State of Connecticut

PUBLIC DOCUMENT No. 24

TWENTY-NINTH ANNUAL REPORT

OF

The Connecticut Agricultural Experiment Station

FOR THE YEAR ENDING OCTOBER 31

1905

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1906

PUBLICATION

APPROVED BY

THE BOARD OF CONTROL.

CONNECTICUT AGRICULTURAL EXPERIMENT STATION.

OFFICERS AND STAFF.

FOR THE YEAR ENDING OCTOBER 31, 1905.

STATE BOARD OF CONTROL.

Ex officio.

His Excellency HENRY ROBERTS, Hartford, *President.*
E. H. JENKINS, New Haven, *Director and Treasurer.*

	Term Expires
Appointed by State Agricultural Society:	
B. W. COLLINS, Meriden.	July 1, 1906
Appointed by Board of Trustees of Wesleyan University:	
Prof. W. O. ATWATER, Middletown.	1906
Appointed by Governor:	
EDWIN HOYT, New Canaan.	1907
JAMES H. WEBB, Hamden.	1908
Appointed by Board of Agriculture:	
T. S. GOLD, West Cornwall, *Vice President.*	1907
Appointed by Governing Board of Sheffield Scientific School:	
W. H. BREWER, New Haven, *Secretary.*	1908

STATION STAFF.

Chemists.

Analytical Laboratory.

A. L. WINTON, PH.D., *Chemist in charge.*
E. MONROE BAILEY, PH.B.
J. L. KREIDER, M.A.†
KATE G. BARBER, B.S.
E. J. SHANLEY, PH.B.§
I. A. ANDREW, PH.B.*

Laboratory for the Study of Proteids.

T. B. OSBORNE, PH.D., *Chemist in charge.*
I. F. HARRIS, M.S.

Botanist.
G. P. CLINTON, S.D.

Entomologist.
W. E. BRITTON, PH.D.

Assistant to the Entomologist.
B. H. WALDEN, B.AGR.

Forester.
AUSTIN F. HAWES, M.F.

Agronomist.
EDWARD M. EAST, M.S.†

Grass Gardener.
JAMES B. OLCOTT, *South Manchester.*

Stenographers and Clerks.
MISS V. E. COLE.
MISS L. M. BRAUTLECHT.

In charge of Buildings and Grounds.
WILLIAM VEITCH.

Laboratory Helper.
HUGO LANGE.

Sampling Agent.
V. L. CHURCHILL, New Haven.

* Till July, 1905. † From September, 1905. § From October, 1905.

TABLE OF CONTENTS.

ANNOUNCEMENT.

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

By subsequent legislative acts it is made the business of this station to analyze all the brands of commercial fertilizers sold in the state, as well as to examine commercial cattle feeds and articles used for human food or drink on sale in Connecticut, with reference to their adulterations. Provision is also made for the testing and marking by this station of all apparatus used in determining the price of milk and cream.

Through the state entomologist, a member of the station staff, the station is required to make regular inspections of nurseries, to visit and examine orchards, nurseries, fields, gardens, or storehouses, at the request of their owners, to advise regarding treatment for insect pests and to diffuse information on the subject.

Through the state forester, also a member of its staff, the station is required to manage the state forest.

In addition to the work of "scientific investigation and experiment" in the service of agriculture, to the work required under special statutes above described, and to the expert work required by the dairy commissioner's office, the station analyzes and tests fertilizers, cattle-foods, seeds, milk and other agricultural materials and products, identifies grasses, weeds, moulds, blights, mildews, useful or injurious insects, suggests methods of combating injurious fungus and insect pests, advises as to the planting, management and care of woodland, etc., and gives information on various subjects of agricultural science, for the use and advantage of the citizens of Connecticut.

The station does not make sanitary analyses of water, as that work has been undertaken by the State Board of Health.

The station makes analyses of fertilizers, feeds, and other products, tests seeds, 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 of Description."

4. That it is physically possible for the station to do the work in a reasonable time.

Results of analysis or investigation that are of general interest are published in bulletins, of which copies are sent to every citizen of the state who applies for them, as far as the editions will permit. These results 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 permit. 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 will be sent on application.

Parcels by express should be prepaid and marked with the name of the sender. Communications should be directed to the

AGRICULTURAL EXPERIMENT STATION,

NEW HAVEN, CONN.

The station grounds, laboratories and office are at 123 Huntington street, between Whitney avenue and Prospect street, 1⅝ miles north of City Hall. Huntington street may be reached by the Mt. Carmel and Whitney avenue electric cars, which pass the railway station every twelve minutes.

The station has telephone connection and may be spoken from all parts of the state at all hours between 7.30 A. M. and 9.30 P. M.

VISITORS ARE ALWAYS WELCOME.

REPORT OF THE BOARD OF CONTROL

OF THE

CONNECTICUT AGRICULTURAL EXPERIMENT STATION.

To His Excellency, Henry Roberts, Governor of Connecticut:

The Board of Control of the Connecticut Agricultural Experiment Station, as required by law, herewith respectfully submits its report for the year ending October 31, 1905.

The following changes have occurred in the station staff: I. A. Andrew, chemist, resigned July 1, to assist in managing a farm.

J. L. Kreider, B.S., a graduate of Lebanon Valley College, who received the degree of M.A. from Yale University in 1905, began work as chemist on September 1.

At the same time E. M. East, M.S., joined the staff as agronomist. Mr. East was graduated at the Illinois State University in 1901, and since then has been on the staff of the Illinois Agricultural Station.

E. J. Shanley, Ph.B., a graduate of Yale University of the class of 1904, joined the staff as chemist on October 1 of this year.

In 1905, thirty-four firms and individuals have entered for sale in this state two hundred and seventy-five distinct brands of commercial fertilizers. During the spring Mr. Churchill visited eighty-eight towns and villages of the state and drew six hundred and one samples of fertilizers.

As required by law, all of these brands have been analyzed under Dr. Winton's direction, and besides them, other samples of fertilizers and manurial waste products, making the total number of fertilizer analyses six hundred.

The results of this work are waiting to be printed.

Under the provisions of the law regarding food products, Mr. Churchill visited twenty-two towns and villages and bought eight hundred and eleven samples of food products, which have been examined and the adulterated foods in all cases promptly reported to the dairy commissioner, with whom rests the enforcement of the law. Two hundred and seventy-one other samples of food products from various sources have been analyzed, and for the dairy commissioner four hundred and forty-seven samples, making the total number of food products one thousand five hundred and twenty-nine. This work has been done in the analytical laboratory under Dr. Winton's direction. The large amount of microscopic study involved has been done wholly by Dr. Winton. The account of this work is also waiting to be printed.

Under the terms of the law regarding commercial feeds three hundred and thirty-seven analyses of feeding stuffs, collected in the fall of 1904, have been made and the results published in January in bulletin No. 147.

Two hundred and twenty-seven samples of feeding stuffs have been drawn within the last few weeks and, with others now being drawn, will be immediately analyzed for the information of dairymen and other feeders of stock.

Dr. Winton has done all of the microscopic work involved in the foregoing work and has directed the chemical work done by him and the assistant chemists, Messrs. Bailey and Andrew, and Miss Barber.

One article has been published by Dr. Winton in a scientific journal containing the results of research.

Dr. Winton also has in the press a volume of 700 pages, with the title "The Microscopy of Vegetable Foods." This work, the result of years of research, will be, we believe, the standard authority on the subject and indispensable to all who are engaged in the examination of human food products.

Under the provisions of the statute regulating the use of Babcock apparatus the station has tested one hundred and seventy pieces of graduated glassware and marked them as prescribed by law.

Four hundred and seventy-three samples of field and garden seeds have been tested with reference to their vitality, at the request of seedsmen and others. This has been done wholly by Mr. Churchill.

The study of the vegetable proteids, chiefly with reference to their decomposition products, has been continued by Dr. Osborne and Mr. Harris, who have been assisted, under a grant from the Carnegie Institution, by S. H. Clapp, B. A., Dr. R. D. Gilbert and Mr. A. C. Gilbert. The results of this year's work, so far as ready, have been printed in four papers which appeared in the American Journal of Physiology.

Dr. Britton, the entomologist, with his assistants, has experimented with various spraying mixtures for the San José scale, having about six thousand trees under test. Special studies have been made of the insects attacking tobacco, of shade tree insects and of those concerned in pollinating the flowers of fruit trees.

As state entomologist, Dr. Britton has made forty-one nursery and fifty-seven orchard inspections.

Four articles have been published in scientific journals containing results of research by Dr. Britton and Mr. Viereck.

Dr. Clinton, botanist of the station, has made further critical studies of the peach scab fungus, the potato blight fungus, and the mildew of lima beans, of which the oospores have been discovered for the first time.

Collections and notes on little known or hitherto unreported diseases of plants of the state have been made.

Other work now in progress is a list of species collected by Dr. Clinton in Porto Rico in 1904, a report on the downy mildews of this state for the geological and natural history survey, and an extension of his monograph on the North American Ustilagineæ for the Flora of North America, prepared by the New York Botanical Garden.

The forester, Mr. Hawes, has practically finished the planting of the Lockwood field of fifty-five acres.

There has been bought from the Lockwood fund an additional tract of forty-five acres adjoining the Lockwood field and called the Clark field. About ten acres of this field have been planted with chestnut and eight acres with pine. These two fields, the property of the station, are used for experimental forestry work.

About one hundred acres have been added to the state's forest in Portland, making its total area one thousand acres, and improvement cutting has been done on about eighty acres of this tract. A tract of about two hundred and fifty acres has been bought for the state forest in the town of Union. This is in large part not wooded at present, but well suited to the growth of white pine which it is proposed to plant there.

Mr. Hawes with two assistants has also made a study of chestnut growth in woodlots and has established some experimental areas in woodland for future study of forest growth. He has also advised and made working plans for a number of persons who desired to improve their woodland or to plant forest trees, and has answered all calls to address farmers on the improvement of farm woodlots.

The station, in coöperation with the Bureau of Plant Industry of the U. S. Department of Agriculture, has made a study of the improvement of the Sumatra, Havana and Broadleaf varieties of tobacco, by selection of seed and of plants for seeding and also by hybridizing. This work has been done at Granby, East Hartford and Poquonock, with assistance from growers in other places.

The experiments in fertilizing peach orchards and in growing alfalfa have been continued.

A canvass of the state was made last winter to find varieties of flint corn which seemed most promising for breeding, and during the summer seven such varieties have been tested together on the farm of Mr. G. A. Hopson, of Wallingford.

The report for the year 1904 is a volume of 482 pages, with 38 plates.

Five bulletins have been issued during the year aggregating 95 pages, with 25 plates and figures. There has also been issued a four page circular—Forestry for Farmers of Connecticut: An Offer of Assistance.

These have been distributed in editions of 12,000.

The number of letters and manuscript reports sent during the year by members of the staff has exceeded 5,400.

Members of the staff have also attended and made addresses at nineteen meetings of farmers within the state.

This board has held three meetings as follows: The annual meeting at Hartford, January 17th, and the regular spring and fall meetings at the Station on May 11th, and October 31st, respectively.

The executive committee has held two formal meetings besides informal conferences.

The treasurer's accounts for the state financial year have been duly examined by the state auditors and found correct.

All of which is respectfully submitted.

(Signed) WILLIAM H. BREWER, *Secretary.*

NEW HAVEN, CONN., November 1, 1905.

REPORT OF THE TREASURER.

E. H. JENKINS, in account with the Connecticut Agricultural Experiment Station for the fiscal year ending September 30, 1905.

RECEIPTS.

Balance on hand, October 1, 1904:		
Analysis Fees	$809.99	
Insect Pest Fund	450.00	
		$1,259.99
State Appropriation, Agriculture	$10,000.00	
State Appropriation, Foods	2,500.00	
State Appropriation, Insect Pests	3,000.00	
United States Treasurer	7,500.00	
Analysis Fees	5,544.18	
Miscellaneous Receipts	90.11	
From the Lockwood Estate	7,949.30	
		36,583.59
		$37,843.58

DISBURSEMENTS.

E. H. Jenkins, Salary	$2,800.00
W. H. Brewer "	100.00
V. E. Cole, "	800.00
L. M. Brautlecht, "	600.00
A. L. Winton, "	2,000.00
T. B. Osborne, "	1,800.00
I. F. Harris, "	1,000.00
E. Monroe Bailey, "	1,200.00
Kate Barber, "	611.52
I. A. Andrew, "	466.67
J. L. Kreider, "	50.00
W. E. Britton, "	1,500.00
G. P. Clinton, "	2,000.00
Austin F. Hawes, "	1,400.00
E. M. East, "	141.66
J. B. Olcott, "	800.00
H. Lange, "	800.00
Wm. Veitch, "	600.00
V. L. Churchill, "	660.00
Labor	1,522.15
Publications	959.38

Postage	$ 308.10	
Stationery	130.95	
Telephone and Telegraph	91.06	
Freight and Express	108.78	
Gas and Kerosene	262.90	
Coal	1,307.50	
Water	117.28	
Chemicals and Laboratory Supplies	1,303.66	
Agricultural and Horticultural Supplies	118.12	
Miscellaneous Supplies	214.88	
Fertilizers	271.93	
Feeding Stuffs	111.78	
Library and Periodicals	412.20	
Tools and Machinery	39.48	
Furniture and Fixtures	12.81	
Scientific Apparatus	221.44	
Traveling by the Board	195.32	
Traveling by the Staff	738.34	
Tobacco Experiment	1,385.62	
Fertilizer Sampling	164.44	
Food Sampling	314.40	
Insect Pest Appropriation to State Entomologist	3,000.00	
Contingent	130.45	
Forestry and Lockwood Expenses	1,801.55	
New Buildings	2,128.00	
Betterments	167.26	
Repairs	453.31	
		$37,322.94
Analysis Fees on hand, Sept. 30, 1905	$ 70.64	
Insect Pest Funds on hand, Sept. 30, 1905	450.00	
		520.64
		$37,843.58

NEW HAVEN, CONN., October 13, 1905.

THIS IS TO CERTIFY that we have examined the accounts of E. H. Jenkins, Treasurer of the Connecticut Agricultural Experiment Station, for the year ending September 30, 1905, compared said accounts with the vouchers therefor and found them correct.

JAMES P. BREE,
WILLIAM P. BAILEY,
Auditors of Public Accounts.

PART I.

Report on Commercial Fertilizers, 1905.

By E. H. JENKINS, *Director*, and A. L. WINTON, *Chemist in charge of the Analytical Laboratory.*

This station is required by statute to analyze yearly at least one sample of every commercial fertilizer which is offered for sale in the state. "Stable manure and the products of local manufacturers of less value than ten dollars per ton," are excepted.

The station is also required to publish these analyses yearly.

DUTIES OF MANUFACTURERS AND DEALERS.

The General Statutes, sections 4581 to 4590, inclusive, make the following requirements regarding commercial fertilizers:

1. The seller is responsible for affixing to every package sold, a label which shall correctly give the number of pounds in the package, name of the fertilizer, name and address of manufacturer, place of manufacture and a statement of composition, expressed in a way approved by this station.

2. He is also responsible for the payment to the station director, on or before May first, annually, of an analysis fee on every brand sold by him.

3. Before any brand of fertilizer is sold in the state, the agent or seller must file with the director of this station two certified copies of the statement named in 1, and a sealed glass jar containing not less than one pound of the fertilizer with an affidavit that it is a fair average sample.

The agent or seller is, however, free from the three obligations just stated if the manufacturer or importer fulfils them instead.

4. In any case the agent or seller must annually report to the director of this station his name, residence, address and the names of the fertilizers which he sells, with the names and addresses of the manufacturers or importers.

Copies of the statutes regarding fertilizers will be sent on application.

The statement of composition referred to in the statute must conform to the following requirements, which are approved by this station:—

A statement of the percentages 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 percentage of *nitrogen* must be stated. Ammonia may also be given when actually present in ammonia salts, and "ammonia equivalent of nitrogen" may likewise be stated.

The percentages of water-soluble and citrate-soluble phosphoric acid may be given separately or together, and the term "available" may be used in addition to, but not instead of, water-soluble and citrate-soluble.

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

In case of bone, fish, tankage, dried meat, dried blood, etc., the statement of chemical composition may take account of the two ingredients, nitrogen and phosphoric acid.

For potash salts the percentage of potash (potassium oxide) should always be given: that of sulphate of potash or muriate of potash may also be stated.

The analysis fee for any brand will usually be ten, twenty or thirty dollars, according as one, two, or all three of the ingredients—nitrogen, phosphoric acid and potash—are contained or claimed to exist in the fertilizer.

OBSERVANCE OF THE FERTILIZER LAW.

During 1905 thirty-four individuals or firms have entered for sale in this state two hundred and seventy-five brands of fertilizers, viz:

Special manures for particular crops	122
Other nitrogenous superphosphates	93
Bone manures and "bone and potash"	28
Fish, tankage, castor pomace and chemicals	32
Total	275

Here follows a list of 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 thus paid for the year ending May 1st, 1906:

Firm.	*Brand of Fertilizer.*
American Agricultural Chemical Co., The, 26 Broadway, N. Y. City.	Bradley's Complete Manure for Potatoes and Vegetables,
	Superphosphate,
	Potato Manure,
	Fertilizer,
	Corn Phosphate,
	Farmers New Method Fertilizer,
	Eclipse Phosphate,
	Complete Manure for Top Dressing Grass and Grain,
	Niagara Phosphate,
	Church's Fish and Potash,
	Crocker's Potato, Hop and Tobacco Fertilizer,
	Ammoniated Corn Phosphate,
	New Rival Fertilizer,
	Darling's Farm Favorite,
	Potato Manure,
	Dissolved Bone and Potash,
	Tobacco Grower,
	Blood, Bone and Potash,
	General Fertilizer,
	East India Potato Manure,
	A. A. Ammoniated Superphosphate,
	Great Eastern Northern Corn Special,
	H. G. Vegetable, Vine and Tobacco Fertilizer,
	General,
	Packers' Union Gardeners' Complete Manure,
	Animal Corn Fertilizer,
	Potato Manure,
	Universal Fertilizer,
	Quinnipiac Market Garden Manure,
	Phosphate,
	Potato Manure,
	Phosphate,
	Corn Manure,
	Climax Phosphate,
	Read's Practical Potato Special,
	Standard Superphosphate,
	Vegetable and Vine Fertilizer,
	Wheeler's Corn Fertilizer,
	Potato Manure,
	Havana Tobacco Grower,
	Bermuda Onion Grower,
	Williams & Clark's Americus H. G. Special Fertilizer,
	Ammoniated Bone Superphosphate,
	Potato Phosphate,
	Americus Potato Manure,
	Americus Corn Phosphate.

Firm.	*Brand of Fertilizer.*
American Agricultural Chemical Co., The,—*Continued.*	A. A. C. Co.'s H. G. Tobacco Manure. Complete Manure with 10% Potash, Grass and Lawn Top Dressing, Castor Pomace, Tobacco Starter and Grower, Dry Ground Fish, Fine Ground Bone, Nitrate of Soda, Muriate of Potash, Complete Tobacco Manure, Southport XX Special, Grass and Oats Fertilizer. Acid Phosphate, H. G. Fertilizers with 10% Potash.
Armour Fertilizer Works, The, Baltimore, Md.	Grain Grower, High Grade Potato, All Soluble, Bone, Blood and Potash, Ammoniated Bone with Potash, Bone Meal, Complete Potato, Corn King, Market Garden.
Berkshire Fertilizer Co., Bridgeport, Conn.	Berkshire Complete Fertilizer, Potato and Vegetable Phosphate, Ammoniated Bone Phosphate, Fine Ground Bone.
Boardman, F. E., Route 1, Middletown, Conn.	Boardman's Complete Fertilizer for Potatoes and General Crops.
Bohl, Valentine, Waterbury, Conn.	Self-Recommending Fertilizer, Complete Market Garden Fertilizer.
Bowker Fertilizer Co., 81 New Street, New York City.	Stockbridge Special Corn Manure, Tobacco Manure, Potato and Vegetable Manure, Grass Top Dressing, Potato and Vegetable Fertilizer, Phosphate, Hill and Drill Phosphate, Farm and Garden Phosphate, or Ammoniated Bone, Fisherman's Brand Fish and Potash, Tobacco Starter, Ash Elements, Carbonates, Sure Crop Phosphate, Market Garden Fertilizer, Corn Phosphate,

Firm.	*Brand of Fertilizer.*
Bowker Fertilizer Co.,—*Continued.*	Early Potato Manure, Fine Ground Dry Fish, Fairfield Onion Fertilizer, Nitrate of Soda, Muriate of Potash, Fine Ground Bone, Complete Alkaline Tobacco Grower, Canada Hard Wood Ashes, Acid Phosphate, Square Brand Bone and Potash. Castor Pomace, Gloucester Fish and Potash, Middlesex Special, Potash Bone.
Buffalo Fertilizer Co., The, Station A., Buffalo, N. Y.	Fish Guano, Farmer's Choice, Ideal Wheat and Corn, Vegetable and Potato, Garden Truck, High Grade Manure, Bone Meal.
Clark, The Everett B. Co., Milford, Conn.	E. B. C. Special Mixture for General Use.
Coe, E. Frank, Co., 133-137 Front St., N. Y. City.	E. Frank Coe's H. G. Ammoniated Bone Superphosphate, Gold Brand Excelsior Guano, Red Brand Excelsior Guano. L. I. Market Garden Special, Columbian Corn Fertilizer, Columbian Potato Fertilizer, Celebrated Special Potato, [FP] Fish and Potash, XXX Pure Ground Bone, Tobacco and Onion Fertilizer, New Englander Corn Fertilizer, New Englander Potato Fertilizer, New Englander XXV Ammoniated Bone.
Connecticut Fat Rendering & Fertilizer Corporation, New Haven, Conn.	Tankage.
Connecticut Valley Orchard Co., The, Berlin, Conn.	C. V. O. Co.'s High Grade Special.
Cooper's Glue Factory, Peter, 13 Burling-Slip, N. Y. City.	Pure Bone Dust.

Firm.	Brand of Fertilizer.
Dennis, George L., Stafford Springs, Conn.	Ground Bone.
Eldredge, T. H., 97 Water St., Norwich, Conn.	Eldredge's Special Fish and Potash Fertilizer, Superphosphate.
Frisbie, L. T. Co., The, Hartford, Conn.	Frisbie's Bone Meal.
James, Ernest L., Warrenville, Conn.	James' Bone Phosphate, Ground Bone.
Joynt, John, Lucknow, Ontario.	Canada Hard Wood Ashes.
Kelsey, E. R., Short Beach, Conn.	Bone, Fish and Potash.
Listers Agricultural Chemical Works, Newark, N. J.	Listers "Success" Fertilizer, "Celebrated" Ground Bone, Standard Potato Manure, Special Corn and Potato, 10% Potato, Standard Pure Bone Superphosphate of Lime.
MacCormack, William, Wolcott, Conn.	Mad River Strictly Pure Ground Bone.
Mapes, F. & P. G. Co., The, 143 Liberty St., N. Y. City.	Potato Manure, Tobacco Starter, Improved, Manure, Wrapper Brand, Fruit and Vine Manure, Economical Potato Manure, Vegetable Manure, or Complete Manure for Light Soils, Average Soil Complete Manure, Tobacco Ash Constituents, Corn Manure, Top Dresser, Improved, Full Strength, Half " Complete Manure "A" Brand, Dissolved Bone, Cereal Brand, Seeding Down Manure.
National Fertilizer Co., Bridgeport, Conn.	Chittenden's Complete Fertilizer, Market Garden Fertilizer, Potato Phosphate, Ammoniated Bone Phosphate, Ground Bone, Universal Phosphate, Fish and Potash, H. G. Special Tobacco Fertilizer, Complete Tobacco Fertilizer, Plain Superphosphate, XXX Fish and Potash, Formula A.,

Firm.	Brand of Fertilizer.
National Fertilizer Co.,—*Continued.*	Chittenden's Soluble Bone and Potash, Special Potato Fertilizer, Dry Ground Fish, Special Tobacco with Carbonate of Potash.
New England Fertilizer Co., The, 43 North Market St., Boston, Mass.	New England Corn and Grain Fertilizer, Perfect Tobacco Grower, Potato Fertilizer, Superphosphate, High Grade Potato Fertilizer, Ground Bone, Corn Phosphate.
Ohio Farmers Fertilizer Co., Columbus, Ohio.	General Crop Fish Guano, Ammoniated Bone and Potash, Potato and Tobacco Special.
Olds & Whipple, Hartford, Conn.	O. & W's. Complete Tobacco Fertilizer, Special Phosphate, Potato Fertilizer, " High Grade, Vegetable Potash, Home Mixture for Corn and Potatoes, Home Mixture for Grass.
Rogers & Hubbard Co., The, Middletown, Conn.	Hubbard's Fertilizer for Oats and Top Dressing, Grass and Grain Fertilizer, Soluble Corn and General Crops Manure, Soluble Potato Manure, Tobacco " All Soils and All Crops Phosphate, Corn Phosphate, Potato " Pure Raw Knuckle Bone Flour, Strictly Pure Fine Bone, Market Garden Phosphate.
Rogers Manufacturing Co., The, Rockfall, Conn.	Complete Potato and Vegetable, High Grade Corn and Onion Fertilizer, Fish and Potash Fertilizer, High Grade Soluble Tobacco, Oats and Top Dressing, Grass and Grain Fertilizer, Soluble Tobacco and Potato, Tobacco Starter, Pure Ground Bone, Knuckle Bone Flour, All Round Fertilizer.
Russia Cement Co., Gloucester, Mass.	Essex XXX Fish and Potash, Corn Fertilizer,

Firm.	*Brand of Fertilizer.*
Russia Cement Co.,—*Continued.*	Essex Market Garden and Potato Manure, A 1 Superphosphate, Complete Manure for Corn, Grain and Grass, Complete Manure for Potatoes, Roots and Vegetables, Tobacco Starter, Special Tobacco Manure, Fine Bone Meal, Dry Ground Fish, Grass and Top Dressing Fertilizer.
Sanderson Fertilizer & Chemical Co., New Haven, Conn.	Sanderson's Formula A., Potato Manure, Superphosphate for Corn and Grain, Special with 10% Potash, Formula B. for Tobacco, Fine Ground Fish, Fine Ground Bone, Top Dressing, Superphosphate with Potash, Atlantic Coast Bone, Fish and Potash, Muriate of Potash, Nitrate of Soda, Double Manure Salt.
Shay, C. M., Fertilizer Co., The, Groton, Conn.	Shay's Potato Manure, Corn Manure, Pure Ground Bone, Grass Fertilizer.
Shoemaker, M. L. & Co., Philadelphia, Pa.	Swift-Sure Bone Meal, Superphosphate for General Use, Superphosphate for Potatoes, Guano for Truck and Onions.
Swift's Lowell Fertilizer Co., 44 No. Market St., Boston.	Swift's Lowell Bone Fertilizer, Potato Phosphate, Dissolved Bone and Potash, Animal Brand, Market Garden Manure, Potato Manure, Empress Brand, Perfect Tobacco Grower, Ground Bone, Lawn Dressing, Superior Fertilizer, Special Grass Mixture, Acid Phosphate, Nitrate of Soda, Muriate of Potash, Tankage.

Firm.	*Brand of Fertilizer.*
Wilcox Fertilizer Works, The, Mystic, Conn.	Wilcox's Potato, Onion and Vegetable Manure, Potato Fertilizer, Complete Bone Superphosphate, Special Superphosphate, High Grade Fish and Potash, Fish and Potash, Grass Fertilizer, Nitrate of Soda, Dry Ground Fish, Pure Ground Bone, Acid Phosphate, Muriate of Potash.
Woodruff, S. D. & Sons, Orange, Conn.	Woodruff's Home Mixture.

The analyses which follow are chiefly useful as a guide in making purchases for the next year. Most of them are of brands which are offered year after year in Connecticut and the analyses serve to show whether these brands are maintaining their original quality.

The larger part of the year's supply of fertilizers is shipped into the state just before planting time, much of it after river navigation is opened. Many brands are not in market till the middle of April. Obviously these trade conditions make it absolutely impossible for the station to sample and analyze the two hundred and seventy-five brands of fertilizers sold in Connecticut and tabulate and publish the results in time to show the composition of all of them before they are bought and applied.

When new brands are offered, the station endeavors to analyze such brands at once and to distribute the report of the results as quickly and widely as possible. Farmers can aid greatly by calling the attention of the station promptly to new kinds of fertilizers which are offered for sale.

SAMPLING AND COLLECTION OF FERTILIZERS.

During April, May and June, Mr. V. L. Churchill, the sampling agent of this station, visited eighty-eight towns and villages in Connecticut to draw samples of commercial fertilizers for analysis. These places were distributed as follows:

Litchfield County	5
Hartford County	23
Tolland County	7
Windham County	8
New London County	12
Middlesex County	12
New Haven County	13
Fairfield County	8
	88

In these places six hundred and one samples were taken, representing all but four of the brands which have been entered for sale in this state.

The sampling agent could not find on sale Acid Phosphate, Nitrate of Soda and Muriate of Potash, sold by the Swift's Lowell Fertilizer Co., nor Ground Bone, sold by the National Fertilizer Co., and no samples of them were deposited by the manufacturers at the station. It was, therefore, impossible to make analyses of them.

With these exceptions an analysis has been made of every brand of fertilizer which has been entered at the station for sale in Connecticut.

When several samples of a single brand are drawn in different parts of the state, the analysis is usually performed, not on any single sample, but on a mixture made of equal weights of all of the several samples. Thus, it is believed, the average composition of the goods is more fairly represented than by the analysis of single samples.

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 diagonally through the entire length of the bag or barrel.

As a rule, the station will not analyze samples taken from dealer's stock of less than one ton, from stock which has lain over from last season, or from stock which 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 the Station's Instructions for Sampling, and must also be properly certified.* A copy of these instructions and blank certificates will be sent on application.

ANALYSES OF FERTILIZERS.

During the year 600 samples of commercial fertilizers and manurial waste-products have been analyzed. A classified list of them is given below and the results of their examination are given in detail in the following pages.

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.

CLASSIFICATION OF THE FERTILIZERS ANALYZED.

	No. of Samples.
1. *Containing Nitrogen as the chief valuable ingredient.*	
Nitrate of soda	9
Dried blood	2
Cotton seed meal	157
Castor pomace	4
Flax seed meal	1
2. *Containing Phosphoric Acid as the chief valuable ingredient.*	
Dissolved rock phosphate	5
Charred bone	1
3. *Containing Potash as the chief valuable ingredient.*	
Carbonate of potash	10
High grade sulphate of potash	4
Double sulphate of potash and magnesia	7
Muriate of potash	11
Kainit	1
Saltpeter waste	3
4. *Containing Nitrogen and Phosphoric Acid.*	
Bone manures	32
Slaughter-house tankage	13
Dry ground fish	12
5. *Mixed Fertilizers.*	
Superphosphates with potash salts	2
Nitrogenous superphosphates	113
Special manures	148
Home mixed fertilizers	11

6. *Miscellaneous Fertilizers and Manures.*

Vegetable potash	2
Cotton hull ashes	19
Wood ashes	21
Lime kiln ashes	2
Garbage ashes	1
Lime	2
South American guano	1
Sweepings from a fertilizer factory	1
Dust from wheat	1
Pulverized sheep manure	1
Rotted cotton seed compost	1
Dust from tobacco	1
Woolen carpet waste	1
Total number analyzed	600

DESCRIPTIONS AND ANALYSES OF FERTILIZERS.*

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

The analyses were made by the methods adopted by the Association of Official Agricultural Chemists and the results are always expressed in percentages, or parts per hundred by weight, of the material examined.

In order to avoid confusion, each sample, as it is received, is given a consecutive number, by which it is distinguished in the laboratory. As the numbers had become so large as to be somewhat unwieldy, the numbering was begun again at unity in 1900.

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. As offered in the Connecticut market it contains about 15.70 per cent. of nitrogen, equivalent to 95.3 per cent. of pure sodium nitrate.

Shipments differ somewhat in composition. The lowest percentage of nitrogen found in any sample this year is 15.36, equivalent to 93.25 per cent. of sodium nitrate.

* The analyses of fertilizers included in this chapter have been made by the chemists of the station, Messrs. Winton, Bailey, Andrew, and Miss Barber, with the help of Mr. Lange. The results have been tabulated and discussed by the director.

Nine samples from the Connecticut market have been analyzed, as follows:—

14120. Sampled and sent from Connecticut School for Boys, Meriden.

14119. Sold by American Agricultural Chemical Co., New York. Sampled from stock of J. G. Schwink, Meriden.

14380. Sampled from stock of the Wilcox Fertilizer Works, Mystic.

14144. Sold by Bowker Fertilizer Co., New York. Sampled from stock of E. E. Burwell, New Haven.

14179. Sampled from stock of S. D. Woodruff & Sons, Orange.

14151. Sold by American Agricultural Chemical Co., N. Y. Sampled from stock of Spencer Brothers, Suffield.

14160. Sampled from stock of Sanderson Fertilizer and Chemical Co., New Haven.

14118. Sold by Bowker Fertilizer Co., New York. Sampled from Bowker's Branch, Hartford.

13963. Sold by Bowker Fertilizer Co., New York. Sampled from stock of Andrew Ure, Highwood.

ANALYSES OF NITRATE OF SODA.

Station No.	14120	14119	14380	14144	14179	14151	14160	14118	13963
Percentage amounts of									
Nitrogen found	15.38	15.90	15.72	15.46	15.76	15.76	15.78	15.72	15.36
Nitrogen guaranteed	15.6	15.0	15.0	----	15.0	15.8	15.0	15.0	15.63
Cost per ton	$49.75*	52.00	52.00	52.00	53.00	54.00	55.00	55.00	----
Nitrogen costs cents per pound	16.2	16.4	16.5	16.8	16.8	17.1	17.4	17.5	----

All the samples are of good quality, the percentage of nitrogen in them ranging from 15.36 to 15.90, with an average of 15.65 per cent.

The retail cost of nitrogen in them ranged from 16.4 to 17.5 cents per pound, the average being 16.9.

We believe that some farmers have undue prejudice against nitrate of soda because its nitrogen is in a form soluble in water and not held by the soil when leached with water. Nitrates will certainly wash down, and so out of sandy, leachy soils when heavy rains fall on them.

* Car lots.

The nitrates are also likely to decompose and the nitrogen to escape if they are applied along with much fresh stable manure. On the other hand, the nitrogen of nitrates acts more quickly than any other form and our experience has shown us the advantage of its use in many instances. Peach orchards in which the trees are past their best performance have been greatly benefited by a dressing of 350 pounds of nitrate per acre in the spring, before plowing. The trees made a vigorous growth of new wood the first season and a largely increased yield of fruit the year after.

Rye which has been partly winter-killed may be greatly benefited by a moderate amount of nitrate in the spring, 200 pounds or more per acre, where a dressing with nitrogen in organic forms would be of little use because the soil is too cold at that time to favor the proper decomposition of the fertilizer.

One of our growers of nursery stock, after years of experience, prefers nitrates to organic forms of nitrogen in his business.

On grass land nitrate is often said to be "flashy" and to affect only the first crop. A single observation carried on for ten years showed a decidedly better turf where nitrate was used annually than where sulphate of ammonia or cotton seed meal was applied in equivalent amount during the same time. The plots being on a pasture, no calculations could be made as to the profit or loss from the several applications.

DRIED BLOOD.

This is blood collected in slaughter houses, and dried by steam or hot air. It sometimes contains wool or hair in small amount and occasionally bone. It is, therefore, not at all uniform in composition, and for that reason the price varies with the actual composition. It is usually sold by the "unit of ammonia." A "unit" is one per cent., or 20 pounds *of ammonia;* but a "unit" of ammonia is about 16.5 pounds *of nitrogen.* Thus, if blood is quoted at $2.64 per unit of ammonia, the price of a pound of nitrogen will be $\frac{264}{16.5}$ or 16 cents.

14145. Sold by Swift's Lowell Fertilizer Co., Boston. Sampled from stock of E. E. Burwell, New Haven.

13965. Sold by Bowker Fertilizer Co., N. Y. Sampled from stock of Andrew Ure, Highwood.

ANALYSES OF DRIED BLOOD.

Station No.	14145	13965
Percentage amounts of		
Nitrogen found	9.58	10.07
Nitrogen guaranteed	9.9	9.75
Cost per ton	$42.00	....
Nitrogen costs cents per pound	**21.9**	....

There would seem to be no economy in paying 22 cents per pound for nitrogen in dried blood when it can be bought in form of nitrate and of cotton seed meal for 17 cents per pound.

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 larger part of the hulls. The hulled seed is ground and the oil expressed. The ground cake from the presses is used as a cattle feed and fertilizer. Formerly the hulls were burned for fuel in the oil factories and the resulting ashes, which contained from 20 to 30 per cent. of potash, were used in this state as a tobacco fertilizer.

The hulls have, however, come into extensive use as a cattle feed at the South, and now sell for this purpose at prices which often forbid their use as a fuel.

According to the rules of the Interstate Cotton Seed Crushers' Association, which, as far as they concern chemical composition, are the same as those of the New York Produce Exchange, if a bargain is made for "choice" cotton seed meal, the seller must deliver meal containing at least 8 per cent. of ammonia, which is equivalent to 6.59 per cent. of nitrogen, or 41.19 per cent. of protein.

If a bargain is made for "prime" cotton seed *from Texas or the Mississippi Valley,* the delivered meal must contain at least the percentages named above. But if "Texas or the Mississippi Valley" is not specified in the order, the buyer may have to content himself with 7½ per cent. of ammonia, equal to 6.18 per cent. nitrogen or 38.62 per cent. protein; which is very low grade.

In the table, pages 25 to 31, are analyses of 157 samples of cotton seed meal from stock bought chiefly, if not wholly, for use as a fertilizer.

The amount of cotton seed meal represented by all these samples is not known, but a part of them represent 1,820 tons, and the total amount is certainly considerably larger.

These figures show that in the small section of Hartford County, from which most of these samples came, more than $50.000 was spent this year for cotton seed meal as a fertilizer.

It has been usual for dealers to guarantee 7.0 per cent. of nitrogen, but during the present year only about one-third of the samples have contained that amount. This has given rise to many complaints and claims for rebates on bills for meal delivered.

The percentage of nitrogen has varied with the month of delivery. Thus

6 lots,	delivered in	Dec., 1904,	averaged	6.95	per cent.	of nitrogen.
28 "	"	Jan., 1905,	"	7.19	"	"
22 "	"	Feb.,	"	7.02	"	"
34 "	"	March,	"	6.84	"	"
51 "	"	April,	"	6.83	"	"
12 "	"	May,	"	6.77	"	"

The average percentages of phosphoric acid and potash in cotton seed meal are 3.15 and 1.90 respectively, which are valued together at $4.42 per ton. To determine the cost of nitrogen, the above figure is subtracted from the ton price and the remainder after multiplying by 100 to reduce it to cents is divided by the number of pounds of nitrogen in a ton of meal.

Thus if a sample of meal contains 6.94 per cent. of nitrogen (which is equivalent to 138.8 pounds in the ton) and costs $27.50 per ton, 27.50 — 4.42 = 23.08. And 2,308 divided by 138.8 = 16.6, which is the cost of nitrogen per pound in cents.

The percentage of nitrogen ranges from 7.93 to 5.60, the latter amount being found in a sample containing an undue amount of hulls. The average percentage of nitrogen is 6.93, being 0.2 per cent. lower than last year.

The cost of nitrogen ranges from 14.2 to 20.6 cents per pound, the average cost being 16.36 cents, a shade less than in 1904.

Nineteen samples, 12 per cent. of the whole number, are not "choice" meal.

Analyses of Cotton Seed Meal.

Station No.	Dealer.	Purchased, Sampled or Sent by	Per cent. of Nitrogen.	Cost per ton.	Nitrogen costs cents per pound.
13925	Olds & Whipple, Hartford	P. D. Kibbe, Hartford	7.93	$27.00	14.2
13799	" " "	P. P. Hickey, Burnside	7.84	27.00	14.4
13816	" " "	W. H. Brewer, Silver Lane	7.72	27.00	14.6
13815	" " "	P. S. Brewer, "	7.73	27.00	14.6
13842	" " "	F. M. Hills, "	7.75	27.00	14.6
14176	L. O. Pomeroy, Suffield (Nat'l Fertilizer Co., Bridgeport)	Station agent	7.70	27.00	14.7
13850	Arthur Sikes, Suffield	W. C. Smith, Suffield, and others	7.64	27.25	14.9
14163	H. K. Brainard, Thompsonville (J. E. Soper & Co.)	G. A. Douglass, Thompsonville	7.18	25.90	15.0
13905	Arthur Sikes, Suffield	D. F. Brown and H. W. Alford, Windsor	7.88	28.00	15.0
13843	" " "	C. A. Prout, Suffield, and others	7.58	27.25	15.1
14212	" " "	H. V. Griffin, East Granby	7.66	27.50	15.1
13849	" " "	F. O. Newton, Suffield, and others	7.80	28.00	15.1
14337	H. K. Brainard, Thompsonville	Wm. C. Vietts, Suffield	7.07	25.90	15.2
13933	Arthur Sikes, Suffield	C. P. Viets, East Granby	7.24	26.50	15.2
14058	" " "	Jacob Lang, R. F. D., Windsor	7.77	28.00	15.2
13931	" " "	A. H. Brown, Windsor, and others	7.78	28.00	15.2
13922	" " "	A. N. Graves, Springfield, Mass.	7.20	26.50	15.3
13814	" " "	J. T. Hill, Suffield, and others	7.72	28.00	15.3
13845	" " "	H. Adams, " "	7.73	28.00	15.3
14167	W. F. Fletcher, Southwick, Mass. (T. H. Bunch, Old Gold Brand)	L. C. Spring, Granby	7.08	26.25	15.4
14019	Spencer Bros., Suffield (Chapin & Co.)	S. R. Spencer, Suffield	7.17	26.50	15.4
13841	Arthur Sikes, Suffield	W. H. Prout, Suffield, and others	7.64	28.00	15.4
13844	" "	A. C. Ludden, " "	7.65	28.00	15.4
13946	F. M. Thompson, Warehouse Point	W. H. Daly, Warehouse Point	6.80	25.50	15.5

Analyses of Cotton Seed Meal.—*Continued.*

Station No.	Dealer.	Purchased, Sampled or Sent by	Per cent. of Nitrogen.	Cost per ton.	Nitrogen costs cents per pound.
14139	W. F. Fletcher, Southwick, Mass. (T. H. Bunch, Old Gold Brand)	L. R. Griffin, Granby	7.04	$26.25	15.5
14169	Spencer Bros., Suffield (J. E. Soper & Co.)	Station agent (stock of R. Greer)	7.10	26.50	15.5
13902	Arthur Sikes, "	Bissell, Graves Co., Suffield	7.14	26.50	15.5
14383	Newell St. John, Simsbury (Humphreys, Godwin & Co., Dixie Brand)	Station agent	7.30	27.00	15.5
13848	Arthur Sikes, Suffield, dark	Chas. H. Wells, Suffield	7.38	27.25	15.5
14450	Olds & Whipple, Hartford, dark	E. P. Brewer, Silver Lane	6.76	25.50	15.6
14165	W. F. Fletcher, Southwick, Mass. (T. H. Bunch, Old Gold Brand)	R. W. Griffin, Granby	6.98	26.25	15.6
14045	Spencer Bros., Suffield (J. E. Soper & Co.)	B. L. Root, Suffield	6.98	26.25	15.6
14244	H. K. Brainard, Thompsonville	Seth Alden, Thompsonville	7.18	26.75	15.6
14262	Arthur Sikes, Suffield	H. V. Griffin, East Granby	7.41	27.50	15.6
14140	W. F. Fletcher, Southwick, Mass. (T. H. Bunch, Old Gold Brand)	L. R. Griffin, Granby	6.96	26.25	15.7
13450	Arthur Sikes, Suffield	Bissell, Graves Co., Suffield	7.02	26.50	15.7
13452	" " "	" " "	7.03	26.50	15.7
13911	" " "	A. N. Graves, Springfield, Mass.	7.04	26.50	15.7
14279	" " "	G. A. Harmon, Suffield, and others	7.33	27.50	15.7
14319	" " "	Geo. A. Peckham, " " "	7.35	27.50	15.7
14076	Geo. B. Robinson, New York (Sledge & Wells Co.)	E. N. Austin, "	6.72	25.65	15.8
14168	W. F. Fletcher, Southwick, Mass. (T. H. Bunch, Old Gold Brand)	L. C. Spring, Granby	6.91	26.25	15.8
14046	Spencer Bros., Suffield (J. E. Soper & Co.)	B. L. Root, Suffield	6.91	26.25	15.8
14044	" " " " "	" " "	6.92	26.25	15.8
13449	Arthur Sikes, "	Bissell, Graves Co., Suffield	6.97	26.50	15.8
14056		Samuel Barr, R. F. D., Suffield	7.00	26.50	15.8

Analyses of Cotton Seed Meal.—*Continued.*

Station No.	Dealer.	Purchased, Sampled or Sent by	Per cent. of Nitrogen.	Cost per ton.	Nitrogen costs cents per pound.
13851	Arthur Sikes, Suffield	W. C. Knox, Suffield, and others	6.96	$26.50	15.9
13928	Spencer Bros., Suffield (Chapin & Co.)	F. A. Scott, "	7.10	27.00	15.9
14166	W. F. Fletcher, Southwick, Mass. (T. H. Bunch, Old Gold Brand)	R. W. Griffin, Granby	6.84	26.25	16.0
13451	Arthur Sikes, Suffield	Bissell, Graves Co., Suffield	6.88	26.50	16.0
14023	" " "	E. S. Seymour, Windsor Locks	6.88	26.50	16.0
14423	Broad Brook Lumber and Coal Co., Broad Brook, off color	Dealers	6.88	26.50	16.0
14022	Arthur Sikes, Suffield	E. S. Seymour, Suffield	6.90	26.50	16.0
13453	" " "	J. F. Barnett, West Suffield	6.91	26.50	16.0
13454	" " "	J. E. Hastings, "	6.91	26.50	16.0
13788	" " "	Bissell, Graves Co., Suffield	6.92	26.50	16.0
14334	E. N. Austin, Suffield (American Cotton Oil Co., Jackson, Tenn. Mill)	Station agent	7.03	26.90	16.0
14042	Arthur Sikes, Suffield	Samuel Orr, West Suffield	7.20	27.50	16.0
13896	" " "	F. F. Ford, Suffield, and others	6.85	26.50	16.1
13895	" " "	J. B. Rose, West Suffield, and others	6.87	26.50	16.1
14014	S. D. Viets, Springfield, Mass. (Am'n Cotton Oil Co., Texarkana Mill)	J. A. DuBon, Poquonock	6.87	26.60	16.1
14245	A. Pouleur, Windsor	Chas. A. Huntington, Windsor	6.92	26.75	16.1
14335	E. N. Austin, Suffield (Am'n Cotton Oil Co., Jackson Mill)	Station agent	6.99	26.90	16.1
14041	Arthur Sikes, Suffield	C. K. & H. T. Hale, Gildersleeve	7.00	27.00	16.1
14407	C. K. Hale, Gildersleeve (T. H. Bunch, Old Gold Brand)	Station agent	7.00	27.00	16.1
14073	Spencer Bros., Suffield (Chapin & Co.)	S. R. Spencer, Suffield	7.15	27.50	16.1

Analyses of Cotton Seed Meal.—*Continued.*

Station No.	Dealer.	Purchased, Sampled or Sent by	Per cent. of Nitrogen.	Cost per ton.	Nitrogen costs cents per pound.
14011	Spencer Bros., Suffield	T. H. Hauser, Suffield	7.17	$27.50	16.1
14057	" " " (Chapin & Co., St. Louis)	Chas. T. Remington, R. F. D. 2, Suffield	6.80	26.50	16.2
13969	Arthur Sikes, "	D. I. King, Suffield	6.81	26.50	16.2
14097	Latham & Chittenden, Granby (T. H. Bunch, Old Gold Brand)	Dealers	6.98	27.00	16.2
14174	Spencer Bros., Suffield (Chapin & Co., Green Diamond Brand)	Station agent (stock of Chas. Remington)	6.77	26.50	16.3
13810	Arthur Sikes, Suffield	Bissell, Graves Co., Suffield	6.78	26.50	16.3
13948	" " "	J. F. Brockett, Suffield, and others	6.78	26.50	16.3
13809	" " "	Bissell, Graves Co., Suffield	6.79	26.50	16.3
13789	" " "	" " " "	6.79	26.50	16.3
14015	T. H. Bunch, Little Rock, Ark., Old Gold Brand	Indian Head Plantations, Tariffville	6.91	27.00	16.3
14266	R. L. Forsyth, Granby (Hunter Bros. Milling Co.)	F. St. John, Granby	6.92	27.00	16.3
14246	Arthur Sikes, Suffield (T. H. Bunch, Old Gold Brand)	Station agent (stock of E. S. Hale, Portland)	6.94	27.00	16.3
14074	Spencer Bros., Suffield (Chapin & Co.)	B. L. Root, Suffield	7.06	27.50	16.3
13891	Olds & Whipple, Hartford (Am'n Cotton Oil Co.)	E. P. Brewer, Silver Lane	6.81	26.75	16.4
14000	" " " "	A. E. Holcomb, Windsor	6.88	27.00	16.4
13980	Arthur Sikes, Suffield	Thomas Devine and O. E. Pitcher, Suffield	6.88	27.00	16.4
13811	Spencer Bros., " (Chapin & Co.)	S. R. Spencer, Suffield	7.03	27.50	16.4
13904	" " " " " "	Edmund Halladay, Suffield	7.04	27.50	16.4
13898	" " " " " "	S. R. Spencer, "	7.05	27.50	16.4
13947	Arthur Sikes "	D. P. Johnson, East Granby	6.68	26.50	16.5
14013	" " "	E. S. Seymour, Windsor Locks	6.68	26.50	16.5
14079	W. F. Fletcher, Southwick, Mass.	Edmund Halladay, Suffield	6.78	26.75	16.5

Analyses of Cotton Seed Meal.—*Continued.*

Station No.	Dealer.	Purchased, Sampled or Sent by	Per cent. of Nitrogen.	Cost per ton.	Nitrogen costs cents per pound.
13840	Arthur Sikes, Suffield	D. Laverty, Windsor	6.98	$27.50	16.5
13908	Spencer Bros., " (Chapin & Co.)	Fuller, Haskins & Halladay, Suffield	6.98	27.50	16.5
14171	" " " (J. E. Soper & Co.)	Station agent	6.98	27.50	16.5
13831	" " " (Chapin & Co.)	S. R. Spencer, Suffield	7.00	27.50	16.5
13927	" " " (")	B. L. Root, Suffield	7.00	27.50	16.5
13906	Arthur Sikes "	Carey Bros., and D. D. Marshall, Windsor	7.00	27.50	16.5
13829	Spencer Bros., " (Chapin & Co.)	Clinton Spencer, Suffield	7.01	27.50	16.5
13926	" " " (")	A. A. Brown, "	7.01	27.50	16.5
13923	Arthur Sikes, "	A. N. Graves, Springfield, Mass.	6.65	26.50	16.6
14006	" " "	E. S. Seymour, Suffield	6.66	26.50	16.6
14336	M. E. Thomson, Ellington (C. M. Cox & Co.)	Station agent (stock of E. F. Miller)	6.73	26.75	16.6
14077	Arthur Sikes, Suffield	James T. Cain, Suffield	6.81	27.00	16.6
13897	Spencer Bros., " (Chapin & Co.)	Daniel Barron, "	6.95	27.50	16.6
13971	Arthur Sikes, "	E. C. Holdridge, " and others	6.62	26.50	16.7
14066	" " "	F. B. Hatheway and Geo. Phelps, Suffield	6.76	27.00	16.7
14078	Spencer Bros., Suffield (Am'n. Cotton Oil Co., Texarkana, Ark.)	Oscar J. Hazard, Suffield	6.89	27.50	16.7
14172	Spencer Bros., Suffield (Chapin & Co.)	Station agent (stock of Chas. Pomeroy)	6.90	27.50	16.7
13979	Arthur Sikes, "	John Carson, Enfield, and others	6.91	27.50	16.7
13970	" " "	James Gamble, Thompsonville, and others	6.92	27.50	16.7
14071	Spencer Bros., " (J. E. Soper & Co.)	Dealers	6.92	27.50	16.7
13955	American Cereal Co., Boston (Sledge & Wells Co., Star Brand)	Ackley, Hatch & Marsh, New Milford	7.06	28.00	16.7
14003	Olds & Whipple, Hartford	Clark Bros., Poquonock	6.74	27.00	16.8
14065	Arthur Sikes, Suffield	C. S. Fuller, Suffield, and others	6.85	27.50	16.8
14069	Spencer Bros., " (Chapin & Co.)	Dealers	6.87	27.50	16.8

ANALYSES OF COTTON SEED MEAL.—*Continued.*

Station No.	Dealer.	Purchased, Sampled or Sent by	Per cent. of Nitrogen.	Cost per ton.	Nitrogen costs cents per pound.
13924	Arthur Sikes, Suffield	A. N. Graves, Springfield, Mass.	6.54	$26.50	16.9
14263	S. D. Viets & Co., Springfield, Mass.	Geo. A. Harmon, Suffield	6.64	26.85	16.9
14060	Arthur Sikes, Suffield	James H. Wilson, Poquonock	6.74	27.25	16.9
14020	Spencer Bros., " (J. E. Soper & Co.)	S. R. Spencer, Suffield	6.83	27.50	16.9
14175	" " " (Chapin & Co.)	Station agent (stock of D. E. Cavanaugh)	6.83	27.50	16.9
13907	Arthur Sikes, "	C. H. Wright, Suffield, and others	6.84	27.50	16.9
13981	Arthur Sikes, Suffield	Price G. Jones, Suffield, and others	6.84	27.50	16.9
14018	Spencer Bros., " (Chapin & Co.)	H. S. Pomroy "	6.84	27.50	16.9
14067	Arthur Sikes, "	F. B. Hatheway, " and others	6.77	27.50	17.0
14016	Olds & Whipple, Hartford	T. K. Marcy, Poquonock	6.77	27.50	17.0
14170	Spencer Bros., Suffield (J. E. Soper & Co.)	Station agent	6.77	27.50	17.0
14021	Arthur Sikes, "	James T. Cain, and D. McComb, Suffield	6.78	27.50	17.0
14137		Fred Thrall, Windsor	6.78	27.50	17.0
14063	Arthur Sikes, Suffield	W. E. Ford, Suffield, and others	6.80	27.50	17.0
14138		Fred Thrall, Windsor	6.80	27.50	17.0
14315		Harry P. Lane, Suffield	6.61	27.00	17.1
13954	John S. Wolfe Co., Pittsfield, Mass. (T. H. Bunch, Old Gold Brand)	Ackley, Hatch & Marsh, New Milford	6.90	28.00	17.1
13899	Arthur Sikes, Suffield	Bissell, Graves Co., Suffield	6.42	26.50	17.2
14007	" " "	Herman Weber and W. J. Wilson, Windsor	6.65	27.25	17.2
14070	Spencer Bros., " (Chapin & Co.)	Dealers	6.70	27.50	17.2
14318	Arthur Sikes, "	A. G. Hinckley, Suffield, and others	6.71	27.50	17.2
13790	" " "	Bissell, Graves Co., Suffield	6.40	26.50	17.3
13932	" " "	O. E. Pitcher, "	6.52	27.00	17.3
14317	Spencer Bros., "	Joseph P. Graham, "	6.53	27.00	17.3
13846	Arthur Sikes, "	J. A. Davis, Suffield, and others	6.67	27.50	17.3

ANALYSES OF COTTON SEED MEAL.—*Concluded.*

Station No.	Dealer.	Purchased, Sampled or Sent by	Per cent. of Nitrogen.	Cost per ton.	Nitrogen costs cents per pound.
14072	Spencer Bros., Suffield (Chapin & Co.)	Dealers	6.67	$27.50	17.3
12992	" " " (American Cotton Oil Co., Texarkana, Ark.)	Dealers	6.68	27.50	17.3
14320	Arthur Sikes, Suffield	H. D. Sikes, Suffield, and others	6.64	27.50	17.4
14505	C. A. Arnold, Broad Brook (Am'n. Cotton Oil Co., England, Ark.	F. A. Hamilton, Warehouse Point	6.27	26.50	17.6
13892	Arthur Sikes, Suffield	A. N. Graves, Springfield, Mass.	6.29	26.50	17.6
14012	Charles D. Clark, Granby (Am'n. Cotton Oil Co., England, Ark.)	John B. Cannon, R. F. D., Granby	6.60	27.60	17.6
13972	H. K. Brainard, Thompsonville (T. H. Bunch, Old Gold Brand)	Seth Alden, Thompsonville	6.31	26.75	17.7
14005	C. D. Clark, Granby (Am'n. Cotton Oil Co.)	Alfred H. Griffin, Granby	6.54	27.60	17.7
14004	" " " (" " ")	" " " "	6.50	27.60	17.8
14173	Spencer Bros., Suffield (Chapin & Co.)	Station agent (stock of S. O. Ranney)	6.63	28.00	17.8
14452	W. J. Cox, East Hartford (F. W. Brode & Co., Owl Brand)	W. G. & F. Comstock, East Hartford	6.63	28.00	17.8
14075	S. D. Viets, Springfield, Mass.	Eugene S. Clark, Poquonock	6.18	26.50	17.9
14228		James P. Graham, Suffield	6.31	27.00	17.9
14099	G. M. White & Co., East Hartford	Dealers	6.58	28.00	17.9
14064	Arthur Sikes, Suffield	E. A. Russell, Suffield, and others	6.37	27.50	18.1
13999	J. H. Cressey & Co., Boston (W. A. Kaiser & Co., Memphis, Tenn.)	Ackley, Hatch & Marsh, New Milford	6.51	28.00	18.1
14043	John S. Wolfe Co., Pittsfield, Mass. (Hunter Bros.)	" " " "	6.47	28.00	18.2
14772	W. J. Cox, Hockanum	Willard E. Treat, Silver Lane	6.48	28.00	18.2
14316		C. C. Austin, Suffield	6.18	27.00	18.3
14211	Arthur Sikes, Suffield	Geo. E. Gompf, " and others	5.60	27.50	20.6

CASTOR POMACE.

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

Four samples have been analyzed this year, as follows:—

14557. Sold by the American Agricultural Chemical Co., New York, sampled and sent by Arthur Manning, Hillstown.

14150. Sold by American Agricultural Chemical Co., New York, sampled from stock of F. S. Bidwell & Co., Windsor Locks.

14478. Sold by Olds & Whipple, Hartford, sampled and sent by P. P. Hickey, Burnside.

14384. Sold by Bowker Fertilizer Co., New York, sampled from stock of Warner & Hardin, Glastonbury, and of H. L. Spear, Suffield.

ANALYSES OF CASTOR POMACE.

Station No.	14557	14150	14478	14384
Percentage amounts of				
Nitrogen found	5.01	4.70	4.89	4.18
Nitrogen guaranteed	....	4.53	....	4.12
Cost per ton	$23.00	23.00	25.00	23.00
Nitrogen costs cents per pound	**20.4**	**21.8**	**23.0**	**24.5**

The percentages of phosphoric acid and potash in castor pomace average 1.95 and 0.98 respectively. The cost of nitrogen is determined in each case by deducting $2.54—the valuation of the phosphoric acid and potash—from the ton price, and dividing the remainder by the number of pounds of nitrogen in a ton of the pomace.

The nitrogen of castor pomace is more costly than that of any other material used at all commonly as a fertilizer. There is no reason to believe that it is worth, agriculturally, what it costs, from 20 to 24½ cents a pound.

FLAX SEED MEAL.

A single sample of flax seed, or linseed, meal, **14062**, sampled from stock of Olds & Whipple, Hartford, by Clark Brothers, Windsor, contained 5.88 per cent. of nitrogen and cost $29.00 per ton. Linseed meal also contains about 2.15 per cent. of phosphoric acid and 1.50 per cent of potash. Valuing these at 4 and 5 cents per pound respectively the nitrogen in this sample cost 21.9 cents. This is somewhat less expensive than the nitrogen of castor pomace and our experiments indicate is quite as good as a tobacco fertilizer.

II. RAW MATERIALS CHIEFLY VALUABLE FOR PHOSPHORIC ACID.

DISSOLVED ROCK PHOSPHATE OR ACID ROCK.

This material, made by treating various mineral phosphates with oil of vitriol, has been practically the only form in which water-soluble phosphoric acid could be bought during the past year.

The following analyses show the quality of the dissolved phosphate sold this year in this state.

14123. Sold by the American Agricultural Chemical Co., New York, from the stock of J. G. Schwink, Meriden.

14398. Sampled from stock of Wilcox Fertilizer Works, Mystic.

13967. Sold by Bowker Fertilizer Co., New York, sampled from stock of Andrew Ure, Highwood.

14180. Sold by the E. Frank Coe Co., New York, sampled from stock of S. D. Woodruff & Sons, Orange.

14124. Sold by National Fertilizer Co., Bridgeport, sampled from stock of the Connecticut School for Boys, Meriden.

ANALYSES OF DISSOLVED ROCK PHOSPHATE.

Station No.	14123	14398	13967	14180	14124
Percentage amounts of					
Water-soluble phosphoric acid	13.68	14.62	12.40	10.70	7.71
Citrate-soluble phosphoric acid	2.21	1.82	2.54	2.88	6.22
Citrate-insoluble phosphoric acid	0.45	0.77	1.52	4.33	1.31
Total phosphoric acid found	16.34	17.21	16.46	17.91	15.24
Total phosphoric acid guaranteed	15.0	....	16.0	....	15.0
Sum of water-soluble and citrate-soluble phosphoric acid found	15.89	16.44	14.94	13.58	13.93
"Available phosphoric acid" guaranteed	14.0	15.0	11.0	14.0	14.0
Cost per ton	$14.00	16.00	....	....	....
"Available phosphoric acid" costs cents per pound	4.3	4.8	....	....	....

The samples show the usual range of composition, the percentage of water-soluble phosphoric acid being exceptionally low in **14124.**

It needs to be remembered that "available phosphoric acid" is purely a trade name for the sum of the water-soluble and citrate-soluble phosphoric acid and has no necessary connection with the actual availability of the phosphoric acid to crops. Water-soluble phosphoric acid is comparatively readily available to plants. When applied to the soil it soon becomes insoluble in water, but exists for a time at least in forms which are easily decomposed and absorbed by the action of the plant roots. This is not by any means equally true of all forms of citrate-soluble phosphoric acid. Some of them are, probably, about as quickly and perfectly "available," in the agricultural sense, as water-soluble phosphates, while others are, by comparison, quite "unavailable" and there is no means, at present known, for determining this difference in the laboratory.

The method of citrate extraction was devised for, and is strictly applicable only to, the determination of that part of the phosphoric acid in a plain superphosphate ("acid phosphate," or dissolved rock phosphate) which had been at first dissolved by sulphuric acid but by further chemical reactions has become insoluble in water. It was formerly called "backgone" or "reverted" phosphoric acid.

But when this method is applied to such mixed fertilizers as are now in the trade, containing bone, tankage and sometimes iron and aluminum phosphates, citrate-solution dissolves much phosphate which has not been made more soluble by the manufacture than it was originally, and some of which cannot be considered as readily "available" to crops.

While "available" phosphoric acid has cost 4½ cents or more per pound at retail, it has been freely bought in mixed car lots for 3½ cents.

CHARRED BONE.

A sample of this material, No. **15123**, from a hardware factory, is a refuse consisting of ground bone which has been roasted without access of air. It contains 5.18 per cent. of sand, 3.47 per cent of charcoal and 36.26 per cent. of phosphoric acid. Experience shows that the phosphoric acid of this char or bone black is very inert in the soil and the material is of little value to apply in its present state. An excellent superphosphate can be made from it, but not profitably, as a rule, on the farm.

III. RAW MATERIALS OF HIGH GRADE CONTAINING POTASH.

CARBONATE OF POTASH.

(ANALYSES ON PAGE 36.)

Commercial carbonate of potash has largely taken the place of cotton hull ashes as a source of potash for tobacco lands. It comes in casks, holding about one thousand pounds, and is a white granular solid which gathers moisture quickly if exposed to damp air and becomes noticeably moist and sticky. It must therefore be kept in tight, closed packages until needed for use. The lumps which are found in it are easily screened out and pulverized. No difficulty has been found in making, storing, or applying a mixture of cotton seed meal and carbonate of potash. If the mixture were kept over for a season, especially if it got damp, there is little doubt that it would cake badly in bags and liberate some nitrogen in form of ammonia from the meal. This tendency to absorb water makes the matter of proper sampling more than usually difficult.

The best way to sample is to bore into the middle of the cask with a long auger, quickly withdraw a sample, putting it at once into a can with a tight cover and later closing the hole in the cask with a bung cork.

The following ten analyses show the composition of the carbonate sold in this state:

14226. Sold by A. Klipstein & Co., 122 Pearl St., New York, sampled and sent by E. O. Marsh, New Milford.

14265. Sold by Klipstein, sampled and sent by John Sullivan, Suffield.

14213. Sold by Klipstein and sent by W. W. Thompson, Warehouse Point.

14313. Sold by Klipstein, sampled and sent by G. A. Douglass, Thompsonville.

14248. Sold by Bissell, Graves Co., Suffield, sampled and sent by O. E. Pitcher, Suffield.

14153. Sold by National Fertilizer Co., Bridgeport, sampled from stock of Chas. T. Remington, Suffield.

14247. Sold by Klipstein, sampled from stock of E. S. Hale, Portland.

14479. Sold by Klipstein, sampled from stock of P. P. Hickey, Burnside.

14312. Sold by Klipstein, sampled and sent by Herman Ude, Suffield.

13416. Sold by T. Sisson & Co., Hartford Sent by T. Sisson & Co.

ANALYSES OF CARBONATE OF POTASH.

