Augur, John P., New Haven, Crescent Mills Pure Cinnamon.	*New Haven.* Philip Hugo, 11 Edwards St.	10	4	5.11	....	do.
9050	Austin, Nichols & Co., New York, Blue Ribbon Pure Cinnamon.	*Greenwich.* Knapp & Studwell.	10	4	4.86	....	do.
9085	Beard & Co., Samuel S., New York, Pure Cinnamon.	*Stamford.* H. Sawyer Daskam.	13	4	5.04	....	do.
9222	Bennett, Simpson & Co., London, Genuine Penang Cinnamon.	*New Haven.* Johnson & Bro., 411 State St.	15	4	5.26	....	do.
9503	Bryan, Miner & Read, New Haven, Pure Cassia.	*Portland.* C. A. Ahlquist.	15	4	2.70	....	do.
9519	Bugbee & Brownell, Providence, Pure Cinnamon.	*Norwich.* A. T. Otis, 261 Main St.	15	4	6.84	....	do.
9497	Bushnell Co., The F. C., New Haven, Absolutely Pure Cinnamon.	*Waterbury.* Thos. Gray, 26 N. Main St.	10	4	3.88	....	do.
9416	Clark, Chapin & Bushnell, New York, Pure Cinnamon.	*Ansonia.* W. H. Bronson, 234 Main St.	10	3	8.02	3.15	do.
9184	Clark, Chapin & Bushnell, New York, Diamond Absolutely Pure Cinnamon.	*New Haven.* Coe & Jenks, 422 State St.	15	4	4.70	....	do.
9432	Colburn Co., The A., Philadelphia, Choicest Java Cinnamon.	G. J. Burt, 894 State St.	15	3½*	4.93	....	do.
9513	Daniels, Cornell & Co., New London, Strictly Pure Cinnamon.	*Groton.* H. E. Marquidt.	10	4	3.18	....	do.
9430	Durkee & Co., E. R., New York, XXX Cinnamon.	*New Haven.* G. J. Burt, 894 State St.	10	2½	5.15	....	do.
9229	Farrington & Co., F. R., New York and Boston, Pure Cinnamon.	S. S. Adams, 412 State St.	5	4	4.37	....	do.
9511	Leggett & Co., Francis H., New York, Best Cinnamon.	*Madison.* F. C. Dowd.	12	4	4.76	....	Contains ginger.
9095	Lincoln, Seyms & Co., Hartford, Pure Cinnamon.	*Hartford.* H. E. Hills & Co., 547 Main St.	12	4	5.89	....	Not found adulterated.
9057	Montanye & Co., W. H., New York, Pure Cinnamon.	*Greenwich.* J. L. Mahoney.	12	4	8.40	4.49	do.
9525	Slade Co., D. & L., Boston, Absolutely Pure Cinnamon.	*New Haven.* I. B. Chandler, 101 Dixwell Ave.	9	4	3.71	....	do.
9449	Sovereign Trading Co., Pure Saigon Cinnamon.	*New Britain.* Sovereign Trading Co., 282 Main St.	10	4	5.02	....	do.
9500	Stickney & Poor, Boston, Absolutely Pure Cassia.	*Portland.* John Bransfield.	15	4	4.24	....	do.
9413	Stickney & Poor, Pure Cinnamon.	*Ansonia.* D. M. Welch & Son, Main St.	10	2½	5.05	....	do.
9422	Sultana Spice Mills, New York, A. & P. Cinnamon.	*New Haven.* Atlantic & Pacific Tea Co., 386 State St.	10	2½	7.15	2.24	do.
9474	Union Spice Co., Pure Cinnamon.	*Hartford.* Union Pacific Tea Co., 174 Asylum St.	10	3	7.27	3.07	do.

* In glass pepper-shaker.

TABLE XXII.—SPICES BOUGHT IN SEALED AND LABELED PACKAGES.—*Concluded.*

Station No.	Brand.	Dealer.	Price per package, cents.	Ounces in package.	Ash. Total.	Ash. Insoluble in H Cl. (Sand).	Remarks.
9329	Union Spice Co., Pure Cinnamon.	*Putnam.* Union Pacific Tea Co.	10	3	5.87	...	Not found adulterated.
9457	Upson Bros., Absolutely Pure Cinnamon.	*Southington.* Upson Bros.	12	4	4.24	....	Contains ginger.
9039	No manufacturer given, Pure Cinnamon.	*Bridgeport.* The Village Market, Main St.	6	2½	5.44	....	Not found adulterated.
	Nutmeg.						
7324	Bennett, Simpson & Co., London, Penang Nutmeg.	*Hartford.* Woodward & Co., 174 Asylum St.	25	4*	7.34	...	do.
9298	Farrington & Co., F. R., New York, Pure Nutmeg.	*New London.* J. E. St. John, 265 Bank St.	10	2	8.46	....	do.
9484	Hills & Co., Gold Seal Nutmeg.	*Hartford.* Hills & Co., 372 Asylum St.	25	2*	6.59	....	do.
9060	Montanye & Co., W. H., New York, Pure Nutmeg.	*Greenwich.* J. L. Mahoney,	28	4	3.47	....	do.
7353	Slade Co., D. & L., Boston, Epicurean Nutmeg.	*Willimantic.* Frank Larrebee, 16 Church St.	15	2	6.10	....	do.
7385	No manufacturer given, Ground Nutmegs.	H. C. Hall, 17 Union St.	15	2	6.37	...	do.

* In glass pepper-shaker.

THE CHEMICAL COMPOSITION OF AUTHENTIC SAMPLES OF SPICES AND SPICE ADULTERANTS.

BY A. L. WINTON, A. W. OGDEN, AND W. L. MITCHELL.

The microscope is, without doubt, the most valuable means of detecting adulteration in ground spices, as it furnishes direct ocular evidence and usually discloses the nature of the foreign material present. But since mineral matters and some other spice adulterants do not have very distinctive microscopic characters, it is necessary to resort to chemical analysis for their detection. Furthermore, the results of quantitative chemical determinations often confirm the conclusions reached by microscopic examination and, in cases of adulteration, furnish data for estimating roughly the percentage of foreign matter present.

A knowledge of the composition of the various grades of whole spices on the market is essential for the proper interpretation of analyses of samples of ground spices of unknown origin.

In 1887, Richardson* published a most valuable report on spices and spice adulteration, in which are given full descriptions of the nature and preparation of the various spices, the quantities imported into the United States, the adulterations practiced, and the methods for detecting adulteration. The report also contains analyses of 42 samples of whole spices, ground in the laboratory of the Department of Agriculture, and of numerous samples of ground spices collected in the open market.

Richardson's analyses of whole spices from the American market are, practically, all that have been published up to date, and have been very generally consulted in interpreting results on suspected samples; but grades of some of the spices are now on the market which were not obtainable at the time that Richardson collected his samples, and, furthermore, since his report appeared new methods of analysis have been devised.

* U. S. Dept. of Agr., Div. of Chem., Bull. 13, Part II.

In our examinations of ground spices the need of further analyses of whole spices has been apparent, and during the present year opportunity was presented for this work.

In response to our request, four of the leading spice importers of the country, namely — E. R. Durkee & Co., Francis H. Leggett & Co., and Austin, Nichols & Co., all of New York, and D. & L. Slade Co. of Boston, courteously granted us permission to sample all the goods in their stock, and also offered us their assistance in other ways.

During the months of August and September, 101 samples of pure whole spices were carefully drawn by a representative of the station from original, unbroken, import packages, in warehouses at New York and Boston. Whenever possible, several packages were opened in drawing each sample.

The firms mentioned, through their knowledge of the trade, also secured for us samples of damaged spices and some of the by-products from spices, which are often mixed with ground spices and are generally rated by official analysts as adulterants.

Various samples of ground nut shells, fruit stones, sawdust, and some other materials used as adulterants, were prepared in the station laboratory.

The samples collected may be classified as follows:

Black pepper,	14 samples.
White pepper,	10 "
Cayenne pepper,	8 "
Ginger,	18 "
Ceylon cinnamon,	6 "
Cassia,	21 "
Cassia buds,	2 "
Cloves,	8 "
Allspice,	3 "
Nutmegs,	5 "
Mace,	6 "
Spice by-products and adulterants,	24 "
Total,	125 samples.

The cereal products used as adulterants have been frequently analyzed in various laboratories, to determine their feeding value, and these analyses we deemed sufficient for our purpose, without collecting and analyzing new samples.

Preparation of Samples.

From one to two pounds of each sample are ground in a steel mill, so as to pass a sieve with round holes 1/25 inch in diameter. This grinding is usually sufficient, but for the determination of starch in white pepper by the diastase method, it is necessary to reduce to a finer powder in a mortar, as, otherwise, the starch is not completely extracted from the hard grains of endosperm.

Methods of Analysis.

Moisture. Two grams are dried at 110° C. to constant weight. From the loss in weight thus sustained is subtracted the amount of volatile ether extract, the difference being moisture.

Total Ash. Two grams are incinerated in a muffle furnace, at a heat below redness.

Ash Soluble in Water. The ash prepared as above is boiled with 50 cc. of water and the insoluble portion collected on a Gooch crucible, washed with hot water, dried, ignited, and weighed. The percentage of insoluble ash thus determined, subtracted from the percentage of total ash, leaves the percentage of water-soluble ash.

Ash Insoluble in Hydrochloric Acid, or "Sand." Two grams of the incinerated material are boiled with 25 cc. of 10 per cent. hydrochloric acid and the insoluble matter collected in a Gooch crucible, washed with hot water, ignited, and weighed.

Lime. A weighed portion is incinerated and the ash dissolved in boiling hydrochloric acid. If soluble silica is present, it is separated in the usual manner. The acid solution, nearly neutralized with ammonium hydrate, is heated to about, but not above 50° C. 3 cc. of acetic acid and ammonium acetate in sufficient quantity are added and the solution is vigorously stirred. When the precipitate of iron phosphate, or of iron phosphate and basic acetate, has settled, it is filtered and washed with water containing a little ammonium acetate. To the filtrate, without neutralizing the acetic acid, ammonium oxalate is added and the precipitate of calcium oxalate collected on a filter, converted into oxide by ignition and weighed.

Volatile and Non-Volatile Ether Extract. The method is that described by Richardson.* Two grams of the ground material are extracted for 20 hours in a Johnson extractor † with absolute ether. The ethereal solution is transferred to a tared capsule and the ether allowed to evaporate at the room temperature. After standing 18 hours over sulphuric acid, the total ether extract is weighed. The extract is then heated, first at 100° for 6 hours and then at 110°, until the weight becomes constant, the loss being the volatile oil; the residue, the non-volatile ether extract.

Absolutely complete extraction of spices, even after treatment with ether for several days, is hardly possible, but the results which follow, Table XXIII, show that, for all practical purposes, extraction for 20 hours is sufficient.

* U. S. Dept. Agr., Div. Chem., Bull. 13, Part II, 165.

† Amer. Jour. Sci., March, 1877, 196.

Table XXIII. Ether-extract from Pure Spices.

	Average per cent. of Ether-extract removed.		
	During 1st 10 hours extraction.	Between 10th and 20th hours of extraction.	Between 20th and 30th hours of extraction.
Allspice. Three samples,	9.28	0.28	0.18
Black Pepper. Eight samples,	9.40	0.14	0.08
Cassia. Three Samples,	5.87	0.27	0.10
Cassia Buds. Two samples,	9.37	0.33	0.14
Cayenne. Eight samples,	20.59	0.43	0.20
Cloves. Eight samples,	25.18	0.25	0.16
Clove Stems. Two samples,	8.56	0.16	0.10
Cinnamon. Three samples,	2.63	0.26	0.19
Ginger. One sample,	4.32	0.18	0.11
Mace. Five samples,	31.53	0.25	0.21
Nutmeg. Two samples,	39.08	0.19	0.11

Alcohol Extract. — Two grams of material are placed in a 100 cc. flask, which is filled to the mark with ninety-five per cent. alcohol (sp. gr. 0.817). The flask is stoppered and allowed to stand twenty-four hours, being shaken every thirty minutes during the first eight hours. The extract is then filtered through a dry filter, and 50 cc. are evaporated to dryness in a flat-bottomed aluminium dish on a water bath, and heated to constant weight at 110° C. The result is practically the same when the time of extraction is forty-eight instead of twenty-four hours.

It is not claimed that this method extracts all matter soluble in alcohol; in fact, the residues separated from the solutions by filtration, when treated for twenty-four hours longer with a fresh portion of ninety-six per cent. alcohol, yield small additional amounts of extract; but the method gives nearly the full amount of extract and the results are concordant; whereas, extraction in a Soxhlet apparatus, if continued until no more extract is removed, is almost an interminable operation, and, as it is difficult to keep the strength and temperature of the extracting alcohol constant, does not give satisfactory results.

Copper-Reducing Matters by Direct Inversion. — Four grams are extracted with ether and washed on a filter that will completely retain the smallest starch granules,* with 150 cc. of ten per cent. alcohol.† Weak alcohol is employed instead of water, because, as pointed out by Lindsey, it is not so liable to carry starch granules through the paper. The residue is transferred to a 500 cc. flask, with 200 cc. of water; 20 cc. of hydrochloric acid (sp. gr. 1.125) are added and

* Schleicher and Schüll's No. 589 blue ribbon washed filters were found satisfactory.

† As Batavia cassia forms with water or dilute alcohol a glutinous mass which clogs the filter, it is not possible to wash samples of this cassia with either liquid previous to inversion, and, for the sake of uniformity, this treatment is also omitted in the determinations made on the other varieties of cassia, as well as on cassia buds and cinnamon.

the whole heated on a boiling water bath for three hours (Sachsse's Method*). After cooling, the solution is nearly, but not quite, neutralized with sodium hydrate solution, made up to 500 cc. and filtered through a dry paper. Reducing matters are determined by Allihn's method,† as follows:

Thirty cc. of a solution containing 173 grams of Rochelle salt and 125 grams of caustic potash in 500 cc. of water, and 30 cc. of a solution of 34.69 grams of pure crystallized copper sulphate in 500 cc. of water are mixed in a beaker of 200 cc. capacity and the mixture heated to boiling. To the boiling liquid, without delay, are added 25 cc. of the solution to be examined, and the heating further continued until boiling begins again. After the reduced copper suboxide has settled it is collected on a Gooch crucible, dried at a moderate heat, and finally, heated *carefully* for three to five minutes at dull redness, care being taken to avoid a bright red heat and to allow access of sufficient air to complete the oxidation to copper oxide. After weighing, the heating should, in all cases, be repeated, to make certain that the oxidation is complete.

From the weight of copper oxide is calculated the weight of metallic copper, the factor .7986 being used, and the corresponding amount of dextrose is found in Allihn's tables. From the weight of dextrose, that of starch is calculated by using the factor 0.9.

In the preparation of asbestos pulp for use in the Gooch crucible, woolly asbestos is cut into small pieces, boiled with hydrochloric acid and washed free from acid and fine particles on a sieve with $\frac{1}{25}$ inch meshes. This asbestos, when packed in the crucibles with the aid of a blunt glass rod, retains completely the finely divided copper suboxide, which is not true of the long fiber variety usually employed in filtering coarser precipitates.

To test the accuracy of the oxidation method, six precipitates which had been weighed as oxide were reduced in hydrogen and weighed as metallic copper.‡ The following are the results:

Station No.	Material.	CuO.	Cu.	
			Calculated from CuO.	Obtained by reduction.
		Gram.	Gram.	Gram.
9688	Decorticated white pepper, ...	0.3450	0.2755	0.2755
9643	Siam white pepper, ...	.3170	.2532	.2531
9644	Singapore white pepper, ...	.3039	.2428	.2433
9682	Pin-head pepper, ...	.1600	.1278	.1281
9684	Pepper shells (hulls and dust), . . .	.1185	.0946	.0948
9690	Pepper shells (hulls), ...	.0600	.0479	.0480

* Chem. Centralbl., 1877, 732. This Station Rep., 1887, 132.

† Jour. Prakt. Chem., *22*, 52. This Station Rep., 1887, 129.

‡ Compare Bartlett, Maine Ag. Ex. Sta. Rep., 1888, 207.

Starch by Diastase Method. — The method employed, except in minor details, is that described by Maercker.*

Four grams of the finely ground material are extracted with ether and ten per cent. alcohol, as described in the preceding section. The wet residue is rubbed up thoroughly in a mortar, washed into a beaker with 100 cc. of water, and made into a paste by boiling for thirty minutes. To prevent sticking to the bottom of the beaker and burning, the heating is performed on an asbestos plate and the liquid is constantly stirred with a rod. The water lost by evaporation is replaced and the beaker immersed in a water bath kept at from 55° to 60° C. When the liquid has cooled to the temperature of the bath, 10 cc. of freshly prepared malt extract† are added and the mixture digested for one hour, with occasional stirring. It is then boiled a second time for fifteen minutes, cooled, and digested, as before, with another portion of 10 cc. of malt extract. After heating to boiling the third time, the liquid is made up to 250 cc. in a graduated flask, filtered through dry paper and 200 cc. of the filtrate removed to a 500 cc. flask. The inversion with acid and determination of the reducing power is conducted as has been described, making a correction for the copper reduced by the added malt extract, which is determined by blank analyses. The residue after the malt digestion, when examined microscopically, should be entirely free from starch.

Cayenne pepper, mustard, and certain other materials, which are practically free from starch — as is shown by the microscope — when treated by the method just described, yield very little or no copper-reducing matter. This treatment is, therefore, without effect on the cellulose, pentosans, or other matters in the spices named, although they yield copper reducing material on treatment with acid.

On the other hand, in decorticated white pepper and Jamaica ginger, which contain little besides starch that is affected by acid, practically the same results are obtained by the diastase method as by direct inversion with acids.

This determination of starch is very valuable as a means of detecting starchy adulterants in spices normally free from starch, and non-starchy adulterants in spices which contain starch.

Crude Fiber is determined by the method of the Association of Official Agricultural Chemists,‡ with slight modifications:

The residue from the determination of ether extract is placed in a 500 cc. Erlenmeyer flask and 200 cc. of boiling 1.25 per cent. sulphuric acid are added. The flask is loosely covered and the liquid heated at once to gentle boiling. The boiling is continued thirty minutes. The solution is filtered on a paper, washed with hot water, and rinsed back into the same flask, with 200 cc. of boiling 1.25 per cent. solution of sodium hydrate nearly free from carbonate. After boiling as before for thirty minutes, the fiber is collected on a weighed paper, thoroughly

* Handbuch der Spiritusfabrikation, 7th Ed., 1898, 109. See also Wiley, Principles and Practice of Agricultural Analysis, 1897, Vol. III, 198.

† Prepared by digesting for two or three hours 100 grams of powdered malt with 1000 cc. of water and filtering.

‡ U. S. Dept. of Agr., Div. Chem., Bull. 46, 63.

washed with hot water, and finally washed with a little alcohol and ether, dried to constant weight at 100° C. and weighed.

The amount of ash in the fiber is determined by incineration, and deducted from the total weight.

Nitrogen by the Kjeldahl Method. — Nitrogen is determined in all the spices, except black and white pepper, by the usual Kjeldahl method.*

Nitrogen by the Gunning-Arnold method. — As nitrogen cannot be accurately determined in black and white pepper by the Kjeldahl method, owing to the presence of piperine, the Gunning-Arnold method is used to determine nitrogen, both in pepper and in the ether extract from the pepper.†

One gram of the material is mixed in a 600 cc. Jena flask with one gram of cupric sulphate, one gram of red oxide of mercury, fifteen to eighteen grams of potassium sulphate, and 25 cc. of sulphuric acid. After heating gently without shaking until frothing ceases, the mixture is boiled from three to four hours. When nearly cool, about 300 cc. of water, 50 cc. of potassium sulphide solution and sodium hydrate solution to alkaline reaction are added and the ammonia is distilled and titrated as usual.

The following percentages of nitrogen were obtained on chemically pure piperine: —

Gunning-Arnold method,	4.77, 4.77, 4.79, and 4.83 per cent.
Absolute method,	4.92 per cent.
Theory,	4.91 " "

By the Kjeldahl and by the Gunning method, percentages ranging from 2.06 to 3.8 were obtained.

The determination by the absolute method was made by Mr. Campbell.

Nitrogen in the Ether Extract. — Ten grams of material are extracted for twenty hours in a Johnson extractor, the extract being collected in a weighed Jena flask of about 250 cc. capacity. The ether is evaporated and the flask with contents is heated, first at 100°, and, finally, to constant weight at 110°. Nitrogen is determined in the weighed extract by the Gunning-Arnold method, as already described.

Cold Water Extract. — Four grams of the material are placed in a 200 cc. flask and water added to the mark. The flask is tightly stoppered and shaken at half-hour intervals during eight hours, after which it is allowed to stand sixteen hours without shaking. A 50 cc. portion of the filtered solution is transferred to a tared aluminium dish and evaporated to dryness on a water bath. The residue is dried to constant weight at 100° C. in a drying oven, two hours' heating being usually sufficient.

This method is much more easily carried out and gives more concordant and somewhat higher results than extraction on a filter, with the same volume of water added in successive portions. Complete extraction on a filter was found impossible.

* U. S. Dept. of Agr., Div. Chem., Bull. 46, 16.

† Ztschr. Anal. Chem., 31, 525.

*Tannin Equivalent.** — Two grams of material in a paper cylinder are extracted twenty hours with Squibbs' absolute ether. The residue is boiled for two hours with 300 cc. water, cooled, made up to 500 cc , and filtered.

Twenty-five cc. of the filtrate are measured into a flask of about 1,200 cc. capacity; 20 cc. of indigo solution and 750 cc. distilled water are added and standard potassium permanganate run in at the rate of one or two drops a second, with constant shaking, until a bright golden yellow is obtained.

The reducing power of 20 cc. of indigo solution is determined in exactly the same manner.

The number of cc. of permanganate required to oxidize the tannin and indigo together, less the amount necessary to oxidize 20 cc. indigo solution alone, gives the number of cc. equivalent to the tannin present.

Standard potassium permanganate is prepared by dissolving 1.333 grams of the pure salt in 1,000 cc. of water. It is standardized by the titration of 10 cc. of decinormal oxalic acid (6.3 grams of pure crystallized acid in 1,000 cc.) which have previously been diluted to 500 cc., heated to 60° C., and mixed with 20 cc. of dilute sulphuric acid (1.3). The permanganate is added slowly, with constant stirring, until a pink color appears.

Indigo solution must be made from sodium sulphindigotate of good quality, otherwise the titration will not be sharp.† Six grams of the salt are dissolved in 500 cc. of water, with the aid of heat, cooled, mixed with 50 cc. of concentrated sulphuric acid, made up to one liter and filtered.

Ten cc. of decinormal oxalic acid solution are equivalent to 0.06235 grams of quercitannic acid, or 0.008 grams of "oxygen absorbed."

The value of the method for the examination of cloves is apparent when the "tannin equivalent" of pure cloves is compared with that of the common adulterants of cloves.

Determinations of tannin equivalent were also made on a few samples of other spices, but the results, as will be seen from the following table, are too low to be of much diagnostic value:

Station No.	Material.	Oxygen Equivalent.	Calculated as Quercitannic Acid.
9631	Cassia,	0.50	3.90
9640	Cinnamon,	0.98	7.80
9618	Ginger,	0.03	.26
9677	Mace,	0.16	1.30
9617	Nutmegs,	0.33	2.60
9610	Red Pepper,	0.13	1.04
9654	Red Pepper,	0.33	2.60
9714	Black Pepper,	0.33	2.60
9690	Pepper Shells,	0.43	3.38
9692	Long Pepper,	0.13	1.04
9609	Cassia Buds,	1.13	8.84

* See U. S. Dept. Ag., Div. Chem., Bull. 13, Part II, 167. Also Allen, Commercial Organic Analysis, 1889, Vol. III, Part I, p. 109 *et seq.*

† The indigocarmin of G. Grueber & Co., Leipsic, is adapted for the purpose.

Notes on the Samples Examined.

Black Pepper, Pepper By-products and Adulterants.

Singapore black pepper, it is stated, is dried over fires in the gambier plantations, and has, in consequence, a strong smoky odor. The berries are hard and perfect. The other varieties of black pepper are usually sun dried.

Singapore, Tellicherry, and Lampong are at present valued in the order stated, although there is but little difference in price.

Acheen, Sumatra, or Penang is of poorer quality and contains more or less empty berries, many of which are broken during transportation. Formerly there were two grades, the East Coast and the West Coast, the latter being considered the better, but the pepper from Sumatra is now graded by the London Produce Brokers' Association as follows:

Class A. One imperial gallon should weigh at least four pounds thirteen ounces (481 grams per liter).

Class B. One imperial gallon should weigh at least four pounds five ounces (431 grams per liter).

Class C. One imperial gallon should weigh at least three pounds thirteen ounces (381 grams per liter).

Class D. One imperial gallon should weigh at least three pounds nine ounces (356 grams per liter).

Class A is the same as West Coast Sumatra, and some lots run over five pounds to the gallon. None of the grades should contain over three per cent. of "dust," which term includes stalks, stone, clay, and other foreign matter.

Messrs. E. R. Durkee & Co. supplied the results of actual tests of the samples procured from them, which are as follows:

No. 9646.* Four pounds fourteen ounces per gallon (488 grams per liter), three and one-half to four per cent. dust.

No. 9647. Four pounds per gallon (400 grams per liter), four per cent. dust.

No. 9648. Three pounds ten ounces per gallon (362 grams per liter).

No. 9682, pin-head pepper, is a mixture of small pepper corns with a large amount of shells.

* The numbers refer to samples whose analyses are given on pp. 198 and 199.

Pepper shells is the trade name for a mixture of hulls and dust obtained as a by-product in the preparation of white pepper. Nos. 9689 and 9684 contain not only shells, but a large amount of powdered material, and represent fairly the goods frequently sold as pepper shells. No. 9690 consists almost entirely of hulls, such as are always present in small amount in the lower grades of Acheen.

Long pepper, the fruit of *Piper longum*, is occasionally used as an adulterant for black pepper. One sample, No. 9692, was analyzed.

White Pepper.

Decorticated white pepper (Nos. 9641 and 9688) consists of hard, smooth kernels which, for the most part, are entirely free from the seed coats. Singapore and Siam white pepper are at present of about the same quality and cost. The samples of Penang drawn by us are all coated with a dirty brown material consisting chiefly of carbonate of lime.

Cayenne Pepper.

The samples of Japan cayenne or chillies are entirely free from stems and calyxes. The pods are about 2 cm. long and 0.5 cm. broad at the broadest part, and of a most brilliant red color.

Zanzibar cayenne is one of the best varieties used for grinding, although at present the quality is rather poor. In the samples examined the slender pods vary in length from 0.5 to 2.0 cm., and are of a dull red or brown color. The stems and calyxes are present, but usually detached from the pods.

Capsicums, or "Bombay peppers," are a low grade of chillies which are now said to come from the vicinity of the river Niger, in Africa. In the samples examined, which are free from stems and calyxes, the brown or yellow brown pods are 2 to 3 cm. long and nearly 1 cm. broad.

Ginger and Ginger By-products.

Two grades of Jamaica ginger come into our market, the "scraped" or "unbleached" and the "bleached" or "limed." The bleached root appears to be the same product as the unbleached, except for a coating of chalk which serves as a protection against the destructive drugstore beetle and other insects.

Cochin ginger (also called Borneo ginger) is of several grades. No. 9670 is stated to be rough washed, but not bleached. No. 9678 has been "cut" (trimmed), scraped, and limed. The samples graded A, B, C, are of light color and fine appearance, but neither scraped nor limed. The roots of D Cochin are not as thick as the A, B, C, and are darker in color.

Both samples of Japan ginger, Nos. 9656 and 9725, consist of short, thick pieces of root coated with lime, and resemble the cut and scraped Cochin, No. 9678.

African ginger (also known as Sierra Leone) and Calcutta ginger (also known as East India) are both dark-colored, unattractive products. Of these the African is much the better in quality, although at present it is sold for about the same price as the Calcutta.

No. 9681, rejections from D Cochin, and No. 9693, ginger cuttings or clippings, should be considered as a ginger by-product and not as ginger.

One of the samples of exhausted ginger, No. 9727, is stated to have come from an English ginger-ale works; the other, No. 9368, is from an extract factory.

Cinnamon, Cassia, and Cassia Buds.

Ceylon, or true cinnamon, is graded according to the diameter of the composite quills, No. 1 extra being the smallest. It is now seldom used in the United States as a spice, the so-called ground cinnamon being prepared from cassia bark or buds.

Saigon cassia, the best grade of cassia, varies in size from pieces scarcely thicker than a sheet of writing paper to coarse bark, one-eighth inch or more in thickness. It is put up in bundles weighing three to four pounds, each consisting entirely of thick, thin, or medium thickness bark. Several bundles of different sized bark are packed in the same mat. The thin bark is considered the strongest. Two samples of broken Saigon (Nos. 9636 and 9707) are of good quality, but No. 9698, graded as No. 2, is inferior, containing pieces of bark one-quarter inch in thickness.

Batavia cassia comes in two grades, No. 1 and No. 2, the latter, which is also known as broken Batavia or short stick, is not so well scraped as No. 1 and comes in shorter pieces.

Whole China cassia is packed in mats containing two bundles of about two pounds each. The outer pieces in the bundles are a foot or more long, but the interior contains chips, and often, more or less dirt. The frosts of some years ago killed many of the trees in China, and it has been stated that the bark of the dead trees is now put on the market. The sample of broken China cassia, No. 9737, owing to the dirt it contains, is entirely unfit for consumption. In order to accurately arrive at the composition, a bale of sixty pounds was separated into two parts, by sifting through a one-quarter inch mesh, and each part was separately analyzed.

One hundred of the cassia buds from No. 9609 weigh 6.15 grams, and from No. 9665 weigh 6.03 grams.

Cloves and Clove Stems.

No particulars other than are given in the table were learned.

Allspice.

No two of the samples are alike in appearance, and it is not remarkable that the analyses show a wide variation in composition.

Nutmegs.

True nutmegs are the dried seed kernels of *Myristica fragrans*, Houttuyn. Of the better grades, the brown (*i. e.* unlimed) Penang nutmegs are sold to some extent in the United States, but not so commonly as the limed kernels from Banda and Singapore.

The Singapore nutmegs examined (Nos. 9617, 9664, and 9719) are from 2.2 to 2.8 cm. long, and from 1.7 to 2.1 cm. broad.

The Padang nutmegs (No. 9673) are deeply wrinkled on the surface and extremely variable in form and size, ranging in length from 2 to 2.9 cm., and in breadth from 1.5 to 2.1 cm.

The so-called Macassar nutmegs, which are probably the same as those known in Europe as Papua or long nutmegs (the seed kernels of *M. argentea*, Warb.), are inferior to the true nutmegs. In the sample examined the kernels are from 2.6 to 3.6 cm. long, and from 1.6 to 2.1 cm. broad.

The sample of grinding nutmegs, No. 9696, consists of abortive and insect-eaten kernels, with some nutmeg shells, and is entirely unfit for consumption. The starchy portion of the insect-eaten kernels has been entirely devoured, leaving only the resinous veins in the interior. On the surface are holes through which the insect emerged. Many of these nutmegs can be readily crushed between the fingers.

Mace.

The true or sweet mace (the seed mantle or arillus of *Myristica fragrans*, Houttuyn) which comes into this country is designated Banda, Penang, Singapore, and Batavia, or Padang, according to its origin. As the product from any of these localities may be good or bad, it is customary to value mace more by its appearance than by its place of growth.

The sample of Banda mace, No. 9619, and the two samples of No. 1 Penang mace, Nos. 9662 and 9717, are of good quality and alike in appearance. No. 9677 (No. 2 Penang) is somewhat inferior.

The "grinding mace," No. 9694, is evidently damaged.

Macassar or wild mace, the arillus of *Myristica argentea*, Warb., has a strong wintergreen flavor, but is considered inferior to the varieties of true or sweet mace. The sample analyzed, No. 9675, contains a few shells of the nutmeg, in addition to the arillus.

Bombay mace, from *Myristica Malabarica*, Lamark, must be regarded as an adulterant. The sample examined, No. 9676, has no value whatever as a spice.

WHOLESALE QUOTATIONS OF SPICES, SEPT. 12, 1898.

Cassia, Batavia, No. 1,	Per lb.,	17 @ 18
broken,		13 @ 15
Canton, matted rolls,		8¾ @ 9
broken,		6¼ @ 7½
Saigon, rolls,		48 @ 52
broken,		37 @ 38
Buds,		23½ @ 25
Cloves, Amboyna,		10¾ @ 12
Zanzibar,		8¾ @ 9
stems,		— @ 4½
Ginger, African,		4¾ @ 5
Calcutta,		4⅝ @ 5
Cochin, A, B, C,		6¼ @ 6¾
D,		5 @ 5½
Jamaica, bleached,		19 @ 20
unbleached,		17 @ 20
Mace, Banda,		45 @ 48
Batavia,		33½ @ 38
Penang,		43 @ 45
Nutmegs, 110's,		32 @ 32½
Pepper, black, Acheen,		9⅛ @ 9½
Singapore,		9⅜ @ 9¾
West Coast Sumatra,		9½ @ —
white, Penang,		16¼ @ 16¾
Singapore,		18 @ 18¼
red, capsicums,		7¼ @ 8½
Zanzibar,		11 @ 12
Pimento, Jamaica, prime,		9¾ @ 10½

TABLE XXIV. BLACK PEPPER, WHITE PEPPER, BY-PRODUCTS, AND ADULTERANTS.