Station No.	14226	14265	14213	14313	14248	14153	14247	14479	14312	13416
Percentage amounts of										
Potash found	67.22	66.54	67.16	65.86	63.94	65.64	67.18	66.95	64.10	60.78
Potash guaranteed	66.0	66.0	66.0	65.0	66.0	66.0	66.0	66.0	66.0	----
Chlorine	0.45	0.90	0.72	1.13	0.07	0.27	0.67	0.90	1.05	1.56
Sulphuric acid	none	trace	none	none	none	none	none	none	none	1.82
Water	1.10	1.10	1.27	1.53	6.60	3.80	1.40	1.80	4.92	----
Cost per ton	$90.00	95.00	95.00	95.00	92.00	95.00	98.25	98.00	----	----
Potash costs cents per pound	**6.7**	**7.1**	**7.1**	**7.2**	**7.2**	**7.2**	**7.3**	**7.3**	----	----

PROBABLE COMPOSITION OF THE SAMPLES.

Potassium carbonate	97.80	95.92	97.18	94.46	93.73	95.80	97.31	96.52	92.03	82.99
Potassium chloride	0.95	1.92	1.51	2.37	0.14	0.57	1.41	1.89	2.21	3.28
Potassium sulphate	none	trace	none	none	none	none	none	none	none	3.96
Water	1.10	1.10	1.27	1.53	6.60	3.80	1.40	1.80	4.92	9.06
Insoluble in water	none	0.14	none	none	none	none	none	none	none	----
	99.85	99.08	99.96	98.36	100.47	100.17	100.12	100.21	99.16	99.29

The differences between 100.00 and the footings in the last line of the table represent in each case the errors of analysis.

Excluding **13416**, which is obviously a lower grade article, of quite different composition, it is seen that the others are closely alike save that three of them contain more moisture than the others. This moisture may have gathered in the sample after it was drawn, as explained above, or may have been in the goods themselves. If stored in a damp place carbonate in the casks may draw moisture and in that case will weigh more than is shown by the invoice weight. In one case a single cask weighed 40 pounds more than the invoice weight, which would represent 4 per cent. of moisture. In this case, while the *percentage* of potash was slightly below guaranty, the total number of pounds of potash delivered was fully what the guaranty called for.

The cost of potash ranges from 6.7 to 7.3 cents per pound, the average being 7.1 cents, about 1.5 cents per pound less than in cotton hull ashes, as will appear on page 101.

HIGH GRADE SULPHATE OF POTASH.

(ANALYSES ON PAGES 38 AND 39.)

This chemical should contain over 88 per cent. of pure potassium sulphate (sulphate of potash), or about 49 per cent. of potassium oxide, a per cent. less than is contained in muriate, and should be nearly free from chlorine.

These four samples, whose analyses appear in the table, all contain more than the guaranteed percentage of potash and are of good quality.

Potash in this form has cost on the average 5.0 cents per pound.

DOUBLE SULPHATE OF POTASH AND MAGNESIA.

(ANALYSES ON PAGES 38 AND 39.)

This material is usually sold as "sulphate of potash" or "manure salt," on a guaranty 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.

Seven samples of this potash salt have been analyzed this year. No. **14294** is stated by the sender to have been bought for $45.00 per ton, the price of muriate. It is, however, double sulphate of potash and the cost of potash in it is therefore reckoned on the cost price of double sulphate, *i. e.* $30.00 per ton.

The average cost of potash in this form has been 5.3 cents per pound, 0.3 cent higher than in high grade sulphate.

MURIATE OF POTASH.

(ANALYSIS ON PAGES 38 AND 39.)

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.

Potash Salts. Percentage Composition and Cost per Pound of Potash.

Station No.	Drawn from Stock in possession of	Sampled and sent by	Percentages found.			Percentages guaranteed.		Cost per ton.	Potash costs cents per pound.
			Potash soluble in Water.	Equivalent Muriate.	Equivalent Sulphate.	Muriate.	Sulphate.		
	High Grade Sulphate of Potash:								
14149	W. E. Burbank, Suffield, from National Fertilizer Co.	Station agent	49.88		92.28		88.8	$48.00	4.8
14152	E. N. Austin, Suffield, from American Agricultural Chemical Co.	"	49.28	----	91.17	----	88.8	49.00	5.0
14143	E. E. Burwell, New Haven, from Swift's-Lowell Fertilizer Co.	"	49.36	----	91.32	----	88.8	49.00	5.0
14156	Spencer Bros., Suffield, from American Agricultural Chemical Co.	"	49.69	----	91.93	----	88.8	53.00	5.3
	Double Sulphate of Potash:								
14249	Bissell, Graves Co., Suffield	Oscar E. Pitcher, Suffield	27.37	----	50.63	----	48.1	27.00	4.9
14114	Conn. School for Boys, Meriden, from National Fertilizer Co.	Station agent	27.33	----	50.56	----	50.0	27.25	5.0
14155	E. N. Austin, Suffield, from American Agricultural Chemical Co.	"	27.11	----	50.15	----	48.1	29.00	5.3
14113	J. G. Schwink, Meriden, from American Agricultural Chemical Co.	"	26.49	----	49.01	----	46.3	28.00	5.3
14142	E. E. Burwell, New Haven, from Bowker Fertilizer Co.	"	26.46	----	48.95	----	44.4	29.00	5.5
14294	----------from Sanderson Fertilizer and Chemical Co.	C. M. Geer, Yantic	26.74	----	49.47	----		30.00	5.6
14161	Sanderson Fertilizer and Chemical Co., New Haven	Station agent	25.32	----	46.84	----	44.4	30.00	5.9
	Muriate of Potash:								
13983	----------from E. Aspinall, N. Y.	A. C. Lake, R. D., Watertown	55.02	86.93	----	82.7	----	43.55	4.0
14116	Conn. School for Boys, Meriden, from National Fertilizer Co.	Station agent	49.53	78.26	----	79.0	----	40.75	4.1*
14117	J. G. Schwink, Meriden, from American Agricultural Chemical Co.	"	50.20	79.32	----	79.0	----	42.00	4.2
14132	----------from S. D. Woodruff & Sons, Orange	Harris J. Warner, Mt. Carmel Center	52.84	83.49	----	----	----	45.00	4.3
14314	----------from Sanderson Fertilizer and Chemical Co.	E. C. Warner, North Haven	52.46	82.89	----	80.0	----	45.00	4.3
14381	M. E. Thompson, Ellington, from Wilcox Fertilizer Works	Station agent	50.83	80.31	----	79.0	----	44.00	4.3
14154	E. N. Austin, Suffield, from American Agricultural Chemical Co.	"	52.47	82.90	----	79.0	----	46.00	4.4
14162	Sanderson Fertilizer and Chemical Co., New Haven	"	51.68	81.65	----	79.0	----	45.00	4.4
14382	Bowker's Branch, Hartford, from Bowker Fertilizer Co.	"	48.98	77.39	----	79.0	----	44.00	4.5
14449	----------from Berkshire Fertilizer Co.	Newton M. Curtis, Sandy Hook	55.62	87.88	----	80.0	----	45.00	4.0
13964	Andrew Ure, Hamden, from Bowker Fertilizer Co.	Station agent	47.48	75.02	----	79.0	----	----	----
	Kainit:								
14115	Conn. School for Boys, Meriden, from National Fertilizer Co.	Station agent	12.49	19.73	----	19.0	----	11.75	4.7*

* Mixed car lots.

Of the eleven samples analyzed, two contain exceptionally high percentages of potash, over 55 per cent., and one an exceptionally low percentage, 47.5.

The average cost of potash has been 4.25 cents per pound.

KAINIT.

(ANALYSIS ON PAGES 38 AND 39.)

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 either the sulphate or the muriate of potash. It is usually sold on a guaranty 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 chiefly 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.

The single sample analyzed this year cost $11.75 per ton in a mixed car lot, the actual potash costing 4.7 cents per pound.

REFUSE SALT OR SALTPETER.

This material is a waste from the refining of saltpeter used in the manufacture of gun powder. It has no very constant composition, as the following analyses show.

13912. Sent by P. P. Hickey, Burnside. **13973** and **14227** were sent by Andrew Kingsbury, Rockville; the first sample being sent to him by the manufacturer, the second carefully drawn by him from a car load sent by the company.

ANALYSES.

Percentage amounts of	13912	13973	14227
Moisture	5.02	....	6.70
Sand and dirt	0.51	0.26	....
Nitrogen as nitrates	0.94	trace	1.65
Potash	7.24	35.50	27.76
Chlorine	52.02	50.12	40.67
Sulphuric acid	0.10	1.71	2.78
Soda and other matters by difference	34.17	12.41	20.44
	100.00	100.00	100.00
Cost per ton			$ 9.50
Valuation per ton			29.20

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.

VALUATION OF FERTILIZERS IN GENERAL.

The following table contains a column headed "Valuation per ton."

The valuation of a fertilizer, as practiced at this station, consists in calculating the retail trade-value or cash-cost at freight centers (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.

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 and sale, and for the convenience or other advantage incidental to their use.

TRADE-VALUES OF FERTILIZER ELEMENTS FOR 1905.*

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 1904, were as follows:

*Adopted at a conference of representatives of the Connecticut, Maine, Massachusetts, New Jersey, Rhode Island and Vermont stations, held in March, 1905.

	Cents per Pound.
Nitrogen in nitrates	17
in ammonia salts	17½
Organic nitrogen, in dry and fine-ground fish, meat and blood, and in mixed fertilizers	18½
in fine* bone and tankage	18
in coarse* bone and tankage	13
Phosphoric acid, water-soluble	4½
citrate-soluble†	4
of fine* ground bone and tankage	4
of coarse* bone and tankage	3
of cotton-seed meal, castor pomace, and ashes	4
of mixed fertilizers, if insoluble in ammonium citrate†	2
Potash as high-grade sulphate in forms free from muriate (or chlorides)	5
as muriate	4¼
as carbonate	8

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. 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:

Sulphate of ammonia,	Carbonate of potash,
Nitrate of soda,	Sulphate of potash,
Dried blood,	Plain superphosphate,
Azotin,	Dry ground fish,
Ammonite,	Bone and tankage,
Muriate of potash,	Ground South Carolina rock.

VALUATION OF BONE AND TANKAGE.

To obtain the valuation of ground bone the sample is sifted into two grades, that finer than 1/50 inch "fine," and that coarser than 1/50 inch, "coarse."

The nitrogen value of each grade is separately computed by multiplying the pounds of nitrogen per ton by the per cent. of each grade, multiplying one-tenth of that product by the trade value per pound of nitrogen in that grade, and taking this final product as the result in cents. Summing

* In this report "fine" as applied to bone and tankage, signifies smaller than 1/50 inch; and "coarse," larger than 1/50 inch.

† 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 thirty minutes, at 65° C., with agitation once in five minutes. Commonly called "reverted" or "backgone" phosphoric acid.

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.

1. *Bone Manures Sampled by the Station agent.*

In the table on pages 44 and 45 are tabulated analyses of twenty-four samples.

GUARANTIES.

Eight of the samples drawn by the agent contain less nitrogen or phosphoric acid than is guaranteed, but in most cases when the percentage of one ingredient is below guaranty, that of the other is considerably above it.

The following brands have failed to meet their guaranty:

14346. Bohl's Self-Recommending Fertilizer. Phosphoric acid found, 22.03, guaranteed, 23.0.

14357. Shay's Pure Ground Bone. Nitrogen found, 2.17, guaranteed 2.7. Phosphoric acid found, 29.62, guaranteed, 30.0.

14338. E. F. Coe Co.'s XXX Ground Bone. Nitrogen found, 2.30, guaranteed, 2.5.

14345. Berkshire Ground Bone. Phosphoric acid found, 18.84, guaranteed, 20.0.

14348. Buffalo Ground Bone. Nitrogen found, 2.37, guaranteed, 2.5.

14360. Swift's Lowell Ground Bone. Nitrogen found, 2.14, guaranteed, 2.5.

14362. Wilcox' Pure Ground Bone. Nitrogen found, 2.28, guaranteed, 2.5.

14364. Hubbard's Strictly Pure Fine Bone. Phosphoric acid found, 21.17, guaranteed, 22.0.

COST AND VALUATION.

The price printed in full-face in the column showing cost per ton is the one used in calculating the percentage difference.*

The average cost of the 24 samples drawn by the station is $28.38 and the average valuation $27.01, a fairly satisfactory agreement.

2. *Sampled by Purchasers and Others.*

In the table above referred to are analyses of eight samples drawn by others than the station agent.

* Percentage difference shows the percentage excess of the cost price over the average retail cost, at freight centers, of the nitrogen and phosphoric acid contained in the fertilizer.

Station No.	Name or Brand.	Manufacturer.	Dealer.	Dealer's cash price per ton.	Valuation per ton.	Percentage difference between cost and valuation.	Chemical Analysis. Nitrogen. Found.	Nitrogen. Guaranteed.	Phosphoric acid. Found.	Phosphoric acid. Guaranteed.	Mechanical Analyses. Finer than 1-50 inch.	Coarser than 1-50 inch.
	Sampled by Station Agent.											
14346	Self-Recommending Fertilizer	Valentine Bohl, Waterbury	Manufacturer	$25.00	$30.33	17.6*	4.25	3.0	22.03	23.0	70	30
			D. B. Wilcox & Co., Waterbury	25.00								
14343	Ground Bone	Am'n Agricultural Chemical Co., N. Y.	E. N. Austin, Suffield	22.50	24.38	7.7*	1.76	1.5	26.23	25.0	58	42
14350	Pure Bone Dust	Peter Cooper's Glue Factory, N. Y.	J. B. Parker, Poquonock	25.00	25.39	1.5*	1.20	0.9	30.64	26.7	53	47
14353	Frisbie's Fine Bone Meal	The L. T. Frisbie Co., Hartford	Edward White, Rockville	29.00	28.56	1.5	4.85	3.3	19.70	18.0	47	53
14357	Shay's Pure Ground Bone	The C. M. Shay Fertilizer Co., Groton	Manufacturer	30.00	29.16	2.9	2.17	2.7	29.62	30.0	71	29
			G. N. Williams Co., New London	28.00								
14352	Swift-Sure Bone Meal	M. L. Shoemaker & Co., Phila., Pa.	F. H. Roff, Guilford	35.00	35.44	3.0	5.84	4.1	23.41	20.0	59	41
			J. P. Barstow & Co., Norwich	38.00								
				36.50								
14543	New England Ground Bone	The New England Fertilizer Co., Boston	A. R. Manning, Yantic	30.00	28.60	4.9	2.89	2.5	26.87	22.0	60	40
14338	E. F. Coe's XXX Ground Bone	E. Frank Coe Co., New York	E. M. Jennings,† Green's Farms	30.00	28.29	6.0	2.30	2.5	27.76	19.0	72	28
14359	Essex Fine Bone Meal	Russia Cement Co., Gloucester, Mass.	Lightbourn & Pond Co., New Haven	30.00	28.21	6.3	4.48	3.3	20.70	18.0	48	52
14345	Ground Bone	Berkshire Fertilizer Co., Bridgeport	Avery Bros., Norwich Town	30.00	27.42	9.4	4.33	2.5	18.84	20.0	60	40
			Manufacturer	30.00								
14358	Sanderson's Fine Ground Bone	Sanderson Fertilizer and Chemical Co., New Haven	R. H. Hall, East Hampton	30.00	26.48	9.5	3.45	2.5	23.13	20.0	45	55
			C. D. Torrey, Putnam	28.00								
				29.00								
14347	Bowker's Fresh Ground Bone	Bowker Fertilizer Co., N. Y.	Bowker's Branch, Southport	27.00	25.37	10.4	2.92	2.5	22.26	18.0	60	40
			J. A. Lewis & Co., Willimantic	29.00								
				28.00								
14348	Buffalo Ground Bone	Buffalo Fertilizer Co., Buffalo, N. Y.	F. H. Gilbert, Jewett City	29.00	26.27	10.4	2.37	2.5	25.84	22.0	61	39
			M. L. Loomis & Son, Westchester	29.00								
14361	Pure Fine Ground Bone	The Rogers Mfg. Co., Rockfall	E. E. Burwell, New Haven	30.00	27.07	10.8	3.50	2.9	24.37	23.0	40	60
14360	Ground Bone	Swift's Lowell Fertilizer Co., Boston	J. O. Fox & Co., Putnam	30.00	27.48	11.0	2.14	2.5	28.34	23.0	63	37
			J. P. Barstow & Co., Norwich	31.00								
				30.50								
14362	Wilcox' Pure Ground Bone	The Wilcox Fertilizer Works, Mystic	T. H. Eldredge, Norwich	30.00	26.03	13.3	2.28	2.5	26.23	22.0	58	42
			Manufacturer	29.00								
				29.50								
14342	Ground Bone	Am'n. Agricultural Chemical Co., N. Y.	J. A. Nichols, Danielson	32.00	26.43	13.5	2.50	2.5	26.12	22.0	55	45
			C. Buckingham, Southport	28.00								
				30.00								
14344	Armour's Bone Meal	Armour Fertilizer Works, Baltimore, Md.	Gault Bros., Westport	30.00	26.27	14.2	2.74	2.5	24.00	24.0	63	37
			W. B. Martin, Rockville	30.00								
14354	Hubbard's Pure Raw Knuckle Bone Flour	The Rogers & Hubbard Co., Middletown	H. W. Andrews, Wallingford	36.00	30.88	15.0	4.00	3.8	25.24	24.7	59	41
			H. H. McKnight, Ellington	35.00								
				35.50								
14363	Fine Knuckle Bone Flour	The Rogers Mfg. Co., Rockfall	E. E. Burwell, New Haven	32.00	30.36	15.3	4.00	3.8	25.66	24.0	50	50
			Manufacturer	35.00								
14364	Hubbard's Strictly Pure Fine Bone	The Rogers & Hubbard Co., Middletown	H. H. McKnight, Ellington	31.00	25.83	18.1	3.84	2.9	21.17	22.0	39	61
			John Bransfield, Portland	30.00								
				30.50								
14351	Ground Bone	Geo. L. Dennis, Stafford Springs	Manufacturer	28.00	23.43	19.5	3.86	2.5	21.36	20.0	7	93
14355	Mad River Pure Ground Bone	Wm. McCormack, Wolcott	Manufacturer	32.00	23.17	38.1	3.93	3.0	20.79	20.0	6	94
14356	Lister's Celebrated Ground Bone	Lister's Agricultural Chemical Works, Newark, N. J.	J. C. Wilcoxson, Stratford	26.00	17.42	49.3	2.79	2.7	12.15	12.0	55	45
			Wm. Sullivan, New Milford	26.00								
	Sampled by Purchasers and others.											
14307	Fine Ground Bone	Sanderson Fertilizer and Chemical Co., New Haven	E. C. Warner, North Haven	28.00	29.34	4.6*	4.19	2.5	22.13	20.0	60	40
14477	"Swiftsure" Bone Meal		Olds & Whipple, Hartford	35.00	35.67	1.9*	5.93	----	22.32	----	66	34
14136	Cooper's Bone Meal	Peter Cooper's Glue Factory, N. Y.	A. Pouleur, Windsor	25.00	24.72	1.1	1.05	0.9	30.65	26.7	50	50
14308	Cooper's Bone	Peter Cooper's Glue Factory, N. Y.	H. K. Brainard, Thompsonville	25.00	24.34	2.7	0.98	0.9	29.83	26.7	56	44
14009	Bone Meal		August Pouleur, Windsor	26.00	25.03	3.9	1.10	----	30.58	26.0	53	47
14366	Swift's Lowell Ground Bone	Swift's Lowell Fertilizer Co., Boston	Zerah P. Beach,† Wallingford	28.00	26.53	5.5	2.14	2.5	27.44	23.0	59	41
14448	Berkshire Fine Ground Bone	Berkshire Fertilizer Co., Bridgeport	Manufacturer	30.00	28.15	6.6	4.76	2.5	18.65	20.0	54	46
14339	James' Ground Bone	E. L. James, Warrenville	Manufacturer	29.00	22.85	26.9	3.96	----	20.53	----	3	97

* Valuation exceeds cost. † Purchaser.

Percentage Composition and Valuation of Tankage.

Station No.	Manufacturer.	Sampled from stock of	Dealer's cash price per ton.	Valuation per ton.	Percentage difference between cost and valuation.	Chemical Analysis. Nitrogen. Found.	Chemical Analysis. Nitrogen. Guaranteed.	Chemical Analysis. Phosphoric acid. Found.	Chemical Analysis. Phosphoric acid. Guaranteed.	Mechanical Analysis. Finer than 1-50 inch.	Mechanical Analysis. Coarser than 1-50 inch.
	Sampled by Station Agent.										
14349	Conn. Fat Rend. and Fertz. Corp., New Haven	Manufacturer	$20.00	$26.23	23.8*	4.44	----	18.51	----	44	56
14122	American Agricultural Chemical Co., New York	J. G. Schwink, Meriden	27.00	28.62	5.7*	5.57	**4.9**	14.52	----	64	36
14148	American Agricultural Chemical Co., New York	Spencer Bros., Suffield	30.00	29.69	1.0	5.53	**4.9**	16.29	----	63	37
14146	Swift's Lowell Fertilizer Co., Boston	E. E. Burwell, New Haven	29.00	28.39	2.1	5.68	**4.9**	15.16	**13.0**	52	48
14341	American Agricultural Chemical Co., New York	E. N. Austin, Suffield	29.00	25.54	13.5	4.95	**4.9**	16.21	----	36	64
14340	American Agricultural Chemical Co., New York	" " "	34.00	28.71	18.4	6.90	**7.4**	11.10	----	45	55
14181	Bought from a broker in New York	S. D. Woodruff, Orange	----	35.44	----	7.91	**4.9**	13.77	----	62	38
14121	National Fertilizer Co., Bridgeport	Conn. School for Boys, Meriden	----	29.68	----	6.77	**5.8**	11.26	----	59	41
13966	Bowker Fertilizer Co., New York	Andrew Ure, Highwood	----	25.76	----	5.48	**4.9**	11.86	**13.7**	56	44
	Sampled by Purchaser.										
13982	Unknown	A. C. Lake, Watertown	28.70	34.93	17.8*	8.24	**5.8**	12.63	**11.1**	55	45
14264	New England Fertilizer Co., Boston	Samuel T. Stockwell, West Simsbury	28.00	29.53	5.2*	5.16	**5.8†**	17.01	**18.0†**	69	31
14135	Conn. Fat. Rend. & Fertz. Corp.	James Webb, New Haven	----	25.17	----	4.08	----	18.68	----	43	57
14134	Unknown	Harris J. Warner, Mt. Carmel Center	----	34.37	----	8.13	----	12.78	----	52	48

* Valuation exceeds cost.

† Stated by purchaser to have been given by the selling agent. The tags sent were marked in pencil 6-7 ammonia, 30–35 bone phosphate, which are equivalent to 5.7 nitrogen and 13.7 phosphoric acid.

SLAUGHTER-HOUSE 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. Tankage has a very variable composition. In general, it contains more nitrogen and less phosphoric acid than bone.

In the table given above are nine analyses of this material made on samples drawn by the Station agent and four made on samples drawn by others.

In sample **14340**, sold by the American Agricultural Chemical Co., was found nitrogen 6.90 per cent., guaranteed 7.4.

In sample **13966**, sold by the Bowker Fertilizer Co., was found 11.86 per cent. of phosphoric acid, guaranteed 13.7.

DRY GROUND FISH.

This is a by-product from the manufacture of fish oil, a process which removes from the fish little that is of value as a fertilizer.

The fresh fish are cooked by steam, pressed to remove the oil, and dried either in the air or, more commonly, in the large factories, by steam. The scrap is sometimes sprinkled with diluted oil of vitriol, to check putrefaction, whereby the bones are softened and to some extent dissolved. Twelve samples have been examined, as follows:—

14536. Sold by Wilcox Fertilizer Works, Mystic, sampled at factory, M. E. Thompson's, Ellington, and Spencer Bros.', Suffield.

14133. Sold by Olds & Whipple, Hartford, sampled and sent by E. S. Seymour, Windsor Locks.

14476. Sold by American Agricultural Chemical Co., New York, sampled and sent by P. P. Hickey, Burnside.

14159. Sold by National Fertilizer Co., Bridgeport, stock of W. E. Burbank, Suffield.

14157. Sold by American Agricultural Chemical Co., stock of E. N. Austin, Suffield.

14396. Sold by Russia Cement Co., Gloucester, Mass., stock of J. & H. Woodford, Avon, and of W. J. Cox, East Hartford.

15879. Sold by American Agricultural Chemical Co., stock of E. N. Austin, Suffield.

14537. Sold by Bowker Fertilizer Co., New York, stock of Bowker's Branch, Hartford, and of Warner & Hardin, Glastonbury.

14397. Sold by Sanderson Fertilizer and Chemical Co., New Haven, stock of J. H. Hackett, Wapping.

14158. Sold by American Agricultural Chemical Co., stock of Spencer Bros., Suffield.

14010. Sold by American Agricultural Chemical Co., sampled and sent by T. H. Hauser, Suffield.

14164. Sold by Bowker Fertilizer Co., stock of E. E. Burwell, New Haven.

Guaranties.

Of the twelve samples, three have less nitrogen than is guaranteed; namely, American Agricultural Chemical Co., **15879** and **14010**, and Bowker's **14164**. Four have less phosphoric acid than is guaranteed; namely, American Agricultural Chemical Co.'s **14476**, **15879**, **14158** and **14010**, and Bowker's **14164**.

Cost and Valuation.

The average cost of the 12 samples is $36.91 and the average valuation $35.83. The valuations and selling prices are in most cases nearly alike, showing that dried fish has been, as in former years, a relatively cheap source of nitrogen and phosphoric acid.

PERCENTAGE COMPOSITION AND VALUATION OF DRY FISH.

	Wilcox's	Olds & Whipple's	Am'n Ag. Chem. Co.'s	National Fertilizer Co.'s	Am'n Ag. Chem. Co.'s	Russia Cement Co.'s	Am'n Ag. Chem. Co.'s	Bowker's	Sanderson's	Am'n Ag. Chem. Co.'s	Am'n Ag. Chem. Co.'s	Bowker's
	14536	**14133**	**14476**	**14159**	**14157**	**14396**	**15879**	**14537**	**14397**	**14158**	**14010**	**14164**
Nitrogen as ammonia	0.41	0.46	0.28	0.18	0.12	0.11	0.38	0.10	0.32	0.16	0.16	0.08
" organic	8.45	8.54	8.20	8.74	8.10	7.85	7.63	8.42	8.04	8.12	7.82	6.71
Total nitrogen found	8.86	9.00	8.48	8.92	8.22	7.96	8.01	8.52	8.36	8.28	7.98	6.79
" " guaranteed	**8.50**	**8.50**	**8.24**	**8.24**	**8.24**	**8.00**	**8.24**	**8.24**	**8.00**	**8.24**	**8.24**	**8.24**
Water-soluble phosphoric acid	0.67	0.72	1.00	0.64	0.48	0.86	0.54	0.38	0.72	0.61	0.73	0.51
Citrate-soluble phosphoric acid	4.97	5.18	4.48	5.18	4.22	9.88	4.74	4.64	5.29	4.93	3.60	2.98
Citrate-insoluble phosphoric acid	1.38	1.43	1.24	1.48	2.27	4.16	1.12	1.39	1.58	1.21	1.06	0.73
Total phosphoric acid found	7.02	7.33	6.72	7.30	6.97	14.90	6.40	6.41	7.59	6.75	5.39	4.22
Total phosphoric acid guaranteed	**6.00**	**6.00**	**7.00**	---	**7.00**	**11.00**	**7.00**	**6.00**	**6.00**	**7.00**	**7.00**	**6.00**
Cost per ton	$35.00	37.00	36.00	38.00	35.00	40.00	35.00	37.00	39.00	39.00	37.00	35.00
Valuation per ton	37.84	38.57	36.30	38.28	35.11	39.77	34.29	36.11	36.38	35.57	33.45	28.24
Percentage difference between cost and valuation	7.5*	4.1*	0.8*	0.7*	0.3*	0.6	2.1	2.5	7.2	9.6	10.6	23.9

* Valuation exceeds cost.

IV. MIXED FERTILIZERS.

SUPERPHOSPHATES WITH POTASH SALTS.

14234. Sanderson's Superphosphate with Potash, made by the Sanderson Fertilizer and Chemical Co., New Haven, sampled from stock of manufacturer and stock of T. H. Eldredge, Norwich.

14470. Chittenden's Soluble Bone and Potash, made by National Fertilizer Co., Bridgeport, sampled from stock of H. A. Bugbee, Willimantic.

ANALYSES AND VALUATIONS.

	14234	14470
Percentage amounts of		
Water-soluble phosphoric acid	8.83	5.60
Citrate-soluble " "	2.43	4.51
Citrate-insoluble " "	0.34	3.25
"Available" phosphoric acid found	11.26	10.11
" " guaranteed	9.0	11.0
Water-soluble potash	2.77	2.08
Potash guaranteed	5.0	2.0
Cost per ton	$20.00	25.00
Valuation per ton	13.60	11.72
Percentage difference between cost and valuation	47.1	113.3

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 the Station Agent.

In the table of analyses, pages 56-71, are given analyses of ninety-seven samples belonging to this class, arranged according to the percentage difference between cost and valuation.

Analyses requiring Special Notice.

A sample of the Buffalo Fertilizer Co.'s Buffalo Garden Truck, No. **14327**, being a mixture of two samples drawn from stock of J. H. Atkins, Middletown, and W. H. H. Chappell, Chesterfield, respectively, was found to have the composition given on pages 60 and 61. The manufacturers protested that this analysis did not represent the average quality of the goods

and stated that the sulphate of potash used in this and another brand tended to separate from the other ingredients of the mixture, after being bagged. At their request another sample was drawn, No. **15122**, from the stock of L. N. Dimmock, New London, the analysis of which appears on pages 58 and 59, and is quite unlike analysis No. **14327**.

The station's sampling tools and method of sampling are specially designed to secure accuracy of sampling, as far as possible, even when the fertilizer in question is not an even mixture.

GUARANTIES.

Of the ninety-seven analyses of nitrogenous superphosphates given in the table, thirty-one, or nearly one-third of the whole number, are below the manufacturer's minimum guaranty in respect of one or more ingredients, and three are deficient in two ingredients. Nitrogen is deficient in eleven cases, phosphoric acid in ten and potash in thirteen.

In some cases the deficiency is but slight and is accompanied by a considerable excess of another ingredient, being explained by imperfect mixing of the ingredients at the factory.

The brands which thus fail to meet fully the claims made for them, as regards composition, are the following:

14409. Woodruff's Home Mixture. Potash found, 6.44, guaranteed, 8.0.

14191. Mapes' Top Dresser Improved. Nitrogen found, 9.86, guaranteed, 10.0.

14147. Swift's Dissolved Bone. Phosphoric acid found, 13.74, guaranteed, 14.0, "Available" phosphoric acid found, 11.66, guaranteed, 12.0.

14427. Coe's Red Brand Excelsior Guano. "Available" phosphoric acid found, 8.48, guaranteed, 9.0.

14416. Hubbard's Market Garden Phosphate. Phosphoric acid found, 9.80, guaranteed, 10.0.

14428. E. F. Coe's Gold Brand Excelsior Guano. Phosphoric acid found, 8.89, guaranteed, 10.0.

14489. American Agricultural Chemical Co.'s Southport XX Special. Nitrogen found, 3.96, guaranteed, 4.1. Potash found, 6.88, guaranteed, 7.0.

15122. Buffalo Garden Truck. Potash found, 6.52, guaranteed, 7.0.

14412. Buffalo High Grade Manure. Nitrogen found, 2.76, guaranteed, 3.3.

14429. Coe's Long Islander Market Garden Special. Phosphoric acid found, 8.96, guaranteed, 10.0. "Available" phosphoric acid found, 8.02, guaranteed, 8.5.

14198. Armour's Bone, Blood and Potash. Nitrogen found, 3.88, guaranteed, 4.1.

14472. Chittenden's Formula A. Nitrogen found, 3.13, guaranteed, 3.3.

14327. Buffalo Garden Truck. Nitrogen found, 2.80, guaranteed, 3.3. Potash found, 5.81, guaranteed, 7.0.

14411. Packers' Union Gardeners' Complete. Potash found, 9.48, guaranteed, 10.0.

14330. American Agricultural Chemical Co.'s Complete with 10 per cent. Potash. Nitrogen found, 3.16, guaranteed, 3.3.

14287. Chittenden's Complete. Phosphoric acid found, 9.79, guaranteed, 10.0.

14332. Williams & Clark's Americus H. G. Special. Nitrogen found, 3.13, guaranteed, 3.3.

14331. Darling's Dissolved Bone and Potash. Potash found, 9.81, guaranteed, 10.0.

14485. Swift's Lowell Market Garden. Nitrogen found, 3.98, guaranteed, 4.1.

14240. Buffalo Fertilizer Co.'s Farmers' Choice. Potash found, 4.55, guaranteed, 5.0.

14420. American Agricultural Chemical Co.'s H. G. Fertilizer with 10 per cent. Potash. Potash found, 9.17, guaranteed, 10.0.

14235. Russia Cement Co.'s Essex Fish and Potash. Potash found, 2.15, guaranteed, 2.3.

14391. Ohio Farmers' Fertilizer Co.'s Ammoniated Bone and Potash. Potash found, 3.28, guaranteed, 4.0.

14370. Lister's Success Fertilizer. Potash found, 1.84, guaranteed, 2.0.

14281. Sanderson's Special with 10 per cent. Potash. Nitrogen found, 1.98, guaranteed, 2.5.

14524. Quinnipiac Phosphate. Nitrogen found, 2.37, guaranteed, 2.5.

14298. Packer's Union Universal Fertilizer. Phosphoric acid found, 8.60, guaranteed, 9.0.

14510. Russia Cement Co.'s Essex A1 Superphosphate. "Available" phosphoric acid found, 6.58, guaranteed, 7.0. Potash found, 1.84, guaranteed, 2.0.

14518. Great Eastern General Fertilizer. Phosphoric acid found, 8.76, guaranteed, 9.0. "Available" phosphoric acid found, 7.43, guaranteed, 8.0.

14529. Bradley's Niagara Phosphate. "Available" phosphoric acid found, 6.83, guaranteed, 7.0.

14373. Ohio Farmers' Fertilizer Co.'s General Crop Fish Guano. Potash found, 0.70, guaranteed, 1.0.

Cost and Valuation.

Cost.

The method used to ascertain the retail cash 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, as well as to the manufacturer of the article, in order to give opportunity for explanation or correction as regards the price or the analysis itself. When the data thus gathered show a wide range of prices, further correspondence is required and the manufacturers are also consulted. In general an average or nearly average price forms the basis of comparison between cost and valuation. The price thus employed is printed in full-face type.

Valuation.

The valuation of a mixed fertilizer, as practiced at this station, consists in calculating the retail trade-value or cash-cost at freight centers (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.

The schedule of trade-values is given on page 42. The organic nitrogen in mixed fertilizers is reckoned at the price of nitrogen in raw material of the best quality, 18½ cents per pound.

Citrate-insoluble Phosphoric Acid is rated 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 except in certain special cases, to be noted later, where carbonate of potash has been used in the mixture.

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 manufacturers' 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 investment, bad debts and, finally, profits.

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.

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

This information helps 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.

The average cost per ton of the ninety-seven nitrogenous superphosphates is $30.79, the average valuation $21.16, and the percentage difference 45.5.

Last year the corresponding averages were, cost $31.07, valuation $20.69, percentage difference 50.1.

The average composition and cost of nitrogenous superphosphates for a number of years have been as follows:—

PERCENTAGE COMPOSITION.

Year.	Nitrogen.	Available phosphoric acid.	Potash.	Cost per ton.
1905	2.56	10.02*	4.59	$30.79
1904	2.68	10.02*	4.31	31.01
1903	2.75	8.12	4.53	30.39
1902	2.51	8.69	4.44	30.14
1901	2.52	8.77	4.48	28.43
1900	2.48	8.77	4.54	30.00

The following statement of the average amounts of nitrogen, phosphoric acid and potash which are purchasable for $30.00 spent in factory mixed goods is based on their average retail prices and chemical composition, and not at all on the station's valuations.

PURCHASABLE FOR THIRTY DOLLARS.

	Nitrogen, pounds.	Phosphoric acid, pounds.	Potash, pounds.	Cost per ton.
In the first 12 samples in the table	72	185	113	$32.33
" next 15 " " "	60	174	114	33.03
" " 12 " " "	60	167	104	32.29
" " 14 " " "	52	197	112	30.11
" " 14 " " "	41	228	69	29.78
" " 11 " " "	39	203	61	30.25
" " 14 " " "	31	203	58	29.40
" last 5 " " "	21	205	47	26.55

* Total phosphoric acid.

A study of the above table shows clearly the state of the trade at the present time in nitrogenous superphosphates.

1. Their prices bear no fixed relation to the amount of plant food in them, therefore no fixed relation to their value.

2. AS A RULE, fertilizers which sell at a low price are really the most costly if we regard the amount of plant food in them.

3. Some of the brands of fertilizers sold in Connecticut by reputable manufacturers and freely bought by some farmers, supply scarcely more than one-third of the plant food which can be bought for the same amount of money in other brands which are sold in the same places. That is, in buying these brands, the farmer is simply throwing away two-thirds of his purchase money.

There is no fraud in the matter. The composition of the low grade fertilizers corresponds fairly well with the guaranties, and if purchasers can be found who will pay for a ton of plant food as much as would suffice to purchase three tons, the seller is not breaking the law in taking advantage of their obtuseness.

2. *Sampled by Purchasers and others.*

On pages 70 and 71 are tabulated analyses of eleven samples of nitrogenous superphosphates which were sent to the station for analysis by interested persons. The station is not responsible for the sampling of these articles.

Nitrogenous Superphosphates.

Station No.	Name or Brand.	Manufacturer.	Dealer.	Dealer's cash price per ton.	Valuation per ton.
	Sampled by Station Agent:				
14409	Woodruff's Home Mixture	S. D. Woodruff & Sons, Orange	R. E. Carey, Cheshire	$28.00	$26.04
			Manufacturer	**27.00**	
14191	Mapes' Top Dresser, Improved, full strength	Mapes F. & P. G. Co., New York	Spencer Bros., Suffield	51.00	45.18
			Mapes' Branch, Hartford	**49.00**	
14147	Swift's Dissolved Bone	Swift's Lowell Fertilizer Co., Boston	E. E. Burwell, New Haven	**26.00**	22.97
14495	Bone, Fish and Potash	E. R. Kelsey, Branford	Loomis Bros.,* Granby	**27.50**	24.16
14304	Wilcox's H. G. Fish and Potash	Wilcox Fertilizer Works, Mystic	W. A. Howard, Woodstock	28.00	24.25
			J. W. Potter, R. F. D., Norwich	27.00	
			Factory	**28.00**	
14302	C. V. O. Co's Complete H. G. Fertilizer	Conn. Valley Orchard Co., Berlin	Factory	**27.00**	22.71
14427	E. F. Coe's Red Brand Excelsior Guano	E. Frank Coe Co., N. Y.	A. L. Burdick, Westbrook	34.00	27.54
			W. H. Burr,† Westport	33.00	
				33.50	
14197	Quinnipiac Market Garden Manure	American Agricultural Chem. Co., N. Y.	C. Buckingham, Southport	32.00	26.71
			Gault Bros., Westport	33.00	
				32.50	
14416	Hubbard's Market Garden Phosphate	Rogers & Hubbard Co., Middletown	H. H. McKnight, Ellington	**38.00**	30.93
14428	E. F. Coe's Gold Brand Excelsior Guano	E. Frank Coe Co., N. Y.	Joseph Adams,† Westport	29.00	24.20
			Chas. Mills,† Westport	29.00	
			W. L. & S. T. Merwin, Milford	32.00	
				30.00	
14489	Southport XX Special	American Agricultural Chem. Co., N. Y.	Gault Bros., Westport	**35.00**	27.82
14196	Swift-Sure Superphosphate for General Use	M. L. Shoemaker & Co., Philadelphia	F. H. Rolf, Guilford	35.00	27.28
			James T. Kane,† Suffield	34.00	
			A. N. Clark, Milford	**34.50**	
14193	Mapes' Vegetable Manure or Complete for Light Soils	Mapes F. & P. G. Co., N. Y.	Spencer Bros., Suffield	42.00	32.40
			Mapes Branch, Hartford	**41.00**	
14284	Am'n Farmers' Market Garden Special	Armour Fertilizer Works, Baltimore	H. T. Child, Woodstock	33.00	26.74
			W. B. Martin, Rockville	35.00	
				34.00	
14547	Complete Manure with 10% Potash	American Agricultural Chem. Co., N. Y.	S. A. Flight, Highwood	**35.00**	27.39

* Stock of F. M. Colton. † Not a dealer.

Analyses and Valuations.

Station No.	Percentage difference between cost and valuation.	Nitrogen.					Phosphoric Acid.							Potash.		
		As Nitrates.	As Ammonia.	Organic.	Total Nitrogen.		Water-soluble.	Citrate-soluble.	Citrate-insoluble.	Total.		So-called "Available."		Found.		Guaranteed.
					Found.	Guaranteed.				Found.	Guaranteed.	Found.	Guaranteed.	As Muriate.	Total.	
14409	3.7	1.26	0.13	2.16	3.55	**3.3**	5.09	3.33	1.49	9.91	**8.0**	8.42	----	6.44	6.44	**8.0**
14191	8.5	9.56	0.30	0.00	9.86	**10.0**	1.94	5.26	1.24	8.44	**8.0**	7.20	----	1.61	5.41	**4.0**
14147	13.2	----	0.06	3.10	3.16	**1.6**	7.62	4.04	2.08	13.74	**14.0**	11.66	**12.0**	0.43	0.43	----
14495	13.8	----	0.50	2.64	3.14	**2.5**	4.24	2.36	0.24	6.84	**5.0**	6.60	**4.0**	0.57	6.06	**4.0**
14304	15.5	----	0.54	3.28	3.82	**3.3**	3.76	2.83	0.45	7.04	**6.0**	6.59	----	5.18	5.18	**4.0**
14302	18.9	----	0.52	2.18	2.70	**2.5**	8.00	1.82	1.39	11.21	**11.0**	9.82	**9.0**	4.23	4.23	**4.0**
14427	21.6	----	1.50	2.13	3.63	**3.0**	6.82	1.66	1.60	10.08	**10.0**	8.48	**9.0**	0.40	6.36	**6.0**
14197	21.7	0.43	1.17	1.80	3.40	**3.3**	6.56	2.59	1.07	10.22	**9.0**	9.15	**8.0**	7.16	7.16	**7.0**
14416	22.9	2.57	0.00	0.89	3.46	**3.5**	4.88	4.37	0.55	9.80	**10.0**	9.25	**7.5**	12.69	12.69	**10.0**
14428	24.0	0.00	0.76	2.11	2.87	**2.4**	5.60	1.29	2.00	8.89	**10.0**	6.89	**8.0**	0.73	6.97	**6.0**
14489	25.8	0.49	1.10	2.37	3.96	**4.1**	5.36	2.93	1.30	9.59	**8.0**	8.29	**7.0**	6.88	6.88	**7.0**
14196	26.5	0.88	---	2.02	2.90	**2.6**	7.93	4.82	0.94	13.69	----	12.75	----	0.70	5.54	**4.0**
14193	26.5	4.45	0.34	0.55	5.34	**4.9**	3.36	4.25	1.05	8.66	**8.0**	7.61	**6.0**	1.42	7.41	**6.0**
14284	27.2	0.35	0.28	2.73	3.36	**3.3**	6.62	2.85	0.70	10.17	**10.0**	9.47	**8.0**	7.00	7.00	**7.0**
14547	27.8	0.05	1.49	1.79	3.33	**3.3**	5.57	1.23	0.50	7.30	**7.0**	6.80	**6.0**	9.58	10.63	**10.0**

NITROGENOUS SUPERPHOSPHATES.

Station No.	Name or Brand.	Manufacturer.	Dealer.	Dealer's cash price per ton.	Valuation per ton.
	Sampled by Station Agent:				
15122*	Buffalo Garden Truck	Buffalo Fertilizer Co., Buffalo, N. Y.	L. N. Dimmock, New London	$35.00	$27.34
14494	Fish and Potash	Rogers Mfg. Co., Rockfall	R. E. Davis, Guilford	27.00	20.83
14412	Buffalo High Grade Manure	Buffalo Fertilizer Co., Buffalo, N. Y.	J. H. Lynch, Ellington	36.00	27.74
14469	Chittenden's XXX Fish and Potash	National Fertilizer Co., Bridgeport	J. W. Potter, Norwich	24.00	19.22
			W. H. Burr,† Westport	28.00	
			G. W. Eaton, Plainville	24.00	
				25.00	
14233	Atlantic Coast Bone, Fish and Potash	Sanderson Fertilizer & Chem. Co., New Haven	Factory	25.00	19.05
			Morse & Landon, Guilford	25.00	
			T. H. Eldredge, Norwich	25.00	
14418	Swift's Superior Fertilizer with 10% Potash	Swift's Lowell Fertilizer Co., Boston	D. W. Barnes, Windsor	----	30.47
				40.00	
14482	Mapes' Average Soil Complete Manure	Mapes F. & P. G. Co., N. Y.	Manchester Elevator Co., Manchester	35.00	26.44
			Mapes Branch, Hartford	35.00	
14431	Darling's Blood, Bone and Potash	American Agricultural Chem. Co., N. Y.	J. W. Gardner, Cromwell	37.00	27.95
14395	Mapes' Dissolved Bone	Mapes F. & P. G. Co., N. Y.	Manchester Elevator Co., Manchester	31.00	23.37
			Mapes' Branch, Hartford	31.00	
14429	E. Frank Coe's Long Islander Market Garden Special	E. Frank Coe Co., N. Y.	W. L. & S. T. Merwin, Milford	34.00	25.65
14256	Berkshire Complete Fertilizer	Berkshire Fertilizer Co., Bridgeport	Avery Bros., Norwich Town	34.00	23.99
			Johnson Bros., Jewett City	34.00	
			Factory	32.00	
14216	Wilcox's Complete Bone Superphosphate	Wilcox Fertilizer Works, Mystic	I. W. Dennison & Co., Mystic	28.00	21.32
			D. C. Spencer, Saybrook	29.00	
				28.50	
14198	Armour's Bone, Blood and Potash	Armour Fertilizer Works, Baltimore	H. M. Clayton, New Britain	38.00	28.42
			Brower & Malone, Norwich	38.00	

* See explanation, page 51. † Not a dealer.

ANALYSES AND VALUATIONS—*Continued.*

Station No.	Percentage difference between cost and valuation.	Nitrogen.					Phosphoric Acid.							Potash.		
					Total Nitrogen.					Total.		So-called "Available."		Found.		
		As Nitrates.	As Ammonia.	Organic.	Found.	Guaranteed.	Water-soluble.	Citrate-soluble.	Citrate-insoluble.	Found.	Guaranteed.	Found.	Guaranteed.	As Muriate.	Total.	Guaranteed.
15122	28.0	0.63	---	2.57	3.20	3.3	6.51	3.75	1.16	11.42	9.0	10.26	8.0	1.00	6.52	7.0
14494	29.6	0.07	---	3.30	3.37	3.3	1.50	2.42	3.67	7.59	6.0	3.92	4.0	4.26	4.26	3.8
14412	29.8	----	---	2.76	2.76	3.3	5.36	2.75	1.68	9.79	8.0	8.11	7.0	0.70	9.94	10.0
14469	30.1	----	---	2.46	2.46	2.5	4.56	2.59	1.33	8.48	7.0	7.15	5.0	3.59	3.96	3.0
14233	31.2	----	0.30	1.98	2.28	1.7	1.60	4.47	2.37	8.44	6.0	6.07	4.0	5.53	5.53	4.0
14418	31.3	0.71	---	2.89	3.60	3.7	5.76	1.75	0.87	8.38	8.0	7.51	7.0	1.18	10.62	10.0
14482	32.4	3.40	0.22	0.56	4.18	4.1	4.08	3.31	1.12	8.51	8.0	7.39	7.0	1.05	5.43	5.0
14431	32.4	0.87	---	3.21	4.08	4.1	4.48	3.40	1.14	9.02	8.0	7.88	7.0	6.94	6.94	7.0
14395	32.6	----	0.30	2.60	2.90	2.1	5.87	8.89	0.77	15.53	----	14.76	12.0	----	----	----
14429	32.6	----	1.33	2.18	3.51	3.4	6.42	1.60	0.94	8.96	10.0	8.02	8.5	5.05	6.24	6.0
14256	33.4	0.52	0.43	1.95	2.90	2.5	5.48	3.27	2.23	10.98	10.0	8.75	8.0	5.94	5.94	6.0
14216	33.7	0.38	---	2.07	2.45	2.1	3.74	6.17	2.03	11.94	9.0	9.91	----	3.82	3.82	3.0
14198	33.7	0.15	1.55	2.18	3.88	4.1	7.04	2.27	0.76	10.07	9.0	9.31	8.0	7.00	7.00	7.0

Nitrogenous Superphosphates.

Station No.	Name or Brand.	Manufacturer.	Dealer.	Dealer's cash price per ton.	Valuation per ton.
	Sampled by Station Agent:				
14472	Chittenden's Formula A	National Fertilizer Co., Bridgeport	G. W. Eaton, Plainville	$35.00	$24.47
			J. N. Lasbury, Broadbrook	31.00	
			J. W. Potter, Norwich	32.00	
				32.75	
14435	Market Garden Complete Fertilizer	Valentine Bohl, Waterbury	Factory	32.00	23.69
14275	Chittenden's Fish and Potash	National Fertilizer Co., Bridgeport	A. H. Cashen, Meriden	32.00	22.42
			W. E. Burbank, Suffield	29.00	
				30.50	
14327*	Buffalo Garden Truck	Buffalo Fertilizer Co., Buffalo, N. Y.	J. H. Atkins, R. F. D. 2, Middletown	33.00	24.92
			W. H. H. Chappell, R. F. D., Oakdale	35.00	
				34.00	
14432	Bowker's Middlesex Special	Bowker Fertilizer Co., N. Y.	Southport Branch, Southport	25.00	18.15
14192	Sanderson's Formula A	Sanderson Fertilizer & Chemical Co., New Haven	Factory	35.00	25.24
			Morse & Landon, Guilford	33.00	
14519	O. & W.'s Special Phosphate	Olds & Whipple, Hartford	Factory	34.00	24.41
14392	N. E. Superphosphate	New England Fertilizer Co., Boston	A. R. Manning, Yantic	33.00	22.84
			J. A. Lewis & Co., Willimantic	31.00	
				32.00	
14217	Wilcox's Fish and Potash	Wilcox Fertilizer Works, Mystic	I. W. Dennison & Co., Mystic	25.00	19.09
			Olds & Whipple, Hartford	29.00	
			D. C. Spencer, Saybrook	26.00	
				26.75	
14374	Mapes' Top Dresser, Improved, one-half strength	Mapes F. & P. G. Co., N. Y.	Manchester Elevator Co., Manchester	31.00	22.75
			Mapes Branch, Hartford	**32.00**	
14411	Packers' Union Gardeners' Complete Manure	American Agricultural Chem. Co., N. Y.	J. W. Gardner, Cromwell	36.00	25.15
			F. L. Mackey, Ellington	35.00	
				35.50	

* See explanation, page 50.

Analyses and Valuations—*Continued.*

Station No.	Percentage difference between cost and valuation.	Nitrogen.					Phosphoric Acid.							Potash.		
					Total Nitrogen.					Total.		So-called "Available."		Found.		
		As Nitrates.	As Ammonia.	Organic.	Found.	Guaranteed.	Water-soluble.	Citrate-soluble.	Citrate-insoluble.	Found.	Guaranteed.	Found.	Guaranteed.	As Muriate.	Total.	Guaranteed.
14472	33.8	0.77	0.40	1.96	3.13	**3.3**	5.60	2.41	1.56	9.57	**8.0**	8.01	**6.0**	6.60	6.60	**6.0**
14435	35.1	1.63	---	1.85	3.48	**3.0**	none	3.75	7.35	11.10	**10.0**	3.75	----	6.30	6.30	**6.0**
14275	36.0	----	---	3.06	3.06	**1.0**	5.63	1.66	1.43	8.72	**6.0**	7.29	----	3.27	4.62	**4.0**
14327	36.4	0.20	---	2.60	2.80	**3.3**	6.51	2.82	1.90	11.23	**9.0**	9.33	**8.0**	0.49	5.81	**7.0**
14432	37.7	0.39	---	1.78	2.17	**2.1**	3.17	1.87	0.84	5.88	**5.0**	5.04	**4.0**	6.52	6.52	**6.0**
14192	38.7	1.06	---	2.21	3.27	**3.3**	4.10	4.38	2.20	10.68	**8.0**	8.48	**6.0**	6.30	6.33	**6.0**
14519	39.3	0.72	---	3.53	4.25	**4.1**	2.64	3.42	0.85	6.91	----	6.06	**4.0**	0.49	3.51	**3.0**
14392	40.1	----	---	2.62	2.62	**2.5**	6.96	3.34	1.34	11.64	**10.0**	10.30	**9.0**	4.33	4.33	**4.0**
14217	40.1	----	0.37	2.30	2.67	**2.5**	2.59	3.52	1.96	8.07	**6.0**	6.11	**5.0**	3.94	3.94	**3.0**
14374	40.7	4.47	--	0.48	4.95	**4.9**	0.91	1.93	1.70	4.54	**4.0**	2.84	----	0.64	2.83	**2.0**
14411	41.2	0.54	0.47	1.61	2.62	**2.4**	4.93	2.86	1.48	9.27	**7.0**	7.79	**6.0**	7.34	9.48	**10.0**

Nitrogenous Superphosphates.

Station No.	Name or Brand.	Manufacturer.	Dealer.	Dealer's cash price per ton.	*Valuation per ton.*
	Sampled by Station Agent:				
14219	Bowker's Fisherman's Brand Fish and Potash	Bowker Fertilizer Co., N. Y.	G. F. Walter, Guilford	**$25.00**	$17.68
			Bowker's Branch, Hartford	25.00	
14390	Bowker's Market Garden Fertilizer	Bowker Fertilizer Co., N. Y.	J. F. Silliman & Co., New Canaan	36.00	24.73
			Bowker's Branch, Hartford	**35.00**	
14330	Complete Manure with 10% Potash	American Agricultural Chem. Co., N. Y.	L. M. Childs, North Grosvenordale	37.00	26.48
			D. B. Wilson & Co., Waterbury	38.00	
				37.50	
14239	Buffalo Fish Guano	Buffalo Fertilizer Co., Buffalo, N. Y.	W. H. H. Chappell, R. F. D., Oakdale	22.00	15.83
			F. H. Gilbert, Jewett City	23.00	
				22.50	
14506	Hubbard's All Soils, All Crops Phosphate	Rogers & Hubbard Co., Middletown	E. T. Clark, Milford	**32.00**	22.19
14287	Chittenden's Complete Fertilizer	National Fertilizer Co., Bridgeport	J. W. Potter, Norwich, R. D. 3	36.00	25.66
			G. A. & H. B. Williams, Silver Lane	38.00	
				37.00	
14332	Williams & Clark's Americus H. G. Special	American Agricultural Chem. Co., N. Y.	W. H. H. Chappell, R. F. D., Oakdale	**37.00**	25.56
			T. B. Atwater, Plantsville	37.00	
14331	Darling's Dissolved Bone and Potash	American Agricultural Chem. Co., N. Y.	Spencer Bros., Suffield	**37.00**	25.53
			T. S. Loomis, Windsor	36.00	
14517	E. F. Coe's [F.P.] Fish and Potash	E. Frank Coe Co., N. Y.	A. L. Burdick, Westbrook	26.00	17.92
14269	Church's Fish and Potash	American Agricultural Chem. Co., N. Y.	J. G. Schwink, Meriden	25.00	17.33
			J. H. Paddock, Wallingford	26.00	
				25.50	
14507	Bowker's Square Brand Bone and Potash	Bowker Fertilizer Co., N. Y.	Bishop & Lynes, Norwalk	32.00	16.98
			Bowker's Branch, Southport	**25.00**	
14238	Mapes' Complete Manure, A Brand	Mapes F. & P. G. Co., N. Y.	Mapes' Branch, Hartford	**34.00**	23.05
			J. P. Barstow & Co., Norwich	36.00	
14485	Swift's Lowell Market Garden Manure	Swift's Lowell Fertilizer Co., Boston	F. E. Weed & Co., New Canaan	**40.00**	27.01

Analyses and Valuations—*Continued.*

Station No.	Percentage difference between cost and valuation.	Nitrogen.					Phosphoric Acid.							Potash.		
					Total Nitrogen.					Total.		So-called "Available."		Found.		
		As Nitrates.	As Ammonia.	Organic.	Found.	Guaranteed.	Water-soluble.	Citrate-soluble.	Citrate-insoluble.	Found.	Guaranteed.	Found.	Guaranteed.	As Muriate.	Total.	Guaranteed.
14219	41.4	0.96	---	1.54	2.50	**2.5**	3.84	1.46	0.61	5.91	**5.0**	5.30	**4.0**	4.53	4.53	**4.0**
14390	41.5	0.78	---	1.84	2.62	**2.5**	4.88	2.04	0.76	7.68	**7.0**	6.92	**6.0**	10.53	10.53	**10.0**
14330	41.6	0.89	0.49	1.78	3.16	**3.3**	4.99	2.19	0.85	8.03	**7.0**	7.18	**6.0**	10.07	10.07	**10.0**
14239	42.1	----	---	1.08	1.08	**0.8**	6.16	3.54	1.75	11.45	----	9.70	**7.0**	0.20	2.79	**2.0**
14506	44.2	1.50	---	0.95	2.45	**2.3**	7.28	5.15	0.80	13.23	**12.0**	12.43	**10.0**	3.03	3.03	**3.0**
14287	44.2	0.85	0.29	2.12	3.26	**3.3**	6.48	2.35	0.96	9.79	**10.0**	8.83	**8.00**	6.85	6.85	**6.0**
14332	44.8	0.99	0.42	1.72	3.13	**3.3**	5.79	3.21	1.12	10.12	**9.0**	9.00	**8.0**	7.21	7.21	**7.0**
14331	44.9	0.31	1.10	1.52	2.93	**2.5**	6.62	0.61	0.54	7.77	**7.0**	7.23	**6.0**	9.81	9.81	**10.0**
14517	45.1	----	0.12	1.81	1.93	**2.0**	5.28	2.99	3.22	11.49	**7.0**	8.27	**6.0**	2.79	2.79	**2.0**
14269	47.1	----	---	2.16	2.16	**2.1**	5.47	1.99	2.10	9.56	**7.0**	7.46	**6.0**	2.34	2.34	**2.0**
14507	47.2	0.08	---	1.79	1.87	**1.7**	2.93	5.20	3.46	11.59	**7.0**	8.13	**6.0**	2.25	2.25	**2.0**
14238	47.5	1.41	0.38	1.03	2.82	**2.5**	4.48	6.51	2.19	13.18	**12.0**	10.99	**10.0**	3.03	3.45	**2.5**
14485	48.1	0.96	0.13	2.89	3.98	**4.1**	5.60	2.16	0.98	8.74	**8.0**	7.76	**7.0**	6.40	6.40	**6.0**

NITROGENOUS SUPERPHOSPHATES.

Station No.	Name or Brand.	Manufacturer.	Dealer.	Dealer's cash price per ton.	Valuation per ton.
	Sampled by Station Agent:				
14252	Chittenden's Market Garden	National Fertilizer Co., Bridgeport	L. O. Pomeroy, Suffield	$33.00	$22.94
			A. H. Cashen, Meriden	35.00	
				34.00	
14240	Buffalo Farmers' Choice	Buffalo Fertilizer Co., Buffalo, N. Y.	F. H. Gilbert, Jewett City	25.00	16.41
			W. H. H. Chappell, R. F. D., Oakdale	24.00	
				24.50	
14523	Baker's A. A. Ammoniated Bone Superphosphate	American Agricultural Chem. Co., N. Y.	Edward White, Rockville	**32.00**	21.30
14203	Armour's All Soluble	Armour Fert. Works, Baltimore, Md.	Brower & Malone, Norwalk	34.00	21.63
			H. M. Clayton, New Britain	31.00	
				32.50	
14188	Swift's Lowell Animal Brand	Swift's Lowell Fertilizer Co., Boston	Standard Feed Co., Bridgeport	33.00	22.15
			Spencer Bros., Suffield	34.00	
				33.50	
14514	All Round Fertilizer	Rogers Mfg. Co., Rockfall	S. I. Munson, East Wallingford	------	18.29
				28.00	
14268	Berkshire Ammoniated Bone Phosphate	Berkshire Fertilizer Co., Bridgeport	Johnson Bros., Jewett City	28.00	17.61
			Factory	**27.00**	
14513	Wilcox's Special Superphosphate	Wilcox Fertilizer Works, Mystic	Factory	**24.00**	15.55
14369	High Grade Ammoniated Bone Superphosphate	E. Frank Coe Co., N. Y.	J. P. Barstow, Norwich	32.00	20.39
			Warner & Hardin, Glastonbury	31.00	
				31.50	
14502	Darling's Farm Favorite	American Agricultural Chem. Co., N. Y.	A. D. Zabriski, R. F. D. 3, Norwich	**28.00**	18.09
14540	Standard Pure Bone Superphosphate of Lime	Lister's Agricultural Chemical Works, Newark, N. J.	A. I. Martin, Wallingford	**32.00**	20.57
14420	H. G. Fertilizer with 10% Potash	American Agricultural Chem. Co., N. Y.	Carlos Bradley, Ellington	**36.50**	23.37
14522	Williams & Clark's Americus Bone Superphosphate	American Agricultural Chem. Co., N. Y.	R. H. Hall, East Hampton	**33.00**	20.90
14235	Essex XXX Fish and Potash	Russia Cement Co., Gloucester, Mass.	Spencer Bros., Suffield	32.00	19.72
			A. R. Manning, Yantic	31.00	
				31.50	

ANALYSES AND VALUATIONS—*Continued.*

Station No.	Percentage difference between cost and valuation.	Nitrogen. As Nitrates.	Nitrogen. As Ammonia.	Nitrogen. Organic.	Nitrogen. Total Nitrogen. Found.	Nitrogen. Total Nitrogen. Guaranteed.	Phosphoric Acid. Water-soluble.	Phosphoric Acid. Citrate-soluble.	Phosphoric Acid. Citrate-insoluble.	Phosphoric Acid. Total. Found.	Phosphoric Acid. Total. Guaranteed.	Phosphoric Acid. So-called "Available." Found.	Phosphoric Acid. So-called "Available." Guaranteed.	Potash. Found. As Muriate.	Potash. Found. Total.	Potash. Guaranteed.
14252	48.2	0.28	---	2.31	2.59	**2.5**	7.36	1.54	0.73	9.63	**9.0**	8.90	**7.0**	6.23	6.23	**6.0**
14240	49.3	----	---	0.80	0.80	**0.8**	4.70	4.23	3.35	12.28	**9.0**	8.93	**8.0**	0.35	4.55	**5.0**
14523	50.2	0.71	---	2.01	2.72	**2.5**	5.76	4.02	2.57	12.35	**11.0**	9.78	**9.0**	2.38	2.38	**2.0**
14203	50.3	----	1.20	1.46	2.66	**2.5**	6.45	2.96	1.08	10.49	**9.0**	9.41	**8.0**	4.02	4.02	**4.0**
14188	51.2	----	---	2.48	2.48	**2.5**	6.80	3.16	1.36	11.32	**10.0**	9.96	**9.0**	4.45	4.45	**4.0**
14514	53.1	----	---	2.06	2.06	**1.7**	4.24	4.10	3.75	12.09	**10.0**	8.34	**8.0**	2.43	2.43	**2.0**
14268	53.3	----	---	1.78	1.78	**0.8**	4.80	3.27	3.32	11.39	**10.0**	8.07	**8.0**	3.23	3.23	**2.0**
14513	54.3	----	---	1.47	1.47	**1.0**	4.32	4.28	2.35	10.95	**9.0**	8.60	----	2.19	2.19	**1.5**
14369	54.5	----	---	2.31	2.31	**1.4**	7.14	1.88	2.60	11.62	**8.0**	9.02	**7.0**	0.39	2.93	**2.3**
14502	54.8	0.41	0.15	1.58	2.14	**2.1**	4.72	3.19	2.13	10.04	**10.0**	7.91	**8.0**	3.14	3.14	**3.0**
14540	55.6	----	0.70	1.69	2.39	**2.5**	7.04	3.61	1.61	12.26	**11.0**	10.65	**9.0**	2.35	2.35	**2.0**
14420	56.2	0.66	---	1.74	2.40	**2.4**	4.67	2.78	1.19	8.64	**7.0**	7.45	**6.0**	9.17	9.17	**10.0**
14522	57.9	1.01	---	1.63	2.64	**2.5**	6.56	3.80	1.86	12.22	**11.0**	10.36	**9.0**	2.07	2.07	**2.0**
14235	59.7	0.35	---	1.89	2.24	**2.1**	4.77	4.83	3.90	13.50	**12.0**	9.60	**9.0**	2.15	2.15	**2.3**

NITROGENOUS SUPERPHOSPHATES.

Station No.	Name or Brand.	Manufacturer.	Dealer.	Dealer's cash price per ton.	Valuation per ton.
	Sampled by Station Agent:				
14391	Ammoniated Bone & Potash	Ohio Farmers' Fertilizer Co., Columbus, Ohio	R. B. Witter, Brooklyn R. A. Sherman, Oneco	**$23.00** 23.00	$14.23
14270	Bradley's Farmers' New Method Fertilizer	American Agricultural Chem. Co., N. Y.	Avery Bros., Norwich Town D. L. Clark, Milford	31.00 29.00 **30.00**	18.54
14271	Bradley's XL Superphosphate	American Agricultural Chem. Co., N. Y.	Avery Bros., Norwich Town Spencer Bros, Suffield	33.00 34.00 **33.50**	20.67
14214	Swift's Lowell Dissolved Bone and Potash	Swift's Lowell Fertilizer Co., Boston	F. S. Bidwell & Co., Windsor Locks A. L. Burdick, Westbrook	30.00 27.50 **28.75**	17.71
14204	Ammoniated Bone with Potash	Armour Fertilizer Works, Baltimore, Md.	Brower & Malone, Norwalk H. M. Clayton, New Britain	34.00 28.00 **31.00**	18.95
14370	Lister's Success Fertilizer	Lister's Agricultural Chemical Works, Newark, N. J.	J. C. Wilcoxson, Stratford J. A. Foster, Stafford Springs	26.00 28.00 **27.00**	16.47
14281	Sanderson's Special with 10% Potash	Sanderson Fertilizer & Chemical Co., New Haven	H. A. Bugbee, Willimantic R. M. Goodale, Durham	35.00 37.00 **36.00**	21.83
14205	Bowker's Farm and Garden or Ammoniated Dissolved Bone	Bowker Fertilizer Co., N. Y.	E. B. Clark Co., Milford Bishop & Lynes, Norwalk	24.00 34.00 **28.00**	16.94
14524	Quinnipiac Phosphate	American Agricultural Chem. Co., N. Y.	Young Bros. Co., Danielson G. M. Williams Co., New London	31.00 34.00 **32.50**	19.50
14274	Chittenden's Universal Phosphate	National Fertilizer Co., Bridgeport	A. H. Cashen, Meriden Gault Bros., Westport	24.00 26.00 **25.00**	14.94
15893	Swift's Dissolved Bone and Potash	Swift's Lowell Fertilizer Co., Boston, Mass.	A. S. Bennett, Cheshire	**30.00**	17.90

ANALYSES AND VALUATIONS—*Continued.*

Station No.	Percentage difference between cost and valuation.	Nitrogen.					Phosphoric Acid.							Potash.		
		As Nitrates.	As Ammonia.	Organic.	Total Nitrogen. Found.	Total Nitrogen. Guaranteed.	Water-soluble.	Citrate-soluble.	Citrate-insoluble.	Total. Found.	Total. Guaranteed.	So-called "Available." Found.	So-called "Available." Guaranteed.	Found. As Muriate.	Found. Total.	Guaranteed.
14391	61.6	----	---	0.82	0.82	**0.8**	5.60	3.45	1.52	10.57	**10.0**	9.05	**8.0**	3.28	3.28	**4.0**
14270	61.8	0.17	---	1.83	2.00	**1.7**	5.68	3.29	1.62	10.59	**9.0**	8.97	**8.0**	3.29	3.29	**3.0**
14271	62.1	0.31	---	2.29	2.60	**2.5**	6.40	3.39	2.03	11.82	**10.0**	9.79	**9.0**	2.20	2.20	**2.0**
14214	62.3	----	---	1.88	1.88	**1.7**	6.96	2.74	1.21	10.91	**10.0**	9.70	**9.0**	2.14	2.14	**2.0**
14204	63.6	----	---	2.53	2.53	**2.5**	3.97	3.98	2.06	10.01	**7.0**	7.95	**6.0**	2.38	2.38	**2.0**
14370	63.9	----	---	1.41	1.41	**0.8**	7.76	2.78	1.23	11.77	**9.0**	10.54	**7.0**	1.84	1.84	**2.0**
14281	64.9	0.38	---	1.60	1.98	**2.5**	4.72	2.16	0.26	7.14	**8.0**	6.88	**5.0**	10.05	10.05	**10.0**
14205	65.3	0.62	---	1.29	1.91	**1.7**	6.02	2.15	1.13	9.30	**9.0**	8.17	**8.0**	2.90	2.90	**2.0**
14524	66.7	0.44	---	1.93	2.37	**2.5**	5.44	3.98	2.16	11.58	**11.0**	9.42	**9.0**	2.26	2.26	**2.0**
14274	67.3	----	---	1.17	1.17	**0.8**	7.44	1.88	3.11	12.43	**10.0**	9.32	**8.0**	1.38	1.38	**1.0**
15893	67.6	----	---	2.00	2.00	**1.7**	6.01	3.08	1.78	10.87	**10.0**	9.09	**9.0**	2.26	2.26	**2.0**

NITROGENOUS SUPERPHOSPHATES.

Station No.	Name or Brand.	Manufacturer.	Dealer.	Dealer's cash price per ton.	Valuation per ton.
	Sampled by Station Agent:				
14371	Chittenden's Ammoniated Bone Superphosphate	National Fertilizer Co., Bridgeport	H. A. Bugbee, Willimantic	$25.00	$18.30
			G. A. & H. Williams, Silver Lane	**31.00**	
14267	Eldredge's Special Fish and Potash Fertilizer	(Made for) T. H. Eldredge, Norwich	David Fox, Westbrook	26.00	16.96
			T. H. Eldredge, Norwich	**29.00**	
14515	Crocker's New Rival	American Agricultural Chem. Co., N. Y.	F. M. Loomis, No. Granby	-----	17.37
				30.00	
14541	Bowker's Hill and Drill Phosphate	Bowker Fertilizer Co., N. Y.	W. T. McKenzie, Yalesville	**35.00**	20.26
14190	Swift's Lowell Bone Fertilizer	Swift's Lowell Fertilizer Co., Boston	Standard Feed Co., Bridgeport	**31.00**	17.67
			F. S. Bidwell & Co., Windsor Locks	31.00	
14376	T. H. Eldredge's Special Superphosphate	(Made for) T. H. Eldredge, Norwich	David A. Fox, Westbrook	26.00	14.98
			T. H. Eldredge, Norwich	**27.00**	
14475	Darling's General Fertilizer	American Agricultural Chem. Co., N. Y.	F. C. Wilcox, Clinton	**38.00**	20.10
14516	E. Frank Coe's XXV Ammoniated Bone Phosphate	E. Frank Coe Co., N. Y.	F. M. Cole & Co., Putnam	27.00	14.24
			Wm. Warner, Westville	28.00	
				27.50	
14201	Gloucester Fish and Potash	Bowker Fertilizer Co., N. Y.	Lightbourn & Pond Co., New Haven	**25.00**	12.85
			W. T. McKenzie, Yalesville	25.00	
14375	Bowker's Sure Crop Phosphate	Bowker Fertilizer Co., N. Y.	Southington Lumber Co., Southington	29.00	14.60
			A. R. Manning, Yantic	28.00	
				28.50	
14232	Swift's Lowell Empress Brand	Swift's Lowell Fertilizer Co., Boston	A. L. Burdick, Westbrook	25.00	13.30
			Waldo Tillinghast, Plainfield	27.00	
				26.00	
14297	Read's Standard Superphosphate	American Agricultural Chem. Co., N. Y.	Carlos Bradley, Ellington	27.50	14.63
			J. A. Nichols, Danielson	30.00	
				28.75	
14539	Quinnipiac Climax Phosphate	American Agricultural Chem. Co., N. Y.	The F. S. Platt Co., New Haven	**30.00**	14.75
14298	Packer's Union Universal Fertilizer	American Agricultural Chem. Co., N. Y.	G. A. Forsyth, Waterford	**28.00**	13.74
			F. L. Mackey, Ellington	28.00	

ANALYSES AND VALUATIONS—*Continued.*

Station No.	Percentage difference between cost and valuation.	Nitrogen.					Phosphoric Acid.							Potash.		
		As Nitrates.	As Ammonia.	Organic.	Total Nitrogen. Found.	Total Nitrogen. Guaranteed.	Water-soluble.	Citrate-soluble.	Citrate-insoluble.	Total. Found.	Total. Guaranteed.	So-called "Available." Found.	So-called "Available." Guaranteed.	Found. As Muriate.	Found. Total.	Guaranteed.
14371	69.4	0.18	---	1.92	2.10	**1.7**	6.51	2.51	1.47	10.49	**10.0**	9.02	**8.0**	2.50	2.50	**2.0**
14267	71.0	----	0.46	1.52	1.98	**1.7**	2.59	3.05	2.04	7.68	**6.0**	5.64	**5.0**	4.87	4.87	**4.0**
14515	72.7	----	---	1.81	1.81	**1.0**	7.24	1.65	2.28	11.17	**9.0**	8.89	**8.0**	2.26	2.26	**2.0**
14541	72.8	0.60	---	1.85	2.45	**2.5**	7.16	3.20	1.22	11.58	**10.0**	10.36	**9.0**	2.21	2.21	**2.0**
14190	75.4	0.08	---	1.80	1.88	**1.6**	6.16	2.32	1.06	9.54	**9 0**	8.48	**8.0**	3.43	3.43	**3.0**
14376	80.2	----	0.23	1.10	1.33	**1.0**	2.99	6.00	1.97	10.96	**10.0**	8.99	**8.0**	2.14	2.14	**1.5**
14475	89.1	0.30	0.18	2.07	2.55	**1.3**	4.18	3.12	1.55	8.85	**7.0**	7.30	**6.0**	4.60	4.60	**3.0**
14516	93.1	----	---	1.18	1.18	**0.8**	4.80	2.79	4.09	11.68	**10.0**	7.59	**7.0**	1.92	1.97	**1.5**
14201	94.6	0.30	---	0.74	1.04	**0.8**	6.27	2.11	1.50	9.88	**9.0**	8.38	**8.0**	1.36	1.36	**1.0**
14375	95.2	0.19	---	1.02	1.21	**0.8**	5.44	3.47	1.70	10.61	**10.0**	8.91	**9.0**	2.14	2.14	**2.0**
14232	95.5	----	---	1.32	1.32	**1.2**	5.14	1.97	0.78	7.89	**8.0**	7.11	**7.0**	2.24	2.24	**2.0**
14297	96.5	----	---	0.99	0.99	**0.8**	4.37	3.57	1.37	9.31	**9.0**	7.94	**8.0**	4.27	4.27	**4.0**
14539	103.4	----	---	1.34	1.34	**1.0**	6.59	1.93	0.96	9.48	**8.0**	8.52	**6.0**	2.28	2.28	**1.0**
14298	103.8	----	---	0.88	0.88	**0.8**	4.43	2.78	1.39	8.60	**9.0**	7.21	**8.0**	4.36	4.36	**4.0**

NITROGENOUS SUPERPHOSPHATES.

Station No.	Name or Brand.	Manufacturer.	Dealer.	Dealer's cash price per ton.	Valuation per ton.
	Sampled by Station Agent:				
14510	Essex A1 Superphosphate	Russia Cement Co., Gloucester, Mass.	W. O. Goodsell, Bristol	$27.00	$13.59
			F. C. Benjamin, Danbury	30.00	
			W. J. Cox, East Hartford	28.00	
				28.25	
14518	Great Eastern General Fertilizer	American Agricultural Chem. Co., N. Y.	T. E. Greene, Plainfield	**29.00**	13.92
14529	Bradley's Niagara Phosphate	American Agricultural Chem. Co., N. Y.	Wilson & Burr, Middletown	25.00	12.25
			Phineas Platt, Milford	27.00	
				26.00	
14538	Bowker's Potash Bone	Bowker Fertilizer Co., N. Y.	A. R. Manning, Yantic	**25.00**	11.46
14373	General Crop Fish Guano	Ohio Farmers' Fertilizer Co., Columbus, O.	R. B. Witter, Brooklyn	22.00	9.68
			R. A. Sherman, Oneco	21.00	
				21.50	
14528	Bradley's Eclipse Phosphate	American Agricultural Chem. Co., N. Y.	Phineas Platt, Milford	30.50	14.06
			F. M. Cole & Co., Putnam	32.00	
				31.25	
	Sampled by Purchasers and others:	*Manufacturer or dealer.*	*Sent by*		
14560	Woodruff's Home Mixture	S. D. Woodruff & Sons, Orange	W. L. Dickinson, South Britain	25.00 **27.00**	27.30
14081	E. B. Clark's Special Mixture	E. B. Clark Co., Milford	Samuel M. Canfield, Milford	29.00	27.29
14306	Bone, Fish and Potash	E. R. Kelsey, Branford	D. W. Patten, Clintonville	24.50	22.60
13997	----------	Olds & Whipple, Hartford	Willard E. Treat, Silver Lane	35.00	29.21
14290	Shay's Special Mixture	C. M. Shay Fertilizer Co., Groton	Thomas G. Whipple, Mystic	20.00	16.60
14291	Atlantic Coast Bone, Fish and Potash	Sanderson Fertilizer & Chemical Co., New Haven	Thomas G. Whipple, Mystic	23.00	18.67
14126	Swift's Animal Brand Fertilizer	Swift's Lowell Fertilizer Co., Boston	J. L. Watrous, R. F. D., Kensington	30.00	22.54
14481	James' Bone Phosphate	Ernest L. James, Warrenville	Manufacturer	30.00	21.76
14561	Packers' Union Universal Fertilizer	American Agricultural Chem. Co., N. Y.	W. L. Dickinson, South Britain	25.50	16.06
14555	Baker's A. A. Ammoniated Superphosphate	American Agricultural Chem. Co., N. Y.	Arthur Brown, Hillstown	32.00	19.73
15126	Peruvian Guano	Sanderson Fertilizer & Chemical Co., New Haven	Geo. S. Champlin, Ashaway, R. I.	40.00	19.72

ANALYSES AND VALUATIONS—*Concluded.*

Station No.	Percentage difference between cost and valuation.	Nitrogen.					Phosphoric Acid.							Potash.		
					Total Nitrogen.					Total.		So-called "Available."		Found.		
		As Nitrates.	As Ammonia.	Organic.	Found.	Guaranteed.	Water-soluble.	Citrate-soluble.	Citrate-insoluble.	Found.	Guaranteed.	Found.	Guaranteed.	As Muriate.	Total.	Guaranteed.
14510	107.9	----	---	1.21	1.21	**1.0**	1.76	4.82	5.28	11.86	**9.0**	6.58	**7.0**	1.84	1.84	**2.0**
14518	108.3	----	---	0.97	0.97	**0.8**	4.40	3.03	1.33	8.76	**9.0**	7.43	**8.0**	4.02	4.02	**4.0**
14529	112.2	0.07	---	1.15	1.22	**0.8**	3.44	3.39	1.79	8.62	**8.0**	6.83	**7.0**	1.43	1.43	**1.0**
14538	118.2	----	---	0.99	0.99	**0.8**	2.51	3.85	1.44	7.80	**7.0**	6.36	**6.0**	2.21	2.21	**2.0**
14373	122.1	trace	---	0.35	0.35	**0.8**	3.12	5.11	2.13	10.36	**9.0**	8.23	**7.0**	0.45	0.70	**1.0**
14528	122.3	----	---	1.18	1.18	**1.0**	6.16	2.14	1.59	9.89	**9.0**	8.30	**8.0**	2.12	2.12	**2.0**
14560	*1.1	1.46	---	2.75	4.21	**3.3**	4.10	4.14	1.35	9.59	**8.0**	8.24	----	5.44	5.44	**8.0**
14081	6.3	0.75	0.18	2.55	3.48	**3.3**	4.85	4.95	2.19	11.99	**8.0**	9.80	----	6.42	6.42	**7.0**
14306	8.4	----	0.45	2.65	3.10	**2.5**	3.49	3.20	0.28	6.97	**5.0**	6.69	**4.0**	0.36	5.45	**4.0**
13997	19.8	0.30	0.29	4.19	4.78	----	0.50	4.42	0.85	5.77	----	4.92	----	0.53	6.38	----
14290	20.5	0.20	---	1.66	1.86	----	2.91	3.59	6.23	12.73	----	6.50	----	2.12	2.12	----
14291	23.2	----	0.29	1.96	2.25	**1.7**	3.42	3.99	0.80	8.21	**6.0**	7.41	**4.0**	1.76	4.07	**4.0**
14126	33.1	----	---	2.64	2.64	**2.5**	6.61	3.33	1.25	11.19	**10.0**	9.94	**9.0**	4.30	4.30	**4.0**
14481	37.9	----	---	2.35	2.35	--	2.96	7.80	2.67	13.43	----	10.76	----	3.64	3.64	----
14561	58.8	0.07	---	1.08	1.15	**0.8**	7.52	1.85	1.36	10.73	**9.0**	9.37	**8.0**	3.56	3.56	**4.0**
14555	62.2	0.28	---	2.08	2.36	**2.5**	6.00	3.61	2.56	12.17	**11.0**	9.61	**9.0**	2.08	2.08	**2.0**
15126	102.8	0.09	0.87	1.08	2.04	----	0.54	10.22	4.34	15.10	----	10.76	----	2.29	2.29	----

* Valuation exceeds cost.

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. Those which are claimed to contain potash in form of carbonate are separately discussed on pages 96 and 97.

1. *Samples Drawn by Station Agent.*

In the table on pages 78-95 are given analyses of one hundred and fifteen brands represented by samples drawn by the Station agents.

Analyses requiring Special Notice.

The Buffalo Fertilizer Co. states that analysis No. **14328**, pages 80 and 81, does not present the average composition of its Vegetable and Potato Manure. The company states that, although thoroughly mixed at the factory, the mixture has a tendency to separate in the bags on handling, the sulphate of potash particularly working towards the bottom and sides of the bags.

The sampling agent was not able to find other lots of this brand in dealer's hands, after the manufacturer's protest was received, or other tests would have been made on this brand.

The C. M. Shay Fertilizer Co. stated that analysis No. **14303**, pages 86 and 87, does not fairly represent their Grass Fertilizer. It was not possible to get another sample for analysis from the stock of a dealer, after this protest was received.

A second analysis, **14542**, pages 94 and 95, was made on a sample sent by the manufacturer.

14454. A sample described by our sampling agent as Darling's Tobacco Grower, drawn from stock of William Bartman, East Haddam, with a guaranty of nitrogen 4.5 per cent., phosphoric acid 5.0, and potash 10.0, contains nitrogen 8.56 per cent., phosphoric acid 8.55 and potash 4.72. The analysis does not agree in any particular with the guaranty, and it is quite obvious that some error has been made, the nature or source of which it is impossible to determine.

Two samples drawn by our agent, one at the factory and the other from C. D. Torrey, Putnam, and marked Sanderson's Top Dressing for Grass and Grain, were mixed and analyzed, No. **14324.**

The mixture contains nitrogen 3.43 per cent., phosphoric acid 9.21 and potash 3.83.

The guaranty of this brand is nitrogen 4.0 per cent., "available phosphoric acid" 7.0, and potash 7.0.

The two samples, as was determined later by analysis, were quite different in their composition. Mr. Torrey also states that at the time our agent called he had on hand but a single bag of the Top Dressing.

It is obvious here also that some error has occurred, the precise nature of which cannot now be determined.

GUARANTIES.

Of the one hundred and fifteen fertilizers in the following tables, forty, or more than one-third of the whole number, fail to meet the maker's minimum guaranty in respect of one or more ingredients. Eight are deficient in nitrogen, four in phosphoric acid, and twenty-two in potash. Four of the number are below the minimum guaranty in respect of two ingredients.

The brands which thus fail to meet fully the minimum claims of the manufacturer by more than one-tenth per cent. are the following:—

14433. Bowker's Fairfield Onion Fertilizer. Potash found, 5.88, guaranteed, 6.0.

14455. American Agricultural Chemical Co.'s H. G. Tobacco Manure. Nitrogen found, 5.57, guaranteed, 5.8. Potash found, 9.82, guaranteed, 10.0.

14276. Hubbard's Soluble Tobacco Manure. Potash found, 9.68, guaranteed, 10.0.

14474. Olds & Whipple's Home Mixture for Corn and Potatoes. Potash found, 5.43, guaranteed, 6.0.

14458. Chittenden's H. G. Special Tobacco Fertilizer. Potash found, 9.78, guaranteed, 10.0.

14462. Essex Special Tobacco Manure. Potash found, 11.65, guaranteed, 12.0.

14328.* Buffalo Vegetable and Potato. Nitrogen found, 2.35, guaranteed, 2.5. Potash found, 6.07, guaranteed, 8.0.

14410. Hubbard's Grass and Grain Fertilizer. Potash found, 11.42, guaranteed, 12.0.

* See notice on page 72.

14493. Olds & Whipple's Home Mixture for Grass. Potash found, 5.65, guaranteed, 6.0.

14300. Buffalo Ideal Wheat and Corn. Nitrogen found, 1.45, guaranteed, 1.6.

14549. Sanderson's Top Dressing for Grass and Grain. Potash found, 6.08, guaranteed, 7.0.

14415. Olds & Whipple's H. G. Potato Manure. Potash found, 9.75, guaranteed, 10.0.

14459. Chittenden's Complete Tobacco Fertilizer. Potash found, 5.21, guaranteed, 5.4.

14483. New England Fertilizer Co.'s H. G. Potato Fertilizer. Potash found, 5.67, guaranteed, 6.0.

14465. American Agricultural Chemical Co.'s Tobacco Starter and Grower. Nitrogen found, 3.04, guaranteed, 3.3.

14471. Chittenden's Potato Special. Nitrogen found, 2.32, guaranteed, 2.5.

14230. Lister's Potato Manure. Nitrogen found, 3.04, guaranteed, 3.3.

14413. Lister's Special 10 per cent. Potato. Potash found, 9.63, guaranteed, 10.0.

14443. New England Perfect Tobacco Grower. Potash found, 5.83, guaranteed, 6.0.

14257. Bowker Fertilizer Co.'s Stockbridge Special Corn Manure. Potash found, 6.51, guaranteed, 7.0.

14303. Shay's Grass Fertilizer. Nitrogen found, 2.70, guaranteed, 3.0.

14288. Armour's American Farmers' Complete Potato. Potash found, 5.50, guaranteed, 6.0.

14490. Read's Vegetable and Vine Fertilizer. "Available" phosphoric acid found, 7.69, guaranteed, 8.0.

14254. Great Eastern Vegetable, Vine and Tobacco. Potash found, 5.78, guaranteed, 6.0.

14473. Ohio Farmers' Potato and Tobacco Special. Phosphoric acid found, 9.47, guaranteed, 10.0. Potash found, 3.34, guaranteed, 4.0.

14488. Packers' Union Potato Manure. "Available" phosphoric acid found, 7.29, guaranteed, 8.0. Potash found, 4.99, guaranteed, 6.0.

14526. American Agricultural Chemical Co.'s Grass and Lawn Top Dressing. Nitrogen found, 3.77, guaranteed, 3.9.

14388. Darling's Potato Manure. Potash found, 4.81, guaranteed, 5.0.

14499. Wheeler's Bermuda Onion Grower. Potash found, 3.57, guaranteed, 4.0.

14535. American Agricultural Chemical Co.'s Grass and Oats Fertilizer. "Available" phosphoric acid found, 10.57, guaranteed, 11.0.

In some of these cases, at least, a deficiency of one ingredient is accompanied by a very considerable excess of another; the discrepancies being largely explained by imperfect mixing of the raw materials at the factory.

Cost and Valuation.

The method of ascertaining the retail cash cost price of the special manures and of computing the valuation is the same as described on page 53.

The average cost per ton of the one hundred and fifteen special manures included in the tables was $33.99, the valuation, $23.92, and the percentage difference, 41.8.

In 1904 the corresponding figures were: Average cost, $33.93; valuation, $23.39; percentage difference, 45.0.

The average composition and cost of special manures for the last five years, excluding those guaranteed to contain potash as carbonate, have been as follows:

Percentage Composition.

Year.	Nitrogen.	Available phosphoric acid.	Potash.	Cost per ton.
1905	2.93	10.38*	6.13	$33.99
1904	2.92	8.56*	5.92	33.93
1903	3.03	8.00	6.32	33.30
1902	3.03	8.17	6.08	33.35
1901	2.87	8.88	6.44	32.64
1900	2.86	8.90	6.35	32.73

Without regarding the station's valuations, but considering only the retail price of the different brands and their actual composition, it appears that the following amounts of nitrogen, phosphoric acid and potash have been purchasable for $30.00 in the different groups of special manures.

	Nitrogen, pounds.	Phosphoric acid, pounds.	Potash, pounds.	Cost per ton.
In the first 13 samples in the table	72	169	139	$37.20
" next 13 " " "	63	181	143	39.36
" " 14 " " "	56	166	129	35.36
" " 13 " " "	55	163	116	34.31
" " 13 " " "	51	172	105	34.84
" " 12 " " "	41	219	86	30.73
" " 11 " " "	43	197	88	31.09
" " 14 " " "	42	194	69	31.77
" " 12 " " "	31	199	71	30.35

These figures agree in their showing with those relating to nitrogenous superphosphates on page 54: That is, *as a rule,*

* Total phosphoric acid.

the cheap or low-priced special manures are really the most costly, when we consider the actual plant food in them. At present the prices of fertilizers bear no constant relation to their real fertilizing value or to the amount of plant food in them; and in some brands of special manures twice as much nitrogen and potash can be bought for the same amount of money as can be bought in certain other brands.

2. Special manures sampled by manufacturers and purchasers.

In the table on pages 94 and 95 are given eight analyses belonging in this class. The station assumes no direct responsibility for the sampling of these goods.

Special Tobacco Manures, claimed to contain potash, either wholly or in part in form of Carbonate.

In the tables on pages 96 and 97 are given twenty-one analyses of mixtures of this kind which require some special explanation, most of it repeated from former reports.

All of these mixtures are claimed to contain potash, largely in form of carbonate, and "available" phosphoric acid. The trade name "available phosphoric acid" has already been discussed on page 34 of this report. It should be added that in strongly alkaline mixtures like these special tobacco manures, from which the alkali cannot be removed by washing with water and which contain no considerable amount of water-soluble phosphates, the conditions prescribed for the use of the ammonium citrate cannot be maintained, and the term "available" phosphoric acid has no definite significance and is of no use in fixing the value of the fertilizer. It is a perfectly meaningless term as applied to such goods as these.

Regarding the guaranty of carbonate of potash, in many cases a chemical analysis cannot certainly prove or disprove the statement that potash is present in that form. The presence of sulphuric acid and chlorine, even in considerable amount, does not necessarily disprove the statement of the manufacturers that the potash in the mixture was introduced wholly as carbonate, for both sulphuric acid and chlorine may have come from other articles used in the mixture, such as acid phosphate,

acid fish, plaster, or whatever else may have been employed along with carbonate of potash.

But the object of using carbonate of potash in tobacco fertilizers is to exclude both chlorides and sulphates. The reason for excluding them is the fear that the quality of the crop will be damaged by their presence.

Our experiments, as well as the experience of growers of tobacco in Connecticut, have also proved that the carbonate is one of the best forms, if not the very best, in which to supply potash to the tobacco crop.

It is an expensive form of potash, but its use is rational, *if thereby sulphates and chlorides are excluded.* But it is quite irrational, because wasteful, to use the relatively expensive carbonate of potash in a mixed fertilizer and to introduce, at the same time, either sulphates or chlorides in other forms than in potash salts, for instance as acid fish, dissolved phosphate, or plaster, for there is no doubt that sulphates or chlorides may be equally harmful to the quality of the tobacco leaf, whether introduced into the fertilizer as potash salts or in other forms.

In making valuations for these fertilizers, potash sufficient to combine with the chlorine present is calculated as chloride; potash sufficient to combine with all the sulphuric acid present is calculated as sulphate, and any excess of potash remaining is then calculated as carbonate. But we repeat that this is merely a calculation for making a valuation and that it does not necessarily conflict with the manufacturers' statements that a part or all of the potash was put into the mixture as high-grade carbonate.

Analysis Requiring Special Notice.

Analysis **14437** of Bowker's Tobacco Ash Elements was made early in the season on a mixture of samples drawn at four different places. Subsequent examination showed that one of these samples was not Tobacco Ash Elements at all. A new mixture was therefore made of the three remaining samples and the analysis of this sample, **16026**, appears in the table.

SPECIAL MANURES.

Station No.	Name or Brand.	Manufacturer.	Dealer.	Dealer's cash price per ton.	Valuation per ton.
	I. *Sampled by Station Agent:*				
14329	Boardman's Complete Fertilizer for Potatoes and General Crops	F. E. Boardman, Westfield	Manufacturer	$32.00	$28.98
14186	Special Mixture for Seed and Potatoes	The E. B. Clark Co., Milford	Manufacturer	29.00	25.65
14426	E. F. Coe's Tobacco and Onion Fertilizer	The E. Frank Coe Co., New York	C. W. Stowe & Son, Milford * C. W. Beardsley, Milford	32.00 32.00	28.14
14417	H. G. Grass and Grain Fertilizer	The Rogers Mfg. Co., Rockfall	Manufacturer	40.00	35.08
14301	Shay's Potato Manure	The C. M. Shay Fertilizer Co., Groton	Manufacturer	30.00	26.11
14322	Wilcox' Potato, Onion and Vegetable Manure	Wilcox Fertilizer Works, Mystic	I. W. Dennison & Co., Mystic M. E. Thompson, Ellington	34.00 32.00 **33.00**	28.35
14460	H. G. Soluble Tobacco Manure	The Rogers Mfg. Co., Rockfall	W. G. Wrisley, Windsor Arthur Sikes, Suffield † Manufacturer	------ 44.00 **43.00**	36.79
14433	Bowker's Fairfield Onion Fertilizer	Bowker Fertilizer Co., N. Y.	Bowker's Branch, Southport	32.00	27.12
14326	Hubbard's Oats and Top Dressing	The Rogers and Hubbard Co., Middletown	H. W. Andrews, Wallingford John Bransfield, Portland	52.00 51.00 **51.50**	43.31
14393	Wilcox' Grass Fertilizer	Wilcox Fertilizer Works, Mystic	Manufacturer Spencer Bros., Suffield	34.00 34.00	28.14
14455	H. G. Tobacco Manure	American Agricultural Chemical Co., N. Y.	E. N. Austin, Suffield	44.00	35.92
14282	Essex Complete Manure for Potatoes, Roots and Vegetables	Russia Cement Co., Gloucester, Mass.	W. J. Cox, East Hartford Broad Brook Lumber Co., Broad Brook	39.00 39.00	31.80
14325	H. G. Fertilizer for Oats and Top Dressing	The Rogers Mfg. Co., Rockfall	S. I. Munson, East Wallingford R. E. Davis, Guilford Manufacturer	44.00 42.00 44.00	35.80
14276	Hubbard's Soluble Tobacco Manure	The Rogers and Hubbard Co., Middletown	A. E. Kilbourne, East Hartford H. W. Andrews, Wallingford	47.00 45.00 **46.00**	37.29
14461	H. G. Soluble Tobacco and Potato Manure	The Rogers Mfg. Co., Rockfall	Arthur Sikes, Suffield E. S. Hale, Portland	39.00 39.00	31.58

* Purchaser. † Stock of L. A. Kent, Suffield.

ANALYSES AND VALUATIONS.

Station No.	Percentage difference between cost and valuation.	Nitrogen.					Phosphoric Acid.							Potash.		
					Total Nitrogen.					Total.		So-called "Available."		Found.		
		As Nitrates.	As Ammonia.	Organic.	Found.	Guaranteed.	Water-soluble.	Citrate-soluble.	Citrate-insoluble.	Found.	Guaranteed.	Found.	Guaranteed.	As Muriate.	Total.	Guaranteed.
14329	10.4	0.14	---	3.34	3.48	**2.8**	5.79	2.47	0.95	9.21	----	8.26	**6.0**	10.08	10.08	**10.0**
14186	13.1	0.88	---	2.47	3.35	**3.3**	5.60	2.52	0.92	9.04	**8.0**	8.12	----	7.16	7.16	**7.0**
14426	13.7	----	1.25	2.29	3.54	**3.0**	5.09	1.88	1.54	8.51	**7.0**	6.97	**6.0**	0.84	8.72	**8.0**
14417	14.0	----	---	3.11	3.11	**3.0**	none	11.07	7.10	18.17	**16.0**	11.07	----	13.96	13.96	**12.5**
14301	14.9	0.73	---	2.27	3.00	**3.0**	2.53	6.97	3.42	12.92	**9.0**	9.50	**8.0**	5.00	6.75	**5.0**
14322	16.4	1.22	---	2.65	3.87	**3.3**	6.36	2.51	1.11	9.98	**8.0**	8.87	**7.0**	4.87	6.95	**6.0**
14460	16.9	1.80	---	3.12	4.92	**5.0**	1.12	7.82	1.87	10.81	**8.0**	8.94	**6.0**	0.69	11.21	**11.0**
14433	18.0	0.90	---	2.98	3.88	**3.3**	5.68	3.16	0.97	9.81	**9.0**	8.84	**8.0**	5.88	5.88	**6.0**
14326	18.9	7.25	---	1.19	8.44	**8.5**	0.00	6.43	3.04	9.47	**8.0**	6.43	**3.9**	9.29	9.29	**8.0**
14393	20.8	1.72	---	2.66	4.38	**4.1**	3.73	5.18	1.67	10.58	**7.0**	8.91	----	5.03	5.03	**5.0**
14455	22.5	----	2.93	2.64	5.57	**5.8**	5.65	1.09	0.65	7.39	**6.0**	6.74	**5.0**	1.00	9.82	**10.0**
14282	22.6	0.76	---	3.14	3.90	**3.7**	4.64	3.10	4.20	11.94	**9.0**	7.74	----	0.72	9.37	**8.5**
14325	22.9	4.87	---	1.63	6.50	**6.3**	2.05	5.21	1.75	9.01	**9.0**	7.26	**7.0**	7.64	7.64	**7.5**
14276	23.4	2.94	0.31	2.10	5.35	**5.0**	0.59	8.56	3.83	12.98	**10.0**	9.15	**7.0**	1.09	9.68	**10.0**
14461	23.5	1.47	---	2.01	3.48	**3.5**	0.77	9.37	3.23	13.37	**9.0**	10.14	**7.0**	0.93	9.80	**8.8**

Special Manures.

Station No.	Name or Brand.	Manufacturer.	Dealer.	Dealer's cash price per ton.	Valuation per ton.
	1. *Sampled by Station Agent:*				
14250	Hubbard's Soluble Potato Manure	The Rogers & Hubbard Co., Middletown	H. W. Andrews, Wallingford A. E. Kilbourne, East Hartford	$40.00 42.00 **41.00**	$33.07
14185	Swift-Sure Superphosphate for Potatoes	M. L. Shoemaker & Co., Phila., Pa.	F. H. Rolf, Guilford A. N. Clark, Milford	35.00 34.50 **34.75**	27.94
14474	O. & W's. Home Mixture for Corn and Potatoes	Olds & Whipple, Hartford	Manufacturer	**32.00**	25.72
14458	Chittenden's H. G. Special Tobacco Fertilizer	National Fertilizer Co., Bridgeport	J. N. Lasbury, Broad Brook W. E. Burbank, Suffield	44.00 46.00 **45.00**	36.16
14462	Essex Special Tobacco Manure	Russia Cement Co., Gloucester, Mass.	W. J. Cox, East Hartford Spencer Bros., Suffield	45.00 47.00 **46.00**	36.57
14463	Mapes' Seeding Down Manure	Mapes F. & P. G. Co., N. Y.	Mapes' Branch, Hartford	**40.00**	31.74
14328*	Buffalo Vegetable and Potato	The Buffalo Fertilizer Co., Buffalo, N. Y.	J. H. Atkins, Middletown W. H. H. Chappell, R. F. D., Oakdale	30.00 33.00 **31.50**	24.86
14434	Stockbridge Grass Top Dressing	Bowker Fertilizer Co., N. Y.	Bowker's Branch, Hartford	**38.00**	29.94
14430	Essex Grass and Top Dressing Fertilizer	Russia Cement Co., Gloucester, Mass	W. J. Cox, East Hartford	**43.00**	33.87
14410	Hubbard's Grass and Grain Fertilizer	The Rogers & Hubbard Co., Middletown	City Coal & Wood Co., New Britain John Bransfield, Portland	41.00 40.00 **40.50**	31.81
14323	H. G. Complete Corn and Onion Manure	The Rogers Mfg. Co., Rockfall	Manufacturer R. E. Davis, Guilford	**35.00** 34.00	27.13
14564	Swift-Sure Guano for Truck, Corn and Onions	M. L. Shoemaker & Co., Phila., Pa.	A. N. Clark, Milford F. H. Rolf, Guilford	**28.00** 28.00	21.63
14457	Stockbridge Special Tobacco Manure	Bowker Fertilizer Co., N. Y.	Bowker's Branch, Hartford	**47.00**	36.29
14424	Mapes' Economical Potato Manure	Mapes F. & P. G. Co., N. Y.	Mapes' Branch, Hartford W. C. Bulkley, Forestville	**35.00** 36.00	26.73
14464	Sanderson's Formula B for Tobacco	Sanderson Fertilizer & Chemical Co., New Haven	J. H. Hackett, Wapping Manufacturer	**35.00** 35.00	26.65

* See notice on page 72.

Analyses and Valuations—*Continued.*

Station No.	Percentage difference between cost and valuation.	Nitrogen. As Nitrates.	Nitrogen. As Ammonia.	Nitrogen. Organic.	Total Nitrogen. Found.	Total Nitrogen. Guaranteed.	Phosphoric Acid. Water-soluble.	Phosphoric Acid. Citrate-soluble.	Phosphoric Acid. Citrate-insoluble.	Phosphoric Acid. Total. Found.	Phosphoric Acid. Total. Guaranteed.	So called "Available." Found.	So called "Available." Guaranteed.	Potash. Found. As Muriate.	Potash. Found. Total.	Potash. Guaranteed.
14250	24.0	2.84	0.30	2.06	5.20	**5.0**	0.56	9.00	3.40	12.96	**10.0**	9.56	**7.0**	1.06	5.84	**5.0**
14185	24.4	0.68	---	2.20	2.88	**2.9**	7.53	3.20	0.63	11.36	----	10.73	----	9.29	9.29	**7.0**
14474	24.4	----	0.60	3.13	3.73	**3.3**	3.92	3.66	0.74	8.32	----	7.58	**7.0**	0.97	5.43	**6.0**
14458	24.4	----	2.89	2.75	5.64	**5.7**	4.75	1.96	0.90	7.61	**7.0**	6.71	**5.0**	0.88	9.78	**10.0**
14462	25.8	1.55	---	3.31	4.86	**4.5**	4.56	2.80	3.00	10.36	**7.5**	7.36	**5.5**	0.96	11.65	**12.0**
14463	26.0	1.85	0.26	0.94	3.05	**2.5**	0.19	9.49	9.00	18.68	**18.0**	9.68	----	11.41	11.41	**10.0**
14328	26.7	----	---	2.35	2.35	**2.5**	7.07	3.53	2.42	13.02	**9.0**	10.60	**8.0**	0.43	6.07	**8.0**
14434	26.9	1.72	---	3.40	5.12	**4.9**	2.48	3.89	1.75	8.12	**5.0**	6.37	**4.0**	6.44	6.44	**6.0**
14430	27.0	3.09	---	2.00	5.09	**5.0**	4.91	3.87	2.76	11.54	**10.0**	8.78	**8.0**	8.63	8.63	**8.0**
14410	27.3	----	0.17	2.83	3.00	**2.2**	0.29	9.97	6.98	17.24	**16.0**	10.26	----	11.42	11.42	**12.0**
14323	29.0	2.03	---	1.92	3.95	**3.6**	3.12	2.91	3.50	9.53	**8.0**	6.03	**6.0**	7.75	7.75	**7.0**
14564	29.4	0.70	---	1.37	2.07	**1.7**	7.01	3.27	1.11	11.39	----	10.28	----	5.66	5.66	**5.0**
14457	29.5	1.50	0.35	4.03	5.88	**5.8**	2.16	3.09	2.04	7.29	**5.0**	5.25	**4.0**	1.18	10.00	**10.0**
14424	30.9	2.74	0.26	0.67	3.67	**3.3**	2.48	3.49	0.96	6.93	**6.0**	5.97	**4.0**	1.40	8.83	**8.0**
14464	31.3	1.12	---	2.17	3.29	**3.3**	2.24	4.39	3.36	9.99	**10.0**	6.63	**6.0**	1.57	8.18	**6.0**

SPECIAL MANURES.

Station No.	Name or Brand.	Manufacturer.	Dealer.	Dealer's cash price per ton.	Valuation per ton.
	1. *Sampled by Station Agent:*				
14456	Wheeler's Havana Tobacco Grower	American Agricultural Chemical Co., N. Y.	F. M. Loomis, North Granby	------ **$38.00**	$28.67
14419	Baker's Complete Potato Manure	American Agricultural Chemical Co., N. Y.	Edward White, Rockville	**36.00**	26.86
14511	Shay's Corn Manure	C. M. Shay Fertilizer Co., Groton	Manufacturer	**26.00**	19.40
14195	Mapes' Potato Manure	Mapes F. & P. G. Co., N. Y.	Spencer Bros., Suffield Mapes' Branch, Hartford	39.00 **38.00**	28.29
14493	O. & W's. Home Mixture for Grass	Olds & Whipple, Hartford	Manufacturer	**34.00**	25.23
14300	Buffalo Ideal Wheat and Corn	Buffalo Fertilizer Co., Buffalo, N. Y.	J. H. Atkins, Middletown, R. D. 2 R. H. Hall, East Hampton	26.00 30.00 **28.00**	20.68
14283	Essex Complete Manure for Corn, Grain and Grass	Russia Cement Co., Gloucester, Mass.	W. J. Cox, East Hartford Broad Brook Lumber Co., Broad Brook	39.00 40.00 **39.50**	29.09
14549	Sanderson Top Dressing for Grass and Grain	Sanderson Fertilizer & Chemical Co., New Haven	Manufacturer	**38.00**	27.68
14253	Bradley's Complete Manure for Potatoes and Vegetables	American Agricultural Chemical Co., N. Y.	C. Buckingham, Southport Avery Bros., Norwich Town	32.00 38.00 **37.00**	26.91
14218	Bowker's Early Potato Manure	Bowker Fertilizer Co., N. Y.	Bowker's Branch, Southport Bowker's Branch, Hartford	31.00 35.00 **36.00**	26.15
14220	Stockbridge Potato and Vegetable Manure	Bowker Fertilizer Co., N. Y.	Bowker's Branch, Hartford Lightbourn & Pond Co., New Haven	**38.00** 40.00	27.60
14415	O. & W's. H. G. Potato Manure	Olds & Whipple, Hartford	Manufacturer	**37.00**	26.84
14200	Armour's H. G. Potato	Armour Fertilizer Works, Baltimore, Md.	Brower & Malone, Norwalk H. M. Clayton, New Britain	34.00 33.00 **33.50**	24.26
14425	Hubbard's Soluble Corn and General Crops	The Rogers & Hubbard Co., Middletown	City Coal & Wood Co., New Britain H. W. Andrews, Wallingford	**35.00** 35.00	25.16

ANALYSES AND VALUATIONS—*Continued.*

Station No.	Percentage difference between cost and valuation.	Nitrogen.					Phosphoric Acid.							Potash.		
		As Nitrates.	As Ammonia.	Organic.	Total Nitrogen.		Water-soluble.	Citrate-soluble.	Citrate-insoluble.	Total.		So-called "Available."		Found.		Guaranteed.
					Found.	Guaranteed.				Found.	Guaranteed.	Found.	Guaranteed.	As Muriate.	Total.	
14456	32.5	----	0.70	2.12	2.82	**2.5**	6.40	1.07	0.46	7.93	**7.0**	7.47	**6.0**	1.14	11.75	**10.0**
14419	34.0	0.66	0.09	2.50	3.25	**3.3**	3.41	3.47	1.69	8.57	**7.0**	6.88	**6.0**	10.02	10.02	**10.0**
14511	34.0	0.06	---	1.99	2.05	**1.6**	2.96	5.43	5.04	13.43	**9.0**	8.39	**8.0**	3.32	3.32	**2.5**
14195	34.3	2.88	0.35	0.59	3.82	**3.7**	3.92	4.94	1.09	9.95	**8.0**	8.86	**8.0**	1.54	7.40	**6.0**
14493	34.8	0.90	---	2.82	3.72	**3.3**	2.72	4.17	1.27	8.16	----	6.89	**6.0**	1.40	5.65	**6.0**
14300	35.4	----	---	1.45	1.45	**1.6**	5.92	4.11	3.02	13.05	----	10.03	**9.0**	0.44	5.55	**5.0**
14283	35.8	0.85	---	2.59	3.44	**3.3**	4.77	4.51	1.31	10.59	**9.5**	9.28	**7.0**	9.65	9.65	**9.5**
14549	37.3	1.98	---	1.94	3.92	**4.0**	5.98	3.31	1.42	10.71	----	9.29	**7.0**	6.08	6.08	**7.0**
14253	37.5	1.35	0.47	1.48	3.30	**3.3**	5.95	3.35	1.61	10.91	**9.0**	9.30	**8.0**	4.85	7.24	**7.0**
14218	37.7	0.67	0.28	2.46	3.41	**3.3**	5.92	1.99	0.92	8.83	**8.0**	7.91	**7.0**	7.65	7.65	**7.0**
14220	37.7	0.76	---	2.62	3.38	**3.3**	4.32	2.96	0.91	8.19	**7.0**	7.28	**6.0**	10.25	10.25	**10.0**
14415	37.9	0.10	0.58	2.83	3.51	**3.3**	1.68	4.34	1.83	7.85	----	6.02	**6.0**	9.75	9.75	**10.0**
14200	38.1	----	---	1.81	1.81	**1.7**	7.12	2.66	0.58	10.36	**10.0**	9.78	**8.0**	10.34	10.34	**10.0**
14425	39.1	1.49	---	1.27	2.76	**2.5**	2.62	5.47	1.82	9.91	**8.0**	8.09	**6.**	9.32	9.32	**8.0**

Special Manures.

Station No.	Name or Brand.	Manufacturer.	Dealer.	Dealer's cash price per ton.	Valuation per ton.
	1. *Sampled by Station Agent:*				
14459	Chittenden's Complete Tobacco Fertilizer	National Fertilizer Co., Bridgeport	Thomas Cavanaugh, Gildersleeve	$38.00	$26.90
			James T. Kane,* Suffield	37.00	
				37.50	
14483	New England High Grade Potato Fertilizer	New England Fertilizer Co., Boston	J. A. Lewis & Co., Willimantic	**33.00**	23.68
14215	Wilcox' Potato Fertilizer	Wilcox Fertilizer Works, Mystic	I. W. Dennison & Co., Mystic	27.00	19.96
			D. C. Spencer, Saybrook	29.00	
				28.00	
14486	Swift's Special Grass Mixture	Swift's Lowell Fertilizer Co., Boston	D. W. Barnes, Windsor	------	27.01
			Edward White, Rockville	**38.00**	
14199	Quinnipiac Potato Manure	American Agricultural Chemical Co., N. Y.	C. Buckingham, Southport	28.00	20.55
			Gault Bros., Westport	30.00	
				29.00	
14465	Tobacco Starter and Grower	American Agricultural Chemical Co., N. Y.	C. M. Beach, New Milford	36.00	24.02
			E. N. Austin, Suffield	32.00	
				34.00	
14466	Tobacco Starter	The Rogers Mfg. Co., Rockfall	H. A. Clarke, Portland*	**35.00**	24.44
			Manufacturer	35.00	
14487	Swift's Lowell Lawn Dressing	Swift's Lowell Fertilizer Co., Boston	Strong & Tanner, East Winsted	**38.00**	26.48
14255	Berkshire Potato and Vegetable Phosphate	Berkshire Fertilizer Co., Bridgeport	Avery Bros., Norwich Town	31.00	20.87
			Manufacturer	**30.00**	
			Johnson Bros., Jewett City	30.00	
14471	Chittenden's Potato Special	National Fertilizer Co., Bridgeport	H. A. Bugbee, Willimantic	**34.00**	23.58
14230	Lister's Potato Manure	Lister's Agric. Chem. Wks., Newark, N. J.	J. C. Wilcoxson, Stratford	36.00	25.66
			C. D. Babcock, Jewett City	38.00	
				37.00	
14299	Complete Potato and Vegetable Fertilizer	The Rogers Mfg. Co., Rockfall	R. E. Davis, Guilford	31.00	22.19
			S. I. Munson, E. Wallingford	33.00	
				32.00	
14445	Swift's Lowell Perfect Tobacco Grower	Swift's Lowell Fertilizer Co., Boston	J. & H. Woodford, Avon	40.00	27.36
			J. B. Pease, Melrose	38.00	
			F. S. Bidwell & Co., Windsor Locks	41.00	
				39.50	

* Purchaser.

Analyses and Valuations—*Continued.*

Station No.	Percentage difference between cost and valuation.	Nitrogen.					Phosphoric Acid.							Potash.		
					Total Nitrogen.					Total.		So-called "Available."		Found.		
		As Nitrates.	As Ammonia.	Organic.	Found.	Guaranteed.	Water-soluble.	Citrate-soluble.	Citrate-insoluble.	Found.	Guaranteed.	Found.	Guaranteed.	As Muriate.	Total.	Guaranteed.
14459	39.4	----	1.42	2.26	3.68	**3.3**	7.52	1.70	0.82	10.04	**10.0**	9.22	**8.0**	0.65	5.21	**†5.4**
14483	39.4	----	---	2.65	2.65	**2.5**	6.35	2.75	1.43	10.53	**9.0**	9.10	**8.0**	1.94	5.67	**6.0**
14215	40.3	0.60	0.30	1.41	2.31	**2.1**	4.38	3.16	1.48	9.02	**7.0**	7.54	----	5.40	5.40	**4.5**
14486	40.7	0.95	0.15	2.86	3.96	**4.1**	5.48	2.39	1.00	8.87	**8.0**	7.87	**7.0**	6.39	6.39	**6.0**
14199	41.1	0.72	---	1.90	2.62	**2.5**	5.12	2.09	1.34	8.55	**7.0**	7.21	**6.0**	5.00	5.00	**5.0**
14465	41.5	0.10	1.39	1.55	3.04	**3.3**	7.20	1.99	1.30	10.49	**9.0**	9.19	**8.0**	0.53	4.56	**4.0**
14466	43.2	1.61	0.17	2.42	4.20	**3.8**	1.07	2.91	5.44	9.42	**5.0**	3.98	**4.0**	0.55	4.03	**3.0**
14487	43.5	1.06	3.02	0.17	4.25	**4.1**	5.04	2.37	0.65	8.06	**8.0**	7.41	**7.0**	1.89	5.26	**5.0**
14255	43.7	----	---	2.36	2.36	**1.7**	3.04	6.24	0.65	9.93	**8.0**	9.28	**6.0**	4.88	4.88	**4.0**
14471	44.1	0.72	---	1.60	2.32	**2.5**	4.22	2.44	1.40	8.06	**8.0**	6.66	**5.0**	10.47	10.47	**10.0**
14230	44.2	0.35	1.24	1.45	3.04	**3.3**	6.77	2.59	0.87	10.23	**9.0**	9.36	**8.0**	7.35	7.35	**7.0**
14299	44.2	trace	---	2.38	2.38	**2.3**	4.96	3.44	4.52	12.92	**10.0**	8.40	**8.0**	5.13	5.13	**5.0**
14445	44.4	0.90	0.14	3.05	4.09	**4.1**	4.80	3.25	0.97	9.02	----	8.05	**7.0**	5.39	6.02	**6.0**

† "Ten per cent. sulphate."

SPECIAL MANURES.

Station No.	Name or Brand.	Manufacturer.	Dealer.	Dealer's cash price per ton.	Valuation per ton.
	1. *Sampled by Station Agent:*				
14296	American Farmers' Corn King	Armour Fertilizer Works, Baltimore	H. T. Child, Woodstock Alfred Ennis, Danielson	$31.00 30.00 **30.50**	$21.11
14278	Hubbard's Potato Phosphate	The Rogers & Hubbard Co., Middletown	H. W. Andrews, Wallingford E. T. Clark, Milford	31.00 32.00 **31.50**	21.78
14413	Lister's Special 10% Potato	Lister's Agri. Chem. Wks., Newark, N. J.	C. D. Babcock, Jewett City	**34.00**	23.48
14368	Packers' Union Animal Corn Fertilizer	American Agricultural Chemical Co., N. Y.	G. A. Forsyth, Waterford H. F. Porter, Hebron	32.00 31.00 **31.50**	21.67
14443	New England Perfect Tobacco Grower	New England Fertilizer Co., Boston	Latham & Chittenden, Granby Warner & Hardin, Glastonbury	40.00 39.00 **39.50**	27.14
14484	O. & W's. Potato Fertilizer	Olds & Whipple, Hartford	Manufacturer	**32.00**	21.97
14189	Swift's Lowell Potato Phosphate	Swift's Lowell Fertilizer Co., Boston	Standard Feed Co., Bridgeport Spencer Bro., Suffield	34.00 35.00 **34.50**	23.67
14527	Bradley's Complete Manure for Top Dressing Grass and Grain	American Agricultural Chemical Co., N. Y.	G. L. Dennis, Stafford Springs S. J. Stevens, Glastonbury	37.00 38.00 **37.50**	25.62
14257	Stockbridge Special Corn Manure	Bowker Fertilizer Co., N. Y.	A. R. Manning, Yantic W. T. McKenzie, Yalesville	40.00 39.00 **39.50**	26.75
14467	Essex Tobacco Starter	Russia Cement Co., Gloucester, Mass.	J. & H. Woodford, Avon H. C. Aborn & Son, Ellington Spencer Bros., Suffield	**34.00** 34.00 35.00	22.88
14236	Essex Market Garden and Potato Manure	Russia Cement Co., Gloucester, Mass.	W. J. Cox, East Hartford A. R. Manning, Yantic	**34.00** 34.00	22.80
14500	Wheeler's Potato Manure	American Agricultural Chemical Co., N. Y.	W. H. Baldwin, Cheshire	**30.00**	20.05
14303*	Shay's Grass Fertilizer	C. M. Shay Fertilizer Co., Groton	Manufacturer	**35.00**	23.08
14389	Crocker's Ammoniated Corn Phosphate	American Agricultural Chemical Co., N. Y.	F. M. Loomis, North Granby W. L. Wellwood, So. Coventry	**28.00** 32.00	18.46

* See notice on page 72.

ANALYSES AND VALUATIONS—*Continued.*

Station No.	Percentage difference between cost and valuation.	Nitrogen.					Phosphoric Acid.							Potash.		
		As Nitrates.	As Ammonia.	Organic.	Total Nitrogen. Found.	Total Nitrogen. Guaranteed.	Water-soluble.	Citrate-soluble.	Citrate-insoluble.	Total. Found.	Total. Guaranteed.	So-called "Available." Found.	So-called "Available." Guaranteed.	Found. As Muriate.	Found. Total.	Guaranteed.
14296	44.5	----	---	2.39	2.39	**2.5**	5.76	3.67	1.67	11.10	**9.0**	9.43	**8.0**	4.09	4.09	**4.0**
14278	44 6	0.91	---	1.15	2.06	**2.0**	6.00	5.00	0.71	11.71	**10.0**	11.00	**9.0**	5.59	5.59	**5.0**
14413	44.8	0.46	---	1.47	1.93	**1.7**	6.51	2.48	1.12	10.11	----	8.99	**8.0**	9.63	9.63	**10.0**
14368	45.4	0.70	---	2.08	2.78	**2.5**	6.14	3.57	2.64	12.35	**11.0**	9.71	**9.0**	2.52	2.52	**2.0**
14443	45.6	0.85	---	3.27	4.12	**4.1**	4.48	3.18	1.18	8.84	**8.0**	7.66	**7.0**	4.79	5.83	**6.0**
14484	45.7	----	0.65	2.17	2.82	**2.5**	2.88	2.75	0.65	6.28	----	5.63	**5.0**	0.90	6.74	**6.0**
14189	45.8	----	---	2.59	2.59	**2.5**	5.04	3.63	1.37	10.04	**9.0**	8.67	**8.0**	1.01	6.25	**6.0**
14527	46.4	2.94	0.39	1.49	4.82	**4.9**	2.51	3.56	2.12	8.19	**6.0**	6.07	**5.0**	2.11	3.10	**2.5**
14257	47.7	1.10	---	2.10	3.20	**3.3**	7.41	3.36	0.87	11.64	**11.0**	10.77	**10.0**	6.51	6.51	**7.0**
14467	48.6	1.36	---	1.21	2.57	**2.5**	5.76	4.01	4.75	14.52	**12.0**	9.77	**9.0**	0.47	3.56	**2.5**
14236	49.1	0.53	---	1.72	2.25	**2.0**	6.00	4.21	2.01	12.22	**10.0**	10.21	**8.0**	5.97	5.97	**5.0**
14500	49.6	----	---	2.37	2.37	**2.1**	7.15	0.96	2.01	10.12	**9.0**	8.11	**8.0**	3.85	3.85	**3.0**
14303	51.6	1.31	---	1.39	2.70	**3.0**	2.40	5.81	4.67	12.88	**9.0**	8.21	**8.0**	5.66	5.66	**5.0**
14389	51.7	0.22	---	1.82	2.04	**2.1**	6.91	2.38	2.54	11.83	**9.0**	9.29	**8.0**	2.17	2.17	**1.5**

Special Manures.

Station No.	Name or Brand.	Manufacturer.	Dealer.	Dealer's cash price per ton.	Valuation per ton.
	1. *Sampled by Station Agent:*				
14288	American Farmers' Complete Potato	Armour Fertilizer Works, Baltimore, Md.	Alfred Ennis, Danielson H. T. Child, Woodstock	$29.00 30.00 **29.50**	$19.31
14468	Bowker's Tobacco Starter	Bowker Fertilizer Co., N. Y.	E. F. Miller, Ellington Bowker's Branch, Southport	32.00 **33.00**	21.60
14491	Sanderson's Potato Manure	Sanderson Fertilizer and Chemical Co., New Haven	Manufacturer R. H. Hall, East Hampton	**30.00** 30.00	19.62
14496	E. F. Coe's New Englander Corn Fertilizer	E. Frank Coe Co., N. Y.	Wm. E. Warner, Westville F. M. Cole & Co., Putnam Young Bros. Co., Danielson	**28.00** 30.00 26.00	18.31
14498	E. F. Coe's Celebrated Special Potato Fertilizer	E. Frank Coe Co., N. Y.	A. L. Burdick, Westbrook Warner & Hardin, Glastonbury	30.00 31.00 **30.50**	19.92
14277	Hubbard's Corn Phosphate	The Rogers & Hubbard Co., Middletown	H. W. Andrews, Wallingford E. T. Clark, Milford A. E. Kilbourne, E. Hartford	26.00 30.00 27.00 **27.75**	18.03
14231	Lister's Special Corn and Potato Fertilizer	Lister's Agric. Chem. Wks., Newark, N. J.	C. D. Babcock, Jewett City J. C. Wilcoxson, Stratford	30.00 28.00 **29.00**	18.76
14490	Read's Vegetable and Vine Fertilizer	American Agricultural Chemical Co., N. Y.	L. M. Childs, No. Grosvenordale	**32.00**	20.69
14237	Chittenden's Potato Phosphate	National Fertilizer Co., Bridgeport	A. H. Cashen, Meriden J. W. Potter, Norwich	34.00 32.00 **33.00**	21.31
14272	Bradley's Potato Fertilizer	American Agricultural Chemical Co., N. Y.	D. L. Clark, Milford W. H. H. Chappell, R. F. D. Oakdale	29.00 32.00 **30.50**	19.64
14531	Armour's Grain Grower	Armour Fertilizer Wks., Baltimore, Md.	Young Bros. Co., Danielson H. M. Clayton, New Britain	25.00 27.00 **26.00**	16.70

Analyses and Valuations—*Continued.*

Station No.	Percentage difference between cost and valuation.	Nitrogen.					Phosphoric Acid.							Potash.		
		As Nitrates.	As Ammonia.	Organic.	Total Nitrogen. Found.	Total Nitrogen. Guaranteed.	Water-soluble.	Citrate-soluble.	Citrate-insoluble.	Total. Found.	Total. Guaranteed.	So-called "Available." Found.	So-called "Available." Guaranteed.	Found. As Muriate.	Found. Total.	Guaranteed.
14288	52.8	----	---	1.72	1.72	**1.6**	4.45	4.05	2.08	10.58	**8.0**	8.50	**7.0**	4.23	5.50	**6.0**
14468	52.8	----	---	2.60	2.60	**2.5**	7.28	1.93	1.28	10.49	**10.0**	9.21	**8.0**	0.52	3.46	**3.0**
14491	52.9	0.40	---	1.63	2.03	**1.7**	3.31	3.45	2.83	9.59	**6.0**	6.76	**5.0**	6.31	6.31	**6.0**
14496	52.9	----	---	1.79	1.79	**0.8**	5.92	1.84	2.41	10.17	**9.0**	7.76	**7.5**	0.80	4.05	**3.0**
14498	53.1	----	---	2.05	2.05	**1.7**	7.36	0.83	1.56	9.75	**9.5**	8.19	**8.0**	0.65	4.53	**4.0**
14277	53.9	0.14	---	1.13	1.27	**1.0**	5.65	5.09	0.65	11.39	**10.0**	10.74	**8.0**	4.65	4.65	**3.5**
14231	54.6	----	---	1.85	1.85	**1.7**	6.53	3.23	1.50	11.26	**9.0**	9.76	**8.0**	3.34	3.34	**3.0**
14490	54.7	0.37	---	1.68	2.05	**2.1**	4.06	3.63	2.67	10.36	**10.0**	7.69	**8.0**	6.58	6.58	**6.0**
14237	54.9	0.21	---	1.95	2.16	**2.1**	5.82	2.87	1.74	10.43	**10.0**	8.69	**8.0**	6.05	6.05	**6.0**
14272	55.3	----	---	2.24	2.24	**2.1**	5.44	3.41	2.43	11.28	**9.0**	8.85	**8.0**	3.23	3.23	**3.0**
14531	55.7	----	---	1.69	1.69	**1.6**	5.87	3.36	1.32	10.55	**10.0**	9.23	**8.0**	2.29	2.29	**2.0**

Special Manures.

Station No.	Name or Brand.	Manufacturer.	Dealer.	Dealer's cash price per ton.	*Valuation per ton.*
	I. *Sampled by Station Agent:*				
14254	Great Eastern Vegetable, Vine & Tobacco	American Agricultural Chemical Co., N. Y.	T. E. Greene, Plainfield S. A. Post, Westbrook	$33.00 33.00	$21.06
14222	Williams & Clark's Potato Phosphate	American Agricultural Chemical Co., N. Y.	Phineas Platt, Milford J. G. Schwink, Meriden	34.50 32.00 33.25	21.11
14251	Bradley's Potato Manure	American Agricultural Chemical Co., N. Y.	Avery Bros., Norwich Town Spencer Bros., Suffield	33.00 34.00 33.50	21.23
14333	Mapes' Corn Manure	Mapes F. & P. G. Co., N. Y.	Southington Lumber Co., Southington W. C. Bulkley, Forestville	36.00 36.00	22.79
14525	Williams & Clark's Americus Corn Phosphate	American Agricultural Chemical Co., N. Y.	Carlos Bradley, Ellington J. G. Schwink, Meriden	29.50 30.00 29.75	18.80
14473	Potato and Tobacco Special	Ohio Farmers' Fertilizer Co., Columbus, Ohio	R. A. Sherman, Oneco L. N. Dimmock, New London	26.00 28.00 27.00	16.99
14377	Sanderson's Corn Superphosphate	Sanderson Fertilizer & Chemical Co., New Haven	Manufacturer C. D. Torrey, Putnam H. A. Bugbee, Willimantic	28.00 30.00 28.00	17.61
14508	Quinnipiac Corn Manure	American Agricultural Chemical Co., N. Y.	Gault Bros., Westport Young Bros., Co., Danielson	28.00 29.00 28.50	17.82
14497	E. F. Coe's New Englander Potato Fertilizer	E. Frank Coe Co., N. Y.	Wm. E. Warner, Westville F. M. Cole & Co., Putnam Young Bros. Co., Danielson	28.00 27.00 26.00	16.75
14533	E. F. Coe's Columbian Corn Fertilizer	E. Frank Coe Co., N. Y.	J. W. Gardner, Cromwell A. L. Burdick, Westbrook	30.00 27.00 28.50	17.65
14414	Mapes' Fruit and Vine	Mapes F. & P. G. Co., N. Y.	Mapes' Branch, Hartford	39.00	24.04
14512	Quinnipiac Potato Phosphate	American Agricultural Chemical Co., N. Y.	Young Bros. Co., Danielson G. M. Williams Co., New London	30.00 32.00 31.00	18.99

Analyses and Valuations—*Continued.*

Station Number.	Percentage difference between cost and valuation.	Nitrogen: As Nitrates.	Nitrogen: As Ammonia.	Nitrogen: Organic.	Total Nitrogen: Found.	Total Nitrogen: Guaranteed.	Phosphoric Acid: Water-soluble.	Phosphoric Acid: Citrate-soluble.	Phosphoric Acid: Citrate-insoluble.	Total: Found.	Total: Guaranteed.	So-called "Available.": Found.	So-called "Available.": Guaranteed.	Potash Found: As Muriate.	Potash Found: Total.	Potash: Guaranteed.
14254	56.7	0.34	---	1.92	2.26	2.1	3.31	4.81	2.64	10.76	10.0	8.12	8.0	5.78	5.78	6.0
14222	57.5	0.36	---	2.31	2.67	2.5	4.88	2.33	1.26	8.47	7.0	7.21	6.0	5.40	5.40	5.0
14251	57.8	0.84	---	1.86	2.70	2.5	4.42	2.70	1.62	8.74	7.0	7.12	6.0	5.53	5.53	5.0
14333	58.0	1.28	0.42	0.70	2.40	2.5	4.00	5.82	1.40	11.22	10.0	9.82	8.0	6.54	6.54	6.0
14525	58.2	0.33	---	2.01	2.34	2.1	5.63	3.22	2.23	11.08	9.0	8.85	8.0	2.00	2.00	1.5
14473	58.9	----	---	1.85	1.85	1.6	3.52	4.39	1.56	9.47	10.0	7.91	8.0	3.34	3.34	4.0
14377	59.0	----	0.25	1.77	2.02	1.7	4.06	4.09	1.96	10.11	9.0	8.15	7.0	2.92	2.92	2.0
14508	59.9	0.20	---	1.99	2.19	2.1	5.04	3.42	2.23	10.69	9.0	8.46	8.0	1.89	1.89	1.5
14497	61.2	----	---	1.54	1.54	0.8	6.64	1.47	2.25	10.36	9.0	8.11	7.5	0.86	3.12	3.0
14533	61.5	----	---	1.69	1.69	1.2	6.50	1.92	2.25	10.67	10.5	8.42	8.5	0.51	3.19	2.5
14414	62.2	1.16	0.38	0.59	2.13	1.6	1.84	4.20	1.48	7.52	7.0	6.04	5.0	1.92	11.27	10.0
14512	63.2	0.59	---	1.61	2.20	2.1	5.36	3.12	1.92	10.40	10.0	8.48	8.0	3.45	3.45	3.0

Special Manures.