Station No.		Importer.	Weight of 1 litre in grams.	Weight of 100 corns, in grams.	Moisture.	Ash. Total.	Ash. Soluble in water.	Ash. Insoluble in HCl.	Ether extract. Volatile.	Ether extract. Non-volatile.	Alcohol extract.	Reducing matters by direct inversion calculated as starch.	Starch by diastase method.	Crude fiber.	Total N. less N. in non-volatile ether extract × 6¼.	Nitrogen. Total.	Nitrogen. In non-volatile ether extract.	Parts of N. in 100 parts non-volatile ether extract.
	Black Pepper:																	
9712	Singapore,	Austin, Nichols & Co., New York,	452.	4.06	12.43	3.68	2.26	0.15	1.10	7.89	9.35	41.36	37.50	11.67	12.31	2.28	0.31	3.92
9649	"	E. R. Durkee & Co., New York,	474.	5.26	11.88	3.09	1.75	0.13	1.08	7.92	8.95	43.47	36.81	10.76	13.81	2.53	0.32	4.05
9614	"	D. & L. Slade Co., Boston,	493.	5.46	11.47	3.54	2.04	0.07	1.08	7.36	8.77	43.26	39.32	10.84	12.19	2.25	0.30	4.02
9615	"	" "	472.	5.20	12.07	3.63	2.25	0.12	1.04	7.71	8.75	43.02	39.24	11.20	12.13	2.25	0.31	4.00
9616	"	" "	489.	4.49	12.16	3.53	2.22	0.12	0.99	7.78	8.62	42.89	39.66	10.75	13.12	2.41	0.31	3.95
	" average,	....	**476.**	**4.89**	**12.00**	**3.49**	**2.10**	**0.12**	**1.06**	**7.73**	**8.89**	**42.80**	**38.51**	**11.04**	**12.71**	**2.36**	**0.31**	**3.99**
9713	Tellicherry,	Austin, Nichols & Co., New York,	535.	4.77	11.86	4.28	2.75	0.00	0.65	6.86	8.47	41.80	37.01	12.23	11.88	2.17	0.27	3.90
9650	"	E. R. Durkee & Co., New York,	561.	4.13	11.27	4.14	2.75	0.02	1.02	7.02	9.14	41.55	37.01	12.17	11.70	2.14	0.27	3.88
	" average,	....	**548.**	**4.45**	**11.56**	**4.21**	**2.75**	**0.01**	**0.83**	**6.94**	**8.80**	**41.67**	**37.01**	**12.20**	**11.79**	**2.15**	**0.27**	**3.89**
9645	Lampong,	E. R. Durkee & Co., New York,	493.	3.43	10.63	6.52	2.16	1.19	1.11	8.67	9.49	37.09	33.41	12.72	11.37	2.15	0.33	3.82
9685	"	Francis H. Leggett & Co., New York,	530.	3.55	12.17	4.86	2.21	0.48	1.23	9.05	9.95	41.42	37.59	11.57	10.50	2.03	0.35	3.85
	" average,	....	**511.**	**3.49**	**11.40**	**5.69**	**2.18**	**0.83**	**1.17**	**8.86**	**9.72**	**39.25**	**35.50**	**12.14**	**10.93**	**2.09**	**0.34**	**3.83**
9646	Acheen, Class A,	E. R. Durkee & Co , New York,	432.	3.44	12.09	5.04	2.78	0.48	1.09	9.17	10.04	38.17	33.30	13.07	10.88	2.11	0.37	4.06
9647	Acheen, Class B,	" "	407.	2.66	12.95	6.15	3.04	1.15	1.15	9.03	9.95	36.40	33.08	14.09	11.75	2.25	0.37	4.06
9648	Acheen, Class C,	....	345.	2.67	11.84	6.10	3.01	1.04	1.28	9.47	10.28	31.41	26.81	16.40	12.25	2.34	0.38	4.01
9683	" "	Francis H. Leggett & Co., New York,	316.	2.12	12.33	6.35	3.19	1.00	1.60	9.64	11.07	28.15	22.05	18.25	12.56	2.39	0.38	3.99
9714	Acheen, Class not given,	Austin, Nichols & Co., New York,	301.	2.18	12.33	5.73	3.20	0.64	1.58	10.37	11.86	30.82	25.39	17.08	12.25	2.36	0.40	3.90
	Acheen, average,	....	**360.**	**2.61**	**12.31**	**5.87**	**3.04**	**0.86**	**1.34**	**9.54**	**10.64**	**32.99**	**28.13**	**15.78**	**11.94**	**2.29**	**0.38**	**4.00**
	All analyses. Maximum,	....	561.	5.46	12.95	6.52	3.20	1.19	1.60	10.37	11.86	43.47	39.66	18.25	13.81	2.53	0.40	4.06
	All analyses. Minimum,	....	301.	2.12	10.63	3.09	1.75	0.00	0.65	6.86	8.47	28.15	22.05	10.75	10.50	2.03	0.27	3.82
	All analyses. Average,	....	....	....	**11.96**	**4.76**	**2.54**	**0.47**	**1.14**	**8.42**	**9.62**	**38.63**	**34.15**	**13.06**	**12.05**	**2.26**	**0.33**	**3.96**
	Pepper By-products and Adulterants:																	
9682	Pinhead. Siftings from Acheen, Class C,	....	....	....	10.95	8.25	2.34	1.74	1.26	8.24	9.66	29.01	25.03	17.51	11.25	2.10	0.30	3.65
9690	Pepper Shells (hulls only),	....	....	....	10.57	11.91	3.20	4.70	0.68	3.04	4.00	11.43	2.30	32.15	14.19	2.36	0.09	2.91
9684	Pepper Shells (hulls and dust),	....	....	....	10.52	10.30	2.28	2.88	1.06	4.77	5.71	21.69	15.30	23.61	12.94	2.21	0.14	3.01
9689	" "	....	....	....	10.66	10.25	2.90	2.63	1.02	4.97	6.30	20.99	14.12	23.27	12.31	2.12	0.15	2.94
9692	Long Pepper,	....	....	....	9.47	5.93	4.20	0.22	1.55	6.61	8.67	42.88	39.55	5.76	12.25	2.18	0.22	3.34
9732	Buckwheat hulls,	....	....	....	7.63	1.84	1.24	0.00	0.07	0.38	2.17	20.51	1.46	43.76	3.06	0.49	....	....
	White Pepper:																	
9641	Decorticated,	E. R. Durkee & Co., New York,	761.	2.77	12.72	1.03	0.44	0.00	0.49	7.26	7.71	64.79	63.60	0.54	11.13	2.10	0.32	4.40
9688	"	Francis H. Leggett & Co., New York,	785.	2.78	13.07	1.10	0.51	0.02	0.63	7.21	7.95	64.92	62.73	0.66	10.94	2.07	0.32	4.45
	" average,	....	**773.**	**2.77**	**12.89**	**1.06**	**0.47**	**0.01**	**0.56**	**7.24**	**7.83**	**64.85**	**63.16**	**0.60**	**11.03**	**2.08**	**0.32**	**4.42**
9716	Singapore,	Austin, Nichols & Co., New York,	618.	4.35	13.12	1.52	0.33	0.10	0.95	7.94	8.35	57.00	54.67	4.25	11.19	2.13	0.34	4.35
9644	"	E. R. Durkee & Co., New York,	599.	4.47	13.82	1.14	0.34	0.09	0.90	7.85	8.55	56.43	53.11	3.95	10.94	2.09	0.34	4.32
	" average,	....	**608.**	**4.41**	**13.47**	**1.33**	**0.33**	**0.09**	**0.92**	**7.89**	**8.45**	**56.71**	**53.89**	**4.10**	**11.06**	**2.11**	**0.34**	**4.33**
9671	Siam,	Francis H. Leggett & Co., New York,	693.	4.81	13.65	1.26	0.39	0.04	0.58	6.81	7.53	58.90	56.33	3.55	10.88	2.03	0.29	4.27
9643	"	E. R. Durkee & Co., New York,	678.	5.00	12.77	1.71	0.46	0.20	0.83	6.54	7.35	59.10	56.10	3.49	10.75	2.01	0.29	4.36
9611	"	D. & L. Slade Co., Boston,	694.	4.49	14.47	1.43	0.28	0.07	0.67	6.58	7.19	59.04	56.10	3 52	10.44	1.95	0.28	4.28
	" average,	....	**688.**	**4.77**	**13.63**	**1.47**	**0.38**	**0.10**	**0.69**	**6.64**	**7.36**	**59.01**	**56.18**	**3.52**	**10.69**	**2.00**	**0.29**	**4.30**
9642	Penang,	E. R. Durkee & Co., New York,	679.	5.38	13.40	2.73	0.52	0.11	0.62	6.36	7.34	57.35	54.74	3.78	10.94	2.03	0.28	4.33
9672	"	Francis H. Leggett & Co., New York,	673.	5.18	14.19	2.96	0.62	0.18	0.76	6.34	7.26	57.24	54.02	3.70	10.82	1.99	0.26	4.05
9715	"	Austin, Nichols & Co., New York,	666.	5.02	13.45	2.82	0.80	0.17	0.89	6.26	7.36	56.94	53.26	3.91	10.88	2.01	0.27	4.32
	" average,	....	**673.**	**5.19**	**13.68**	**2.84**	**0.65**	**0.15**	**0.76**	**6.32**	**7.32**	**57.17**	**54.01**	**3.80**	**10.88**	**2.01**	**0.27**	**4.23**
	All analyses. Maximum,	....	785.	5.38	14.47	2.96	0.80	0.20	0.95	7.94	8.55	64.92	63.60	4.25	11.19	2.13	0.34	4.45
	All analyses. Minimum,	....	599.	2.77	12.72	1.03	0.28	0.00	0.49	6.26	7.19	56.43	53.11	0.54	10.44	1.95	0.26	4.05
	All analyses. Average,	....	....	....	**13.47**	**1.77**	**0.47**	**0.10**	**0.73**	**6.91**	**7.66**	**59.17**	**56.47**	**3.14**	**10.89**	**2.04**	**0.30**	**4.31**

TABLE XXV.—CAYENNE PEPPER.

Station No.		Importer.	Weight of 100 pods in grams.	Moisture.	Ash. Total.	Ash. Soluble in water.	Ash. Insoluble in HCl.	Ether extract. Volatile.	Ether extract. Non-volatile.	Alcohol extract.	Reducing matters by direct inversion calculated as starch.	Starch by diastase method.	Crude fiber.	Nitrogen × 6¼.	Total nitrogen.
9720	Japan,	Austin, Nichols & Co., New York,	6.82	5.78	5.80	4.54	0.14	1.02	20.89	25.46	8.19	1.46	21.44	13.75	2.20
9679	"	Francis H. Leggett & Co., New York,	6.70	5.61	5.96	4.93	0.05	1.16	21.15	23.77	7.15	1.35	21.95	14.63	2.34
9610	"	D. & L. Slade Co., Boston,	7.14	6.45	5.18	4.17	0.08	0.78	21.81	23.19	7.65	0.80	21.65	13.44	2.15
	" average,	....	**6.89**	**5.95**	**5.65**	**4.55**	**0.09**	**0.99**	**21.28**	**24.11**	**7.66**	**1.20**	**21.68**	**13.94**	**2.23**
9721	Zanzibar,	Austin, Nichols & Co., New York,	4.27	4.86	5 43	3.40	0.18	1.99	18.37	21.52	8.91	0.84	24.91	13.31	2.13
9654	"	E. R. Durkee & Co., New York,	4.40	6.87	5.61	3.36	0.19	1.24	17.17	23.22	9.31	0.84	24 34	13.94	2.23
9626	"	D. & L. Slade Co., Boston,	4.50	3.67	5.24	3.30	0.11	2.57	19.11	25.64	9.04	0.90	23.44	13.31	2.13
	" average,	....	**4.39**	**5.13**	**5.43**	**3.35**	**0.16**	**1.93**	**18.22**	**23.46**	**9.09**	**0.86**	**24.23**	**13.52**	**2.16**
9653	Capsicums,	E. R. Durkee & Co., New York,	21.96	7.08	5.15	4.13	0.20	0.73	21.16	24.42	8.95	0.84	20.69	13.56	2.17
9695	"	Austin, Nichols & Co., New York,	23.31	5.48	5.08	4.02	0.23	1.34	21.56	27.61	8.55	1.06	20.35	13.38	2.14
	" average,	....	**22.63**	**6.28**	**5.11**	**4.07**	**0.21**	**1.03**	**21.36**	**26.01**	**8.75**	**0.95**	**20.52**	**13.47**	**2.15**
	All analyses, Maximum,	....	23.31	7.08	5.96	4.93	0.23	2.57	21.81	27.61	9.31	1.46	24.91	14.63	2.34
	All analyses, Minimum,	....	4.27	3.67	5.08	3.30	0.05	0.73	17.17	21.52	7.15	0.80	20.35	13.31	2.13
	Average,	....	....	**5.73**	**5.43**	**3.98**	**0.15**	**1.35**	**20.15**	**24.35**	**8.47**	**1.01**	**22.35**	**13.67**	**2.18**

TABLE XXVI.—GINGER AND GINGER BY-PRODUCTS.

Station No.		Importer.	Moisture.	Ash. Total.	Ash. Soluble in water.	Ash. Insoluble in HCl.	Lime. (CaO.)	Ether extract. Volatile.	Ether extract. Non-volatile.	Alcohol extract.	Reducing matters by direct inversion calculated as starch.	Starch by diastase method.	Crude fiber.	Nitrogen × 6¼.	Cold water extract.	Total nitrogen.
	Ginger.															
9618	Jamaica, bleached (limed),	D. & L. Slade Co., Boston,	10.56	9.35	2.32	0.03	3.53	1.34	2.82	4.04	56.00	53.95	2.37	9.00	15.68	1.44
9723	" " "	Austin, Nichols & Co., New York,	10.57	7.28	2.95	0.02	1.92	1.21	3.43	5.37	58.63	55.61	2.38	9.69	16.10	1.55
	" " " average	....	**10.56**	**8.31**	**2.63**	**0.02**	**2.72**	**1.27**	**3.12**	**4.70**	**57.31**	**54.78**	**2.37**	**9.34**	**15.89**	**1.49**
9724	Jamaica, unbleached,	Austin, Nichols & Co., New York,	11.72	4.72	3.40	0.51	0.28	1.76	3.97	5.23	58.41	56.13	4.28	6.25	14.81	1.00
9655	" "	E. R. Durkee & Co., New York,	10.27	4.18	2.84	0.11	0.30	1.61	3.82	4.90	56.31	55.05	3.72	9.75	17.55	1.50
9620	" "	D. & L. Slade Co., Boston,	11.67	3.61	2.64	0.05	0.20	2.01	3.94	5.32	58.05	57.10	3.17	7.56	14.73	1.21
	" " average,	....	**11.22**	**4.17**	**2.96**	**0.22**	**0.26**	**1.79**	**3.91**	**5.15**	**57.59**	**56.09**	**3.72**	**7.85**	**15.69**	**1.24**
9678	Cochin, cut and scraped (limed),	Francis H. Leggett & Co., New York,	9.97	5.36	2.95	0.08	1.29	1.49	2.95	3.63	62.42	60.31	2.60	7.50	13.22	1.20
9670	Cochin, rough washed,	" " " "	9.96	3.81	2.42	0.12	0.24	2.47	4.50	6.19	56.65	53.94	4.22	8.00	12.66	1.28
9624	Cochin, A, B, C,	D. & L. Slade Co., Boston,	10.54	3.66	2.62	0.15	0.25	1.86	3.64	4.89	59.73	58.05	3.68	8.06	12.18	1.29
9657	" "	E. R. Durkee & Co., New York,	10.33	4.06	2.18	0.06	0.71	2.32	3.75	4.36	58.43	56.62	3.57	8.25	12.66	1.32
	" " average,	....	**10.43**	**3.86**	**2.40**	**0.10**	**0.48**	**2.09**	**3.70**	**4.62**	**59.08**	**57.33**	**3 62**	**8.15**	**12.42**	**1.30**
9660	Cochin, D,	E. R. Durkee & Co., New York,	9.91	5.48	2.89	0.68	0.56	2.52	5.08	5.98	53.43	49.86	5.10	7.88	12.04	1.26
9697	"	Austin, Nichols & Co., New York,	8.71	4.96	2.67	0.23	0.55	3.09	5.15	5.55	53.97	49.05	5.50	7.81	12.41	1.25
	" average,	....	**9.31**	**5.22**	**2.78**	**0.45**	**0.55**	**2.80**	**5.11**	**5.77**	**53.70**	**49.45**	**5 30**	**7.84**	**12.22**	**1.25**
9656	Japan (limed),	E. R. Durkee & Co., New York,	11.13	4.34	1.73	0.15	1.07	0.96	3.86	5.18	61.02	58.70	2.62	6.00	12.72	0.96
9725	" "	Austin, Nichols & Co., New York,	11.65	8.04	1.89	1.28	2.26	0.96	4.02	4 86	60.08	55.40	2.84	4.81	10.92	0.77
	" " average,	....	**11.39**	**6.19**	**1.81**	**0.71**	**1.66**	**0.96**	**3.94**	**5.02**	**60.55**	**57.05**	**2.73**	**5.40**	**11.82**	**0.86**
9722	African,	Austin, Nichols & Co., New York,	9.99	4.14	2.73	0.14	0.26	2.66	5.42	6.30	57.15	53.36	4.31	7.94	13.31	1.27
9659	"	E. R. Durkee & Co , New York,	9.89	3.61	2.17	0.08	0.28	2.94	5.28	6.58	57.42	53.08	4.74	7.88	12.38	1.26
9623	"	D. & L. Slade Co , Boston,	10.03	4.24	2.65	0.11	0.21	2.60	5.34	6.14	55.65	51.60	4.93	7.94	13.61	1.27
	" average,	....	**9.97**	**4.00**	**2.52**	**0.11**	**0.25**	**2.73**	**5.35**	**6.34**	**56.74**	**52.68**	**4.66**	**7.92**	**13.10**	**1.27**
9658	Calcutta or East India,	E. R. Durkee & Co., New York,	10.19	7.55	4.09	2.29	0.26	1.73	3.37	4.37	55.39	52.48	5.37	7.69	12.51	1.23
9621	" " " "	D. & L. Slade Co., Boston,	10.86	6.47	3.60	1.74	0.27	1.84	3.52	4.29	55.62	51.24	5.08	7.25	12.04	1.16
	" " " " average,	....	**10.52**	**7.01**	**3.84**	**2.01**	**0.26**	**1.78**	**3.44**	**4.33**	**55.50**	**51.85**	**5.22**	**7.47**	**12.27**	**1.19**
	All analyses, Maximum,	....	11.72	9.35	4.09	2.29	3.53	3.09	5.42	6.58	62 42	60.31	5.50	9.75	17.55	1.55
	All analyses, Minimum,	....	8.71	3.61	1.73	0 02	0.20	0.96	2.82	3.63	53.43	49.05	2.37	4.81	10.92	0.77
	All analyses, Average,	....	10.44	5.27	2.71	0.44	0.80	1.97	4.10	5.18	57.45	54.53	3.91	7.74	13.42	1.23
	Ginger By-Products.															
9681	Rough, scraggy ginger, rejections from Cochin D,	....	4.99	8.05	4.03	0.89	0.61	6.05	9.55	11.60	31.38	19.35	13.18	7.00	14.65	1.12
9693	Ginger cuttings,	....	3.19	9.20	3.90	1.81	1.06	7.06	2.76	9.20	40.23	31.14	8.69	8.69	17.72	1.39
9727	Exhausted ginger from English ginger ale works,	....	10.61	2.12	0.59	0.18	.....	1.61	3.86	4.88	59.86	54.57	5.17	6.94	6.15	1.11
9368	Exhausted ginger from extract works,	....	8.02	5.05	3.55	1.50	.....	0.13	0 54	1.52	....	....	....	....	16.42	.....

TABLE XXVII.—CEYLON CINNAMON, CASSIA, AND CASSIA BUDS.

Station No.		Importer.	Moisture.	Ash. Total.	Ash. Soluble in water.	Ash. Insoluble in HCl.	Ether extract. Volatile.	Ether extract. Non-volatile.	Alcohol extract.	Reducing matters by direct inversion calculated as starch.	Crude fiber.	Nitrogen × 6¼.	Total nitrogen.
	Ceylon Cinnamon.												
9668	No. 1, extra,	E. R. Durkee & Co., New York,	7.92	4.16	1.40	0.03	1.46	1.38	12.74	17.55	38.48	4.06	0.65
9667	No. 1,	" " "	7.90	4.41	2.08	0.05	1.49	1.42	12.70	19.53	38.09	3.69	0.59
9666	No. 2,	" " "	7.79	4.33	1.61	0.09	1.62	1.46	12.40	22.00	36.40	3.50	0.56
9699	"	Austin, Nichols & Co., New York,	9.34	4.41	1.62	0.03	1.49	1.37	11.85	20.12	34.61	3.94	0.63
9640	No. 4,	E. R. Durkee & Co., New York,	8.33	5.99	2.71	0.02	1.54	1.35	13.60	19.98	35.23	3.25	0.52
9680	Chips,	Francis H. Leggett & Co., N. York	10.48	5.63	1.79	0.58	0.72	1.68	9.97	16.65	34.38	3.75	0.60
	All analyses, Maximum,	....	10.48	5.99	2.71	0.58	1.62	1.68	13.60	22.00	38.48	4.06	0.65
	All analyses, Minimum,	....	7.79	4.16	1.40	0.02	0.72	1.35	9.97	16.65	34.38	3.25	0.52
	All analyses, Average,	....	**8.63**	**4.82**	**1.87**	**0.13**	**1.39**	**1.44**	**12.21**	**19.30**	**36.20**	**3.70**	**0.59**
	Cassia.												
9635	Saigon, thin,	E. R. Durkee & Co., New York,	7.48	4.78	1.64	0.38	4.88	3.26	5.63	18.36	21.38	5.06	0.81
9629	"	D. & L. Slade Co., Boston,	6.53	4.17	2.05	0.17	4.85	3.09	8.70	25.38	17.31	4.63	0.74
9634	Saigon, medium,	E. R. Durkee & Co., New York,	7.55	4.80	2.02	0.25	5.15	2.34	7.91	25.29	22.65	3.75	0.60
9633	Saigon, thick,	" " "	7.06	5.99	2.52	0.21	3.94	2.43	5.49	21.37	28.80	3.63	0.58
9628	"	D. & L. Slade Co., Boston,	7.95	5.08	2.07	0.08	4.58	2.37	5.14	24.61	25.41	3.75	0.60
9636	Saigon, broken, No. 1,	E. R. Durkee & Co., New York,	7.56	6.20	2.28	0.98	3.67	2.55	3.92	20.74	25.09	4.50	0.72
9707	" "	Austin, Nichols & Co., New York,	9.12	5.08	1.81	0.68	2.43	2.78	6.87	20.57	24.95	4.25	0.68
9698	Saigon, broken, No. 2,	" " "	7.89	5.73	2.13	0.21	2.84	4.13	9.16	18.36	25.45	3.87	0.62
	Saigon, average, all analyses,	....	**7.64**	**5.23**	**2.06**	**0.37**	**4.04**	**2.87**	**6.60**	**21.83**	**23.88**	**4.18**	**0.67**
9705	Batavia, No. 1,	Austin, Nichols & Co., New York,	8.73	4.75	1.83	0.04	1.59	1.49	16.74	26.95	19.17	4.50	0.72
9637	"	E. R. Durkee & Co., New York,	9.53	4.04	1.49	0.06	2.61	1.32	12.39	25.60	17.03	4.88	0.78
9627	"	D. & L. Slade Co., Boston,	8.65	4.73	1.85	0.02	2.47	1.45	13.31	20.25	20.31	4.63	0.74
9700	Batavia, No. 2,	Austin, Nichols & Co., New York,	9.92	4.46	1.64	0.05	1.23	1.42	13.07	21.15	21.02	5.32	0.85
9638	"	E. R. Durkee & Co., New York,	9.01	5.12	1.90	0.05	1.95	1.51	14.50	16.65	22.09	5.19	0.83
9686	"	Francis H. Leggett & Co., N. York,	10.16	4.37	1.63	0.05	2.12	1.39	11.00	18.68	21.51	5.44	0.87
	Batavia, average, all analyses,	....	**9.33**	**4.58**	**1.72**	**0.04**	**1.99**	**1.43**	**13.50**	**21.55**	**20.19**	**4.99**	**0.80**
9704	China or Canton, No. 1, extra,	Austin, Nichols & Co., New York,	11.91	3.01	1.58	0.10	0.93	1.56	4.57	32.04	23.80	3.31	0.53
9706	China or Canton, No. 1,	" " "	11.71	3.65	1.06	0.78	1.06	1.87	4.71	27.45	23.66	3.94	0.63
9639	" " "	E. R. Durkee & Co., New York,	11.13	3.47	0.71	1.31	1.44	1.67	7.80	30.28	23.08	3.44	0.55
9687	" " "	Francis H. Leggett & Co., N. York,	10.95	5.37	0.98	2.42	1.64	1.70	5.21	28.13	23.97	3.94	0.63
9630	" " "	D. & L. Slade Co., Boston,	10.87	4.18	1.28	1.07	1.30	1.75	4.90	24.03	25.70	4.13	0.66
9708	China or Canton, broken,	Austin, Nichols & Co., New York,	11.08	5.58	1.21	2.22	1.48	2.27	4.73	20.57	26.83	4.56	0.73
9737*	" " "	....	8.90	20.00	1.04	15.47	0.84	1.79	3.76	17.35	24.66	4.18	0.67
9631	Coarse, from No. 9737, 47 per cent.,	....	10.09	4.20	1.30	1.11	1.36	2.27	5.18	22.37	26.51	4.31	0.69
9632	Fine, from No. 9737, 53 per cent.,	....	7.84	34.02	0.81	28.21	0.37	1.38	2.50	12.91	23.03	4.06	0.65
	China, average, all analyses, excluding Nos. 9737, 9631, and 9632,	....	**11.27**	**4.21**	**1.14**	**1.32**	**1.31**	**1.80**	**5.32**	**27.08**	**24.51**	**3.89**	**0.62**
	All analyses, excluding Nos. 9737, 9631, and 9632, Maximum,	....	11.91	6.20	2.52	2.42	5.15	4.13	16.74	32.04	28.80	5.44	0.87
	All analyses, excluding Nos. 9737, 9631, and 9632, Minimum,	....	6.53	3.01	0.71	0.02	0.93	1.32	4.57	16.65	17.03	3.31	0.53
	All analyses, excluding Nos. 9737, 9631, and 9632, Average,	....	**9.24**	**4.73**	**1.68**	**0.56**	**2.61**	**2.12**	**8.29**	**23.32**	**22.96**	**4.34**	**0.69**
	Cassia Buds.												
9665	No particulars given,	E. R. Durkee & Co., New York,	7.12	4.58	2.88	0.19	4.65	6.27	10.90	10.44	13.89	8.00	1.28
9609	" "	D. & L. Slade Co., Boston,	8.74	4.70	2.88	0.35	3.11	5.65	10.86	10.98	12.80	7.06	1.13
	Average,	....	**7.93**	**4.64**	**2.88**	**0.27**	**3.88**	**5.96**	**10.88**	**10.71**	**13.35**	**7.53**	**1.20**

* Contained large amount of dirt; unfit for consumption until cleaned by sifting.

TABLE XXVIII. CLOVES AND CLOVE STEMS.

Station No.		Importer.	Weight of 100 cloves in grams.	Moisture.	Ash.			Ether extract.		Alcohol extract.	Reducing matters by direct inversion calculated as starch.	Starch by diastase method.	Crude fiber.	Nitrogen × 6¼.	Oxygen absorbed by aqueous extract.	Quercitannic acid equivalent to O absorbed.	Total nitrogen.
					Total.	Soluble in water.	Insoluble in HCl.	Volatile.	Non-volatile.								
	Cloves.																
9711	Penang, ...	Austin, Nichols & Co., New York,	10.04	8.16	5.28	3.25	0.05	17.99	6.61	15.58	9.41	2.59	7.94	6.44	2.42	18.90	1.03
9625	"	D. & L. Slade Co., Boston,	8.51	7.81	5.30	3.48	0.00	20.04	6.25	14.86	8.91	2.70	7.85	7.06	2.36	18.38	1.13
	" average, . . .	....	**9.28**	**7.99**	**5.29**	**3.37**	**0.03**	**19.02**	**6.43**	**15.22**	**9.16**	**2.65**	**7.90**	**6.75**	**2.39**	**18.64**	**1.08**
9710	Amboyna, ...	Austin, Nichols & Co., New York,	9.26	7.36	6.16	3.57	0.02	20.53	6.39	15.20	8.23	3.15	7.97	6.00	2.17	16.90	0.96
9669	"	Francis H. Leggett & Co , N. York,	10.34	8.06	6.22	3.72	0.02	20.42	6.63	15.21	8.87	2.59	8.11	5.94	2.08	16.25	0.95
9622	"	D. & L. Slade Co., Boston,	9.58	8.26	6.17	3.56	0.08	20.45	6.67	15.18	8.19	2.65	7.06	5.94	2.14	16.77	0.95
	" average, . . .	....	**9.73**	**7.89**	**6.18**	**3.62**	**0.04**	**20.47**	**6.56**	**15.20**	**8.43**	**2.80**	**7.71**	**5.96**	**2.13**	**16.64**	**0.95**
9709	Zanzibar, ...	Austin, Nichols & Co , New York,	7.64	7.03	5.96	3.61	0.13	17.86	6.24	14.68	9.18	3.15	8.24	6.25	2.63	20.54	1.00
9651	"	E. R. Durkee & Co., New York,	8.22	7.93	6.22	3.75	0.08	17.82	6.59	13.99	9.50	2.97	9.02	5.88	2.34	18.28	0.94
9612	"	D. & L. Slade Co., Boston,	8.15	7.89	6.02	3.67	0.10	18.32	6.53	14.25	9.63	2.08	8.60	5.94	2.49	19.50	0.95
	" average, . . .	....	**8.00**	**7.62**	**6.07**	**3.68**	**0.10**	**18.00**	**6.45**	**14.31**	**9.44**	**2.73**	**8.62**	**6.02**	**2.49**	**19.44**	**0.96**
	All analyses, Maximum, . .	....	10.34	8.26	6.22	3.75	0.13	20.53	6.67	15.58	9.63	3.15	9.02	7.06	2.63	20.54	1.13
	All analyses, Minimum, . .	....	7.64	7.03	5.28	3.25	0.00	17.82	6.24	13.99	8.19	2.08	7.06	5.88	2.08	16.25	0.94
	All analyses, Average, . .	....	**8.97**	**7.81**	**5.92**	**3.58**	**0.06**	**19.18**	**6.49**	**14.87**	**8.99**	**2.74**	**8.10**	**6.18**	**2.33**	**18.19**	**0.99**
	Clove Stems (adulterant).																
9691	Particulars unknown, . . .	....	....	7.93	7.68	4.43	0.48	5.13	3.92	7.88	14.53	1.91	18.73	6.00	2.61	20.41	0.96
9652	" " . . .	....	....	9.54	8.29	4.08	0.71	4.87	3.73	5.70	13.72	2.42	18.69	5.75	2.19	17.16	0.92
	Average, . . .	....	....	**8.74**	**7.99**	**4.26**	**0.60**	**5.00**	**3.83**	**6.79**	**14.13**	**2.17**	**18.71**	**5.88**	**2.40**	**18.79**	**0.94**

TABLE XXIX.—ALLSPICE OR PIMENTO.

Station No.		Importer.	Weight of 100 corns in grams.	Moisture.	Ash. Total.	Ash. Soluble in water.	Ash. Insoluble in HCl.	Ether extract. Volatile.	Ether extract. Non-volatile.	Alcohol extract.	Reducing matters by direct inversion calculated as starch.	Starch by diastase method.	Crude fiber.	Nitrogen × 6¼.	Oxygen absorbed by aqueous extract.	Quercitannic acid equivalent to O, absorbed.	Total Nitrogen.
9703	Jamaica,	Austin, Nichols & Co., N. Y.,	8.30	9.45	4.15	2.43	0.00	3.57	7.72	14.27	20.65	3.76	20.46	5.19	1 10	8.58	0.83
9661	do	E. R. Durkee & Co., N. Y.,	6.61	9.75	4.76	2.69	0.03	3.38	5.46	13 71	16.87	1.82	23.98	5.69	1.59	12.48	0.91
9613	do	D. & L. Slade Co , Boston,	5.32	10.14	4.50	2.29	0.06	5.21	4.35	7.39	16.56	3.54	22.74	6.37	1.03	8.06	1.02
	All analyses, Maximum,	....	8.30	10.14	4.76	2.69	0.06	5.21	7.72	14.27	20.65	3.76	23.98	6.37	1.59	12.48	1.02
	All analyses, Minimum,	....	5.32	9.45	4.15	2.29	0.00	3.38	4.35	7 39	16.56	1.82	20.46	5.19	1.03	8.06	0.83
	All analyses, Average.	....	**6.74**	**.7 8**	**4.47**	**2.47**	**0.03**	**4.05**	**5.84**	**11.79**	**18.03**	**3.04**	**22.39**	**5.75**	**1.24**	**9.71**	**0.92**

TABLE XXX.—NUTMEGS.

Station No.		Importer.	Weight of 100 nutmegs in grams.	Moisture.	Ash. Total.	Ash. Soluble in water.	Ash. Insoluble in HCl.	Ether extract. Volatile.	Ether extract. Non-volatile.	Alcohol extract.	Reducing matters by direct inversion calculated as starch.	Starch by diastase method.	Crude fibre.	Nitrogen × 6¼.	Total Nitrogen.
	True Nutmegs, limed.														
9617	Singapore,	D. & L. Slade Co., Boston,	423	5.79	2.23	0.84	0.00	3.40	36.87	10.80	25.60	23.34	2.49	7.00	1.12
9664	Probably Singapore,	E. R. Durkee & Co , N. Y.,	405	8.98	2.13	0.82	0.01	2.56	36.29	10.42	25.56	23.62	2.38	6.56	1.05
9719	" "	Austin, Nichols & Co., N. Y.,	390	8.12	2.48	0.93	0.00	3.10	36.94	11.09	25.51	24.20	2.65	6.62	1.06
	Average, Nos. 9617, 9664 & 9719	....	**406**	**3.63**	**2.28**	**0.86**	**0.00**	**3.02**	**36.70**	**10.77**	**25.56**	**23.72**	**2.51**	**6.73**	**1.08**
9673	Padang,	Francis H. Leggett & Co., N.Y.,	255	10.83	3.26	1.46	0.00	6.94	28.73	17.38	17.19	14.62	3.72	6.75	1.08
	All analyses, Maximum,	....	423	10.83	3.26	1.46	0.01	6.94	36.94	17.38	25.60	24.20	3.72	7.00	1.12
	All analyses, Minimum,	....	255	5.79	2.13	0.82	0.00	2.56	28.73	10.42	17.19	14.62	2.38	6.56	1.05
	Macassar or Long Nutmegs.														
9674	Limed,	....	575	5.24	3.32	1.25	0.00	4.70	32.88	16.79	29.97	29.25	2.07	6.95	1.11
	Damaged Nutmegs.														
9696	"Grinding Nutmegs," (worm eaten),	....	104	17.23	6.37	4.33	0.12	9.76	11.32	14.71	5.71	1.63	7.95	9.73	1.49

TABLE XXXI. — ANALYSES OF MACE.