Station No.	Name or Brand.	Manufacturer.	Dealer.	Dealer's cash price per ton.	Valuation per ton.
	1. *Sampled by Station Agent:*				
14504	Crocker's Potato, Hop and Tobacco	American Agricultural Chemical Co., N. Y.	W. L. Wellwood, So. Coventry	$32.00	$18.87
			F. M. Loomis, North Granby	31.00	
14488	Packers' Union Potato Manure	American Agricultural Chemical Co., N. Y.	G. A. Forsyth, Waterford	32.00	19.28
			E. T. Tillinghast, Danielson	32.00	
14520	Mapes' Cereal Brand	Mapes F. & P. G. Co., N. Y.	Mapes' Branch, Hartford	28.00	16.82
14273	Bradley's Corn Phosphate	American Agricultural Chemical Co., N. Y.	W. H. H. Chappell, R. F. D., Oakdale	32.00	19.17
			F. S. Bidwell & Co., Windsor Locks	32.00	
14509	Great Eastern Northern Corn Special	American Agricultural Chemical Co., N. Y.	R. H. Hall, East Hampton	34.00	20.32
			S. A. Post, Westbrook	34.00	
14503	Williams & Clark's Potato Manure	American Agricultural Chemical Co., N. Y.	D. B. Wilson & Co., Waterbury	32.00	19.09
			Carlos Bradley, Ellington	32.00	
14221	Bowker's Potato and Vegetable Phosphate	Bowker Fertilizer Co., N. Y.	Lightbourn & Pond Co., New Haven	30.00	17.87
			Bowker's Branch, Hartford	30.00	
14526	Grass and Lawn Top Dressing	American Agricultural Chemical Co., N. Y.	T. B. Atwater, Plantsville	37.00	21.90
14388	Darling's Potato Manure	American Agricultural Chemical Co., N. Y.	H. F. Cady, Stafford	34.00	20.54
			T. S. Loomis, Windsor	36.00	
				35.00	
14534	Essex Corn Fertilizer	Russia Cement Co., Gloucester, Mass.	W. J. Cox, East Hartford	34.00	19.57
			J. B. Parker, Poquonock	33.00	
				33.50	
14499	Wheeler's Bermuda Onion Grower	American Agricultural Chemical Co., N. Y.	W. H. Baldwin, Cheshire	28.00	16.18
14501	Bowker's Potato and Vegetable Fertilizer	Bowker Fertilizer Co., N. Y.	G. F. Walter, Guilford	37.00	21.34
14295	New England Potato Fertilizer	New England Fertilizer Co., Boston	A. R. Manning, Yantic	31.00	17.21
			Rockville Milling Co., Rockville	30.00	
			E. F. Miller, Ellington	30.00	
14535	Grass and Oats Fertilizer	American Agricultural Chemical Co., N. Y.	J. H. Paddock, Wallingford	20.00	11.88
			H. F. Porter, Hebron	22.00	
				21.00	

Analyses and Valuations—*Continued.*

Station No.	Percentage difference between cost and valuation.	Nitrogen.					Phosphoric Acid.							Potash.		
		As Nitrates.	As Ammonia.	Organic.	Total Nitrogen.		Water-soluble.	Citrate-soluble.	Citrate-insoluble.	Total.		So-called "Available."		Found.		Guaranteed.
					Found.	Guaranteed.				Found.	Guaranteed.	Found.	Guaranteed.	As Muriate.	Total.	
14504	64.3	0.32	---	1.80	2.12	**2.1**	6.11	2.68	2.02	10.81	**9.0**	8.79	**8.0**	3.14	3.14	**3.0**
14488	65.9	0.28	0.22	1.58	2.08	**2.1**	1.54	5.75	3.71	11.00	**10.0**	7.29	**8.0**	4.99	4.99	**6.0**
14520	66.5	0.89	0.43	0.68	2.00	**1.6**	3.12	4.26	2.09	9.47	**8.0**	7.38	**6.0**	3.18	3.18	**3.0**
14273	66.9	0.20	---	2.20	2.40	**2.1**	5.74	3.38	2.28	11.40	**9.0**	9.12	**8.0**	1.85	1.85	**1.5**
14509	67.3	0.71	---	1.80	2.51	**2.5**	5.81	3.71	2.07	11.59	**11.0**	9.52	**9.0**	2.61	2.61	**2.0**
14503	67.6	0.29	---	1.90	2.19	**2.1**	5.50	3.18	2.07	10.75	**9.0**	8.68	**8.0**	3.23	3.23	**3.0**
14221	67.9	0.36	---	1.50	1.86	**1.7**	7.28	2.77	1.14	11.19	**10.0**	10.05	**9.0**	2.20	2.20	**2.0**
14526	68.9	1.48	1.11	1.18	3.77	**3.9**	1.41	5.87	1.23	8.51	**6.0**	7.28	**5.0**	2.53	2.53	**2.0**
14388	70.4	0.36	0.47	1.65	2.48	**2.5**	4.99	2.98	1.50	9.47	**7.0**	7.97	**6.0**	4.81	4.81	**5.0**
14534	71.2	0.38	---	1.82	2.20	**2.0**	3.65	5.17	3.82	12.64	**11.0**	8.82	**8.5**	3.05	3.05	**3.0**
14499	73.1	----	---	1.13	1.13	**0.8**	7.26	2.05	2.01	11.32	**9.0**	9.31	**8.0**	3.57	3.57	**4.0**
14501	73.4	0.67	---	2.02	2.69	**2.5**	7.04	1.33	0.69	9.06	**9.0**	8.37	**8.0**	4.60	4.60	**4.0**
14295	74.3	----	---	1.63	1.63	**1.6**	5.76	2.36	0.84	8.96	**8.0**	8.12	**7.0**	4.43	4.43	**4.0**
14535	76.8	----	---	---	---	----	6.30	4.27	2.47	13.04	**12.0**	10.57	**11.0**	2.12	2.12	**2.0**

SPECIAL MANURES.

Station No.	Name or Brand.	Manufacturer.	Dealer.	Dealer's cash price per ton.	Valuation per ton.
	1. *Sampled by Station Agent:*				
14532	E. F. Coe's Columbian Potato Fertilizer	E. Frank Coe Co., N. Y.	J. W. Gardner, Cromwell Balch & Platt, West Winsted	$30.00 32.00 **31.00**	$17.40
14521	Wheeler's Corn Fertilizer	American Agricultural Chemical Co., N. Y.	J. R. Morgan, Bethel	**32.00**	17.86
14530	New England Corn Phosphate	New England Fertilizer Co., Boston	A. R. Manning, Yantic	**31.00**	17.21
14187	Swift's Lowell Potato Manure	Swift's Lowell Fertilizer Co., Boston	Standard Feed Co., Bridgeport F. S. Bidwell & Co., Windsor Locks	30.00 32.00 **31.00**	16.84
14563	Read's Practical Potato Special	American Agricultural Chemical Co., N. Y.	J. A. Nichols, Danielson J. G. Schwink, Meriden L. A. Fenton, Norwich Town	32.00 29.00 30.00 **30.25**	15.96
14202	Bowker's Corn Phosphate	Bowker Fertilizer Co., N. Y.	G. F. Walter, Guilford Bishop & Lynes, Norwalk	33.00 30.00 **31.50**	16.50
14372	New England Corn and Grain Fertilizer	New England Fertilizer Co., Boston	A. R. Manning, Yantic Rockville Milling Co., Rockville	**28.00** 28.00	14.61
	2. *Sampled by Purchasers and others.*		*Sent by*		
15125	Sanderson's Formula B for Tobacco	Sanderson Fertilizer & Chemical Co., New Haven	Geo. S. Champlin, Ashaway, R. I.	32.00	31.14
14551	Hubbard's Soluble Tobacco Manure	The Rogers & Hubbard Co., Middletown	Arthur Brown, Hillstown	42.50	36.35
14059	Rogers' Tobacco Manure	The Rogers Mfg. Co., Rockfall	Jas. H. Wilson, Poquonock	44.00	37.09
14209	Sanderson's Formula B for Tobacco	Sanderson Fertilizer & Chemical Co.. New Haven	Wm. W. Thompson, Warehouse Point	34.00	26.93
14553	Hubbard's Soluble Potato Manure	The Rogers & Hubbard Co., Middletown	Arthur Brown, Hillstown	40.00	31.50
14550	Tobacco Starter and Grower	American Agricultural Chemical Co., N. Y.	Arthur Brown, Hillstown	34.00	24.65
14542 *	Shay's Grass Fertilizer	C. M. Shay Fertilizer Co., Groton	Manufacturer	35.00	23.52
14554	Special Potato	E. Frank Coe Co., N. Y.	Arthur Brown, Hillstown	34.00	19.08

* See notice on page 72.

ANALYSES AND VALUATIONS—*Concluded.*

Station No.	Percentage difference between cost and valuation.	Nitrogen. As Nitrates.	Nitrogen. As Ammonia.	Nitrogen. Organic.	Total Nitrogen. Found.	Total Nitrogen. Guaranteed.	Phosphoric Acid. Water-soluble.	Phosphoric Acid. Citrate-soluble.	Phosphoric Acid. Citrate-insoluble.	Phosphoric Acid. Total. Found.	Phosphoric Acid. Total. Guaranteed.	So-called "Available." Found.	So-called "Available." Guaranteed.	Potash. Found. As Muriate.	Potash. Found. Total.	Potash. Guaranteed.
14532	78.2	----	---	1.50	1.50	**1.0**	6.88	2.14	2.62	11.64	**10.0**	9.02	**8.5**	0.32	2.95	**2.5**
14521	79.2	----	---	2.01	2.01	**1.7**	6.48	2.29	1.78	10.55	**9.0**	8.77	**8.0**	2.41	2.41	**2.0**
14530	80.1	----	---	1.80	1.80	**1.8**	5.92	2.73	0.94	9.59	**9.0**	8.65	**8.0**	3.13	3.13	**3.0**
14187	84.1	----	---	1.73	1.73	**1.7**	4.96	2.65	1.14	8.75	**8.0**	7.61	**7.0**	4.00	4.00	**4.0**
14563	89.5	0.03	---	0.93	0.96	**0.8**	3.57	2.38	1.34	7.29	**5.0**	5.95	**4.0**	7.97	7.97	**8.0**
14202	90.9	0.64	---	1.24	1.88	**1.7**	5.78	2.35	0.99	9.12	**9.0**	8.13	**8.0**	2.65	2.65	**2.0**
14372	91.6	----	---	1.41	1.41	**1.2**	5.44	2.65	0.89	8.98	**8.0**	8.09	**7.0**	2.36	2.36	**2.0**
15125	2.8	0.84	---	2.63	3.47	**3.3**	0.67	6.77	2.53	9.97	**10.0**	7.44	**6.0**	1.85	6.37	**6.0**
14551	16.9	2.72	0.38	1.82	4.92	**5.0**	0.86	8.01	3.30	12.17	**10.0**	8.87	**7.0**	1.37	10.75	**10.0**
14059	18.6	1.84	0.22	3.23	5.29	----	1.95	6.57	1.11	9.63	----	8.52	----	1.06	10.81	----
14209	26.3	0.98	---	2.73	3.71	**3.3**	0.93	5.91	4.78	11.62	**10.0**	6.84	**6.0**	1.62	6.26	**6.0**
14553	27.0	2.51	0.24	2.12	4.87	**5.0**	0.88	7.68	5.13	13.69	**10.0**	8.56	**7.0**	1.17	5.49	**5.0**
14550	37.9	----	1.34	1.64	2.98	**3.3**	7.25	2.16	2.83	12.24	**9.0**	9.41	**8.0**	0.51	4.58	**4.0**
14542	48.8	1.17	0.09	1.77	3.03	**3.0**	3.60	4.54	3 60	11.74	**8.0**	8.14	----	5.13	5.13	**5.0**
14554	78.2	----	---	2.02	2.02	**1.7**	6.35	1.68	1.55	9.58	**10.0**	8.03	**8.0**	0.49	4.00	**4.0**

TOBACCO FERTILIZERS CONTAINING CARBONATES. ANALYSES AND VALUATIONS.

Station No.	Name or Brand.	Manufacturer.	Dealer or Purchaser.	Nitrogen: as nitrates.	Nitrogen: as ammonia.	Nitrogen: organic.	Nitrogen: Total: Found.	Nitrogen: Total: Guaranteed.	Phosphoric Acid: Water-soluble.	Phosphoric Acid: Citrate-soluble.	Phosphoric Acid: Citrate-insoluble.	Phosphoric Acid: Total: Found.	Phosphoric Acid: Total: Guaranteed.	Phosphoric Acid: So-called "Available": Total.	Phosphoric Acid: So-called "Available": Guaranteed.	Potash: Guaranteed.	Potash: Water-soluble.	Potash: Calculated as chloride.	Potash: Calculated as sulphate.	Potash: Calculated as carbonate.	Chlorine.	Sulphuric acid.	Cost per ton.	Valuation.
14438	Complete Tobacco Manure	American Agricultural Chemical Co., New York	E. N. Austin, Suffield T. S. Loomis, Windsor O. S. Olmstead, Melrose Broad Brook Lumber Co., Broad Brook S. J. Stevens, Glastonbury	---	---	4.79	4.79	**4.5**	0.00	5.10	3.41	8.51	**4.0**	5.10	**3.0**	**5.5**	5.22	1.45	2.27	1.50	1.09	1.93	$33.00 36.00 34.50 35.00 35.00	$29.06
14552	Complete Tobacco Manure	American Agricultural Chemical Co., New York	Arthur Manning,[1] Hillstown	---	---	4.91	4.91	**4.5**	none	6.19	1.40	7.59	**4.0**	6.19	**3.0**	**5.5**	3.69	0.74	2.40	0.55	0.56	2.04	35.50	27.59
15880	" " "	Americal Agricultural Chemical Co., New York	S. J. Stevens, Glastonbury Alfred Weldon, "	---	---	4.48	4.48	**4.5**	0.22	6.14	1.41	7.77	**4.0**	6.36	**3.0**	**5.5**	5.16	1.00	2.11	2.05	0.75	1.79	---- ----	28.49
14440	Bowker's Complete Alkaline Tobacco Grower	Bowker Fertilizer Co., New York	Seth Viets,[2] Suffield J. B. Parker, Poquonock	---	---	4.49	4.49	**4.0**	0.00	7.40	5.07	12.47	**5.0**	7.40	**4.0**	**5.0**	4.63	0.35	2.20	2.08	0.26	1.87	34.00 33.00	30.39
13415	Bowker's Tobacco Carbonates	Bowker Fertilizer Co., New York	Bowker's Branch, Hartford	---	---	0.58	0.58	trace	trace	10.09	4.11	14.20	**7.0**	10.09	**6.0**	**15.0**	15.01	0.25	3.50	11.26	0.19	2.98	38.00	33.60
14292	" " "	Bowker Fertilizer Co., New York	James R. Hayes & Son,[3] Granby	---	---	0.82	0.82	---	---	10.22	5.32	15.54	**7.0**	10.22	**6.0**	**15.0**	13.74	0.80	4.89	8.05	0.60	4.16	38.00	31.79
14439	" " "	Bowker Fertilizer Co., New York	Newell St. John, Simsbury Seth Viets,[4] Suffield J. B. Parker, Poquonock	---	---	0.61	0.61	---	0.00	9.55	3.24	12.79	**7.0**	9.55	**6.0**	**15.0**	16.01	0.85	3.06	12.10	0.64	2.60	38.00 38.00 38.00	34.35
13414	Bowker's Tobacco Ash Elements	Bowker Fertilizer Co., New York	Bowker's Branch, Hartford	---	---	0.65	0.65	trace	none	11.11	4.50	15.61	**7.0**	11.11	**6.0**	**15.0**	14.74	0.55	14.19	----	0.41	16.96	32.00	27.75
16026	Bowker's Tobacco Ash Elements	Bowker Fertilizer Co., New York	Seth Viets,[5] Suffield " " " J. B. Parker, Poquonock	---	---	0.64	0.64	---	0.00	10.00	4.26	14.26	**7.0**	10.00	**6.0**	**15.0**	15.36	0.65	14.71	----	0.49	16.63	30.50 30.50 31.00	27.33
14441	Mapes' Tobacco Manure (Wrapper Brand)	Mapes F. & P. G. Co., N. Y.	T. S. Loomis, Windsor O. S. Wood, Ellington Spencer Bros., Suffield	4.65	---	1.85	6.50	**6.2**	0.00	4.67	1.29	5.96	**4.5**	4.67	---	**10.5**	11.08	2.11	2.54	6.43	1.59	2.16	46.00 48.00 47.00	41.54
14442	Mapes' Tobacco Ash Constituents	Mapes F. & P. G. Co., N. Y.	Mapes' Branch, Hartford Spencer Bros., Suffield	0.05	---	0.61	0.66	**0.5**	0.00	1.21	5.08	6.29	**5.7**	1.21	---	**15.0**	15.70	3.36	12.34	----	2.53	12.42	32.00 33.00	20.63
14194	Mapes' Tobacco Starter, Improved	Mapes F. & P. G. Co., N. Y.	Spencer Bros., Suffield Mapes' Branch, Hartford	3.12	0.50	1.91	4.53	**4.1**	2.21	4.96	1.96	9.13	**8.0**	7.17	**6.0**	**1.0**	2.46	1.28	1.18	----	0.96	----	36.00 35.00	24.74
14453	Special Tobacco Manure with Carbonate Potash	National Fertilizer Co., Bridgeport	J. N. Lasbury, Broad Brook	---	---	4.68	4.68	**4.5**	0.11	5.03	0.62	5.76	**4.0**	5.14	**3.0**	**5.5**	5.05	0.80	1.69	2.56	0.60	1.44	31.00	28.16
14223	O. & W's. Complete Tobacco Fertilizer	Olds & Whipple, Hartford	A. A & W. G. Forbes, Silver Lane	1.37	---	4.03	5.40	**4.5**	0.38	3.50	0.65	4.53	---	3.88	**3.0**	**5.5**	6.46	0.53	2.54	3.39	0.40	2.16	34.00	31.38
14224	O. & W's. Complete Tobacco Fertilizer	" " " "	P S Brewer, Silver Lane	1.33	---	4.00	5.33	**4.5**	0.37	3.40	0.64	4.41	---	3.77	**3.0**	**5.5**	6.41	0.53	2.68	3.20	0.40	2.28	34.00	30.88
14229	O. & W's. Complete Tobacco Fertilizer	" " " "	Wm. H. Brewer, Silver Lane	1.00	---	4.20	5.20	**4.5**	0.34	3.56	0.83	4.73	---	3.90	**3.0**	**5.5**	5.64	0.39	2.26	2.99	0.29	1.92	34.00	29.80
14378	O. & W's. Complete Tobacco Fertilizer	" " " "	Patrick Connor, Poquonock	0.29	---	4.53	4.82	**4.5**	0.38	4.69	1.75	6.82	---	5.07	**3.0**	**5.5**	5.55	1.00	2.96	1.59	0.75	2.52	35.00	28.89
14444	O. & W's. Complete Tobacco Fertilizer	" " " "	L. A. Kent, Suffield G. F. King, " Samuel Orr, " J. F. Adams, " H. L. Spear, " L. W. Allen, " D. F. Remington, Suffield Spencer Bros., Suffield Factory	0.44	0.28	4.23	4.95	**4.5**	0.48	5.04	1.73	7.25	---	5.52	**3.0**	**5.5**	5.49	0.86	2.26	2.37	0.65	1.92	36.00 36.00 36.00 36.00 36.00 36.00 36.00 35.00 35.00	30.06
14446	O. & W's. Complete Tobacco Fertilizer	" " " "	Joseph Watson, Enfield	0.56	0.22	4.09	4.87	**4.5**	0.48	5.58	1.82	7.88	---	6.06	**3.0**	**5.5**	5.67	1.12	2.11	2.44	0.84	1.79	35.00	30.38
14447	O. & W's. Complete Tobacco Fertilizer	" " " "	" " "	0.72	0.17	4.42	5.31	**4.5**	0.32	5.00	1.46	6.78	---	5.32	**3.0**	**5.5**	6.10	1.00	2.20	2.90	0.75	1.87	35.00	31.96
14480	O. & W's. Complete Tobacco Fertilizer	" " " "	John Laverty, Poquonock	---	0.24	4.59	4.83	**4.5**	0.50	3.47	1.28	5.25	---	3.97	**3.0**	**5.5**	5.69	1.29	2.43	1.97	0.97	2.07	36.00	28.24

[1] Sampled and sent by Arthur Brown, Hillstown.
[2] Purchased by Julius Moore, Suffield.
[3] Sampled and sent by Alfred H. Griffin, Granby.
[4] Purchased by W. H. Hastings, Suffield.
[5] Purchased by James Wood, Suffield.

Home Mixtures. Formulas, Analyses and Valuations.

Station No.	Made by	Formulas. Pounds per ton. Nitrate of Soda.	Dried Blood.	Castor Pomace.	Dry Fish.	Tankage.	Ground Bone.	Dissolved Bone Black.	Acid Phosphate.	Muriate of Potash.	Double Sulphate of Potash.	Saltpeter Waste.	Kainit.
13968	Andrew Ure, Highwood, Special Mixture	---	---	---	---	---	---	---	---	---	---	----	-----
14125	J. G. Schwink, Meriden	100	---	---	---	750	---	---	750	200	200	----	-----
14225	A. C. Lake, Watertown	140	---	---	---	780	---	---	650	430	----	----	-----
14285	Conn. School for Boys, Meriden, Grass Mixture	500	---	---	---	500	---	---	400	250	----	----	350
14286	" " " " Potatoes	100	---	---	---	750	---	---	750	200	200	----	-----
14305	W. B. Thrall, Rockville	100	---	---	---	750	---	750	---	---	400	----	-----
14394	W. H. Baldwin, Cheshire	---	---	---	---	---	---	---	---	---	----	----	-----
14556	Arthur Manning, Hillstown	600	---	700	700	---	---	---	---	---	----	----	-----
14558	Barnes Bros., Yalesville	150	850	---	---	---	---	---	900	100	----	----	-----
15124	Andrew Kingsbury, Coventry	375	---	---	---	---	400	---	600	---	----	625	-----

Station No.	Analyses. Nitrogen as Nitrates.	Nitrogen as Ammonia.	Nitrogen Organic.	Total Nitrogen.	Water-soluble Phosphoric Acid.	Citrate-soluble Phosphoric Acid.	Citrate-insoluble Phosphoric Acid.	Total Phosphoric Acid.	Potash.	Cost (Unmixed) and Valuation. Cost per ton.	Valuation per ton.
13968	0.59	-----	2.09	2.68	3.42	2.71	1.67	7.80	4.32	-------	$19.33
14125	1.13	-----	2.39	3.52	3.78	4.83	1.64	10.25	8.63	$25.00	28.33
14225	0.96	---	2.86	3.82	4.59	5.10	1.12	10.81	11.03	27.84	31.88
14285	3.79	-----	1.67	5.46	1.92	3.25	0.68	5.85	9.49	28.37	31.74
14286	0.64	-----	2.57	3.21	3.14	5.11	1.82	10.07	8.51	23.35	26.76
14305	0.89	-----	1.81	2.70	4.88	2.53	6.02	13.43	4.90	28.25	23.17
14394	-----	-----	1.48	1.48	8.43	2.67	1.05	12.15	7.57	24.00	22.06
14556	5.12	-----	4.07	9.19	0.26	1.42	0.26	1.94	1.05	35.08	34.88
14558	0.91	-----	4.32	5.23	6.08	1.69	0.81	8.58	2.66	28.83	28.47
15124	3.15	-----	0.13	3.28	3.30	6.14	0.92	10.36	11.65	26.02	29.34

HOME MIXTURES.

In the table given above are analyses of ten home-mixtures which were in most cases sampled and sent by the persons who made them. Sample **14305** was mixed for the purchaser by a fertilizer company according to a formula furnished by him.

The same is true of sample **14558**.

The cost given does not in most cases cover the cost of mixing, but includes freight to owner's freight station.

These mixtures have a wide range of composition, to be sure, but the average of the nine whose cost is known is

Nitrogen	4.21 per cent.
Phosphoric acid	9.27
Potash	7.27
Cost per ton	$27.69

If we reckon the cost of mixing at $2.31, a very liberal figure, it appears that in the home-mixtures $30.00 bought 84 pounds of nitrogen, 185 pounds of phosphoric acid and 145 pounds of potash. This is more than could be bought for the same money in the highest grade factory mixed superphosphates or special manures, as may be seen by comparing these figures with those given on pages 54 and 75.

VEGETABLE POTASH.

This material, sold by Olds & Whipple, Hartford, is stated to be the ashes of refuse from beet sugar factories.

14131. Sampled and sent by E. S. Seymour, Windsor Locks, from stock of Olds & Whipple.

14436. Sampled by station agent from stock of J. C. Eddy, Simsbury, Olds & Whipple, Hartford and D. F. Remington, Suffield.

Analyses.

	14131	14436
Water-soluble potash	25.19	24.84
Total potash	26.44	
Chlorine	2.25	2.25
Sulphuric acid	2.25	2.21
Cost per ton	$40.00	40.00
Water-soluble potash costs cents per pound	**7.9**	**8.1**

Most of the potash in this material is in form of carbonate.

COTTON HULL ASHES.

This material is the ashes of the hulls which are separated from the "meats" of the cotton seed preliminary to the expression of cotton seed oil. For a time these ashes were abundant in our market and much prized as a potash fertilizer for tobacco. Then, for a few years, they could not be obtained, but during 1905 a considerable amount has been brought into this state.

Eighteen analyses have been made during 1905 which appear in the following table, together with one analysis of so-called "cotton-boll ashes," which have a similar composition.

14050. Car of 30 tons sold to Bissell-Graves Co., Suffield, **14047,** car of 20 tons sold to Henry Adams, J. F. Merrill and others, Suffield; **14040,** 3 tons sold to Edmund Halladay, Suffield. The three lots sold by Arthur Sikes of Suffield.

14280. Bought of Humphreys, Godwin & Co., Memphis, Tenn. Sampled and sent by H. S. Chapman & Co., Suffield.

14049. Car of 20 tons sold to W. H. Prout and others, Suffield; **14048,** car of 20 tons sold to W. H. Prout, D. I. King and others, Suffield; **14184,** sampled and sent by W. H. Prout, Suffield; **14211,** car of 15 tons sold to G. E. Gompf, J. S. Gardner and A. R. Austin, Suffield; **14258,** car of fifteen tons sold to Oscar Hazard and others of Suffield; **14261,** six tons sold to C. K. and H. T. Hale, Gildersleeve. The six lots from stock of Arthur Sikes, Suffield.

14399. Sampled by station agent from stock of C. K. Hale, Gildersleeve, bought of Arthur Sikes, Suffield.

14243. Sampled and sent by O. G. Hazard from stock bought of Arthur Sikes, Suffield.

14260. Car of 15 tons sold to John Sullivan and G. A. Peckham of Suffield; L. M. Pomeroy, West Suffield, and J. B. Cannon, Granby; **14259,** car of 15 tons sold to G. N. Thompson, Suffield, and others. The two lots from stock of Arthur Sikes, Suffield, and sampled by him.

14544. Bought of Humphreys, Godwin & Co., Memphis, Tenn., sampled and sent by Arthur Sikes, Suffield.

12991. "Cotton Boll Ashes" from American Cotton Oil Co., Memphis, Tenn., sampled and sent by Spencer Bros., Suffield.

13830. Sold by American Cotton Oil Co., 27 Beaver St., New York. Sampled and sent by Spencer Bros., Suffield.

13930. Sampled and sent by Arthur Sikes, Suffield.

14080. Sampled and sent by H. C. Warner, West Suffield, from stock of W. F. Fletcher, Southwick, Mass.

The percentage of water-soluble potash ranges from 12.64 to 23.61 and averages 19.80. Four of the samples are decidedly

ANALYSES OF COTTON HULL ASHES.

Station No.	Phosphoric Acid.				Potash.		Sulphuric Acid.	Chlorine.	Cost per ton.	Potash costs cents per pound.
	Water-soluble.	Citrate-soluble.	Citrate-insoluble.	Total.	Total.	Water-soluble.				
14050	0.19	7.88	0.71	8.78	26.91	22.72	2.94	0.30	$41.00	7.2
14047	0.45	7.15	0.66	8.26	26.84	23.61	2.81	0.21	41.00	7.3
14040	0.20	7.30	0.75	8.25	27.17	23.45	2.90	0.22	41.00	7.4
14280	1.28	6.21	0.95	8.44	22.60	20.60	2.68	0.19	38.00	7.6
14049	0.37	8.12	0.68	9.17	27.04	22.01	2.72	0.24	41.00	7.7
14048	0.19	7.38	0.66	8.23	26.33	22.15	2.90	0.27	41.00	7.8
14184	0.26	7.69	0.49	8.44	27.00	21.84	3.85	0.28	41.00	7.9
14211	1.17	5.69	0.76	7.62	14.92	12.64	1.92	0.07	27.50	8.5
14261	1.31	6.30	0.90	8.51	22.16	20.00	2.75	0.09	41.00	8.6
14258	1.33	5.77	0.93	8.03	21.74	19.96	2.77	0.15	41.00	8.7
14399	0.93	6.50	0.90	8.33	21.94	19.72	2.89	0.11	41.00	8.8
14243	1.25	5.79	0.97	8.01	22.03	19.50	2.73	0.11	41.00	8.9
14260	0.97	6.51	0.93	8.41	21.68	19.36	2.92	0.08	41.00	8.9
14259	1.18	6.00	0.73	7.91	21.28	19.22	2.56	0.08	41.00	9.0
14544	1.04	5.61	1.38	8.03	21.04	19.38	2.86	0.30	41.00	9.0
12991*	0.27	6.36	0.62	7.25	24.84	21.28	3.20	0.15	45.00	9.2
13830	0.75	5.20	0.55	6.50	17.03	15.00	3.44	0.12	34.32	9.8
13930	0.45	7.26	0.59	8.30	20.22	17.40	2.26	0.20	41.00	9.9
14080	0.96	7.30	0.66	8.92	20.90	16.40	1.67	0.07	44.00	11.3

* Cotton-boll ashes.

inferior as respects their potash content, but there is no evidence that they are adulterated. In some of the samples less than two per cent. of the total potash is insoluble in water, while in others over five per cent. is insoluble. The solubility of the potash is affected by the heat to which the hull ashes are subjected in the furnaces and by accidental impurities like sand, which may be there. If ashes are heated sufficiently with sand the potash may unite with sand and silicates to make compounds which are only very slowly and incompletely soluble in water, but which are broken up by acids.

Valuing the phosphoric acid in these samples as in mixed fertilizers, the cost of potash, which is largely in form of carbonate, ranges from 7.2 cents to 11.2 cents per pound, the average being 8.55 cents or 1.5 cents more per pound than in high grade carbonate, as appears on page 37.

WOOD ASHES.

In the table, pages 102 and 103 are given twenty-one analyses of "wood ashes" which show the usual range of composition.

Wood Ashes.

Station No.	Dealer or Purchaser.	Sampled or Sent by.
	Bowker Fertilizer Co., New York—	
14183	W. T. McKenzie, Yalesville	F. Seth Wiard, Yalesville
14242	Robert Hubbard, Middletown	Robert Hubbard
14311	Seth Viets, Suffield	Herman Ude, Suffield
14400	Barnes Bros., Yalesville	Barnes Bros.
14402	Seth Viets, Suffield	Station agent (stock of H. L. Spear)
14559	E. F. Jennison, Hartford	Barnes Bros., Yalesville
	John Joynt, Lucknow, Ont.—	
13998	J. G. Whitney, New Canaan	J. G. Whitney
14241	G. E. Norton, Bristol	G. E. Norton
14309	Ernest N. Austin, Suffield	Ernest N. Austin
14401	H. C. Aborn & Son, Ellington	Station Agent
	F. S. Bidwell, Windsor Locks	
15127	J. Arthur Sherwood, R. F. D. 5, Long Hill	J. Arthur Sherwood
15919	I. C. Fanton, Westport	I. C. Fanton
	F. R. Lalor, Dunnville, Ont.—	
13405	J. H. Elwood, Greens Farms	Station Agent
14128	Thos. Holt, Southington	Thomas Holt
	Geo. L. Monroe & Sons, Oswego, N. Y.—	
15191	Herbert Barnes, 1212 Quinnipiac Ave., New Haven	Herbert Barnes
14082	F. S. Bidwell, Windsor Locks	Ernest N. Austin, Suffield
14310	H. K. Brainard, Thompsonville	G. A. Douglass, Thompsonville
	Chas. Stevens—	
13847	Wm. H. Wilson, Harwinton	Wm. H. Wilson
14545	P. Havey, Suffield	P. Havey
13813	Chase Rolling Mill, Waterbury	W. M. Shepardson, Middlebury
14293	W. H. H. Miller, Glastonbury	W. H. H. Miller

The percentage of total potash ranges from 6.91 to 3.35 and that of lime from 50.05 to 26.51.

The last one given in the table, which is excluded from the averages, is apparently leached ashes.

The average composition of the ashes is:—

Total potash	5.08
Water-soluble potash	4.40
Phosphoric acid	1.39
Lime	32.98
Cost per ton	$10.37

If water-soluble potash is valued at eight cents per pound and phosphoric acid at four cents, the lime in ashes of average composition costs about 34 cents per 100 pounds.

Percentage Composition.

Total potash.	Potash solub in water.	Phosphoric acid.	Lime.	Magnesia.	Chlorine.	Sand and soil.	Charcoal.	Sulphuric acid.	Cost per ton.
5.37	4.57	1.83	28.40	------	------	------	------	------	$10.00
5.73	4.93	1.27	31.64	------	------	------	------	------	9.50
5.45	4.66	1.51	33.54	------	------	------	------	------	10.00
6.74	5.72	1.69	33.39	------	------	------	------	------	11.00
4.90	4.28	1.36	33.50	------	------	------	------	------	11.00
3.71	3.28	1.32	31.06	------	------	------	------	------	11.00
3.78	3.14	1.32	31.21	------	trace	------	------	------	11.75
5.13	4.49	1.24	29.72	------	------	------	------	------	9.50
6.02	4.73	1.60	26.51	------	------	------	------	------	12.00
6.90	6.28	1.41	28.37	------	------	------	------	------	11.00
									12.00
3.35	2.87	0.84	37.62	------	------	------	------	------	10.50
4.38	3.17	1.33	------	------	------	25.50	4.31	1.48	9.25
3.83	3.47	1.22	34.92	------	------	------	------	------	9.00
5.34	5.05	1.40	38.54	------	------	------	------	------	9.25
3.95	3.28	1.23	30.42	------	------	------	------	------	9.50
5.22	4.70	1.30	36.03	------	------	------	------	------	10.00
4.44	3.74	0.92	29.67	------	------	------	------	------	10.50
6.33	5.70	1.74	50.05	2.46	trace	------	------	0.69	------
6.91	6.31	1.54	26.80	------	------	------	------	------	------
4.05	3.65	1.73	35.26	------	------	------	------	------	------
------	1.85	------	37.21	------	------	------	------	------	------

Lime Kiln Ashes.

14083. Sampled and sent by E. N. Austin, Suffield.

14403. Sold by New England Lime Co., Canaan. Sampled by station agent from stock of M. E. Thompson, Ellington.

Analyses of Lime Kiln Ashes.

Percentage amounts of	14083	14403
Total potash	2.94	2.80
Water-soluble potash	2.56	2.41
Lime	35.50	42.85
Phosphoric acid	1.02	1.22
Cost per ton	$6.00	8.50
Lime costs cents per 100 pounds*	.15	.43

* Valuing water-soluble potash at 8 cents and phosphoric acid at 4 cents per pound.

LIME.

Two samples of unslaked lime, **15916** and **15920**, sent for analysis by P. D. Kibbe, Hartford, are stated to be from stock of Olds & Whipple, Hartford and sell for $9.00 and $8.00 per ton respectively.

ANALYSES.

	15916	15920
Insoluble in acid	2.52	2.28
Lime	46.09	47.28
Magnesia	32.70	33.81

Both samples are made from magnesian limestone such as occurs in the western part of this state. The lime in them costs about 85 cents per 100 pounds; lime and magnesia together cost about 50 cents per 100 pounds.

SOUTH AMERICAN GUANO.

No. **14405**. Sampled and sent by E. P. Brewer, Silver Lane, was stated by the Philadelphia firm selling it to contain 13 per cent. of ammonia, (equivalent to 10.7 per cent. of nitrogen,) 5 of "available" phosphoric acid and 2 of potash.

ANALYSIS OF SOUTH AMERICAN GUANO.

Percentage amounts of	
Nitrogen, organic	10.94
Water-soluble phosphoric acid	2.08
Citrate-soluble phosphoric acid	1.44
Citrate-insoluble phosphoric acid	0.19
Total potash	1.59
Water-soluble potash	0.84

A guano composed of the excrement of birds contains a considerable part of its nitrogen in form of ammonia and is soluble and very quickly available to plants. This material, however, contains no ammonia, the microscope shows it to be full of insect residues and it is probably a bat guano. The nitrogen in such material comes largely from insect wings and wing cases and is as inert in the soil as hair. Its purchase for use as a fertilizer cannot under ordinary circumstances be advised.

SWEEPINGS FROM A FERTILIZER FACTORY.

No. **14289**, sent by T. G. Whipple, Mystic, had the following composition.

Percentage amounts of	
Nitrogen as nitrate	0.24
Nitrogen, organic	1.04
Water-soluble phosphoric acid	3.71
Citrate-soluble phosphoric acid	2.08
Citrate-insoluble phosphoric acid	0.45
Water-soluble potash	1.48
Cost per ton	$19.00
Valuation per ton	11.11

DUST FROM WHEAT.

Sample No. **14182**, from the Ready Bits factory in New Haven, sampled by the station agent, contained 2.08 per cent. of nitrogen.

PULVERIZED SHEEP MANURE.

Sample No. **14127**, sent by the Stafford Floral Co., contained 2.42 per cent. of nitrogen.

ROTTED COTTON SEED COMPOST.

Sample **13410**, sent by the Bissell Graves Co., Suffield, contained 1.70 per cent. of nitrogen, 0.61 of phosphoric acid and 0.93 per cent. of potash. Its value as a commercial fertilizer is very small.

DUST FROM TOBACCO STEMMED BY MACHINERY.

Sample **14406**, sent by J. & H. Woodford, Avon, contained nitrogen 2.07 per cent., phosphoric acid 0.45 per cent., potash 1.86 per cent. This material, finely powdered, would serve as an insecticide for sucking insects, lice, etc., in the garden and incidentally as a fertilizer.

CARPET WOOL.

12990 is a sample of carpet shearings sent by C. H. Brainard, Thompsonville. It could be delivered on the land for about $2.50 per ton. The sample contained 13.88 per cent. of nitrogen. The nitrogen of wool waste is very inert, but may be made soluble by treatment with caustic soda. At the price named, which is equivalent to less than one cent per pound for nitrogen, it would be worth the experiment of composting with manure or other decaying matter.

SUMMARY.

The cash retail cost in Connecticut of nitrogen in raw materials during 1905 as shown in this report has been

	Cents per pound. Highest.	Lowest.	Average.
In Nitrate of soda	17.5	16.4	16.9
Dried blood	....	....	21.9
Cotton seed meal	20.6	14.2	16.4
Castor pomace	24.5	20.4	22.4
Flax seed meal	....	....	21.9

The corresponding price of "available" phosphoric acid in form of dissolved rock phosphate has been

	4.8	4.3	4.5

The corresponding price of potash in raw materials has been

In High grade carbonate	7.3	6.7	7.1
Carbonate as "vegetable potash"	8.1	7.9	8.0
High grade sulphate	5.3	4.8	5.0
Double sulphate	5.9	4.9	5.3
Muriate of potash	4.5	4.0	4.25
Saltpeter waste	..	..	0.7
Kainit	..	..	4.7

The price of lime *per 100 pounds* has been

In Wood ashes	..	..	34
Lime kiln ashes	15	4.3	..
Ground slaked lime	..	..	85

PART II.

TENTH

REPORT ON FOOD PRODUCTS.

New Haven, December 1, 1905.

To His Excellency, Henry Roberts, Governor of Connecticut:

As required by law, I herewith respectfully submit to you the Tenth Report of the Connecticut Agricultural Experiment Station on Food Products for the year ending July 31, 1905.

The work which has been done during the year is reported in the following pages, by Dr. Winton, chief of the chemical laboratory.

The station is charged only with the examination of food products, the publication of its findings and the report to the dairy commissioner of all cases of adulteration found. With the commissioner rests the enforcement of the law, and in his report will be found the record of prosecutions brought for violations of the law regarding food products.

It has hitherto been the practice of the station to examine gratuitously for private individuals the few samples of food products submitted by them, when accompanied with the required information regarding the origin of the samples. This was done with the belief that such examinations were, or might be, of general information and profit.

It has, however, become absolutely necessary to abandon this practice in large measure, in order that the station, with its present resources, may do the work required of it under various state laws. The number of samples sent in as above described had become very large, so that they very seriously interfered with our required work. (As will be seen in following pages, more than 260 samples of this kind were examined this year.) A part of the samples were from manufacturers or wholesalers, where no point of interest to the public was involved, and certain samples were found to have been sent merely for the purpose of deciding bets.

It is clear that, with the present public interest in the purity of food products, no institution with a yearly appropriation of $2500 for the purpose, can carefully examine all the samples which the citizens of the state may care to send in for one reason or another. It is also clear that to accomplish most in stopping fraud in food, the matter of collecting food products for analysis should largely be left to the discretion of those specially charged with the work.

The station does not absolutely decline to examine any sample submitted by a purchaser or consumer, but in the public interest it has become necessary to strictly limit the amount of such work.

Very respectfully,

E. H. JENKINS, *Director*.

REPORT OF THE EXAMINATIONS OF FOOD PRODUCTS SOLD IN CONNECTICUT

In the year ending July 31, 1905.

BY A. L. WINTON, E. MONROE BAILEY, I. A. ANDREW, AND KATE G. BARBER.

MILK.

Milk Sampled by the Station.—As in preceding years, all the samples here discussed were bought of milkmen during the summer months. The sampling agent visited fifteen towns and collected a total of 228 samples, all of which were analyzed in the station laboratory. The analysis included determinations of specific gravity, total solids, and fat (to detect skimmed milk or watered milk), tests for preservatives (boric acid, formaldehyde, etc.), and tests for foreign colors (coal-tar dyes, anatto, etc.).

A summary of the results is given in Table I, and the results in detail in Table II, pages 111-115.

From Table I it appears that of the 228 samples examined 78 were below standard in solids, 131 in solids not fat and 15 in fat. In all 134 failed to fully meet the standard requirements for market milk.

The following dealers sold milk which was grossly adulterated:

13763 Chas. Bahadoorigian, New Britain .... Watered
13783 David Krall, New Haven .... Formaldehyde
14583 A. Rice, New Haven (Montowese) .... Watered
13689 L. Burriesce, Stamford (Talmadge Hill) .... Watered

The following dealers sold milk which is below the United States standard and the station standard. The samples range from milk which is of poor quality in every particular all the way down to that which is unfit for sale on account of its chemical composition and is probably watered.

13721 J. E. Macdonald & Son, Bridgeport (Shelton).
14679 G. Winkler,* Derby.
14598 F. O. Jackson, Middletown.
14568 C. W. Brock, New Haven (Whitneyville).
14584 L. C. Palmer, New Haven.
14569 J. H. Story, New Haven.
13688 J. H. Bedell, Stamford.
13700 Emmet L. Weed, Stamford.
13746 T. B. Eggleston, Waterbury.
13753 W. Messick, Waterbury.
13750 Joseph Nagle,* Waterbury.
13748 F. C. Porter,* Waterbury.
13754 G. S. Van Atta, Waterbury.

There are also a dozen or more samples which, while they contain the percentage of fat necessary to meet the standard in that particular, are yet of very poor quality and some of them also are no doubt watered.

COMPOSITION OF MARKET MILK FOR THE LAST FIVE YEARS.

	Average Percentages. Solids.	Fat.	Percentage of adulterated samples.
Summer of 1905	12.36	4.04	1.8
" " 1904	12.44	4.05	8.9
" " 1902	12.63	4.13	10.9
" " 1901	12.50	4.00	8.5
" " 1900	12.53	3.99	11.4

Milk Sampled by the Dairy Commissioner.—Seventeen samples were examined, of which twelve were adulterated.

Milk Sampled by Health Officers.—On October 11, 1904, five sealed samples were received from G. W. Anderson, health officer, Stamford. All were of good quality excepting the following:

* As stated by driver.

13338. Marked: "Robt. Tryon, Roxbury." Contained formaldehyde.

Dr. E. A. McLellan, health officer, Bridgeport, sent the following on July 7, 1905.

14562. Stated to be market milk of Mr. Cole. Specific gravity at 60° F., 28.1; total solids, 10.82%; fat, 3.3%. Below standard.

TABLE I.—SUMMARY OF ANALYSES OF MILK BOUGHT OF MILKMEN, 1905.

Place.	Number of Samples.	Below twelve per cent. of total solids.	Below eight and one-half per cent. of solids not fat.	Below three and one-quarter per cent. of fat.	Contain boric acid (borax).	Contain formaldehyde.	Colored with anatto.	Colored with coal-tar dye.
Bridgeport	36	14	22	1	0	0	0	0
Derby	11	4	6	1	0	0	0	0
Glastonbury	2	0	0	0	0	0	0	0
Hartford	29	8	20	0	0	0	0	0
Middletown	19	3	8	1	0	0	0	0
New Britain	13	4	6	0	0	0	0	0
New Haven	35	20	27	3	0	1	0	0
New London	19	3	6	0	0	0	0	0
Norwalk	5	1	1	0	0	0	0	0
Norwich	13	4	6	1	0	0	0	0
South Glastonbury	1	0	1	0	0	0	0	0
South Norwalk	7	3	5	0	0	0	0	0
Stamford	16	6	10	3	0	0	0	0
Waterbury	12	7	10	5	0	0	0	0
Willimantic	10	1	3	0	0	0	0	0
Total for 1905	228	78	131	15	0	1	0	0
" 1904	316	108	185	31	2	5	5	2
" 1902	292	80	130	22	1	3	4	3
" 1901	375	109	190	43	2	7	--*	--*
" 1900	246	54	100	34	7	14	--*	--*

* No tests for colors were made in 1900 and 1901.

The following sample was received on July 18, 1905, from Dr. Geo. T. Crowley, inspector of milk, New Britain.

14565. Stated to be peddled by Mrs. August Albert. Specific gravity at 60° F., 21.2; total solids, 7.59%; fat, 2.00%. Watered milk.

Milk Sampled by Consumers and Dealers.—During the year 218 samples have been examined for private parties. As the station can in no case vouch for the accuracy of the sampling and as most of the results are not of public interest, details are not here given.

TABLE II.—MILK BOUGHT OF MILKMEN.

Station No.	Sampled.	Dealer.	Specific gravity at 60° F.	Total solids.	Solids not fat.	Fat.	Preservative.	Color.
		Bridgeport.		%	%	%		
13727	July 17	Benjamin Barski*	30.0	11.84	8.44	3.4	None	Natural.
14654	31	F. Campbell, Long Hill	27.9	10.89	7.59	3.3	"	"
13728	17	P. E. Card, Farm Dairy	29.6	11.98	8.08	3.9	"	"
13717	17	J. Davis, Trumbull*	26.6	10.59	7.29	3.3	"	"
14664	31	J. M. Disbrow*	28.7	12.02	8.12	3.9	"	"
14653	31	W. E. Disbrow, Sport Hill Dairy	31.3	12.29	8.59	3.7	"	"
14663	31	Ernest Feaz	30.5	12.51	8.41	4.1	"	"
13729	17	John Flynn	28.6	11.27	7.87	3.4	"	"
13725	17	D. M. Fuller, Long Hill	29.7	12.04	8.34	3.7	"	"
13716	17	A. W. Hall*	28.0	10.76	7.36	3.4	"	"
13715	17	Hillside Farm Dairy	31.2	12.52	8.62	3.9	"	"
14666	31	A. C. Howard & Son	32.7	13.31	9.01	4.3	"	"
14670	31	D. B. Hoyt	25.5	10.45	7.15	3.3	"	"
14656	31	Joshua Kent, Sport Hill	30.0	12.50	8.40	4.1	"	"
13721	17	J. E. Macdonald & Son, Maplewood Dairy, Shelton	27.5	10.65	7.45	3.2	"	"
13720	17	J. E. Macdonald & Son, Maplewood Dairy, Shelton	30.9	12.15	8.35	3.8	"	"
13724	17	G. Machalowski, Trumbull	28.9	11.77	8.07	3.7	"	"
13726	17	Wm. McClellan	27.3	11.53	7.83	3.7	"	"
14668	31	F. A. Marsh, Excelsior Dairy, Easton	30.9	13.32	8.72	4.6	"	"
14662	31	Robert Marsh*	30.6	12.80	8.60	4.2	"	"
14660	31	C. G. Miller, Stratfield Dairy*	33.1	13.61	9.31	4.3	"	"
13730	17	Mitchell Dairy	30.6	13.72	8.82	4.9	"	"
13719	17	Geo. Nichols*	27.0	11.22	7.62	3.6	"	"
14659	31	The Nickel Plate Dairy, Long Hill	32.0	13.30	8.90	4.4	"	"
14657	31	Park City Dairy	33.0	13.13	9.13	4.0	"	"
13723	17	H. W. Parks*	28.3	10.95	7.45	3.5	"	"
13718	17	Geo. Randall*	31.2	12.39	8.39	4.0	"	"
14665	31	Howard Randall*	30.6	12.17	8.47	3.7	"	"
14658	31	The Roger Farm Dairy	29.7	11.98	8.18	3.8	"	"
14669	31	W. A. Russell*	30.7	12.42	8.52	3.9	"	"
13722	17	John G. Schmitt, R. F. D. 52*	28.9	11.67	7.97	3.7	"	"
14667	31	Chas. Sherwood, Woodshire Dairy	29.7	13.41	8.51	4.9	"	"
14655	31	J. W. Sherwood	29.9	12.25	8.25	4.0	"	"
14652	31	Howard Silliman*	31.9	12.81	8.61	4.2	"	"
14661	31	Geo. Smith, Long Hill*	31.6	12,82	8.62	4.2	"	"
13731	17	Wm. A. Tatters*	31.1	12.84	8.84	4.0	"	"
		Derby.						
14675	Aug. 1	A. B. Barnes, Orange*	30.8	12.78	8.48	4.3	"	"
14680	1	W. B. Booth*	26.3	12.72	7.72	5.0	"	"
14671	1	D. H. Clark	30.9	11.58	8.28	3.3	"	"
14676	1	C. D. Dimon*	31.5	12.67	8 67	4.0	"	"
14673	1	M. W. Johnson, Monroe	31.3	12.67	8.77	3.9	"	"
14678	1	McConnery Bros.*	29.7	11.86	8.16	3.7	"	"
14681	1	G. Muscarello*	30.7	12.93	8.63	4.3	"	"
14674	1	C. W. Ran, Monroe*	30.2	13.68	8.58	5.1	"	"
14672	1	W. W. Saunders*	31.9	13.21	8.81	4.4	"	"
14677	1	F. Wheeler*	29.2	11.98	8.08	3.9	"	"
14679	1	G. Winkler*	30.8	11.29	8.39	2.9	"	"
		Glastonbury.						
14714	Aug. 29	A. L. Peck, Maple Crest Dairy	30.5	14.30	9.10	5.2	"	"
14713	29	Frank Urbansky	32.0	12.69	8.79	3.9	"	"

* Statement of driver. Names not marked with * were given on the cart.

TABLE II.—MILK BOUGHT OF MILKMEN—*Continued.*

Station No.	Sampled.	Dealer.	Specific gravity at 60° F.	Total solids.	Solids not fat.	Fat.	Preservative.	Color.
		Hartford.		%	%	%		
14692	Aug. 2	J. F. Auglum	29.0	**11.61**	**8.01**	3.6	None	Natural.
14693	2	W. A. Ayer	31.4	12.76	8.56	4.2	"	"
13711	July 14	Brault Bros.	31.1	13.26	8.76	4.5	"	"
13706	14	C. J. Christensen, Bloomfield	30.3	12.74	8.64	4.1	"	"
14698	Aug. 2	A. Cohen	28.3	**11.88**	**7.98**	3.9	"	"
13708	July 14	O. A. Davis, Wethersfield	30.0	12.32	**8.32**	4.0	"	"
14696	Aug. 2	Geo. L. Derby, West Hartford	31.4	12.72	8.82	3.9	"	"
14699	2	H. I. Epstein	30.4	12.93	**8.43**	4.5	"	"
13713	July 14	J. J. Felth, West Hartford	30.2	12.39	**8.39**	4.0	"	"
13705	14	Wm. P. Francis, Bloomfield	31.0	12.99	8.59	4.4	"	"
14689	Aug. 2	P. Gulmartin, Bloomfield	30.4	12.92	8.72	4.2	"	"
13707	July 14	The Hartford Dairy Co.	30.1	12.08	**8.38**	3.7	"	"
13703	14	The Hartford Dairy Co.	30.4	**11.80**	**8.30**	3.5	"	"
14683	Aug. 2	The Hartford Dairy Co.	30.4	12.08	**8.38**	3.7	"	"
14685	2	J. A. Jensen	32.4	13.46	8.96	4.5	"	"
13712	July 14	F. Kudkowski, West Hartford	29.6	13.28	**8.48**	4.8	"	"
13704	14	J. W. Merrill	26.6	**11.95**	**7.45**	4.5	"	"
14690	Aug. 2	F. Orleander, West Hartford	27.5	**11.00**	**7.50**	3.5	"	"
13714	July 14	Ridgeside Farm, Newington	30.2	12.33	**8.33**	4.0	"	"
13709	14	J. C. Saunders, Wethersfield	30.3	**11.77**	**8.07**	3.7	"	"
14687	Aug. 2	L. W. Seymour	30.6	12.42	**8.42**	4.0	"	"
14688	2	Frank Staton, Wethersfield*	29.4	12.69	**8.19**	4.5	"	"
14695	2	J. O. Stratton	29.3	12.63	**8.33**	4.3	"	"
14686	2	Otto Thompson	30.5	13.09	**8.39**	4.7	"	"
14697	2	A. B. Waterman, Newington	29.7	12.16	**8.16**	4.0	"	"
13710	July 14	Geo. L. Wells, Wethersfield	28.4	**10.89**	**7.59**	3.3	"	"
14694	Aug. 2	E. J. Wickham, Manchester	28.0	**11.83**	**7.73**	4.1	"	"
14691	2	J. Velmstrom	31.4	12.12	8.62	3.5	"	"
14684	2	No. 68	31.4	12.78	8.58	4.2	"	"
		Middletown.						
14600	July 25	F. B. Ashton*	30.8	13.36	8.66	4.7	"	"
14606	25	T. Coleman	31.1	13.06	8.56	4.5	"	"
14592	25	Daniels Bros., Millbrook Farm	30.3	**11.72**	**8.22**	3.5	"	"
14601	25	Chas. T. Davis	33.7	14.40	9.30	5.1	"	"
14602	25	R. Davis, Oak Grove Dairy	31.1	14.29	**8.39**	5.9	"	"
14609	25	Jas. Dripps	30.3	13.92	8.82	5.1	"	"
14605	25	A. W. Gilbert	30.2	12.65	**8.45**	4.2	"	"
14608	25	Robert Hubbard	31.6	12.74	8.74	4.0	"	"
14598	25	F. O. Jackson, Walnut Grove Dairy	31.0	**11.62**	**8.42**	**3.2**	"	"
14596	25	Johnson Bros.	29.9	**11.92**	**8.22**	3.7	"	"
14604	25	Frank Jones*	29.3	12.01	**7.91**	4.1	"	"
14607	25	Lee Bros.*	31.3	13.61	8.81	4.8	"	"
14599	25	H. E. Merrill, Utopia Farm Cromwell	30.5	12.44	8.64	3.8	"	"
14603	25	C. C. Plum	30.4	12.07	**8.37**	3.7	"	"
14594	25	E. H. Plum	31.6	13.72	8.82	4.9	"	"
14597	25	E. J. Roberts, Mapleshade Dairy	31.4	12.35	8.65	3.7	"	"
14591	25	M. R. Rohan, Mt. Higby Farm	30.6	12.79	**8.49**	4.3	"	"
14593	25	L. M. Tucker, Cedar Hill Dairy	31.5	12.17	8.57	3.6	"	"
14595	25	Fred Zens	31.4	12.87	8.77	4.1	"	"

* Statement of driver. Names not marked with * were given on the cart.

TABLE II.—MILK BOUGHT OF MILKMEN—*Continued.*

Station No.	Sampled.	Dealer.	Specific gravity at 60° F.	Total solids.	Solids not fat.	Fat.	Preservative.	Color.
		New Britain.		%	%	%		
13763	July 20	Chas. Bahadoorigian, Stanley Quarter*	24.7	**10.50**	**6.90**	3.6	None	Natural.
13760	20	E. A. Elliott, No. 16	31.5	12.67	8.57	4.1	"	"
13772	20	F. J. Elton, No. 7	30.8	12.36	**8.36**	4.0	"	"
13771	20	A. W. Hall, No. 55	31.3	12.50	8.70	3.8	"	"
13766	20	A. Hansen, No. 78, Kensington*	30.3	12.35	8.55	3.8	"	"
13770	20	C. F. Johnson, No. 34, Kensington	30.5	**11.61**	**8.21**	3.4	"	"
13764	20	Edward Lundell, No. 41	31.5	13.82	9.02	4.8	"	"
13768	20	I. J. Newton, West Hartford	31.1	12.93	8.63	4.3	"	"
13761	20	Joe Shapiro, No. 8	28.4	**10.92**	**7.42**	3.5	"	"
13773	20	Antoni Switai, No. 29	30.8	12.55	8.75	3.8	"	"
13767	20	Geo. Van Epps, No. 101, Cloverdale Dairy	30.4	14.00	8.70	5.3	"	"
13769	20	J. H. Weymouth, Newington*	30.3	12.35	**8.15**	4.2	"	"
13765	20	No. 20	30.5	**11.92**	**8.22**	3.7	"	"
		New Haven.						
14582	July 24	G. G. Allen, Quinnipiac ave.	28.2	**11.59**	**8.09**	3.5	"	"
13781	21	W. M. Andrew, Orange	30.4	12.05	8.55	3.5	"	"
14590	24	A. D. Andrus, No. 117	27.5	**11.33**	**7.43**	3.9	"	"
14586	24	John J. Augur, No. 10	29.7	**11.75**	**8.25**	3.5	"	"
14576	24	W. M. Bailey*	30.9	12.06	**8.46**	3.6	"	"
13775	21	J. E. Bishop & Sons, No. 2	30.8	12.15	8.55	3.6	"	"
14585	24	Geo. J. Borst, No. 46	29.9	**11.46**	**8.16**	3.3	"	"
14577	24	Wm. Brennan, Foxon	29.1	12.03	**8.23**	3.8	"	"
14568	21	C. W. Brock, Whitneyville	30.8	**11.66**	**8.46**	**3.2**	"	"
13776	21	C. Carlson & Pierson Co.	26.9	**10.76**	**7.46**	3.3	"	"
13780	21	Clover Dairy Creamery	27.1	**10.84**	**7.54**	3.3	"	"
13774	21	Clover Dairy Creamery	29.9	**11.93**	**8.33**	3.6	"	"
13777	21	D. Dwyer, No. 31	29.9	12.46	**8.36**	4.1	"	"
14571	21	H. J. Fabrique, 195 Lenox st.	29.8	**11.69**	**8.09**	3.6	"	"
13785	21	H. J. Fabrique	29.0	**11.62**	**7.82**	3.8	"	"
13778	21	J. Gold, No. 8	28.5	**11.68**	**8.08**	3.6	"	"
14682	Aug. 1	A. Golden, Scranton & Day sts.	29.9	**11.74**	**8.14**	3.6	"	"
14567	July 21	G. B. Hall, No. 137	29.8	12.50	8.50	4.0	"	"
14572	24	J. R. Huston, No. 28	31.0	12.64	8.54	4.1	"	"
14587	24	J. W. Johnson, Pond Lily Dairy	30.3	12.36	8.56	3.8	"	"
13783	21	David Krall, No. 30, 28 Dow st.*	27.4	**10.97**	**7.57**	3.4	Formaldehyde	"
14588	24	David Krall, No. 30, 28 Dow st.*	31.4	12.77	8.97	3.8	None	"
14570	21	W. H. Lee, Fairlea Farm	30.3	13.86	8.56	5.3	"	"
14575	24	H. G. Meserole, No. 96, East Haven	31.9	**11.72**	**8.42**	3.3	"	"
14579	24	New England Dairy	28.8	12.56	**8.36**	4.2	"	"
13779	21	R. N. Noble, 1500 Quinnipiac ave.	30.3	**11.94**	**8.34**	3.6	"	"
14584	24	L. C. Palmer	29.6	**11.38**	**8.38**	**3.0**	"	"
14574	24	L. C. Palmer, No. 45	30.3	12.66	**8.46**	4.2	"	"
14583	24	A. Rice, Montowese	25.1	**10.37**	**6.97**	3.4	"	"
13782	21	C. W. Russell, No. 141 Tyler City	30.2	12.47	**8.37**	4.1	"	"
14580	24	R. A. Scholz, No. 113	27.5	15.29	**8.19**	7.1	"	"
14569	21	J. H. Story, Cedar Hill Dairy	29.4	**10.92**	**8.12**	**2.8**	"	"
14578	24	W. F. Thompson, No. 86	30.5	**11.94**	**8.34**	3.6	"	"
13784	21	Max Walley, Washington ave.*	30.6	12.42	8.72	3.7	"	"
14573	24	Spring Glen Farm, James I. Webb, Manager	30.3	**11.90**	**8.10**	3.8	"	"

* Statement of driver. Names not marked with * were given on the cart.

TABLE II.—MILK BOUGHT OF MILKMEN—*Continued.*

Station No.	Sampled.	Dealer.	Specific gravity at 60° F.	Total solids.	Solids not fat.	Fat.	Preservative.	Color.
		New London.		%	%	%		
14621	July 27	J. Ackerman*	31.9	13.81	8.91	4.9	None	Natural.
14631	27	Frank Alexander*	26.1	**10.86**	**7.16**	3.7	"	"
14638	27	L. H. Beckwith, Stony Brook Dairy	30.3	12.57	**8.37**	4.2	"	"
14637	27	W. H. Benham, Riverside Dairy	28.7	12.49	**8.19**	4.3	"	"
14625	27	Woodbury Bush*	31.4	13.60	9.00	4.6	"	"
14635	27	C. W. Campbell	31.4	12.97	8.87	4.1	"	"
14626	27	John Carlton, Millstone Farm*	31.1	12.00	8.70	3.3	"	"
14634	27	H. G. Champion, Waterford	31.6	14.36	9.06	5.3	"	"
14629	27	David Coffey*	30.4	13.52	8.72	4.8	"	"
14633	27	F. L. Dimock*	30.5	**11.91**	**8.31**	3.6	"	"
14624	27	T. H. Hanney, Waterford	29.8	13.26	8.56	4.7	"	"
14627	27	H. C. Lamphere	30.5	13.00	8.80	4.2	"	"
14628	27	Newbury's Dairy	30.6	14.06	8.86	5.2	"	"
14620	27	Oakland Farm	27.9	**11.29**	**7.69**	3.6	"	"
14636	27	Leon St. Germain, Cohanzie st.	30.6	13.10	8.60	4.5	"	"
14630	27	Frank Seilvier*	27.1	12.14	**7.54**	4.6	"	"
14622	27	G. Snelitzkie*	29.7	13.95	8.75	5.2	"	"
14632	27	H. T. Squire, Ocean ave.	31.1	13.49	8.69	4.8	"	"
14623	27	Julius Watrous*	31.2	12.93	8.83	4.1	"	"
		Norwalk.						
13740	July 18	Mrs. E. R. Aiken, Silver Mine Dairy	30.4	14.35	8.75	5.6	"	"
13741	18	David Jenks*	26.5	**10.37**	**7.07**	3.3	"	"
13739	18	R. Loudon, Sear Hill Dairy	30.8	13.00	8.50	4.5	"	"
13742	18	C. Ruscoe, No. 10, Maple Grove Dairy	31.4	12.70	8.70	4.0	"	"
13743	18	G. J. Shaller, Comstock Hill Dairy	31.5	13.47	8.57	4.9	"	"
		Norwich.						
14643	July 28	H. Burnham*	27.4	**11.46**	**7.96**	3.5	"	"
14644	28	J. H. Butler, Norwich Town*	31.3	15.54	9.34	6.2	"	"
14648	28	H. F. Davis*	29.0	12.36	**8.16**	4.2	"	"
14645	28	W. S. DeWolf*	31.9	13.47	9.17	4.3	"	"
14640	28	G. A. Jenks, Preston*	31.2	12.33	8.53	3.8	"	"
14650	28	H. L. Kenney*	30.3	12.60	8.50	4.1	"	"
14646	28	F. K. Kingsley*	29.9	12.43	**8.33**	4.1	"	"
14641	28	Fred Palmer*	27.3	13.51	**8.11**	5.4	"	"
14642	28	John Peckham*	26.6	**11.62**	**7.42**	4.2	"	"
14639	28	G. T. Rogers*	31.3	**11.41**	8.51	**2.9**	"	"
14647	28	John Rogers*	30.3	13.17	8.67	4.5	"	"
14649	28	Ransom Sholes*	25.9	**11.23**	**7.23**	4.0	"	"
14651	28	Lewis Smith*	30.0	13.80	8.50	5.3	"	"
		South Glastonbury.						
14715	Aug. 29	James Reed*	28.8	12.48	**8.48**	4.0	"	"
		South Norwalk.						
13745	July 18	G. W. Guyer, Compo Dairy	29.8	**11.74**	**8.14**	3.6	"	"
13732	18	Chas. H. Hawxhurst	25.4	**10.59**	**7.09**	3.5	"	"
13733	18	Chas. H. Hawxhurst, No. 9	30.4	12.23	**8.43**	3.8	"	"
13735	18	Chas. E. Hoyt	27.6	**11.46**	**7.76**	3.7	"	"
13734	18	W. D. Keeler, Ridgewood Farm	27.3	13.16	**7.76**	5.4	"	"
13744	18	F. R. Waters, White Oak Dairy	31.5	12.51	8.81	3.7	"	"
13736	18	Webb & Jackson, Model Milk Dairy	31.8	12.71	8.91	3.8	"	"

* Statement of driver. Names not marked with * were given on the cart.

TABLE II.—MILK BOUGHT OF MILKMEN—*Concluded.*

Station No.	Sampled.	Dealer.	Specific gravity at 60° F.	Total solids.	Solids not fat.	Fat.	Preservative.	Color.
		Stamford.		%	%	%		
13696	July 13	J. H. Bedell, No. 109, Long Ridge Dairy	29.0	**11.93**	**8.03**	3.9	None	Natural.
13687	13	J. H. Bedell, No. 110, Long Ridge Dairy	28.2	**11.74**	**7.84**	3.9	"	"
13688	13	J. H. Bedell, No. 111, Long Ridge Dairy	27.3	**10.41**	**7.51**	**2.9**	"	"
13702	13	Bouton's, No. 119	28.2	13.54	**7.94**	5.6	"	"
13689	13	L. Burriesce, No. 125, Talmadge Hill	23.2	**8.26**	**6.16**	**2.1**	"	"
13692	13	G. C. Chard, No. 114, Riverbank Dairy	30.6	12.56	**8.36**	4.2	"	"
13698	13	Consolidated Milk and Cream Co.	31.0	12.50	8.60	3.9	"	"
13701	13	H. I. Dann, No. 133, Mt. Pleasant Dairy	30.8	12.59	**8.49**	4.1	"	"
13697	13	H. I. Dann, No. 134, Mt. Pleasant Dairy	30.9	12.77	8.57	4.2	"	"
13699	13	Noroton Dairy, No. 118	31.5	12.70	8.80	3.9	"	"
13695	13	Rock Hill Dairy, No. 105	31.5	13.38	8.98	4.4	"	"
13694	13	Darius Sarr, No. 145, Hillcrest Dairy	30.3	12.73	**8.43**	4.3	"	"
13693	13	Stanley Thompkins, No. 122*	30.3	12.58	**8.48**	4.1	"	"
13690	13	W. F. Waterbury, No. 103, Maplehurst Dairy	31.7	13.03	8.83	4.2	"	"
13700	13	Emmet L. Weed, No. 116, Springdale Dairy	28.8	**10.87**	**7.77**	**3.1**	"	"
13691	13	Westover Dairy, No. 113, H. L. Palmer, Supt.	30.9	**11.89**	8.59	3.3	"	"
		Waterbury.						
13752	July 19	James Bergen*	29.8	12.33	**8.23**	4.1	"	"
13758	19	Cashman Bros., Watertown	30.1	12.28	8.58	3.7	"	"
13747	19	F. P. Clough, Meadow Farm	30.4	12.05	**8.35**	3.7	"	"
13746	19	T. B. Eggleston, Bucks Hill Road	26.7	**10.62**	**7.42**	**3.2**	"	"
13756	19	I. K. J.	30.8	**11.68**	**8.28**	3.4	"	"
13755	19	J. W. Laughlin, Watertown	28.9	12.01	**7.81**	4.2	"	"
13757	19	Maple Hill Dairy, No. 22	29.0	**11.90**	**7.90**	4.0	"	"
13753	19	W. Messick, No. 62	29.2	**11.13**	**7.93**	**3.2**	"	"
13751	19	W. J. Munson, Watertown Road	30.5	12.51	8.51	4.0	"	"
13750	19	Jos. Nagle*	27.8	**10.51**	**7.51**	**3.0**	"	"
13748	19	F. C. Porter*	27.8	**10.42**	**7.42**	**3.0**	"	"
13754	19	G. S. Van Atta, No. 23	27.1	**10.23**	**7.23**	**3.0**	"	"
		Willimantic.						
14610	July 26	Brindamour Bros.	31.9	13.07	8.77	4.3	"	"
14611	26	C. A. Hawkins, Cloverdale Dairy	30.8	**11.79**	**8.19**	3.6	"	"
14614	26	C. H. Hoxie	28.0	13.00	**8.10**	4.9	"	"
14613	26	G. A. Jacobs	30.8	13.57	8.77	4.8	"	"
14612	26	G. W. Rappelye, Phelps Crossing	29.8	12.83	**8.33**	4.5	"	"
14615	26	F. Rosebrooks	30.0	13.38	8.68	4.7	"	"
14616	26	I. H. Stanton*	30.0	13.29	8.69	4.6	"	"
14617	26	J. H. Stearns, Mountain Milk Farm	31.3	12.50	8.60	3.9	"	"
14619	26	V. D. Stearns, Evergreen Dairy	31.1	12.92	8.82	4.1	"	"
14618	26	Chas. Young*	31.5	15.50	9.40	6.1	"	"

* Statement of driver. Names not marked with * were given on the cart.

CONDENSED MILK.

A sample of condensed milk, sold in bulk (No. **13839**), was analyzed at the request of the New England Dairy Co., New Haven, with the following results:

	In the original sample.	In the milk solids.
	%	%
Ash	1.75	5.91
Protein	7.96	26.89
Milk sugar	15.04	50.79
Fat	4.86	16.41
Milk solids	29.61	100.00
Cane sugar	42.75	
Water	27.64	
	100.00	

The low percentage of fat in the milk solids shows that the product was made from skimmed milk. According to the United States standards, the milk solids of sweetened condensed milk should contain not less than 25 per cent. of fat, whereas the sample in question contained but 16.41 per cent.

CREAM.

Two samples collected by the Dairy Commissioner, one by L. C. Root, milk inspector, Stamford, and twenty-two by consumers and dealers have been examined. The amount of fat in them ranged from 13.0 to 49.89 per cent. One of the samples sent by a retail dealer contained boric acid.

STERILINE.

This product, analyzed at the request of the Dairy Commissioner, appears to be condensed separator skim milk to which gelatin has been added. The results of the analysis follow:

	%
Casein, albumen and gelatin (N × 6.37)	8.92
Ash	2.16
Fat	trace
Sugar by difference	14.17
Total solids	25.25

EVAPORATED CREAM.

This product, although known commercially as evaporated cream, is (as is usually stated on the label) unsweetened condensed milk.

Two samples sent by Henry D. Lewis, New Haven, have been examined:

13426. Top Notch Evaporated Cream, Van Camp Condensed Milk Co., Effingham, Ill. Contains 28.63 per cent. of total solids and 7.10 per cent. of fat. Not found adulterated.

13427. Borden's Peerless Evaporated Cream, Borden's Condensed Milk Co., New York. Contains 29.03 per cent. of total solids and 7.55 per cent of fat. Not found adulterated.

The words "Evaporated Cream," *without explanation,* on the label are misleading, and such goods are misbranded within the meaning of the state law.

LARD.

Lard according to the United States standards "is the rendered fresh fat from slaughtered, healthy hogs, is free from rancidity, and contains not more than one per cent. of substances, other than fatty acids, not fat, necessarily incorporated therewith in the process of rendering." Compound lard is a mixture of cotton seed oil with enough stearin to give it the requisite degree of solidity and a small amount of real lard. Lard stearin (the residue left after expressing lard oil), cotton seed stearin (obtained in the manufacture of "Winter" cotton seed oil), or, rarely, paraffine, may be used in place of beef stearin.

Although compound lard is made according to different formulas to meet the requirements of different markets, the product almost invariably contains more cotton seed oil than all the other ingredients taken together. Real lard is a minor constituent.

During the year, seventy-one samples, bought for lard by the station agent from grocers and butchers, have been examined. Of these twenty-four were compound lard and therefore were classed as adulterated (Table III). Of twenty-two samples, later submitted by the Dairy Commissioner, four were pure lard, six were compound lard sold for pure lard and twelve were marked "compound."

TABLE III.—ADULTERATED LARD.

Station No.	Brand.	Dealer.	Price per pound, cents.
		Bridgeport.	
13487	Sold in bulk	Centennial Tea Co., 1688 Main st.	10
		Danbury.	
13531	" "	City Grocery, 147 Main st.	8
		Derby.	
13649	" "	The New York Grocery Co., 217 Main st.	6
		Hartford.	
13585	" " "	Citizen's Grocery & Provision Co., 267 Main st.	10
		Meriden.	
13621	" " "	M. W. Booth, 41 E. Main st.	10
13622	" " "	Meriden Tea & Coffee Co., 77 E. Main st.	10
		Middletown.	
13558	" " "	York State Butter Store, O. H. Cone, 262 Main st.	10
13555	" " "	Middletown Cash Grocery, 354 Main st.	10
13559	" " "	Middletown Cash Grocery, 354 Main st.	11
		Naugatuck.	
13641	" " "	The Union Supply Co., Main st.	13
		New Britain.	
13561	" " "	Public Market, 371 Main st.	8
		New Haven.	
13599	" " "	New Haven Provision Store, 384 Grand ave.	10
13603	" " "	Union Supply Co., 442 State st.	13
		Norwalk.	
13525	" " "	New York Grocery Co., 35–37 Main st.	9
		South Norwalk.	
13517	" " "	Lorenzo Dibble, 13 N. Washington ave.	10
13519	" " "	New York Grocery Co., 118 E. Washington ave.	9
13521	" " "	United Grocery Co., 22 N. Washington ave.	10
		Stamford.	
13506	" " "	O. S. Brown, 54 Park Row	10
13511	" " "	Empire State Tea Co., 303 Main st.	10
		Wallingford.	
13620	" " "	Laden Bros., 104 Center st.	10
		Waterbury.	
13541	" " "	Boston Butter House, 147 S. Main st.	10
13539	" " "	McCarthy's, 671 Broadway and E. Main st.	10
13542	" " "	Public Market, 161–163 S. Main st.	10
13549	" " "	John Tato, 366 W. Main st.	10

OLIVE OIL.

Of the sixty-two samples examined, thirty-two were purchased of grocers and thirty of druggists.

Although all the samples were bought for olive oil, thirteen sold by grocers were marked "Salad Oil," "Nut Oil," etc., and therefore are technically "compounds" and are separately tabulated. (Table V.) In all cases these salad oils were wholly or in large part cotton seed oil.

All the samples found to be adulterated, nine in number, were purchased of druggists in ordinary medicine vials and were distinctly labelled olive oil (Table IV). The adulteration in eight of the samples was cotton seed oil, and in one sample, sesame oil.

A summary of the samples examined follows:

	From Grocers.	From Druggists.	Total.
Not found adulterated	19	21	40
Adulterated	0	9	9
Marked "Salad Oil," "Nut Oil," etc.	13	0	13
	32	30	62

TABLE IV.—ADULTERATED OLIVE OIL.

Station No.	Dealer.	Dealer.	Price per bottle, cents.	Ounces of oil in bottle.
	Adulterated with Cotton Seed Oil.			
12648	Sold in druggist's vial	*Bridgeport:* Hartigan's Pharmacy, 1299 Main st.	15	4
12646	" " "	Washington Park Pharmacy, E. Main st. and Barnum ave.	20	4
12672	" " "	*Hartford:* L. G. Harris, Park and Wadsworth sts.	20	4
12638	" " "	*New Haven:* Hull's Corner Drug Store, Howard and Congress ave,	15	4
12676	" " "	*New London:* Taylor's Pharmacy, 239 State st.	15	4
12958	" " "	*Torrington:* C. H. Dougal, 95 Main street	20	4
12952	" " "	*Waterbury:* John Moore, 563 E. Main st.	20	4
	Adulterated with Sesame Oil.			
12668	Sold in druggist's vial	*Meriden:* F. M. Kibbe & Co., 40 W. Main st.	20	4
12630	" " "	*New Haven:* S. L. Salisbury, 6 Grand ave.	20	4

TABLE V.—"SALAD OIL," CONSISTING OF, OR CONTAINING, COTTON SEED OIL.

Station No.	Brand.	Dealer.	Price per bottle, cents.	Ounces of oil in bottle.
12666	G. Campanini, Livorno, Italia. Huile Salad, Medaille D'Or	*Meriden*: H. E. Bushnell, 75 W. Main st.	25	16
12636	E. Loubon, Nice. Extra Superfine Purest Salad Oil	*New Haven*: S. S. Adams, 609 Howard ave.	10	6
12632	Midas Frères, Bordeaux. Huile d'Salad	Atlantic & Pacific Tea Co., State st.	10	9
12634	Antonio Fava, Nice. Huile de Salad, d'Aix	C. F. Curtis, 932 State st.	10	5
12631	E. Loubon. Superfine Huile Salad	A. H. Duhan, 1134 State st.	10	6
12635	Union Oil Co., Providence, R. I. Providence Pure Salad Oil	3 G's Cash Store, Edwards and Nash sts.	10	5
12633	E. Loubon, Nice. Huile d'Salad	A. H. Waterbury, 250 Grand ave.	10	6
12656	San Bernadino Salad Oil. H. J. Voss, Agent	*Norwalk*: N. Y. Grocery Co., 35 Main st.	10	10
12652	M. K. J. & Fils. Huile Supérieure	*Stamford*: H. Newstad & Co., 35 Pacific st.	10	6
12654	M. Schoenberg & Co., N. Y. White Label Pure California Salad Oil	H. Newstad & Co., 35 Pacific st.	6	3

NUT OIL.

In Europe the oils expressed from the walnut, and other nuts are used as salad oils. The term nut oil is also loosely applied to various other edible oils.

The following three samples labelled "Nuss-Oel," purchased by the station agent, were found to contain large percentages of cotton seed oil.

No. 12644. Nuss-Oel, bought of G. Englehardt, 599 East Main St., Bridgeport. Contains cotton seed oil.

No. 12641. Excelsior Nuss-Oel, C. W. Walter, Lauterbach a/ Harz, bought of A. Felberg, 222 Congress Ave., New Haven. Contains cotton seed oil.

No. 12650. Blank's Deutsches Importirtes Nuss-Oel, Successor to Licht, 56 Cedar St., Brooklyn, N. Y., bought of Plochin's Delicatessen, 367 Congress Ave., New Haven. Contains cotton seed oil.

CORN OIL.

This oil is expressed from the germs of Indian corn. A sample purporting to be corn oil submitted by S. S. Thompson, New Haven, was found to contain cotton seed oil and, probably, other foreign oils. Refraction at 15.5° C., 72.5; specific gravity at 15.5° C., 0.920; Halphen test, deep red.

COFFEE.

Forty three samples of ground coffee collected by the station have been examined, of which eighteen were adulterated (Table VI), and two were marked "compound." Numerous brands of coffee which during previous years have been found to be pure, were not collected by the agent.

All the adulterated samples, with one exception, were sold in bulk and ten were purchased from branches of the same retail house. Eleven were adulterated with chicory and a material made from wheat middlings resembling ground coffee ("imitation coffee"), two with chicory and peas, one with chicory, peas and a roasted cereal, and four with chicory alone.

The samples marked "compound" were as follows:

12716. "Combination coffee," bought of A. M. Stacy, 123 State St., New London, price 25¢ per pound. Contains chicory and peas.

13473. Sold in bulk. Stamped compound, Standard Tea House, J. H. McGuire, 1019 Main St., Hartford. Contains chicory, peas and cereal.

The following sample of coffee substitute was examined:

11525. Johan Hoff's Malt Coffee, Continental Mfg. & Dis. Co., N. Y., bought of Wm. E. Ford, 511 State St., New Haven. Contained malt and chicory.

Eight samples of coffee were submitted by the Dairy Commissioner, of which one was adulterated and three were marked compound.

Three samples sent by individuals were all found to be pure.

TABLE VI.—ADULTERATED GROUND COFFEE.

Station No.	Brand.	Dealer.	Price per pound, cents.	Adulterants.
		Ansonia.		
12727	Sold in bulk	Walsh Bros., 246 Main st.	25	Chicory, peas.
13645	" " "	Walsh Bros., 246 Main st.	25	" "
		Bridgeport.		
11521	Scheuer's Gold Medal Coffee	S. Scheuer, 52 Cannon st.	30	Chicory.
11519	Sold in bulk	The Village Store Co., 746 E. Main st.	25	Chicory, imitation coffee.*
13462	" " "	The Village Store Co., 746 E. Main st.	25	" "
11522	" " "	The Village Store Co., 1624 Main st.	25	" "
13461	" " "	The Village Store Co., 1624 Main st.	25	" "
11524	" " "	The Village Store Co., 244 State st.	25	" "
13460	" " "	The Village Store Co., 244 State st.	25	" "
		Danbury.		
11529	Sold in bulk	The Danbury Grocery Co., Main st.	25	Chicory.
11527	" " "	The Great Atlantic & Pacific Tea Co., 163 Main st.	25	Chicory, imitation coffee.*
13467	" " "	The Great Atlantic & Pacific Tea Co., 163 Main st.	25	" "
11528	" " "	The Village Store Co., 238 Main st.	25	" "
13466	" " "	The Village Store Co., 238 Main st.	25	" "
		Hartford.		
12720	Sold in bulk	Buckley & Reardon, 559 Main st.	25	Chicory, imitation coffee.*
13476	" " "	Buckley & Reardon, 559 Main st.	25	Chicory.
12706	" " "	J. H. McGuire, 1019 Main street	25	Chicory, peas, cereal.
		Waterbury.		
13468	Sold in bulk	J. F. Phelan, 42 E. Main street	25	Chicory.

* Brown lumps made from wheat middlings to resemble coarsely crushed roasted coffee.

SPICES.

Examinations have been made of 159 samples of ground spices, collected by the station, of which 22 were found adulterated or below standard. Particulars with regard to the adulterated samples are given in Table VII; a summary of all the results follows:

	Number of samples not found adulterated.	Number of samples adulterated or below standard.	Foreign Matter.
Mustard	64	9	Turmeric, wheat product, maize product, rice product.
Black Pepper	28	7	Cocoanut shells, maize product, wheat product, olive stones, cayenne, excess of ash.
White Pepper	3	1	Maize product.
Cayenne	2	1	Maize product, excess of ash.
Cinnamon	1	1	Cocoanut shells, excess of ash.
Cloves	2	3	Clove stems, excess of ash.
Allspice	2	..	
Ginger	35	..	

Two of the samples of black pepper contained high percentages of ash indicating either that they were adulterated with pepper shells (the by-product from the preparation of white pepper), or else were contaminated with an undue amount of dirt.

Of ten samples of spices sent by the Dairy Commissioner six were adulterated and two were marked compound.

Five samples were sent by consumers, of which four were pure and one, a sample of black pepper, was grossly adulterated with a wheat product, a maize product, and charcoal.

PREPARED MUSTARD.

This product, also known as German mustard, French mustard, and mustard paste, is prepared from ground mustard seed, or mustard flour (ground mustard seed freed from hulls), salt, spices, and vinegar.

Common admixtures are starchy matter (wheat flour, corn flour, etc.), mustard hulls (a by-product from the manufacture of mustard flour), sugar, chemical preservatives, and artificial colors.

Twenty-eight brands found on sale in Connecticut have been examined. The names of the manufacturers and dealers

TABLE VII.—SPICES, ADULTERATED OR BELOW STANDARD.

Station No.	Brand.	Dealer.	Price per ¼ lb., cents.	Ash.	Sand.	Foreign Matter.
	Mustard.	*Bridgeport.*		%	%	
12731	Sold in bulk	Partick Lavery, 1219 Pembroke st.	5	2.90	-----	Turmeric, wheat product, maize product.
12738	Sold in bulk	E. E. Wheeler, 1131 Main st.	5	4.70	-----	Turmeric, wheat product.
		Derby.				
12943	Sold in bulk	James McEnery, 73 Elizabeth st.	10	4.14	-----	Turmeric, wheat product, rice product.
		Hartford.				
12852	Sold in bulk	N. Y. Butter & Grocery House, 256 Albany ave	10	3.39	-----	Turmeric, wheat product, rice product.
		Meriden.				
12768	Samuel S. Beard & Co., New York. Pure Mustard	Union Tea Co., 45 W. Main st.	10	5.31	-----	Turmeric, wheat product.
		New Britain.				
13616	Sold in bulk	Winthrop Tea Co., 161 E. Main st.*	10	-----	-----	Turmeric, wheat product.
13565	Samuel S. Beard & Co., New York. Pure Mustard	Winthrop Tea Co., 161 E. Main st.	10	5.05	-----	Turmeric, wheat product.
		New London.				
12838	Sold in bulk	The Boston Tea Store, 231 Bank st.	8	4 31	-----	Turmeric, wheat product, rice product.
		Waterbury.				
12916	Sold in bulk	Santoro Bros., 34 Abbott ave.	10	2.54	-----	Turmeric, wheat product, maize product.
	Black Pepper.	*Bridgeport.*				
13490	Sold in bulk	John Hughes & Co., 1634 Main st.	8	3.03	-----	Cocoanut shells, maize product.
13497	The A. Colburn Co., Philadelphia. Colburn's [A] Spices	H. Isenberg, 109 State st.	10	8.28	-----	Excess of ash.
		Derby.				
13647	Sold in bulk	R. F. Cuddihy, Anson and 6th sts.	8	7.67	-----	Excess of ash.

* Statement.

TABLE VII.—SPICES, ADULTERATED, OR BELOW STANDARD—*Continued.*

Station No.	Brand.	Dealer.	Price per ¼ lb., cents.	Ash.	Sand.	Foreign Matter.
	Black Pepper.	*Naugatuck.*				
13639	Sold in bulk	Daly's Grocery Store, 252 Water st.	8	6.60	-----	Cereal product.
		New Haven.				
13604	Union Supply Co., Jewell Brand Pepper	Union Supply Co., 442 State st.	10	4.98	-----	Wheat product.
		Wallingford.				
13619	Sold in bulk	Laden Bros., 104 Center st.	10	9.25	-----	Olive stones.
		Waterbury.				
13543	Sold in bulk	Manhattan Grocery Co., 171 S. Main street	7	9.05	-----	Olive stones, cayenne.
	White Pepper.	*New Haven.*				
13607	J. & W. Cahill & Co. Cahill's Pure Aromatic Spices	J. & W. Cahill & Co., Church and George sts.	10	2.35	-----	Maize product.
	Cayenne.	*New Haven.*				
13608	J. & W. Cahill & Co. Cahill's Pure Aromatic Spices	J. & W. Cahill & Co., Church and George sts.	10	6.30	-----	Maize product.
	Cinnamon.	*Bristol.*				
13627	Sold in bulk	W. F. Smithwick, 161 N. Main st.	10	2.18	-----	Cocoanut shells.
	Cloves.	*Naugatuck.*				
13634	David Trubee & Co., Bridgeport. Sea Side Mills	West Side Grocery, 1 Church st. and Rubber ave.	10	8.70	-----	Excess of ash.
		Hartford.				
13580	Sold in bulk	The Great Atlantic & Pacific Tea Co., 979 Main st.	7	9.41	-----	Excess of ash.
		New London.				
13483	Sold in bulk	J. M. Miner, 57 Huntington st.	10	9.94	-----	Clove stems, excess of ash.

together with the results of tests for preservatives, colors and cereal starch are given in Table VIII. Statements as to the nature or composition of twelve of the brands taken from the tables are appended as foot notes.

From the table it appears that thirteen brands contained cereal starchy matter, four contained salicylic acid, and twenty-five were colored.

The color of eleven samples was due to turmeric, but as this root is valuable as a spice its use in prepared mustard is legitimate. Coal-tar dyes, belonging either to the nitro-colors or azo-colors ("tropeolins"), were detected in fourteen samples.

Analyses of the samples free from cereal starch are given in Table IX, and of those containing considerable amounts of this admixture, in Table X. The analyses are calculated not only to the material as sold, but also to the dry, fat- and salt-free material. Following the latter figures in Table IX are given the maxima, minima, and average results of Leach's analyses of six samples of ground whole mustard seed.

From Table IX it appears that the percentages of ash, crude fiber, and crude starch in the dry, fat- and salt-free material are usually higher, and of protein lower, than in ground mustard seed, but most of these differences can be explained by the presence of spices, especially those rich in starch, such as turmeric and black pepper. The high per cent. of crude fiber in No. 12699 is quite probably due to an excess of mustard hulls, and the higher per cent. of crude starch may also be due to the action of the acid on these hulls. The presence of added sugar would, of course, raise the per cent. of crude starch.

From these results it appears that the dry, fat- and salt-free material of a mixture of ground mustard seed, salt, vinegar, and spices ought not to contain more than 24 per cent. of crude starch or 12 per cent. of crude fiber, or less than 35 per cent. of protein.

The methods of analysis employed will be described in the Proceedings of the Association of Official Agricultural Chemists for 1905.

CREAM TARTAR.

Only one sample of eighteen examined was found to be adulterated. The description and analysis of this adulterated sample follows:

13591. "Star Brand Pulverized Cream Tartar, Extra Fine. J. S. Brockway & Co., 213 State St., Boston. Warranted quarter pound full weight and guaranteed as to quality and strength." Bought of Joseph Connor & Son, 72 Water St., Norwich. Price 10 cts. per quarter pound package. Adulterated with acid phosphate of lime, alum, plaster, and starch. See page 131.

TABLE VIII.—PREPARED MUSTARD.

Station No.	Brand.	Dealer.	Preservative.	Color.	Starchy Matter.
		Bridgeport.			
12688	Joseph Campbell Preserve Co., Camden, N. J. Campbell's Prepared Mustard*	Atlantic & Pacific Tea Co., 707 E. Main st.	None	Tropeolin	Maize product.
12687	E. A. Charbonneau & Co., Detroit. Belle Isle Brand†	Logan Bros., 1170 Pembroke st.	"	Turmeric / Nitro-color	" "
12601	The Silver Lane Pickle Factory, F. C. Gould, Silver Lane, East Hartford, Conn.	A. Mertens, 263 State st.	"	Turmeric / Nitro-color	Small amount starch.
12689	Chas. Gulden. Moutarde surfine‡	N. Y. Grocery, 855 Kossuth st.		Turmeric	None.
12690	Eagle Packing Co., N. Y. Düsseldorfer Mustard, Extra Quality§	S. Scheuer, 52 Cannon st.	"	"	Much starch.
		Bristol.			
12705	Francis H. Leggett & Co., New York. Nabob Prepared Mustard	C. A. Lane	"	Turmeric	Small amount starch.
		Danbury.			
12695	Francis H. Leggett & Co., New York. Premier Prepared Mustard	W. D. Baldwin, 93 White st.	"	Nitro-color	None.
		Hartford.			
12701	Geo. K. McMechen & Son Co., Wheeling, W. Va. McMechen's Wine Flavored Mustard, Reliable Quality ‖	Boston Grocery, 751 Main st.	"	Turmeric	Much starch.
12702	Tice-Marsters Spice Co., Brooklyn. Boston, Extra Quality¶	Cannon & Flannagan, 236 Park st.	"	Tropeolin	Maize product.
12700	The Williams Bros. Co., Detroit. Finest Quality Compound Prepared Mustard**	A. H. Tillinghast, 341 Main st.	"	Turmeric	Wheat and maize.
		Meriden.			
12698	Janin Frères & Co., Bordeaux. Moutarde diaphane	Meriden Tea & Coffee Co., 77 E. Main st.	"	Turmeric	None.
		Middletown.			
12945	Philip J. Ritter Conserve Co., Philadelphia, Pa. Extra Quality German Mustard. Wein Senf	Lawton & Wall, 468 Main st.	"	Turmeric	"

* "Mustard seed, mustard bran and flour 170, salt 025, spices 005, grain vinegar 800."
† "Pure mustard seed 20%, pure spices and herbs 1½%, salt 2½%, pure grain vinegar 76%."
‡ "Pure and select mustard seed, vinegar and spices."
§ "Vinegar 75, pure mustard 19, pure spices 04½, cereals 01, vegetable coloring 00½."
‖ "Compound: mustard seed 20%, spices and herbs 3%, pure malt vinegar 75%, salt 2%."
¶ "Compound: mustard, turmeric, salt, vinegar, spices."
** "Pure mustard seed 20%, salt 2½%, pure spices and herbs 1½%, pure grain vinegar 76%."

TABLE VIII.—PREPARED MUSTARD—*Continued.*

Station No.	Brand.	Dealer.	Preservative.	Color.	Starchy Matter.
		New Britain.			
12699	Chas. Israel & Bros., New York. Friedrichstädter Senf, Extra Quality	Union Trading Co., 61 Arch st.	Salicylic acid	Nitro-color	None.
		New Haven.			
12685	Blenner's German Mustard	A. H. Duhan, 1134 State st.	None	Turmeric	Maize product.
12686	H. J. Heinz Co., Pittsburgh. Prepared Mustard.	A. Fehlberg, 222 Congress ave.	"	Natural	None.
12683	Ernst Eulert, Brooklyn, N. Y. Sanssouci Mustard	S. J. Hugo, 120 Crown st.	"	"	"
12681	Flaccus Bros., Wheeling, W. Va. Steer's Head*	R. E. Kirst, 1322 State st.	Salicylic acid	Nitro-color	"
12682	Kidwell Bros. Co., Baltimore. American Fancy Mustard †	Logan Bros., 341 Grand ave.	None	Turmeric / Nitro color	"
12680	The John T. Doyle Co., New Haven. Doyle's Country Club Mustard	Union Supply Co., 113 Congress ave.	"	Nitro-color	"
12684	Excelsior Mustard Mills, New York. French Mustard	D. M. Welch & Son, 8 Grand ave.	"	Turmeric	"
		New London.			
12704	The Silver Lane Pickle Factory, F. C. Gould, Silver Lane, East Hartford, Conn.	L. Christensen, 133 Bank st.	Salicylic acid	Tropeolin / Nitro-color	Maize product.
12703	LeRoy Packing Co., Boston. LeRoy Extra Quality German Mustard (Wein Senf)	C. H. Thomas, 61 Bank st.	None	Nitro-color	None.
		Norwalk.			
12693	F. D. Lawton & Co., Norwalk ‡	F. D. Lawton, 47 Main st.	"	Natural	"
12692	Düsseldorf Mustard, Prima Qualität, Etiquette Deposée	N. Y. Grocery Co., 35 Main st.	"	Turmeric	Much starch.
12694	John Robinson & Co., New York. English Club Mustard, Superior Quality §	Raymond & Co., 9 Main st.	"	"	Wheat product.
		South Norwalk.			
12697	Alartie & Cie. Moutarde de Bordeaux, Etiquette Déposée	Gustave Friedrick, Railroad ave.	"	Nitro-color	None.
12696	H. J. Voss, Jersey City, N. J. Voss's XXX German Mustard	N. Y. Grocery, 110 E. Washington street	Salicylic acid	"	Much starch.
		Waterbury.			
12951	Recanier frères, Bordeaux, Moutarde Impériale (toujours prêt) ‖	Kingsbury Branch, 256 N. Main st.	None	Tropeolin / Nitro-color	None.

* "Mustard seed 18534, spices 00780, malt vinegar 79462, salt 01224."
† "Compound: pure mustard seed 20%; salt 2½%, pure spices and herbs 1½%, pure grain vinegar 76%." ‡ "*With spices and fine herbs.*"
§ "Liquid mustard compound." ‖ "*Pure mustard seed 20%, pure malt vinegar 75%, salt 2%, turmeric ½%, pure spices and herbs 2½%.*"

TABLE IX.—ANALYSES OF PREPARED MUSTARD FREE FROM CEREAL STARCH.

Station No.	In the Material as sold.											In the dry, fat- and salt-free material.				
	Water.	Acidity calculated as acetic acid.	Total solids.	Total ash.	Common salt.	Ash other than salt.	Protein.	Crude fiber.	Crude starch.*	Nitrogen-free extract.	Fat.	Ash.	Protein.	Crude fiber.	Crude starch.*	Nitrogen-free extract.
	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%
12689	76.49	3.66	19.85	3.15	1.95	1.20	4.53	0.92	2.35	5.07	6.18	10.24	38.65	7.85	20.05	43.26
12695	79.26	3.22	17.52	3.45	2.53	0.92	4.44	1.09	2.16	4.24	4.30	8.61	41.53	10.20	20.20	39.66
12698	79.72	2.98	17.30	3.10	2.13	0.97	4.22	1.39	2.70	5.09	3.50	8.31	36.16	11.91	23.13	43.62
12945	79.00	3.03	17.97	3.16	2.06	1.10	4.40	1.48	2.02	5.03	3.90	9.16	36.64	12.32	16.82	41.88
12699	79.45	2.80	17.75	4.79	3.69	1.10	3.81	1.68	2.90	5.31	2.16	9.24	32.01	14.12	24.37	44.63
12686	73.01	3.32	23.67	3.09	2.03	1.06	6.12	1.12	2.92	6.11	7.23	7.35	42.47	7.77	20.26	42.41
12683	74.61	3.17	22.22	3.12	1.87	1.25	5.09	1.14	2.60	6.06	6.81	9.23	37.59	8.42	19.20	44.76
12681	83.68	3.00	13.32	2.60	1.78	0.82	3.62	0.77	1.83	4.21	2.12	8.70	38.43	8.17	19.43	44.70
12682	81.36	2.91	15.73	3.32	2.28	1.04	4.16	1.04	2.37	4.76	2.45	9.45	37.82	9.45	21.55	43.28
12680	77.30	2.80	19.90	3.64	2.66	0.98	5.50	1.23	2.44	5.05	4.48	7.68	43.11	9.64	19.13	39.57
12684	79.17	3.18	17.65	3.06	2.13	0.93	4.25	1.14	1.94	5.08	4.12	8.16	37.28	10.00	17.02	44.56
12703	81.66	2.98	15.36	2.80	1.80	1.00	4.56	1.06	2.42	4.47	2.47	9.02	41.12	9.56	21.82	40.30
12693	77.41	2.74	19.85	4.03	2.90	1.13	5.35	1.15	2.48	4.72	4.60	9.15	43.32	9.31	20.08	38.22
12697	77.78	2.90	19.32	3.73	2.58	1.15	5.19	1.16	2.49	5.05	4.19	9.16	41.35	9.24	19.84	40.25
12951	78.90	3.10	18.00	3.79	2.48	1.31	5.40	1.28	2.31	4.30	3.23	10.66	43.94	10.42	18.80	34.98
Maximum	83.68	3.66	23.67	4.79	3.69	1.31	6.12	1.68	2.92	6.11	7.23	10.66	43.94	14.12	24.37	44.76
Minimum	73.01	2.74	13.32	2.60	1.78	0.82	3.62	0.77	1.83	4.21	2.12	7.35	32.01	7.77	16.82	34.98
Average	**78.59**	**3.05**	**18.36**	**3.38**	**2.32**	**1.06**	**4.71**	**1.17**	**2.40**	**4.98**	**4.12**	**8.94**	**39.44**	**9.89**	**20.11**	**41.73**
Analyses of 6 samples of whole mustard seed by Leach. (Journ. Amer. Chem. Soc., 1904, **26**, 1206.)											Maximum	7.64	48.31	10.33	15.91	48.55
											Minimum	6.28	37.50	7.24	11.94	37.84
											Average	**6.83**	**44.31**	**8.05**	**13.82**	**40.81**

* Reducing matters by direct inversion calculated as starch. Mustard seed contains no real starch.

TABLE X.—ANALYSES OF PREPARED MUSTARD CONTAINING CEREAL STARCH.

Station No.	In the Material as sold. Water.	Acidity calculated as acetic acid.	Total solids.	Total ash.	Common salt.	Ash other than salt.	Protein.	Crude fiber.	Crude starch.*	Nitrogen-free extract.	Fat.	In the dry, fat- and salt-free material. Ash.	Protein.	Crude fiber.	Crude starch.*	Nitrogen-free extract.
	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%
12688	80.18	2.65	17.17	2.28	1.60	0.68	3.06	1.04	6.81	9.26	1.53	4.84	21.80	7.41	48.50	65.95
12687	79.85	2.72	17.43	2.45	1.51	0.94	4.22	0.94	3.71	6.83	2.99	7.27	32.64	7.27	28.69	52.82
12691	85.63	2.78	11.59	2.48	1.66	0.82	2.37	1.20	2.18	4.08	1.46	9.68	27.97	14.17	25.73	48.18
12690	84.45	2.72	12.83	2.78	2.08	0.70	3.00	1.00	2.97	5.04	1.01	7.19	30.80	10.27	30.49	51.74
12705	83.87	2.60	13.53	2.94	2.21	0.73	3.00	1.59	2.24	3.82	2.18	7.99	32.82	17.40	24.51	41.79
12701	87.32	2.79	9.89	2.45	1.97	0.48	1.53	1.32	2.12	3.83	0.76	6.70	21.37	18.44	29.61	53.49
12702	79.14	3.42	17.44	2.80	1.89	0.91	3.34	1.03	6.93	8.98	1.29	6.38	23.42	7.22	48.60	62.98
12700	78.69	3.54	17.77	2.37	1.55	0.82	4.19	1.20	4.57	7.08	2.93	6.17	31.53	9.03	34.39	53.27
12685	81.43	2.91	15.66	2.82	2.08	0.74	3.50	1.04	2.98	5.05	3.25	7.16	33.89	10.08	28.85	48.87
12704	81.14	2.86	16.00	4.21	3.39	0.82	3.37	1.26	3.45	5.56	1.60	7.45	30.61	11.44	31.34	50.50
12692	84.70	2.80	12.50	2.83	2.20	0.63	2.94	0.96	3.13	4.80	0.97	6.75	31.51	10.29	33.55	51.45
12694	70.44	1.86	27.70	3.03	1.87	1.16	6.38	0.22	13.69	15.35	2.72	5.02	27.61	0.95	59.22	66.42
12696	79.57	2.39	18.04	3.34	2.60	0.74	4.31	1.16	5.39	8.05	1.18	5.19	30.22	8.13	37.80	56.46
Maximum	85.63	3.54	27.70	4.21	3.39	1.16	6.38	1.59	13.69	15.35	3.25	9.68	33.89	18.44	59.22	66.42
Minimum	70.44	1.86	9.89	2.28	1.51	0.48	1.53	0.22	2.12	3.82	0.76	4.84	21.37	0.45	24.51	41.79

* Reducing matters by direct inversion calculated as starch. Mustard seed contains no real starch.

ANALYSIS.

Sulphuric acid	27.51
Phosphoric acid	8.83
Lime	12.16
Alumina	4.95
Starch and other substances	46.55
	100.00

HORSE RADISH.

A sample labelled: "Pure Horse Radish. Guaranteed Strictly Pure. Put up by Richard Zastrow, New Haven, Conn." was found to contain maize starch.

VANILLA EXTRACT.

Standard vanilla extract of the United States Pharmacopœia is prepared from vanilla beans, cane sugar, and dilute alcohol, 100 grams of the beans being used for each 1000 cc. of the extract.

The common adulterants of vanilla extract are tonka bean extract, artificial vanillin, artificial coumarin, carmel, and coal-tar colors. Artificial vanillin is identical with the chief flavoring principle of the vanilla bean, but the extract made from this substance lacks the true flavor of genuine vanilla extract, owing to the absence of other substances, which cannot be successfully imitated. At the present time vanillin, itself an adulterant, is adulterated with acetanilid (antifebrine), which not only is worthless for flavoring but is injurious to health. Tonka beans are much cheaper than vanilla beans and have a ranker flavor due to coumarin, which is also prepared artificially for use in extracts.

Eighty-seven samples of vanilla extract have been examined, of which twenty-five were not found adulterated, forty-seven were variously adulterated, and fifteen were labelled compound.*

The adulterated samples are described in Table XI. Coumarin was present in thirty-nine samples and acetanilid in

* The method employed for the determination of vanillin, coumarin and acetanilid is that described by Winton and Bailey: Journ. Amer. Chem. Soc., 1905, **27**, 719; the other methods are those given by Winton and Silverman; Rep. of this Station, 1901, 154; Journ. Amer. Chem. Soc., 1902, **24**, 1128.

TABLE XI.—ADULTERATED EXTRACT OR ESSENCE OF VANILLA.

Station No.	Brand.	Dealer.	Price per bottle, cents.	Capacity of bottle, ounces.	Vanillin.	Coumarin.	Acetanilid.	Color.
					%	%	%	
12798	Eureka Mfg. Co., Hartford, Conn.	*Ansonia:* P. W. Forgarty, 13 High street	15	1½	0.14	0.00		Artificial.
12799	The Twentieth Century Extract Co., Hartford, Conn.	Peoples Grocery Co., 138 Main st.	15	1½	0.27	0.03		Artificial.
12800	Walsh Bros., Ansonia, Conn.	Walsh Bros., 246 Main st.	20	2½	0.66	0.12		Artificial.
12612	Sold in druggist's vial	*Bridgeport:* Dupee's Pharmacy, 59 Fairfield ave.	20	4	0.23	0.05		Artificial.
12603	Victor Mfg. Co., Hartford, Conn.	E. L. Sullivan, 1142 E. Main st.	10	1½	0.21	0.04		Artificial.
12606	The Twentieth Century Extract Co., Hartford, Conn.	The Logan Bros. Co., 410 E. Main street	15	1½	0.23	0.03		Artificial.
12605	Good Value Extract Co., New York, Good Value	W. L. Woolfram, 1001 E. Main st.	10	1½	0.05	0.10		Artificial.
12857	Sold in druggist's vial	*Bristol:* Merriman Bros., 149 Main street	40	4	0.05	0.03		Natural.
12781	Baldwin & MacDonald, Danbury, Conn.	*Danbury:* Baldwin & MacDonald, 256 Main st.	15	2	0.59	0.09		Artificial.
12785	The Union Pacific Tea Co., New York, Sovereign	Union Pacific Tea Co., 253 Main street	20	2	0.63	0.13		Artificial.
12854	Sold in druggist's vial	*Hartford:* T. J. Blake, Jr., Albany ave., and East st.	35	4	0.60	0.04		Artificial.
12891	Aetna Mfg. Co., Hartford, Conn.	Brown, Thompson & Co., Main street	9	1½	0.28	0.04		Artificial.
12890	J. T. Robertson, Hartford, Conn., Robertson's	S. B. Cowles, 156 Albany ave.	25	2	0.16	0.05		Artificial.
12803	H. M. Grant, Meriden, Conn., Elite Brand	*Meriden:* Grant's Tea Store, State and E. Main sts.	10	1½	0.14	0.08		Artificial.
12804	Sold in druggist's vial	Geo. Lamping, E. Main st.	35	4	0.13	0.04		Natural.
12801	Union Tea Co., New Britain & Meriden, Conn., Superior Vanilla Flavoring	Union Tea Co., 45 W. Main st.	15	1½	0.21	0.04		Artificial.
12903	D. Johnson & Co., Middletown, Conn.	*Middletown:* C. Allison, 31 Main street	15	1½	0.21	0.04	0.08	
12900	J. G. Hedges, Middletown, Conn.	Lawton & Wall, 468 Main st.	20	2	0.63	0.07		
12910	New England Tea Co., Middletown, Conn.	New England Tea Co., 442 Main street	20	2	0.15	0.03		
12907	The McKee Medicine Co., Middletown, Conn.	O. Thompson & Co., 592 Main st.	25	4	0.32	0.00	0.13	
12929	Sold in druggist's vial	*Naugatuck:* S. Gladding, Jr., & Co., Church st.	40	4	0.24	0.08		Natural.
12930	Arcadian Extract Co., Union City, Conn.	Moulthrop & Gray, Water st.	25	2	0.31	0.09		Artificial.*
12811	Manufacturer not given	*New Britain:* J. W. Cotter & Co., Elm & Park sts.	30	4	0.71	0.06		Artificial.
12810	C. H. Talcott & Co., Hartford, Conn., Delmonico	Wm. Foulds, 236 Park st.	25	2	0.12	0.07		Natural.
12814	Sold in druggist's vial	J. H. Lutz, 253 E. Main st.	30	4	0.54	0.05		Artificial.
12806	J. E. Murphy, New Britain, Conn.	J. E. Murphy, 500 Main st.	10	1½	0.35	0.06	0.13	Artificial.
12599	Sold in druggist's vial	*New Haven:* J. P. Crowley, 302 Congress ave.	35	4	0.59	0.10		Artificial.
12968	Frederick Bros.	Frederick Bros., 253 Davenport avenue	10	1½	0.20	0.03		Artificial.
13442	Sterling Extract Co., New York, Sterling	Gibbons Bros., State & Pearl sts.	25	2	0.43	0.00		Artificial.*
12969	The Carlson Tea & Butter Co., New Haven, Standard Quality	The Carlson Tea & Butter Co. 488 State st.	12	2	0.26	0.03		Artificial.

* Coal-tar dye.

TABLE XI.—ADULTERATED EXTRACT OR ESSENCE OF VANILLA.

Station No.	Brand.	Dealer.	Price per bottle, cents.	Capacity of bottle, ounces.	Vanillin.	Coumarin.	Acetanilid.	Color.
					%	%	%	
12966	The John T. Doyle Co., New Haven, Doyle's	John L. Thuesen, 309 Oak st.	10	1	0.60	0.10		Artificial.
12589	Tower's	H. M. Tower, 379 Congress ave.	10	1½	0.40	0.07		Artificial.
12824	Nichols & Harris, New London, Conn.	*New London:* Keefe, Davis & Co., 125 Bank st.	25	2	0.07	0.00		Artificial.
12823	Chas. M. Taylor, New London, Lauman's	C. H. Thomas, 61 Bank st.	20	1½	0.52	0.10		Artificial.
12870	Slater Extract Co., Pawtucket, R. I.	*Norwich:* Disco Bros., 267 Main street	25	4	0.36	0.10		Artificial.
12866	Sold in druggist's vial	*Putnam:* Simon Farley, 54 Elm street	40	4	2.55	0.09		Artificial.
12622	Manufacture not given	*Stamford:* O. S. Brown, 50 Park Row	10	1½	0.30	0.05		Artificial.
12616	Sold in druggist's vial	A. L. Embree, 3 Park Row	40	4	0.10	0.05		Artificial.
12793	Seeman Bros., New York, Warfield Brand	*So. Norwalk:* C. Becker & Son, 141 E. Washington st.	15	1½	0.04	0.00		Artificial.
12787	Sold in druggist's vial	G. C. Stillson, E. Washington st.	35	4	0.07	0.04		Natural.
12932	Sage's Laboratory, Torrington, Conn., Sage's Choice No. 1	*Torrington:* Torrington Co-operative Co., 135 Main st.	25	2	0.11	0.05		
12911	Premium Brand	*Waterbury:* N. Y. & China Tea Co., 181 S. Main st.	10	1½	0.19	0.00	0.15	
12927	Sold in druggist's vial	Riverside Pharmacy, Bank and Riverside sts.	20	4	0.20	0.00		Artificial.
12923	" " " "	The McCarthy Pharmacy, 434 S. Main st.	40	4	0.90	0.06		
12862	" " " "	*Willimantic:* Chas. deVillers, 873 Main st.	35	4	0.36	0.00		Artificial.
12937	The C. L. Cotton Perfume & Extract Co., Earlville, N. Y., O.K.	*Winsted:* King & Gay, Main st.	20	2	0.09	0.06		Artificial.
12934	Sold in druggist's vial	Wm. H. Mills, 390 Main st.	40	4	0.25	0.03		Artificial.

four, the latter being undoubtedly an adulterant of the artificial vanillin employed. Caramel or a similar substance was detected in thirty-two samples and a coal-tar dye in two.

All but three of the compound extracts contained coumarin and two of these in addition contained acetanilid. All were artificially colored. Details with regard to these samples, including the formulas printed on the bottles, are given in Table XII.

Acetanilid being injurious to health, the sale of an extract containing it is illegal, even when marked compound.

LEMON EXTRACT.

Pure lemon extract, prepared according to the United States Pharmacopœia, is an alcoholic solution containing five parts by volume of lemon oil, colored with lemon peel.

Since the alcohol in a good extract costs about four times as much as all the other constituents together, unscrupulous manufacturers are accustomed to reduce the expense of manufacture by substituting dilute alcohol.

But lemon oil is practically insoluble in dilute alcohol, hence by reducing the strength of the alcohol the manufacturer cuts out the lemon oil almost entirely, thus rendering the extract almost worthless for flavoring purposes.

A good extract, on dilution with half its bulk of water, should at once become cloudy from the separation of lemon oil which later rises to the surface.

Many of the brands on the market contain so little lemon oil that it can hardly be detected either by chemical analysis or by the nostrils. They are commonly made either by shaking

TABLE XII.—COMPOUND EXTRACT OR ESSENCE OF VANILLA.

Station No.	Brand.	Dealer.	Price per bottle, cents.	Capacity of bottle, ounces.	Vanillin.	Coumarin.	Acetanilid.	Color.
					%	%	%	
12602	Trumbull & Co., Hartford, Conn.*	*Bridgeport:* Patrick Lavery, 1219 Pembroke st.	10	1	0.31	0.04		Artificial.
12610	G. W. Smith, Village Store, Bridgeport, Conn. G. W. Smith †	The Village Store Co., 1624 Main street	15	2	0.08	0.05		Artificial.
12786	Queen City Mfg. Co., Newburgh, N. Y. Queen City ‡	*Danbury:* L. Libertino, 51 Liberty street	10	1½	0.23	0.07	0.11	Artificial.
12893	St. John's §	*Hartford:* Dow's Grocery, 2 Church street	10	1½	0.07	0.05		Artificial.
12894	John H. McGuire, Hartford, Conn. The Waldorf Brand ‖	J. H. McGuire, 1019 Main st.	15	1½	0.04	0.07		Artificial.
12901	Oakdale Packing Co., Phila. Oakdale	*Middletown:* Middletown Cash Grocery, 354 Main st.	15	1½	0.14	0.00		Artificial.
12586	Sold in druggist's vial ¶	*New Haven:* M. F. Hope, 359 Grand ave.	40	4	0.38	0.10		Artificial.
12600	F. J. Markle, New Haven. Gold Medal Brand	F. J. Markle, 101 Dixwell ave.	10	1½	0.12	0.00		Artificial.
12596	Forest City Extract Co., Portland, Maine. Forest City**	E. Schoenberger & Son, 92 George street	25	1½	0.07	0.12		Artificial.
12581	The Union Supply Co.'s	Union Supply Co., 113 Congress ave.	10	1½	0.04	0.05		Artificial.
12583	Star Extract Co., Boston. Star Brand	D. M. Welch & Son, 8 Grand ave.	10	1½	0.11	0.00		Artificial.
12863	Haskill, Adams & Co., Boston ††	*Putnam:* Edward Mullan, Main st.	35	4	0.05	0.09		Artificial.
12623	Hart's	*Stamford:* E. O. Lester, 282 Main st.	10	1½	0.04	0.09		Artificial.
12617	C. N. Searle, New Haven ‡‡	J. L. Smallhorn, 233 Main st.	25	4	0.40	0.11	0.15	Artificial.
12922	Miner, Read & Garrette, New Haven. Anchor Brand	*Waterbury:* Penn. Merchandise Co., 118 E. Main st.	10	1½	0.14	0.05		Artificial.

* "Ext. vanilla beans 7.20%, alcohol 13.50%, sugar 12.60%, caramel, .80%, vanillin .34%, coumarin .06%, water 65. 60%."

† "Formula compound. 45 parts hydro-alcoholic solution Mexican vanilla beans (active principle)."
"45 parts hydro-alcoholic solution tonka beans (active principle)."
"10 parts hydro-saccharated solution, colored artificially with caramel."

‡ "Vanilla 17, vanillin 10, coumarin 8, syrup 100, alcohol dil. 8.40, color 25."

§ "Formula compound. 45 parts hydro-alcoholic solution Mexican vanilla beans (synthetically prepared)."
"45 parts hydro-alcoholic solution tonka beans (active principle)."
"10 parts hydro-saccharated solution with caramel."

‖ "Vanilla 1.00, aqua 4.84, tonka 2.70, sugar 1.44, caramel .02."

¶ "Statement. Contains coumarin and vanillin."

** "Crystallized sugar 13.72, corn syrup 11.14, caramel .57, Spanish fruit juice 4.57, glycerine chemically pure 1.71, vanillin .03, coumarin .21, pure grain alcohol 7.46, distilled water 60.59."

†† "1-2 vanilla, 1-2 tonka, colored."

‡‡ "Made from vanillin and coumarin."

lemon oil with weak alcohol and removing the excess of oil, or by dissolving a little "citral" or other substitute in dilute alcohol. The bogus extracts are usually colored a beautiful golden-yellow with turmeric tincture or, more commonly, a coal-tar dye. An ounce of such an extract selling for 10 cents contains material costing but a fraction of a cent, and almost worthless as a flavor.

Eighty-seven brands of lemon extract have been examined during the year. Only twenty-five of these contained 4.50 per cent. of lemon oil by weight (equivalent to about 4.30 per cent. by volume) and were therefore of good quality. The remaining sixty-two samples, of which fifteen were marked as compounds, contained in every instance less than 4.50 per cent. of pure lemon oil and in most instances only a trace. One sample (No. 12964), contained a foreign oil of the nature of turpentine. Most of the samples were colored either with turmeric or coal-tar dyes (nitro-colors, azo-colors, etc.).

BUTTER.

During the year the Dairy Commissioner has submitted twenty-five samples, of which ten were renovated butter. Only three of these samples were labelled "renovated."

One sample sent by O. G. Beard, Shelton, and two sent by the Yale Dining Hall were not found adulterated.

A sample sent by The L. C. Bates Co., New Haven, was found to be renovated butter.

TABLE XIII.—EXTRACT OR ESSENCE OF LEMON, ADULTERATED OR BELOW STANDARD. (LEMON OIL BELOW 4.50 PER CENT.)

Station No.	Brand.	Dealer.	Price per bottle, cents.	Capacity of bottle, fluid ounces.	Specific gravity at 15.5° C.	Alcohol by weight.	Lemon oil by weight. Polariscope method.	Lemon oil by weight. Mitchell's precipitation method.	Refractive index of precipitated oil at 30° C.	Color.
						%	%	%		
12899	Walsh Bros.	*Ansonia:* Walsh Bros., 246 Main street	20	2	.8584	73.94	2.60	2.90	1.4691	Turmeric.
12601	The Union Pacific Tea Co., New York, Sovereign	*Bridgeport:* Union Pacific Tea Co., 664 E. Main st.	20	2	.9120	50.14	0.63	0.61		Azo-dye.
12858	Sold in druggist's vial	*Bristol:* Perry N. Holley, Main st.	35	4	.8265	83.22	4.19	4.16		
12856	The C. L. Cotton Perfume & Extract Co., Earlville, N. Y., Cotton's.	C. A. Lane	20	2	.9315	43.95	0.15	0.00		Artificial.
12782	Sam'l Stuart & Co., Hartford, Conn. Standard Quality	*Danbury:* M. McPhelemy, 42 White st.	10	1½	.9087	54.20	0.53	0.56		Nitro-color.
12896	Sold in druggist's vial	*Derby:* Kelty's Pharmacy, 42 Elizabeth st.	25	4	.8400	80.36	3.76	4.30	1.4697	
12898	J. D. Welch & Co., New Haven, Derby & Ansonia, Conn.	D. M. Welch & Son, 312 Main st.	15	2	.8736	66.95	1.79	1.99	1.4697	
12815	Trumbull & Co., Hartford, Conn.	*Hartford:* D. F. Burns, 304 Park street	10	1½	.9130	49.95	0.52	0.47		
12964	M. C. Monagle & Rogers, Middletown, N. Y.	Hills & Co., 372 Asylum st.	50	4	.8223	83.65	4.49†	7.52†	1.4672†	
12853	Sold in druggist's vial	N. K. Morgan, 147 Albany ave.	20	4	.8552	73.64	2.60	2.61	1.4697	
12895	Wise, Smith & Co., Superior	Wise, Smith & Co., Main st.	13	2	.9238	46.64	0.38	0.74		Nitro-color.
12905	Bergquist Bros., Concentrated	*Middletown:* Bergquist Bros., 588 Main st.	30	4	.8615	74.96	0.44	0.60		
12902	D. Johnson & Co., Middletown, Conn.	D. J. Hartman, 528 Main st.	25	2	.9425	37.99	0.00	0.00		Azo-dye.
12909	New England Tea Co.	New England Tea Co., 442 Main street	20	2	.9636	25.96	0.00	0.00		Azo-dye.
12908	Perfect Extract Co., Hartford, Conn. Perfect	O. Thompson & Co., 592 Main st.	15	1½	.9132	51.24	0.41	0.28		Nitro-color.
12813*	Manufacturer not given	*New Britain:* J. W. Cotter & Co., Elm & Park sts.	20	4	.9772	23.99	0.10	0.00		Nitro-color.
12807	Victor Mfg. Co., Hartford, Conn.	Thos. McCabe, 591 Main st.	10	1	.9395	39.97	0.14	0.00		Nitro-color.
12808	Union Tea Co., Superior Lemon Flavoring	Union Tea Co., 317 Main st.	10	1½	.9405	39.55	0.05	0.00		Nitro-color.
12967	The Union	*New Haven:* Wm. R. Bailey, 413 Congress ave.	10	1½	.9143	51.61	0.40	0.46		Nitro-color.
12585	Sold in druggist's vial	J. T. Hillhouse, Grand ave. & E. Pearl st.	20	4	.8792	65.57	1.47	1.47		
12595	F. J. Markle, Concentrated	F. J. Markle, 105 Broadway	10	1½	.9789	13.75	0.12	0.00		Nitro-color.
12970	The Carlson Tea & Butter Co., Standard Quality	The Carlson Tea & Butter Co., 488 State st.	12	1½	.9133	50.83	0.44	0.56		Artificial.
12590	H. M. Tower, Tower's Concentrated	H. M. Tower, 379 Congress ave.	10	1½	.9143	51.20	0.40	0.47		Artificial.
12580	Star Extract Co., Boston, Star Brand	D. M. Welch & Son, 28 and 30 Congress ave.	10	1½	.9737	19.62	0.05	0.00		Nitro-color.
12826	Sold in druggist's vial	*New London:* Taylor's Pharmacy, 239 State st.	25	4	.8736	66.53	2.49	2.66		
12825	Bakers' Extract Co., New York, Bakers' Special.	The Mohican Co., 241 State st.	20	4	.8197	87.85	3.27	3.14	1.4691	Azo-dye.
12871	Slater Extract Co., Pawtucket, R. I. Concentrated	*Norwich:* Disco Bros., 267 Main street	25	4	.9562	30.35	0.31	0.00		
12971	J. E. Thompson, New York, Thompson's Triple	Welcome Smith, 137 Main st.	50	4	.8763	66.20	1.52	1.86	1.4694	Azo-dye.
12864	The Lee & Osgood Co., Norwich, Conn., Concentrated	*Putnam:* Edward Mullan, Main st.	25	4	.8222	86.01	3.04	3.13		

* Contained 8.68 per cent. of non-volatile residue (largely glycerine).

† The disagreement of results on lemon oil by the two methods and the low refraction of the oil are proofs of adulteration.

TABLE XIII.—EXTRACT OR ESSENCE OF LEMON, ADULTERATED OR BELOW STANDARD. (LEMON OIL BELOW 4.50 PER CENT.)

Station No.	Brand.	Dealer.	Price per bottle, cents.	Capacity of bottle, fluid ounces.	Specific gravity at 15.5° C.	Alcohol by weight.	Lemon oil by weight. Polariscope method.	Lemon oil by weight. Mitchell's precipitation method.	Refractive index of precipitated oil at 30° C.	Color.
						%	%	%		
12794	Hart's	*So. Norwalk:* F. D. Lawton, 22 Main st.	10	1½	.9219	48.04	0.44	0.00		Azo-dye.
12792	Chester Mfg. Co., New York, Chester's Extra Fine	N. Y. Grocery Co., 110 E. Washington st.	10	2	.9664	23.12	0.10	0.00		Nitro-color.
12789	J. G. Powers & Co., New York, 20th Century	Edwin Wilcox, 70 E. Washington street	10	4	.9140	50.44	0.52	0.37		Nitro-color.
12620	Lambert & Lowman, Detroit, Royal Brand	*Stamford:* H. S. Daskham, 23 Atlantic st.	35	4	.9416	38.11	0.11	0.00		Azo-dye.
12625	Fitch A. Hoyt, High Grade	F. A. Hoyt, Atlantic Square.	25	2	.8520	75.53	3.15	3.33	1.4691	
12619	Sold in druggist's vial	W. H. Jones, 173 Main st.	40	4	.8428	79.21	3.28	3.47	1.4697	Turmeric.
12921	The John T. Doyle Co., New Haven, Conn., Doyle's	*Waterbury:* Dixon's Grocery, 332 N. Main st.	25	2	.9390	40.36	0.14	0.00		Artificial.
12912	Sage's Laboratory, Torrington, Conn., Sage's Choice No. 1 Extract	The White Simons Co., 165 Bank st.	18	2	.8990	58.45	0.72	0.58		Turmeric.
12859	C. H. Talcott & Co., Hartford, Conn., Delmonico	*Willimantic:* A. A. Trudeau, 941 Main st.	25	2	.8254	86.84	3.19	2.92	1.4691	Turmeric.
12861	Sold in druggist's vial	Wilson's Drug Store, 723 Main st.	20	4	.8612	71.02	2.21	3.09	1.4697	

TABLE XIV.—"COMPOUND" EXTRACT OR ESSENCE OF LEMON.

Station No.	Brand.	Dealer.	Price per bottle, cents.	Capacity of bottle, fluid ounces.	Specific gravity at 15.5° C.	Alcohol by weight.	Lemon oil by weight. Polariscope method.	Lemon oil by weight. Mitchell's precipitation method.	Refractive index of precipitated oil at 30° C.	Color.
						%	%	%		
12611	S. Scheuer & Co., Easton, Pa., "Tru-Blu."	*Bridgeport:* S. Scheuer, 52 Cannon street	20	4	.9589	28.73	0.14	0.00		Nitro-color.
12609	G. W. Smith, Village Store, Bridgeport, Conn. *	The Village Store Co., 244 State street	15	2	.9329	42.39	0.14	0.00		Azo-dye.
12820	Forest City Extract Co., Portland, Me., Forest City†	*Hartford:* Boston Grocery, 751 Main st.	20	1½	.9538	31.91	0.37	0.00		Nitro-color.
12892	St. Johns*	Davis Grocery, 2 Church st.	10	2	.9573	30.70	0.05	0.00		Turmeric.
12809	The Union Supply Co., Highly Concentrated	*New Britain:* Union Supply Co., 483 Main st.	15	1½	.9808	13.79	0.10	0.00		Nitro-color.
12592	Centennial American Tea Co., Concentrated	*New Haven:* The Centennial Am. Tea Co., 363 State st.	20	1½	.9858	9.82	0.10	0.00		Nitro-color.
12627	Pansy Extract Co., Phil., Pansy ‡	*Norwalk:* Grand Central Grocery, 19 Main st.	10	1½	.9530	32.87	0.08	0.00		
12874	Leech & Co., New York, "Plymouth"	*Norwich:* The Mohican Co., Main street	10	1	.9669	23.69	0.00	0.00		Azo-dye.
12795	Brunswick Mfg. Co., New York, Brunswick §	*So. Norwalk:* Central Food Co., Railroad & Washington sts.	10	1	.9365	42.63	0.51	0.00		
12791	156 Chambers st., New York, Arcadian	F. F. Sherman, 17 N. Main st.	10	1½	.9545	31.39	0.10	0.00		Artificial.
12913	Public Market, Waterbury, Conn. Gold Seal*	*Waterbury:* Kingsbury Branch, 256 N. Main st.	15	2	.9604	28.08	0.10	0.00		
12936	The C. L. Cotton Perfume & Extract Co., Earlville, N. Y. O. K.‖	*Winsted:* Larkins & Sparks, 110 Main st.	10	1½	.9613	27.18	0.00	0.00		Nitro-color.