Station No.		Importer.	Moisture.	Ash. Total.	Ash. Soluble in water.	Ash. Insoluble in HCl.	Ether extract. Volatile.	Ether extract. Non-volatile.	Alcohol extract.	Reducing matters by direct inversion calculated as starch.	Starch by diastase method.	Crude fiber.	Nitrogen × 6¼.	Total Nitrogen.
	True Mace:													
9619	Banda,	D. & L. Slade Co., Boston,	10.75	1.81	1.09	0.00	8.65	22.00	23.05	32.35	27.90	3.04	6.25	1.00
9662	Penang,	E. R. Durkee & Co., New York,	12.04	1.85	1.06	0.06	6.27	22.56	22.07	34.42	30.43	2.99	6.37	1.02
9717	"	Austin, Nichols & Co., New York,	9.78	1.85	1.06	0.03	6.97	21.63	22.58	33.39	30.04	2.94	6.25	1.00
9677	" No. 2,	Francis H. Leggett & Co., New York,	11.62	2.54	1.33	0.21	8.45	23.72	24.76	26.77	23.12	3.85	7.00	1.12
9694	"Grinding Mace" (damaged),		12.51	5.74	2.37	1.13	14.97	20.96	22.27	8.32	4.73	7.64	10.94	1.75
	All analyses, excluding No. 9694, Maximum,		12.04	2.54	1.33	0.21	8.65	23.72	24.76	34.42	30.43	3.85	7.00	1.12
	All analyses, excluding No. 9694, Minimum,		9.78	1.81	1.06	0.00	6.27	21.63	22.07	26.77	23.12	2.94	6.25	1.00
	All analyses, excluding No. 9694, Average,		**11.05**	**2.01**	**1.13**	**0.07**	**7.58**	**22.48**	**23.11**	**31.73**	**27.87**	**3.20**	**6.47**	**1.03**
	Other Varieties of Mace													
9675	Macassar,		4.18	2.01	1.11	0.03	5.89	53.54	32.89	10.39	8.78	4.57	7.00	1.12
9676	Bombay (adulterant),		0.32	1.98	1.37	0.07	4.65	59.81	44.27	16.20	14.51	3.21	5.06	0.81

TABLE XXXII. — MISCELLANEOUS SPICE ADULTERANTS.

Station No.		Moisture.	Ash. Total.	Ash. Soluble in water.	Ash. Insoluble in HCl.	Ether extract. Volatile.	Ether extract. Non-volatile.	Alcohol extract.	Reducing matters by direct inversion calculated as starch.	Starch by diastase method.	Crude fiber.	Nitrogen × 6¼.	Oxygen absorbed by aqueous extract.	Quercitannic acid equivalent to O, absorbed.	Total Nitrogen.
9718	English-walnut shells,	7.69	1.40	0.77	0.00	0.12	0.55	1.84	19.30	1.01	56.58	1.69	0.53	2.08	0.27
9728	Brazil-nut shells,	9.08	1.59	1.06	0.17	0.07	0.57	1.01	12.96	0.73	50.98	4.19	0.33	1.30	0.67
9730	Almond shells,	7.80	2.86	2.39	0.05	0.16	0.64	5.16	22.72	0.84	49.89	1.75	0.40	1.56	0.28
9735	Cocoanut shells,	7.36	0.54	0.50	0.00	0.00	0.25	1.12	20.88	0.73	56.19	1.13	0.47	1.82	0.18
9729	Date stones,	8.24	1.24	0.76	0.04	0.36	8.38	16.72	20.88	2.19	5.72	5.31	0.61	2.34	0.85
9733	Spruce sawdust,	8.77	0.23	0.16	0.00	0.07	0.77	1.50	15.48	1.13	64.03	0.56	0.30	1.17	0.09
9734	Oak sawdust,	5.73	1.22	0.32	0.02	0.07	0.84	6.25	17.10	1.68	47.79	1.63	3.13	12.22	0.26
9731	Linseed meal,	8.71	5.72	1.74	0.55	0.04	6.58	9.46	21.15	14.06	8.30	31.81	1.00	3.90	5.09
7830	Cocoa shells,	10.44	8.40	4.66	0.83	1.00	2.99	4.77	8.68	3.15	14.12	16.19	1.26	4.94	2.59
9736	Red sandalwood,	4.42	0.70	0.28	0.07	1.21	11.47	19.37	6.79	1.12	52.30	3.06	0.59	2.29	0.49

Discussion of Analyses.

The analyses reported herewith, in the tables on pages 198 to 211, together with those made at the Department of Agriculture, should serve as sufficient data for fixing standards of purity for these spices; but it is not the purpose of this article to formulate a set of standards, as that work has already been undertaken by the Association of Official Agricultural Chemists.

A discussion of the analyses of each spice follows:

Black Pepper.

Of the methods employed in our work the determinations of the non-volatile ether extract and of the nitrogen in this extract furnish the most valuable means of detecting adulterants of vegetable origin in both black and white pepper.

When a sample of black pepper is adulterated with buckwheat hulls, cocoanut shells, or some other material deficient in ether extract, the percentage of non-volatile extract will be diminished, without changing perceptibly the parts of nitrogen in 100 parts of the extract; but when the sample is mixed with linseed meal or some other oily material, the percentage of non-volatile ether extract may remain about the same as in the original pepper, but the parts of nitrogen in 100 of the extract will be reduced.

The nitrogen content of the extract of the samples analyzed is quite constant, varying only from 3.82 to 4.06 parts in 100 of the extract.

Both the alcohol and ether extracts are highest in Acheen black pepper, the cheapest grade on the market, and for this reason a considerable amount of adulterant in Acheen pepper might not be disclosed by a determination of either of these extracts.

The starch and reducing matters, by direct inversion, are highest in the best grades of black pepper, and lowest in the cheapest grades, while the reverse is true of fibre, total ash, and ash soluble in water, and ash insoluble in HCl. Determination of these six ingredients may be useful to some extent in ascertaining the quality of a sample, if not its purity.

From our analyses, it appears that genuine black pepper of low grade may contain more than 5 per cent. of ash and 14 of fiber, which are given in the Austrian codex as the maxima; although 2 per cent. of sand, the maximum of the codex, has not been exceeded in any of our analyses. The per cent. of nitrogen and of albuminoids in adulterated pepper may be either greater, less, or the same as in the genuine pepper, depending on the nature of the adulterant used.

White Pepper.

Determinations of the ether and alcohol extracts and of nitrogen in the ether extract are the best means of detecting starchy adulterants. The parts of nitrogen in 100 of ether extract range from 4.05 to 4.45.

If olive stones, nut shells, sawdust, or similar materials are used as adulterants, determinations of starch (best by the diastase method) and of fiber will be valuable for their detection.

In all cases the percentages of total ash in pure white pepper are below 3 per cent., the maximum of the Austrian codex. The percentage of nitrogen and albuminoids will not usually furnish evidence of adulteration.

Cayenne Pepper.

The percentages of non-volatile ether extract range from 17.17 to 21.81, and of alcohol extract, from 21.52 to 27.61. These figures are much higher than in farinaceous materials, fruit stones, nut shells, and most of the other cayenne adulterants. Determination of starch by the diastase method is of great value when farinaceous matter is present. Red sandal wood is not readily detected by any of the methods just mentioned, but, if present in considerable amount, a determination of fiber should furnish valuable evidence. Other woods, nut shells, fruit stones, also increase the per cent. of fiber.

All of the samples contain less than 6 per cent. of ash, the limit of the Austrian codex.

Ginger.

The composition of the cereal products which are usually employed as ginger adulterants is not very different from that of pure ginger, and the microscope must usually be depended on to detect such materials.

Adulterated ginger may show a deficiency of volatile ether extract, but, as genuine ginger sometimes contains less than 1 per cent., a low percentage of volatile ether extract alone is not sufficient evidence of adulteration.

The highest per cent. of calcium oxide in any of the samples not evidently limed is 0.71, but in the limed samples the percentages range from 1.07 to 3.53. As carbonate and sulphate of lime are used to adulterate ground ginger, it should be determined whether the grinding of limed ginger is legitimate, and, if so, what maximum of lime should be allowed in ground ginger.

The two samples of exhausted ginger examined differ widely from each other in composition. No. 9727, the sample from the ginger-ale works, having been treated with water, is deficient in cold-water extract, water-soluble ash, and alcohol extract, but not in ether extract. The other sample, No. 9368, which was obtained from the extract factory, contains the full amount of cold-water extract and water-soluble ash, but is strikingly deficient in alcohol extract and ether extract, both volatile and non-volatile, and must have been extracted with some solvent other than water—probably strong alcohol.

Acetic acid is used in this country by some of the extract manufacturers, but we have no figures which show the composition of ginger after extraction by this solvent.

Cinnamon, Cassia, and Cassia Buds.

The only marked difference between Ceylon cinnamon and cassia, brought out by the analyses, is in the fiber, the former containing an average of 36.20, the latter of 22.96 per cent.

Cassia buds have a higher percentage of non-volatile ether extract and nitrogen, and a lower percentage of fiber, than the bark, but are otherwise similar in composition.

Saigon cassia contains more volatile oil than the Batavia and China varieties, and Ceylon cinnamon. Batavia cassia and

Ceylon cinnamon have about twice as much alcohol extract as Saigon or China cassia.

We have also found that Batavia cassia differs from the other varieties, in that it contains a gum which, on treatment with water or weak alcohol, forms a glutinous paste. (See foot note, p. 187).

The analyses of the sample of broken China cassia, No. 9737, and of the coarse and fine materials obtained from this sample by sifting, show to what extent cassias may be mixed with dirt in China.

Ground cassia should not contain more than 7 per cent. of ash and little, if any, more than 2 per cent. of sand.

Aside from determination of ash, it is doubtful if chemical analysis of cassia will be of use in detecting adulteration.

Cloves.

This spice is rich in volatile ether extract, alcohol extract, and tannin, and determination of these constituents will usually be sufficient when only non-starchy adulterants have been detected by the microscope.

As cloves contain no starch, a test with iodine solution will disclose farinaceous matter, or any other foreign material containing starch.

By the diastase method a small amount of reducing matter is obtained (1.91 to 2.42 per cent. calculated as starch), but the amount is too small to impair the usefulness of this method as a means of disclosing starchy adulterants. The samples of cloves examined contain less than 10 per cent. of fiber and between 0.94 and 1.13 per cent. of nitrogen.

There is no common adulterant which does not differ radically in composition from cloves, in respect to several ingredients.

Red sandal wood cannot be readily detected by the determination of starch or alcohol extract, but it contains almost no volatile ether extract and has six times as much fiber as cloves.

The Austrian codex states that pure cloves will not contain more than 8 per cent. of ash. Our figures are well within this limit.

Clove stems have about one-quarter as much volatile oil, half as much fixed oil and alcohol extract, and over twice as much fiber as cloves.

Allspice.

The samples analyzed differ materially in composition. Clove stems, a common adulterant, cannot probably be distinguished from allspice by chemical analysis.

On comparing the analyses of allspice with the analysis of cocoanut shells in Table XXXII, p. 210, it will be seen that the two materials are radically different in composition, and that this adulterant, when present in considerable amount, can be detected by analysis.

Nutmeg.

True and long nutmegs have about the same chemical composition. The addition of almost any available adulterant, excepting oil seeds or oil cake, will tend to lower the percentage of volatile and non-volatile ether extract. When shells or sawdust are present, fiber determinations should be made.

As the starchy matter of the sample of grinding nutmegs had been eaten out by insects (see description of sample), only 1.63 per cent. of starch was found by the diastase method. The percentage of fixed oil is also much lower than in sound nutmegs, but that of volatile oil is abnormally high, due, probably, to the removal of other matters.

Mace.

True mace is readily distinguished from Macassar or Bombay mace by the percentage of fixed oil and starch, as shown in the following statement:

	Non-volatile ether extract.	"Starch" by diastase method.
True mace (Aver., Nos. 9619, 9662, 9717),	22.48	27.87
Macassar mace,	55.54	8.78
Bombay mace,	59.81	14.51

None of the varieties contains starch, in the ordinary acceptance of the term, as iodine produces a red and not a blue coloration. Tschirch* has shown, however, that the irregular

* Ber. d. Deutsch. bot. Ges., 6, 1888, 138. See also Tschirch, Angewandte Pflanzen-anatomie, 1888, pp. 90 and 100, and same author, Anatomischer Atlas, 1887, pp. 252 and 253.

shaped granules which are evident under the microscope consist of starch granules impregnated with amylodextrin, to which granules he has given the name, "amylodextrin-starch."

Our experiments show that this carbohydrate is readily soluble in diastase, and may be determined by the diastase method.

The results thus obtained are valuable as a means of detecting adulteration, and of distinguishing true from Macassar and Bombay mace.

Note on the Chemical Composition of Mustard Flour.

Pure mustard flour is prepared from one variety of mustard seed, or from a mixture of different varieties, with the removal of the hulls and usually of a portion of the fatty oil. As the product contains only a portion of the seed, standards of purity cannot be based on analyses of the whole seed from which it is prepared.

No analyses of mustard seed or of authenticated samples of mustard flour have been made at this Station, but on page 168 are given analyses of 26 brands of mustard flour sold in sealed packages bearing the names of the manufacturers.

The maxima, minima, and average results of the analyses of 18 samples which were not found adulterated or artificially colored, either by chemical or microscopical examination, are as follows:

	Total ash.	Ether extract.		Reducing matters by direct inversion calculated as starch.	Starch by diastase method.	Crude fiber.	Nitrogen, × 6¼.
		Volatile.	Non-volatile.				
Maximum,	7.35	1.90	28.10	6 12	2.08	4.87	43.56
Minimum,	4.81	0 00	17.14	1.85	0.28	1.58	35 63
Average,	**5.99**	**0.56**	**20.61**	**4.33**	**1.07**	**2.58**	**39.57**

WHEAT FLOUR.

By A. L. Winton.

A sample of flour bought in another State and referred to this station for examination was found to contain a considerable quantity of maize starch.

To discover whether the flour sold in Connecticut markets is adulterated in this way, twenty-five different brands of flour were bought and carefully examined microscopically. No evidence of any form of adulteration was found.

The names of the brands examined, and of the dealers from whom they were bought are given in Table XXXIII.

Table XXXIII. — Wheat Flour not found Adulterated.

Station No.	Brand.	Dealer.
9602	The King's Best, H. H. King & Co., Minneapolis,	*Hartford.* K. Goldberg, 66 Talcott St.
9603	Townshend's Butterfly, Stillwater, Minn.,	T. A. Shaw, 535 Main St.
9604	Crocker's Best XXXX, Minneapolis,	T. A. Shaw, 535 Main St.
9601	Shumacher's White Cloud, Akron, O ,	E. P. Yates & Co., 711 Main St.
9436	White Seal Fancy Patent, Norton & Co , Chicago,	*New Haven.* Edward Boyhan, 554 Grand Ave.
9143	The Hoosier Hulled Whole Wheat Flour, Seymour, Ind.,	I. B. Chandler, 101 Dixwell Ave.
7806	Fancy Roller Process Hungarian Patent, Pt. Jefferson Milling Co , L. I.,	Geo. W. Clark, 987 State St.
9437	Roller Process Princess, Fancy Family, St. Louis,	G. W. Cooper, Grand Ave. & Artizan St.
9442	Jones Hungarian Superlative, Hecker, Jones, Jewell Milling Co.,	A. F. Copeland, 1206 State St.
9444	Staten Island Milling Co.'s Fancy Patent, Minnesota,	J. L. Folley, Grand Ave. & Bradley St.
9440	Pillsbury's Best XXXX, Pillsbury Washburn Flour Mills, M'apolis,	Philip Hugo, Edward & Nash Sts.
9438	Prima Donna, Anchor Mill Co., Superior,	F. A. Hull, 399 Grand Ave.
9439	White Loaf, Bryan, Miner & Read, New Haven,	Conrad Rausch, Foster & Avon Sts.
9441	Gold Medal, Washburn Crosby Co., Minneapolis,	J. J. Sullivan, Nash & Eagle Sts.
9445	Daily Bread, Liberty Mills,	389 Grand Ave.
9701	Wilson's Choice White Rose Pastry Flour,	*New London.* M. Wilson Dart, Howard & Bank Sts.
9702	Bridal Veil, Central Milling Co., Buffalo,	Edward Keefe, 495 Bank St.
9487	Schumacher's Patent, Akron, Ohio,	*Waterbury.* D. L. Dickenson, 431 W. Main St.
9485	Christian's Superlative, Pettit Mills, Minneapolis,	Dillon's Cash Store, 43 E. Main St.
9486	Gold Seal Fancy Patent, The F. C. Bushnell Co., New Haven,	N. W. Heater, 157 E. Main St.
9488	The Angelus, Thompson Milling Co., Lockport, N. Y.,	798 Bank St.
9523	Fancy Patent Superlative, E. G. W. & Co., Minneapolis,	*W. Winsted.* Chas. Smith, Main St.
7970	Schumacher's XXX Graham, Akron, Ohio,	*Willimantic.* H. Levin, 493 Main St.
9521	Ceresota, Western Consolidated Milling Co., Minneapolis,	*Winsted.* I. K. Camp, Main St.
9522	Peerless XXXX, E. G. W. & Co., St Louis,	Larkin & Sparks, Main St.

FOOD PRODUCTS EXAMINED FOR THE DAIRY COMMISSIONER IN THE YEAR ENDING JULY 31, 1897.

BY E. H. JENKINS.

A considerable part of the chemical and polariscopic work here described was done by Messrs. Winton, Ogden & Mitchell. All adulterated samples were also examined by Mr. Jenkins, who was summoned to attend court cases of prosecution for violation of the law.

VINEGAR.

Thirty-two samples sent by the Dairy Commissioner were examined during the twelvemonth ending July 31, 1897.

Solids. Of the samples marked "cider vinegar",
3 had between 1.0 and 1.5 per cent. of solids.
9 " " 1.5 " 2.0 " " "
16 " over 2.00 per cent. of solids.
The highest percentage found was 3.57.

Acidity. Of the samples marked "cider vinegar",
2 had between 2.5 and 3.0 per cent. of acidity.
1 " " 3.0 and 3.5 " " " "
5 " " 3.5 " 4.0 " " " "
20 " over 4.0 per cent. of acidity.
The highest percentage found was 6.41.

Three samples marked "White Wine Vinegar" contained from 0.15 to 0.25 per cent. of solids, and from 4.53 to 4.60 per cent. of acidity.

MOLASSES.

Two hundred and three samples of molasses and syrups have been examined in the year ending July 31, 1897.

Method of Examination. — 13.024 grains (one-half the normal weight) of molasses were dissolved in about 80 cc. of water, 3 cc. of basic lead acetate were added, the volume was made up to 100 cc. and the whole was thoroughly mixed and passed through a dry filter. The rotation of the clear and nearly colorless filtrate was determined, in a 200 mm. tube, with a Schmidt and Haensch half shade double compensation polariscope. The reading, doubled, gave the sugar degrees or per cent. No correction was attempted for the volume of the lead precipitate.

To 50 cc. of the filtrate referred to above, were added 5 cc. conc. C. P. hydrochloric acid, and, after thorough mixing, the flask containing the solution was placed in a cold water bath, which was then quickly heated to 68° C. After standing at that temperature for 10 minutes, the contents of the flask were quickly cooled and the solution, filtered from lead chloride when necessary, was examined in a 220 mm. tube, provided with a water jacket. The temperature was noted with the reading. This reading, doubled, gave the sugar degrees after inversion.

Water, heated to 86° C., was then passed through the jacket and a third reading made at that temperature.

The rotatory power of dextrose is not greatly affected by the temperature, but that of levulose diminishes as the temperature rises, so that invert sugar becomes practically inactive at about 86°.

Results of Examination. — Of the 203 samples of molasses and syrups examined for the Dairy Commissioner, 34 were adulterated with glucose syrup and 169 were free from this adulterant. The percentage of adulterated samples was 20.1. In the previous year it was 32.8. The numerous prosecutions brought by the Commissioner have probably lessened the introduction and sale of adulterated molasses in this State.

It is also noticeable that the proportion of glucose added in the adulterated samples is less than in the previous year. There are a considerable number of samples which, by direct polarization, show no higher polarization sugar than is found in some genuine molasses (50 to 60 per cent.). But polarization after inversion at room temperature and at 86° C. demonstrates the presence of an adulterant.

MAPLE SYRUPS.

Two samples, labeled "Maple Syrup," were examined for the Commissioner, and were found to contain no glucose.

SYRUPS.

Four samples, labeled "Syrup," "Crystal Syrup," or "Vanilla Drips," tested for the Commissioner, were found to consist largely of glucose syrup.

Cream.

A sample marked "Bryant's Pasteurized Cream," contained 47.25 per cent. of butter fat. A sample marked "Pure Cream, the Mount Philip Farm, Weatogue," contained 47.0 per cent. of butter fat. In neither sample was there found either borax or formaldelyde.

Butter and Oleomargarine.

Seventeen samples have been examined for the Dairy Commissioner during the year ending July 31, 1897.

Methods of Examination.

Specific Gravity. This is determined at the temperature of boiling water by means of Westphal's balance, as first described by Estcourt and by J. Bell, Chem. News, Vols. xxxiv, 254, and xxxviii, 267.

The balance is so adjusted that water at 15.5° C. shall represent unity.

With distilled water, at the temperature of boiling, the instrument indicates a specific gravity of .9625. If the specific gravity of fat at the temperature of boiling water is desired, using the weight of an equal volume of distilled water, *at that temperature* as a standard, the reading of the instrument must be multiplied by 1.039.

We have also used for this determination a specific gravity spindle made by Greiner of New York City, 6⅜ inches long, reading from .8550–.8700, and graduated to show differences of .0005 in sp. gr.

Volatile Fatty Acids.— These were determined by the Reichert method, the saponification being effected by the method of Leffmann and Beam, as described in the Analyst, xvi, 1891, p. 153. The result of the determination is expressed by the number of cubic centimeters of $\frac{1}{10}$ normal sodium hydroxide solution necessary to neutralize the acid distilled from 2.5 grams of the fat.

Results of Examination.

Of the samples examined, 10 were butter and 7 were imitation butter, or oleomargarine.

The specific gravity of the melted fat, determined by the method above named, in a single sample of pure butter, was 0.8649; in the samples of imitation butter, or oleomargarine, it ranged from .08596 to 0.8062.

The volatile fatty acids determined as above described, in 2.5 grams of butter-fat, ranged from 13.50 cc. to 16.50 cc. In the like quantity of imitation butter they ranged from 0.13 to 0.70.

SUMMARY.

The following table contains a summary of the results of the work done during the past year in the examination of food products :

	No. of samples not found to be adulterated.	No. of samples found to be adulterated.	No. of samples containing borax or salicylic acid, not otherwise adulterated.	Total.
Collected by the Station —				
Purchased in Connecticut Market :				
Jellies,	27	43	..	70
Preserves, Jams, Marmalades, etc.,	6	45	..	51
Teas,	89	..	..	89
Coffee,	34	11	..	45
Coffee Compounds,	22	..	..	22
Coffee Substitutes,	6	..	..	6
Flour,	25	..	..	25
Ginger,	67	24	..	91
Malt Liquors,	35	..	12	47
Sausage,	5	..	14	19
Honey,	27	10	..	37
Maple Syrup,	3	..	..	3
Milk,	13	..	..	13
Cream,	19	..	4	23
Canned Soups,	32	..	..	32
Canned Vegetables,	65	..	..	65
Chili Sauce,		1	..	1
Mince Meat,	9	..	..	9
Ground Spices in labeled packages,	142	28	..	170
	626	162	30	818
Purchased from Importers :				
Pure Spices, Spice By-products, etc.,	125	...	..	125
Total collected by the Station,	751	162	30	943
Collected by the Dairy Commissioner :				
Vinegar,	20	12	..	32
Molasses,	169	34	..	203
Syrups,	4	..	..	4
Cream,	2	..	..	2
Butter,	10	7	..	17
Total collected by Dairy Commis'r,	205	53	0	258
Sent by Individuals :				
Milk,	96	..	..	96
Cream,	9	..	..	9
Total from all sources,	1,061	215	30	1,306

SOME COMMON DISEASES OF MELONS.

By Wm. C. Sturgis.

For several years the growing of melons in southern Connecticut has been attended with discouraging results, sometimes amounting to complete failure. Before striking off melons from the list of plants which can be grown with profit, it is well to consider the causes which have led to failure, and to attempt the application of remedial measures.

In common with most members of its family, the melon is a plant of rank growth and succulent, delicate tissues. The fruit contains about eighty-four per cent. of water, and the leaves and stems when dried under pressure show, by their extreme thinness, that they also contain a very high percentage of water when fresh. For its full development, the plant requires a light, warm soil, and it thrives best under conditions of high temperature, dry air, and continuous sunshine. The melon plant is as delicate in constitution as in texture. It does not adapt itself readily to varying conditions or sudden climatic changes, its physiological balance is easily upset, while its tissues offer little resistance to the attacks of insects, fungi, and bacteria.

I

At least three different causes are accountable for the recent failures of the melon crop. The first and most important is unquestionably a bacterial disease which has been very accurately studied and described by Dr. E. F. Smith of the United States Department of Agriculture. Unfortunately, we have as yet no extended account, in English, of Dr. Smith's investigations, but the disease itself is doubtless familiar to all melon-growers. It is characterized by a sudden wilting of the leaves, which is quite independent of atmospheric conditions, being as liable to occur in cloudy as in clear weather. As far as my experience goes, a plant thus wilted never recovers as do plants which droop from the effects of sudden sunshine after cloudy weather. Usually only a single plant in a hill shows the disease; occasionally all the plants in a hill will be smitten at once; but, in any case, a plant once attacked is doomed; the leaves wilt down and wither completely, while the stem either dries or becomes food for eel-worms, putrefactive bacteria and other agents of decay. It sometimes happens that where a vine branches near the ground, one branch may be attacked and the rest of the vine remain healthy; if, in such a case, the diseased branch is cut off at its junction with the main stem, the rest of the vine may escape infection. I have noted several cases during the past summer in which a vine was saved by the removal of a diseased branch before the infection had reached the main stem.

The specific cause of this disease, Dr. Smith describes as a rod-shaped, ciliated, motile bacillus (a name applied to a certain genus of bacteria), isolated or united in pairs and occurring in the vessels of the leaf-ribs and stem, from the cut ends of which it oozes in slimy, milk-white drops. It grows readily in pure cultures on a number of the usual culture media, such as beef-broth, potato decoction, boiled potato, etc. It requires the presence of free oxygen and an alkaline medium for its best development; it is extremely sensitive to heat, a temperature of 43° C. (108° F.), maintained for ten minutes, being sufficient to destroy it, and, while very sensitive to desiccation, it may live for months if kept moist.

By isolating this bacillus in pure cultures and inoculating melons and cucumbers with it, as well as by transferring it directly from diseased to healthy plants, Dr. Smith proved conclusively that the organism in question is the specific cause of the disease, and that it is probably identical with a similar organism attacking squashes. According to Dr. Smith's published researches, the immediate cause of the death of melon plants invaded by this bacillus is not the destruction of tissues, but the choking of the vessels by its accumulation within them and the consequent arrest of water-supply to the leaves. The plants become infected through the leaves, probably by the agency of insects such as the striped cucumber-beetle (*Diabrotica vittata*) and the squash-bug (*Coreus tristis*).

When the infected leaf wilts, the bacillus has already traversed its vessels and reached the stalk; here it multiplies, at first in the spiral vessels only, but later in the large dotted ducts, choking them up more or less. At first there is no destruction of the tissues, the diseased stem appearing quite normal, but later the walls of the vessels are destroyed and large cavities are formed, filled with the bacillus. Owing to the predilection shown by this organism for the *tracheae* or vessels of the stem, it has been named by Dr. Smith *Bacillus tracheiphilus*.

That this is actually the disease which, for the past five years at least, has destroyed a large percentage of the melon vines in Southern Connecticut there can be no doubt. Continuous observation in the field, in three separate localities, during the past season, convinced me that the chief source of trouble was the bacterial organism above mentioned. A plant wilts suddenly, without apparent cause; from cut stems of wilted plants kept under a bell-jar in the laboratory, viscid, milky drops ooze out, swarming with motile bacilli, apparently identical with those described by Dr. Smith; microscopic examination of diseased stems shows that the large vessels (water-channels) of the wooden portion are almost filled with yellowish masses of the same organism, while the petioles of squash leaves inoculated with a small portion of one of the viscid drops from a diseased melon stem show the characteristic symptoms of the disease in the course of five days.

One other point, however, is worthy of mention. In examining a vine from which a wilted branch had been removed a few days previously, it was seen that the main stalk at the cut was covered with a dense whitish mold, and that the whole plant had begun to droop. It was thereupon pulled up and further search brought to light another wilted plant, the base of which was likewise covered with white mold. This plant was also removed and both were microscopically examined the following day. The mold proved to be a species of *Fusarium*, the vegetative portion of which had permeated the stalk; where the latter was broken and the tissues were exposed, the fungus had fruited, producing vast numbers of pointed, cylindrical, slightly curved, 3-5-septate spores, measuring $30\text{-}54 \times 4.5\text{-}5.7\ \mu$. The two stalks were divided longitudinally and placed in a moist atmosphere under a bell-jar. In twenty-four hours they were examined again and the mycelium of the *Fusarium* was found to have given rise to masses of minute elliptical bodies, non-septate, and measuring $8.5 \times 3.8\ \mu$. The genus *Fusarium* includes a number of so-called species, most of which occur on dead vegetable matter, though a few are known to infest living plants. The mere fact that a member of the genus occurs in the tissues of the crown of melon plants would not be worth mentioning were it not that more than one disease of plants, characterized at first by wilting, has been traced directly to the accumulation in the water-passages at the crown, of the mycelium and spores of a *Fusarium*. Such a disease in cotton has been described by Atkinson, and in tomatoes by Massee. In the Twenty-first Annual Report of this Station (1897), I described a disease of carnations apparently due to the same cause. Furthermore, Smith describes* a disease of watermelons in the South as caused by a fungus which gains access to the plant through the roots, appears abundantly at the crown, produces on the surface of the stem "large lunulate, 3-5-septate conidia (50 μ long)," and, in the internal tissues of the stem, produces " minute, elliptical, colorless conidia (10 μ long) . . . on white mycelium which plugs the water ducts," and thus causes the plants to wilt and finally die. The resemblance between this fungus, which Dr. Smith has named provisionally *Fusarium niveum*, and the one found by me in wilted muskmelon plants, as well as the similarity, in appearance, of plants infested by them, warrants the suspicion that the wilt-disease which has been so prevalent lately in our muskmelon fields may be due in part to the attacks of a species of *Fusarium*, possibly the same as that associated with the wilt of watermelons.

II

The second disease which, in former years, has caused serious injury to muskmelons, is a black mold occurring in circular patches upon the leaves, and known as *Alternaria Brassicae, var. nigrescens*. This fungus was noted and its effects described in our Nineteenth Annual Report (1895.)

III

The third trouble is entirely different from either of those described above. When cool, cloudy weather alternates with hot sunshine it is frequently noticed that the large leaves near the center of the hills turn yellow at their margins. Later, these yellowed margins become brown and dry, and finally the whole leaf is diseased. As the leaves die down they begin to

* Proc. Am. Asso. Adv. Sc., XLIII, p. 289; and XLIV, p. 190.

decay, the tissues become infested with eel-worms, putrefactive bacteria and molds of various kinds, and sometimes the whole plant is ruined. In this case the initial injury is due to a derangement of the proper activities of the plant. I have frequently had occasion to mention the dangers to plant-life of sudden atmospheric changes, especially from damp, cloudy weather and low temperature, to a dry, hot air. When both the soil and the atmosphere are surcharged with moisture, evaporation takes place very slowly from the leaves, and is abundantly compensated for even by the lessened absorptive activity of the roots due to the low temperature of the soil. If now the plants are suddenly exposed to a hot sun, evaporation from the leaves becomes very active, while the roots are unable to respond to the sudden demand made upon them, since the soil temperature changes but slowly. Consequently the leaves give off water more rapidly than they receive it, the cells tend to collapse and, if the equilibrium is not speedily restored either by increasing the absorptive activity of the roots through warming the soil, or by decreasing the evaporative activity of the leaves through shading or sprinkling, the leaf tissues will die. Such a condition is, of course, much more liable to occur in the case of plants, like the melon, which absorb water with avidity and retain a very large quantity of it in their delicate tissues, than in plants with denser tissues requiring and retaining less water.

There are, then, three distinct troubles to which are to be ascribed the recent losses in our melon-fields:—First, a Wilt caused by the bacterial organism *Bacillus tracheiphilus*, and possibly also by a fungus of the genus *Fusarium;* secondly, a blight of the leaves occasioned by a variety of the fungus *Alternaria Brassicæ;* and thirdly, Leaf-Burn, a physiological trouble that follows sudden disturbance of equilibrium between water-absorption and evaporation.

With the view of obtaining further information regarding the possible control of these troubles, three experiments were conducted during the past summer in different localities and on different soils, viz. at Saugatuck, in Fairfield county, and at New Haven and North Haven, in New Haven county. At Saugatuck the melons occupied a rather low piece of ground and a fine, dark, loamy soil, not particularly favorable for melons except in a very dry season. Ten rows were selected, each containing sixteen hills. Ten hills in each row were treated with fungicides, the remaining six serving as checks. Three rows received Bordeaux mixture, three potassium sulphide, one sulphur, and three "Laurel Green," a "combined fungicide and insecticide" prepared by the Nichols Chemical Company, Syracuse, N. Y., and containing ten per cent. of copper and seven and three-quarters per cent. of arsenic.* The melons at North Haven occupied an ideal soil for melons, warm, sandy, and deep. A plot was selected comprising twelve rows, with twelve hills in each row. Six hills in each row received fungicidal treatment, the remainder served as checks. Besides this treatment, one-half of the hills in each plot were mulched heavily with tobacco stems in order, if possible, to prevent the inroads of melon-lice, and to guard the roots from sudden changes of temperature. The fungicides applied to these plots were the same as those used at Saugatuck. The melons at New Haven were on a dry, rather gravelly soil, and served only to test the effects of a heavy mulch of marsh hay, about two-thirds of the field being mulched in this manner.

From these three experiments it was thought probable that there would be obtained some definite information as to the efficacy of root protection and the application of fungicides in preventing disease. In case the treated and untreated plants alike should show no sign of disease, the experiments would still serve to show the effect of fungicides on the delicate foliage of the vines.

The effect of mulching, as seen in the field of Mr. A. N. Farnham of New Haven, where marsh hay was used, and at Mr. H. P. Smith's of North Haven, where tobacco stems served a like purpose, was not particularly striking. At Mr. Farnham's the mulch checked the growth of weeds and protected the melons from the dirt, but all of the vines, whether mulched or not, showed extraordinary vigor, and it is very doubtful whether mulching with hay will, in ordinary seasons, prove remunerative. In periods of severe and protracted drought it would undoubtedly be of value in conserving the soil moisture until the same result was attained by the growth of the vines themselves.

As to the value of tobacco-stem mulch, the experiment at North Haven presented some interesting facts, although,

* See Cornell Univ. Agr. Exp. Sta., Bull. 149, p. 720. 1898.

owing to the entire absence of plant-lice, nothing was learned regarding its efficacy in protecting the vines from those insects. Merely as a covering for the soil, tobacco seemed to be of even less value than marsh hay, and is, of course, much more costly. Weeds throve with peculiar luxuriance where the tobacco was used. But, as a source of plant-food, the value of the tobacco became more and more apparent as the fruiting season approached. The whole field had received a liberal application of fertilizer* before the seed was planted, and this proved sufficient to maintain the vigor of the vines until the fruit was about half grown. On August 13th a visit was paid to the field and the appearance of the vines left nothing to be desired. The leaves were of a rich green color, indicative of perfect health, the vines completely covered the ground, and the fruit was setting in great abundance and growing very rapidly. Nine days later the whole field had a yellowish tone, and closer inspection of the vines showed that they were evidently suffering from lack of food. The larger leaves, especially those near the center of the hills, were of a pale green color, very different in tone from that which had characterized them nine days previously. Moreover, on these leaves were beginning to appear the circular brown spots marked with darker concentric rings which indicate the presence of the *Alternaria*. Only on the plots mulched with tobacco did the vines show their former vigor. These facts can only be explained on the theory of an insufficient, or rather, an ill-regulated supply of plant-food. As I have said, the fertilizer for the whole season was applied at the same time and before the seed was planted. Had the season been a dry one, or had the rainfall been evenly distributed throughout the summer, or had the soil been less liable to leach, this original supply of plant-food would doubtless have been sufficient to carry the vines through. But the actual conditions were quite the reverse of this. The fertilizer was applied on May 9th and at the time of planting; the seed was planted between May 14th and 23rd. The month of May was very rainy, heavy rains occurring on sixteen of the thirty-one days. Then followed a long period of great

* Canada wood ashes was applied broadcast, at the rate of half a ton to the acre, a week before the seed was planted, and, at the time of planting, each hill received a fork-full of compost consisting of three parts of barnyard manure and one part of tobacco-stems.

drought, beginning on May 28th and continuing, practically without intermission, except for three light showers, until July 4th. During July there were seven days of rain, and the month of August was characterized by a succession of very heavy thunder storms which did great damage on loose soils. Under these circumstances melon vines grew rapidly during June and made large demands on the fertility of the soil. These demands were increased when the fruit began to form, while simultaneously the heavy downpours of August, falling upon the loose, sandy soil, washed much of the remaining fertilizer down beyond the reach of the roots and thus decreased the already limited supply of plant-food. These conditions were aggravated by the facts that too many vines had been allowed to a hill and that the set of fruit was enormous. Four vines occupied each hill, and on August 22nd I counted as many as thirteen almost full-grown melons in one hill. To form this amount of fruit there must have been a demand upon the soil which, under the circumstances, it could not supply, and the vines began to show signs of starvation. Just here the value of the tobacco mulch began to be apparent. Soaked by the rains and undergoing a natural process of decay, the tobacco stems readily gave up to the soil all of their soluble constituents, which proved sufficient to carry the vines through. A similar effect was seen in the melon patch at Saugatuck. A case of tobacco stems had been left over from an experiment of the preceding year, and Mr. Wakeman, the owner of the field, having no other use for them, applied them liberally to twenty hills, early in July. The soil was closer and less liable to leach than the North Haven soil, so that the vines in general showed no evidence of starvation; nevertheless, those which were supplied with tobacco stems were plainly more vigorous and retained their vigor longer than any others in the field.

I am not prepared to recommend tobacco stems either as a mulch or as a fertilizer for melons, since the cost would be prohibitive, but I think that the facts above stated justify the following conclusion:

When melons are grown upon a loose, sandy soil, which is liable to leach, it is advisable to apply the fertilizer in small amounts and at intervals throughout the season, or until the spread of the vines makes tillage no longer practicable, rather than to make a single application of a large amount at the beginning of the season. The former method will be found to be of special advantage in a season characterized by repeated and heavy rains, and if more than two vines are grown in one hill.

As to the effect of fungicides upon the diseases of melons, the experiments are rather inconclusive. They were designed to test the resistance of the foliage and to protect the latter from the *Alternaria*. The fungus, however, failed to appear at all on the vines at Saugatuck, and at North Haven it appeared first about the middle of August, when the vines were in a half-starved condition. Whether it would have appeared at all if the vines had been in better general health is an open question, though the hills mulched with tobacco certainly showed less of the trouble than did the others.

Of the four fungicides used — Bordeaux mixture, potassium sulphide, sulphur, and Laurel green — sulphur was the only one which injured the foliage seriously. This was the third season that I had used this fungicide on melons, having conceived great hopes of it from its well-known efficacy in checking the mildew of so tender-leaved a plant as the rose, and from the excellent results which had attended its use on celery on various occasions. In 1896 I recommended it for melons on the farm of the Messrs. Meeker of Westport, and Mr. Meeker reported that it burned the plants. In 1897 I used it myself in an experiment with melons at Mr. S. B. Wakeman's at Saugatuck, and, although I noted that the vines on which it was used showed evidences of severe blighting or burning, I was not prepared to lay the whole blame upon the sulphur, since all of the vines were practically ruined by excessive rains before the fruiting season. The experiments of the past summer, however, leave no further room for doubt. At North Haven the first application was made on July 6th; at Saugatuck, on July 7th. These were repeated on July 15th and 16th respectively. On the 22nd and 23rd the vines were so badly burned that the treatment with sulphur was discontinued. At North Haven no further applications were made to these vines and later one of the rows recovered partially, but the other two were irretrievably ruined. At Saugatuck, where the injury was not so serious, potassium sulphide was substituted for the sulphur and the vines recovered their vigor in a measure.

The application of sulphur to the leaves of melons is not to be recommended. Although valuable as a fungicide, it has a decided tendency to burn the leaves.

The Bordeaux mixture used in both experiments was made according to the 6-4-50 formula and was applied four times at North Haven—July 6th, 15th, and 22nd, and August 2nd. At Saugatuck the melons were less advanced, and five applications were made—July 7th, 16th, and 23rd, and August 3rd, and 16th. The potassium sulphide was used in the proportion of two ounces to five gallons of water, and the Laurel green in the proportion of one pound to ten gallons. All of these were applied on the same dates. No injury of any kind resulted from the use of either the potassium sulphide or the Laurel green, but the vines sprayed with the Bordeaux mixture of full strength showed indications, after the third treatment, that the mixture was too strong; for the subsequent treatments it was made up on the 5-5-50 formula and diluted, before use, to half that strength. (See p. 266.) This proved perfectly satisfactory.

Bordeaux mixture (containing not more than three pounds of copper sulphate to fifty gallons of water), Potassium sulphide, and Laurel green are safe fungicides for use upon melon vines.

As to the efficacy of these fungicides in protecting the vines from fungous attack but little can be said. The only disease which affected them very seriously was the bacterial wilt. This appeared shortly after the runners began to grow rapidly, and continued throughout the season. It is worthy of note that at no time were any predaceous insects found in connection with this bacterial disease, although, taking the check rows as a fair sample of the field, the disease at North Haven destroyed almost thirteen per cent. of the vines, and at Saugatuck almost three per cent. At each spraying the vines were carefully examined and those showing the wilt wholly or in part were immediately pulled up and removed from the field.

The following is the record of this operation:

NUMBER OF WILTED PLANTS.

	At North Haven.	At Saugatuck.
In Bordeaux rows,	3.	3.
Check,	5.	0.
In Potassium sulphide rows,	8.	1.
Check,	4.	4.
In Sulphur rows,	?	2.
Check,	10.	0.
In Laurel green rows,	15.	2.
Check,	9.	1.

It is evident that no conclusion can be drawn from these figures, unless it be that fungicides are useless in combatting the bacterial wilt of melons. If this be so, it is only in line with what we know of the bacterial diseases of other plants. They do not readily succumb to fungicides.

It is probable that the susceptibility of melons to contract the bacterial wilt is unaffected by the fungicides commonly used against fungous diseases. Removing and destroying all wilted vines is the only practical method of preventing the spread of the disease.

Observations on the spread, at North Haven, of the leaf disease caused by the fungus *Alternaria Brassicae* were convincing as to the efficacy of both Bordeaux mixture and potassium sulphide as preventives. The vines sprayed with each of these fungicides remained absolutely free from the *Alternaria*, while the characteristic brown blotches of the fungus made their first appearance, about the middle of August, on all of the corresponding check rows and increased in number throughout the fruiting season, damaging the vines to a considerable extent. It was noticeable, however, that the fungus appeared simultaneously with the first indications of the starved condition of the vines, none of the check rows, owing to an oversight, having received the tobacco mulch. This fact, coupled with the equally significant absence of the disease on the Saugatuck melons which at no time showed any sign of a lack of plant-food, would seem to indicate that the *Alternaria* attacks only vines which have been weakened by other causes.

Dilute Bordeaux mixture and Potassium sulphide may both be regarded as efficient preventives of the blotching of melon-leaves by the fungus *Alternaria Brassicæ, var. nigrescens.* There are decided indications that vines thoroughly nourished and otherwise well cared for will not ordinarily suffer from this trouble.

As to the value of Laurel green, the results at North Haven are unfavorable. The rows sprayed with it began to be blotched at the same time and to about the same degree as the check rows. The Laurel green used was too coarse to remain in suspension even as well as Paris green. Only while vigorously stirred could the mixture be evenly distributed. This is an objection to its use in a spray, no matter how effective it might prove when suitably applied.

MILDEW OF LIMA BEANS.

By Wm. C. Sturgis.

In the Annual Report of this Station for 1897, p. 165, occurs the following statement: "Much can be done by the grower, apart from the application of fungicides, to lessen the susceptibility of lima beans to mildew. The selection of well-drained land and a light soil is important, but, above all, care must be taken, by reducing the number of vines in a hill and by planting the poles erect, to insure conditions as little favorable as possible to fungous disease." With the co-operation of Mr. S. B. Smith of East Haven, upon whose land the spraying experiment of last year was conducted, it was planned to test the difference between thick planting and thin planting, and between upright poles and slanting poles, as regards the prevalence of mildew. Four rows, each comprising thirty-six hills, were selected near the center of a large field of beans. On the first row the poles were set upright; on the second they were set slanting in pairs, so that the tips of the poles in each pair were together, on the third upright and on the fourth slanting. The first three rows were divided into sections of six hills each, and after the beans were well started above ground each hill was either thinned out or increased by transplanting, so that, beginning in the first section with one plant to a hill, the hills in each succeeding section contained one more plant than those of the preceding one. Thus the crop from the three rows would show the comparative results, as regards the yield, of having from one to six plants to the hill; and also any advantage, as regards the prevalence of mildew, which might accrue from planting thinly and preventing the excessive crowding of the vines at the tops of the poles. The fourth row was included merely as a check. It was set, according to the usual custom, with slanting poles, and the hills throughout contained an average of two or three plants. No spraying was done during the course of the experiment, since the latter had in view solely the connection between the prevalence of mildew and certain methods of culture, and it was therefore undesirable to check the possible spread of the mildew by the use of Bordeaux mixture, as was done last year. A similar experiment, though on a much smaller scale, was conducted on the Station grounds.

During the winter much time and labor had been expended in the endeavor to unravel the question as to how and where the mildew succeeded in passing the winter. With this end in view a quantity of pods and portions of vines completely covered with the fungus had been gathered the previous autumn and placed out of doors where they would be exposed to the weather without being disturbed. Eight months later this refuse was brought into the laboratory and examined with the utmost care for resting-spores, a perennial mycelium, or any other form in which the fungus might have been perpetuated. Through the kindness of Mr. A. N. Farnham of Westville, I also secured a large quantity of refuse from a mildewed crop of beans which had lain in the field all winter, and this was carefully examined. In neither case was there found any trace of a vegetative or reproductive body which could be even remotely associated with the *Phytophthora* causing the mildew. The old pods were a veritable fungus-garden, but all of the species observed were common saprophytes such as species of *Fusarium*, *Alternaria*, *Macrosporium*, and the like.

Failing in this search and yet feeling sure that somewhere in that mass of refuse there must at least be the living mycelium of the *Phytophthora* awaiting only a favorable opportunity to become again active, this refuse was used as a mulch for the beans which had been planted at the Station. It was spread thickly upon the ground before the beans had started, and the latter were allowed to come up directly through it.

Finally, from the pods contained among this refuse, I succeeded in collecting a score or so of fairly sound beans which were planted in a separate row with the hope that one or two might germinate, notwithstanding the winter's exposure, and throw some light on the source of infection. It seemed reasonable to suppose that if the mildew passed the winter in a dormant condition in the beans themselves, then the plants produced from such beans would inevitably become mildewed early, providing that the weather were favorable to the development of the fungus, while if the latter were dormant in the old pods and vines, the forcing of young plants to grow up through a mulch of such refuse would certainly result in an early and disastrous attack.

That everything conspired to favor such an attack during the past season, was evident from the great damage which was caused by the mildew on the Smith farm at East Haven. The fungus made its appearance there on August 5th, and by the 26th of that month over fifty per cent. of the pods were destroyed and there were no prospects of any further development of pods. The beans were on rather low, moist ground, and the weather during August was, on the whole, damp, close and sultry. Notwithstanding this, hardly a trace of the mildew appeared on the vines at the Station. Many of the beans were destroyed by field mice shortly after being planted, but a fair stand was secured; the vines grew well and produced perfectly sound pods until almost the close of the season, when some mildew appeared. The mulch of refuse from a mildewed crop had practically no effect on the vines which grew up through it, a fact which would indicate that such refuse remaining on the field is not, as would naturally be supposed, a menace to the crop of the next season. Of the beans collected from the refuse, only one germinated, but that one produced a vigorous, thrifty vine which bore a full crop of perfectly sound pods. Apparently, then, the propagative power of the mildew does not reside in the diseased seed. No clue was obtained from these experiments as to the important question of how and where the mildew is propagated from one season to another. The latest researches along this line, in connection with the related potato mildew, *Phytophthora infestans,* prove conclusively that that fungus passes the winter in the stored tubers, in the form of mycelium,* and analogy would lead one to suppose that in the same way the bean-mildew remains dormant in the diseased vines, pods, or seeds. As has been seen, however, neither observation nor experiment have thus far given any indication that such is the case.

The extensive experiment at East Haven was designed to test the comparative effect upon the prevalence of mildew and upon the total yield, of close and open planting and of upright and slanting poles. The results are of interest, but are not wholly conclusive. As regards the total yield, it was very seriously diminished by the mildew and this diminution was not proportional to the varying number of plants to a hill, for the reason that the sections containing the smallest number of plants were on the lowest ground and were first and most seriously attacked by the mildew. The crop on these sections, therefore, was proportionately less than it

* Ludwig Hecke, in Journal für Landwirthschaft, XLVI, pp. 71–74 and 97–142. 1898.

would have been if the only factor concerned had been the smaller number of vines to a hill. Moreover, on the upper sections where the hills each bore five or six plants, it was impossible to bring so many plants to maturity, since three or four were always more vigorous than the rest and consequently survived, while the weaker ones were dwarfed and often produced no fruit whatever. It appears safe to assert that it will not pay to attempt to grow more than four and probably three lima-bean plants to a hill.

Bearing these facts in mind we will consider the records of the various plots. Gatherings were made on August 5th, 12th, 20th, and 26th, and September 1st. At each gathering all of the marketable pods were picked and a record kept of the total number of pods and the number mildewed. At the final picking, on September 1st, all of the pods two inches or more in length were gathered, as the mildew had infested the fruiting tips of the vines to such an extent that there was no prospect of a further development of pods. The following record, therefore, represents very accurately the total yield of the vines and the percentage of mildewed pods for the whole season, on the experimental rows:

Row A—Poles Upright.

Number of vines to a hill, .	6	5	4	3	2	1
Total number of pods, . .	478	595	639	631	528	417
Number of mildewed pods, .	236	228	332	315	192	248
Percentage of mildewed pods, .	49%	38%	52%	50%	36%	59%

Row B—Poles Slanting.

Number of vines to a hill, .	6	5	4	3	2	1
Total number of pods, . .	540	445	390	494	478	453
Number of mildewed pods, .	267	211	193	227	253	218
Percentage of mildewed pods, .	49%	47%	49%	46%	53%	48%

Row C — Poles Upright.

Number of vines to a hill, .	6	5	4	3	2	1
Total number of pods, . .	624	564	567	632	350	275
Number of mildewed pods, .	308	361	289	299	168	124
Percentage of mildewed pods, .	49%	64%	50%	47%	48%	45%

A glance at these tables shows that in this instance the position of the poles has had no effect whatever upon the prevalence of the mildew. On the three sections planted with six vines to a hill, where we would naturally expect to find a decided difference owing to the excessive crowding of the growth at the top of the poles, no difference is apparent, while upon the section planted with a smaller number of vines the percentages of mildewed pods permit of no deductions regarding upright *vs.* slanting poles. The same is true in a measure regarding the effect, on the mildew, of thin *vs.* thick seeding. The highest percentage of mildew in row A occurs where only one plant was allowed to a hill. In row B it occurs where two plants were allowed, and in row C where five plants were allowed to grow in one hill.

The total yield was so seriously diminished by the mildew that no inferences can be drawn from the figures as to the comparative value, in this respect, of upright and slanting poles, but it is interesting to note, regarding thin *vs.* thick seeding, that increasing the number of vines in a hill does not increase the yield proportionately. In this respect two or three vines to a hill show as good a record as do five or six. In an ordinary season two vines to a hill would be an ample allowance. The past season was an extraordinary one in that the weather was exceptionally conducive to the spread of the mildew. The loss of over fifty per cent. of the pods and the practically complete destruction of the crop by September 1st, only four weeks after the first appearance of the mildew, shows the severity of the attack, and it is very probable that under such conditions no merely cultural methods would ever suffice to prevent or even to lessen the destructiveness of the fungus. One other fact served in a measure to vitiate the results. As stated above, the field where the beans were grown sloped downward slightly from north to south. A marshy piece of land adjoins the field on the south, and in rainy weather the soil is so wet at that end that it is difficult to secure a stand of beans. The experimental rows ran north and south so that the soil at the lower end of every row was decidedly more moist than that at the upper end. This had a marked influence on the mildew, causing it to appear earlier and with more severity on the more thinly seeded sections where it was expected to be less severe. That this caused an exceptionally high percentage of mildew on these sections and therefore tended necessarily to lead to erroneous conclusions regarding the value of thin seeding is shown by the record of row D, which was a normal field row, set, as usual, with slanting poles and bearing an average of two or three plants to a hill. This row yielded, on August 12th, a total of 305 pods, of which nineteen, or six per cent., were mildewed; the mildewed pods occurred only on the lowest six hills. On August 20th the lower half of this row yielded 287 pods, of which forty-four per cent. were mildewed, while the upper half yielded 272 pods, of which only twelve per cent. were mildewed. Later, when the mildew was at its height, there was no appreciable difference between the upper and lower portions of this row, but it is very evident that the wetness of the soil in the lower portion of the field exercised an important influence upon the inception and spread of the trouble. If this had been foreseen the experimental rows would have been run east and west and we should have looked for a marked advantage from thin seeding, an advantage which, under the circumstances, was offset by the more favorable conditions existing for the spread of the mildew where thin seeding was tried.

I am confident that the loose, dry soil upon which the beans were planted at the Experiment Station was the chief factor in preventing the appearance of the mildew until very late in the season. All other conditions were as favorable to it as on the Smith farm, and every means, short of direct infection, was used to induce an attack. It would be useless to attempt to draw any conclusions from these experiments.

They serve, however, to emphasize the importance of selecting high, well-drained land for the culture of lima beans, and they indicate that a wet soil tends to induce the spread of the mildew in a degree which no cultural methods will wholly counteract.

PRELIMINARY NOTES ON TWO DISEASES OF TOBACCO.

By Wm. C. Sturgis.

For the last three years my attention has been repeatedly called to a peculiar disease of growing tobacco, and I have been urged to investigate it with the view of ascertaining its cause. The pressure of other work and the distance of the Experiment Station from the principal tobacco regions of the State have prevented my giving to this matter the attention which it deserves, and the following notes are compiled largely from the published works of foreign investigators, supplemented by such information as I have been able to gather from the growers and from personal observation. In this connection I wish to express my indebtedness to Mr. W. K. Ackley of East Hartford for his valuable assistance in the way of supplying information and in affording every facility for a study of diseased tobacco in the field.

THE SO-CALLED "CALICO" OF TOBACCO.

This disease of tobacco is very common in certain seasons and in certain portions of the tobacco region about Hartford. It may make its first appearance either in the seed-bed or in the field. In the former case the young plants, when they are from one to six inches high, begin to show a mottled appearance of the leaves, at first visible only as an almost imperceptible pale green color of the tips of the leaves, but soon arresting attention by the spread of this pale color, in blotches, all over the leaf surface, the contrasting shades of green being very noticeable. Such plants are of course discarded when transplanting to the field is begun; nevertheless, the same disease may appear later in the field, sometimes within a week of transplanting and sometimes not until after the plants have been topped and suckered. When a plant is attacked in the field it soon becomes a noticeable object, even from a distance. It is usually smaller than its neighbors, it does not present the healthy, dark green color of a sound plant, the leaves are narrow and are inclined to stand up stiffly, and on closer inspection the peculiar mottling of the leaves is very distinct. The pale color, first visible at the tips of the leaves, gradually

progresses downwards, following with more or less regularity the course of the veins. The paler tissues grow less rapidly than those of the darker portions, so that the mottled appearance becomes intensified by the thickening of the darker areas and the leaf surface presents a blistered appearance. Another characteristic of a diseased plant is the tendency of the leaves to curl downward at their margins, owing to the fact that the growth of the marginal tissues is checked. From this time on the plant is worthless and is generally removed. If allowed to remain, the paler portions of the mottled leaf lose their green color, and the whole leaf becomes yellow and sprinkled over, especially toward the tip, with small circular spots where the tissues are bleached, dead, and brittle. Sometimes the leaf, in the later stages of the disease, takes on a uniform reddish-brown color. The disease, in its progress, resembles a process of ripening in which every phase, from the first indistinct mottling characteristic of a fully ripe leaf, to the final brown color of the leaf when cured, is represented in an intensified form and a brief period of time.

What is recognized among experts as true calico makes its appearance early, in the seed-bed or the field; attacks, at first, the middle and lower leaves; spreads from them to the upper, younger leaves; and usually is at its worst before the time for topping. At that time, or when the flower buds begin to form, especially if a period of cold, damp and cloudy weather is followed by hot, clear weather, some plants in a field show what growers call "mottled-top." The topmost leaves of the plant become mottled, but this appearance is finer and less pronounced than in the case of true calico. The leaves show the same tendency to stand erect, but are very susceptible to hot sunshine, drooping under it so conspicuously that a "mottled-top" plant can be readily recognized at a distance of several rods. What the ultimate fate of such plants is I am unable to say from personal observation, but it is not regarded as serious, since the affected portion is removed when the plants are topped and it does not spread to the remainder of the plant. I am also assured by certain experts that, under favorable conditions, a "mottled-top" will recover, though from the nature of the case it is only by an oversight in topping that it is given an opportunity to do so. One more point regarding "mottled-top" is worthy of mention. Leaves affected in this manner are supposed to be tougher in texture than sound leaves, and, as a matter of fact, a "mottled-top" leaf which has become wilted can be crumpled in the hand without injury; but this is evidently merely the toughness which characterizes any tissue which has become flaccid through the withdrawal of water, and cannot be considered as a symptom of disease.

From careful observation of plants affected with "calico" and with "mottled-top," I have been unable to escape the conclusion that they are merely two phases of one and the same trouble. When it affects the plants early, whether in the seed-bed or in the field, and attacks severely the larger middle and lower leaves, it is called "calico"; but when it appears later in the season and produces only mild symptoms in the younger, top leaves, it is called "mottled-top." I may add that many growers are inclined to accept this hypothesis.

We may now pass to a consideration of some of the conditions under which calico develops. That it occurs throughout the tobacco fields of Hartford county is an undoubted fact, but it is equally certain that it is far more serious in some localities than in others. Thus, on the western side of the Connecticut River calicoed plants are seldom if ever seen in the seed-beds, and they occur only sporadically in the field. I have never seen a field of tobacco really seriously affected with calico in that region. The suckers, it is true, often show calico, but that is a condition very commonly occurring everywhere. On the eastern side of the river, particularly in the townships of East Hartford and South Windsor, calico is a very serious trouble almost every year. I have seen fully ten per cent. of the plants destroyed by it in a single field, and the damage seldom falls below one per cent. It is of interest, therefore, to compare the conditions prevailing on the two sides of the river.

Soil. — On the west side the best tobacco fields consist of a loose, deep, sandy soil, easily worked and fairly retentive of water. As a rule these lands, before being brought under cultivation, were covered with a second growth of white birch after having been denuded of the original forests of white pine. The surface of the soil crusts over after a rain, but the soil itself is rather loose in texture and does not bake or pack, hence it acts as a good conductor of heat and its temperature becomes readily adjusted to that of the atmosphere. On the east side, particularly where calico prevails, the soil contains

a larger percentage of silt or clay, hence it is more retentive of water, absorbs and gives off heat much less rapidly, requires constant tillage and, after a rain, bakes hard. When packed and slightly moistened, its surface has a slimy feel and becomes quickly covered with a coating of green algae. The difference between these two soils, especially as regards their susceptibility to changes of temperature, is worthy of note. It should also be noted, however, that in some localities on the east side the soil approaches in character that of the west side, being lighter and sandy, and that, in the opinion of certain growers, these localities are quite as liable to produce calicoed tobacco as are the clay soils. Upon this point further information is most desirable.*

Variety of Tobacco. — Few plants are more profoundly influenced by the character of the soil in which they grow than is tobacco. As a rule a close, heavy soil is best adapted to a large, rather coarse tobacco, curing to a dark color, while a lighter soil is suited to varieties with a smaller leaf, thin and silky in texture and curing to a bright color. The differences between the soils on the east and west sides, therefore, have their counterpart in the varietal differences between the tobaccos raised. On the west side, Havana is grown exclusively; on the east, seed-leaf; and the prevailing theory is that these cannot be reversed with profit.

Method of Culture. — The construction and the sowing of the seed-beds, as well as the general methods of transplanting and growing the crop, are essentially the same on the two sides of the river, and call for no comment.

Manuring. — In this particular the custom prevailing on the one side differs materially from that on the other. On the east side, natural manures are used very largely; on the west side, fertilizer-chemicals form the staple, if not exclusive, supply of plant-food. Of course there are exceptions on both sides, and individual judgment has led to numerous experiments with fertilizers, but the usual custom is as above stated, although on the east side there is a growing tendency to supplement the liberal application of stable manure with the sulphates of potash and ammonia, dissolved bone-black, etc.

Selection of Seed. — Usually the large growers raise their

* Those interested in this matter should consult U. S. Dept. Agric., Div. of Soils, Bull. 11, entitled "Tobacco Soils of the United States."

own seed year after year. Where calico prevails, the custom is to raise and use seed from sound plants for a period of three years, and then to secure a supply from some neighboring grower. This custom is of course based upon the supposition that calico may be transmitted through the seed, a supposition which, as we shall see later, is erroneous.

These very brief notes are sufficient to show that the principal points of difference between the conditions under which tobacco is grown on the east side of the Connecticut River, where calico is abundant, and on the west side, where it is very seldom, if ever, a serious trouble, are three in number; first, a marked difference in the texture of the soil; secondly, a consequent difference in the variety of tobacco which can be profitably raised; and thirdly, a difference in the substances used as sources of plant-food. We may eliminate the second difference, since it is directly dependent upon the first and since it is no explanation of the cause of calico to say that seed-leaf is more susceptible than Havana.

The essential differences then, are found in the soil and in the fertilizers. Which of these, if either, is accountable for calico? Before attempting to answer this question it will be of interest to note the results of certain observations and investigations which we have made on calicoed tobacco. External injuries which, either as cause or symptom, are connected with a plant disease, may be due to the attacks of predaceous insects or of parasitic fungi, to the invasion of the tissues by bacteria, or to causes of a physiological nature whereby the normal functions of the plant become deranged and wilting, yellowing, or spotting of the foliage results. Repeated and careful microscopic examination of the tissues of calicoed tobacco-plants precludes the theory of insect-injury. Calicoed leaves are not only free from insects themselves, but they show no sign of punctures or other indications of insect-attack. The external tissue of the stalks also shows no injury attributable to insects. Occasionally there are found in the tissues of the roots a few nematodes or eel-worms, but they are as frequently found in the root-tissue of sound plants.

It may be said with an equal degree of certainty that calico is not due to fungi. In the last stages of the disease, when the affected leaves have become brown and spotted, the dead tissues are frequently invaded by molds, but the latter are only such as occur commonly on any dead vegetable

substance, and in the earlier stages of the disease there is no trace of any fungus upon or within the tissues of the leaf. Search has also been made in the tissues of the stem and root of calicoed plants for fungi which are known to invade the water passages of some plants and, by their rapid growth, prevent the upward passage of water, and thus produce a wilting of the plant, and finally its death. No such fungus has been found.

As to the presence of bacteria in the diseased tissues, I cannot speak with any certainty. Direct microscopic observation is not to be relied upon, since the contents of the cells are so dense that they would effectually mask the presence of bacteria, unless the latter were present in great abundance; this they certainly are not. The only sure method of determining the presence or absence of bacteria is by means of cultures from the diseased tissues, and this I have not yet attempted. If the disease is caused by bacteria it would seem strange that it is not apparently contagious. It sometimes happens that where the plants are set by machine, two plants are dropped in the same spot. In such cases I have myself seen, and experts tell me that it is a common occurrence, that one of the plants becomes calicoed while the other remains perfectly healthy. In re-setting calicoed plants there is no evidence to show that the fresh plant is at all more liable to become calicoed from having been set in the spot previously occupied by a diseased plant. Moreover, the fact that suckers from a perfectly sound plant are very liable to calico and that a plant or stub bearing calicoed suckers may have shown no sign of the trouble, militates against the theory of bacterial infection. Finally, if the disease is caused by bacteria there would be a strong probability that seed from a calicoed plant would have a tendency to reproduce the disease. This, however, does not seem to be the case, as the following experiment shows:

In the spring of 1897, wishing to follow the course of calico continuously in the field, I secured from the seed-beds of Mr. Ackley of East Hartford twenty seedlings showing calico and, from the same bed, twenty apparently healthy seedlings. These were brought to the Station and set in two parallel rows in the garden. They were set too close together, the soil was not adapted to tobacco, only a very small amount of fertilizer was added to it and the plants received very little attention in the way of tillage. With one exception, all of these forty plants were badly calicoed within six weeks. The exception was one of the originally healthy plants. The calicoed plants were dwarfed and the trouble ran its course with great energy; nevertheless, most of the plants flowered and ripened an abundance of seed. This seed was gathered and, in the following spring, after being sprouted, was sown in flats in the green-house. Of the hundreds of seedlings thus raised not a single one showed a sign of calico in the flats. Thirty seedlings were transplanted and set in a row in the Station garden; the soil in this place had received a dressing of barnyard manure and ten of the plants were given in addition about two bushels of manure, ten more received a handful of mixed chemical fertilizer dropped in the bottom of each hole before setting the plants and the remaining ten were planted without any additional fertilizing. All of the plants, especially those provided with an abundance of plant-food, showed great vigor and remained perfectly healthy. Meantime, from the same lot of seedlings, a dozen were sent to Mr. Ackley, who set them in a warm corner near the barn where they received the drainage from the barnyard. These also failed to show any sign of calico and formed plants of extraordinary size and vigor. It would seem apparent, therefore, that calico is not communicable through the seed.

Although it is by no means proven that calico is not a bacterial disease, and although the evidence that it is not so is entirely inferential, yet the facts above noted certainly create an impression that we must look elsewhere than to bacterial infection for the cause of calico.

We have thus excluded from the list of possible causes the attacks of insects, whether above or below ground, and of parasitic fungi on or within the tissues of diseased plants; the case against bacteria is doubtful, and there remains only the question of some physiological disturbance. Such a disturbance may arise as the result of artificial injury whereby the normal functions of the plant are hindered or arrested, or it may be due to abnormal natural conditions producing a similar result. In the former case, if the leaves and stalk are normal and uninjured, attention is at once directed to the root.

The opinion is often expressed with regard to calico that it is due to an unnatural twisting of or injury to the roots of the seedling in the process of transplanting, or to setting the plant over a stone or other obstruction which prevents the normal

growth of the tap-root. It is evident, however, that this theory fails to explain the existence of calico in the seed-bed, and, furthermore, the examination of the root-systems of scores of calicoed plants in the field, and a comparison between them and those of sound plants, shows no essential differences except such as are correlated with the dwarfed habit and weakened vitality of the calicoed plant.

Secondly, disturbances in the functional activity of a plant due to abnormal natural causes may be connected either with the soil, including its texture, composition, and contents, whence the plant draws its food and water; or with the atmosphere from which the plant derives the carbon for building up its framework and into which it transpires the excess of water absorbed by the roots.