* "Formula compound: 70 parts hydro-alcoholic solution oil lemon, 30 parts aqua, colored artificially with trace of turmeric."

† "Oil lemon .13, imported citral .07, redistilled oil lemon grass .07, distilled water 61.66, pure grain alcohol 37.53, coloring matter .54."

‡ "Alcohol, extract lemon peel, oil lemon, water."

§ "Prepared from absolutely pure lemon oil dissolved in 100 % pure U. S. pure spirits, without addition of coloring or other substance."

‖ "Oil lemon 15, tartrazine non-poisonous color, alcohol dilute 989."

MOLASSES.

Two hundred samples were submitted by the Dairy Commissioner, of which fifteen contained glucose syrup.

MAPLE SUGAR.

A sample sent by W. H. Olcott, South Manchester, and another sent by John N. Lane, Meriden, were not found adulterated.

JAM.

A sample of jam from The John T. Doyle Co., New Haven, contained a currant product (possibly the residue from the manufacture of currant jelly), glucose, starch, and a coal-tar dye.

VINEGAR.

Three samples drawn by the Dairy Commissioner were not found adulterated.

A sample marked cider vinegar sent by the Hallett Table Water Co., Bridgeport, contained but 3.08 per cent. of acid and 1.26 per cent. of solids and was therefore below standard.

CHOCOLATE AND COCOA.

Two samples of chocolate sent by the Howland Dry Goods Co., Bridgeport, contained a small amount of maize starch. A sample of cocoa from the same house was not found adulterated.

WHISKEY.

Three samples submitted by the New Haven Board of Health were tested for wood alcohol with negative results.

TABLE XV.—SUMMARY OF THE RESULTS OF EXAMINATIONS OF FOOD PRODUCTS IN 1905.

	Not found adulterated.	Adulterated or below standard.	Compounds.	Total number examined.
Sampled by Station.				
Milk	95	133	----	228
Lard	47	24	----	71
Olive Oil and Substitutes	40	9	13	62
Coffee and Coffee Substitutes	23	18	3	44
Vanilla Extract	25	47	15	87
Lemon Extract	35	39	12	86
Spices	137	22	----	159
Prepared Mustard	----	----	28	28
Cream Tartar	17	1	----	18
Total	419	293	71	783
Sampled by Health Officers, Consumers and Dealers.				
Milk	182	36	----	218
Cream	22	1	----	23
"Evaporated Cream"	2	----	----	2
Condensed Milk	----	1	----	1
Butter	3	1	----	4
Vinegar	----	1	----	1
Coffee	2	----	----	2
Coffee Substitute	----	1	----	1
Spices	4	1	----	5
Chocolate	----	2	----	2
Cocoa	1	----	----	1
Rock Candy Drips	1	----	----	1
Maple Syrup	1	----	----	1
Jam	----	1	----	1
Horse Radish	----	1	----	1
Corn Oil	----	1	----	1
Whiskey	3	----	----	3
Olive Oil	2	1	----	3
Vanilla Extract	----	----	1	1
Total	223	48	1	272
Sampled by Dairy Commissioner.				
Cream	5	----	----	5
"Steriline"	----	----	1	1
Butter	15	7	3	25
Vinegar	3	----	----	3
Molasses	185	15	----	200
Milk	5	12	----	17
Spices	2	6	2	10
Lard	4	6	12	22
Cream Tartar	----	----	1	1
Coffee	4	1	3	8
Total	223	47	22	292
Total from all sources	865	388	94	1347

PART III.

COMMERCIAL FEEDING STUFFS.

BY E. H. JENKINS AND A. L. WINTON.

THE LAW REGULATING THEIR SALE.

Section 4591 of the general statutes of Connecticut so defines the term "concentrated commercial feeding stuff" that it covers practically all feeds *excepting the following:*—hay and straw, whole seeds, unmixed meal made directly from any one of the cereals or from buckwheat, and feed ground from whole grain and sold directly from manufacturer to consumer.

Section 4592 requires that every package of concentrated commercial feeding stuff shall bear a statement giving the name and address of manufacturer or importer, the number of net pounds in the package, the name of the article and the percentages of protein and fat contained in it.

Section 4593 requires every manufacturer, importer, agent, or seller to file with this station, upon request, a certified copy of the statement above described.

The penalty prescribed for violation of the foregoing sections is not more than $100 for the first offense and not more than $200 for each subsequent offense.

Section 4595 authorizes this station to take samples from any manufacturer, importer, agent, or dealer in a prescribed fashion and requires this station to analyze, annually, at least one sample of each brand which it has collected and to publish these analyses in station bulletins, "together with such additional information in relation to the character, composition and use thereof as may be of importance."

The dairy commissioner is charged with the enforcement of the provisions of these sections of the statutes.

In compliance with these requirements the following report has been prepared.

SAMPLING OF COMMERCIAL FEEDING STUFFS.

During the fall of 1905, Mr. V. L. Churchill, the sampling agent of this station, visited fifty-four towns and villages of this state and took two hundred and sixty-four samples of feeds in the way prescribed by law. These samples have been examined chemically and microscopically and the results appear in the following pages with appropriate discussion.

There are also given analyses of feeds which were sent to the station for analysis by individuals. Other samples of feeds have been sent for microscopic examination by other stations.

EXPLANATIONS OF ANALYSES OF FEEDING STUFFS.

An analysis gives the percentage amounts of Water, Ash, Protein, Fiber, Nitrogen-free Extract and Fat.

Percentage Amount is the amount in 100. If the protein in a feed is 17.5 per cent., every 100 pounds of that feed contain 17.5 pounds of protein; and since a ton is twenty hundred pounds, a ton of the feed will contain twenty times 17.5 or 350 pounds of protein.

Water. However dry a feeding stuff appears to be, it always contains a considerable and variable quantity of water which cannot be seen or felt, but which can be driven out by heat. The amount of water thus present in feeding stuffs is constantly changing with the temperature and moisture-content of the air about them, and accordingly no very close comparison of different feeds is possible unless the proportions of water they contain are known and comparison is made on perfectly dry or water-free substance.

Ash is what is left when the combustible part of a feeding stuff is burned away by heating to faint redness in a current of air. Besides sand, usually an accidental impurity, the ash consists chiefly of lime, magnesia, potash and soda, combined with chlorine and carbonic, sulphuric and phosphoric acids.

Protein is a general term which, as used here, includes all the nitrogenous materials of a concentrated feeding stuff, whatever their character may be. In such feeds the protein substances for the most part bear a general resemblance in composition and properties to the animal proteins, egg albumin (white of egg), flesh fibrin (lean meat), and milk casein (curd). It is from this protein of the food alone that the animal can make albumin, fibrin and casein. The nitrogenous materials are the most costly and the most valuable ingredients of concentrated commercial feeds, which should be bought chiefly for the protein which is in them.

Nitrogen-free Extract, sometimes called *Carbohydrates,* includes starch, gum, sugar and pectin bodies. They are readily extracted from the feeding stuff by water and dilute acid.

Fiber is the essential constituent of the walls of vegetable cells and is seen in a nearly pure state in cotton fiber or paper pulp. It is the most insoluble part of the vegetable substance and of subordinate value in the ration.

Ether Extract includes fat oil, solid fat, wax, chlorophyl (the green coloring matter of plants), and other coloring matters, in brief everything which can be extracted from the perfectly dry feeding stuff by absolute ether.

Regarding the uses of the above-named parts of feeds:

Water and *ash* need not be considered, for, while indispensable to stock, both are abundantly supplied in other ways than in commercial feeds.

Protein is an essential ingredient of the food of every animal, because from no other substance can the waste of muscles, tendons and the working tissues and membranes be renewed; nor can the casein of milk, the albumin and other constituents of the egg, nor new body substance of any sort be obtained by the animal from any other source than protein. The necessary elements from which the animal organism constructs these substances are yielded in available form only by protein. Without protein the animal can live but a short time.

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

Fiber and *nitrogen-free extract* cannot restore the worn-out muscles or membranes of the animal any more than coal can be made to renew the used-up packing, bolts, valves, flues and gearing of a steam-engine. Proteins are to the ox or the man what brass and iron are to the machine, the materials of construction and repair.

But *fat, fiber* and *nitrogen-free extract* are to the animal very much what coal and fuel are to the steam-engine. Their consumption generates the power which runs the mechanism. Their burning (oxidation) in the blood of animals produces the results of life just as the combustion of coal in the fire-box of the steam-engine produces the motion and power of that machine. For this combustion in the system, digestible fat has more than twice the value of digestible nitrogen-free extract.

There is, however, this difference between the engine and the animal: The former may be stopped for repairs; the latter may run at a low rate, but if it be stopped it cannot resume work. Hence the repairs of the animal must go on simultaneously with its waste. Therefore, the material of which it is built must admit of constant replacement, and the dust and shreds of its wear and tear must admit of escape without impeding action. The animal body is as if an engine were fed not only with coal and water, but with iron, brass and all the materials for its repair, and also is as if the engine consumed its own worn-out parts, voiding them as ashes or as gas and smoke. Proteins, or the blood- and tissue-formers, are thus consumed in the animal, as well as the fat, fiber and nitrogen-free extract or fuel proper. The fact that proteins admit of consumption implies that when the proper fuel is insufficient, they may themselves serve as fuel. Such is the case, in fact. But, nevertheless, the two classes of substances have distinct offices in animal nutrition, and experience has proved that for each special case of animal nutrition a special ratio of digestible proteins to digestible fat, fiber and nitrogen-free extract is the best and most economical, and, within certain limits, is necessary.

THE USES OF ANALYSES OF FEEDING STUFFS.

These uses are several. First, by an analysis compared with the average of others, any buyer of a feed can see whether it is of the usual quality. Thus on page 170 the analysis of cotton seed meal, No. 15680 compared with the average of twelve analyses given on the same page, shows that its quality is much below average as regards protein, the most valuable ingredient.

Secondly, by an analysis compared with the manufacturer's guaranty the buyer can see whether in composition the feed meets what is claimed for it. Thus on page 176 the analyses of Chicago gluten meal show that the feed contains on the average about 6 per cent. less of protein than is called for by the manufacturer's guaranty.

Thirdly, an analysis often shows clearly whether or not the feed is adulterated and may indicate also the form of adulteration.

It also makes clear the composition of mixtures which are sold under names which either convey no meaning or convey a false impression.

Fourthly, comparison of analyses of a number of kinds of feed with their prices will greatly help in deciding whether any one of them is worth to the feeder what is asked for it. Too often the prices of feeds bear no relation to their real feeding value.

Lastly, the chief use of these tables by feeders should be as a guide to the skillful compounding of rations for farm animals. How this is done cannot be briefly explained within the limits of a bulletin. A knowledge of the principles of cattle feeding is essential, which should be gathered by studying books which treat of the principles of cattle-feeding and of the art of compounding rations.

DISCUSSION OF THE ANALYSES.

The microscopical and chemical work in connection with these analyses has been done by Dr. Winton or under his direction, with the coöperation of Messrs. Bailey, Kreider and Shanley; the results have been prepared for publication and discussed by the director.

Cotton Seed Meal.

Analyses on pages 170 and 171.

Of the twelve samples collected by the station, nine fail to meet the manufacturer's minimum guaranty,* as appears in the following statement:—

	Percentage Amounts of Protein. Found.	Protein. Guaranteed.	Fat. Found.	Fat. Guaranteed.
Chapin & Co., Green Diamond brand....	37.9	43.0	7.8	9.0
" " "	41.0	43.0	8.0	9.0
Cox & Co., Magnolia brand............	42.0	43.0	8.1	9.0
Georgia Cotton Oil Co.	....	....	7.2	8.0
Humphreys, Godwin & Co., Dixie brand	40.0	41.0	8.0	9.0
W. A. Keiser & Co., Eagle brand.......	41.4	43.0	..	..
Hunter Bros.	40.0	43.0	8.5	9.0
J. T. & R. S. Wells, Star brand.........	41.3	43.0	6.3	9.0
" " "	39.8	43.0	6.8	9.0

The cause of this unusual discrepancy may be found in the fact that the meal of 1904 crop contains considerably less protein and fat and correspondingly more fiber and non-nitrogenous extract than in other years and that the mills have not allowed for this in their guaranties. It is also stated that it is not found profitable to remove the hulls as completely as formerly and it is quite likely that from now on cotton seed meal will run considerably lower in protein than it has heretofore.

The average percentage of nitrogen found in 157 samples bought in the spring of 1905 for fertilizers was 6.93. The average percentage of nitrogen in twelve samples bought in the fall of 1905 for feed is 6.52.

The average percentages of protein and fat, as determined at this station, and the average prices, quoted by retailers, at the time the samples were drawn, have been as follows for the last seven years:

	1899	1900	1901	1902	1903	1904	1905
Number of Samples.....	10	4	6	8	25	17	12
Percentage of protein ...	46.4	43.9	44.4	43.0	43.2	43.4	40.75
" " fat	10.4	8.6	9.8	10.3	9.2	9.6	8.02
Average price	$24.00	27.00	28.80	29.70	29.04	28.88	28.89

* In this report the protein in a feed is considered in substantial agreement with the guaranty if it is not more than 0.7 per cent. below it. An allowance of one-tenth per cent. of nitrogen is made in comparing the actual and guaranteed composition of fertilizers (to cover possible errors of sampling and analysis), and as protein is calculated from nitrogen by multiplying by 6¼, an allowance about 6¼ times as large as that for nitrogen is made for protein.

The inferior quality of the present supply of cotton seed meal clearly appears in this comparison.

Cotton Seed Meal, sampled and sent by Purchasers.

Four samples from individuals were partially analyzed as follows:—

13421. Hunter Brothers. Sampled and sent by the Collinsville Grain Co. 13448, sampled and sent by R. G. Davis, New Haven. 13817. Bought of R. G. Davis, sampled and sent by A. H. Doolittle, Bethany. 13903. Sold by C. H. Fairty, sampled and sent by D. A. St. John, New Canaan.

Analyses.

	13421	13448	13817	13903
Water	7.71	....	....	....
Ash	7.10	....	....	....
Protein	42.62	42.56	42.25	43.12
Fat	9.02	....	....	....
Cost per ton	....	....	$28.00	29.00

A single sample of Sea Island Cotton Seed Meal, 16078, sent by Meech & Stoddard, Middletown, contained 3.98 per cent. of nitrogen, equivalent to 24.87 per cent. of protein, with 1.61 per cent. of phosphoric acid and 1.74 of potash. It sells at $22.00 per ton. When bright cotton seed meal sells at $29.00 and contains 40.75 per cent. of protein, a meal containing but 24.87 per cent. of protein would be worth, as a source of protein, not more than $17.70 per ton.

Linseed Meal.

Analyses on pages 170 and 171.

"Linseed Meal," "Oil Meal" and "Flax Seed Meal" are trade names for ground flax seed from which more or less of the oil has been removed. By the "old process" the oil is partly removed by pressure, leaving from 5 to 10 per cent. in the meal. By the "new process" the oil is so far extracted by naphtha as to leave, usually, less than 2½ per cent. in the meal. New process meal is rather more uniform in composition and contains more protein than old process meal.

One sample of new process and five of old process meal have been examined and all are of fair quality and unadulterated. A single sample, 15836, sold by Mann Bros., Buffalo, contains 32.7 per cent. of protein where 34.0 per cent. is guaranteed.

The average percentages of protein and fat found in linseed meal for the last four years, as determined at this station, with the average prices at the time the samples were drawn, as quoted by retailers, are as follows:

	New Process.				Old Process.			
	1902	1903	1904	1905	1902	1903	1904	1905
No. of Samples.......	4	2	3	1	6	9	11	5
Percentage of protein..	39.8	36.4	36.2	35.6	32.8	33.1	33.8	32.7
" " fat	2.1	3.2	3.1	2.8	7.8	7.5	7.1	7.1
Average price	$31.00	32.50	28.33	32.00	32.00	30.77	31.45	32.00

While the term "oil meal" has been and still is used in the trade to refer only to linseed, there have been referred to this station for examination, three samples from other states of material sold as "oil meal" which contain no linseed at all, but are ground Dakota mustard seed cake containing other weed seeds.

Another sample of "linseed meal," thus referred, contains cocoa shells, obviously added as an adulterant.

Rape Seed Meal.

A sample of this material, consisting of the ground cake left after expressing the oil, was sent for an opinion of its value by a dairyman to whom it was offered, with a guaranty of 23.0 per cent. protein and 7.0 per cent. fat. Rape seed meal is somewhat used as feed for cattle in Europe. It is stated that great care is necessary in feeding it to cows, for some lots contain half a per cent. of oil of mustard, which spoils the flavor of the butter.

Wheat Products.

These are by-products in the manufacture of wheat flour. Several different processes of milling are in common use, yielding by-products which are not alike in composition.

Wheat Bran consists of the outer layers of the wheat berry, which are dark in color and do not easily pulverize.

Wheat Middlings, as found in the feed market, consist of inner layers of the covering of the berry, which are lighter in color and more easily pulverized than bran, and of other parts from which fine white flour cannot be made.

Many mills do not sell bran and middlings separately, but run them together, often with other waste wheat products, and sell the mixture as "Mixed Feed."

With few exceptions the samples of wheat feed described in the tables of analyses are not accompanied, as is required by law, with any statements of composition.

Bran from Winter Wheat.

Analyses on pages 170 and 171.

Nine analyses are given in the table. All the samples are pure and of good quality as regards chemical composition.

Bran from Spring Wheat.

Analyses on pages 170–173.

All of the sixteen samples examined appear to be pure wheat products, but some contain rather low percentages of protein. Thus six of them have not more than 13.5 per cent. of protein.

The Washburn-Crosby Co. is the only firm here represented which gives the guaranty as required by law.

The guaranty is 14.56 protein and 3.5 fat. The analyses of two samples show 13.62 and 14.19 of protein, 4.73 and 4.65 of fat.

Middlings from Winter Wheat.

Analyses on pages 172 and 173.

Only four samples have been analyzed, all of them pure and of good quality.

Middlings from Spring Wheat.

Analyses on pages 172 and 173.

Of the sixteen samples examined all are pure and of good quality, but only those made by the Washburn-Crosby Co. had the guaranty as required by law. This company guarantees 17.96 protein and 6.02 fat. The two analyses showed 16.75 and 17.25 per cent. of protein and 4.75 and 5.21 of fat.

Mixed Feed from Winter Wheat.

Analyses on pages 174 and 175.

Twenty-one samples have been examined. All are of fair quality. The American Cereal Co. is the only firm represented which gives a guaranty. This is 17.75 protein, 4.20 fat. The sample contained 16.12 protein and 4.53 fat.

percentage of protein in these samples is 8.96 (or 10.19 per cent. in the water-free material) and the average price is $25.35 per ton. This is relatively a low grade, high-priced feed. It is possible to breed corn which, while yielding more bushels per acre than farmers are getting now, will also contain a good deal more protein to the bushel. This work of improving our flint, dent and sweet varieties is now engaging the attention of this station.

A sample of Pop Corn Waste, 15129, sent by E. H. Austin, Gaylordsville, has the following composition:

Water	10.52
Ash	1.66
Protein	11.56
Fiber	2.33
Nitrogen-free Extract	69.38
Fat	4.55
	100.00

Gluten Meal.

Analyses on pages 176 and 177.

Two brands of gluten meal were found in our market in the fall of 1905.

The Chicago Gluten Meal, made by the Glucose Sugar Refining Co., Chicago, has an average of 31.93 per cent. of protein and 5.5 per cent. of fat,—nearly two per cent. less of protein than last year and six per cent. less than is guaranteed. The manufacturers guaranteed 38 per cent. of protein and 3 per cent. of fat in this feed, but we are informed that the manufacture has now ceased and the factory has been dismantled.

Cream Gluten made by the Illinois Sugar Refining Co., Chicago, contains 32.68 per cent. of protein and 4.81 per cent. of fat. 35.50 per cent. of protein and 3.0 per cent. of fat are guaranteed, so that in composition this brand also falls far short of the manufacturer's claim, and the guaranty is misleading.

Gluten Feed.

Analyses on pages 176–181.

Eleven different firms offer brands of this popular dairy feed.

American Cereal Co., Chicago. A single sample contains 24.00 per cent. of protein and 4.75 of fat, instead of 28.0 of protein and 3.0 of fat, which are guaranteed.

Buffalo Cereal Co., Buffalo. The protein in four samples ranges from 22.9 to 25.4. The average is 24.23 per cent. of protein, instead of 28.0 per cent. guaranteed.

Peoria Cereal Co., Peoria, Ill., Continental Gluten Feed. The gluten feed made by this firm has the highest percentage of any of the brands, 28.75, but this is more than six per cent. lower than is claimed by the manufacturer, viz: 35 per cent. The material contains corn, oat and barley residues and is a distillery product, not a residue from glucose or starch manufacture. Its digestible portion is, therefore, calculated as for distillery grains. A sample, 13913, sent by T. S. Gold, West Cornwall, contained 32.37 per cent. of protein. Another sample, 13945, sent by Edwin C. Davis, Somers, had the following composition:

Water	6.03
Protein	31.00
Fat	12.77

Douglas & Co., Cedar Rapids, Iowa. A single sample contains 18.75 per cent. of protein, whereas 26.5 per cent. is guaranteed.

Flint Mill Co., Milwaukee. The average percentage of protein found in two samples is 19.68 as against 25 per cent. guaranteed. A sample of this brand, 13818, sent by R. W. Jennings, Torrington, contains 26.25 per cent. of protein.

Glucose Sugar Refining Co., Chicago. Buffalo Gluten Feed. The percentage of protein in eleven samples ranges from 21.37 to 26.25, the average being 24.38 and the guaranty 25.0. Only three of the eleven samples fell distinctly below the manufacturer's guaranty in respect to protein, and this and the Globe Gluten Feed made by the New York Glucose Co. are the only brands of gluten feed found in the Connecticut market this year which meet the guaranties of their manufacturers. A single sample, 15917, sent by W. H. Lee, Orange, bought of Abner Hendee, New Haven, contains protein 23.62 per cent., fat 3.95 per cent.

J. C. Hubinger Bros. Co., Keokuk, Iowa. The average protein found in four samples is 24.20 per cent; guaranteed 26.00 per cent.

National Starch Co., Chicago. Queen Gluten Feed. The protein found in the single sample is 22.00 per cent.; guaranteed 25.0.

New York Glucose Co. Globe Gluten Feed. The percentage of protein in ten samples ranges from 26.25 to 29.25, the average being 26.99 and the guaranty 26.0. This brand and the Glucose Sugar Refining Co.'s Buffalo Gluten Feed are the only ones found in the Connecticut market this year which meet the manufacturer's guaranties.

J. E. Soper & Co.'s Bay State. The average percentage of protein in four samples is 18.54, instead of 26.0, as guaranteed. This brand and that of Douglas & Co., Cedar Rapids, and of the Flint Mill Co., contain less than 20 per cent. of protein, though 25 and 26 per cent. of protein are guaranteed.

Warner's Sugar Refining Co., Waukegan, Ill. The average percentage of protein in four samples is 21.98. The amount guaranteed is 25.0.

Two samples of gluten feed, 14002, brand unknown, and 16080, Buffalo gluten sent by W. H. Lee, Orange, contain 22.75 and 23.50 per cent., respectively, of protein, and one of Tiger Gluten Feed, 14017, sent by S. A. Smith & Son, Clintonville, made by the St. Louis Syrup & Preserving Co., contains 22.87 per cent. of protein, instead of 25.0 guaranteed. Another sample of gluten feed, 16081, from Abner Hendee, contains 23.75 per cent. of protein.

Hominy Feed.

Analyses on pages 180 and 181.

This material, also called "Hominy Chop" and "White Meal," is a by-product from hominy mills and breweries and is quite popular with dairymen.

Hominy Feed, with the names of the following firms upon the bags, did not bear the statement of composition which is required by the law concerning feeding stuffs: M. F. Berringer, Philadelphia; The Coles Co. and Meech & Stoddard, Middletown; Hollister, Chase & Co., Simpson, Hendee & Co. and William R. Payne & Son, New York, and J. S. Wolfe Co., Pittsfield, Mass.

The Hominy Feed sold by Suffern, Hunt & Co., contains considerably less protein, 9.75 per cent., than is guaranteed, 11.00 per cent.; the other brands meet fairly well the manufacturers' guaranties.

Several samples of Hominy Feed sent by individuals had the following composition:

13425, from F. B. Newton, Plainville. 13893, sold by Chapin & Co., Boston, sent by T. A. Stanley, New Britain. 13910, Hominy Chop, and 13909, Star Hominy Chop, made by Toledo Elevator Co., sent by Meech & Stoddard, Middletown. 13953, Star Feed, made by the Toledo Elevator Co., sent by A. L. Hitchcock, Plainville. 14130, "A by-product from cracked corn," sent by R. G. Davis, New Haven.

Analyses.

	13425	13893	13910	13909	13953	14130
Water	....	8.93	....	....	....	....
Ash	....	3.34	....	....	....	....
Protein	10.37	9.06	10.06	9.00	8.63	8.81
Fiber	....	7.29	....	....	....	....
Nitrogen-free Extract	....	64.68	....	....	....	....
Fat	7.48	6.70	....	....	....	....
		100.00				

The Star Chop apparently contains a larger proportion of cob than the average hominy chop.

Rye Feed.

Analysis on pages 182 and 183.

Seven analyses are given in the table. All of the samples are pure and of fair average quality, but none of them has the guaranty of composition required by law.

The prices, all of which were quoted in October last, range from $22.50 to $28.00 per ton.

At the latter price rye feed could not be economically used at present.

Malt Sprouts.

Analysis on pages 182 and 183.

The two samples examined, neither having the required guaranty, have about the usual composition.

Dried Distillery Grains.

Analyses on pages 182 and 183.

Ajax Flakes.—This material is the grains from which starch and sugar have been largely removed by "mashing" in the distilleries and which have then been dried.

In the three samples examined the average percentage of protein found is 30.89, guaranteed 33.0. Average fat found 13.35, guaranteed 12.0. Two of the "Dairy Feeds" noticed on pages 186 and 184, namely 15768, Empire State Dairy Feed, and 15591, Biles Dairy Feed Fourex Grains, are also dried distillery grains, which have proved to be an excellent dairy feed.

A sample, 13920, marked *Protein Corn Distillers Grains* from C. F. Keck & Co., Milwaukee, Wis., has the following composition:—

Water	11.77
Ash	1.87
Protein	26.56
Fiber	10.21
Nitrogen-free Extract	39.34
Fat	10.25
	100.00

Buckwheat Middlings.

Analysis on pages 182 and 183.

This material, made in this state, maintains its usual quality as a high protein feed, selling at a very reasonable price, $22.00 per ton.

A sample of Birkett Buckwheat Feed, 13435, sent by Meech & Stoddard, Middletown, contains only 12.87 per cent. of protein and another sample, sent by Thomas Holt, Southington, contains but 9.81 per cent. These contain a large amount of hulls, which are nearly worthless as feed.

The Buckwheat Middlings are free from them.

Alfalfa Meal.

Analysis on pages 182 and 183.

This material appears to be true to name and to be dried and ground alfalfa hay. It contains 20.25 per cent. of protein

and is offered for $38.00 per ton. Cotton seed meal, containing pound for pound twice as much protein, sells for $28–$30. The price of this alfalfa meal is, therefore, out of all proportion to its value as a dairy feed.

Miscellaneous Mixed Feeds.

Various Corn and Oat Feeds.

Analyses on pages 182 and 183.

These are mixtures of factory waste products, sold under various proprietary names, some of them containing a considerable amount of oat hulls.

The protein in them ranges from 8.00 to 9.75 and the woody fiber from 3.87 to 12.24.

No guaranty is given by the Husted Mill and Elevator Co. The other brands are sold with guaranties, which in all cases are substantially justified by the composition of the goods.

A sample of Victor Feed, 13437, sent by Dr. Geo. E. Corwin, Jr., Lakeville, contains 7.81 per cent. of protein.

Corn and Wheat Feeds.

Analysis on pages 182 and 183.

Mixtures of Corn and Wheat.

Colonial Choice Middlings, made by Miner-Hillard Mill Co., Wilkes Barre, Penn., is a mixture of wheat and corn products containing no undue proportion of cob and meets the manufacturer's guaranty.

Mixtures of Corn-Cobs and Wheat Feed.

Analyses on pages 182–185.

Dairy Mixed Feed manufactured for Jennings & Fulton, Boston, is stated to be a mixture of winter wheat bran, winter wheat ship stuff and corn cob meal.

The average percentages of protein and fat in the three samples examined are 11.16 and 3.07, respectively. The guaranty is 12.05 protein and 3.20 fat.

Jersey Mixed Feed and *Indiana Mixed Feed* made by the Indiana Mill Co., Terre Haute, have the same guaranty as the above, and the same statement of ingredients.

A single sample of *Blue Grass Mixed Feed,* manufacturer not stated, contains but 10.75 per cent. of protein, while 12.50 per cent. is guaranteed.

Corn, Oats and Barley.

Analyses on pages 184 and 185.

Analyses of two brands appear in the table. That made by the Husted Mill and Elevator Co. is sold without guaranty. Schumacher's Stock Feed, made by the American Cereal Co., substantially meets its guaranty of 12 per cent. protein and 4.0 per cent. of fat.

Proprietary Horse Feeds.

Analyses on pages 184 and 185.

Sucrene Horse Feed, made by American Milling Co., Chicago, Ill., is a mixture of wheat, oat, corn, barley and other products, with some linseed meal. The guaranty is 13.50 per cent. of protein and 3.50 of fat. Two samples analyzed contains 11.87 and 12.62 per cent. of protein and 2.48 and 2.64 per cent. of fat, respectively.

Horse Feed, made by the Buffalo Cereal Co., Buffalo, N. Y., is a mixture of oats, cracked corn, wheat bran and linseed meal and substantially meets the owner's guaranty.

Horse Feed, made by the H. O. Co., Buffalo, N. Y., is a mixture of corn, oats (or oat hulls), wheat bran and peanuts, and meets the manufacturer's guaranty.

Proprietary and other Dairy and Stock Feeds.

Analyses on pages 184 and 185.

A considerable number of brands of these feeds have been examined, of all degrees of concentration, the protein in them ranging from 8.25 to 32.00 per cent.

With the exception of that sold by the Daniels Mill Co., all have a guaranty of composition, as required by law.

The following brands contain considerably less protein than is guaranteed.

	Guaranteed.	Found.
Quaker Dairy Feed	14.0*	11.75
Biles' Union Grains	24.0	22.00
Dickinson's Stock Food	10.0	8.25
Clark Bros. & Co.'s Empire State Dairy Feed	36.2	29.50
Lenox Stock Feed	9.9	8.50
Hammond Dairy Feed	17.0	14.62

* Reduced December 1 to 12.0 per cent.

These dairy and stock feeds are mixtures of a great variety of products or factory wastes. In such a ground mixture it is usually impossible to say whether the ingredients used are sound, saleable products, or are damaged and waste articles. The following list shows the various ingredients found by microscopic examination of the feeds. *Quaker Dairy Feed,* oat and wheat products, cotton seed meal, trace of corn. *Sucrene Dairy Feed,* wheat, corn, barley and oat products, cotton seed meal and some weed seeds. *Biles Fourex Grains,* and *Clark Bros. & Co.'s Empire State Dairy Feed,* maize, barley, oat and rye residues. They are dried distillery grains. *Biles Union Grains,* maize, oat, barley and rye residues, with wheat bran, malt sprouts, cotton seed and linseed. *Buffalo Cereal Co.'s Creamery Feed,* corn and oat products and cotton seed meal. *3X Stock Feed, Daniels Mill Co.'s Stock Feed, H. O. Mills, New England Stock Feed,* corn, oats and wheat products. *Durham Stock Feed, Haskell's Stock Feed,* corn and oat feed. *Great Western Cereal Co.'s Excelsior Stock Feed, Dickinson's Stock Feed, Lenox Stock Feed,* cracked corn and oat product. *Blatchford's Calf Meal,* cotton seed, linseed, beans, carob-beans, wheat product and fenugreek. *H. O. Dairy Feed,* corn, oat and wheat products and cotton seed meal. *Protena Dairy Feed,* wheat bran, corn product, cotton seed meal and ground hay, with characters of alfalfa. *Hammond Dairy Feed,* malt sprouts and other barley product, oat and maize products and weed seeds.

A sample of Quaker Dairy Feed, 13921, sent by C. C. Chapin, Thompsonville, contained moisture 7.13, protein 12.13, fat 3.55 per cent. which is about the usual composition of this brand.

A sample of Sucrene Dairy Feed, 15128, sent by F. B. Ashton, Middletown, containing 15.31 per cent. of protein, was by a clerical error reported as containing only 6.31 per cent.

Proprietary Poultry Feeds.

Analyses on pages 186 and 187.

Six brands of poultry feeds have been examined. *American Cereal Co.'s Poultry Feed* contains corn, a wheat product and cotton seed meal. *Buffalo Cereal Co.'s Poultry Feed,* rolled oats, cracked corn, wheat bran. *H. O. Co.'s Poultry Feed,* cracked corn, rolled oats, wheat bran and peanuts. *Purina Chick Feed,* screenings (containing wheat, wild mustard, black bindweed, foxtail and cockle), cracked white Kafir corn, or a related variety of sorghum, millet and cracked corn. *Daniels Mill Co.'s Chick Food,* millet, cracked corn, wheat and grit. *Cyphers Incubator Co.'s Laying Feed,* wheat bran and coarse corn meal. A sample marked "Poultry Food," without the name of brand or manufacturer, sent by H. L. Jeffrey, New Preston, contains 14.75 per cent. of protein and 14.46 per cent. of salt. It is composed of wheat bran, with a little linseed, cayenne pepper and salt and possibly other ingredients.

Beef Scrap and Meat Meal.

Analyses on pages 186 and 187.

These samples have the usual composition of such material.

THE DIGESTIBILITY OF FEEDING-STUFFS.

A certain part of every feeding-stuff is indigestible and passes through the body into the dung without doing anything to sustain the animal. The value of a commercial feed rests wholly in that portion of it which the animal can, under favorable conditions, digest or appropriate and make a part of itself. Some animals have greater power of digestion than others, and the amount of any ingredient, protein, fat, or fiber, digested by a given animal depends much on the proportion of other ingredients which are fed along with it. Thus, if starchy matter is fed in too large proportion, a considerable part of it will pass into the dung and be wasted. But fed in proper fashion over 90 per cent. of it may be taken up by the body and nourish it.

Table I gives the "digestion coefficients" of most of the feeds mentioned in Table IV.

The digestion coefficient of protein, for example, in cotton seed meal is 88. This means that in a properly made ration, neat cattle, in good health, may be expected, on the average, to digest about 88 parts out of every 100 parts of the protein of cotton seed meal of good quality. The table has no great mathematical precision, but is, nevertheless, a valuable general guide in feeding.

The use of the table is quite simple. Suppose analysis shows a certain sample of cotton seed meal to contain 43.5 per cent. of protein; that is, 43.5 pounds of protein in 100 pounds of the meal. It is desired to know how much *digestible* protein is contained in 100 pounds of meal. The table of "digestion coefficients" shows that of every 100 pounds of crude protein in cotton seed meal 88 pounds are digestible. It follows, by the rule of three (100 is to 88 as 43.5 is to 38.28), that, of the 43.5 pounds of protein, 38.28 pounds are digestible. To apply the table, multiply the percentage found on analysis by the proper coefficient taken from the table and divide the product by 100. The result will be the percentage amount of *digestible* protein, fiber, etc., as the case may be.

In Table IV, under the averages of analyses, will be found calculated the average digestible nutrients contained in the different feeding-stuffs, so far as the data at hand permit.

TABLE I.—DIGESTION COEFFICIENTS, OR PERCENTAGES OF THE FOOD INGREDIENTS, FOUND BY ANALYSES, WHICH ARE DIGESTIBLE BY NEAT CATTLE.

(Lindsay's Compilation, Fourteenth Report Massachusetts (Hatch) Agricultural Station 1902, page 195.)

	Protein.	Fiber.	Nitrogen-free Extract.	Fat.
Cotton Seed Meal.........	88	32	64	93
Linseed Meal, new process..	85	74	84	93
Linseed Meal, old process...	89	57	78	89
Corn Meal*	70	..	94	91
Gluten Meal	84	..	88	98
Gluten Feed	85	76	89	83
Wheat Bran	77	21	69	66
Wheat Middlings	77	30	78	88
Wheat Mixed Feed.........	77	26	74	77
Rye Meal	84	..	92	64
Malt Sprouts	80	34	69	100
Dried Distillers' Grains....	74	..	82	95
H. O. Dairy Feed.........	78	41	70	85
Quaker Oat Feed..........	81	43	67	89
Quaker Dairy Feed........	78	41	70	85
Corn and Oat Feeds.......	71	48	83	87

* Also assumed for hominy feeds.

REGARDING THE PURCHASE OF COMMERCIAL FEEDING-STUFFS.

A well-managed dairy farm should produce all of the coarse fodder,—in form of corn fodder or stover, hay and ensilage,—which is needed for the stock, and, excepting under unusual conditions, should also supply an abundance of starchy food, such as corn meal and in some cases oats and barley, for feeding purposes.

These the farmer should be able to produce in abundance.

But in order to feed them without waste and also to supply a deficiency in them, it is almost always advisable or necessary, in the absence of clover, alfalfa, or other leguminous crops, to buy feeds *rich in digestible protein;*—considerably richer in it than corn meal.

The analyses given on following pages show what feeds are at present on our market, which of them meet this demand for digestible protein at reasonable prices and which of them do not meet this demand and cannot be fed to advantage.

The main facts given in Table IV are summarized in Table II, which shows, first, the average composition of these feeding-stuffs as determined by our recent examination and arranged according to the per cent. of protein in them; second, the amount of digestible matter in each feed, as far as we have been able to calculate it, and third, the average retail prices of the feeds in October and November last.

The table divides the commercial feeds into five classes.

1. Those having over 30 per cent. of protein in them:—Cotton seed, linseed and gluten meals, dried distillers' grains and buckwheat middlings.

   Their average price is $29.24 per ton and average protein 33.3 per cent.

2. Feeds having between 20 and 30 per cent. of protein:—Certain gluten feeds, some brands of distillers' grains, alfalfa meal and certain proprietary dairy feeds.

   Alfalfa meal is excluded from the averages, on account of the price, which is prohibitive. These feeds have an average cost of $26.61 and contain an average of 24.6 per cent. protein.

3. Feeds having between 15 and 20 per cent. of protein:—Certain gluten feeds, middlings, mixed feed and winter bran, and some proprietary dairy feeds.

   Their average price is $24.74 and their average percentage of protein 17.1 per cent.

4. Feeds having between 10 and 15 per cent. of protein:—Spring bran, hominy feed, and various proprietary feeds. The average price is $24.17 and average percentage of protein 12.2.

5. Feeds with less than 10 per cent. of protein:—Corn meal, mixtures of corn and oats (hulls) and a considerable number of "stock feeds," which are essentially mixtures of corn and oats. These cost on the average $23.70 per ton and contain an average of 8.8 per cent. of protein.

The table shows that feeds are bought and sold at prices which bear no just relation to their feeding value.

Thus, it is not difficult to select feeds selling at about the same price, one of which contains twice as much protein as the other.

The whole class of feeds which contain on the average 23.8 per cent. of protein costs on the average only $3.00 per ton more than that class of feeds which contains but 8.8 per cent. of protein.

In most cases a feeder cannot use to advantage any boughten feed containing less than 15 per cent. of protein.

Ready mixed feeds, made of a number of by-products or factory wastes, may wisely be let alone, unless the buyer can see for himself out of just what raw material the mixture is being prepared. Low grade, damaged corn, shriveled wheat, peanut refuse and wheat screenings containing many weed seeds, are not infrequently found in such feeds by careful examination, but are not easy for the buyer himself to recognize.

TABLE II.—AVERAGE COMPOSITION OF FEEDS IN CONNECTICUT MARKET, DIGESTIBLE MATTER IN THEM AND SELLING PRICE.

	In 100 pounds of feed are contained pounds of						In 100 pounds of feed are contained pounds of digestible				
	Water.	Ash.	Protein.	Fiber.	Nitrogen-free Extract (Starch, etc.).	Ether Extract (fat)	Protein.	Fiber.	Nitrogen-free Extract.	Fat.	Cost per ton.
Containing over 30 per cent. protein.											
Cotton Seed Meal	8.9	6.3	40.8	9.3	26.7	8.0	35.9	3.0	17.1	7.5	$28.89
Linseed Meal, new process	11.0	5.3	35.6	9.2	35.8	3.1	30.3	6.8	30.1	2.8	32.00
" " old process	10.5	5.4	32.7	8.5	35.8	7.1	29.1	4.8	27.9	6.4	32.00
Cream Gluten Meal	9.0	1.7	32.7	2.0	49.8	4.8	27.4	--	43.8	4.7	33.00
Chicago " "	9.1	1.8	31.9	2.3	49.4	5.5	28.4	--	45.9	5.1	31.75
XXXX Dairy Feed	7.7	2.2	31.2	11.9	35.5	11.5	23.1	--	29.2	10.9	27.00
Dried Distillery Grains	7.5	2.0	30.9	12.6	33.6	13.4	22.9	--	27.6	12.7	27.33
Buckwheat Middlings	11.9	5.8	30.9	8.6	34.3	8.5	----	--	----	---	22.00
Containing 20 to 30 per cent. of protein.											
Empire State Dairy Feed	7.4	2.2	29.5	12.9	36.4	11.6	21.8	--	29.9	11.0	27.00
Continental Feed	7.7	3.5	28.8	10.6	37.6	11.8	21.3	--	30.9	11.2	28.00
Gluten Feed, Globe	9.2	3.1	27.0	7.4	50.2	3.1	22.9	5.7	44.7	2.6	25.80
Malt Sprouts	9.2	6.0	25.7	10.7	46.5	1.9	20.5	3.6	32.2	1.9	20.50
Gluten Feed, Buffalo	9.0	1.8	24.4	7.0	54.4	3.4	20.7	5.3	48.5	2.8	26.55
" Buffalo Cereal Co.	9.7	2.5	24.2	7.3	52.8	3.5	20.6	5.6	47.0	2.9	27.00
" Hubinger's	8.0	1.7	24.2	7.7	55.2	3.2	20.6	5.8	49.0	2.6	26.75
" Am. Cereal Co.	9.8	2.6	24.0	7.3	51.5	4.8	20.4	5.5	45.9	3.9	27.00
Dairy Union Grains	8.9	6.7	22.9	8.8	45.4	7.2	----	--	----	---	28.00
Gluten Feed, Queen	11.2	1.1	22.0	7.1	55.9	2.7	18.7	5.4	49.9	2.2	28.00
" Warner's	9.1	1.7	22.0	7.2	56.3	3.7	18.8	5.5	50.1	3.1	25.75
H. O. Dairy Feed	8.7	3.9	20.3	12.3	50.0	4.8	15.8	5.0	35.0	4.1	29.00
Alfalfa Meal	10.0	12.3	20.3	18.6	36.6	2.2	----	--	----	--	38.00
Containing 15 to 20 per cent. of protein.											
Gluten Feed, Flint	8.9	1.1	19.7	6.4	59.0	4.9	16.7	4.8	52.6	4.1	27.00
Creamery Feed, Buffalo Cereal Co.	8.9	4.2	19.6	11.8	50.8	4.7	----	--	----	---	26.00
Protena	9.1	7.6	19.1	17.6	42.9	3.7	---	--	----	---	26.00
Gluten Feed, Cedar Rapids	8.5	0.9	18.8	7.6	58.8	5.4	15.9	5.7	52.4	4.5	29.00
" Bay State	9.8	1.0	18.5	5.3	61.3	4.1	15.8	4.1	54.5	3.4	25.75
Wheat Middlings, Spring	11.3	4.7	16.8	6.0	56.3	4.9	12.9	1.8	43.9	4.3	23.31
" Winter	11.0	4.3	16.4	5.6	58.2	4.5	12.7	1.7	45.4	4.0	23.12
Rye Feed	12.3	3.7	15.8	3.8	61.3	3.1	13.3	--	56.3	2.0	23.93
Mixed Feed, Winter	11.0	5.8	15.7	7.6	55.4	4.5	12.1	2.0	41.1	3.5	22.70
Bran, Winter	10.5	6.7	15.2	8.8	54.2	4.6	11.7	1.8	37.4	3.0	21.22
Mixed Feed, Spring	10.9	4.9	15.1	7.5	57.1	4.5	11.6	2.0	42.3	3.5	22.86
Sucrene Dairy Feed	11.4	6.2	15.0	8.6	55.1	3.7	----	--	----	---	26.00
Containing 10 to 15 per cent. of protein.											
Hammond Dairy Feed	10.7	7.1	14.6	9.5	54.4	3.7	----	--	----	---	25.00
Bran, Spring	10.9	6.3	14.1	10.5	53.5	4.7	10.8	2.2	36.9	3.1	21.13
Colonial Middlings	11.4	3.5	13.1	5.6	60.0	6.4	----	--	----	---	26.00
H. O. Horse Feed	8.9	3.8	12.9	9.4	59.8	5.2	----	--	----	---	27.00
Sucrene Horse Feed	12.2	6.7	12.2	8.0	58.3	2.6	----	--	----	---	27.00
Quaker Dairy Feed	9.3	5.3	11.8	17.6	52.9	3.1	----	--	----	---	21.00
Horse Feed, Buffalo Cereal Co.	9.8	3.7	11.5	10.3	59.6	5.1	----	--	----	---	26.00
Various Mixtures of Wheat Feed and Corn Cob	10.1	4.9	11.2	14.7	56.1	3.0	----	--	----	---	20.71
Hominy Feed	9.6	2.8	10.2	5.2	64.2	8.0	7.1	--	60.3	7.3	23.88
XXX Stock Feed	9.2	3.9	10.1	11.8	59.6	5.4	----	--	----	---	24.00

TABLE II.—AVERAGE COMPOSITION OF FEEDS IN CONNECTICUT MARKET, DIGESTIBLE MATTER IN THEM AND SELLING PRICE.—*Continued.*

	In 100 pounds of feed are contained pounds of						In 100 pounds of feed are contained pounds of digestible				
	Water.	Ash.	Protein.	Fiber.	Nitrogen-free Extract (Starch, etc.).	Ether Extract (fat)	Protein.	Fiber.	Nitrogen-free Extract.	Fat.	Cost per ton.
Containing less than 10 per cent. of protein.											
Daniels' Stock Feed	12.5	2.1	9.9	4.8	67.2	3.5	7.0	2.3	55.8	3.1	$26.00
New England Stock Feed	9.8	3.2	9.1	10.4	63.0	4.5	6.5	5.0	52.3	3.9	24.00
Haskell's "	7.5	3.6	9.0	8.8	64.3	6.8	6.3	4.2	53.3	5.9	25.00
Cord Meal "	12.1	1.4	9.0	1.9	71.6	4.0	6.3	--	67.4	3.6	25.35
Excelsior Stock Feed	8.6	5.9	8.6	12.2	58.4	6.3	6.1	5.9	48.5	5.5	22.00
Lenox "	11.7	3.1	8.5	9.1	64.7	2.9	6.0	4.4	53.6	2.6	25.00
Durham "	10.4	4.8	8.3	12.7	57.8	6.0	5.9	6.1	47.8	5.2	24.00
Dickinson's "	10.5	3.3	8.3	11.1	63.1	3.8	5.9	5.3	52.4	3.3	20.00
Various other corn and oat feeds	10.3	3.2	8.8	8.2	64.9	4.6	6.2	3.9	53.8	4.0	24.20
Victor Corn and Oat Feed	10.5	3.8	8.1	10.3	63.4	3.9	5.8	4.9	52.5	3.4	21.50

THE WEIGHT OF ONE QUART OF VARIOUS FEEDING STUFFS.

The following table gives the weight of one quart of the feeds named, and is useful to calculate the weight of grain ration fed, from the measure which is almost universally used on farms.

This table was prepared by Mr. H. G. Manchester, of Winsted.

TABLE III.—THE AVERAGE WEIGHT OF ONE QUART OF EACH OF THE FEEDS NAMED.

	Pounds.
Cotton Seed Meal	1.5
Linseed Meal, old process	1.1
Linseed Meal, new process	0.9
Gluten Meal	1.7
Gluten Feed	1.4
Distillers' Grains	0.7
Wheat Bran, coarse	0.5
Wheat Middlings, coarse	0.8
Wheat Middlings, fine	1.1
Mixed Wheat Feed	0.6
Corn Meal	1.5
Hominy Meal	1.3
Provender	1.5
Oats	1.2
Rye Bran	0.6
H. O. Dairy Feed	0.7
Victor Corn and Oat Feed	0.7

TABLE IV.—ANALYSES OF COMMERCIAL FEEDS. SAMPLED IN 1905.

Station No.	Brand.	Retail Dealer.	Analyses. Water.	Ash.	Protein.	Fiber.	Nitrogen-free Extract. (Starch, gum, etc.)	Fat. (Ether Extract.)	Price per ton.
	Cotton Seed Meal.								
15680	Green Diamond. Chapin & Co., Boston	*Hartford:* Daniels Mill Co.	9.87	5.41	37.87	11.45	27.60	7.80	$29.00
15726	" " "	*Colchester:* Colchester Grain & Coal Co.	9.19	6.08	41.00	8.29	27.47	7.97	28.00
15626	Magnolia Brand. Chas. M. Cox Co., Boston	*Wallingford:* E. E. Hall	8.06	6.78	42.00	8.08	26.95	8.13	28.00
15638	Georgia Cotton Oil Co., Augusta, Ga.	*New Britain:* M. D. Stanley	8.82	5.69	38.25	10.56	29.51	7.17	29.00
15631	Dixie Brand. Humphreys, Godwin & Co., Memphis, Tenn.	*Meriden:* Meriden Grain and Feed Co.	8.98	6.40	40.00	9.62	27.00	8.00	29.00
15735	Dixie Brand. Humphreys, Godwin & Co., Memphis, Tenn.	*Willimantic:* H. A. Bugbee	8.76	7.51	43.25	5.06	25.61	9.81	29.00
15765	Eagle Brand. W. A. Kaiser & Co., Memphis, Tenn.	*Yantic:* A. R. Manning	8.84	6.12	41.44	8.89	25.50	9.21	30.00
15773	J. E. Soper & Co., Boston	*Norwich:* Norwich Grain Co.	9.21	7.95	41.25	8.24	23.95	9.40	29.00
15688	The Hunter Bros., Milling Co., St. Louis	*Hartford:* Smith, Northam & Co.	8.61	5.80	43.00	10.09	25.29	7.21	30.00
15716	" " " "	*Middletown:* Meech & Stoddard	9.90	6.64	40.00	8.47	26.47	8.52	28.00
15709	Star Brand. J. T. & R. S. Wells, Memphis, Tenn.	*Suffield:* Spencer Bros.	8.51	5.69	41.25	11.57	26.71	6.27	29.00
15829	" " " " " "	*Danbury:* F. C. Benjamin & Co.	7.99	6.00	39.75	10.70	28.77	6.79	28.00
		Average of the 12 analyses	**8.89**	**6.34**	**40.75**	**9.25**	**26.75**	**8.02**	**28.89**
		Average digestible	----	----	**35.9**	**3.0**	**17.1**	**7.5**	
	Linseed Meal, New Process.								
15675	American Linseed Co., Chicago, Ill.	*Hartford:* Daniels Mill Co.	10.98	5.34	35.62	9.17	35.84	3.05	**32.00**
		Digestible	----	----	**30.3**	**6.8**	**30.1**	**2.8**	
	Linseed Meal, Old Process.								
15737	American Linseed Co., New York	*Willimantic:* H. A. Bugbee	10.17	4.96	33.87	8.03	36.54	6.43	32.00
15836	Mann Bros. Co., Buffalo, N. Y.	*Winsted:* Balch & Platt	11.24	5.31	32.69	7.77	35.20	7.79	33.00
15683	Metzger Seed and Oil Co., Toledo, Ohio	*Hartford:* Smith, Northam & Co.	10.90	6.03	29.69	9.67	36.78	6.93	31.00
15811	Midland Linseed Co., Minneapolis	*New Canaan:* C. H. Fairty	10.13	5.40	33.12	8.89	35.68	6.78	32.00
15782	Wright & Hills Linseed Oil Co., Chicago	*New London:* P. Schwartz	9.80	5.24	34.12	8.20	34.88	7.76	32.00
		Average of the above 5 analyses	**10.45**	**5.39**	**32.69**	**8.51**	**35.82**	**7.14**	**32.00**
		Average digestible	----	----	**29.1**	**4.8**	**27.9**	**6.4**	
	WHEAT PRODUCTS. *Bran from Winter Wheat.*								
15608	Ballard's. Ballard & Ballard, Louisville, Ky.	*New Haven:* Abner Hendee	9.95	6.35	15.75	7.67	55.59	4.69	24.00
15609	Choice Flaked. Commercial Milling Co., Detroit, Mich.	" "	10.13	5.47	14.06	8.46	57.30	4.58	20.00
15746	Eagle Mill and Elevator Co., Higginsville, Mo.	*Danielson:* Waldo Bros.	9.93	7.36	14.87	9.28	53.85	4.71	20.00
15751	Taylor's. The Northwestern Elev. and Mill Co., Toledo, Ohio	" Quinebaug Store	10.20	8.95	15.37	8.79	52.62	4.07	20.00
15803	Peru Milling Co., Peru, Ind.	*Derby:* The Peterson-Hendee Co.	10.06	6.48	15.81	8.59	54.44	4.62	22.00
15846	Saginaw Mill Co., Saginaw, Mich.	*Waterbury:* D. L. Dickinson	11.34	6.46	14.25	10.26	53.25	4.44	24.00
15762	Star and Crescent Mill Co., Chicago	*Yantic:* A. R. Manning	11.15	7.05	15.12	8.68	53.11	4.89	20.00
15687	Voigt's. Voigt Mill Co., Grand Rapids, Mich.	*Hartford:* Smith, Northam & Co.	11.48	5.79	14.50	8.52	55.63	4.08	22.00
15604	—	*New Haven:* J. T. Benham Estate	9.95	6.67	17.00	8.67	52.76	4.95	19.00
		Average of these 9 analyses	**10.47**	**6.73**	**15.19**	**8.77**	**54.28**	**4.56**	**21.22**
		Average digestible	----	----	**11.7**	**1.8**	**37.4**	**3.0**	
	Bran from Spring Wheat.								
15750	John Alden Co., Minneapolis	*Danielson:* Quinebaug Store	9.55	7.25	14.75	10.43	53.32	4.70	21.00
15662	Alton Milling Co., Alton, Iowa	*Plainville:* G. W. Eaton	11.49	5.92	13.00	10.38	54.95	4.26	22.00
15798	Bay State Milling Co., Winona, Minn.	*Ansonia:* Ansonia Flour and Grain Co.	10.27	6.62	14.25	11.79	52.19	4.88	24.00

TABLE IV.—ANALYSES OF COMMERCIAL FEEDS—*Continued.* SAMPLED IN 1905.

Station No.	Brand.	Retail Dealer.	Analyses. Water.	Ash.	Protein.	Fiber.	Nitrogen-free Extract. (Starch, gum, etc.)	Fat. (Ether Extract.)	Price per ton.
	WHEAT PRODUCTS—*Continued.* *Bran from Spring Wheat.*								
15613	Badger. Berger-Crittenden Milling Co., Milwaukee	*Branford:* S. V. Osborn	11.18	5.56	13.44	9.54	57.03	4.25	$22.00
15733	Niagara. Cataract City Milling Co., Niagara Falls, N. Y.	*Willimantic:* H. A. Bugbee	10.59	5.83	13.75	9.18	55.67	4.98	20.00
15790	Cataract City Mill Co., Niagara Falls, N. Y.	*Hamden:* I. W. Beers	10.50	7.15	15.56	10.40	51.09	5.30	19.00
15642	◊ Ogilvie's. C. M. Cox, Boston, Mass.	*New Britain:* M. D. Stanley	11.22	6.12	13.44	9.39	54.68	5.15	23.00
15739	Fulton Milling Co., Sioux Falls, S. Dak.	*Putnam:* F. M. Cole & Co.	10.78	6.91	15.12	10.97	51.24	4.98	19.00
15694	Clover Leaf. The Gardner Mill, Seymour Carter, Hastings, Minn.	*Manchester:* Manchester Elevator Co.	11.23	5.83	13.37	11.26	53.78	4.53	22.00
15723	Fancy Flaky. Hubbard Milling Co., Mankato, Minn.	*Colchester:* Colchester Grain & Coal Co.	11.43	7.04	13.50	10.83	52.66	4.54	19.00
15636	Duluth Imperial. Imperial Mill Co., Duluth, Minn.	*Meriden:* A. H. Cashen	11.48	5.32	14.87	8.08	55.75	4.50	21.00
15629	L—K.	*Meriden:* Meriden Grain and Feed Co.	10.81	5.65	13.12	10.82	55.36	4.24	22.00
15809	Ben Hur. Royal Mill. Co., Minneapolis	*Stamford:* Scofield & Miller	10.76	6.56	13.87	11.68	52.74	4.39	20.00
15653	Washburn, Crosby Co.'s, Washburn Mills	*Southington:* Southington Lumber and Feed Co.	10.63	6.47	14.19	11.07	52.99	4.65	22.00
15706	" " "	*Suffield:* Spencer Bros.	12.14	5.86	13.62	11.30	52.35	4.73	23.00
15742	Broad Flaky. Wells Flour Mill. Co., Wells, Minn.	*Putnam:* F. M. Cole & Co.	10.35	6.92	15.12	11.52	50.96	5.13	19.00
		Average of these 16 analyses	**10.90**	**6.31**	**14.06**	**10.54**	**53.49**	**4.70**	**21.13**
		Average digestible	----	----	**10.8**	**2.2**	**36.9**	**3.1**	
	Middlings, Winter Wheat.								
15760	Trojan. The Allen & Wheeler Co., Troy, Ohio	*Jewett City:* J. E. Leonard & Son	10.78	4.38	16.50	4.99	58.95	4.40	25.00
15789	Cataract City Mill. Co., Niagara Falls, N. Y.	*Hamden:* I. W. Beers	11.16	3.87	14.87	5.92	59.96	4.22	21.50
15664	M. Hecker-Jones-Jewell Milling Co., New York	*Plainville:* G. W. Eaton	10.88	4.60	16.37	7.65	56.08	4.42	25.00
15743	Fancy. Williams Bros. Co., Kent, Ohio	*Putnam:* Bosworth Bros.	11.05	4.27	18.00	3.85	57.80	5.03	21.00
		Average of these 4 analyses	**10.97**	**4.28**	**16.44**	**5.60**	**58.19**	**4.52**	**23.12**
		Average digestible	----	----	**12.7**	**1.7**	**45.4**	**4.0**	
	Middlings, Spring Wheat.								
15749	Standard. John Alden Co., Minneapolis, Minn.	*Danielson:* Quinebaug Store	11.11	5.23	17.87	6.82	53.83	5.14	21.00
15799	Bay State Milling Co., Winona, Minn.	*Ansonia:* Ansonia Flour and Grain Co.	11.09	5.39	17.50	7.07	53.05	5.90	23.00
15744	Standard. L. Christian & Co., Minneapolis, Minn.	*Putnam:* Bosworth Bros.	11.28	6.00	16.25	6.41	55.00	5.06	20.00
15761	Snowball. Gardner Mills, Seymour Carter, Hastings, Minn.	*Jewett City:* J. E. Leonard & Son	10.84	4.36	16.50	6.48	57.04	4.78	25.00
15805	Gooding-Coxe Co., Minneapolis, Minn.	*Guilford:* Morse & Landon	12.08	3.74	16.00	5.70	57.80	4.68	24.00
15659	Commander. Gregory Cook Co., Duluth, Minn.	*Plainville:* F. B. Newton	12.12	3.61	15.75	4.76	59.19	4.57	25.00
15619	W. J. Jennison, Minneapolis	*East Haven:* F. A. Forbes	11.64	3.20	16.12	4.65	60.46	3.93	22.00
15617	The Northwestern Consolidated, Minneapolis	*Branford:* S. V. Osborn	11.29	4.75	14.37	8.18	57.13	4.28	25.00
15667	B. Pillsbury's, Minneapolis, Minn.	*Bristol:* W. O. Goodsell	11.68	5.65	16.12	8.38	53.29	4.88	22.00
15712	XX Daisy. Pillsbury's, Minneapolis, Minn.	*Thompsonville:* H. K. Brainard	12.24	4.12	18.12	2.99	58.14	4 39	27.00
15810	Ben Hur. Royal Mill. Co., Minneapolis	*Stamford:* Scofield & Miller	11.69	4.82	18.81	4.77	54.83	5.08	25.00
15695	Star and Crescent Mill. Co., Chicago, Ill.	*Rockville:* Edward White	11.65	3 80	15.31	5.29	59.74	4 21	24.00
15644	Standard. Washburn, Crosby Co.'s, Washburn Mills	*New Britain:* C. W. Lines Co.	11.74	4.60	16.75	5.53	56.63	4 75	23.00
15728	" " "	*East Hampton:* R. H. Hall	11.13	5.76	17.25	8.14	52.51	5.21	23.00
15754	George Urban Milling Co., Buffalo, N. Y.	*Plainfield:* J. P. Kingsley & Son	11.39	4.95	17.81	6.76	53.98	5.11	21.00
15741	No. 1 Extra. Wells Flour Mill. Co., Wells, Minn.	*Putnam:* F. M. Cole & Co.	11.42	4.77	18.00	4.57	55.70	5.54	23.00
		Average of these 16 analyses	**11.34**	**4.67**	**16.78**	**6.03**	**56.34**	**4.84**	**23.31**
		Average digestible	----	----	**12.9**	**1.8**	**43.9**	**4.3**	

TABLE IV.—ANALYSES OF COMMERCIAL FEEDS—*Continued.* SAMPLED IN 1905.