As to the soil and its composition, it is naturally and primarily considered as a vehicle of plant-food supply. In this connection, it will be remembered, we noted as one of the essential differences existing between soils upon which calico is common and those upon which it is comparatively rare, that the bulk of the plant-food is supplied in the former case by stable manure and in the latter by fertilizer chemicals. Are we justified in concluding that here at length we have found the essential factor in the prevalence of calico? There have not been a sufficient number of critical experiments along this line to form the basis for a trustworthy answer to this question, nevertheless there are facts which have a direct bearing upon it. That calico is not due to a lack of plant-food is to be inferred first from the fact that quite as much plant-food is applied to the soil in one case as in the other, and secondly from the fact that calicoed plants occur here and there, without regularity, among the sound plants in a field liberally and evenly supplied with a complete plant-food. An inadequate food-supply would hardly become apparent in this sporadic manner. Moreover, the opinion of experts in raising tobacco is directly opposed to the theory that stable manure is responsible for calico, and their opinion is that of intelligent, practical men, who have experimented along this very line with the view of checking the disease. It is more than doubtful if calico is due to a lack either of plant-food in general, or of any one in particular of the essential elements of plant-food,—nitrogen, potash, or phosphoric acid. The case is somewhat different as regards lime,

—a substance which, on certain soils, is necessary to the best plant-growth. Lime may act beneficially in a number of ways. Occasionally it may enter directly into the economy of the plant, but usually its value lies in its mechanical and chemical action upon soils containing a large percentage of clay, undecomposed vegetable matter, or zeolitic silicates. In the case of most clayey soils, it tends to bind the finest particles together, thus making the soil more porous; where vegetable matter abounds, this is decomposed and made available by lime; in the case of zeolitic silicates, lime unites with them and liberates potash, ammonia, and other valuable constituents of plant-food, which thus become available.

Acting on the presumption that on the close, clayey soil of the tobacco fields of East Hartford the application of lime might be followed by good results, one of the largest tobacco-growers in that neighborhood was advised to try it. In accordance with this advice, he applied last fall on a portion of his land two and a half barrels of slacked lime per acre, and supplemented it the following spring by an application, broadcasted and harrowed in just before setting, of a barrel and a half of lime. The experiment was rather roughly planned and conducted, and no exact record of the results was kept, but the experimenter reported that no appreciable benefit resulted so far as the prevalence of calico was concerned.* It is highly desirable that this experiment should be repeated under better conditions, but meanwhile we may presume that whatever benefit results from the use of lime will be due, more to its effect upon the texture of the soil, than to supplying an element of plant-food which in all probability is not deficient.

A consideration of the soil in its mechanical aspects bears a close relation to certain facts connected with atmospheric conditions and the effect of the latter upon plant-life. To this consideration the question of the cause of calico has now been narrowed down, if we except the possible theory of bacterial infection. We have frequently called attention to the fact that a period of hot sunshine following a period of cool, cloudy weather may have a very deleterious effect upon a plant by

* Since the above was written I have heard of one well-authenticated case in which a heavy application of lime to the clayey tobacco-land of East Hartford was followed by a very marked decrease in the amount of calico usually seen.

causing such rapid evaporation of water from the leaves that the roots are unable to supply the demand. The effect of such a disturbance of equilibrium will become apparent in a wilting of the plant and, if long continued or repeated, will cause a diminished rate of growth and possibly the death of certain tissues situated at a distance from the source of supply and nourished only by the fine terminations of the veins; such tissues are situated at the tips and edges of the leaves, hence the tips will show signs of a lack of water and the margins, checked in their growth, will tend to become incurved. These symptoms will be the more marked the more sudden and violent are the atmospheric changes. Moreover, a plant of rank growth and succulent tissues will be more seriously affected than one in which growth is slow. Finally, the effect will be more serious if the soil is fine and close in texture than if it is loose and porous, since in the former case it is more retentive of moisture and therefore a poorer conductor of heat. In such a soil, the roots, if once chilled and their absorptive capacity diminished, as happens when the weather is cool, damp and cloudy, recover that capacity only as rapidly as the soil-temperature approximates that of the atmosphere; consequently, a plant growing in such a soil might be irretrievably ruined by a sudden access of sunshine long before the roots, buried in the cold, non-conductive soil, could so far recover their capacity for absorbing water as to supply the suddenly increased demand on the part of the leaves.

So much by way of theory. What have we by way of facts in the case of calico?

First, the general appearance and behavior of calicoed plants bears the closest resemblance to that of plants affected by the conditions above described. No one could observe a calicoed tobacco-plant and compare its appearance with that of tomato-plants forced to active growth in the greenhouse and affected as described in the Annual Report of this Station for 1896, pp. 232-234, without concluding that the two diseases were attributable to very similar causes.

Secondly, the tobacco-plant, like the tomato, but in a still higher degree, is of extremely rank growth, while the value of the leaf depends largely upon the delicacy of the tissues composing it; hence the plant is intolerant of sudden atmospheric changes and becomes more so the more those characters which give it commercial value are emphasized.

Thirdly, the calico of tobacco is prevalent in a district characterized by a close soil of fine texture, which packs hard, retains moisture, and is a poor conductor of heat; it is less common on loose, porous soil devoid of clay.

Fourthly, the disease is sporadic in its nature, attacking one plant and leaving the next one untouched; this is only what might be expected when we consider the differences which are known to exist between individuals of the same species and growing under identical conditions, as regards susceptibility to external conditions. A damper spot in the soil, a slightly unfavorable position of the roots, the close proximity of a stronger plant, an exceptional delicacy of texture or of that intangible quality which we call physical constitution,— any or all of these causes might be sufficient to predispose a plant to calico while its neighbor remains perfectly healthy.

Fifthly, the fact that suckers from the butts of plants which have been cut, are disposed to calico, may possibly be correlated with the fact that these suckers are produced at a season characterized, in this climate, by sudden atmospheric changes, that they are composed of rapidly growing tissue and are directly exposed to the full force of the sun, and that the soil is no longer kept open and porous by means of tillage.

Sixthly, there is a vague impression, hardly amounting to a theory, on the part of many growers of tobacco, that the attacks of calico are not so severe in places where the plants are in a measure shaded by trees, as where they are fully exposed.

Lastly, a number of experts in tobacco have, irrespective of any theory of mine, expressed to me their decided conviction that serious outbreaks of calico occur only during periods of sudden and marked atmospheric changes.

SUMMARY.

1. The peculiar appearances known as "calico" and "mottled-top" of tobacco are probably symptoms of one and the same disease. The former may occur very early in the life of the plant, even in the seed-bed, and usually attacks first the older leaves; the latter occurs later, is less pronounced, and affects only the topmost leaves.

2. The disease occurs abundantly in some localities, notably on the close, clayey soils on the east side of the Connecticut river; sparingly in other localities, where the soil is open and porous.

3. The disease is not contagious. As to its infectiousness, no direct statement can as yet be made.

4. It is not caused by predaceous insects, nematodes, or parasitic fungi.

5. Bacteria have not been seen associated with the disease, but no critical method for their isolation or culture has been applied and therefore the question of their influence cannot at present be answered. The facts observed, however, are not favorable to the theory of bacterial infection.

6. The disease is not inherent in the seed. Seed from badly calicoed plants may produce perfectly sound plants and *vice versa*.

7. It seems probable that the disease is purely a physiological one, caused primarily by sudden changes of atmospheric conditions which disturb the normal balance between evaporation of water from the leaves and its absorption by the roots, and secondarily by soil-conditions which prevent the speedy restoration of that balance. This supposition is supported by numerous facts.

Preventive Measures. These must, of course, be regulated by the opinion which is formed as to the probable cause of the disease. If it is bacterial, the only means of eradicating it from the field is by pulling, removing from the field and burning, every plant showing the least sign of the disease. In case it arises primarily in the seed-bed, the latter must be removed to fresh, uncontaminated land. A still more effective precaution in the latter case, would be to remove the soil, to the depth of a foot, over the space to be occupied by the seed-bed, and to replace it with soil thoroughly sterilized by being baked on a bed of sheet-iron placed over a hot fire, in much the same way as the sand used in the making of concrete walks is treated. If, on the other hand, the disease is a physiological one, there are two lines along which experiments might be conducted with fair hopes of success; first, the addition to the soil of some substance which will render the soil more porous and more permeable to heat; secondly, the protection of the plants, at critical seasons, from a sudden access of sunshine. To accomplish the first-named purpose lime will probably be in many cases, the cheapest and most effective agent. The quantity necessary and the best time to apply it are matters which can be settled only by experiment. To accomplish the second object, it might be possible and practicable to adopt some such device as that used by tobacco-growers in Florida. It consists of long mats composed of slats fastened together with twine. Wires are stretched across the field at intervals and upon these the mats are spread. The slats have narrow spaces between them so that they allow of the passage of rain and sun-light, while at the same time they screen the plants from the direct rays of the sun. It is said that tobacco grown under these conditions is exceedingly fine. We hope, another season, to investigate these matters thoroughly.

THE SO-CALLED "SPOTTING" OF TOBACCO.

If that can be called a disease which is characterized by symptoms such as tobacco-growers desire to see in moderation, which enhance the market value of the leaf and which can be induced artificially with profit, then the "spotting" of tobacco comes under this head. It is a peculiar disease, never very common, not confined to any one locality and not characteristic of any special soil. What its earliest stages are I am unable to say, inasmuch as it is impossible to predict when it will occur and therefore to be on the watch for its first appearance, and, furthermore, because it only becomes noticeable when well advanced. As I have seen it in the field and in specimens sent to the Station, it is signalized by the presence on the leaf of small circular spots. These usually occur in the greatest number at or near the tips of the leaves and, at first, are yellowish in color and somewhat irregular in outline. Later they take on a circular form and become marked off from the surrounding tissue by a narrow border of a darker color. The tissue within this border finally dies and becomes almost white, but, except in severe cases, it does not break away from the leaf. A leaf so affected looks as though it had been sprinkled over with some caustic substance which has killed the tissues without disintegrating them. It bears a close resemblance also to the "leaf-spot" caused on certain plants by the attacks of fungi. Sometimes the spotting is slight and the spots themselves are scattered evenly over the whole leaf-surface; in such cases buyers are willing to pay a higher price for the tobacco, spotted wrappers being in demand. The spot can be successfully imitated by spraying the ripening leaves with a caustic liquid, and, where this is well done, the tobacco also brings a higher price.

It is only when the spot invades practically the whole leaf and causes the breaking of the tissues that it does serious damage. I have repeatedly, but thus far unsuccessfully, attempted to discover the primary cause of this trouble both by consulting the opinion of experienced tobacco-growers and by careful microscopic examination of the spots. Some say that it is due to particles of sand adhering to the leaves; others that it is caused by drops of water, which, acting as lenses, burn the leaf where they rest; but with regard to these theories it is sufficient to say that they have been put to proof in many attempts to produce the spot artificially, and have signally failed. Scores of the spots have been microscopically examined during the past three years without showing any evidence of the presence of fungi, insects, or bacteria. Nothing further, therefore, can be said regarding this trouble, nor would it have been considered worthy of mention at present were it not for its resemblance to a disease of tobacco which occurs in Europe and Asia.

FOREIGN INVESTIGATIONS UPON TWO DISEASES OF TOBACCO.

In 1885 Dr. Adolf Mayer, Director of the Experiment Station at Wageningen, Holland, published an account of a disease of tobacco to which he gave the name "Mosaikkrankheit," or Mosaic Disease.* This disease is characterized as follows: In from three to five weeks after setting, there appears upon the leaf-surface of plants, otherwise healthy, a mottled coloration in shades of dark and light green. The tissues of the darker portions become thicker and grow much more rapidly than the paler portions, so that an irregular wrinkling of the leaf-surface results. As the disease progresses certain of the paler and thinner portions of the leaf die out prematurely in a manner not altogether unlike that which is seen in fully ripe leaves, though to a much greater degree. When one leaf is diseased, all the younger leaves of the same plant also show the disease, but in correspondingly earlier stages. Frequently several diseased plants occur together in the field, but, quite as often, sound and diseased plants are irregularly distributed and a diseased plant never appears to be a source of contagion to those surrounding it.

From this description and the colored figures which accompany it, it is difficult to avoid the conclusion that the "Mosaic" of Dutch tobacco is the same as the "Calico" of Connecticut tobacco. As to the cause of the former, Mayer's

* Die landwirthschaftlichen Versuchs-Stationen, Bd. XXXII, p. 451. 1885.

investigations exclude the theories of a deficiency in the supply of plant-food; the attacks of nematodes; sudden changes of atmospheric and other conditions in the hot-beds, where the seedlings are raised; mechanical injuries to the roots in transplanting; the sudden change from conditions of long-continued high temperature, as in the hot-bed, to the cooler temperature of the field; the use of seed from diseased plants; and finally, the presence of parasitic fungi. But it was discovered that the juice of a diseased plant, when introduced into the mid-rib of a leaf on a sound plant, would reproduce the disease, the "period of incubation" being regularly ten or eleven days. Nevertheless, neither microscopic examination of diseased leaf-tissue, nor cultures from its sap, availed to show the presence of bacteria in connection with the disease. The infectious sap was filtered, but it still retained its virulence; if, however, it was passed through a double filter-paper, Mayer found that it lost its infectious character. Heating the sap for several hours at 80° C. had the same effect upon it.

Mayer thereupon concludes that (1) "The mosaic of tobacco is a bacterial disease from which, however, the infectious organisms have not been isolated. Their form and life-history is therefore unknown. (2) The contagiousness of the disease, by the artificial transfer of sap, has been proved with certainty. Under natural conditions no evident contagion, from one plant to another, occurs. Seeds of diseased plants can produce sound plants. (3) The spread of the contagion must be sought in the soil of the field or hot-bed, since certain fields, especially those in continuous use (for tobacco culture) are peculiarly subject to the disease. A case of the transfer of the disease by means of the soil has never been proved."

Upon the basis of these conclusions, Mayer recommends the renewal of the soil in the hot-beds, rotation of crops, the removal of the stubs of diseased plants after the crop is harvested, and the use of fertilizer chemicals in place of stable-manure. Three years later, in a brief note, he records a case in which the renewal of the soil in a portion of a hot-bed resulted in the almost total elimination of the disease, while one quarter of the plants from hot-beds where the soil was not renewed were diseased.

We are not in a position to question these statements, but it is to be noted that the mere fact that sap from a diseased plant will induce similar symptoms of disease when injected into the

tissues of a sound plant is not, in itself, a conclusive proof that the cause of the disease is bacterial. Smith's researches upon peach-yellows have shown that a healthy tree budded from one affected with the disease will contract it, although there is not the slightest evidence that peach-yellows is a bacterial disease. The two cases are not precisely parallel since the energy of contagion in the case of yellows, resides, not in the extracted sap of the diseased tree, but in the vital cellular union between the diseased bud and the healthy stock; nevertheless, it serves as a general illustration of the fact above mentioned. But apart from this, Mayer's investigations must be regarded rather as circumstantial evidence than direct proof, since he has neither observed, nor succeeded in isolating, any specific germ.

Shortly after the publication of Mayer's observations, two Russian investigators described another disease of tobacco to which they gave the name of "Spotted Disease" (*Pockenkrankheit*).* This disease, according to these observers, appears in June as white or brown spots of various shapes and sizes upon the leaves. They are sometimes simple specks, sometimes half rings, circles, or zig-zag lines following or crossing the veins. The first sign of the disease is the appearance of one or more shiny spots on the surface of the leaf. The gloss becomes gradually more pronounced and presently the tissues composing it collapse to half their normal thickness. Later these tissues become dry and brown or bleached, and sometimes separate from the surrounding tissues which remain apparently sound. The time required for a leaf to become sprinkled over with such spots is very short, sometimes a single day. The trouble is worse on open, dry land, but a diseased plant is not a source of danger to its neighbors.

That this disease is different from Mayer's mosaic disease is indicated by the fact that although, as Mayer had previously stated, a leaf in the last stages of "mosaic" might show a characteristic spotting, the "spotted disease" is never preceded by the mottled appearance associated with "mosaic." Neither insects nor fungi were found to be the cause of the "spotted disease," no bacteria were found in the affected spots, and infection of sound plants with the extract of diseased leaves

* Iwanowsky & Poloftzoff, Mém. de l'Acad. Imp. d. Sc. de St. Petersbourg. XXXVII, No. 7. 1890.

failed to reproduce the disease. Hence it is concluded to be of a physiological character. Careful experiments by means of cultures in water and sand precluded the theory of a general or particular lack of the essential elements of plant-food as a cause of the spotting and, after numerous investigations, the conclusion was reached, and it appears to be incontrovertible, that a spotting of the lower leaves of a tobacco-plant may and does occur when the plant lacks water, owing to the drain of the upper and younger leaves upon the older, lower ones. A similar spotting of the middle leaves occurs whenever the plant, after having stood for some hours in a damp atmosphere, is suddenly transferred to a dry atmosphere, owing to the fact that, under such circumstances, the leaves transpire water faster than the roots can supply it. Such conditions are shown to exist in the field, and our authors conclude that cool, damp nights with abundant dew, followed by a sudden access of high temperature shortly after sunrise, accompanied by dry winds and rapid evaporation, are responsible for this peculiar spotting of tobacco leaves. "The 'spotted disease' of tobacco is a disease which first becomes apparent when a high degree of atmospheric humidity is succeeded by a period of rapid and excessive transpiration. A changeable climate, a few days of rain succeeded suddenly by hot sunshine, — rather than prolonged drought, causes the most severe spotting."

It is evident that in this so-called "spotted disease" of tobacco we have a disease very similar to, if not identical with, that known in Connecticut as "spotting," and, furthermore, that this disease is as distinct from the "mosaic" of foreign tobacco as "spotting" is from "calico." If the statements of the Russian investigators above mentioned are correct (and there is every reason for so regarding them), "spotting" is probably due to excessive transpiration induced by sudden atmospheric changes.

Returning now to the subject of "mosiac." In 1892 Iwanowsky* confirmed Mayer's statements that the sap of diseased leaves is contagious, that it loses its virulence upon being heated to nearly the boiling point, and that the disease is to be ascribed to bacterial infection. He denies, however, that the sap loses its virulence by filtration even through a

* Land-und Forstwirthschaft. 1892. Cf. Beih. z. Bot. Centralbl., Bd. III, p. 266.

Chamberland filter, and explains this fact on the ground that it contains a soluble poison excreted by the bacteria of "mosaic." Iwanowsky was unable to isolate the specific germ on artificial media, but he states that he saw the bacteria and proved their presence in the tissues of diseased leaves. Here he leaves the subject, giving no further information concerning the organism.

In 1894 the French investigators Prillieux and Delacroix* identified the "mosaic" disease with a similar disease of tobacco occurring in France, and known as "nielle" (smut). The latter is characterized by the formation of spots upon the leaf surface, where the tissue becomes dry and of a grayish-yellow color. These spots are surrounded by a dark colored line, where the cells are suberized (corky), and which limits the infected area. In the cells of the spots is found a motile bacillus, 0.66 μ long, united in chains and imparting a yellow color to culture media. The article containing these notes is brief and very incomplete. The description given of the French disease raises serious doubts as to whether it is at all similar to the "mosaic" as described by Mayer.

In 1897 Marchal described,* under the name "La Mosaïque du Tabac" (the mosaic of tobacco), a disease which, in outward appearance, is fairly comparable to the one described by Mayer. He emphasizes, however, the spotting of the leaves, which, as has been shown, must probably be regarded as a different trouble, and merely repeats the observations of Prillieux and Delacroix that in the tissues of the grayish spots limited by a darker border is found a short, motile bacillus, forming chains in culture media, imparting to the latter a yellow color, and capable of reproducing the disease by inoculations from pure cultures. He states further that this natural contagion is inactive in the field and does not spread from a diseased to a healthy plant, but that in the soil of the seed-beds, replete with organic matter, it finds conditions highly favorable to its development. Here it attacks the seedlings, but inasmuch as its presence in the latter is indicated by no external symptom, it is impossible to distinguish and discard the diseased plants at the time of transplanting. The renewal or the sterilization of the soil in the seed-beds is therefore the only practical method of controlling the disease.

* C'mpt's rend. hebd. des Séances de l'Acad. des Sc., CXVIII-XII, p. 668. 1894.
† Revue Mycologique, XIX, 73, p. 13. 1897.

Finally, very recently, Beijerinck has ascribed the "mosaic" of tobacco to the action of a fluid not associated with bacteria, unlike any known enzyme, though acting in a similar manner, and possessing the ability to increase when brought into intimate association with the living protoplasm of active, formative tissues. I have been unable to obtain the original article in which this substance and its effects are described, but from the abstracts which I have seen* I gather that a good deal more work upon the subject is necessary before the conclusions of the author can be unqualifiedly accepted. This, so far as I know, completes the record of foreign investigations upon this class of tobacco diseases. It is evident that they consist of a number of isolated observations, made by investigators in widely separated localities and stated in terms which leave much to be inferred. What methods were used to isolate the specific germ and to avoid external contamination; what was the exact behavior of the germ in artificial cultures; what symptoms were produced in sound tobacco plants by inoculation either with pure cultures of the germ or with the extract of diseased tissues; whether these symptoms were identical with those observed by other investigators; whether from plants artificially infected the specific germ could again be isolated, and whether the diseases occurring in France are identical with those observed in eastern Europe and Asia,— all such questions are of primary importance, but concerning none of them have we any scientifically conclusive statements, with the possible exception of the work of the Russian investigators regarding the cause of the "spotted disease." One observer names and describes a disease which he infers is due to bacteria; a second states that he has seen the germ in the tissues, but has failed to isolate it; a third has isolated a germ from diseased leaves, but, according to his description, the external symptoms accompanying the presence of the germ differ materially from those described by the first observer and agree more nearly with those stated by a fourth to be characteristic of quite another disease due to entirely different causes. In view of these facts it seems best to limit our attention for the present to the diseases of tobacco which have come under our personal observation, and to record only such facts regarding them as our own experiments may in future elucidate.

*Centralbl. Bakt. u. Par., 2 Abth. Bd. V, No. 1, pp. 27-33, 1899.

MISCELLANEOUS NOTES ON PLANT-DISEASES AND SPRAYING.

By Wm. C. Sturgis.

Monilia fructigena on the Peach. During the spring of 1898 many complaints were received to the effect that the blossoms and twigs of peach trees were rotting. The trouble was not confined to peaches, but was very common also on the ornamental shrub known as the Double-flowering Almond. Specimens received from various localities showed that the rotting was due to an exceptionally severe outbreak of the fungus, *Monilia fructigena*, which does so much damage to the stone fruits. It rarely happens that this fungus does serious injury except to the fruit and just before the latter ripens. But it will be remembered that the latter part of April and the whole of May were characterized by heavy rains and much damp weather, conditions peculiarly favorable to the growth of the fungus. Peach trees bloomed during the first week in May, and the blossoms, failing to set and being soaked by the continuous rains, fell an easy prey to the *Monilia*. After destroying the blossoms the fungus worked into the twigs, killing the tissues and causing the leaves to wither, turn brown and finally decay. From the infested tissues of the twigs and through cracks in the bark gum oozed in large drops, and after every rain the twigs, leaves and decaying flowers showed the ash-colored, dusty heaps of the fungous spores. During the fruiting season, also, the weather was exactly suited to the spread of this disease; during August the blighted twigs and leaves again became covered with the fungus which had been kept in abeyance by the dry weather of mid-summer, and it spread with great rapidity to the ripening fruit. Added to this, the wet weather of August induced a severe attack of the scab-fungus, *Cladosporium carpophilum*, so that it is doubtful if, in many years, the peach crop has been so disastrously affected by these two fungi.

As to remedial measures, some good would certainly have been done if, as soon as dry weather came, the blighted twigs had been cut off and burned. This was done in the case of a small double-flowering almond; the shrub recovered entirely and experienced no further damage from the fungus even during the continuous wet weather of August. Judicious spraying, too, would have checked the rotting of the fruit, if we may judge by the excellent results attending the use of Bordeaux mixture in other places, notably in Delaware.* Our own experience, however, has been such as to cause us to hesitate before recommending the treatment of peach trees with Bordeaux mixture. Last year, in accordance with our advice, Mr. J. H. Hale of South Glastonbury sprayed a portion of his peach orchard, with the result that all of the sprayed trees lost their leaves. They recovered later and bore almost a full crop of fruit, but the loss of the leaves weakened the trees, and was undoubtedly caused by the Bordeaux mixture. During the past summer all of the fruit trees on the Station grounds, including a few peaches, Japanese plums, and apricots, were thoroughly sprayed with Bordeaux mixture made on the 6-4-50 formula. The foliage of quinces, pears, European plums, and apples was uninjured, but the peaches, Japanese plums, and apricots were completely defoliated, and the individual leaves presented the exact appearance of leaves affected with the shot-hole fungus. No fungus was found upon them and the injury was attributed entirely, and I believe rightly, to the Bordeaux mixture. I am unable to account for the discrepancy between this result and that uniformly obtained in Delaware, unless it be that our mixture was too strong. In Delaware six pounds of copper sulphate and nine pounds of lime are used in making fifty gallons of the mixture. We used the same proportion of copper sulphate but only four pounds of lime, on the supposition that sufficient lime to neutralize the whole of the copper sulphate would ensure the foliage against injury. This does not seem to be the case, and further experiments are needed to show just what form of Bordeaux mixture can be safely used upon peach trees.†

A Bacterial Blight of Lima Beans. Early in August the lima beans on the farm of Mr. S. B. Smith of East Haven began to show a peculiar blighted appearance. On the leaves were numerous reddish spots, circular in outline and bounded by a darker-colored border. Sometimes two or more of these spots coalesce. On the pods the first sign of the trouble is a small depressed spot, still green like the rest of the pod, but appearing watery and translucent; later the tissues of such spots become discolored and the spots themselves finally resemble those on the leaves. Thin sections through such a spot show that the cells are filled with a motile bacillus apparently identical with *Bacillus Phaseoli*, Sm.* This bacterial blight was first noted on lima beans by Professor S. A. Beach of the New York Experiment Station.† In 1893 Professor B. D. Halsted described a similar disease on wax beans,‡ and it seems fairly certain that both diseases are caused by the same organism. On wax beans the disease has been known certainly since 1886, but its occurrence on lima beans seems to be more recent. That it bids fair to become a very serious trouble was evident from its effects upon the beans at Mr. Smith's. Within a week after its first appearance it had swept over the whole field, the vines looked as though they had been sprayed with some caustic liquid, and, although no exact determination was made, probably ten per cent. of the pods were rendered unmarketable, to say nothing of the weakening of the vines by the partial destruction of the foliage.

Halsted has shown§ that seed from blighted pods may reproduce the disease; that the latter is worse upon land which has previously borne a diseased crop, especially if any of the refuse remains on the land; that an excess of moisture is favorable to the spread of the disease, and that it may be checked in a measure by the use of Bordeaux mixture. Where this disease is prevalent, therefore, great care should be taken to secure seed from a locality known to be free from it; if the crop has been diseased, neither wax nor lima beans should be grown on that same soil the next year; well-drained land should be selected, and, if practicable, the vines should be thoroughly sprayed with Bordeaux mixture. Two sprayings between July 15th and August 15th would probably serve to lessen very decidedly the injury caused by both the bacterial blight and the mildew.

The Damping-off of Peas. The damping-off of seedlings is a trouble only too well known to every one who has had much to do with growing plants under glass. It is characterized by

* See Del. Coll. Agr. Exp. Sta., Rep. IX, 1897, pp. 20-30.

† Cf. Corn. Univ. Agr. Exp. Sta., Bull. 164, pp. 385-388, 1899.

* Proc. Am. Asso. Adv. Sc., XLVI, p. 288. 1898.

† N. Y. Agr. Exp. Sta., Bull. 48, p. 331. 1892.

‡ N. J. Agr. Exp. Sta., Rep. 13 (1892), p. 283. 1893.

§ N. J. Agr. Exp. Sta., Rep. 17 (1896), pp. 328-333, 1897.

a sudden wilting of the seedlings, due evidently to a decay of the stem at the surface of the soil. If the stem is examined in the early stages of the disease, the tissues will be found to be traversed in all directions by the colorless vegetative threads (*hyphae*) of a fungus. These threads produce various kinds of reproductive bodies which either have their rise in a sexual process (*oospores*) or are produced non-sexually (*conidia* and *zoospores*). The fungus has long been known and bears the name *Artotrogus De Baryanus* (Hesse).* It does not often cause serious damage in the open, since for its best development it requires a high temperature, considerable moisture, and a close atmosphere, but it greatly injured garden peas during the past summer, the young plants decaying to such an extent that in one locality, at least, it was a difficult matter to get a crop. Microscopic examination of the infested seedlings showed an abundance of *oospores* in the tissues of the stems. These agreed perfectly with those of *Artotrogus De Baryanus*, but, according to Hesse, this species does not attack peas. Atkinson mentions in the Cornell Bulletin above referred to, p. 252, a species,—*Artotrogus Sadebeckianus* (Wittmack), "producing epidemics of diseases in lupines and peas," but I have been unable to find any description of this species or to determine whether the one noted on peas is identical with this or not. In any case, the course to be followed in order to prevent a recurrence of the trouble would be the same, viz.: thin planting, to secure an abundance of light and air for the seedlings; the avoidance of a heavy soil containing an excess of water; and the use of chemical fertilizers where practicable, rather than barnyard manure, upon the organic matter of which the fungus can feed and grow.

Plant-Diseases and the Weather. There is a general impression that wet weather is in itself a cause of the fungous diseases of plants. This is based upon the fact that during a period of damp weather plants are prone to suffer from a variety of diseases known as mildews, blights, rusts, molds, etc., which are not apparent in dry weather. But, in so far as such diseases are connected with parasitic fungi, it is no more true that they are caused by wet weather than that the occurrence of weeds is due to that cause. A certain weed can only have

* For a full description of this and other "damping-off" fungi, see Cornell Univ. Agr. Exp. Sta., Bull. 94. 1895.

its origin in a seed of that same species, although the plant developed from that seed may require damp weather for its growth. In the same way and for the same reason a fungus has its origin in a spore which requires moisture for its germination and development. If there were no weed-seeds there would be no weeds; if there were no spores, speaking broadly, there would be no fungi or fungous diseases, no matter whether the weather were wet or dry. The past season has exemplified the connection which exists between wet weather and the spread of plant-diseases due to fungi, but in one case at least it has shown how dry weather may induce disease. About the middle of July it was noticed that wax beans were seriously diseased. The leaves were covered with large yellow blotches which in turn bore a copious growth of a black mold. The appearance of such leaves was very striking and it was thought at first that they were suffering from the attacks of one of the black "rusts." Further investigation, however, showed that the black mold was a species of *Alternaria*, which occurs commonly on dead leaf-tissues. For some time search was vainly made for the cause of the yellowing of the leaves, but finally a patch of beans was found on which the trouble had developed more recently. It was then seen that the leaves were infested beneath with the mite commonly known as "red spider," and that the yellow blotches corresponded to the areas where the mites were present in the largest numbers. Growers of plants under glass are familiar with the fact that the foliage of many plants, if kept dry, is subject to the attacks of "red spider," and that two or three syringings with clear water is sufficient to remedy the trouble. In a certain sense, then, this trouble is dependent upon the atmospheric conditions. The past season presented exceptionally favorable conditions for the "red spider." The month of June was extremely dry and the insects multiplied very rapidly on the lower surface of the bean-leaves; three heavy rains occurred on July 4th, 12th, and 13th, which sufficed to destroy the mites, but not before the latter had caused the yellowing of the leaves and the death of the tissues in large patches; the warm, damp weather which followed gave an opportunity for the development of fungi, and on the dead patches there soon appeared the black mold. It was a striking illustration of the effects of both dry and wet weather, not in directly causing a diseased condition, but in giving a favorable opportunity for the development of parasitic organisms. Doubtless if the beans could have been thoroughly syringed with water two or three times in June, they would have remained healthy notwithstanding the dry weather.

A Convenient Method of Preparing Bordeaux Mixture in Small Quantities. In experimental work where small plots have to be sprayed, I proceed as follows, using the 5-5-50 formula as being at the same time efficient, safe, and readily divisible by 5 or 10. Half a pound of copper sulphate is dissolved in a quart of hot water and poured into a fruit-jar of that capacity; half a pound of lime is slacked, diluted with water to make a quart, and placed in another fruit-jar. These amounts are easily weighed out, the operation of dissolving and slacking can be done quickly, and in a couple of hours enough half-pound lots of sulphate and of lime can be prepared to make a good many gallons of Bordeaux mixture, and, if the jars are tightly closed, their contents will keep indefinitely. To make five gallons of Bordeaux mixture an ordinary wooden pail holding two gallons and a half, and a forty-pound (five-gallon) candy pail such as can be cheaply bought of any grocer, are needed. Into the latter is poured the contents of one jar of lime and the pail is then half filled with water. Into the small pail is emptied a jar of copper sulphate solution and this pail is then filled with water. Finally, by pouring the contents of the small pail quickly into the large pail and stirring well, a perfect Bordeaux mixture is obtained. If a weaker mixture is desired, the five gallons of full strength may be made up, half of it poured back into the smaller pail and then the larger pail filled up with water. Both solutions being dilute and being mixed quickly by a single operation, the hydroxide of copper is precipitated in a very finely divided form and does not settle readily or clog the nozzle.

Notes on Spraying Apparatus. During the past season we have experimented with a number of pumps adapted for use with a barrel or with a pail. Among the barrel-pumps, two have done admirable work. These are the "Eclipse, No. 2," manufactured by Messrs. Morrill & Morley of Benton Harbor, Mich., and the "Pomona," made by the Gould's Manufacturing Company of Seneca Falls, N. Y. The principle upon which these two pumps work is practically the same and was described in our Bulletin 125. The "Eclipse" works a little

more easily than the "Pomona," it is a trifle lighter, and the mechanism is simpler. On the other hand the "Pomona" is made in two forms adapted either to the head or the side of the barrel, while the "Eclipse" can only be used on the head. These pumps represent the most efficient type of spraying-pump on the market and both are thoroughly satisfactory.

The bamboo extension made by Morrill & Morley is the best appliance we have yet seen for directing a spray into the tops of trees. It is simply a light bamboo pole, bored out and lined with brass. When fitted with a double Vermorel nozzle it delivers a far-reaching spray, covering a large area.

Of all the pail-pumps which we have used, the "Success Kerosene Sprayer," manufactured by the Deming Company of Salem, Ohio, has proved the most serviceable. This pump has a detachable tank for kerosene, from which the oil is drawn by the stroke of the piston, is mixed in the cylinder with the water contained in the pail, and issues from the nozzle in the form of an emulsion. A gauge regulates the supply of kerosene from zero up to 50 per cent., and tests which we have made indicate that the gauge is fairly accurate. We have used this apparatus, with the gauge set to deliver 20 per cent. of kerosene, to destroy plant-lice on Viburnum, roses, honeysuckles, and other plants. The leaves were uninjured, while the lice were completely destroyed.

With the tank removed and the aperture closed by a screw-cap, this pump can be used with fungicides. It is well adapted for the spraying of plants on a small scale and was used with great satisfaction in some of our spraying work during the past season.

ROSE CULTURES.

By W. E. Britton.

In October, 1897, a small section of bench space in the forcing house having an area of 14.5 square feet was equally divided by a partition and one-half filled with compost, the other with a mixture of coal ashes and peat moss. To the latter were added 15 grams of nitrogen in nitrate of soda, 6 grams of phosphoric acid in dissolved bone black, and 30 grams of potash in muriate. For 100 square feet of bench space these applications would be 2 lbs. 12 oz. of nitrate, 1 lb. 1 oz. of dissolved bone black, and 1 lb. 15 oz. of muriate. Fifty grams of carbonate of lime were added to each plot. In the center of each plot was set a Duchesse de Brabant rose which had been growing for two years, and in the corners four other plants of the same variety of a year's growth.

The plants in the coal ashes at first dropped their leaves more than those in the compost, but soon put out new ones and began to bloom. The plants in both plots blossomed continually all winter and were exceedingly thrifty with perfect foliage, free from mildew. The plants set in coal ashes and peat gave larger blooms, but rather ligher in color than those from the compost plot. There was no difference as regards fragrance and form. The first blossom was picked December 4th, and the last one June 2d, when the plants were removed from the benches. The fertilizers added as well as the yields obtained is given in the following table:

Rose Cultures.

Soil.	Plot 207 A. Compost.	Plot 207 B. Coal Ashes and Peat Moss.
Fertilizers (grams)—		
Nitrate of soda,	0	94.8
Equivalent nitrogen,	..	15.
Dissolved boneblack,	0	35.34
Equivalent phosphoric acid,	..	6.
Muriate of potash,	0	64.5
Equivalent potash,	..	30.
Yield—		
Total number of blooms,	42	58
Average diameter of blooms, inches,	2.20	2.28
Average length of stem, inches,	4	4.8
Average weight of blooms, grams,	5	6

ENTOMOLOGICAL NOTES.

By W. E. Britton.

Ravages of the Squash Lady-Beetle.—The squash lady-bird, *Epilachna borealis*, Fabr, injured squash vines at the Station by devouring the foliage during August and September. Most of the lady-beetles (*Coccinellidæ*) are beneficial instead of injurious, and feed upon other insects such as plant-lice, scales, and larvæ. There are two or three species, however, that injure cultivated plants, and *E. borealis* is the one most commonly found in the Northern and Eastern States. The insect feeds in both the larval and adult stages. The adult has a curious habit of marking out a circular area upon the leaf and then feeding within this area until all the soft tissue has been devoured, when another feeding ground is marked out and in turn exhausted. The eggs are deposited in clusters on the leaves and hatch in about twelve days, according to Professor J. B. Smith,* who has given the species considerable study. Smith states that he observed a newly-hatched larva devour several unhatched eggs of the cluster, showing that the carnivorous habits of the family have not been overcome entirely in this herbivorous species. Most of the feeding is done, however, in the larval state. The larva is light yellow in color and covered with black forked spines. Pupæ are also found upon the leaves. The adult beetle is yellowish-brown in color with seven black spots upon each wing-cover and four smaller ones upon the thorax. It is about three-eighths of an inch in length. This is the first time in five years that the species has been injurious in the Station garden. An application of arsenical poison when the beetles first commence to feed will prevent any serious injury.

Genista Injured by Blister Beetles.—Several species of "blister beetles" feed upon a great variety of plants. About the middle of June some plants of *Genista tinctoria* in an ornamental planting were considerably injured by a gray blister beetle, *Macrobasis unicolor*, Kirby. Hand-picking was practiced in this case, but an application of paris green or any of the other arsenites would probably prevent any great injury.

Leaf-Beetle on the Hornbeam.—On May 30th, adults of *Serica trociformis*, Burm., were abundant on young trees of the

* New Jersey Experiment Station, bulletin 94.

hornbeam or water beech, *Carpinus Caroliniana*, in Westville. The foliage was completely riddled in some cases. Both sexes were present. The female is of a reddish brown color with black head and thorax. The male is of a uniform color and nearly black. This beetle is about one-fourth of an inch in length and both male and female are about the same size. Poisoning of the foliage will, of course, prevent it from being seriously injured by this beetle.

Elm Leaf Beetle. — The elm leaf beetle, *Galerucella luteola*, Mull., which for the last few years has seriously injured elm trees in Connecticut, was much less abundant during 1898 than for several seasons previous. It could be found, however, without much hunting, and many small trees in New Haven were defoliated. On most of the larger trees the injury was scarcely noticeable; in one or two localities the trees presented a brown color, caused by the larvæ of this beetle devouring the green portion of the foliage. We are probably not yet rid of the pest, and tree owners and municipal authorities should be on the watch for its appearance the coming season, fully prepared to save the trees if the beetle appears to be present in threatening numbers.

A Borer in Plum Trees. — During June Mr. M. N. Wooding of Hamden sent to the Station a section of the trunk of a Japan plum tree which was infested with borers. The piece of wood was placed in the breeding cage until we had time to examine it. Meantime, the borers did not seem inclined to emerge from their burrows or tunnels, the openings of which were plainly discernible scattered over the bark. Upon splitting open the tree-trunk many small dark-colored beetles were found in the burrows. The larval and pupal stages were also represented. The species is closely allied to, but entirely distinct from, the destructive "fruit bark beetle" that has become so well known in Connecticut orchards. The former burrows wholly inside the wood, while the latter works between the wood and the bark. By the courtesy of Dr. L. O. Howard, entomologist of the Department of Agriculture, Washington, D. C., one of his assistants identified the species as *Xyleborus pyri*, Peck. It is now considered identical with the European *X. dispar*, Fabr. Miss Ormerod states* that this insect was rare in England until ten years ago, when it seriously damaged

* A Text-Book of Agricultural Entomology, p. 101.

young plum trees in two or three localities. In this country the beetle occasionally injures the tulip tree (*Liriodendron*) and various kinds of fruit trees. Both sexes were found in the tunnels.

The female is about one-eighth of an inch in length and one-sixteenth in breadth. The male is considerable smaller, being three-thirty-seconds of an inch long and having about the same breadth of body as the female. The male, however, is much thinner and the extremities of the body taper much less abruptly. Both sexes are black or dark brown in color.

The tunnels were cylindrical in shape and extended to the center of the trunk, which was about three inches in diameter. Ramifications were not numerous, but were found in several clefts. A fungus was growing inside the tunnels, and is said to be "cultivated" by several species of beetles whose larvæ as well as adults feed upon it inside the burrows. *Xyleborus dispar* is often called the "pear blight beetle," but it has no connection with either the fungous or the bacterial disease of the pear sometimes called "pear blight."

It is doubtful if a satisfactory remedy can be suggested against the injury done by *Xyleborus dispar*, which is likely to be only occasional. Perhaps if the trunks and branches of trees are coated with whitewash or Bordeaux mixture to which a little Paris green has been added, an attack may be prevented.

The Oak Pruner. — During the latter part of summer, the ground underneath many of the oak trees in and about New Haven was thickly strewn with twigs which had fallen from them as if broken off by the wind. Examination of these twigs showed that each one had been eaten nearly off, and that it contained a burrow usually at the pith. If the twig were split open along the line of the burrow, a borer about three-eighths of an inch long would be found inside. This is the half-grown larva of a small brown beetle, *Elaphidion villosum*, Fabr.

The beetle deposits the egg near the tip of a young branch and when hatched the borer works his way inside the twig and burrows along the pith. When nearly half-grown he cuts the twig nearly off and retreats into his burrow. These twigs, almost severed by the larvæ, are easily broken off by winds and fall to the ground. The borer remains in his burrow in the fallen twig until the following spring, sometimes in the larval and sometimes in the pupal state. The adult appears about midsummer.

The only remedial treatment that can be recommended against this curious insect is to gather and burn all infested twigs, thus destroying the larvæ in the burrows, and somewhat lessening the number the following year.

Kerosene and the San José Scale. — Since preparing the last Annual Report, the San José scale has been reported from Ivoryton, Nichols, Cheshire, Burnside, and Rowayton. In addition to these new places, new centers of infection have been discovered in New Haven, Hartford, and Bridgeport.

There are indications that the scale spreads somewhat less rapidly in Connecticut than many believed it would, but it still remains a dreaded pest of the fruit grower, and orchardists and nurserymen need to be always on the watch lest the insect be introduced into their domains.

Spraying with clear kerosene has been given a trial in Connecticut. On the 1st of last March several seriously infested Japan plum trees in New Haven were sprayed with kerosene. Two months later no living scales could be found. The kerosene was purchased in the market for illuminating purposes and was supposed to be of good quality. It was applied by means of a "Success" bucket pump, through a Vermorel nozzle, and the spraying was done on a bright day with plenty of air stirring, so that evaporation would be rapid. Where the kerosene was applied with care, little or no injury resulted. One tree literally covered with scales from top to bottom was drenched with kerosene; nearly all the branches were killed back about half way to the trunk.

At the Station, uninfested trees of apple, pear, peach, plum, cherry, and quince were sprayed with kerosene on February 28th. For several weeks no injury was apparent. Later, it was observed that some of the fruit buds and small twigs had been killed.

Spraying with clear kerosene is scarcely a safe treatment for the average grower to employ. If his trees are infested he had better apply kerosene and water, which will do less injury and will kill the scale. At the Cornell Station, excellent results were obtained by using a mixture containing 20 per cent. of kerosene. For this work a special pump is necessary. A suitable outfit has been figured in Bulletin 126, p. 7, of this Station. A similar pump is now manufactured by the Goulds Manufacturing Company of Seneca Falls, N. Y.

Elm Scale. — On June 14th my attention was called to a young elm tree near the Station that was infested with scales. I found the insect to be the elm scale, *Gossyparia ulmi*, Geoff. It was easily killed by washing the tree with a strong solution of ordinary soap. Whale-oil soap would probably be better.

Other Scale Insects. — Various species of scale insects have been received during the season from different sections of the State. Among the most common are the "Oyster Shell Bark-Louse," *Mytilaspis pomorum*, Bouché, and the "Scurfy Bark-Louse," *Chionaspis furfurus*, Fitch. The former is especially common upon apple, lilac, birch, ash, willow, and poplar, and is a long and slender curved scale, nearly the same color as the bark upon which it is fastened. The latter species is light gray in color, is broad and pear-shaped and commonly infests the apple and pear. Both of these insects winter as eggs, which are not easily killed by insecticides, but if the infested trees are treated with whale-oil soap solution just after the eggs hatch, or about June 1st, the young insects are very easily destroyed.

The Rose scale, *Diaspis rosæ*, Sand., is also received here frequently. This is a large scale, the adult females being one-eighth of an inch in diameter, nearly circular in outline, very light gray in color, and found upon the rose, blackberry, raspberry, and sometimes the pear. The "tulip scale," *Lecanium tulipiferæ*, Cook, is also common. It is a large brown scale nearly hemispherical in shape and infests the small branches of the tulip tree.

A *Lecanium* on the grape was received in June from Bristol; it has not yet been determined, and perhaps is a new species. The several species comprising the genus *Lecanium* have no armor and are called soft scales. They are very susceptible to contact insecticides such as whale-oil soap solution, and the rose scale can be controlled in the same manner.

Woolly Aphis on Pine. — About the middle of June plant lice were noticed on several small pine trees (*Pinus strobus*) growing at the Station. Their bodies were covered with a whitish cottony substance, and they resembled the well-known woolly aphis of the apple, and answered the description of a closely allied species, *Schizoneura pinicola*, Thomas. A single spraying with fir tree oil rid the trees of their woolly parasites.

The Pear Psylla. — *Psylla pyricola*, Först., was unusually abundant throughout Connecticut in 1898. It was first noticed at the Station about July 1st and had then somewhat injured the pear trees.

The pear psylla is a jumping plant louse of about one-tenth of an inch in length. It injures the trees by sucking the sap from the tender twigs. It exudes a sweet sticky "honey-dew," which soon covers the foliage and branches. In the honey-dew a fungus grows, giving the trees a blackened sooty appearance. The leaves usually turn yellow or red and fall prematurely.

This insect is rather hard to control and an insecticide which kills by contact should be used against it. The most vulnerable period in its life history is just after the leaves of the pear tree expand in the spring. Honey-dew is not then abundant, and a thorough application of kerosene emulsion or whale-oil soap will destroy many of the insects. If it becomes necessary to give a later treatment, the application should be made after a rain, as some of the honey-dew is then washed off and the insecticide will be more likely to come in contact with the insects.

Peas Injured by the Zebra Caterpillar. — On June 14th, pea vines in the Station garden were fast being devoured by small caterpillars. Several plants had already been stripped of their leaves. The young larvæ placed in the breeding-cage and properly fed grew rapidly, and after one or two moultings were easily recognized as the larvæ of the zebra moth, *Mamestra picta*, Harr. This identification was confirmed later by the emergence of the adults.

Many garden plants are subject to an occasional attack from this species, but it is rather seldom that much injury is caused. The arsenites will keep it in check if properly applied.

Red Humped Caterpillar. — This caterpillar was abundant on some black walnut (*Juglans nigra*) seedlings at the Station during September. The larvæ were rapidly devouring the foliage when found and further injury was prevented by gathering the caterpillars. Spraying with the arsenites is the usual remedy. The insect is known as *Œdemasia concinna*, S. & A., and frequently feeds upon the foliage of the apple tree.

Chrysanthemum Stalk Borer. — On June 29th, some chrysanthemum stems were sent to the Station from Newington. The plants had been injured by some insect that burrowed in the pith. In one of the stalks was a larva of the moth, *Gortyna nitela*, Guenée, and this species was probably the author of the injury. Cornstalks containing larvæ of the same species were also received during the season. There is no remedy except to destroy the insects when found.

Angoumois Grain Moth. — October 11th some ears of pop-corn were sent to the Station from a large storehouse. The grain was thoroughly infested with the Angoumois Grain Moth, *Sitotroga cereallella*, Oliv., which is abundant in granaries and storehouses throughout the eastern United States, and which attacks growing corn in the South.

The best remedy is to enclose the grain in tight boxes or bins and treat with carbon bisulphide, using one pound of the liquid for each one hundred bushels of grain.

EXPERIMENTS IN CHESTNUT GRAFTING.

BY W. E. BRITTON.

Purpose of Experiments. — Since the coming of the Japanese chestnuts a new interest in chestnut culture has been awakened in Connecticut. The native chestnut *Castanea dentata*, (Marsh.) Borkh. grows naturally throughout the State and covers a considerable portion of the wooded area. Trees have been cut over many acres and some of the sprouts issuing from the stumps are of a suitable size to graft. It has long been known that the chestnut could be grafted, and since the improved varieties of European and Japanese chestnuts were obtained there have been many attempts to graft these upon the native stocks. The practice, however, has not been wholly successful, and the work described in this paper was carried out in order to determine the most favorable time for setting cions in this latitude, and also the best methods of grafting.

Stocks. — The stocks used were all of the American species; the cions were set either in the more thrifty branches of large trees, in young seedlings, or in sprouts which had sprung up from the stumps of a previous growth of chestnut timber.

Cions of the following varieties, representing two botanical species, were used in the experiment, viz.: European Chestnut, *Castanea Castanea* (L.) Sudworth: varieties, Paragon, Ridgely, Comfort, and Numbo; Japanese Chestnut, *Castanea Japonica*, Blume: varieties, Alpha, Reliance, Superb.

A portion of the cions were bought from the Pomona Nurseries, Parry, N. J., and others were kindly given by Mr. J. H. Hale of South Glastonbury and Mr. N. S. Platt of New Haven. All the cions were dormant when set. After being cut from the trees they were kept in a dormant condition by storing them in damp sand in a dark portion of the ice-house.

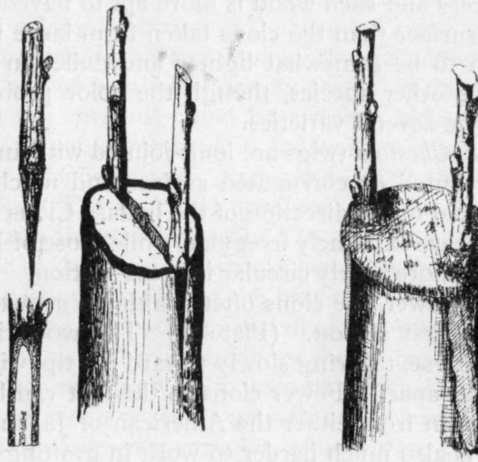
Characteristics of the Cions. — It will be interesting and profitable to note briefly the difference in twigs or cions between the American, European, and Japanese species. Though this is a botanical consideration it is of practical value, and has been mentioned much less frequently in chestnut literature than the characters of the foliage and fruit, which will not be touched upon in this paper. A person familiar with the three kinds of chestnuts can usually distinguish them by the appearance of the matured twigs or cions. The three species are represented by their twigs in Plate 1. Each has alternate buds borne upon opposite sides of the shoot.

American Chestnut twigs are rather slender, nearly cylindrical though often irregular, and considerably enlarged below the buds. The buds are prominent, but smaller and closer together than the European. Twigs often branch on young and vigorous trees and such wood is more apt to have an irregular and fluted surface than the cions taken from large trees. The twigs seem to be somewhat lighter and duller in color than those of the other species, though the color probably varies greatly in the several varieties.

European Chestnut twigs are long-jointed with an angular or irregularly fluted or corrugated surface and much thickened just below and in the direction of the buds. Cions of Paragon and Ridgely are extremely irregular, while those of Numbo and Comfort are more nearly circular in cross-section. The species is a strong grower, the cions often making a growth of five or six feet the first season. (Plate 2.) The wood is therefore large and coarse, tapering slowly toward the tip, with the buds large and far apart. Fewer cions to the foot can be cut from this wood than from either the American or Japanese species. The wood is also much harder to work in grafting on account of the irregularity of surface. A vigorous shoot often branches or produces laterals the same season.

The lenticels or white spots on the bark of the four varieties here noticed are far more abundant than on twigs of the American or Japanese chestnuts. This is especially true of the Paragon. The leaf-scars below the buds are also larger and of different shape.

Japanese Chestnuts produce cions which are very unlike the European. The wood is nearly cylindrical, though slightly flattened, the greatest diameter being between the sides which bear the buds. The buds are small, almost triangular with acute points, and are much nearer together on the stem than in either the American or European chestnuts. The twigs are smooth and of good size at the base, but there is a greater tendency for the young growth to branch (*i. e.*, produce laterals) than in the other species; so that it is common to find forked cions, and above the fork the wood is small and slender, tapering to a size that is altogether too small to use for cions except in very small stocks. These slender tips should be discarded.



a *b* *c*

FIG. 1. — Cleft-grafting ; *a* shows how the cions should be cut ; *b*, cions set in stock ; *c*, the same waxed.

Forms of Grafts Employed. — 1. The *common cleft-graft* (see Fig. 1.) was chiefly used. Two cions were usually placed in each stock; in a few small stocks single cions were set. Where cleft-grafting is practiced the best results will be obtained in selecting stocks between one-half and one and one-half inches in diameter. Except in very small stocks this form of graft needs no tying; the pressure of the stock holds the cion in place.

a *b* *c*

PLATE I.—CHESTNUT TWIGS.

a American chestnut; *C. dentata* (Marsh) Borkh.
b European chestnut; *C. castanea* (L.) Sudworth.
c Japanese chestnut; *C. japonica* Blume.

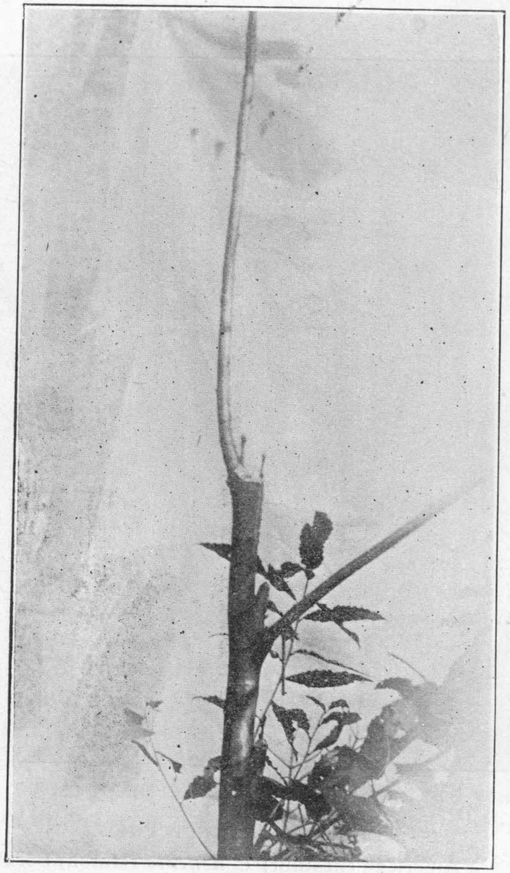


PLATE 2.—Chestnut cleft-graft; Ridgely cions set May 6th; grew over six feet the first season.

2. The *tongue or whip graft* was employed where it seemed desirable to graft small twigs nearly as small as the cion itself. A better union of cion and stock followed this form of graft. The tongue graft and the method of preparing the cion are shown in Fig. 2. This graft should always be tied.

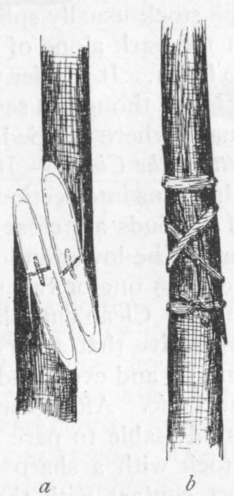


FIG. 2.—Tongue or whip graft; *a* shows manner of preparing stock and cion; *b*, the same, put together and tied.

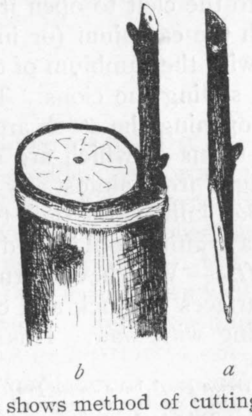


FIG. 3.—Bark graft; *a* shows method of cutting cion; *b* cion has been inserted and tied, but not waxed.

The third form of graft may be called a *bark graft*.* The cion is cut wholly on one side to the form of a wedge. During the grafting season the bark of the chestnut separates easily from the wood and usually the cion can be readily pushed into its place after inserting the point between the bark and wood of the stock. A knife is sometimes necessary to make an opening. The bark of the stock usually splits open along the outside of the cion; but the bark alone of the cion is exposed so that the split does no harm. It is safer to tie this form of graft (which is shown in Fig. 3), though in several cases a union and good growth were made where not tied.

Preparing and Setting the Cions. — It is a common practice with grafters to cut the cions into sections, each portion having two buds, or more if the buds are close together, as in case of the Japanese chestnut. The lower end of the cion is then cut in the shape of a wedge on one or two sides, according to the form of graft to be made. Clean cuts should be made, and for this purpose it is imperative that a very sharp knife be used. The cut should be smooth and even, and is better if made with a single sweep of the knife. After sawing off the stock at a convenient size, it is advisable to pare the outer edge of the cut surface of the stock with a sharp knife. This probably allows a more perfect contact with the wax and favors the healing of the wound, but the principal reason for doing it is to remove the torn wood so that the grafter can see to get the cion in the proper place. The stock is then split and a wedge is driven into the cleft to open it. The cions are then set in the cleft with the cambium (or inner bark) of the cion directly in contact with the cambium of the stock. Great care should be taken in setting the cions. The knife for splitting and the wedge for opening the stock are usually combined in one tool, different forms of which are shown in Fig. 4, and which may be procured from almost any seedsman or nurseryman. A good pocket knife is the only tool needed in making a tongue graft, and a grafting tool is used only in a cleft-graft.

Waxing the Grafts. — Whichever form of graft is employed, the cut and cleft surfaces of stock and cion should always be protected by covering with wax. This keeps the graft from

* Some writers call this a *crown graft*, but a *crown graft* may be any sort of a graft at the crown of the tree or plant, *i. e.*, at the surface of the ground. To avoid confusion, therefore, I prefer to call the graft herein described a *bark graft*.

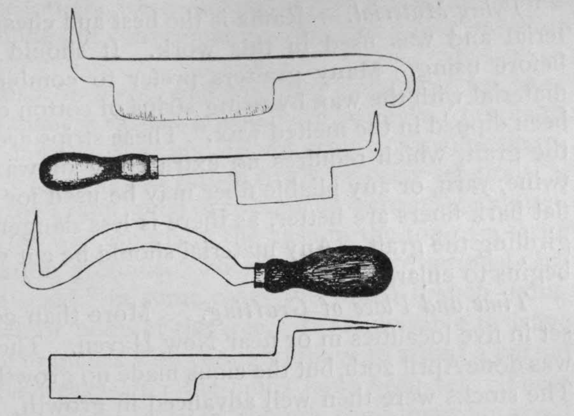


FIG. 4. — Various forms of grafting tools.

drying out and at the same time prevents the germs of decay from coming in contact with the mutilated surfaces of the wood. In the experiments herein described wax was used liberally and great care exercised that it be made to adhere firmly to the stock and cions, leaving no possible chances for air to enter or water to escape. The tops of the cions where cut were also well covered with wax.

Grafting Wax. — There are various formulas for making grafting wax, and doubtless most of them give good results. The wax used in this experiment was made after the following formula, which the writer prefers to some others:

Common Rosin	4 pounds.
Tallow, ...	1 pound.
Beeswax, ...	1 "
Gum Shellac, ...	½ ounce.

The tallow should be melted first in a kettle over a fire; the rosin should then be added, and when nearly melted add the beeswax. After all is in liquid form add the shellac and stir constantly to prevent the last-named substance from collecting in lumps or from burning on the bottom of the kettle. Pour the contents of the kettle when well melted into a greased basin filled with water. After a few minutes separate the wax into lumps of from one-quarter to one-half pound each, and "pull" vigorously until uniform in color and texture. It is then ready for use. If not well "pulled" or "worked," it will be of a dark color and lumpy.

Tying Material. — Raffia is the best and cheapest tying material and was used in this work. It should be moistened before using. Many grafters prefer to combine their tying material with the wax by using strips of cotton cloth that have been dipped in the melted wax. These strips are wound about the graft, which requires no extra tying or waxing. Cotton twine, yarn, or any pliable fiber may be used for tying, but the flat bark fibers are better, as there is less danger of cutting or girdling the graft. Any material should be cut when the graft begins to enlarge.

Time and Place of Grafting. More than 200 cions were set in five localities in or near New Haven. The first grafting was done April 20th, but the cions made no growth for a month. The stocks were then well advanced in growth. Of the cions set, four were knocked out of place, two pulled out by boys, and four made good growth, but were broken off, presumably by winds. Twelve started to grow and then died; ten of these were set in thrifty sprouts growing upon the top of a dry gravelly knoll and were killed by drought. The cions which started to grow and afterwards failed are excluded from the percentages given in the table below.

TABLE I. — RESULTS OF CHESTNUT GRAFTING, 1898.

Time of setting cions.	No. of cions set.	Alive October 1st.		
		No. of cions alive.	Per cent. of No. set.	Average growth.
Between April 20th and May 1st,	29	3	10	18 inches
" May 1st and May 15th, .	56	26	46	28 "
" May 15th and June 1st,	41	13	32	23 "
" June 1st and June 15th,	47	22	47	22 "
After June 15th, . . .	12	2	17	8 "

From the table it appears that a greater percentage of cions failed among those set previous to May 1st and after June 15th than among those set between these dates. Of cions set during the first half of May and those set during the first half of June the percentages that grew are practically the same. Of cions set the latter half of May a somewhat smaller percentage survived, probably because they were set in the tops of large trees, while the others were mostly placed in thrifty young sprouts or seedlings of convenient size to graft while standing on the ground.

It should also be mentioned that the cions first set were mostly of the Japanese varieties, which are more dwarf in habit than the European chestnuts and do not grow as rapidly; therefore the average growth was rather small for early set cions.

In making the grafts some of the stocks were fully exposed to the sun. This was especially the case in the top of a large tree on the Station grounds. These stocks were seriously injured by "sun-scald," in some cases the whole branch dying back to the fork or body of the tree. It is advisable to leave a portion of the branches with enough foliage to afford a partial shade for a few weeks after the cions have been set. These should be mostly removed later, though some may be saved to graft the following season. Where the stock has been injured in this manner, the cion, if it grows at all, will probably never make a good union with the stock. With small stocks there is less surface to "callus" and heal over, hence a better union. Where the "whip" or "tongue" graft was employed, the union is smoother and looks better than with the other forms of grafting. The bark graft is probably the least satisfactory in this respect. Injury from winds may be prevented by tying the graft to a stake or some other support.

Experience of Others. — During the seasons of 1895 and 1896 the late Judge A. J. Coe had considerable grafting done upon some chestnut sprout-land in Meriden. Most of the sprouts of convenient size growing on eighteen acres were cleft-grafted. The cions were of two varieties originated by Luther Burbank of Santa Rosa, California, and belonged to the Japanese species (*C. Japonica*, Blume). These varieties have since been named "Coe" and "McFarland." A portion of the cions grew and a considerable number of these were afterward destroyed by fire. The writer made several visits to the orchard in 1897, and while no accurate census was taken, the proportion of grafts which lived and grew was probably not over thirty or thirty-five per cent.

Upon request, Mr. J. H. Hale has kindly furnished the following information regarding his experience in chestnut grafting:

"My experiments thus far have been mostly with such varieties as Numbo and Paragon, which are of the European type and have not united as readily with our native stocks as the Japanese varieties we have tested.

"In the spring of '97 we put in about 600 grafts, beginning when the leaves were just sprouting on the stocks and finishing up a week or ten days later. The cions were perfectly dormant, having been kept so on ice. Fully 50 per cent. of them started to grow, but after attaining a growth of from four to six inches many of them died out, so that about 25 per cent. only lived and grew through the season. Of the Japanese variety, Reliance, about 75 per cent. made a good growth, and two of these cions are now fruiting freely this year. The stocks were mostly sprouts one to two inches in diameter; 'cleft,' 'saddle,' and 'tongue' grafting were practiced, 'cleft' grafting being the least successful.

"From our own experience here and observation in the Pennsylvania nut orchards, I am under the impression that tongue grafting on small stocks, not over a half inch in diameter, is likely to prove the most successful."

Mr. N. S. Platt was asked to give an account of his chestnut grafting. He kindly replied as follows:

"I have grafted only three kinds of chestnuts, the Paragon, Numbo, and Japanese. The young wood of the Paragon is coarse and angular, and cions are not so easily set in a cleft or bark graft as the Numbo, which has slender long-jointed wood. The latter variety I usually set by paring the graft on one side, leaving the pared portion long and slender and inserting it under the bark on one side of the stock.

"I used stocks about five-eighths to three-fourths inches in diameter where the cion was inserted. The graft, when set in this way, needs to be supported by tying to a stake from the time it has grown five or six inches till the end of the second year, to prevent it from blowing out; by that time the junction is usually strong.

Some Japanese grafts that I set in the top of a large tree, perhaps ten inches in diameter at the ground and four inches where grafted, grew for a year or two, but the junction was not good between the two, and all failed.

"I have usually splice-grafted the Paragon, using strips of waxed cloth and sometimes tying raffia over the cloth to bring all snugly together. As soon as the graft and stock enlarge, the raffia must be cut.

"For stocks I have gathered nuts myself and planted them; have purchased and planted Paragon nuts, and have purchased one year sweet chestnut seedlings from Ohio. Have had all these in nursery rows and grafted them there. I put Paragon grafts in Paragon stocks, but also put Paragon and Numbo into both native and Ohio stocks. The union of graft with stock has been good with these two kinds in all the stocks used. The Paragon stocks were the more rapid growers, but the grafts lived no better and made no better union in Paragons than in natives. I set one hundred or more buds, but all failed. Grafting at the surface of the ground and root grafting were also failures. I employed Thomas Meehan & Sons to root graft and plant 1,000 stocks, I agreeing to take all that grew at a certain price. Mr. Meehan said to start with he did not know what could be done, but that he had an expert grafter and would like to try. At the end of the season he wrote me that he could find but two alive. The most of my grafting was done in the nursery rows, and to get trees for sale I preferred to graft three feet high and liked a stem one-fourth to three-fourths inches in diameter where grafted; if the former size, I would use the splice graft; if larger, the bark graft.

"Have sometimes had fifty per cent. of grafts start to grow, though often not more than thirty-three or twenty-five per cent. Have uniformly kept the cions in ice-houses lying flat on the ice, till new growth on the stocks is one or two inches long. For cions have used wood grown the previous season, also some a year older that contained good buds or spurs. Have found the after care during the first season almost as important as the grafting. The chestnut graft seems to need a full supply of sap till at least half the first season is passed, and it must have it or it will dry up in the midst of growth. See to this by keeping off robber shoots and by cutting off additional branches if there are any, even though in full leaf and growth.

"One of my first trees to graft was a wild tree about six inches in diameter, and in it I set cions in about eight stocks. Cions lived in about two-thirds of the stocks, but because I gave them no help all died in mid-summer. If I had cut off additional branches after growth had commenced, it would probably have saved them."

Conclusions. — Though the chestnut cannot be grafted as successfully as the apple or pear, about 50 per cent. of good cions can be made to grow on proper stocks, if the work is done carefully and at the right time.

From a single season's experience (1898) it would appear that the best time for grafting chestnuts in this vicinity is from May 15th to June 15th. Early set cions made no growth until about May 20th. Growth on the stocks was then well advanced.