Station No.	Brand.	Retail Dealer.	Analyses.						Price per ton.
			Water.	Ash.	Protein.	Fiber.	Nitrogen-free Extract. (Starch, gum, etc.)	Fat. (Ether Extract.)	
	WHEAT PRODUCTS—*Continued.* *Mixed Feed from Winter Wheat.*								
15693	Acme. Acme Milling Co., Indianapolis, Ind.	*Manchester:* Manchester Elevator Co.	11.49	5.87	17.00	7.19	54.00	4.45	$22.00
15759	Trojan. The Allen & Wheeler Co., Troy, Ohio	*Jewett City:* J. E. Leonard & Son	10.30	5.55	15.62	6.77	57.30	4.46	25.00
15820	Buckeye. The American Cereal Co., Chicago, Ill.	*Bethel:* Johnson & Morrison	11.23	5.81	16.12	7.49	54.82	4.53	22.00
15785	Erie. Chapin & Co.	*Clintonville:* S. A. Smith	10.40	5.42	15.50	8.08	56.22	4.38	22.00
15791	Edison. " St. Louis	*Hamden:* I. W. Beers	10.61	5.07	16.19	6.47	57.07	4.59	21.00
15708	Eagle Fancy. Chas. M. Cox & Co., Boston	*Suffield:* Spencer Bros.	12.12	5.87	16.12	8.02	53.31	4.56	24.00
15794	Red Star. Hannibal Milling Co., Hannibal, Mo.	*Hamden:* I. W. Beers	11.71	6.12	16.25	7.88	53.30	4.74	20.00
15672	Manhattan. Hecker-Jones-Jewell Co., New York	*Bristol:* G. W. Eaton	10.41	5.95	16.50	9.19	53.45	4.50	24.00
15786	" " " "	*Clintonville:* S. A. Smith	10.57	5.00	15.25	8.46	56.03	4.69	23.00
15654	Hunter Bros. St. Louis, Mo.	*Southington:* Southington Lumber and Feed Co.	10.73	6.32	17.50	8.26	52.71	4.48	24.00
15660	Sunshine. Hunter Bros., St. Louis, Mo.	*Plainville:* G. W. Eaton	11.66	6.33	15.94	7.45	54.03	4.59	24.00
15722	Kehlor Bros.	*Colchester:* Colchester Grain & Coal Co.	12.27	6.77	16.37	7.80	51.63	5.16	22.00
15643	Snow Flake. Lawrenceburg Roller Mill Co., Lawrenceburg, Ind.	*New Britain:* C. W. Lines Co.	11.32	6.37	16.37	6.95	54.60	4.39	24.00
15657	Lexington Roller Mills Co., Lexington, Ky.	*Plainville:* F. B. Newton	11.71	5.70	16.25	6.33	55.80	4.21	24.00
15752	Taylor's. The Northwestern Elev. and Mill Co., Toledo, Ohio	*Danielson:* Quinebaug Store	10.03	6.27	16.75	7.21	55.38	4.36	22.00
15612	Rex Mill Co., Kansas City	*New Haven:* Abner Hendee	11.55	5.96	15.62	8.16	54.18	4.53	21.00
15725	Angola. Simpson Hendee, New York	*Colchester:* Colchester Coal and Grain Co.	11.52	5.06	14.62	8.74	56.00	4.06	22.00
15623	Try-me. Sparks Milling Co., Alton, Ill.	*Wallingford:* E. E. Hall	10.73	6.23	16.50	7.50	54.48	4.56	21.00
15736	Diamond. S. D. Veits, Springfield, Mass.	*Willimantic:* H. A. Bugbee	10.45	4.83	15.50	6.04	59.95	4.23	22.00
15833	Waggoner-Gates Mill. Co., Independence, Mo.	*New Milford:* T. Soule & Co.	10.11	6.35	17.00	7.49	54.34	4.71	24.00
15704	Washburn-Crosby Co., Washburn Mills	*Suffield:* Arthur Sikes	10.35	4.75	16.00	7.09	57.40	4.41	24.00
		Average of these 21 analyses	**11.01**	**5.79**	**15.66**	**7.55**	**55.49**	**4.50**	**22.70**
		Average digestible	----	----	**12.1**	**2.0**	**41.1**	**3.5**	
	Mixed Feed from Spring Wheat.								
15691	Royal. Brooks Elevator Co., Minneapolis	*Manchester:* Barrows & Kurney	11.19	4.85	14.12	9.26	56.28	4.30	24.00
15600	Columbia. Chas. M. Cox Co., Boston	*New Haven:* J. T. Benham Estate	10.77	4.51	14.00	7.03	59.61	4.08	20.00
15649	Croesus. The Gardner Mill, Seymour Carter, Hastings, Minn.	*New Britain:* C. W. Lines Co.	11.40	5.02	14.50	8.52	56.23	4.33	22.00
15658	Rutland. Flint Mill Co., Milwaukee, Wis.	*Plainville:* F. B. Newton	11.28	5.32	14.25	8.35	56.14	4.66	24.00
15690	Huron. " " "	*East Hartford Meadow:* G. M. White & Co.	11.46	4.76	14.25	8.75	55.96	4.82	22.00
15707	Vermont. " " "	*Suffield:* Spencer Bros.	11.60	4.26	14.87	7.74	57.12	4.41	25.00
15589	Samoset. Chas. M. Cox Co., Boston, Mass.	*New Haven:* R. G. Davis	11.25	5.12	13.75	7.29	58.14	4.45	21.00
15641	Wirthmore. " " " "	*New Britain:* M. D. Stanley	11.05	4.82	16.44	6.00	57.42	4.27	25.00
15630	" " " " "	*Meriden:* Meriden Grain and Feed Co.	10.91	4.44	14.25	7.26	59.50	3.64	27.00
15596	" Fancy " " " "	*New Haven:* R. G. Davis	12.30	5.63	15.62	7.26	54.38	4.81	22.00
15731	Duchess Fancy. R. J. Hardy & Sons, Boston	*Stafford Springs:* Geo. L. Dennis	11.00	3.98	14.56	6.81	58.87	4.78	23.00
15697	Boston. Imperial Milling Co., Duluth, Minn.	*Rockville:* Rockville Milling Co.	11.10	4.94	14.62	7.91	56.90	4.53	23.00
15668	Northwestern Consolidated Mill Co.	*Bristol:* W. O. Goodsell	10.53	4.90	14.69	8.54	56.72	4.62	24.00
15627	Fancy. Pillsbury's, Minneapolis	*Wallingford:* E. E. Hall	10.25	3.94	15.12	5.86	60.91	3.92	21.00
15669	" " "	*Bristol:* W. O. Goodsell	10.70	4.94	15.25	7.18	56.82	5.11	24.00
15730	Occident. Russell-Miller Milling Co., Valley City, No. Dak.	*Stafford Springs:* Geo. L. Dennis	11.94	4.97	16.12	7.08	54.98	4.91	23.00

TABLE IV.—ANALYSES OF COMMERCIAL FEEDS—*Continued.*

SAMPLED IN 1905.

Station No.	Brand.	Retail Dealer.	Analyses.						Price per ton.
			Water.	Ash.	Protein.	Fiber.	Nitrogen-free Extract. (Starch, gum, etc.)	Fat. (Ether Extract.)	
	WHEAT PRODUCTS—*Concluded.* *Mixed Feed from Spring Wheat.*								
15622	Gold Mine. Sheffield King Milling Co., Minneapolis	*Wallingford:* E. E. Hall	7.47	4.52	14.62	6.90	62.61	3.88	$21.00
15674	Thornton & Chase Mill. Co., Buffalo, N. Y.	*Bristol:* G. W. Eaton	11.32	5.55	16.87	8.54	53.20	4.52	24.00
15806	Superior. Washburn-Crosby Co.'s, Washburn Mills	*Guilford:* G. F. Walter	10.50	5.02	16.25	7.58	55.77	4.88	22.00
15814	" " " "	*South Norwalk:* M. T. Hatch	11.41	4.82	16.37	6.61	55.96	4.83	24.00
15621	Webster Mill Co., Webster, So. Dak.	*Wallingford:* E. E. Hall	10.22	4.40	15.25	6.35	60.35	3.43	21.00
15740	Wells Flour Mill. Co., Wells, Minn.	*Putnam:* F. M. Cole & Co.	10.80	6.15	16.25	8.86	52.56	5.38	21.00
		Average of these 22 analyses	10.88	4.86	15.09	7.53	57.15	4.49	22.86
		Average digestible	----	----	11.6	2.0	42.3	3.5	
	MAIZE PRODUCTS. *Corn Meal.*								
15652	Atwater Mills, Plantsville	*Plantsville:* Atwater Mills	12.57	1.27	8.62	1.58	72.23	3.73	25.00
15781	Buffalo Cereal Co., Buffalo, N. Y.	*New London:* P. Schwartz	10.67	2.31	10.25	3.22	65.57	7.98	28.00
15611	Coles Co., Middletown, Conn.	*New Haven:* Abner Hendee	11.99	1.39	9.25	1.59	72.32	3.46	25.50
15595	R. G. Davis, New Haven	" R. G. Davis	13.24	1.20	8.32	1.63	72.38	3.23	24.00
15766	A. R. Manning, Yantic	*Yantic:* A. R. Manning	12.64	1.36	8.87	1.57	71.63	3.93	26.00
15770	" " "	" " "	11.82	1.26	8.62	1.51	74.36	2.43	26.00
15603	No Brand	*New Haven:* J. T. Benham Estate	12.17	1.06	8.81	1.98	72.86	3.12	23.00
		Average of the above 7 analyses	12.14	1.40	8.96	1.87	71.65	3.98	25.35
		Average digestible	----	----	6.3	----	67.4	3.6	
	Gluten Meal.								
15646	Chicago Gluten. Glucose Sugar Refining Co., Chicago	*New Britain:* C. W. Lines Co.	8.35	1.44	31.87	2.27	50.40	5.67	34.00
15681	" " " "	*Hartford:* Daniels Mill Co.	11.06	2.31	29.37	2.72	49.54	5.00	31.00
15767	" " " "	*Yantic:* A. R. Manning	7.95	1.60	32.87	2.30	49.57	5.71	32.00
15830	" " " "	*New Milford:* F. R. Green	9.16	1.95	33.62	1.80	47.80	5.67	30.00
		Average of these 4 analyses	9.13	1.82	31.93	2.27	49.34	5.51	31.75
		Average digestible	----	----	28.4	----	45.9	5.1	
15684	Cream Gluten. Ill. Sugar Refining Co., Chicago	*Hartford:* Smith, Northam & Co.	8.06	1.39	33.00	2.07	50.94	4.54	32.00
15838	" " "	*Torrington:* F. U. Wadhams	9.97	2.07	32.37	2.01	48.50	5.08	34.00
		Average of these 2 analyses	9.01	1.73	32.68	2.04	49.73	4.81	33.00
		Average digestible	----	----	27.4	----	43.8	4.7	
	Gluten Feed.								
15756	American Cereal Co., Chicago, Ill.	*Plainfield:* Waldo Tillinghast	9.79	2.62	24.00	7.31	51.53	4.75	27.00
		Digestible	----	----	20.4	5.5	45.9	3.9	
15632	Buffalo Cereal Co., Buffalo, N. Y.	*Meriden:* A. H. Cashen	9.73	3.17	25.44	7.14	50.97	3.55	27.00
15780	" " " "	*New London:* P. Schwartz	10.44	2.51	22.87	7.15	53.02	4.01	27 00
15823	" " " "	*Danbury:* C. W. Keeler	8.94	2.94	24.50	7.87	52.21	3.54	27.00
15844	" " " "	*Thomaston:* L. E. Blackmer	9.54	1.51	24.12	7.17	54.91	2.75	27.00
		Average of these 4 analyses	9.66	2.53	24.23	7.33	52.79	3.46	27.00
		Average digestible	---	----	20.6	5.6	47.0	2.9	
15700	Continental.* Continental Cereal Co., Peoria, Ill.	*Suffield:* Arthur Sikes	7.37	3.57	28.75	10.60	37.90	11.81	27.00
15771	" " " " "	*Norwich:* Norwich Grain Co.	8.03	3.42	28.75	10.67	37.35	11.78	29.00
		Average of these 2 analyses	7.70	3.49	28.75	10 63	37.64	11.79	28.00
		Average digestible	----	----	21.3	----	30.9	11.2	
15772	Cedar Rapids. Douglas & Co., Cedar Rapids, Ia.	*Norwich:* Norwich Grain Co.	8.50	0.93	18.75	7.56	58.83	5.43	29.00
		Amount digestible	----	----	15.9	5.7	52.4	4.5	

* A distillery product. See p. 157.

TABLE IV.—ANALYSES OF COMMERCIAL FEEDS—*Continued.*

SAMPLED IN 1905.

Station No.	Brand.	Retail Dealer.	Analyses.						Price per ton.
			Water.	Ash.	Protein.	Fiber.	Nitrogen-free Extract. (Starch, gum, etc.)	Fat. (Ether Extract.)	
	MAIZE PRODUCTS—*Continued.* *Gluten Feed.*								
15738	Flint Gluten Feed. Flint Mill Co., Milwaukee	*Putnam:* F. M. Cole & Co.	8.95	1.02	20.37	6.22	59.18	4.26	$27.00
15842	" " " " "	*Torrington:* E. H. Talcott	8.80	1.10	19.00	6.51	59.05	5.54	27.00
		Average of these 2 analyses	**8.87**	**1.06**	**19.68**	**6.36**	**59.13**	**4.90**	**27.00**
		Average digestible	----	----	**16.7**	**4.8**	**52.6**	**4.1**	
15625	Buffalo Gluten Feed. C. M. Cox Co., Boston., agents for Glucose Sugar Refining Co.	*Wallingford:* E. E. Hall	9.45	1.85	25.75	5.91	51.89	5.15	25.00
15734	" " " " "	*Willimantic:* H. A. Bugbee	9.94	3.15	26.25	7.04	50.69	2.93	26.00
15779	" " " " "	*New London:* The Arnold Rudd Co.	7.23	0.80	24.37	7.63	56.65	3.32	26.00
15645	Buffalo Gluten Feed. Glucose Sugar Refining Co., Chicago	*New Britain:* C. W. Lines Co.	10.78	2.31	24.94	6.52	52.01	3.44	27.00
15676	" " " "	*Hartford:* Daniels Mill Co.	9.84	1.70	24.00	6.95	53.74	3.77	26.00
15698	" " " "	*Rockville:* Rockville Milling Co.	10.26	2.02	23.75	7.03	53.68	3.26	27.00
15807	" " " "	*Bridgeport:* Berkshire Mills	7.23	2.39	25.62	6.71	54.85	3.20	27.00
15813	" " " "	*South Norwalk:* M. T. Hatch	8 25	1.01	23.75	6.74	57.36	2.89	27.00
15827	" " " "	*Danbury:* F. C. Benjamin & Co.	8.98	0.94	21.37	7.81	57.92	2.98	27.00
15831	" " " "	*New Milford:* F. R. Green	10.27	2.36	24.12	7.06	52.93	3.26	27.00
15914	" " " "	*Waterbury:* The Platts Mill Co.	6.89	1.01	24.25	7.63	57.10	3.12	27.00
		Average of these 11 analyses	**9.01**	**1.78**	**24.38**	**7.00**	**54.44**	**3.39**	**26.55**
		Average digestible	----	----	**20.7**	**5.3**	**48.5**	**2.8**	
15605	J. C. Hubinger Bros. Co., Keokuk, Iowa	*New Haven:* Abner Hendee	8.03	1.57	25.19	7.36	54.85	3.00	26.00
15615	" " "	*Branford:* S. V. Osborn	8.02	1.56	23.75	7.89	55.65	3.13	26.00
15835	" " "	*Winsted:* Balch & Platt	7.77	1.79	23.87	8.03	55.65	2.89	27.00
15915	" " "	*Watertown:* M. D. Leonard	8.15	1.90	25.00	7.39	53.91	3.65	28.00
		Average of these 4 analyses	**7.99**	**1.70**	**24.20**	**7.67**	**55.07**	**3.17**	**26.75**
		Average digestible	----	----	**20.6**	**5.8**	**49.0**	**2.6**	
15692	Queen Gluten Feed. National Starch Co., Chicago, Ill.	*Manchester:* Barrows & Kurney	11.18	1.05	22.00	7.07	56.05	2.65	**28.00**
		Digestible	----	----	**18.7**	**5.4**	**49.9**	**2.2**	
15620	Globe Gluten Feed. N. Y. Glucose Co.	*East Haven:* F. A. Forbes	8.91	3.54	26.94	7.23	50.38	3.00	25.00
15628	" " " "	*Meriden:* Meriden Grain and Feed Co.	9.33	3.45	26.44	7.58	50.00	3.20	26.00
15661	" " " "	*Plainville:* G. W. Eaton	13.29	2.92	27.50	7.37	46.57	2.35	26.00
15711	" " " "	*Thompsonville:* H. K. Brainard	8.87	2.75	27.00	7.76	50.11	3.51	27.00
15718	" " " "	*Middletown:* Meech & Stoddard	8.31	3.51	26.44	7.10	51.67	2.97	26.00
15783	" " " "	*Clintonville:* S. A. Smith	8.63	3.14	26.37	7.49	50.58	3.79	24.00
15787	" " " "	*North Haven:* Co-operative Feed Co.	7.63	3.07	29.25	7.47	50.01	2.57	25.00
15793	" " " "	*Hamden:* I. W. Beers	8.51	3.15	26.87	7.86	50.69	2.92	25.00
15815	" " " "	*Norwalk:* The Holmes, Keeler & Selleck Co.	9.03	3.09	26.87	7.40	49.92	3.69	27.00
15834	" " " "	*Canaan:* Ives & Peirce	9.46	2.65	26.25	7.09	51.76	2.79	27.00
		Average of these 10 analyses	**9.19**	**3.13**	**26.99**	**7.44**	**50.17**	**3.08**	**25.80**
		Average digestible	----	----	**22.9**	**5.7**	**44.7**	**2.6**	
15640	Bay State. J. E. Soper & Co., Boston	*New Britain:* M. D. Stanley	8.32	1.05	19.25	5.34	62.23	3.81	26.00
15670	" " " " "	*Bristol:* W. O. Goodsell	10.87	1.08	20.37	4.36	59.39	3.93	27.00
15802	" " " " "	*Derby:* The Peterson-Hendee Co.	9.78	0.92	16.25	7.46	60.24	5.35	26.00

TABLE IV.—ANALYSES OF COMMERCIAL FEEDS—*Continued.* SAMPLED IN 1905.

Station No.	Brand.	Retail Dealer.	Analyses.						Price per ton.
			Water.	Ash.	Protein.	Fiber.	Nitrogen-free Extract. (Starch, gum, etc.)	Fat. (Ether Extract.)	
	MAIZE PRODUCTS—*Concluded.* *Gluten Feed.*								
15588	Bay State. J. E. Soper & Co., Boston	*New Haven:* R. G. Davis	10.19	0.97	18.31	4.18	62.94	3.41	$24.00
		Average of these 4 analyses	**9.79**	**1.00**	**18.54**	**5.33**	**61.22**	**4.12**	**25.75**
		Average digestible	----	----	**15.8**	**4.1**	**54.5**	**3.4**	
15614	Warner's Gluten Feed. Warner Sugar Refining Co., Waukegan, Ill.	*Branford:* S. V. Osborn	9.40	1.34	20.62	7.53	58.33	2.78	26.00
15655	" " " "	*Southington:* Southington Lumber and Feed Co.	8.42	1.97	24.06	6.60	54.21	4.74	26.00
15720	" " " "	*Middlefield:* A. E. Miller	9.77	1.74	22.62	7.42	54.81	3.64	25.00
15804	" " " "	*Guilford:* Morse & Landon	8.89	1.55	20.62	7.27	57.95	3.76	26.00
		Average of these 4 analyses	**9.12**	**1.65**	**21.98**	**7.20**	**56.32**	**3.73**	**25.75**
		Average digestible	----	----	**18.8**	**5.5**	**50.1**	**3.1**	
	Hominy Feed.								
15701	M. F. Berringer, Philadelphia, Pa.	*Suffield:* Arthur Sikes	9.47	3.02	10.75	5.20	62.15	9.41	24.00
15634	Hominy Feed. Buffalo Cereal Co., Buffalo, N. Y.	*Meriden:* A. H. Cashen	9.79	2.61	10.50	4.27	64.55	8.28	25.00
15755	" " " " " "	*Plainfield:* Waldo Tillinghast	10.43	2 82	10.94	4.18	62.47	9.16	23.00
15764	" " " " " "	*Norwich:* Norwich Grain Co.	10.30	2.61	10.62	3.89	64.94	7.64	25.00
15616	Chapin & Co., Boston	*Branford:* S. V. Osborn	11.40	2.50	10.37	4.09	64.55	7.09	24.00
15656	Green Diamond. Chapin & Co., Boston	*Southington:* Southington Lumber and Feed Co.	9.84	2.50	9.75	5.45	65.68	6.78	25.00
15710	" " "	*Thompsonville:* H. K. Brainard	10.83	2.96	10.69	5.05	61.77	8.70	24.00
15727	The Coles Co., Middletown	*East Hampton:* R. H. Hall	9.19	2.74	10.37	4.17	64.84	8.69	24.00
15618	Paragon. Chas M. Cox Co., Boston	*East Haven:* F. A. Forbes	10.54	3.22	11.37	4.59	61.26	9.02	23.00
15624	" " " "	*Wallingford:* E. E. Hall	7.34	2.92	10.12	4.30	66.25	9.07	23.00
15663	Wirthmore. " " "	*Plainville:* G. W. Eaton	10.09	3.16	10.75	4.27	60.91	10.82	25.00
15788	" " " "	*North Haven:* Co-operative Feed Co.	9.52	2.76	10.31	4.85	63.84	8.72	23.00
15800	Monarch Chop. Husted Mill & Elev. Co. Buffalo, N. Y.	*Shelton:* Taylor & Morse	10.67	2.81	8.12	9.68	64.58	4.14	22.50
15822	Husted Mill and Elevator Co., Buffalo, N. Y.	*Newtown:* Taylor & Hubbell	10.03	2.47	9.50	6.58	64.35	7.07	25.00
15774	The Hunter Bros. Mill. Co., St. Louis, Mo.	*Norwich:* Chas. Slosberg	8.71	3.30	10.87	5.07	62.25	9.80	24.00
15753	Hollister, Chase & Co., New York	*Plainfield:* J. P. Kingsley & Son	8.53	2.72	10.25	4.43	65.71	8.36	22.50
15776	Peerless. F. L. Kidder & Co., Paris, Ill.	*Mystic:* J. L. Manning	9.83	2.31	10.00	5.50	65.32	7.04	24.00
15777	Meech & Stoddard, Middletown, Conn.	*Groton:* Groton Grain Co.	8.95	3.35	9.50	8.68	62.74	6.78	23.00
15671	Choice Steam Cooked Hominy Feed. Miner, Hillard Mill. Co., Wilkesbarre, Pa.	*Bristol:* G. W. Eaton	9.50	2.66	10.50	4.48	64.39	8.47	25.00
15795	Steam Cooked Hominy Feed. Miner-Hillard Mill. Co., Wilkesbarre, Pa.	*Ansonia:* Ansonia Flour and Grain Co.	10.34	2.87	10.62	4.74	62.46	8.97	23.00
15590	Wm. M. Payne & Son, New York	*New Haven:* R. G. Davis	9.89	2.77	10.62	2.62	65.90	8.20	23.00
15784	" " "	*Clintonville:* S. A. Smith	9.66	2.53	10.25	3.96	65.45	8.15	24.00
15792	" " "	*Hamden:* I. W. Beers	9.41	2.67	10.62	4.56	64.61	8.13	23.00
15724	Simpson, Hendee & Co., New York	*Colchester:* Colchester Grain and Coal Co.	9.96	2.60	10.75	3.55	66.04	7.10	25.00
15763	Suffern, Hunt & Co., Decatur, Ill.	*Yantic:* A. R. Manning	9.38	2.87	9.75	3.87	65.33	8.80	24.00
15757	Star Feed. The Toledo Elev. Co., Toledo, Ohio	*Jewett City:* J. E. Leonard & Son	8.02	3.15	9.37	9.89	62.85	6.72	24.00
15821	" " " " "	*Bethel:* Johnson & Morrison	8.47	2.83	9.00	9.89	63 38	6.43	24.00
15837	The J. S. Wolfe Co., Pittsfield, Mass.	*Winsted:* Balch & Platt	8.69	2.72	9.87	3.66	67.11	7.95	24.00
15682	No Brand	*Hartford:* Smith, Northam & Co.	8.63	2.76	10.37	3.97	65.86	8.41	26.00
15721		*Middlefield:* A. E. Miller	9.74	2.91	9.50	6.88	63.92	7.05	23.00
		Average of these 30 analyses	**9.57**	**2.80**	**10.20**	**5.21**	**64.19**	**8.03**	**23.88**
		Average digestible	----	----	**7.1**	----	**60.3**	**7.3**	

TABLE IV.—ANALYSES OF COMMERCIAL FEEDS—*Continued.*

SAMPLED IN 1905.

Station No.	Brand.	Retail Dealer.	Analyses. Water.	Ash.	Protein.	Fiber.	Nitrogen-free Extract. (Starch, gum, etc.)	Fat. (Ether Extract.)	Price per ton.
	Rye Products.								
15602	Rye Feed. Abner Hendee, New Haven	*New Haven:* J. T. Benham Est.	11.65	3.52	16.19	3.89	61.52	3.23	$22.50
15699	" "	*Rockville:* Rockville Milling Co.	12.34	3.61	15.25	4.06	61.77	2.97	24.00
15797	" Miner-Hillard Mill Co., Wilkesbarre, Pa.	*Ansonia:* Ansonia Flour and Grain Co.	11.89	3.93	16.25	3.83	61.09	3.01	28.00
15840	" " " " "	*Torrington:* F. U. Wadhams	11.76	4.12	16.50	4.32	59.83	3.47	25.00
15715	" Oneoto Mill Co., Oneoto, N. Y.	*Middletown:* Meech & Stoddard	12.36	4.14	15.87	4.14	60.22	3.27	25.00
15597	" H. G. Stone Milling Co., Rochester, N. Y.	*New Haven:* R. G. Davis	13.46	3.39	15.50	3.20	61.64	2.81	20.00
15689	" H. G. Stone & Co., " "	*Hartford:* Smith, Northam & Co.	12.42	3.50	15.25	3.44	62.48	2.91	23.00
		Average of these 7 analyses	**12.27**	**3.74**	**15.83**	**3.84**	**61.23**	**3.09**	**23.93**
		Average digestible	----	----	**13.3**	----	**56.3**	**2.0**	
	Barley Products.								
15593	Malt Sprouts. Chas. M. Cox Co., Boston	*New Haven:* R. G. Davis	9.56	5.30	23.75	11.01	49.14	1.24	20.00
15825	Barley Sprouts. Chase Grain Co., New York	*Danbury:* F. C. Benjamin & Co.	8.79	6.65	27.62	10.42	43.97	2.55	21.00
		Average of these 2 analyses	**9.15**	**5.97**	**25.68**	**10.71**	**46.60**	**1.89**	**20.50**
		Average digestible	----	----	**20.5**	**3.6**	**32.2**	**1.9**	
	Dried Distillery Grains.								
15673	Ajax Flakes. Chapin & Co., Boston	*Bristol:* G. W. Eaton	8.17	2.15	31.25	12.56	32.90	12.97	28.00
15686	" " "	*Hartford:* Smith, Northam & Co.	7.36	2.00	32.81	11.48	31.92	14.43	26.00
15843	" Flint Mill Co., Milwaukee	*Torrington:* E. H. Talcott	7.09	1.89	28.62	13.66	36.08	12.66	28.00
		Average of these 3 analyses	**7.54**	**2.01**	**30.89**	**12.56**	**33.65**	**13.35**	**27.33**
		Average digestible	----	----	**22.9**	----	**27.6**	**12.7**	
	Buckwheat Products.								
15748	Buckwheat Middlings. Quinebaug Mills, Danielson, Conn.	*Danielson:* Quinebaug Mills	11.93	5.75	30.87	8.62	34.35	8.48	22.00
	Alfalfa Meal.								
15816	Purina Alfalfa Meal. Purina Mills, St. Louis, Mo.	*Norwich:* The Holmes, Keeler & Selleck Co.	10.01	12.28	20.25	18.56	36.71	2.19	38.00
	Corn and Oat Feeds.								
15599	Victor Corn and Oat Feed, American Cereal Co.	*New Haven:* J. T. Benham Est.	10.37	3.73	8.12	10.06	63.83	3.89	19.00
15717	" " " "	*Middletown:* Meech & Stoddard	10.72	3.95	8.12	10.57	62.66	3.98	24.00
		Average of these 2 analyses	**10.54**	**3.84**	**8.12**	**10.31**	**63.26**	**3.93**	**21.50**
		Average digestible	----	----	**5.8**	**4.9**	**52.5**	**3.4**	
15633	Corn & Oat Chop. Buffalo Cereal Co., Buffalo, N. Y.	*Meriden:* A. H. Cashen	10.01	3.72	8.00	12.24	62.25	3.78	23.00
15606	Boss Corn and Oat Feed. The Great Western Cereal Co.	*New Haven:* Abner Hendee	9.46	4.76	8.87	10.29	61.57	5.05	21.00
15832	Corn and Oats. Husted Mill and Elev. Co., Buffalo, N. Y.	*New Milford:* Ackley, Hatch & Marsh	11.93	2.05	9.75	3.87	68.05	4.35	26.00
15665	Acme Feed. Acme Milling Co., Olean, N. Y.	*Bristol:* W. O. Goodsell	11.19	2.47	8.00	6.86	67.56	3.92	25.00
15775	Pearl Cooked Oat Feed. Flint Mill Co., Milwaukee, Wis.	*Norwich:* Chas. Slosberg	9.01	3.07	9.37	7.69	64.73	6.13	26.00
		Average of these 5 analyses	**10.32**	**3.21**	**8.79**	**8.19**	**64.85**	**4.64**	**24.20**
		Average digestible	----	----	**6.2**	**3.9**	**53.8**	**4.0**	
	Corn and Wheat Feeds.								
15679	Colonial Choice Middlings. Miner-Hillard Mill. Co., Wilkesbarre, Pa.	*Hartford:* Daniels Mill Co.	11.44	3.48	13.12	5.59	59.99	6.38	**26.00**
	Corn-Cob and Wheat Feeds.								
15826	Indiana Mixed Feed. J. H. Cressey & Co., Boston	*Danbury:* F. C. Benjamin & Co.	9.75	5.85	11.56	14.08	55.56	3.20	20.00
15696	Dairy " Jennings & Fulton, "	*Rockville:* Rockville Milling Co.	11.02	4.65	10.94	15.09	55.22	3.08	21.00

TABLE IV.—ANALYSES OF COMMERCIAL FEEDS—*Continued.* SAMPLED IN 1905.

Station No.	Brand.	Retail Dealer.	Analyses. Water.	Ash.	Protein.	Fiber.	Nitrogen-free Extract. (Starch, gum, etc.)	Fat. (Ether Extract.)	Price per ton.
	CORN-COB AND WHEAT FEEDS—*Concluded.*								
15732	Dairy Mixed Feed. Jennings & Fulton, Boston	*Stafford Springs:* Geo. L. Dennis	10.28	4.59	10.62	14.38	57.24	2.89	$21.00
15651	" " J. & F.	*Plantsville:* Atwater Mills	10.00	5.94	11.94	13.93	54.96	3.23	22.00
15598	Indiana " Indiana Milling Co., Terre Haute, Ind.	*New Haven:* J. T. Benham Est.	9.98	4.65	10.62	16.71	55.21	2.83	20.00
15745	Jersey " " " "	*Danielson:* Waldo Bros.	10.27	4.68	11.87	13.47	57.19	2.52	22.00
15747	Blue Grass Mixed Feed	" Young Bros. Co.	9.40	4.21	10.75	14.98	57.57	3.09	19.00
		Average of these 7 analyses	**10.10**	**4.94**	**11.19**	**14.66**	**56.13**	**2.98**	**20.71**
	CORN, OATS AND BARLEY.								
15801	Corn, Oats and Barley Feed. Husted Mill and Elev. Co., Buffalo, N. Y.	*Shelton:* Taylor & Morse	11.27	3.19	9.06	9.76	62.92	3.80	26.00
15601	Schumacher's Stock Feed. American Cereal Co.	*New Haven:* J. T. Benham Est.	9.25	4.23	11.12	10.22	60.42	4.76	24.00
	PROPRIETARY HORSE FEEDS.								
15714	Sucrene Horse Feed. Am'n Mill. Co., Chicago	*Middletown:* Meech & Stoddard	12.75	6.76	11.87	7.45	58.69	2.48	27.00
15796	" " " "	*Ansonia:* Ansonia Flour and Grain Co.	11.62	6.68	12.62	8.44	58.00	2.64	27.00
		Average of these 2 analyses	**12.19**	**6.72**	**12.24**	**7.96**	**58.33**	**2.56**	**27.00**
15635	Horse Feed. Buffalo Cereal Co., Buffalo, N. Y.	*Meriden:* A. H. Cashen	9.84	3.68	11.50	10.31	59.59	5.08	26.00
15610	H. O. Co.'s Horse Feed, Buffalo, N. Y.	*New Haven:* Abner Hendee	8.89	3.75	12.87	9.44	59.82	5.23	27.00
	PROPRIETARY DAIRY AND STOCK FEEDS.								
15685	Quaker Dairy Feed. American Cereal Co.	*Hartford:* Smith, Northam & Co.	9.33	5.32	11.75	17.59	52.96	3.05	21.00
15648	Sucrene Dairy Feed. American Milling Co., Chicago, Ill.	*New Britain:* C. W. Lines Co.	10.28	6.17	16.12	9.57	53.37	4.49	26.00
15713	" " " " "	*Middletown:* Meech & Stoddard	12.71	6.15	13.00	6.76	59.09	2.29	26.00
15719	" " " " "	" " "	11.21	6.35	15.94	9.54	52.53	4.43	26.00
		Average of these 3 analyses	**11.40**	**6.22**	**15.02**	**8.62**	**55.00**	**3.74**	**26.00**
15591	Dairy Feed XXXX Grains. The J. W. Biles Co., Cincinnati, Ohio	*New Haven:* R. G. Davis	7.84	2.24	30.31	11.30	36.97	11.34	27.00
15769	" " "	*Yantic:* A. R. Manning	7.48	2.24	32.00	12.39	34.29	11.60	27.00
		Average of these 2 analyses	**7.66**	**2.24**	**31.16**	**11.85**	**35.62**	**11.47**	**27.00**
		Average digestible	----	----	**23.1**	----	**29.2**	**10.9**	
15592	Dairy Feed, Union Grains. The J. W. Biles Co., Cincinnati, Ohio	*New Haven:* R. G. Davis	8.37	6.96	23.44	7.92	46.02	7.29	27.00
15677	" " "	*Hartford:* Daniels Mill Co.	9.17	7.63	23.37	8.83	43.78	7.22	
15729	" " "	*East Hampton:* R. H. Hall	9.25	5.52	22.00	9.64	46.44	7.15	29.00
		Average of these 3 analyses	**8.93**	**6.70**	**22.94**	**8.79**	**45.43**	**7.21**	**28.00**
15666	Creamery Feed. Buffalo Cereal Co., Buffalo, N.Y.	*Bristol:* W. O. Goodsell	8.94	4.24	19.62	11.84	50.71	4.65	26.00
15778	XXX Stock Feed. " " "	*New London:* The Arnold Rudd Co.	9.20	3.87	10.12	11.81	59.57	5.43	24.00
15705	Durham Stock Feed. The Great Western Cereal Co., Chicago	*Suffield:* Arthur Sikes	10.42	4.77	8.31	12.72	57.78	6.00	24.00
		Digestible	----	----	**5.9**	**6.1**	**47.8**	**5.2**	
15828	Excelsior Stock Feed. " " "	*Danbury:* F. C. Benjamin & Co.	8.57	5.87	8.62	12.23	58.42	6.29	22.00
		Digestible	----	----	**6.1**	**5.9**	**48.5**	**5.5**	
15819	Blatchford's Calf Meal. Waukegan, Ill.	*Norwich:* Brower & Malone	11.44	5.46	26.25	3.69	48.33	4.83	60.00
15678	Stock Feed. Daniel's Mill Co., Hartford	*Hartford:* Daniels Mill Co.	12.47	2.09	9.87	4.79	67.25	3.53	26.00
		Digestible	----	----	**7.0**	**2.3**	**55.8**	**3.1**	

TABLE IV.—ANALYSES OF COMMERCIAL FEEDS—*Concluded.* SAMPLED IN 1905.

Station No.	Brand.	Retail Dealer.	Analyses. Water.	Ash.	Protein.	Fiber.	Nitrogen-free Extract. (Starch, gum, etc.)	Fat. (Ether Extract.)	Price per ton.
	PROPRIETARY DAIRY AND STOCK FEEDS—*Concluded.*								
15845	Stock Feed. The Mill Dickinson's	*Waterbury:* D. L. Dickinson	10.48	3.25	8.25	11.09	63.12	3.81	$20.00
		Digestible	----	----	**5.9**	**5.3**	**52.4**	**3.3**	
15758	Haskell's Stock Feed. W. H. Haskell & Co., Toledo, Ohio	*Jewett City:* J. E. Leonard & Son	7.46	3.62	9.00	8.83	64.27	6.82	25.00
		Digestible	----	----	**6.3**	**4.2**	**53.3**	**5.9**	
15650	New England Stock Feed. H. O. Co. Mills, Buffalo, N. Y.	*New Britain:* C. W. Lines Co.	9.81	3.19	9.12	10.44	62.97	4.47	24.00
		Digestible	----	----	**6.5**	**5.0**	**52.3**	**3.9**	
15808	H. O. Dairy Feed. Buffalo, N. Y.	*Stamford:* Scofield & Miller	8.65	3.94	20.31	12.27	50.03	4.80	29.00
		Digestible	----	----	**15.8**	**5.0**	**35.0**	**4.1**	
15768	Clark Bros. & Co. Pure Empire State Dairy Feed. J. D. Page & Co., Syracuse, N. Y.	*Yantic:* A. R. Manning	7.35	2.21	29.50	12.92	36.41	11.61	27.00
		Digestible	----	----	**21.8**	----	**29.9**	**11.0**	
15639	Protena Dairy Feed. Purina Mills, St. Louis, Mo.	*New Britain:* M. D. Stanley	8.81	7.20	18.12	17.51	44.45	3.90	27.00
15702	" " " " "	*Suffield:* Arthur Sikes	9.35	7.99	20.12	17.61	41.47	3.46	25.00
		Average of these 2 analyses	**9.08**	**7.60**	**19.12**	**17.56**	**42.96**	**3.68**	**26.00**
15824	Lenox Stock Feed. The Strong, Lefferts Co., Springfield, Mass.	*Danbury:* F. C. Benjamin & Co.	11.72	3.11	8.50	9.14	64.59	2.94	25.00
		Digestible	----	----	**6.0**	**4.4**	**53.60**	**2.6**	
15594	Hammond Dairy Feed. Western Grain Products Co., Milwaukee	*New Haven:* R. G. Davis	10.67	7.12	14.62	9.47	54.46	3.66	25.00
	PROPRIETARY POULTRY FEEDS.								
15812	Poultry Feed. American Cereal Co.	*New Canaan:* C. H. Fairty	11.86	3.36	13.12	5.39	61.24	5.03	32.00
15637	" Buffalo Cereal Co., Buffalo, N. Y.	*Meriden:* A. H. Cashen	10.22	3.15	16.25	4.11	60.67	5.60	34.00
15607	H. O. Co.'s Poultry Feed. Buffalo, N. Y.	*New Haven:* Abner Hendee	10.50	3.18	17.25	4.45	58.50	6.02	35.00
15817	Purina Chick Feed. Purina Mills, St. Louis, Mo.	*Norwalk:* The Holmes, Keeler & Selleck Co.	11.19	3.31	12.37	4.41	63.41	5.31	44.00
15818	Daniels Mill Co., Hartford, Conn.	*Norwalk:* The Holmes, Keeler & Selleck Co.	10.80	13.97	9.62	3.51	58.78	3.32	49.00
15839	Laying Feed. Cyphers Incubator Co., Buffalo.	*Torrington:* F. U. Wadhams	12.59	3.20	14.06	4.11	62.32	3.72	40.00
	ANIMAL MEAL AND BONE FOR POULTRY.								
15841	Bone and Meat Meal. Rogers Mfg. Co., Rockfall	*Torrington:* F. U. Wadhams	7.11	38.76	41.37	----	----	6.05	44.00
15703	Frisbie's Beef Scrap. The L. T. Frisbie Co., Hartford	*Suffield:* Arthur Sikes	9.79	27.31	46.56	----	----	13.33	45.00
15647	Swift's Lowell Bone and Meat Meal. Swift's Lowell Fert. Co., Boston, Mass.	*New Britain:* C. W. Lines Co.	6.80	31.68	45.19	----	----	10.34	48.00

SUMMARY.

The examinations of these feeds show that in many cases the dealers do not give the guaranties, as required by law. When given, they are too often misleading, being much higher than the composition of the goods warrants. This is especially noticeable in the gluten meals and gluten feeds.

The mixtures of wheat feed and corn-cobs, formerly sold, illegally, as "wheat feed," are now sold under distinctive names and with a guaranty; thus complying with the law.

There are still on the market a large number of low grade mixed feeds, of very moderate feeding value, but sold for only a few dollars per ton less than the standard high grade feeds.

PART IV.

FIFTH REPORT

OF THE

STATE ENTOMOLOGIST OF CONNECTICUT

To the Director and Board of Control of the Connecticut Agricultural Experiment Station:

Section 4387 of the General Statutes requires that the State Entomologist publish each year an account of the work and expenditures of his office. I transmit herewith my fifth annual report, and in its preparation have followed the custom of previous years, the period covered by the work being for the calendar year of 1905, except that the financial report covers the year ending September 30, 1905, and therefore corresponds with the State fiscal year.

Respectfully submitted,

W. E. BRITTON,

State Entomologist.

REPORT OF THE RECEIPTS AND EXPENDITURES OF THE STATE ENTOMOLOGIST FROM OCTOBER 1ST, 1904, TO SEPTEMBER 30TH, 1905.

Receipts.

From E. H. Jenkins, Treasurer	$3,132.77
G. P. Clinton, for stamps	.59
T. Campbell, for mileage	1.44
Prof. S. A. Forbes, electrotypes	1.08
	$3,135.88

Expenditures.

Field, office and laboratory assistance	$1,371.47
Printing and illustrations	601.07
Postage	14.86
Stationery	9.42

Telephone and telegraph	$ 1.90	
Express, freight and cartage	31.25	
Library	120.95	
Laboratory apparatus and supplies	327.71	
Spraying apparatus and supplies	54.99	
Office supplies	137.94	
Traveling expenses	251.91	
	$2,923.47	
Balance, cash on hand	212.41	
		$3,135.88

Memorandum—This account of the State Entomologist has been duly audited by the State Auditors of Public Accounts.

Organization, Equipment, Etc.

Mr. B. H. Walden has continued as general assistant during the year. Most of the curatorial work of the collection has been done by him, as has also most of the photographic work. He has assisted in the work of spraying and other investigation and in the preparation of this report. Mr. Henry L. Viereck assisted in field and laboratory work from June 15 to September 15. A stenographer has been employed for half of each day to assist in the correspondence, cataloguing of specimens, and the preparation of manuscript. This work was done by Miss Anna Davis Clark during January, and by Miss Elizabeth B. Whittlesey for the remaining portion of the year.

The insect collection has been increased during the season, and several important additions have been made to the library.

A portion of the station greenhouse has been made available for the use of the entomological department as an insectary. While not ideal in its appointments, this house will serve the purpose of an insectary, and render it possible to study certain insects under conditions which can be kept more nearly under control than if out of doors.

Exhibits.

Entomological exhibits were made at the annual meeting of the Connecticut Pomological Society at Hartford in February, and at the meeting of the State Board of Agriculture at Willimantic in December.

Lectures.

The State Entomologist has given ten addresses and lectures before granges, village improvement societies, farmers' institutes, etc., during the year. Four of these were illustrated with lantern slides.

Correspondence.

1037 letters have been written during the year on matters pertaining to the work of the department.

74 packages have been sent out by mail and express.

Publications from the Entomological Department.

Fourth Report of State Entomologist, March, 1905. 112 pp., 16 plates, 11 figures. (12,000 copies.)

Bulletin 151, June, 1905. "The Chief Injurious Scale Insects of Connecticut," by W. E. Britton. 16 pp., 17 figures. (12,000 copies.)

Bulletin of Immediate Information, No. 1, October, 1905, "Combating the San José Scale in 1905," by W. E. Britton and B. H. Walden. 4 pp. (1,000 copies.)

"The Lime and Sulphur Wash Without Boiling," *Rural New Yorker*, March 4, 1905, by W. E. Britton. 4 mss. pages.

*"The Fall Web Worm Partially Double Brooded in Connecticut," by W. E. Britton. Bulletin No. 52, Bureau of Entomology, United States Department of Agriculture, p. 42. 1 page.

*"Addition to Our Knowledge of the Cabinet Beetle (*Anthrenus verbasci* Linn)," by H. L. Viereck, Bulletin No. 52, Bureau of Entomology, United States Department of Agriculture, p 48. 1 page.

"Mosquitoes and Their Relation to Public Health," by W. E. Britton. (Read at Conference of Health Officers, Hartford, December, 1904. Report of State Board of Health for 1905.)

"Some New or Little Known *Aleyrodidae* from Connecticut," (describing *Aleyrodes acteae,* a new species), by W. E. Britton, *Entomological News,* Vol. 16 (March), 1905, p. 65. 2 pp., 1 plate.

"Description of the Larva of *Delphastus pusillus* Lec., with Notes on the habits of the Species," by W. E. Britton, *Canadian Entomologist,* Vol. 37 (May), 1905, p. 185. 2 pp., 1 figure.

"Trees Injured by White Lead and Oil," by W. E. Britton, *Rural New Yorker,* July 15, 1905. 3 mss. pages, 1 figure.

"Poultry Pests," by W. E. Britton, *Connecticut Farmer,* September 9, 1905.

* Read at meeting of American Association of Economic Entomologists, Philadelphia, Pa., December, 1904. Proceedings published by Bureau of Entomology.

Examination of Orchards, Gardens, Etc.

Forty-eight orchards, gardens and greenhouses have been inspected by the State Entomologist or his assistant, mostly by request of the owners. In addition, the office has once been called upon to examine a swamp near a village to learn if mosquitoes were breeding therein.

Nursery Inspection.

Thirty-five nurseries have been inspected during the year, and thirty-four certificates granted. The form of the certificate is the same as has been issued for the past two years, and is reproduced in the third report for 1903, p. 206. The insect pest law regarding nursery inspection also remains unchanged, and is not reproduced in this report, but may be found on p. 200 of the report for 1903.

In general, as regards freedom from pests, the nurseries were found to be in better shape than in 1904. One or two exceptions showed negligence and lack of care, and a drastic cleaning up of these was required.

The nursery firms receiving certificates in 1905 were as follows:

List of Nursery Firms Receiving Certificates in 1905.

Name of Firm.	Location.	Inspection Finished.	Certificate Number.
Allen, Chas. I.	Terryville	Nov. 1,	204
Atwater, C. W.	Collinsville	Sept. 25,	179
Barnes Bros. Nursery Co.	Yalesville	Oct. 12,	192
Beers, S. Perry	Greenfield Hill	Oct. 3,	186
Bowditch, J. H.	Pomfret Center	Oct. 20,	199
Bridgeport Nursery Co.	Bridgeport	Nov. 10,	207
Burr & Co., C. R.	Manchester	Sept. 25,	180
Comstock & Lyon	Norwalk	Sept. 26,	181
Conine, F. E.	Stratford	Sept. 26,	182
Conn. Agricultural College	Storrs	Oct. 26,	201
Conway, W. B.	New Haven	Nov. 9,	206
Dehn & Bertolf	Greenwich	Oct. 17,	196
East Rock Park Nursery	New Haven	Oct. 11,	191
Elizabeth Park Nursery	Hartford	Sept. 22,	178
Elm City Nursery Co.	New Haven	Sept. 8,	174
Gardner's Nurseries	Cromwell	Sept. 29,	183
Gurney & Co., H. H.	New Canaan	Sept. 21,	177
Hale, J. H.	So. Glastonbury	Oct. 12,	193
Holcomb, Irving	Granby	Oct. 3,	185
Hoyt's Sons Co., Stephen	New Canaan	Sept. 21,	176
Hunt & Co., W. W.	Hartford	Oct. 4,	187
Jewell, Harvey	Cromwell	Sept. 29,	184
Kellner, H. H.	Danbury	Oct. 18,	197
Kelsey & Sons, David S.	West Hartford	Nov. 22,	208
Keney Park Nursery	Hartford	Oct. 28,	202
Norton, A. F.	New Britain	Nov. 1,	203
Pierson, A. N.	Cromwell	Sept. 18,	175
Platt Co., The Frank S.	New Haven	Sept. 27,	200
Ruedlinger, C. N.	Hartford	Nov. 4,	205
Ryther, O. E.	Norwich	Oct. 19,	198
Scott, J. W.	Hartford	Oct. 4,	188
Vidbourne & Co., J.	Hartford	Oct. 16,	194
Woodruff, C. V.	Orange	Oct. 7,	189
Woodruff & Sons, S. D.	Orange	Oct. 7,	190

Chief Lines of Investigation.

Scale-Insect Studies.—As in former years, considerable attention has been given to the destruction of the San José scale in Connecticut orchards by spraying, and several experiments were conducted. Over 6,000 trees, consisting of apple, pear, plum, but mostly of peach, were sprayed early in spring with various mixtures of lime and sulphur. The kerosene-limoid mixture was given a trial in comparison with these mixtures, but was not very satisfactory. A full account of these experiments is given in this report. Fumigation tests in destroying this insect on nursery stock are now in progress. We find that the scale breeds continuously throughout the winter on fruit trees in greenhouses.

The other kinds of scale-insects of Connecticut have been collected and studied, and a number of the most serious pests among them were figured and described in Bulletin No. 151.

Tobacco Insects.—The insects attacking tobacco in Connecticut have received attention from this office for three years. During 1905, however, more progress was made than has been possible before. Insects were collected from fields in different parts of the state, and their effect on the plants studied. A large number of tobacco worms were gathered, for the purpose of rearing adults, some of which emerged in the fall. As this investigation has not been finished, we have considered it best to withhold the publication of the results until the work of at least one more year can be available to settle certain questions. Tobacco plants everywhere were severely attacked by cutworms, and a note regarding treatment recommended against this pest will be found on p. 260.

Mosquito Investigations.—The mosquito investigations described in the last report (1904, p. 253) were continued briefly during 1905. On account of a drought during May and another in July, there was much less stagnant water, and therefore less mosquito breeding, than in 1904. The territory about several inland towns and cities, including Farmington, New Britain and Rockville, was examined, and the results are included in this report. Upon request, a swamp area near the cemetery at Milford was examined, and a report made to the health officer of that town. See page 224.

Insects which Pollinate Fruit Blossoms.—Extensive collections have been made of the insects which visit the flowers of fruit trees and plants during the past two seasons. A complete list of these has been prepared, and is published on page 207 of this report, with the addition of notes regarding the relative value of the various species in carrying pollen.

The Connecticut Insect Fauna.—As mentioned in last year's report, a study of the insect fauna of Connecticut is being made, and this work has been continued through the season. The northeastern portion of the state was visited, Mr. Viereck making collections at Rockville, West Thompson and Putnam in July, and Mr. Britton at Stafford Springs the latter part of August. Torrington and Colebrook were also visited by Messrs. Britton and Viereck, and important collections were made. Mr. Walden collected extensively at Scotland in August, and much collecting was done on short trips around New Haven. Lists of Connecticut insects will eventually be published. Such lists of two orders (Orthoptera and Hymenoptera) are now being prepared under the direction of the State Entomologist, and will be published by the Geological and Natural History Survey of the State. Lists of other orders will be undertaken later. These lists are based upon the specimens in the station collection, though of course additional records are obtained wherever possible.

Tests of Insecticides.—In the course of the season there were opportunities for experiment in the destruction of insects by means of various insecticides, and many such tests were made. Arsenate of lead has been used in a number of cases where an arsenical poison was needed, and has been found satisfactory.

General Observation on Injurious and Beneficial Insects.—Observation and records are constantly being made of insects causing injury to plants or animals, especially those forms which attack cultivated crops and shade trees. Parasites have been reared from many of the collected specimens.

Entomological Features of 1905.

Like the season of 1904, the preceding winter was unusually severe, and certain kinds of insect life were destroyed by it. About 35 per cent. of the over-wintering San José scales were killed. During the latter part of the season, however, the scales multiplied rapidly, and many trees were found thoroughly infested when not known to be infested early in the season.

Cutworms were extremely abundant, and did more damage than in 1904 or for several years. Corn, tobacco and other field crops were severely injured by them. Sweet corn, which is extensively grown for seed, had to be replanted in many cases. Tobacco had to be reset, in some instances several times. Vegetables of nearly all kinds in gardens and on truck farms were greatly injured by the attacks of cutworms. It seems strange that the large growers do not practice using the poisoned bait of bran mash which has so often been found successful.

The onion maggot, though still doing some damage, was much less injurious than in 1904. The cabbage maggot, however, did much damage in various parts of the state.

Woolly aphis is becoming more and more prevalent in young orchards and on nursery trees. On the roots, this insect is difficult to control, and some orchardists are now putting tobacco dust around the young trees when planting them. The apple aphis, *Aphis pomi* DeG., was not very abundant.

The elm leaf beetle still continues to decrease, and very little damage resulted from its attack on New Haven trees in 1905. Many of the elm trees were defoliated, but from a different cause. The white-marked tussock moth was more abundant in Connecticut than for ten years. In New Haven, trees in the eastern portion of the city were injured more than elsewhere, and the insect was observed to be common in Hartford, Bridgeport and Norwalk.

The woolly maple leaf scale is beginning to attract attention as a pest of the sugar maple and specimens were sent in from three localities. This scale and the white-marked tussock moth are treated more fully in another part of this report.

The fall web worm was present everywhere, and denuded many trees in August and September.

The potato beetle was far more common than in 1903 or 1904.

COMBATING THE SAN JOSÉ SCALE IN 1905.

By W. E. Britton and B. H. Walden.

In 1905 about 6,000 fruit trees were sprayed in our experiments. These were in five different orchards, and were situated as follows:

Westville	150	pear trees.
Middletown	68	peach "
Westport	125	" "
West Haven	395	" "
Southington	5,271	peach and apple trees.
Total	6,009	

Spray Mixtures.

The spraying materials were chiefly lime and sulphur mixtures, and included the regular boiled mixture both with and without salt in comparison with three of the self-boiled mixtures, namely: lime, sulphur and sodium sulphide; lime, sulphur and caustic soda; lime, sulphur and sal soda. Kerosene-limoid mixture was also tested in competition with the lime and sulphur preparations. The mixtures were prepared after the formulas given below:

Formulas.

	Ingredients	Preparation
Mixture No. 1.	20 lbs. lime. 14 lbs. sulphur. 40 galls. water.	Light sulphur flour added dry to the slaking lime. Boiled 45-60 minutes.
Mixture No. 2.	20 lbs. lime. 14 lbs. sulphur. 10 lbs. salt. 40 galls. water.	Light sulphur flour and salt added to the slaking lime. Boiled 45-60 minutes.
Mixture No. 3.	20 lbs. lime. 10 lbs. sulphur. 10 lbs. sodium sulphide. 40 galls. water.	Best whitewash or finishing lime started slaking, sulphur added. When at greatest heat sulphide was added with constant stirring.
Mixture No. 4.	20 lbs. lime. 14 lbs. sulphur. 5 lbs. caustic soda. 40 galls. water.	Best whitewash or finishing lime started slaking with hot water, and sulphur added. When at greatest heat, caustic soda was added with constant stirring.
Mixture No. 5.	20 lbs. lime. 14 lbs. sulphur. 10 lbs. sal soda. 40 galls. water.	Best whitewash or finishing lime started slaking with hot water, and sulphur added. When at greatest heat sal soda was added with constant stirring.
Mixture No. 6.	40 lbs. limoid. 10 galls. kerosene. 30 galls. water.	Kerosene absorbed by the limoid and stirred or churned violently to mix with the water.

As in previous tests, twigs were examined before treatment to ascertain how many scales had been winter-killed. By this method it is possible to represent more accurately the values of the different preparations as scale destroyers. This examination showed that on the average 35 per cent. of the wintering scales had been killed.

Twigs were cut late in June, just before the young began to appear, and a second count was made to determine the number and proportion killed by the spraying. A general examination of the orchards was made about October 1st.

To illustrate. If in the early spring count, out of 1,000 wintering scales examined 350 are found dead, we count 35 per cent. as winter-killed, leaving, out of every 1000 scales, 650 alive. If in June we find 25 alive out of every 1,000 scales counted, we assume that the spray has killed 625 out of every 650, which is equivalent to 96.1 per cent.

Westville Experiments.

The pear trees treated are the same as described in the account of our spraying experiments of last year (see Bulletin 146, p. 11), and are owned by A. N. Farnham. They had been considerably injured by scale before any treatment was given them, so that while not now badly infested, many are unthrifty, and are not making a satisfactory growth. The spraying was done on March 28th, with a "Hardie" No. 6 pump, only self-boiled mixtures being used. Eighty trees were sprayed with lime, sulphur and caustic soda (formula

TABLE I.—EXPERIMENTS AT WESTVILLE.

Experiment numbers.	Kind of trees.	Number of trees treated.	Condition of trees before treatment.	Materials applied.	Out of 100 Scales on Twigs— Winter killed.	Killed by treatment.	Alive after treatment.	Percentage efficiency of treatment.
4–31	Pear	80	Medium sized trees. Not vigorous. Moderately infested.	Formula No. 4— 20 lbs. lime. 14 lbs. sulphur. 5 lbs. caustic soda. 40 galls. water. (Self-boiled.)	34	61.5	4.5	93.2
32–49	Pear	70	"	Formula No. 3— 20 lbs. lime. 10 lbs. sulphur. 10 lbs. sodium sulphide. 40 galls. water. (Self-boiled.)	35	63.5	2.6	96
		150						

No. 4). The remaining seventy trees were sprayed with lime, sulphur and sodium sulphide (formula No. 3).

There was very little difference in the adhesive quality of the mixtures, and when the twigs were cut for the second examination in June, lime could be seen on the under sides of the branches and in the more protected places. Table I, page 198, shows the results. Formula No. 3 here gave a greater percentage efficiency than formula No. 4. When examined on October 2d, the trees were in fair shape, and about half had made good growth though many were not vigorous on account of previous injury. Living scales were found on most of the trees, but were most abundant on the outside rows, and reinfestation may have been responsible for it. Some trees bore fruit, and this was practically free from scale. A few trees only were infested with psylla.

WESTPORT EXPERIMENTS.

An orchard of small peach trees near the railroad, owned by Mr. S. B. Wakeman, was found during the winter to be moderately infested with scale. Plans were made to spray it, using both lime and sulphur and the kerosene-limoid mixtures. A portion of the trees were sprayed with the latter mixture, but on account of bad weather it was impossible to finish the work until the buds were open and too late to apply the lime and sulphur treatment. Table II, page 200, shows that over seven per cent. of the scales survived the treatment.

An examination of this orchard was made on October 17th, and though plenty of living scales could be found on most of the trees, there were few trees badly infested, and abundance of dead scales showed that the treatment was fairly satisfactory. As the other mixtures were not used in this orchard there is no basis for comparison.

EXPERIMENTS AT MIDDLETOWN.

These tests were made in a peach orchard of moderate size, owned by J. M. Hubbard & Son, and found during the winter to be infested with scale. The owners sprayed the entire orchard with the boiled lime and sulphur mixture. Sixty-eight trees were included in our tests, twenty-one being treated

Table II.—Experiments at Middletown and Westport.

Experiment numbers.	Kind of trees.	Number of trees treated.	Condition of trees before treatment.	Materials applied.	Out of 100 Scales on Twigs— Winter killed.	Killed by treatment.	Alive after treatment.	Percentage efficiency of treatment.
50–54	Peach	21	Medium sized bearing trees. Some had been injured by scale.	Formula No. 1— 20 lbs. lime. 14 lbs. sulphur. 40 galls. water. (Boiled.)	41	54.5	4.6	92.3
55–62	Peach	47 — 68	"	Formula No. 2— 20 lbs. lime. 14 lbs. sulphur. 10 lbs. salt. 40 galls. water. (Boiled.)	44	51.7	4.3	92.3
150–163	Peach	125*	Mostly small bearing trees. Some badly infested.	Formula No. 6— 40 lbs. limoid. 10 galls. kerosene. 30 galls. water.	35	57.9	7.1	89

* Westport.

with lime and sulphur, and forty-seven being sprayed with lime, sulphur and salt. The mixture was cooked in the orchard by steam from a "Kinney Safe" engine, and applied with an "Eclipse" pump fitted with two lines of hose and double Vermorel nozzles. The results shown in Table II, page 200, indicate that the salt did not affect the mixture as a scale-destroyer.

When the twigs were cut in June, no difference was found in the sticking qualities of the two mixtures.

The final examination, made on October 5th, showed that the scale was well controlled throughout the entire orchard and but few living scales were found. Traces of the mixture still remained on many of the trees.

Experiments at West Haven.

These experiments were carried on in the peach orchard of Mr. N. S. Platt, on rather large trees of seven or eight years' planting. The orchard was more or less infested throughout, and some trees had been killed by scale.

The spray liquid was applied with a "Hardie" No. 6 pump mounted upon a drag. In these tests limoid and kerosene (formula No. 6) was tried in comparison with the self-boiled mixtures. A majority of the trees were sprayed with formula No. 3, formula No. 4 was used on more than a hundred trees, and a number of trees were left unsprayed.

Table III, page 202, shows formula No. 4 to have been rather more efficient than formula No. 3 in this orchard. Limoid and kerosene (formula No. 6) was less efficient than either of the others.

The final examination was made on October 2d, when the benefits of spraying were marked. Unsprayed trees were literally covered with living scales, while adjacent sprayed ones were nearly clean. Of course a few living ones could be seen on most of the trees, but they were more numerous on the trees treated with limoid and kerosene (formula No. 6) than on the other sprayed trees, though all were about equally situated as regards liability to reinfestation.

This last examination confirms the results expressed in figures in Table III, regarding the effectiveness of the mixtures. Trees treated with lime, sulphur and caustic soda (formula No. 4) and those sprayed with lime, sulphur and

TABLE III.—EXPERIMENTS AT WEST HAVEN.

Experiment numbers.	Kind of trees.	Number of trees treated.	Condition of trees before treatment.	Materials applied.	Out of 100 Scales on Twigs— Winter killed.	Killed by treatment.	Alive after treatment.	Percentage efficiency of treatment.
64–88 214–220	Peach	213	Good sized bearing trees. Some had been injured by scale.	Formula No. 3— 20 lbs. lime. 10 lbs. sulphur. 10 lbs. sodium sulphide. 40 galls. water. (Self-boiled.)	34	61.0	4.9	92.4
89–92 200–207	Peach	132	"	Formula No. 4— 20 lbs. lime. 14 lbs. sulphur. 5 lbs. caustic soda. 40 galls. water. (Self-boiled.)	35	60.9	4.1	93.7
208–213	Peach	50 — 395	"	Formula No. 6— 40 lbs. limoid. 10 galls. kerosene. 30 galls. water.	27	65.8	7.2	90.1

sodium sulphide (formula No. 3) were all remarkably free from living scales, though plenty of dead ones were found. A heavy rain the following night washed off some of the lime, sulphur and caustic soda (formula No 4), but did not greatly diminish its insecticidal value.

SOUTHINGTON EXPERIMENTS.

These experiments were conducted in the orchards of E. Rogers and J. H. Merriman in the Shuttle Meadow region of Southington. Some trees were badly infested, but most of them were uninjured. For the most part the boiled lime and sulphur mixture (formula No. 1) was used. One hundred and fifty trees were sprayed with formula No. 2 (containing salt), 240 with lime, sulphur and sodium sulphide mixture (formula No 3), 80 with lime, sulphur and sal soda (formula No. 5), and 85 with limoid and kerosene (formula No. 6). "Spramotor" pumps fitted with double lines of hose and mounted on wagons were used in this orchard. Both "Spramotor" and double "Vermorel" nozzles were employed. The mixture was boiled near the orchard in open barrels with steam from a "Kinney Safe" engine. It is always advisable where possible to place the cooking plant near a water supply. Mr. Rogers here used an ejector to draw water from a well, as is shown on plate I, b, and this was found to be a satisfactory arrangement. A neighbor, Mr. W. N. Dunham, sprayed several hundred trees, and for boiling the mixture used a small boiler of stationary pattern, though light and transportable. This boiler was not expensive, could be carried about in an express wagon, and was found satisfactory. His outfit is shown on plate I, a.

Table IV, page 204, shows the results. The highest percentage efficiency of treatment was given by the lime, sulphur and sodium sulphide mixture (formula No. 3); the lowest, by the kerosene and limoid mixture (formula No. 6).

When examined in June, the kerosene and limoid apparently had not injured the trees, and all sprayed trees were in good condition. When finally examined on October 9th, few living scales could be found on the sprayed trees in Mr. Rogers' peach orchard, though there were plenty of dead ones. Occasionally we noticed a small twig or branch with an abun-

TABLE IV.—EXPERIMENTS AT SOUTHINGTON.

Experiment numbers.	Kind of trees.	Number of trees treated.	Condition of trees before treatment.	Materials applied.	Out of 100 Scales on Twigs— Winter killed.	Killed by treatment.	Alive after treatment.	Percentage efficiency of treatment.
93–98	Peach Apple	4606 110	Medium sized trees not badly infested. Medium sized trees. Some badly infested.	Formula No. 1— 20 lbs. lime. 14 lbs. sulphur. 40 galls. water. (Boiled.)	35	60.0	4.9	92.3
99–103	Peach	150	Bearing trees of medium size. Moderately infested.	Formula No. 2— 20 lbs. lime. 14 lbs. sulphur. 10 lbs. salt. 40 galls. water. (Boiled.)	39	56.5	4.5	92.6
105–114	Peach	240	Small bearing trees. A few badly infested.	Formula No. 3— 20 lbs. lime. 10 lbs. sulphur. 10 lbs sodium sulphide. 40 galls. water. (Self-boiled.)	40	57.8	2.2	96.3
115–121	Peach	80	Small bearing trees. A few badly infested.	Formula No. 5— 20 lbs. lime. 14 lbs. sulphur. 10 lbs. sal soda. 40 galls. water. (Self-boiled.)	39	55.7	5.3	91.2
122–129	Peach	85	Large trees, badly infested. Some killed by scale.	Formula No. 6— 40 lbs. limoid. 10 galls. kerosene. 30 galls. water.	26	63.5	10.6	85.7
		5271						

dance of living scales, while the remainder of the tree was nearly free from them. These branches in all probability had not been well coated with the spray. The presence of salt in the mixture made no difference in the appearance of sprayed trees. Some medium-sized apple trees which were sprayed on a windy day were quite badly infested, but certain portions of the trees were also covered with dead scales, and the lack of thoroughness in spraying these trees doubtless accounts for their condition. Similar trees in Mr. Merriman's apple orchard were better sprayed, and are now comparatively free from scale. The young peach trees in the Merriman orchards are remarkably clean, and the October examination confirmed the figures obtained in June regarding the effectiveness of the self-boiled mixtures. Some large trees were sprayed with limoid and kerosene (25 per cent. kerosene) and the others with the boiled lime and sulphur mixture. Many of the former though thoroughly covered by the spray, and perfectly white after treatment, were found to be badly infested with living scales when examined in October. In adjoining rows, similar trees treated with lime and sulphur were comparatively free. This seems to indicate that (1) either the limoid and kerosene mixture was not as effective in killing the scales, or (2) that the scales more readily reëstablished themselves on trees sprayed with it.