Do not remove all the foliage from around the graft at first, as it should be shaded for a time; otherwise the stock may be seriously injured or entirely killed by the sun. This injury is most likely to occur where the stocks are large. Many of the cions will need supporting, after growth begins, or they will be broken off by strong winds.

The best union results from "whip" or "tongue" grafting on small stocks.

Chestnut Literature. — If the reader desires further information on this subject, or to acquaint himself with the practices of commercial chestnut growing, he should consult the following publications:

The Nut Culturist, by A. S. Fuller, Orange Judd Company, N. Y., 1896.

Nut Culture, Division of Pomology, U. S. Department of Agriculture, Washington, D. C., 1896.

Nuts for Profit, by J. R. Parry, Parry, N. J., 1897.

The European and Japanese Chestnuts in the Eastern United States, by G. Harold Powell, Bulletin 42, Delaware Experiment Station, Newark, Del., 1898.

The author wishes to express his thanks to all who have aided his work, especially Messrs. Hale and Platt, who kindly supplied cions, and have contributed written accounts of their own experience in chestnut grafting.

ON THE AVAILABILITY TO GRASS OF NITROGEN IN FORM OF NITRATE OF SODA, COTTON-SEED MEAL, AND FINE HARD BONE.

By E. H. Jenkins and W. E. Britton.

These experiments were made in galvanized iron pots, wired on the upper edge, eight inches in diameter and twelve inches deep. The bottom is slightly concave, and in the center of the bottom is a hole with a collar three-fourths of an inch in diameter. The pot is supported on three iron legs, so that the lowest point of the collar is two and one-half inches above the platform on which the pot stands. These pots are like those used in experiments described in our earlier reports. The soil used was a very sandy loam from a field which, it was stated, had not been manured, fertilized, or cultivated for many years. Six determinations of nitrogen in samples taken from as many different parts of the heap of soil which had been screened, mixed and ready for use, gave the following percentages of nitrogen: 0.097, 0.100, 0.100, 0.099, 0.099, 0.098. Each pot contained twenty-nine pounds of soil and 13.022 grams of soil-nitrogen. Each pot had an area of very nearly 1-125,000 of an acre.

To the soil of each pot was added 9.5 grams of precipitated calcium carbonate (containing lime equal to one ton of slaked lime per acre), 1.8 grams of muriate of potash, equivalent to about 500 pounds per acre and 1.2 grams of precipitated phosphate of lime (containing phosphoric acid equal to that in about 1,000 pounds of acid phosphate per acre), besides the nitrogenous fertilizer as indicated in Table I.

The three nitrogenous matters used were nitrate of soda, 15.89 per cent. of nitrogen; cotton-seed meal, 7.40 per cent., and Rogers & Hubbard's pure raw knuckle bone, with 3.67 per cent. of nitrogen. These materials were all sifted to pass circular holes one-fiftieth inch in diameter.

The quantities supplied to the soil of the several pots are given in Table I. They were equivalent to the following quantities per acre:

Nitrate of Soda,	461 lbs	per acre, and	231	pounds	per acre.
Cotton-seed Meal,	991 "	"	496	"	"
Bone,	1,990 "	"	995	"	"

The quantities of fertilizer-nitrogen were alike, whether applied in form of nitrate, cotton-seed meal, or ground bone. In each pot were first placed fourteen pounds of the soil under experiment. With fifteen pounds of the soil were carefully mixed the fertilizers mentioned above, and this mixture was then filled into the pot, great pains being taken to pack the soil alike in all the pots of the series.

The pots, including a layer of gravel on the bottom, weighed five pounds each, and each received twenty-nine pounds of soil, equivalent to twenty-five pounds twelve ounces of water-free soil. The soil with 15.50 per cent. of water in it contained 70 per cent. of the moisture which it could hold if saturated, and with 11.60 per cent. of water in it the soil had 50 per cent. of what it could hold if saturated.

During the course of these experiments the moisture content of the soil was therefore allowed to sink to 11.6 per cent., and was then raised, by adding water, partly on the surface and partly at the bottom, to 15.50 per cent., as determined by frequent weighings.

Into each pot were transplanted three small sets, cut from a turf of common red-top. One dozen such sets as were used for this purpose contained 0.052 grams nitrogen. The pots were filled and planted Feb. 14th to Feb. 17th, and stood till June 10th in the greenhouse, having a temperature by day of about 60° F., and by night about 50° F. During the summer the pots were placed in the summer vegetation house, and brought into the greenhouse again in October.

The grass was cut whenever it reached a length of three or four inches, thus imitating the practice of grazing or lawn-mowing, and all the clippings were carefully saved.

In early summer nitrogen was determined in the three clippings which had been already made, and again in the fall it was determined in the next three clippings. The first three clippings were made on March 31st, April 27th, and June 7th. The three later cuttings were made July 11th, Aug. 29th, and Oct. 1st. After the last cutting the growth was very slow, and the grass in every pot looked yellow, as if starving. A seventh cutting was, however, made on Jan. 7, 1899. The following table presents the results of this experiment:

TABLE I. ON THE AVAILABILITY TO GRASS OF NITROGEN IN NITRATE OF SODA, COTTON-SEED MEAL, AND FINE, HARD, RAW BONE.

EXPERIMENT OF 1898.

Station No.	Crop.	Nitrogenous Fertilizer.	Equivalent pounds per acre.	Nitrogen per pot.	1st Three Cuttings. Air-dry Weight.	Grams Nitrogen.	2d Three Cuttings. Air-dry Weight.	Grams Nitrogen.	7th Cutting. Air-dry Weight.	Grams Nitrogen.	Total Crop. Air-dry Weight.	Grams Nitrogen.
357	Grass	Nothing	0.00	0.00	10.6	.3795	14.9	.3248	1.7	.0356	27.2	.7399
358	"	"	0.00	0.00	11.4	.3887	16.3	.2950	1.4	.0282	29.1	.7119
359	"	"	0.00	0.00	12.0	.3972	17.4	.3149	1.8	.0343	31.2	.7464
360	"	"	0.00	0.00	10.9	.3793	13.4	.3015	1.8	.0367	26.1	.7175
361	"	Nitrate of Soda	461	2665	17.4	.5933	18.7	.3441	1.9	.0351	38.0	.9725
362	"	"	461	.2665	18.4	.6072	16.9	.3262	1.4	.0308	36.7	.9642
363	"	"	231	.1333	12.8	.4646	16.1	.3349	1.7	.0340	30.6	.8335
364	"	"	231	.1333	13.3	.4748	15.0	3315	1.1	.0245	29.4	.8308
365	"	Cot. Seed Meal	991	.2665	14.6	.5256	14.9	.3099	1.4	.0293	30.9	.8648
366	"	"	991	.2665	13.6	.5086	14.5	.3190	1.4	.0312	29.5	.8588
367	"	"	496	.1333	12.0	.4500	14.9	.3218	1.8	.0340	28.7	.8058
368	"	"	496	.1333	12.4	.4662	15.3	.3322	1.5	.0292	29.2	.8276
370	"	Ground Bone	1990	.2665	12.0	.4044	14.1	.3017	1.6	.0374	27.7	.7435
371	"	"	995	.1333	12.5	.3988	11.8	.2714	1.2	.0255	25.5	.6957

Examination of the table shows that *the soil alone*, without nitrogenous fertilizer, yielded in the year's cropping, seven cuttings, from 26.1 to 31.2 grams, an average of 28.4 grams of air-dry crop, and from .7119 to .7464 grams, — an average of .7289 grams — of crop-nitrogen. The first three cuttings took an average of 11.2 grams of air-dry matter, with .3862 grams of nitrogen; the next four cuttings took more air-dry matter, 17.2 grams, but less nitrogen, .3428 grams.

That is, the first three crops had 3.45 per cent. of nitrogen, the next four only 2.00 per cent.

An application of *nitrate of soda* at the rate of 460 pounds per acre, pots 361 and 362, yielded in the year's cropping 37.4 grams of air-dry crop and .9683 grams nitrogen. Deducting what was cropped from pots which had no nitrogenous fertilizer we have 9.0 grams of air-dry crop and .2394 grams nitrogen as the added yield from the .2665 grams of nitrate-nitrogen in the fertilizer. That is, 90.0 per cent. of the nitrate-nitrogen of the fertilizer was recovered in the crop, and the weight of crop was increased by 31.7 per cent.

The percentage of nitrogen in the first three cuttings was 3.35 and in the subsequent cuttings only 1.90 per cent.

Use of one-half the aforesaid amount of nitrate, or 231 pounds per acre; — pots 363 and 364, — gave a total yield of 30.0 grams of air-dry crop, containing .8321 grams of nitrogen. Deducting the crop from unfertilized soil there remains 1.6 grams of crop and .1032 grams of nitrogen as the increase from .1333 grams of nitrate-nitrogen in the fertilizer. That is, 77.4 per cent. of the nitrate-nitrogen of the fertilizer was recovered in the crop, — a smaller proportion than where a double quantity of nitrate was used.

Here, as before, the earlier crops weighed less but had more nitrogen than the later. The percentages of nitrogen were in the first three cuttings 3.59, and in the subsequent cuttings 2.14. These figures show that an addition to the soil of nitrogen in the form of nitrate of soda at the rate of 460 pounds per acre, increased the yield of grass nearly one-third over what the same soil yielded without nitrogenous fertilizers. About nine-tenths of the nitrogen put on in the fertilizer was taken off again in the first year's cropping. Only one-tenth was lost or left in the soil, roots, and stubble.

On the other hand, 231 pounds of nitrate of soda per acre increased the crop by about one-eighteenth (5.6 per cent.). A little less than eight-tenths of the nitrogen put on in the fertilizer (231 pounds of nitrate of soda per acre) was taken off again in the cropping. Two-tenths were lost or left in the soil.

An application of *cotton-seed meal*, at the rate of 990 pounds per acre, yielded 30.2 grams of air-dry crop and .8618 grams of nitrogen. Deducting what was cropped in pots which received no fertilizer-nitrogen, there is left 1.8 grams of air-dry crop and .1329 grams of crop-nitrogen to be attributed to the .2665 grams of fertilizer-nitrogen in the cotton-seed meal; 49.9 per cent. of the fertilizer-nitrogen has been recovered in this crop, while the crop had been increased by 6.3 per cent. The percentage of nitrogen in the first three cuttings was 3.67 and in the following cuttings 2.14 per cent.

The total yield of air-dry crop from the smaller application of cotton-seed meal, 496 pounds per acre, was 29.0 grams, with .8167 grams of nitrogen. Deducting as before the yield of the soil without nitrogenous fertilizers, we have 0.6 grams of crop and .0878 grams nitrogen as the added yield produced by the

.1333 grams of fertilizer-nitrogen; 65.9 per cent. of the fertilizer-nitrogen has been recovered in the crop. But the total yield has been increased by only 2.1 per cent.

As before, the first three cuttings contained most nitrogen, 3.75 per cent., while the later cuttings contained only 2.14 per cent.

The last two pots of the series, Nos. 370 and 371, received an application of *fine and hard raw bone*; one at the rate of 1,990 pounds per acre, the other at half that rate.

As noted above, the four pots to which no fertilizer-nitrogen was added, yielded an average of 28.4 grams of crop, containing .7289 grams of nitrogen. Neither pot to which bone was added yielded as large a crop as this,—the amounts are 27.7 and 25.5 grams, — one of them yielded slightly more nitrogen than those which received no fertilizer-nitrogen, viz., 0.7435 grams, and the other slightly less, viz., 0.6957 gram. So that the nitrogen of the bone has increased neither the air-dry crop nor the crop-nitrogen appreciably, while that of nitrate of soda and of cotton-seed meal had a marked effect.

It appears that the effect of the nitrogenous fertilizers on the amount of crop-nitrogen was shown chiefly in the first three clippings. In the second half of the year the yield of nitrogen was not very much larger on those pots which had received fertilizer-nitrogen than on those which had received none.

But, on the other hand, the gross yield of air-dry crop was considerably greater in the latter part of the year than in the early part immediately following the application of the nitrogenous matters.

These facts appear in the following statement:

TABLE II.—EXPERIMENTS OF 1898, GRASS.

CROPS AND CROP-NITROGEN HARVESTED IN THE TWO HALF-YEARS.

Fertilizer Nitrogen.		Nitrogen Harvested.		Air-dry Crop Harvested.	
In Form of	Amount. Pounds per Acre.	In First Half-Year. Grams.	In Second Half-Year. Grams.	In First Half-Year.	In Second Half-Year.
None, . . .	....	.3862	.3428	11.2	17.2
Nitrate of Soda, .	461	.6002	.3681	17.9	19 5
" " .	231	.4697	.3625	13.1	16 9
Cotton-seed Meal,	991	.5171	.3497	14.1	16.1
" " .	496	.4581	.3586	12.2	16.8
Raw Bone, . .	1,990	.4044	.3391	12.0	15.7
" .	995	.3988	.2969	12.5	13.0

Immediately after the last cutting the pots were top-dressed with the same forms of nitrogen which they originally received, and the experiment is continued. The surface of the soil is now in most cases nearly covered with a sod which has grown from the original three sets.

These tests illustrate certain facts regarding plant-food which may be briefly noted:

Here are pots each containing twenty-nine pounds of soil in which there is more than thirteen grams of soil-nitrogen; enough, at a low estimate, to produce thirteen maximum crops, *if it were available.*

Yet this soil cannot produce a single large crop, and in nearly an entire year, under very favorable conditions, has not yielded to the crop more than one-seventeenth of the nitrogen it contains. This fact well illustrates the inert character of the nitrogen in this soil. Again, an addition to this soil of .2665 grams of nitrogen in a quickly available form, increased the air-dry crop by nearly one-third. Yet this quantity of nitrogen is but one-fiftieth of the nitrogen originally in the soil; an amount almost too small to determine with accuracy by chemical means.

That is, an amount of fertilizer-nitrogen in the soil, which can barely be detected in the soil by chemical analysis, may yet be enough to make the difference between a good crop and a poor one.

As the applications of fertilizers were planned to correspond to the amounts which might be applied to equal areas of grass-land, it is worth noting how the crops correspond. If we multiply the crops by 125,000 and divide by 454 to reduce grams to pounds, it appears that from the pots which received an abundance of phosphoric acid and potash, *but no nitrogen,* we harvested at the rate of 7,351 pounds per acre of air-dry crop (much dryer than ordinary hay at harvest), or 3.6 tons. Where nitrate was put on at the rate of 460 pounds per acre we harvested in one case 9,939, in the other 9,719 pounds of hay,—9,879 pounds on the average, or about 4.9 tons per acre. Of course the chance for error is large in calculating yields per acre from such small areas, but the results indicate at least that our crops were larger than could be expected from similar areas in the field.

Strict comparison cannot be made between these pot cultures and meadow-land because on one hand the trials went on without break from Feb. 17th to Jan. 7th, and under conditions of temperature, illumination, and water supply that were, on the whole, more favorable than could happen out-of-doors. On the other hand, the sets at first covered but a small portion of the surface of the soil, and they have not only yielded the crops whose amounts have been stated, but they have also nearly or wholly covered the soil with turf and penetrated it extensively with their roots. Accordingly the results of this first year's growth are but partially represented in the harvested crops. In all the pots a considerable amount of soil-nitrogen has already become root and turf-nitrogen, and no doubt much of the fertilizer-nitrogen not recovered in the harvests has been appropriated by the plants and will benefit future crops. The grass is now established, and the second year of its growth may be expected to show a better effect from the fertilizers, unless it suffers for want of the resting period which grass under natural conditions experiences during our winter season.

In these tests where nitrate of soda was used at the rate of 461 pounds per acre (73 pounds of nitrogen), 90 per cent. of the fertilizer-nitrogen was recovered in the crop. From an equal amount of nitrogen in form of cotton-seed meal, 50 per cent. of the fertilizer-nitrogen was recovered, while from an equal amount of nitrogen in fine hard raw bone not more than 5.0 per cent. was recovered.

When half the quantities of nitrogen named above were used the following percentages of the fertilizer-nitrogen were recovered in the crops: From nitrate of soda, 77 per cent., from cotton-seed meal, 66 per cent., from bone, none.

A small part of the nitrate-nitrogen, about half of the cotton-seed meal nitrogen, and nearly all of the bone-nitrogen has not been recovered in the crops. This is either in the roots of the grass which are still in the soil or it has been removed from the soil by microbe action and has passed off in gaseous form; or it is in the soil, perhaps, in available or, more likely, in rather inert forms.

As regards the inefficiency of the bone as a fertilizer it should be remembered that in these trials the hardest, most compact, and, therefore, least alterable variety of bone was purposely chosen. It is not improbable that the grass would have done better with a considerably greater supply of water, and it is certain that a softer and more porous bone would have yielded nitrogen much more rapidly and abundantly. The result shows, however, that hard bone dust requires either to be partially rotted or steamed or else treated with sulphuric acid before applying to sandy or light-loamy soils if profitable, *i. e.*, quick returns are to be expected from its use as a fertilizer.

EXPERIMENTS IN CURING AND IN FERMENTING TOBACCO.

By E. H. Jenkins.

These experiments are in continuation of those begun in 1897, and described in the Twenty-first Report of this Station, p. 223. The cured crop of 1897 was destroyed by fire before it had been fully examined as to its quality.

In 1898 a new barn was built on the land of the Connecticut Tobacco Experiment Company, in Poquonock, where our experiments have been hitherto made.

This barn is 60 feet long, 32 feet wide, 16 feet high to the eave plates, having vertical ventilators of the usual kind, hinged just below the eaves and opening down to the sills. It also has a ventilator two feet by three in each gable end, just below the peak, with a shutter which can be closed or opened from the ground by cords. Below this ventilator there are six narrow ventilators, hinged from the top. On each end of the barn are two large doors, built in the usual way, and on one side is a small door for entering the barn during the cure. The sides and ends of the barn are battened on the inside. The lower tier of poles for hanging tobacco rests on slip-girths, so that the lath of tobacco on this tier hang crosswise of the building, like those above. The barn is built on stone and brick piers. The space between the sills and the surface of the ground is boarded up. In the center of the barn is a brick chimney — with a flue thirteen by eight inches in the clear, — which goes through the roof just to one side of the ridge pole. Except that the barn has a chimney and is made as tight as possible and battened, it is not at all unlike other barns in the neighborhood. Two stoves of heavy sheet iron, two feet eight inches from front to back, with a breadth and height of two feet four inches, each stove having a cast-iron door with draft, are used for heating the barn. One stove on each side of the barn, midway from end to end of it, is set in an excavation outside the building, the bottom of the stove being six feet below the level of the sill. Around the sides and rear end of the stove is a brick wall, having an air space of five inches closed in the front side. This wall is five inches higher than the top of the stove, iron bars are laid across it, which support a sheet-iron cover, and this, in turn, is covered with earth. On the front, near the bottom, are openings which supply air to this air-space, which surrounds the stove except on the front and bottom.

This whole structure is three feet below the sill at its nearest point. From the stove, and through the air-space, a smoke pipe seven inches in diameter passes under the sill and into the barn straight to the chimney, having a rise of about five feet in going the distance of seventeen or eighteen feet. From the air-space, two hot-air flues, seven inches in diameter, pass into the barn, which is built with its ridge running east and west. Within the building and four feet from the south side of the barn one of these flues turns at a right angle and runs east to within four feet of the east end of the barn, thence north to within four feet of the center line of the building, and thence west till it joins the smoke pipe near the chimney. The other hot-air flue on the south side runs in a similar way to the west end of the barn and back again to the smoke pipe. The arrangement on the north side of the barn is similar. By brick supports these hot-air pipes are given a pretty uniform pitch, rising all the way from where they enter the barn to where they enter the chimney.

The hot-air flues are also connected where they enter the building, with the smoke pipe, and by the use of dampers one can send all the smoke through the smoke pipe direct, and the hot air from the hot-air chamber, through the flues; or the products of combustion can be sent through the hot-air pipes.

It is best to start the fires with direct draft to the chimney, but when the chimney has got well warmed the draft is sufficient to draw the smoke through the hot-air flues without smoking the building at all.

The pipes are numbered, and, when not in use, taken up, boards being laid down where the pipe runs below the surface of the ground and covered over with earth. After the barn is filled with the harvested tobacco the pipes can be laid in an hour's time.

In front of each stove the earth is sloped up to the general surface of the field, and boards are so placed as to prevent caving. A lean-to affords protection to the one who tends the fires. The building was inspected by the insurance companies and insured on a premium of one and one-half per cent.

The land, a little less than two acres, was dressed in the spring of 1898 with 2,000 pounds of castor pomace, plowed in early, 3,000 pounds of cotton-seed meal, and 1,600 pounds of

cotton-hull ashes applied broadcast, near planting time, and 1,000 pounds of Swift-Sure Superphosphate, put on as a "starter" in the rows just before setting time.

The crop was set about the tenth of May. The harvest generally in the state was a large one. This particular piece, however, suffered from drought, and nearly stopped growing for two weeks, when it had reached about two-thirds of its full height. Then, with abundant rain, it finished its growth, but the crop was a light one, — about 1,250 pounds per acre, — and the quality was rather poor.

It is worth noting that the dry weather immediately followed the last cultivation with the Prout hoe. If showers had followed this cultivation, the crop would have been a normal one. Or if the cultivation had been omitted, or done with a very shallow cultivator, the following dry weather would have done much less harm. The Prout hoe, when the plants were well developed, pruned the roots so much that *in a dry time* they could not supply what water the plants needed. After the plants are three feet high or more it is probably safe to till very shallow. Deep cultivation at that time, *if followed by abundant rain,* will do no harm, but if followed by dry weather may set back the growing crop. On July 29th the crop was put in the barn.

On the west half of the barn the lath were hung six inches apart, from top to bottom of the barn. On the east half they were seven inches apart on the two lower tiers and six inches on the upper ones.

On July 30th, at 4 P. M., all doors and ventilators were closed, except the two in the gable ends, and fire was started in the furnaces. The heat was well distributed by the flues, the temperature inside was brought to 80-87, while without it ranged from 69 to 74, with fog or rain.

It had been assumed that sufficient air would enter the building below through cracks between the boards and under the sills. A careful examination of the tobacco, however, on August 5th showed that, particularly near the outside on the sides and ends, the circulation was insufficient, the leaf was not drying sufficiently, and in one or two places water had condensed on the leaves. All the ventilators and doors were immediately opened, the weather being fair, and the whole was brought into good condition again. The boards below the sill

THE FERMENTATION OF TOBACCO IN BULK.

By E. H. Jenkins.

The nature of the fermentations which take place in the curing, fermenting, and aging of leaf tobacco has been recently studied by Dr. Loew of the United States Department of Agriculture, whose conclusions are given in a report (No. 59), "On the Curing and Fermentation of Cigar Leaf Tobacco," issued by the United States Department of Agriculture.

Dr. Loew finds that, — contrary to the statements of Suchsland and others, — the fermentation of tobacco is not caused by bacteria, nor is the aroma of tobacco due to the action of specific bacteria.

Fermenting tobacco, when it has the proper content of moisture, from 18 to 25 per cent., is germicidal in its action, and few if any microbes are found on freshly fermented leaves.

The principal changes that take place in the curing and fermentation are due to the action of soluble ferments or enzymes found in the plant while growing, and perhaps while wilting after the harvest. The enzymes are chemical bodies, — not living organisms, like bacteria or molds, — which, under proper conditions, cause extensive chemical changes in bodies associated with them. A familiar example is the enzyme of malt, called diastase. Malt, by reason of this diastase, can convert many times its weight of starch into a sugar.

In the fermentation of tobacco leaf the main changes are caused by two oxidizing enzymes alone, by the agency of which the oxygen of the air is made to unite with various compounds contained in the leaf. The development of color and aroma is due principally to the action of these oxidizing enzymes.

Dr. Loew finds that one of these is no longer able to act when it is heated to 149°-151° Fahr., while the other is rendered inactive only by a much higher temperature, 188°-190° Fahr.

These observations of Dr. Loew, which it is to be hoped will be supplemented by further studies, are of the greatest interest and importance to growers and packers of leaf tobacco. It has long been known that tobacco, if packed too closely, will not ferment properly; which is readily understood if fermentation is an oxidation process, requiring the presence of air, which too close packing almost entirely excludes. It is a question whether, under our usual methods of packing in cases, sufficient air is always present for fermentation, until by drying in the cases the leaves have shrunk somewhat, and thus admitted air.

If these enzymes or ferments are the controlling factors in fermentation, it is of importance to study their occurrence and the things which favor their presence, and especially their activity in the cured leaf.

In the Northern States wrapper leaf tobacco is, almost universally, fermented in cases. The sorted leaves, tied by their butts, with an inferior leaf, into "hands," containing from thirteen to twenty or more leaves, are carefully packed in cases, with the aid of a press, each case containing about 300 pounds. This is done during the winter and early spring, and these cases are piled three or four high in warehouses, usually unheated, where they lie over one summer. They are turned over once or twice during the time, and in the early fall samples are drawn and the cases are sold to manufacturers or dealers by the sample. It is believed that little fermentation goes on till early summer. Tobacco fermented or "sweated" in this way cannot, therefore, be sold to manufacturers till a year after harvesting.

It cannot be examined during the fermentation or "sweat" to see if it is taking damage of any kind, and the success of the process is always in doubt until it is done and the cases are stripped in the fall.

In the Southern States, in Cuba and in Sumatra, leaf tobacco is always fermented in piles or "bulks," which are constantly examined and frequently turned over and rebuilt. The skillful operator can see at once if the operation is not going as it should, and can frequently correct the trouble.

Formerly, when leaf having a dark color was in demand, Connecticut packers sometimes "forced-sweated" the leaf, which had been previously fermented in the usual way. To do this, the leaf was made as damp as was thought safe, packed again into cases, and placed in a room where a high temperature — 100°-120° Fahr. — was maintained. In five or six weeks the process was complete.

During the last two years, owing to the scarcity of fermented wrapper leaf in the market, packers have hastened the fermentation of new-crop leaf by placing the cases, packed as usual, in rooms heated to 90°, 100°, or even to 130° Fahr.—depending on the packer's idea of what might be most favorable. Some have kept the air of these rooms quite moist, the relative humidity being 80 per cent.

In this way the leaf could be put on the market in six or eight weeks from the time it was packed. It is too early to decide whether as fine a quality of leaf is secured in this way as by the old-fashioned and slower method.

In order to test the method of fermenting Connecticut wrapper leaf by the process used at the South, i. e., in a heap instead of in a case, the crop described in the previous paper, page 299, was fermented in the following way:

A basement room was used for the purpose, the temperature of which was about 80° Fahr. day and night, because of a main steam pipe which passes through it to another building. By means of live steam from a pet cock on this pipe, the temperature could be raised to 90° Fahr. or more, and the air made very moist. By means of maximum and minimum thermometers and a hygrometer the heat and moisture could be watched, and with the aid of steam and occasional sprinkling of floor and walls kept quite uniform.

On November 1st a bulk was made as follows: On the cement floor were laid damp tobacco stems covered with trash tobacco, well pressed down, making a layer five inches deep. At each end were stanchions to hold the bulk, and matched planed pine boards were put against them, next the tobacco. About 930 pounds of tobacco, 314 pounds of top leaves, and 616 pounds of seconds (bottom, "sand" leaves), all tied in hands, were piled up between the stanchions, just as they are laid in a case, the butts to the side of the bulk.

The whole made a pile about five feet high. The top leaves were judged to be in good condition for fermenting; the seconds were too dry, but we preferred not to apply moisture till we had some experience with the process.

Near the bottom, center, and top of this bulk, as it was built, were laid electrical thermometers, devised by Whitney and Evans and kindly loaned to us for the purpose by Professor Whitney, chief of the Division of Soils, United States Department of Agriculture. By this means, with a special telephone instrument, the temperature can be taken at any time without

disturbing the bulk at all. The top and sides of the bulk were covered with stems and trash tobacco, held in place by a few scantling.

During the fermentation the temperature of the room averaged 82°, and after a few days' experience in regulating it, ranged from 77° to 85°. The relative humidity averaged 80 per cent., ranging from 75 to 91.

The temperature of the top of the bulk rose to 100° Fahr. in nine days, or at the rate of four degrees in twenty-four hours. The temperature of the center rose to 102° Fahr. in the same time, at the rate of four and one-half degrees in twenty-four hours. The temperature at the bottom in the same time rose to 79° Fahr., or less than two degrees per day.

Very soon after the tobacco has become warm by reason of the fermentation, it develops a very characteristic sweetish odor, reminding one of that of beeswax, or perhaps of plug tobacco. There is absolutely no smell of ammonia at this stage of the process, but as the temperature of the bulk goes down after the active fermentation is over the sweetish smell gradually diminishes, the tobacco within the bulk develops some ammonia, and the leaf begins to acquire the odor of fermented tobacco.

The bulk was now made over, putting what was on top before at the bottom of the new bulk. The bottom of the first bulk was at the top of the second, while the center of the first bulk was at the center of the second. The hands were shaken out to prevent the leaves from becoming matted together.

The temperature of the top of the new bulk rose to 102° Fahr. in five and one-half days, or at the rate of four degrees in twenty-four hours.

The temperature of the center, which fell to 92° in making over the bulk, rose to 98° Fahr. in four and one-half days, little more than one degree daily, while the temperature of the bottom (which had been the top of the first bulk) fell in making over the bulk to 86° Fahr., and rose to 89° in six and one-half days.

From this time, about November 18th, the temperature slowly and steadily declined till December 9th, when the temperature readings were discontinued, although the temperature and humidity of the room were kept constant. On this date the temperature of the top and middle of the bulk was 93° Fahr., and of the bottom 85° Fahr.

This bulk stood till January 4th, when the top leaves were separated, cased, and sent to a dealer for sale. They were still quite damp, easily handled, and had lost in the fermentation only 4.4 per cent. of their weight. We are informed by the dealer that they have since lost weight considerably by drying out in the case, as was to be expected. The leaf was pronounced by him well sweated; it had lost the sweet smell so characteristic of fermenting tobacco and looked and smelled like old leaf. It had nothing peculiar about it different from leaf fermented in the usual way.

We were advised to dampen the seconds and try fermenting them further, which we did, applying *very* little moisture, and making the bulk on January 4th. The temperature rose scarcely at all, and on January 14th the leaves were made quite moist by blowing and a new bulk built. The temperature rose from 79° Fahr. to 100° Fahr. in four and one-half days, little more than four degrees per day, and then sank continuously.

On February 6th the tobacco had entirely lost its sweet smell and was giving off ammonia. It was then cased and sent away for sale.

We next undertook the fermentation of the wrappers, in the way above described. They were in rather "high case," fully as damp as was deemed safe, and contained 27.5 per cent. of water.

The bulk contained 1,305 pounds, and was built January 13, 1899. The top and sides of this bulk were covered with woolen blankets, two-inch plank being laid on top of the bulk, and the whole pressed down by the weight of several persons. The temperature of the room averaged about 85° and the relative humidity 85 per cent. during the first two weeks, and from then on the temperature averaged 80° Fahr., and relative humidity 70 to 75 per cent. The temperature of the tobacco in the bulk was as follows:

	Jan. 13.	Jan. 18.	Increase.	Increase per Day.
Top of bulk,	71°	93°	22°	4½°
Center of bulk,	65°	91°	26°	5°
Bottom of bulk,	68°	82°	14°	3°

On the 18th the bulk was built over, putting at the bottom of the new bulk what had been at the top of the first one, and shaking out the leaves which were inclined to mat together.

The temperature record of this bulk was as follows:

	Jan. 18.	Jan. 24	Increase.	Increase per Day.
Top of bulk,	84°	98°	14°	4°
Center of bulk,	86°	99°	13°	4°
Bottom of bulk,	89°	91°	2°	..

On the 27th mold was found on a few hands next the blanket, on the top of the bulk where the blanket had been wet, and fearing there was more beneath, the bulk was again made over. No more mold was found.

The temperature changes from this time on were as follows:

	Jan. 27.	Feb. 6.	Increase.	Increase per Day.
Top of bulk,	82°	95°	13°	1.3°
Center of bulk,	83°	93°	10°	1.0°
Bottom of bulk,	84°	81°	—3°	....

From February 6th the temperature steadily and slowly declined throughout the bulk. On February 27th the bottom temperature was 78°, the center 84°, and the top 89°. The air of the fermenting room was then allowed to cool gradually to 70°, and became dryer as the tobacco was pronounced well sweated.

The tobacco remained in this bulk until March 27th, when it was cased and shipped. At this time it had nearly lost the characteristic sweet smell of fermenting tobacco, and had a slight smell of ammonia. During the fermentation it lost about 8 per cent. of its weight.

The leaf was examined by a dealer in leaf tobacco, and by a cigar manufacturer, both of whom found it "well-sweated," not distinguishable from leaf fermented by the usual methods, and having an odor of old tobacco, quite different from the leaf which had been fermented at a high temperature in cases.

These observations indicate that high temperatures, 120°-130°, are not at all necessary for the rapid fermentation of tobacco, and that our Connecticut leaf will ferment perfectly well in piles instead of cases, and when the process is complete, will be moist enough to be readily handled and cased down.

ANALYSES OF FEEDS.

The following feeds have been examined by Messrs. Winton, Ogden, and Mitchell, at the request of those named below, who have sent the samples to the Station:

10847. Blatchford's Calf Meal, made by E. W. Blatchford & Co., Chicago. Sent for microscopic examination by the Maine Agricultural Station. Mr. Winton found it to contain a large proportion of linseed meal; bean products (hulls and starch identified), wheat (wheat starch and hairs identified), and fenugreek were also found.

Dr. Woods states that the sample has the following composition:

Water,	7.70
Ash,	5.46
Protein,	25.63
Fiber,	5.28
Nitrogen-free Extract,	50.37
Fat,	5.56
	100.00

Of two samples of "wheat-flour" sent by Dr. B. W. Kilgore, State chemist of Mississippi, one was found by Mr. Winton to consist wholly of wheat, the other contained a large quantity of corn starch.

10231. Chicago Gluten Feed. Stock of B. B. Broadbent, Hamden Plains. Sampled and sent by John B. Phelps, Hamden.

10823. Gluten Feed, sent by Charles M. Jarvis, East Berlin.

10229. The H. O. Co.'s Dairy Feed. Stock of R. G. Davis, New Haven. Sampled and sent by E. A. Bradley, Hamden.

10230. Quaker Oat Feed. Stock of Abner Hendee, New Haven. Sampled and sent by E. A. Bradley, Hamden.

10155. Chaff. Sent by A. N. Farnham, New Haven.

Analyses.

	Chicago Gluten Feed. 10,231.	Gluten Feed. 10,823.	H. O. Dairy Feed. 10,229.	Quaker Oat Feed. 10,230.	Chaff. 10,155.
Water,	6.81	10 45	6.14	5.74	7.41
Ash,	.95	2.81	4.57	5.40	10.02
Protein,	23.88	14.81	20.38	11.75	7.75
Fiber,	7.26	7 94	12.29	11.44	24.95
Nitrogen-free Extract,	56.11	53.96	52.00	61.64	47.52
Fat (Ether Extract),	4 99	10.03	4.62	4 03	2 35
	100.00	100.00	100.00	100.00	100.00

Water-Free.

Ash,	1.02	3.14	4.87	5 73	10.82
Protein,	25.63	16.55	21.71	12.47	8 37
Fiber,	7.79	8.87	13.09	12.14	26.95
Nitrogen-free Extract,	60.21	60.24	55 41	65.39	51.32
Fat (Ether Extract),	5 35	11.20	4 92	4.27	2.54
	100 00	100 00	100.00	100.00	100 00

A large number of "Feeds" are now on the market, being residues or by-products from some manufacture. Thus the gluten feeds are by-products of starch and glucose manufacture; H. O. Feed and Quaker Oat Feed come from factories where certain "breakfast foods" are prepared. The first question with the feeder should be, are they concentrated feeds, containing decidedly more nitrogenous matter, protein, than belongs to corn-meal? If not, it seldom if ever pays to buy them. The feeder should raise his own ensilage, corn fodder and corn-meal. The use of boughten feeds is to supplement home-grown products by increasing the *proportion* of digestible protein in the ration. This cannot be done with feeds which, like corn meal, contain no more than ten or eleven per cent. of protein. If the prepared feeds do not contain more protein than wheat bran, sixteen to eighteen per cent., it is still a question whether it will not pay better to buy a standard article, like wheat bran, which has been thoroughly proved in dairy practice, than to try these new preparations.

TESTS OF THE VITALITY OF VEGETABLE SEEDS.

By E. H. Jenkins.

Since November, 1897, three hundred and thirty-three samples of seed have been examined as to their vitality. This work has been done chiefly in the interest of seed growers and seed dealers in this State, and has been executed for the most part by Mr. V. L. Churchill.

The methods of testing adopted by the Association of American Agricultural Colleges and Experiment Stations have been closely followed, and the standard germinating chambers have been used.

Table I presents the average, maximum and minimum vitality of all the seeds tested at the Station by the newly adopted methods. The age of the seeds given in the table is that reported by the seedsmen or growers who sent the samples. The samples were in all cases drawn by the persons sending them. Since the samples were sent by the seedsmen for their own information, and it was understood that the results of the tests were not to be published as representing the character of their goods, there was no motive for any misrepresentation as to the age of the seed. The samples for the most part undoubtedly represented cleaned seed as prepared for market.

Table I.—Germination Tests of Vegetable Seeds

	Age of Seed in years, when tested.	Number of Samples.	Average Percentage by number of Seed Sprouting.	Maximum.	Minimum.
Beans, ...	0–1	7	86 5	100.0	56.7
	1–2	15	91.1	100.0	72.0
	2–3	8	87.0	100.0	59.0
	3–4	15	92.3	99.0	83.0
Beets, ...	0–1	18	162.0	211.0	65.5
	1–2	13	175.7	230.0	120.5
	2–3	4	146.6	192.0	73.5
Brussels Sprouts, . . .	3–4	1	36.0	....	....
Cabbage, ...	0–1	23	80.9	94.0	44.0
	1–2	9	78.4	96.5	38.8
	2–3	3	71.5	88.0	43.0
	3–4	3	74.7	91.5	55.8
	4–5	2	64.9	85.8	44.0
	6–7	1	63.8	....	....
Carrots, ...	0–1	19	59.5	90.8	35.0
	1–2	15	48.7	91.3	14.5
	2–3	5	43.6	54.2	31.0
Cauliflower, ...	0–1	1	84.5	....	....
	1–2	4	51.1	88.3	27.5
	3–4	1	77.3	....	....
Celery, ...	0–1	17	68.0	83.5	38.3
	1–2	7	42.9	63.8	25.3
	2–3	9	55.5	79.3	9.8
	3–4	5	55.4	63.5	27.3
Corn, Sweet, . . .	0–1	3	93.3	99.0	83.0
	1–2	13	74.5	98.0	37.5
Cress, ...	0–1	3	61.5	91.3	35.5
Cucumber, ...	0–1	10	86.3	99.0	57.0
	1–2	8	85.9	95.5	67.5
	3–4	4	76.4	90.0	64.5
	4–5	1	79.0	....	....
Dandelion, ...	0–1	1	70.3	....	....
Egg Plant.	0–1	1	40.0	....	..
Kale, ...	...	3	85.5	92.0	78.3
Kohl Rabi, ...	...	2	90.1	93.5	86.8
Leek, ...	0–1	3	84.5	86.0	83.5
	1–2	3	76.5	79.3	74.0
	2–3	1	35.5	....	....
Lettuce, ...	0–1	25	90.4	100.0	18.0
	1–2	23	84.3	100.0	23.5
	2–3	11	74.3	98.8	23.8
	5–6	1	10.3	....	...
Mangel Wurzel, . . .	0–1	2	190.0	203.0	177.0
	1–2	3	153.0	176.0	138.0
	2–3	3	131.0	181.0	101.0
Musk Melon, ...	0–1	8	75.4	100.0	28.0
	1–2	10	67.9	96.5	29.0
	3–4	5	45.4	81.0	19.5

TABLE I. — CONTINUED.

	Age of Seed in years when tested.	Number of Samples.	Average Percentage by number of Seed Sprouting.	Maximum.	Minimum.
Onion, Connecticut grown, .	0–1	155	72.4	97.5	36.8
	1–2	31	55.5	91.5	0.8
	2–3	20	18.1	68.3	0.5
	3–4	1	59.5	....	....
California grown, .	0–1	33	91.3	97.5	77.3
	1–2	9	86.5	98.0	58.5
	2–3	3	85.9	91.5	87.5
	3–4	1	10.0	....	....
Parsley, ...	0–1	1	73.3	....	....
	1–2	4	37.1	72.0	7.8
Parsnip, ...	0–1	4	52.5	63.5	34.3
	1–2	4	15.6	42.8	2.5
	2–3	1	30.3	....	....
Peas, ...	3–4	2	98.5	99.0	98.0
Pepper, ...	0–1	4	76 6	89.5	61.0
	1–2	1	29.3	....	....
Pumpkin, ...	0–1	5	70.7	95.0	40.0
Radish, ...	0–1	18	87.7	99.8	72.0
	1–2	15	67.4	87.0	31.0
	2–3	7	38.0	55.5	22.5
	3–4	10	31.6	69.5	5.3
Salsify, ...	0–1	1	80.5	....	....
Spinach, ...	0–1	14	80.7	89.7	59.5
	1–2	1	72.0	....	....
Squash, ...	0–1	12	84.9	100.0	68.8
	1–2	2	86.5	98.0	75 0
	3–4	5	44.4	82.0	1.0
Tomato, . . .	0–1	8	82.8	97.0	76.0
	1–2	6	86.7	93.5	77.5
	2–3	1	65.5	....	....
	3–4	3	70.2	96.2	43.5
Turnip, ...	0–1	2	92.9	96.8	89.0
	1–2	4	95.8	97.8	90.5
	3–4	3	76.5	94.5	49.8
Water Melon, . . .	0–1	7	82.7	100 0	56.3
	1–2	6	39.6	77.0	0.0
	2–3	7	43.5	81.0	0.0
	3–4	1	42.0	....	....
	5–6	1	69.5	....	....

The "percentage" of beet seed and mangel wurzel sprouting, as given in the table, is nearer 200 than 100. To test the vitality of beet seed one hundred "seeds" are put in the germinating apparatus and all the sprouts are counted. As each beet "seed" is a fruit which may contain from two to six separate seeds, it is evident that the possible number of sprouts may be 600. To count the actual number of seeds in the one hundred fruits examined, which would make a true percentage statement of sprouting power possible, would be extremely laborious; but the form of statement here followed is sufficiently intelligible and is justified by usage.

Vitality of Onion Seed as affected by the Age of the Seed.

Since November 1, 1896, the Station has examined 110 samples of onion seed of the crops of 1896, 1897, and 1898. To these, in the following table, are added the results of tests made in previous years, by the methods recommended by the Association of Agricultural Colleges and Experiment Stations. In the samples examined, the percentage by number of seed which sprouted was as follows:

TABLE II.—VITALITY OF ONION SEED.

	CONNECTICUT GROWN		CALIFORNIA GROWN.	
	No. of Samples.	Per cent. Sprouted.	No. of Samples.	Per cent. Sprouted.
Seed stated to be less than 1 year old,	155	72.3	33	91.3
Seed stated to be between 1 and 2 years old, ...	31	55.6	9	86.6
Seed stated to be between 2 and 3 years old, ...	20	18 1	3	85.9
Seed stated to be between 3 and 4 years old, ...	1	59 5	1	10.0

While the number of samples examined of California-grown seed is not large enough to make a close comparison, it is quite evident that a larger percentage of the California seed germinates than of the Connecticut seed.

Table II also shows that onion seed more than one year old, as a rule, has much less sprouting capacity than new seed, although in Table V are numerous cases of onion seed more than a year old which sprout as well as most new seed.

Whether the plants produced from old seed are as vigorous and productive as those from fresh seed is quite another question, on which laboratory germination tests can give no light.

Comparison of the Vitality of Crops of Connecticut-grown Onion Seed in the years 1894–1898.

The average sprouting capacity of Connecticut-grown onion seed, as determined for a number of years at this Station, has been as follows:

TABLE III.—VITALITY OF CROPS OF ONION SEED.

	No. of Samples Tested.	Average Percentage Sprouted.
In 1880	14	87.0
1894	25	82.9
1895	13	85.5
1896	44	72 4
1897	39	77.9
1898	68	69.3

The sprouting capacity of onion seed in 1898 has been unusually low, for reasons which are not evident.

The Sprouting Capacity of Different Varieties.

The average sprouting capacity of four varieties, of which a considerable number of samples has been tested, is as follows (only those samples are here included which were alleged to be less than one year old at the time of testing):

TABLE IV.—SPROUTING CAPACITY OF DIFFERENT VARIETIES OF ONION SEED.

Variety.	No. of Samples Tested.	Average Percentage of Sprouting Seed.
Yellow Globe, . .	77	73.9
Red Globe, . . .	62	76 6
White Globe, . .	39	75.4
White Portugal, . .	22	68 3
Wethersfield Red, . .	2	72.4

Four of the varieties are essentially alike in sprouting capacity, but the White Portugal appears to be inferior to them in this regard.

In 1898 the seed of the yellow globe variety had a lower percentage vitality than either the red or white globe varieties.

TABLE V.—GERMINATION TESTS MADE IN 1898 OF ONION SEED RAISED IN CONNECTICUT.

Variety.	Station No.	Age of Seed in years, when tested.	Percentages of Seed, by Number. Sprouted in 14 days.	Remained Hard.	Decayed.	No. of Days within which one-half of the Sprouting Seed Germinated.
Yellow Globe, Crop of 1895, .	1686	3–4	59.5	29.2	11.3	4
Crop of 1897, .	1685	1–2	81.8	3.2	15.0	3
Crop of 1898, .	1684	0–1	87.2	0.5	12.3	3
	1695	0–1	64.3	17.5	18.2	3
	1728	0–1	48.3	7.0	44.7	3
	1730	0–1	43.5	8.5	48.0	3
	1731	0–1	55.0	11.8	33.2	3
	1733	0–1	53.8	11.0	35.2	3
	1734	0–1	49.3	11.0	40.7	3
	1748	0–1	59.3	7.0	33.7	3
	1749	0–1	72.0	6.0	22 0	3
	1750	0–1	75.3	6.2	20.5	3
	1760	0–1	74.0	7.2	18.8	4
	1898	0–1	62.5	4.0	33.5	4
	1899	0–1	46.3	9.0	44.7	4
	1900	0–1	59.8	5.2	35.0	4
	1942	0–1	61.8	3.5	34.7	3
	1943	0–1	53.0	8.8	38.2	3
	1950	0–1	49.0	6.2	44.8	3
	1951	0–1	52.0	10.5	37.5	3
	1954	0–1	53.0	6.5	40.5	3
	1955	0–1	45.8	9.0	45.2	3
	1968	0–1	66.8	7.8	25.4	4
	1973	0–1	81.0	2.0	17.0	3
Red Globe, Crop of 1898, .	1683	0–1	82.7	6.5	10.8	3
	1718	0–1	80.7	3.5	15.8	3
	1719	0–1	65.5	6.0	28.5	3
	1720	0–1	91.0	5.0	4.0	3
	1721	0–1	78.8	5.0	16.2	3
	1722	0–1	72.3	5.0	22.7	3
	1723	0–1	70.5	7.0	22.5	3
	1724	0–1	76.0	6.0	18.0	3
	1725	0–1	87.0	5.2	7.8	3
	1726	0–1	61.8	13.5	24.7	3
	1727	0–1	62.8	12.5	24.7	3
	1729	0–1	63.8	11.0	25.2	4
	1735	0–1	46.3	9.5	45.2	3
	1737	0–1	83.3	5.0	11.7	3
	1751	0–1	54.0	5.5	40.5	3
	1752	0–1	74.0	7.3	18.7	3
	1753	0–1	63.0	6.8	30.2	3
	1754	0–1	80.3	4.5	15.2	3
	1901	0–1	67.3	10.0	22.7	4
	1902	0–1	79.5	2.2	18.3	4
	1903	0–1	83.5	3.5	13.0	3
	1944	0–1	77.3	3.8	18.9	3
	1945	0–1	79.8	4.8	15.4	3
	1946	0–1	74.8	4.2	21.0	3

TABLE V.—CONTINUED

Variety.	Station No.	Age of Seed in years, when tested.	Percentages of Seed, by Number. Sprouted in 14 days.	Remained Hard.	Decayed	No. of Days within which one-half of the Sprouting Seed Germinated.
Red Globe, Crop of 1898,	1947	0–1	78.0	3.2	18.8	3
	1948	0–1	67.3	10.0	22.7	3
	1949	0–1	74.8	3.0	22.2	3
	1953	0–1	82.0	2.2	15.8	3
	1970	0–1	92.0	2.8	5.2	4
	1972	0–1	64.5	8.2	27.3	3
Wethersfield Red, Crop of 1897,	1688	1–2	84.0	1.0	15.0	2
Crop of 1898,	1761	0–1	89.8	2.8	7.4	4
Early Red Flat, Crop of 1896,	1687	2–3	33.3	38.5	28.2	3
Crop of 1898,	1758	0–1	97.5	0.0	2.5	3
White Globe, Crop of 1897,	1689	1–2	38.8	39.5	21.7	3
Crop of 1898,	1682	0–1	77.0	4.8	18.2	3
	1732	0–1	66.8	5.0	28.2	3
	1736	0–1	66.5	6.0	27.5	3
	1738	0–1	56.5	11.0	33.5	3
	1739	0–1	67.0	6.7	26.3	3
	1740	0–1	61.3	8.0	30.7	3
	1755	0–1	79.8	8.8	21.4	3
	1897	0–1	73.3	6.5	20.2	4
	1944	0–1	72.3	6.8	20.9	3
	1952	0–1	68.8	5.5	25.7	3
	1969	0–1	88.5	5.2	6.3	4
	1971	0–1	67.3	4.5	28.2	3
White Portugal, Crop of 1896,	1661	2–3	18.2	31.0	50.8	5
	1662	2–3	8.2	70.0	21.8	6
	1663	2–3	0.5	48.5	51.0	10
	1664	2–3	7.7	73.0	19.3	5
	1665	2–3	11.0	53.0	36.0	5
	1666	2–3	10.3	65.5	24.2	5
	1667	2–3	2.2	58.2	39.6	4
	1668	2–3	12.0	51.5	36.5	5
	1669	2–3	38.5	33.0	28.5	4
	1670	2–3	65.0	17.5	17.5	4
	1671	2–3	3.8	81.5	14.7	6
	1672	2–3	13.0	83.0	4.0	6
	1673	2–3	6.8	78.2	15.0	4
	1675	2–3	2.5	84.5	13.0	4
	1680	2–3	6.7	74.8	18.5	5
Crop of 1898,	1681	0–1	77.8	6.0	6.2	3
	1896	0–1	79.0	5.1	15.9	4
Prize Taker, Crop of 1896,	1690	2–3	68.3	12.5	19.2	3

EGG ALBUMIN.

BY THOMAS B. OSBORNE.

Crystallized egg albumin was first observed by F. Hofmeister, whose directions for preparing it are briefly as follows (Zeitschr. f. physiol chemie, 14, 165): Fresh egg white is whipped to a froth, and after standing twenty-four hours is mixed with an equal volume of saturated solution of neutral ammonium sulphate and filtered to separate globulin. The filtrate is collected in wide, shallow dishes and allowed to evaporate at ordinary temperature for several days, or until no further precipitate of albumin appears. The substance thus deposited is re-crystallized several times from half-saturated ammonium sulphate solution, by evaporation, as before, until it is obtained in clear, acicular crystals unmixed with spheroids.

Hopkins has recently shown (Jour. Physiology, 23, 131) that the crystallization of egg albumin is greatly facilitated by the addition of acetic acid to the half-saturated ammonium sulphate solution. I have found that crystallization is thus promoted, because crystallized egg albumin is a compound of the protein substance with acid.

As Hopkins observes, when egg white is first mixed with half-saturated ammonium sulphate solution an alkaline reaction towards litmus can be detected and a decided odor of free ammonia develops. I find that after this solution has stood for some hours, all evidence of free ammonia disappears, and the solution is then perfectly neutral to litmus and continues neutral during the gradual separation of the albumin. The deposited substance, however, whether in the form of spheroids or of crystals, when filtered out and dissolved in water, reacts distinctly acid with litmus, as well as with phenolphthalein.

In order to obtain well-crystallized albumin by Hofmeister's method it is necessary to precipitate it several times, evidently because, during the first precipitations an insufficient amount of acid is formed or set free to produce the crystalline compound. It is well known that neutral aqueous solutions of ammonium salts lose ammonia and become acid when evaporated or exposed to the air.

If acetic acid be added, as Hopkins directs, all the albumin that separates is completely crystallized by a single precipitation, and that, too, without concentrating by evaporation.

I have found that if, instead of acetic acid, a molecularly equivalent quantity of hydrochloric acid be added, the separation takes place even more quickly and, so far as my experience goes, within a short time is more complete than with acetic acid during the same time.

Thus, I prepared from two equal portions of perfectly fresh egg-white a quantity of crystallized albumin by aid of each of these acids, with the following results:

One portion of 1,500 cc. of egg-white was mixed, as Hopkins directs, with an equal volume of saturated ammonium sulphate solution and filtered over night. Next morning saturated ammonium sulphate solution was added to the clear filtrate to incipient precipitation, and thereupon 46.5 cc. of 10 per cent. acetic acid were added, drop by drop, with constant shaking, and the mixture was set aside in a cold room.

The other 1,500 cc. of egg-white was similarly treated, but instead of acetic acid, 67.5 cc. of 4 per cent. hydrochloric acid, well mixed with 232.5 cc. of half-saturated ammonium sulphate solution were added very gradually, with constant agitation and formation of some permanent precipitate.

After three hours a very large crystalline precipitate had separated in the portion with hydrochloric acid. This precipitate was then filtered out, but the portion with acetic acid was allowed to stand for twenty-four hours, as the deposit appeared to be much less than that in the hydrochloric solution.

These two precipitates were each twice recrystallized, freed as completely as possible from mother liquor by pressing out with filter paper, dissolved in water, and the solutions dialyzed for ten days, until wholly freed from sulphate, when they were filtered clear and evaporated at about 50°. The residue left by the acetic acid solution (A 1) weighed 29 grams; that from the hydrochloric acid (H 1) 59 grams.

The filtrates from the several crystallizations of these two preparations yielded a second crop of crystallized albumin; that from the acetic acid solution (A 2) weighing 43 grams; that from the hydrochloric solution (H 2) 7.9 grams. Similarly, from the mother liquors from these preparations, two other entirely crystalline products were obtained, weighing respectively (A 3) 8 grams, and (H 3) 4.9 grams. From the finally remaining acetic acid solutions another preparation separated, consisting wholly of spheroids (A 4), which weighed 9.1 grams.

There were thus secured from 1,500 cc. of egg-white, by adding acetic acid, 80 grams of well crystallized albumin, and from 1,500 cc., with hydrochloric acid, 71.8 grams, or 5.3 and 4.9 grams respectively per 100 cc. of egg-white.

The crystallized albumin, like all other preparations of native proteids which I have as yet examined, is a compound of a protein substance with an acid. In order to neutralize to litmus and to phenolphthalein the solutions of one gram of each of these preparations of crystallized albumin, it was necessary to add the following quantities of decinormal potassium hydroxide solution:

	A1.	A2.	A3.	A4.	H1.	H2.	H3.
To phenolphthalein,	2.05 cc.	2.30 cc.	2.30 cc	2 35 cc	2 05 cc	2.25 cc.	2.20 cc.
To litmus,	1.30 cc.	1.60 cc.	1.65 cc.	1 55 cc.	1 30 cc.	1.60 cc.	1.50 cc.
Difference,	0.75 cc.	0.70 cc.	0.65 cc.	0 80 cc.	0 75 cc.	0.65 cc.	0.70 cc.

If the molecular weight of the protein substance is assumed to be about 15,000,* one gram would react with 0.67 cc. of a decinormal solution, a quantity nearly equal to the difference in acidity shown by these two indicators. Three molecules of acid reacting with one of albumin would be equal to 2 cc. of decinormal solution per gram of albumin, a quantity in very close agreement with that found for the two large fractions A 1 and H 1), and which differs but little from that required to neutralize one gram of the other fractions.

When crystallized albumin, dissolved in water, was neutralized with decinormal potassium hydroxide, the solution evaporated to dryness and the proteid matter burned off, an ash was left containing potassium carbonate nearly equivalent to the acid of the albumin originally neutralized. From this it would appear that the acid is mostly, if not wholly, organic.

As yet I have not been able to discover what acid or acids are united to the albumin. Neutralization of the substance suspended in 50 per cent. alcohol resulted in the formation of a gummy mass difficult to filter and wash, and from which none of the products of neutralization could be separated. Neutralizing a solution of ten grams of crystallized albumin and dialysis in distilled water failed to give enough salts in the diffusate to shed light on the nature of the acid. Neutralization with

* Sabanejeff (Chem. Centrbl, (*1891*), 10.) found the molecular weight of purified egg albumin by determining the lowering of the freezing-point to be 15,000.

baryta of a solution of two grams of the albumin gave a very slight precipitate, which after standing some days was filtered out, washed, and ignited, but only four milligrams of mineral matter were obtained.

The preparations showed no excess of sulphur over that usually found in coagulated and thoroughly washed albumin prepared without the use of sulphuric acid or sulphates. Determination of total phosphorus showed A 1 and H 1 to contain 0.37 and 0.40 per cent. phosphorus pentoxide respectively. These preparations contained 0.87 and 0.69 per cent. of ash which was almost wholly insoluble in water and appeared to consist chiefly of calcium phosphate. The total phosphorus in these preparations was equivalent to 0.59 and 0.64 per cent. of tricalcium phosphate respectively.

Towards lacmoid these preparations reacted alkaline, about 1 cc. of decinormal acid being required to neutralize the solution of one gram, and 3 cc. to give an acid reaction. When one gram was treated with decinormal hydrochloric acid no evidence of free acid was shown with tropaeolin, until 8 or 9 cc. were added.

When pure water solutions containing 2.5 per cent. of my albumin preparations were heated, they all became turbid at 58°-59°, and a minute quantity of flocks separated at 59°-60°. On gradually raising the temperature the coagulum slowly increased, until at 70° much of the dissolved albumin had coagulated. The solutions heated for some time at 74° and filtered still contained a little proteid, which even on heating at 99° did not separate until some salt was added.

No break in this gradual coagulation of the albumin was detected, the solutions when filtered after partial coagulation yielding a coagulum on again heating up to the temperature to which they had been previously raised. When solutions of pure 10 per cent. sodium chloride brine containing 2.5 per cent of any of these preparations except A 3, H 3, and A 4, were slowly heated, turbidity developed at 56°-59°, and flocks at 56°-60°.

Only a trace of coagulum was obtained, however, below 64°, and the solutions filtered therefrom remained perfectly clear until heated to nearly or quite 70°, when the albumin began to coagulate. It was, however, found necessary to heat the solution to nearly 84° before most of the proteid separated.

The three preparations, A 3, H 3, and A 4, behaved as just

described, except that each yielded a relatively considerable coagulum below 64°. These preparations, it is to be noted, are final fractions obtained in small quantity, and it is probable that the coagulum obtained at 60°-64° is due to the presence of a different substance from that constituting the chief part of the other fractions. This is the more probable as A 3 and A 4 also showed a difference in specific rotation as well as in composition.

The degree of acidity has much influence on the coagulation of albumin. Exact neutralization to phenolphthalein, as might be expected, entirely prevents coagulation, even on boiling. When crystallized albumin is so far neutralized that its acidity is equal to 1.2 cc. of decinormal acid per gram of albumin, a solution containing 2.5 per cent. of the proteid becomes slightly opalescent on heating to 72°, and remains otherwise unchanged, even after heating for a long time in a boiling water bath. If, however, the acidity is but 0.1 cc. greater, or equal to 1.3 cc. per gram of albumin, the solution becomes turbid at 70° and very opaque after heating in the water bath at 99°. The difference between the two solutions is marked, and it is evident that the additional 0.1 cc. causes a change in the condition of the albumin. An acidity of 1.33 cc. per gram is almost exactly equal to two molecules of acid per molecule of albumin, assuming the latter to have a molecular weight of 15000.

From this it would seem to be necessary to add three molecules of acid to one of albumin, in order to form the coagulable substance.

The specific rotation of these preparations was approximately determined by means of a Schmidt & Haensch polariscope, using a 200 millimeter tube. The readings on the sugar scale were converted into degrees of circular polarization by multiplying by 0.346. The formula used in calculating the results is:

$$(a)_D = \frac{a \times 100}{p \times d \times l}$$

where a=observed rotation.
p=per cent of albumin in the solution.
d=density of the solution.
l=length of tube in decimeters.

The results obtained were as follows:

Preparation.	Per Cent. of Dissolved Albumin.	Solvent.	Rotation.	Average.
A1,	5.861	Water	−29° 48′	−29° 17′
	6.670	"	−28° 46′	
A2,	3.422	"	....	−29° 23′
A3,	3.273	"	....	−33° 3′
A4,	3.404	"	....	−41° 45′
H1,	3.425	10 p. ct. NaCl.	−29° 0′	−28° 35′
	3.237	Water	−28° 33′	
	6.478	"	−28° 1′	
H2,	1.699	"	....	−28° 14′
H3,	3.207	"	....	−39° 31′

As the results obtained on A 1, A 2, H 1, and H 2 agree closely, and as these preparations represent very different proportions of the total albumin of the egg-white, it seems probable that we have in these fractions but one proteid substance.

Bondzynski and Zoja, working with solutions containing ammonium sulphate, obtained similar but somewhat lower figures for the specific rotation of their least soluble fractions, namely, 25° 8′ and 26° 2′, duplicate determinations on the same fraction. Three other fractions gave them 29° 16′, 34° 18′, and 42° 54′, figures agreeing fairly with those obtained by me for my more soluble fractions. They determined the albumin in the polarized solution by coagulation, a process not so exact as that employed by me, which consisted simply in evaporating the pure water solution, drying to constant weight at 110°, and deducting ash. A slight error in determining the dissolved albumin causes a considerable error in the specific rotation.

The effect of acid and alkali on the rotation of crystallized albumin solutions is shown by the following results, obtained by dissolving one gram of A 2 in 25 cc. of water and treating with the given quantities of acid or of alkali:

1 gram A. 2	+ nothing		−29° 17′
	+ 0.8 cc.	N/10 HCl	−29° 5′
	+ 8.0 cc.	"	−33° 46′
	+ 1.4 cc.	N/10 KOH	−28° 45′
	+ 2.7 cc.	"	−30° 20′
	+ 4.2 cc.	"	−32° 30′

It is to be noted that by 8 cc. of the acid and by 4.2 cc. of the alkali a rotation was produced about 10 per cent. higher than with the smaller quantities of acid or alkali. This increase may well be due to a local over-reaction taking place on mixing the acid and alkali with the proteid solution, it having been demonstrated that large proportions of acids and alkalies yield products of high specific rotation.

Panormoff (Ref. in Chem. Centrbl., 1898, II., 358 and 487) has studied the specific rotation of fractionally precipitated crystallized egg albumin, and concludes that there are two albumins present in egg-white, one with a specific rotation of —23.6°, and the other —36.2°. The albumin with the lower rotation he obtains from the so-called egg globulin precipitated by adding to egg-white an equal volume of saturated ammonium sulphate solution. This he succeeded in crystallizing, and, so prepared, finds it to have the properties and composition of albumin. He considers, therefore, the egg globulin to be a compound of egg albumin with some unknown substance.

As egg-white is alkaline to litmus, and ammonia is set free on adding to it a saturated solution of ammonium sulphate, it is not surprising that a product should be produced of different solubility from that of the acid albumins which we have been considering.

Panormoff converted his crystallized albumin into a chloride by dialysis against 0.2 per cent. hydrochloric acid. He analyzed the product obtained, and it is interesting to note that, if calculated free from hydrochloric acid, the figures for the albumin are in exceedingly close agreement with the average of the best analyses of albumin. Furthermore, the proportion of hydrochloric acid in Panormoff's compound is the same as I have found albumin capable of fixing by using tropæolin as an indicator. I found that one gram of albumin unites with 8 cc. of decinormal acid, or 0.0292 gram hydrochloric acid, to form a compound showing no free acid with tropæolin, while Panormoff's chloride contained 2.92 per cent., or exactly the same quantity.

In regard to the composition of egg albumin, confusion has recently been caused by Hofmeister, who states (Ztschr. physiol. Chem., 24, 166) that he has found in repeatedly recrystallized egg albumin 1.01 and 1.18 per cent. of sulphur, and that Dr. F. N. Schulz, in his laboratory, has obtained 1.24 and 1.27 per cent.. He consequently calls in question the purity of the samples of crystallized albumin analyzed by Bondzynski and Zoja. As Hofmeister's figures for carbon are higher, and for nitrogen lower, than those of Bondzynski and Zoja, and of other investigators who have analyzed *amorphous* egg albumin, the whole question of the composition of this substance is again thrown into confusion.

Having at hand a sample of egg albumin which had been three times recrystallized in the manner described by Hofmeister as necessary for its purification, and obtained in the same proportion from egg-white as stated by him to be the usual yield after thorough purification, and which had been coagulated with alcohol and thoroughly washed until all ammonium sulphate was removed, I analyzed it, dried at 110°, with the result given under No. 1.

Analyses of the seven fractionally crystallized preparations (A 1, 2, 3, and 4, and H 1, 2, and 3) were made after drying them to constant weight at 110°, and are as follows:

	No. 1.	H 1.	H 2.	H 3.
Carbon,	52.18	52.85	52.33	51.72
Hydrogen,	6.91	6.92	6.90	6.90
Nitrogen,	15.67	15.66	15.77	15.26
Sulphur,	1.70	1.57	1.64	1.96
Oxygen,	23.54	23.00	23.36	24.06
	100.00	100.00	100.00	100.00
Ash,	0.56	0.69	0.67	0.59
Total Phosphorus pentoxide,	....	0.40	0.21	trace

	A 1.	A 2.	A. 3.	A. 4.
Carbon,	52.60	52.61	52.33	51.44
Hydrogen,	7.02	6.94	6.93	6.88
Nitrogen,	15.54	15.76	15.40	15.20
Sulphur,	1.61	1.61	1.78	1.91
Oxygen,	23.23	23.08	23.56	24.57
	100.00	100.00	100.00	100.00
Ash,	0.87	0.65	0.67	0.40
Total Phosphorus pentoxide,	0.37	0.28	trace	trace

There can no longer be question that the amount of sulphur in albumin is greater than that stated by Hofmeister. My sulphur determinations were made with extreme care, fusing more than a gram of the substance over an alcohol lamp with pure sodium hydroxide and peroxide in a nickel crucible, dissolving the fusion* in hydrochloric acid, nearly neutralizing

* A black substance containing sulphur (nickel sulphide) often appears which must be completely dissolved, otherwise too low results will be obtained.

the excess of acid, and precipitating with barium chloride from a boiling solution of at least 800 cc. volume. Blank determinations showed no trace of sulphur in the re-agents, and also that none was absorbed during fusion over the alcohol lamp.

These results agree with those obtained by Bondzynski and Zoja, though the difference in composition between their extreme fractions was not quite so great as found for my preparations.

The composition, rotation, heat-coagulation points, and reactions of the crystallized egg albumin obtained by aid of hydrochloric or acetic acid show this to be the same substance as that which has in the past been regarded as egg albumin.

The results of Bondzynski and Zoja, of Panormoff, and my own, make it plain that there are two protein substances in egg-white, which are commonly obtained admixed when egg albumin is prepared by the usual processes. Further work on large quantities of egg-white is already in progress here, with a view to the complete separation of these bodies.

Moerner (Zeitschr. f. physiol. Chem., 18, 525) has described ovomucoid as identical with Neumeister's pseudopeptone (Zeitschr. Biologie, 9, 369), and states that it constitutes about one-eighth of the organic matter of egg-white. Since ovomucoid is described as largely, though not wholly, precipitated by two-thirds saturation of its solution with ammonium sulphate, it ought, if present as such in egg-white, to be found among the more soluble fractions thrown down by successive additions of ammonium sulphate.

It is intended to direct especial attention to the isolation of this substance and to determine, if possible, in how far it may be admixed with the albumins.

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