The average percentage efficiency of each of these insecticides, for the localities where tested, may be found in Table V.

TABLE V.—PERCENTAGE EFFICIENCY OF INSECTICIDES.

FORMULA NO.	Percentage of Efficiency of Insecticides at Westville	Middletown.	Westport.	West Haven.	Southington.	Average for these localities.
1. Lime and sulphur	----	92.3	----	----	92.3	92.3
2. Lime, sulphur and salt	----	92.3	----	----	92.6	92.5
3. Lime, sulphur and sodium sulphide	96.	----	----	92.4	96.3	94.9
4. Lime, sulphur and caustic soda	93.2	----	----	93.7	----	93.5
5. Lime, sulphur and sal soda	----	----	----	----	91.2	91.2
6. Limoid and kerosene	----	----	89.	90.1	85.7	88.3

COST OF THE DIFFERENT MIXTURES.

The boiled lime and sulphur mixture without salt is the cheapest of all so far as the cost of materials is concerned.

The operation of boiling of course increases the cost, but probably this does not exceed fifteen or twenty cents per barrel of forty gallons where the proper kind of an outfit is employed. For use on a few trees in the back yard, or even for spraying an orchard of 200 or 300 trees, one of the self-boiled mixtures will probably be the least expensive if there is no convenient outfit for boiling at hand.

In reckoning the cost of materials, lime is figured at $2.00 per barrel of 300 lbs., sulphur at $2.85 per C., hay salt at 60 cts. per C., caustic soda (74 per cent.) in 25 lb. pails at 6 cts. per lb., sal soda, 2 cts. per lb., sodium sulphide in 110 lb. drums at 3½ cts., per lb., limoid at $2.50 per bbl., and kerosene at 10 cts. per gallon; these being current prices for small quantities. In large lots the prices are considerably lower. The materials to make forty gallons or enough to fill a spray barrel of each of the various mixtures cost as follows:

Formula No. 1	$ .54
" No. 2	.60
" No. 3	.78
" No. 4	.84
" No. 5	.74
" No. 6	1.66

Where Materials may be Purchased.

Lime may be purchased from dealers in all parts of the State. Mortar lime can be used in making a boiled mixture, but generally there is, in it, much more sediment to clog strainers and nozzles; therefore we recommend the use of whitewash or finishing lime, and in preparing a self-boiled mixture mortar lime should never be used.

Sulphur and caustic soda may be obtained through any wholesale drug firm, or may be purchased direct from dealers in New York.

Limoid is hydrated lime, and can be purchased from the manufacturers, The Charles Warner Company, Wilmington, Del. Sodium sulphide is sold by the Roessler & Hasslacher Chemical Company, 100 William St., New York City, and sal soda, hay salt and kerosene may be obtained anywhere from local merchants.

For a detailed account of the methods of preparing the various mixtures, and description of spraying apparatus, etc., the reader is referred to Bulletin No. 146, or to the report of this station for 1904, page 240.

SUMMARY.

1. About 6000 peach, apple and pear trees in Westville, Middletown, Westport, West Haven and Southington were sprayed in the spring of 1905 to destroy the San José scale.

2. The insecticides used were the boiled mixtures of lime and sulphur; lime, sulphur and salt; the self-boiled mixtures of lime, sulphur and sodium sulphide; lime, sulphur and caustic soda; and the kerosene and limoid mixture (see formulas, p. 196).

3. In these tests the lime, sulphur and sodium sulphide mixture gave the highest percentage efficiency, and the kerosene and limoid the lowest, though the difference was not striking, and all of the mixtures employed must be considered as fairly effective scale destroyers. The beneficial effect (if any) of salt in the boiled mixture was scarcely perceptible.

4. The cost of the materials is least for the boiled mixtures, and we recommend those where steam can be obtained for the purpose. The cost of boiling, however, makes the price nearly equal to the cost of the self-boiled mixture. Boiled lime and sulphur mixture is probably cheapest for the large orchard, and one of the self-boiled mixtures will prove cheapest for the small orchard and garden. Though somewhat easier to prepare and apply, the cost of the kerosene and limoid will make it prohibitory on a large scale.

A summarized account of these experiments was printed as Bulletin No. 1 of Immediate Information, containing four pages, and mailed to the Connecticut members of the Pomological Society in October. Only 1,000 copies were printed.

INSECTS COLLECTED FROM THE FLOWERS OF FRUIT TREES AND PLANTS.*

By W. E. Britton and Henry L. Viereck.

For many years horticulturists and entomologists have regarded the honey bee, *Apis mellifera* Linn., as the most important species of insect engaged in the pollination of the flowers of our fruit-bearing trees and shrubs. Benton states† that bees are the most abundant of the insects visiting the

* This paper as originally prepared was read before the meeting of the American Association of Economic Entomologists at Philadelphia, December 29 and 30, 1904, but was withdrawn from publication in the proceedings of that meeting, and has not until this time been published. The paper has been emended and rearranged, and contains important additions.

† Frank Benton, The Honey Bee, Bulletin I, Division of Entomology, p. 63.

fruit blossoms. In his study of the pollination of pear flowers ten years ago, Waite found about fifty different kinds of insects visiting pear blossoms, but that the common honey bee was "the most regular and important abundant visitor, and probably does more good than any other species." * In an address before the Georgia State Horticultural Society in 1903, Professor Wilmon Newell stated that "no insect so effectually accomplishes this distribution of pollen as the honey bee." † According to Müller also the honey bee is an abundant visitor of plum, pear, apple, currant and gooseberry flowers in Europe.‡

The importance of honey bees in pollinating fruit flowers has been pointed out by a great number of popular and technical writers, and we were somewhat surprised in looking over the results of a few minutes' collecting in the garden in 1904 to find that honey bees were exceedingly scarce in comparison with other species of *Hymenoptera,*—or in fact with other insects. Observations were therefore continued on some of our common fruit trees. No attempt is here made to give a complete list of the insect visitors of these plants. The lists represent only the insects taken from the flowers and in sweeping over them. The collecting was done mostly by the writers at odd moments during sunny forenoons on the grounds of the Experiment Station in New Haven. The dates of the collecting were from May 4th to May 14th, 1904, during which time currant, gooseberry, apple, pear, plum and cherry were in bloom; the insects from blackberry flowers were taken June 3d, 1904. During 1905 many specimens were taken from apple and quince flowers at Branford by Rev. H. W. Winkley, and the results are incorporated in this paper. The Branford specimens were collected from May 11th to May 22d. During this time Mr. B. H. Walden also collected insects on quince, cherry, peach, raspberry and strawberry at New Haven. The accompanying list contains the results of all these collections.

It is not known to the writers that bees are kept in the immediate vicinity of the Experiment Station; there are

* M. B. Waite, The Pollination of Pear Flowers, Bulletin V, Division of Vegetable Pathology, p. 79.

† Proceedngs, 27th Annual Meeting, Georgia State Horticultural Society, 1903.

‡ H. Müller, The Fertilization of Flowers (Thompson's translation).

several hives less than two miles away. Wild honey bees are probably not very abundant so near the city. We should expect them to be much more abundant at Branford.

The writers desire to express their obligations to Mr. C. W. Johnson of Boston for determining the *Diptera.* The *Hymenoptera* have been identified by Mr. Viereck.

The species of plants collected from, together with the number of specimens and species of insects taken from each, is as follows:—

Plant.	No. of Insects.	No. of Species.
Ribes oxyacanthoides, American Gooseberry	883	72
" *rubrum,* Common Red Currant	123	59
" *nigrum,* Common Black Currant	154	23
Prunus sp. (probably a native species)	39	15
" *triloba,* Japan Plum	405	44
" *avium,* Sweet Cherry	370	37
" *persica,* Peach	12	8
Pyrus malus, Common Apple	229	52
" *communis,* Common Pear	73	29
Cydonia vulgaris, Common Quince	77	30
Rubus nigrobaccus, Common High Bush Blackberry	18	8
" *strigosus,* Red Raspberry	22	13
Fragaria virginiana, Strawberry	11	6
Total	2,416	396

The following list shows the number of species in each order, so far as they could be determined, with the number of specimens of each species.

In the *Hymenoptera,* the sexes have been recorded separately, but workers or neuters are enumerated only in the column of totals. It will be seen that the females greatly predominate.

List of Insects Collected from the Flowers of Fruit Trees and Plants.

American Gooseberry, *Ribes oxyacanthoides*.

Hymenoptera (Bees, wasps, ants).	Male	Female	Total No. Specimens
Pteronus ribesii Scop.	..	7	7
Dolerus aprilis Nort.	..	1	1
Bracon sp.	..	3	3
Doryctes ? sp.	..	2	2
Apanteles sp.	..	..	4
Dacnusa ? sp.	..	..	2
Sympratis ? sp.	..	1	1
Thersilochus sp.	..	4	4
Undetermined Tryphonids (4 species)	..	..	4
" Chalcidids (4 species)	..	..	5
Lasius sp.	..	..	1
Colletes inaequalis Cress.	1	2	3
" *valida* Cress.	5	1	6
Halictus fasciatus Nyl.	..	26	26
" *lerouxii* Lep.	..	30	30
" (*Evylaeus*) *arcuatus* Robt.	..	19	19
" " *truncatus* Robt.	..	9	9
" " *pectinatus* Robt. ?	..	1	1
" (*Chloralictus*) *pilosus* Sm.	..	32	32
" " *sp.*	..	20	20
" " *zephyrus* Sm.	..	4	4
" " *sp.*	..	31	31
" " "	..	2	2
" " "	..	14	14
" " *sparsus* Robt.	..	417	417
Trachandrena forbesii Robt.	4	4	8
" " var.	1	1	2
" *sp.*	1	..	1
" *sp.*	1	..	1
" *sp.*	..	1	1
" *crataegi* Robt.	4	..	4
Andrena carlini Ckll.	..	1	1
" *vicina* Sm.	50	4	54
" *nasoni* Robt.	8	5	13
" *salicacea* Robt.	1	1	1
" (*Opandrena*) *bipunctata* Cress.	1	6	7
" *sp.*	5	2	7
Nomada imbricata Sm.	..	1	1
Ceratina dupla Say.	2	7	9
Synhalonia atriventris Sm.	2	..	2
Total, 46 species	85	659	760

Diptera (Flies, mosquitoes).	Specimens
Ceratopogon fusculus Coq.	10
Rhamphomyia nana Loew.	1
Lonchoptera lutea Panz.	20
" *riparia* Meig.	20
Eristalis bastardi Macq.	2
Panzeria radicum Fabr.	4
Homalomyia scalaris Fabr.	1
Phorbia fusciceps Zett.	3
Fucellia fucorum Fall.	2
Scatophaga stercoraria Linn.	6
Chlorops assimilis Macq.	8
Elachiptera costata Loew.	19
Oscinis coxendix Fitch.	3
" *sp.*	1
Drosophila graminum Fall.	1
" *sp.*	2
Agromyza angulata Loew.	2
Desmometopa m-nigrum Zett.	1
" *latipes* Meig.	1
Total, 19 species	107

Coleoptera (Beetles).	Specimens
Phyllotreta sinuata Steph.	1
Epitrix cucumeris Harris.	2
Diabrotica vittata Fabr.	1
Adalia bipunctata Linn.	1
Total, 4 species	5

Hemiptera (Bugs, leaf-hoppers, etc.).	Specimens
Lygus pratensis Linn.	4
Undetermined Tettigonid	1
" Jassid	6
Total, 3 species	11

Common Red Currant, *Ribes rubrum*.

Hymenoptera (Bees, wasps, ants).	Male	Female	Total No. Specimens
Dolerus aprilis Nort.	1	1	2
Apanteles sp.	1	..	1
" "	..	1	1
Sympratis ? sp.	..	1	1
Exochus semirufus Cress.	1	..	1
Undetermined Tryphonid	..	..	1
Ichneumon subcyaneus Cress.	1	..	1
" *seminiger* Cress.	..	1	1
Undetermined Chalcidid	..	..	1
" "	..	..	1
Crematogaster lineolata Say.	..	..	1

HYMENOPTERA (Bees, wasps, ants)—*Cont'd.*

	Male	Female	Total No. Specimens
Cryptocheilus conicus Say.	1	..	1
Colletes valida Cress.	2	..	2
Oxystoglossa similis Robt.	..	1	1
Halictus fasciatus Nyl.	..	1	1
" (*Evylaeus*) *truncatus* Robt.	..	1	1
" (*Chloralictus*) *zephyrus* Sm.	..	7	7
" " *sp.*	..	13	13
" " *sparsus* Robt.	..	3	3
" " *n. sp.* ?	..	1	1
" " *n. sp.*	..	1	1
Trachandrena crataegi Robt.	3	..	3
" *forbesii* Robt.	1	..	1
" " var.	1	1	2
Andrena mandibularis Robt.	..	1	1
" *nasoni* Robt.	3	1	4
" *vicina* Sm.	3	..	3
" *sp.*	1	..	1
Total, 28 species	19	35	58

DIPTERA (Flies, mosquitoes).

	Specimens
Undetermined Chironomid	1
Sciara sp.	1
Rhamphomyia brevis Loew.	1
Pipiza albipilosa Will.	1
" *femoralis* Loew.	1
Melanostoma mellinum Linn.	1
Hyalomyodes triangulifera Loew.	1
Panzeria radicum Fabr.	4
Sarcophaga helicis Town.	1
" *sp.*	1
" "	1
Lucilia caesar Linn.	1
Phormia regina Meig.	1
Ophyra leucostoma Wied.	1
Anthomyia radicum Linn.	3
Phorbia cinerella Fall.	1
" *fusciceps* Zett.	16
Fucellia fucorum Fall.	2
Scatophaga stercoraria Linn.	6
Sepsis violacea Meig.	1
Nemopoda cylindrica Fabr.	1
Piophila casei Linn.	8
Chlorops variceps Loew.	1
Oscinis coxendrix Fitch.	2
Agromyza diminuta Walk.	1
Desmometopa latipes Meig.	1
" *m-nigrum* Zett.	1
Total, 27 species	61

COLEOPTERA (Beetles).

	Specimens
Anthrenus verbasci Linn.	1
Adalia bipunctata Linn.	1
Total, 2 species	2

HEMIPTERA (Bugs, leaf-hoppers, etc.).

	Specimens
Lygus pratensis Linn.	1
Undetermined Psyllid	1
Total, 2 species	2

Black Currant, *Ribes nigrum.*

HYMENOPTERA (Bees, wasps, ants).

	Male	Female	Total No. Specimens
Apanteles sp.	1	..	1
Thersilochus sp.	..	3	3
Vespa germanica Fabr.	..	1	1
Agapostemon radiatus Say.	..	1	1
Halictus lerouxii Lep.	..	2	2
" (*Evylaeus*) *arcuatus* Robt.	..	6	6
" " *truncatus* Robt.	..	19	19
" (*Chloralictus*) *sparsus* Robt.	..	81	81
" " *zephyrus* Sm.	..	9	9
" " *sp.*	..	2	2
" " "	..	4	4
" " *pilosus* Sm.	..	8	8
Andrena vicina Sm.	2	..	2
Bombus consimilis Cress.	..	1	1
" *pennsylvanicus* DeG.	..	1	1
Total, 15 species	3	138	141

DIPTERA (Flies, mosquitoes).

	Specimens
Eristalis bastardi Macq.	1
Lucilia caesar Linn.	3
Scatophaga stercoraria Linn.	2
Nemopoda cylindrica Fabr.	1
Piophila casei Linn.	1
Chlorops assimilis Macq.	1
Phorbia fusciceps Zett.	3
Total, 7 species	12

COLEOPTERA (Beetles).

	Specimen
Adalia bipunctata Linn.	1
Total, 1 species	1

Wild Plum, *Prunus sp.*

HYMENOPTERA (Bees, wasps, ants).	Male	Female	Total No. Specimens
Halictus (Evylaeus) arcuatus Robt.	..	1	1
Trachandrena crataegi Robt.	1	3	4
Andrena vicina Sm.	..	1	1
" *salicacea* Robt.	..	1	1
" *(Opandrena) bipunctata* Cress.	..	18	18
Total, 5 species	1	24	25

DIPTERA (Flies, mosquitoes).	Specimens
Ceratopogon fusculus Coq.	1
Undetermined Chironomid	2
Stratiomyia discalis Loew.	1
Odontomyia pubescens Day.	1
Hilaria leucoptera Loew.	2
Triodonta curvipes Wied.	1
Zodion fulvifrons Say.	1
Nemopoda minuta Wied.	3
Total, 8 species	12

COLEOPTERA (Beetles).	Specimens
Crepidodera helxinus Linn.	1
Attagenus piceus Oliv.	1
Total, 2 species	2

Japan Plum, *Prunus triloba.*

HYMENOPTERA (Bees, wasps, ants).	Male	Female	Total No. Specimens
Sympratis ? sp.	..	1	1
Aphanogmus ? sp.	..	1	1
Formica fusca subsericea Say.		..	4
Ancistrocerus tigris Saus.	1		1
Colletes inaequalis Cress.	..	1	1
Halictus fasciatus Nyl.	..	1	1
" *lerouxii* Lep.	..	1	1
" *(Evylaeus) arcuatus* Robt.	..	7	7
" " *truncatus* Robt.	..	5	5
" *(Chloralictus) pilosus* Sm.	..	1	1
" " *zephyrus* Sm.	..	1	1
" " *sparsus* Robt.	..	207	207
" " *sp.*	..	3	3
Paralictus cephalicus Robt.	..	1	1
Trachandrena crataegi Robt.	13	3	16
" *claytoniae* Robt.	..	1	1
" *forbesii* Robt.	1	3	4
" " var.	..	1	1
" *sp.*	..	1	1

HYMENOPTERA (Bees, wasps, ants)—*Cont'd.*	Male	Female	Total No. Specimens
Andrena vicina Sm.	..	4	4
" *nasoni* Robt.	6	4	10
" *salicacea* Robt.	..	2	2
" *(Opandrena) bipunctata* Cress.	19	65	84
Total, 23 species	40	314	358

DIPTERA (Flies, mosquitoes).	Specimens
Ceratopogon fusculus Coq.	1
Camptocladius byssinus Schr.	9
Sciara sp.	1
Undetermined Empid	2
Platychirus hypoboreus Staeg.	4
Panzeria radicum Fabr.	2
Cynomyia cadaverina Desv.	1
Phormia regina Meig.	1
Hyetodesia lucorum Fall.	1
Phorbia fusciceps Zett.	6
Undetermined Anthomyid	1
Scatophaga stercoraria Linn.	3
Sepsis violacea Meig.	1
Nemopoda stercoraria Desv. ?	1
Piophila casei Linn.	7
Chlorops assimilis Macq.	1
Total, 16 species	42

COLEOPTERA (Beetles).	Specimens
Crepidodera helxinus Linn.	1
Aphodius granarius Linn.	1
Anthrenus scrophulariae Linn.	1
Xantholinus cephalus Say.	1
Adalia bipunctata Linn.	1
Total, 5 species	5

Sweet Cherry, *Prunus avium.*

HYMENOPTERA (Bees, wasps, ants).	Male	Female	Total No. Specimens
Apanteles sp.	..	..	1
Undetermined Cynipid			1
Vespa diabolica Saus.	..	1	1
Colletes inaequalis Cress.	..	1	1
Agapostemon radiatus Say.	..	2	2
Halictus fasciatus Nyl.	..	5	5
" *lerouxii* Lep.	..	1	1
" *(Evylaeus) arcuatus* Robt.	..	14	14
" " *truncatus* Robt.	..	7	7

HYMENOPTERA (Bees, wasps, ants)—*Cont'd.*	Male	Female	Total No. Specimens
Halictus (*Chloralictus*) *zephyrus* Sm.	..	15	15
" " *pilosus* Sm.	..	14	14
" " *sparsus* Robt.	..	185	185
" " *obscurus* Robt. ?	..	1	1
" " *n. sp.*	..	1	1
" " *sp.*	..	2	2
" " "	..	7	7
" " "	..	7	7
Trachandrena crataegi Robt.	..	1	1
" *forbesii* Robt.	1	..	1
" " var.	..	3	3
" *claytoniae* Robt.	..	1	1
" *hippotes* Robt.	..	1	1
Andrena vicina Sm.	2	13	15
" *mandibularis* Robt.	..	3	3
" *nasoni* Robt.	12	2	14
" *carlini* Ckll.	1	1	2
" (*Opandrena*) *bipunctata* Cress.	7	40	47
Bombus virginicus Oliv.	..	1	1
Apis mellifera Linn.	..	..	5
Total, 29 species	23	329	359

DIPTERA (Flies, mosquitoes).	Specimens
Undetermined Chironomid	1
Xylota ejuncida Say.	1
Phorbia fusciceps Zett.	2
Piophila casei Linn.	3
Total, 4 species	7

COLEOPTERA (Beetles).	Specimens
Crepidodera helxinus Linn.	1
Epuraea labilis Er.	1
Carpophilus discoideus Lec.	1
Adalia bipunctata Linn.	1
Total, 4 species	4

Peach, *Prunus persica.*

HYMENOPTERA (Bees, wasps, ants).	Male	Female	Total No. Specimens
Halictus (*Chloralictus*) *versatus* Robt.	..	1	1
" " *n. sp.*	..	1	1
" " *obscurus* Robt.	..	3	3
" " *sparsus* Robt.	..	2	2
Andrena (*Opandrena*) *bipunctata* Cress.	..	2	2
Bombus virginicus Oliv.	..	..	1
" *ridingsii* Cress.	..	..	1
Apis mellifera Linn.	..	..	1
Total, 8 species	0	9	12

Apple, *Pyrus malus.*

HYMENOPTERA (Bees, wasps, ants).	Male	Female	Total No. Specimens
Caliroa ? sp.	..	1	1
Amblyteles sp.	..	1	1
Camponotus pennsylvanicus DeG.	..	..	2
Formica fusca subsericea Say.	..	..	1
Vespa maculata Linn.	..	1	1
" *diabolica* Sauss.	..	1	1
Agapostemon radiatus Say.	..	2	2
Halictus lerouxii Lep.	..	4	4
" (*Chloralictus*) *zephyrus* Sm.	..	11	11
" " *pilosus* Sm.	..	5	5
" " *sparsus* Robt.	..	30	30
" " *obscurus* Robt.	..	1	1
" " *versatus* Robt.	..	6	6
" " *sp.*	..	..	3
" " "	..	..	4
" (*Evylaeus*) *truncatus* Robt.	..	1	1
Andrena nasoni Robt.	..	1	1
" *vicina* Sm.	..	5	5
" *carlini* Ckll.	..	6	6
" *sp.*	4	..	4
" (*Opandrena*) *bipunctata* Cress.	1	11	12
Trachandrena claytoniae Robt.	..	1	1
" *crataegi* Robt.	..	1	1
" *hippotes* Robt.	..	1	1
Synhalonia atriventris Sm.	1	..	1
Osmia (*Ceratosmia*) *lignaria* Say.	..	34	34
Xylocopa virginica Dru.	15	..	15
Bombus ridingsii Cress.	..	1	1
" *americanorum* Fabr.	..	1	1
" *consimilis* Cress.	5	2	7
" *virginicus* Oliv.	..	2	2
Apis mellifera Linn.	..	..	31
Total, 32 species	26	130	197

DIPTERA (Flies, mosquitoes).	Specimens
Ceratopogon sp.	1
Chironomus modestus Say.	1
Undetermined Cecidomyid	1
Chrysogaster pulchella Will.	1
Helophilus hamatus Loew.	1
Triodonta curvipes Wied.	1
Sarcophaga helicis Town.	1
Lucilia caesar Linn.	1
Homalomyia scalaris Fabr.	3

DIPTERA (Flies, mosquitoes)—*Cont'd.*

	Specimens
Anthomyia radicum Linn.	1
Phorbia cinerella Fall.	1
" *fusciceps* Zett.	4
Undetermined Anthomyid	1
Scatophaga stercoraria Linn.	1
Lonchaea rufitarsis Macq.	1
Piophila casei Linn.	4
Total, 16 species	24

COLEOPTERA (Beetles).

	Specimens
Telephorus bilineatus Say.	2
Adalia bipunctata Linn.	1
Bradycellus rupestris Say.	4
Total, 3 species	7

HEMIPTERA (Bugs, leaf-hoppers, etc.).

	Specimen
Miris affinis Reut.	1

Pear, *Pyrus communis.*

HYMENOPTERA (Bees, wasps, ants).

	Male	Female	Total No. Specimens
Nematus sp.		1	1
Agapostemon radiatus Say.		2	2
Paralictus cephalicus Robt.		1	1
Halictus fasciatus Nyl.		1	1
" (*Evylaeus*) *arcuatus* Robt.		1	1
" " *truncatus* Robt.		2	2
" (*Chloralictus*) *sparsus* Robt.		3	3
" " *n. sp.*		..	1
" " *zephyrus* Sm.		1	1
" " *sp.*		4	4
Trachandrena crataegi Robt.	3		3
" *forbesii* Robt.		1	1
" *claytoniae* Robt.		1	1
Andrena vicina Sm.		1	1
" *nasoni* Robt.	6	12	18
" *macgillivrayi* Ckll. var.		..	1
" (*Opandrena*) *bipunctata* Cress.	3	8	11
Total, 17 species	12	40	53

DIPTERA (Flies, mosquitoes).

	Specimens
Undetermined Chironomid	2
Tachydromia pusilla Loew.	3
Platychirus hypoboreus Staeg.	1
Metachaeta helymus Walk.	1

DIPTERA (Flies, mosquitoes)—*Cont'd.*

	Specimens
Undetermined Tachinid	1
Morellia micans Macq.	1
Phorbia fusciceps Zett.	3
Piophila casei Linn.	4
Chlorops assimilis Macq.	1
Total, 9 species	17

COLEOPTERA (Beetles).

	Specimens
Diabrotica vittata Fabr.	1
Anthrenus scrophulariae	1
" *verbasci*	1
Total, 3 species	3

Quince, *Cydonia vulgaris.*

HYMENOPTERA (Bees, wasps, ants).

	Male	Female	Total No. Specimens
Exochus pallipes Cress.	..	1	1
Formica fusca subcericea Say.		..	2
Odynerus (*Ancistrocerus*) *campestris* Sauss.	..	..	1
Halictus lerouxii Lep.	..	1	1
" *fasciatus* Nyl.	..	9	9
" (*Lasioglossum*) *coriaceum* Sm.	..	1	1
" (*Evylaeus*) *truncatus* Robt.	..	3	3
" (*Chloralictus*) *pilosus* Sm.	..	5	5
" " *zephyrus* Sm.	..	2	2
" " *tegularis* Robt.	..	6	6
" " *sparsus* Robt.	..	18	18
" " *obscurus* Robt. ?	..	1	1
" " *versatus* Robt.	..	3	3
" " *sp.*		1	1
Andrena (*Opandrena*) *bipunctata* Cress.	..	2	2
" " *nasoni* Robt.	..	3	3
Trachandrena crataegi Robt.	1	1	2
Ceratina dupla Say.	1	..	1
Osmia (*Ceratosmia*) *lignaria* Say.		..	1
Bombus virginicus Oliv.		1	1
" *consimilis* Cress.	..	1	1
Apis mellifera Linn.		..	3
Total, 22 species	2	58	68

DIPTERA (Flies, mosquitoes).

	Specimens
Tachydromia pusilla Loew.	2
Mesogramma marginata Say.	1
Tropidia quadrata Say.	1
Syritta pipiens Linn.	1
Ophyra leucostoma Wied.	1
Nemopoda cylindrica Fabr.	1
Agromyza aeneiventris Fall.	1
Total, 7 species	8

COLEOPTERA (Beetles).

	Specimen
Diabrotica vittata Fabr.	1

Common Blackberry, *Rubus nigrobaccus*.

HYMENOPTERA (Bees, wasps, ants).	Male	Female	Total No Specimens
Prenolepis imparis Say.	..	..	2
Halictus (*Chloralictus*) *sp.*	..	1	1
Trachandrena forbesii var.	..	1	1
" *sp.*	1	..	1
Andrena (*Opandrena*) *bipunctata* Cress.	3	7	10
Bombus americanorum Fabr.	..	1	1
" *ridingsii* Cress.	..	..	1
Apis mellifera Linn.	..	..	1
Total, 8 species	4	10	18

Red Raspberry, *Rubus strigosus*.

HYMENOPTERA (Bees, wasps, ants).	Male	Female	Total No. Specimens
Eumenes fraterna Say.	..	..	1
Odynerus pennsylvanicus Sauss.	..	..	1
Prosopis affinis Sm.	..	2	2
" *pygmaea* Cress.	..	1	1
Halictus fasciatus Nyl.	..	1	1
" (*Chloralictus*) *sparsus* Robt.	..	1	1
Andrena sp.	..	1	1
" *hilaris* Sm. ?	..	1	1
Ceratina dupla Say.	..	4	4
Alcidamea producta Cress.	1	1	2
Celioxys sp.	1	..	1
Osmia pumila Cress.	..	4	4
Bombus ridingsii Cress.	1	1	2
Total, 13 species	3	17	22

Strawberry, *Fragaria virginiana*.

HYMENOPTERA (Bees, wasps, ants).	Male	Female	Total No. Specimens
Formica sp.	..	..	1
Halictus fasciatus Nyl.	..	2	2
" (*Chloralictus*) *versatus* Robt.	..	5	5
Trachandrena claytoniae Robt.	..	..	1
Total, 4 species	0	7	9

COLEOPTERA (Beetles).

	Specimens
Crepidodera helxinus Linn.	1
Byturus unicolor Say.	1
Total, 2 species	2

RELATIONSHIP BETWEEN THE FLOWERS AND THEIR INSECT VISITORS.

It will be noticed that the Hymenoptera are more abundant on the blossoms of these fruits than are the other orders of insects. A majority of the Hymenoptera in these collections—majority of both species and individuals—belong to the super-family *Apoidea*, which includes the honey bee and the bumble bee. These bees are known to gather pollen and nectar for their young, and this explains their visits to the flowers. In each of the lists of hymenoptera most of the species are bees. Beginning with *Colletes*, or in some cases with *Agapostemon* and *Halictus*, all others on the lists belong to the *Apoidea*.

Just what the other insects are doing in the flowers is more uncertain. It is known that certain beetles feed upon pollen, and doubtless the flies and parasitic hymenoptera are attracted by the nectar upon which they may feed.

Let us first consider the *Hymenoptera*. It will be noticed from the foregoing list that by far the most abundant visitors to these flowers were the small bees belonging to the *Halictidae* called "sweat bees," and the *Andrenidae*. These have long been known to be important agents in the transfer of pollen.

Of the 760 specimens collected on *Ribes oxyacanthoides*, 417, or more than half, were *Halictus* (*Chloralictus*) *sparsus* Robt. Other species important to the plant on account of their numbers were *Halictus fasciatus* Nyl. 26, *H. lerouxii* Lep. 30, *H.* (*Evylaeus*) *arcuatus* Robt. 19, *H.* (*Chloralictus*) *pilosus* Sm. 32, *Andrena vicina* Sm. 54, *A. nasoni* Robt. 13, and three species of *Halictus* (*Chloralictus*) which are probably new, represented respectively by 20, 31 and 14 specimens.

On the red currant we find some of the same species, but the proportions are entirely different. Here one of the new species of *Halictus* (*Chloralictus*) was the most abundant, and was represented by 13 specimens out of 58. *C. zephyrus* Sm. had 7 examples, while the other 26 species are each represented by less than 4 specimens.

Of 141 specimens taken from black currant, 81 were *Halictus* (*Chloralictus*) *sparsus* Robt., 19 *H.* (*Evylaeus*) *truncatus* Robt., 9 *H.* (*Chloralictus*) *zephyrus* Sm., 8 *H.* (*C.*) *pilosus* Sm., and 6 *H.* (*Evylaeus*) *arcuatus* Robt.

The undetermined *Prunus* was visited chiefly by *Andrena (Opandrena) bipunctata* Cress., 18 out of the 25 specimens of *Hymenoptera* being that species.

358 specimens of *Hymenoptera* were collected on *Prunus triloba,* the Japan plum, and 207, or about three-fifths, were *Halictus (Chloralictus) sparsus* Robt., 84 were *Andrena (Opandrena) bipunctata* Cress., 16 *Trachandrena crataegi* Robt., 10 *Andrena nasoni* Robt., 7 *Halictus (Evylaeus) arcuatus* Robt., and 5 *H. (E.) truncatus* Robt.

From *Prunus avium* 359 specimens of *Hymenoptera* contained 185 of *Halictus (Chloralictus) sparsus* Robt., 14 of *C. pilosus* Sm., 15 of *C. zephyrus* Sm., 14 of *Halictus (Evylaeus) arcuatus* Robt., 15 of *Andrena vicina* Sm., 14 of *A. nasoni* Robt. and 47 of *Andrena (Opandrena) bipunctata* Cress. There were also 7 specimens of each of three other species of *Halictus,* and 5 of the honey bee, *Apis mellifera* Linn.

Very few insects could be found on peach blossoms, and all that we captured belong to the *Hymenoptera.* Apparently insects do not visit the blossoms in such great numbers and swarm about the trees as is the case with apple, plum and cherry. Of the 12 specimens captured, 3 were *Halictus (Chloralictus) obscurus* Robt., and there were 2 specimens each of *H. (C.) sparsus* Robt. and *Andrena (Opandrena) bipunctata* Cress. One honey bee was taken.

Of 197 specimens collected from apple, 34 were *Osmia lignaria,* the commonest species. Honey bees were more abundant than on the other fruit flowers, 31 being taken. The next most abundant species was *Halictus (Chloralictus) sparsus* Robt., 30 specimens; *Xylocopa virginica* Dru., 15; *Andrena (Opandrena) bipunctata* Cress., 12; *Halictus (Chloralictus) zephyrus* Sm., 11; bumble bee, *Bombus consimilis* Cress., 7 Other species, making a total of 32, had each a lesser number of examples.

On pear flowers, 18 out of the 53 *Hymenoptera* specimens were *Andrena nasoni* Robt., 11 *A. (Opandrena) bipunctata* Cress., and there were not over 3 or 4 specimens of any other species. *Halictus (Chloralictus) sparsus* Robt., which was so abundant on gooseberry, Japan plum, sweet cherry and apple, was not taken at all from pear in 1904, but 3 examples were captured in 1905. No honey bees were taken.

The collection from quince flowers was made at New Haven and Branford wholly in 1905. Of 68 specimens, 18 were *Halictus (Chloralictus) sparsus* Robt., 9 were *H. fasciatus* Nyl., and of the other kinds not over 6 examples of a species were taken. This included 3 honey bees.

The 18 specimens of *Hymenoptera* from the blackberry contained a single honey bee, and 10 examples of *Andrena (Opandrena) bipunctata* Cress., which seems to be an important visitor.

The commonest insects collected from red raspberry were *Cerantina dupla* Say. and *Osmia pumila* Cress., 4 each. Not over 2 specimens each were taken of any of the other species, which were 13 in all.

From strawberry flowers 9 specimens were taken, 5 of which were *Halictus (Chloralictus) versatus* Robt., and 2 were *H. fasciatus* Nyl.

The collections from the flowers of the peach, blackberry, raspberry and strawberry are meager, and perhaps no general statements should be made regarding them. Nevertheless, they indicate the more important pollinating species for the particular localities where taken.

There is no doubt that some of the *Diptera* aid in pollinating the blossoms, for some species are so hairy that if they visit the flowers at all they are certain to carry away some pollen. Such species are *Scatophaga stercoraria* Linn., *Eristalis bastardi* Macq., *Phorbia fusciceps* Zett., and the few specimens representing the genera *Panzeria, Tridonta, Sarcophaga, Fucellia, Lucilia* and *Anthomyia;* but except the first and third, these were not sufficiently abundant to be considered as important. It is interesting to note that the commonest flies on these flowers, *Elachiptera costata* Loew., *Ceratopogon fusculus* Coq., *Chlorops assimilis* Macq., *Lonchoptera riparia* Meig. and *L. lutea* Panz., are not hairy, but smooth and shiny and not well fitted to carry pollen. The same is true of the species of *Nemapoda, Camptocladius, Tachydromia* and *Piophila* represented in these collections. The few beetles and bugs captured are hardly worth considering as carriers of pollen.

In other localities or in other seasons, the results of such collecting might be quite different. In 1904 there were fewer honey bees taken than in 1905, yet the small bees were effective pollinators. The trees and bushes bore a heavy crop of fruit. Rainy weather interfered somewhat with the transfer of pollen in 1905, and though the small fruits had a good crop, some of the tree fruits bore lightly.

With our knowledge of the habits of the insects collected, together with the conditions surrounding the localities where they were taken, it seems fair to assume that on account of their great numbers the small bees belonging to the *Halictidae* and the *Andrenidae* are more important agents in carrying pollen than has formerly been supposed, and in the vicinity of New Haven during the seasons of 1904 and 1905 were of far greater benefit in pollinating the flowers of the plants from which they were collected than were the honey bees.

ADDITIONAL MOSQUITO INVESTIGATIONS.

By W. E. Britton and H. L. Viereck.

In the Report for 1904, page 253, was published an account of the investigations regarding Connecticut mosquitoes and their breeding places. This report treats of mosquito conditions over the entire salt marsh area along the coast, and of the regions about Hartford, East Hartford, Middletown and Cheshire. During 1905 very little attention was given to mosquito work, but a swamp in Milford was visited by request, and the regions about Farmington, New Britain and Rockville were examined by Mr. Viereck in August. The season of 1905 was marked by a shortage in precipitation, especially during the last half of the summer; consequently at the time of Mr. Viereck's visits to these places nearly all pools were dry, and very little mosquito breeding was found.

Milford.

Letters were received regarding the swamp adjoining and just east of the cemetery and north of the railroad. This swamp was visited by Messrs. Britton and Viereck on August 10th, and the pools of the swamp were tested. Both *Anopheles* and *Culex* larvae were found, though not very abundant. The swamp should be cleaned up and drained or filled. The

former would probably be difficult or impossible on account of the topography of the region, but as the area is small, it would not be an expensive matter to fill about the edges, leaving, perhaps, a central pond to be stocked with fish.

While around this swamp we were literally covered with salt marsh mosquitoes (*Culex sollicitans*), which came from their hiding places in the brush of the swamp. These mosquitoes do not breed here, but probably came from the large salt marsh to the south of the village. Improving the swamp near the cemetery would not, therefore, greatly reduce the numbers of mosquitoes in the village, because they come chiefly from the salt marsh. But a place of this kind so near the village and cemetery should be put in the best sanitary condition.

Farmington.

The region between the railroad station and the village was examined August 18th. This area was found nearly free from breeding places, though it comprised a marshy section extending along a primary branch of the Farmington river, and a similar area imperfectly drained by a secondary branch of the same stream. In the latter marsh, tests were made in pools on the property of Mr. A. H. Hopson and in the field adjoining on the side toward the railroad station. *Anopheles* and *Culex* larvae were taken in the last two places mentioned, as many as six *Anopheles* being found in one ladleful of water. These larvae were taken to the laboratory, but *A. punctipennis* was the only species of *Anopheles* reared from the material. For this area better drainage should be provided, and this can be done at small expense.

Though tests were made in nearly all of the suspicious pools, no mosquito larvae were found in the marsh area along the branch of the Farmington river, but as the examination was made after a period of drought, it is quite possible that under other conditions mosquito breeding might occur in this area.

New Britain.

On the eighteenth of August the region about New Britain was examined for possible mosquito-breeding places. The local health officer was consulted, and stated that no complaints had been made about mosquitoes, and that the only possible breeding place of a serious character to be found in the vicinity would be the pond at the foot of Arch Street near the end of the car line. This pond is used for cutting ice in winter, and when examined consisted of little more than a mud flat with a stream running through the center. Near the stream was a small pool in the mud, but no mosquito larvae were found in it. From the appearance of this region it is probably never a serious breeding place.

Rockville.

On August 22d Mr. Viereck visited Rockville, but found not even an area that could be suspected of breeding mosquitoes. Though examined during a period of dry weather, the region seems to be well drained, and the report of the health officer for the past ten years indicates comparative freedom from malaria. The few cases that occur might easily have originated out of town.

Salt Marsh Mosquito at Middletown.

Mr. Walden captured an adult specimen of *Culex sollicitans* at Middletown, July 3d, near the summit of Round Hill. This locality is sixteen or seventeen miles from the coast as the bird flies, and this species of mosquito breeds only in the salt marshes. It is known to migrate inland in search of food, and in New Jersey goes as far as thirty miles, but we have never before taken the species in Connecticut except along the coast.

THE WOOLLY MAPLE LEAF SCALE.

Phenacoccus acericola King.

This insect was first studied at Peoria, Ill., by Miss E. A. Smith, who published an account of the species in the North American Entomologist for 1880, page 73, under the name of *Pseudococcus aceris* Geoff., supposing it to be identical with the European species. In most of the literature this insect has been recorded under that name. On further study it was found to be different from the European species, and was described and named by Mr. George B. King in 1902.*

* Canadian Entomologist, Vol. 34, p. 211.

It is now about five years since I first observed this insect on the maple street trees of New Haven, though the insect may have been present for a much longer time. It has now become quite a serious pest of the sugar maple in Connecticut towns and cities. I have seen it in many places in New Haven, Hartford, Bridgeport and South Norwalk.

On August 2d some maple leaves were sent by a New Haven seed firm with the statement that one of their customers brought them in and asked to know a remedy. The leaves came from a place on Humphrey Street, and were seriously infested with the woolly maple leaf scale. I visited the place immediately, and found a sugar maple of ten or twelve inches in trunk diameter, which was so thoroughly infested that scarcely a leaf was free from the white masses of wax. Many leaves had already dropped. The upper portion of the trunk was completely covered with the larvae. A leaf, showing larvae and waxy egg masses, and a piece of bark from the trunk, showing larvae and male pupae, all from this tree, are reproduced on Plate VII. Two other small trees near by were also infested, though less seriously.

Experiments in Destroying this Pest.

The owner feared that the trees would be killed, and wished to save them if possible. At that time I had not seen any definite advice regarding treatment, and I recommended that the trees be sprayed with ordinary kerosene emulsion. This was done on August 4th, and the mixture contained two gallons kerosene, one half pound common hard soap and one gallon of hot water as a stock solution, this being diluted nine times before using. A few days later I found that a few of the scales had been killed, but that most of them had not been injured by the spray. The owner informed me that the spraying did no good.

These trees were sprayed the second time, August 17th, using an emulsion containing more kerosene and made up with a soft naphtha soap without hot water. Two gallons kerosene, one pound soap, one gallon water, were the quantities used, the whole being diluted five times before applying. This time the trees were very thoroughly drenched, and the spray was directed against the lower sides of the leaves and upon the bark of the trunk and branches where the larvae were gathered in the crevices. Even with this emulsion containing more kerosene, and with the naptha soap, it was a somewhat difficult matter to moisten the egg-masses on account of the wax. The first spray striking a leaf rolls off in small drops, but if the nozzle is kept long enough in one place, the mass finally becomes soaked with the emulsion.

A few days after this treatment the trees were examined, and nearly all of the insects appeared to be dead. A few leaves only showed indications of having been injured slightly by the spray.

After making these tests, I ran across Professor Cooley's "Notes on Some Massachusetts *Coccidae*"* in which he states that in the cities of Springfield and Holyoke the authorities have found it necessary to adopt combative measures to control this insect. In Springfield the bark was scraped during the winter and treated with a concentrated whale oil soap solution applied with whitewash brushes. Although this seems to have killed most of the insects, yet at the end of the following summer they had multiplied so rapidly that the treatment was repeated the next winter.

The maples of Holyoke were sprayed with one pound of whale oil soap dissolved in one gallon of water in February, 1896, and for the next two years the insects were not sufficiently abundant to require further treatment.

Unquestionably the best remedial treatment is a winter spray of petroleum, whale oil soap, or some of the contact poisons which can be used in much more concentrated form than can be applied to the foliage. It is difficult to combat this insect with summer sprays. If kerosene emulsion contains much more than 15 per cent. of kerosene, there is danger of injuring the foliage, and if half this percentage of kerosene is employed it will not destroy the scale.

Description, Life History and Habits.

On the under sides of the leaves may be seen masses of white wax about one-fourth of an inch (6 to 7 mm.) in length and somewhat less in width (though varying greatly in size),

* Bureau of Entomology, U. S. Department of Agriculture, Bulletin 17 N. S., p. 61.

having a powdery and woolly appearance. In this mass we find the body of the living or dead female, and a large number of eggs. The adult female is light yellow in color, and is about 5 mm., or one-fifth of an inch long, bearing a number of spinnerets and short spines on the upper surface of the body. The antennae are 9-jointed, the last joint being the longest. The adult male has two wings, and is red in color.

Eggs are found throughout the waxy secretion, and are from 0.3 to 0.4 mm. in length and about half as wide, and light yellow in color.

The larvae when first hatched occupy the under surface of the leaf, though often found on both sides. The female is pale yellow, while the male larva is reddish yellow. When mature the males crawl about over the bark of the branches and trunk, and transform to pupae in the crevices of the rough bark, the adults emerging about two weeks later. The maturing females forsake the leaves and crawl about on the bark, mate with the males, and later return to the leaves and settle upon the under surface. Soon after, the secretion of white wax is commenced, and eggs are deposited in it, both forming a larger mass. Some of this wax often falls or is torn from the leaves by storms, and it adheres to anything coming in contact with it. The number of eggs ranges from 500 upward, and there are three generations each year, according to Dr. L. O. Howard,* who has published one of the most comprehensive accounts of this insect, from which I have gleaned many of the facts set forth in this paper.

At the approach of winter the larvae go to the bark of the branches and trunk, where they line the crevices with their waxy secretion, and remain therein during the winter, crawling about on warm days. They are usually most abundant on the upper portion of the trunk and around the base of the larger branches. The woolly egg-masses and male cocoons are shown on Plate VII.

Natural Enemies.

From material collected, we bred a number of Syrphid flies, and even found some of the larvae feeding upon the scales. Specimens of the adults were submitted to Mr. C. W.

* Insect Life, Vol. VII, p. 235, 1894.

Johnson, of the Boston Society of Natural History, who is a specialist in the *Diptera,* and were identified as *Baccha fascipennis* Wied. This fly is a slender species, with dark bands across the wings. It was sufficiently abundant to warrant us in believing it an important natural enemy of the scale.

The fly, however, was parasitized, and some of the pupae did not yield adult flies, but gave tiny hymenopterous parasites belonging to the genus *Terastichus.* Dr. Howard states that *Baccha fascipennis* Wied. was bred from material sent to him from Jamaica Plains, Mass., and that a species of *Pachyneuron* was reared from the puparium. Three species of lady beetles, *Hyperaspis signata, Anatis 15-punctata* and the twice-stabbed lady beetle, are recorded as feeding upon the woolly maple leaf scale in Illinois, and the first was found feeding on the scales received by the Bureau of Entomology from Massachusetts.* All three of these lady beetles occur in Connecticut.

THE WHITE-MARKED TUSSOCK MOTH.

Hemerocampa (Orgyia) leucostigma S. & A.

One of the serious defoliators of shade trees in towns and cities is the white-marked tussock moth, an insect which has done considerable damage during the year of 1905. Early in July I noticed a horsechestnut tree on Elm Street, New Haven, near the corner of York Street, which was being defoliated by the caterpillars, and I sent my assistant to collect material. Mr. Amrhyn, Superintendent of Parks, called upon us to examine an infested tree in Bay View Park, which Mr. Walden did on July 20th. A single chestnut had been wholly stripped of leaves by the caterpillars. The same day elm trees on Orange Street near the corner of Bradley Street were examined by Mr. Walden, attention having been called to these trees by Mr. Frank S. Platt. A large number of cocoons were present on the trunks and larger branches of the trees, and from most of these the moths had emerged. The females were laying eggs, and many white egg-masses could be seen. A photograph of one of the trees with egg-masses on the trunk is shown on Plate VIII. On July 26th, I was called to Hartford to look at some infested trees, and a similar state of affairs was

* Insect Life, Vol. VII, p. 235, 1894.

found. Large elm and poplar trees on North Main Street near the railroad tunnel were so attacked that they had been partially defoliated, and the trunks were literally covered with the cocoons and egg-masses. Egg-masses and cocoons were also received by mail from Hartford.

Later we saw evidences of the work of the insect through the eastern part of the city of New Haven, especially in Grand Avenue and State Street, where a number of elms had been defoliated. The authorities put men at work destroying the egg-masses on some of the worst infested trees along the city streets.

Life History and Habits.

There are two broods each year in Connecticut, and the insect passes the winter in the egg stage. The eggs hatch in May, and the young caterpillars begin to feed upon the under side of the leaves, eating at first only the green portion, and leaving the framework. As the caterpillars increase in size, they eat holes through the leaves, and when nearly full-grown are voracious feeders and devour the whole leaf except perhaps the largest veins. The larval stage lasts about five weeks, during which time the caterpillars molt or cast their skins five times. When nearly mature, the caterpillars have the habit of crawling considerable distances, and are able to go over the ground from one tree to another. Where numerous, they migrate from the defoliated trees, and may be seen crawling over fences, sidewalks or vehicles, and in this way other trees having no egg-masses become attacked.

The larva is very striking and handsome in appearance, of yellow color beneath, with grey stripes along the sides, and a black dorsal stripe between two narrow yellow ones. Along the sides on the grey and yellow stripes are a number of yellow tubercles, each bearing white hairs. Four tufts of white hair are borne on the back of the anterior end of the body, while on the posterior portion in the middle of the black dorsal stripe are two bright red tubercles without hairs. Head and dorsal front portion of first segment are bright coral red. On each side of the head is a pencil or tuft of long black hairs, and a larger tuft occurs on the posterior extremity. The legs and pro-legs are yellow.

The mature larva spins its cocoons about the first week in July, and with the silken threads mixes some of the long hairs of its own body, forming a grey cocoon, which is usually placed on the rough bark of the trunk or larger branches, though sometimes on the small twigs or leaves. The insect

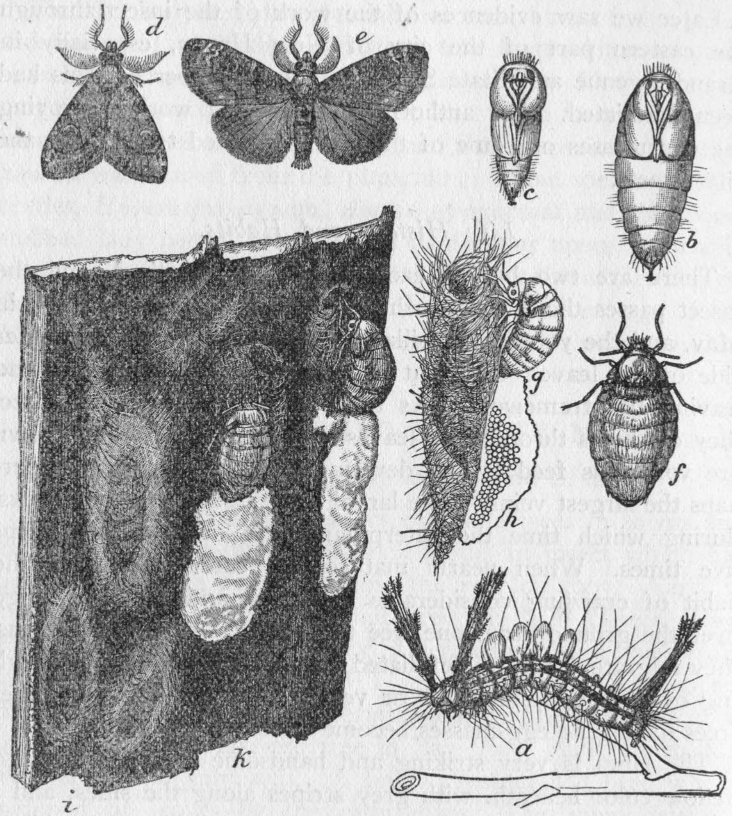


FIG. 1.—White-marked Tussock Moth. *a*, larva; *b*, female pupa; *c*, male pupa; *d*, *e*, male moth; *f*, female moth; *g*, female laying eggs; *h*, egg-mass; *i*, *k*, cocoons—all slightly enlarged. (After Howard, Bur. of Ent., U. S. Dept. of Agr.)

remains in the cocoon nearly two weeks, and as has already been mentioned in this paper, adults had emerged and many egg-masses had been laid on July 20th. The female is without wings, and greatly resembles the females of the canker worms though larger. She is about one-half or five-eighths of an inch long, and grey in color, and usually lays the egg-masses (containing from 75 to 200 eggs) on the empty cocoons. We often see the females hanging in this position on the old

cocoons and egg-masses long after they are dead. The male is a greyish brown moth having feathered antennae, and a wing expanse of about an inch. The adults, caterpillars, cocoons and egg-masses are shown in figure 1, and on Plates VIII and IX.

The eggs laid in July soon hatched, and we fed the caterpillars through August and into September, when they became full-grown and pupated, and adults emerged from some of the cocoons.

Poplars, elms, and soft maples seem to be the trees commonly attacked and injured, but the insect is known to feed upon nearly all kinds of fruit trees, and most of the forest and shade trees except conifers.

Remedies.

There are two chief methods of controlling this insect; (1) by poisoning the foliage, and (2) by destroying the eggs. For spraying, arsenate of lead (about 3 lbs. in 50 gallons of water) is probably the best poison to be used, and it should be sprayed upon the leaves in June in order to destroy the larvae of the first brood. As this poison adheres well to the foliage, it may not be necesssary to make more than one thorough application.

The destruction of the eggs is perhaps the most economical method of fighting the pest, and this can be accomplished in two ways: (1) by scraping off and burning the egg-masses, or (2) by treating them on the tree with something that will prevent their hatching. The former method is practiced in New York and some other large cities, where men are employed for the purpose, and become very expert in the use of a specially made tool, consisting of a small hoe blade mounted on the end of a long pole. By means of this tool many of the egg-masses can be reached from the ground and dislodged. If left upon the ground or not destroyed, the eggs will hatch, and they should be burned or treated with creosote oil or something that will prevent hatching. Kirkland advises the use of crude creosote oil for destroying the eggs. A sponge on the end of a long pole is dipped in the liquid and placed against the egg-masses. The oil is rather dark colored, and the white egg-masses are sufficiently discolored by it to show where treated. This was first used for killing gypsy moth eggs, which are yellowish brown in color, and 15 per cent. of coal tar was added to the oil to color the eggs so that the treated ones could be distinguished from those not treated.

Banding the trunks of unattacked trees will prevent the caterpillars from crawling up, but is of little use if eggs, larvae, or pupae are already in the tree.

THE MORE IMPORTANT COCCIDAE OR SCALE-INSECTS OF CONNECTICUT.*

The terms "scale," "scale-insect" and "bark-louse" are commonly used to designate insects belonging to the family Coccidae of the order Homoptera. The Homoptera are often included in the Hemiptera, to which belong the true bugs, aphids or plant-lice, and leaf-hoppers. These insects all suck their food, and many of them cause serious injury to cultivated plants. The Hemiptera have incomplete transformations, and the Coccidae are probably the most degraded of the Hemiptera. The males are said to have complete transformations, but possess only two wings in the adult state. Soon after birth the young crawl about for a few hours; otherwise the females are without means of locomotion except in a few species, and are attached to the bark or foliage of trees and plants, from which they suck out the sap for food. Some of our worst pests are scale-insects. The object of this paper is to illustrate and describe briefly the more important kinds occurring in Connecticut, so that people will be able to recognize them more readily and combat them more successfully.

As some of these insects secrete a substance which forms a shell or covering for protection, they are called armored scales. Other kinds not forming shells are known as unarmored or soft scales. Most of the unarmored scales secrete honey dew like the plant-lice.

The Latin names and arrangement of the following species are the same as given in Mrs. Fernald's Catalogue of the Coccidae of the World. The illustrations (Plates II–VI) are all original, and show the insects natural size except where otherwise indicated. Plate III, d, is from a drawing. All others are from photographs.

*A part of this paper was published in June as Bulletin 151. With some additions and changes it is here reproduced in different form.

Unarmored or Soft Scales.

1. **THE GREENHOUSE ORTHEZIA**—*Orthezia insignis* Dougl.

This insect is not fixed, but crawls about like the mealy bugs, and is shown on Plate II, e. Full-grown specimens are about 1.5 mm long. It attacks a great variety of greenhouse plants, Lantana and Coleus being favorites. The treatment used against mealy bugs, page 236, is advised against this insect. All breed continuously in greenhouses, and there are probably many generations each year.

2. **PIT-MAKING OAK SCALE**—*Asterolecanium variolosum* Ratz.

This scale is circular, usually greenish-yellow in color, and has a glassy appearance. It forms a pit or depression in the bark where it is situated, and it is about 2 mm in diameter. (See Plate III, a.) This species has been sent to the Station several times on English oak, *Quercus robur,* though it is known to attack other oaks. Kerosene emulsion and whale oil soap have been used as a spray with good results in destroying this insect.

3. **OAK GALL SCALE**—*Kermes galliformis* Riley.

A globular gall-like scale found on oak twigs. It is grey, about as high as long, and slightly broader than its length, which is about one-fourth of an inch. There is a longitudinal dorsal furrow or constriction. Shown on Plate VI, b.

4. *Kermes andrei* King.

Slightly smaller than the preceding, without constriction, light brown, shiny, with three or four dark brown transverse bands. This scale is also found on oak, but is not very common.

5. **ELM SCALE**—*Gossyparia spuria* Modeer.

A dark-colored oval scale margined by a white cottony fringe is not uncommon upon elm trees about New Haven. It seems to prefer small trees, but is sometimes found on the lower branches of medium-sized and large trees. The insect is about 3 mm long, brown or black surrounded by a fringe of white wax, and is shown on Plate III, c. The young are born alive, appearing about the middle of June in Connecticut, and settle along the veins of the leaves chiefly on the under sides. Later in the season they return to the larger branches and trunk, and occupy the crevices of the bark, where they remain through the winter. There is but one brood each year. Honey dew is given off profusely by the nearly mature females, and often drips upon the ground. The scales are readily destroyed at any time of the year by spraying with kerosene emulsion or soap and water.

6. WOOLLY MAPLE LEAF SCALE—*Phenacoccus acericola* King.

White powdery masses of wax 6 or 7 mm long are frequently seen on the under side of leaves of the sugar maple. The waxy mass contains the mature female (often dead) and a large number of eggs. This insect is shown on Plate VII, and a full account of it is given on page 226 of this report.

7. COMMON MEALY BUG—*Pseudococcus citri* Risso.

The mealy bug is a common pest of plants in greenhouses and dwellings and even out of doors in summer. Unlike most scales, the mealy bugs are not fixed to their food plants, but are able to move about, and they attack nearly all kinds of plants. The full-grown females are about 4 mm long and oval in shape. They are creamy or dirty white, and covered with a wax secretion which gives them a mealy appearance. They usually congregate in the crotches and at the axils of the leaves so as to be somewhat protected. The illustration, Plate II, d, shows them gathered along the mid-vein of a leaf. Spraying with soap and water or fir tree oil or dipping the plants in the mixture is the remedy, but hydrocyanic acid gas fumigation is doubtless the most satisfactory for greenhouses.

8. LONG SPINED MEALY BUG—*Pseudococcus longispinus* Targ.

Resembles the preceding, except that the adults bear filamentous appendages at the posterior end of the body. The species is well distributed.

9. COTTONY MAPLE SCALE—*Pulvinaria innumerabilis* Rathv.

This scale can be recognized during early summer by the large white egg-masses on the twigs. Nearly all maples as well as many other trees are attacked, but the insect seems to prefer the silver maple. It is not as yet a very serious pest in Connecticut, but in Chicago, Denver, and some other Western cities the maples are being seriously injured by it, and extensive spraying is practiced. There is one annual brood, with eggs laid in May and June, which hatch in July and August. The young first settles on the leaves. The males appear in early fall and mate with the females, which migrate to the twigs, where they remain through the winter. In the spring they increase rapidly in size, and soon deposit their egg-masses and shrivel and die. The brown female with white egg-mass protruding posteriorly is about 12 mm (½ inch) long, and is shown on Plate III, d. The species is abundantly attacked by insect parasites.

Kerosene emulsion is used as a remedy.

A closely allied species, *P. acericola* Walsh & Riley, is reported from New York and Massachusetts, and doubtless occurs here, but the writer has not observed it. It seems to be confined almost exclusively to the silver maple, and the egg-masses are laid on the leaves instead of the twigs. This requires two migrations,—from the leaves to the twigs in fall, and from twigs to the new leaves in spring. The females with egg-masses are about ½ inch long, the egg-mass tapering backward, with four longitudinal ridges.

10. SOFT SCALE—*Coccus hesperidum* Linn.

Much has been written about this scale, which was formerly placed in the genus *Lecanium*. It is an oval, slightly convex brown species commonly found on citrus trees, oleanders and many other plants in greenhouses. Females are viviparous, but the generations are not well marked. Soap and water or kerosene emulsion will readily destroy these scales at any season of the year.

11. APRICOT SCALE—*Eulecanium armeniacum* Craw.

During recent years this species has become common out of doors in Connecticut, and a wide range of plants are attacked.

We have observed it on plum, grape, chestnut, ash and rose. It is oval in shape, about 4 mm long, strongly convex, and light or dark brown in color. Plate IV, d, gives a good idea of its appearance. This scale is sufficiently abundant to cause considerable injury, and remedial measures must be taken against it. There is one brood annually, the eggs hatch about July 1st, and the scale winters in a partially grown condition. Spraying in winter with kerosene emulsion has been successful, but where orchards are treated with lime and sulphur washes for the San José scale, no other treatment need be given.

12. *Eulecanium canadense* Ckll.

A brown scale on elm twigs, collected in New Haven, June 10th, 1905, by Mr. Walden, proved to be this species. Externally it resembles *E. armeniacum,* and doubtless the same remedy will control it.

13. **NEW YORK PLUM SCALE**—*Eulecanium cerasifex* Fitch.

Plum twigs thoroughly infested with this scale were received from Berlin in 1904. Superficially it looks like *E. armeniacum,* which is shown on Plate IV, d. The writer has made no observations regarding its life history. Where it occurs the same treatment advised for *armeniacum* should be employed.

14. *Eulecanium kingii* Ckll.

A few specimens on sassafras were identified as this species by Mr. Geo. B. King. In appearance it closely resembles the three preceding species.

15. **TERRAPIN SCALE**—*Eulecanium nigrofasciatum* Perg.

The writer has several times collected this scale from the twigs of silver maple, a favorite food plant, which the scale often injures, though it is known to infest fruit and other trees. The females are smaller than in any other species of the genus mentioned in this paper. The adult female is of a reddish color spotted with dark red or black, 2 mm long, convex, with about twelve radiating ridges, most conspicuous near the margin. There is probably one brood each year, eggs being formed in May and hatching in July. (See Plate IV, e.)

16. **TULIP SCALE**—*Eulecanium tulipiferae* Cook.

This scale is becoming quite common on wild and cultivated tulip trees throughout the state. It is the largest of all the brown scales, the hemispherical females often reaching a diameter of 8 mm, or ⅓ of an inch. The male scales are much smaller and more elongated. The light grey pupa skins remain on the bark after the adult males have emerged. Both sexes are shown on Plate IV, f. Apparently there is but one brood each year, the viviparous females producing young about September 1st. They are partially grown when winter sets in. As a rule the lower branches are first attacked, and often killed, when those next higher will in turn become infested. Linden and magnolia are also attacked by this scale. Kerosene emulsion, and soap and water applied in the form of a spray, in autumn, are the common remedies.

17. **FERN SCALE**—*Saissetia filicum* Bdv.

A large brown scale resembling the hemispherical scale, but slightly shorter and more convex, and much less common. It has been an inhabitant of the Station greenhouses, where it seems to prefer the holly shield fern, *Cyrtomium falcatum.*

18. **HEMISPHERICAL SCALE**—*Saissetia hemisphaerica* Targ.

This is probably the most common of all the large brown scales found in greenhouses and dwellings. It has a long list of food plants, and may be expected to attack almost any kind of plant, but chiefly palms, ferns, *Cycas* and orchids. It is from 3 to 4 mm long, and reddish or dark brown in color. Specimens are found on both leaves and stems. (See Plate III, b.) It probably breeds continuously throughout the year. Kerosene emulsion, fir tree oil and soap and water can be used as sprays and greenhouses can be fumigated with hydrocyanic acid gas to destroy this insect.

ARMORED SCALES.

19. **WHITE ELM SCALE**—*Chionaspis americana* Johnson.

This scale, which attacks the twigs of the elm, closely resembles the scurfy scale, shown on Plate IV, c. It is not very abundant in Connecticut.

20. *Chionaspis corni* Cooley.

The females are pear-shaped, males are small and with sides parallel. Both sexes are white, and closely resemble the scurfy scale, to which the species is closely related. It occurs commonly on wild dogwood, *Cornus candidissima*. The life history is probably similar to that of the scurfy scale.

21. **EUONYMUS SCALE**—*Chionaspis euonymi* Comst.

This species was recently sent to the writer from Hartford, where it was abundant on *Euonymus radicans* along a brick wall. The wall was covered with canvas, and the plants fumigated with hydrocyanic gas.

The euonymus scale resembles the scurfy scale, but the females are somewhat smaller and darker in color. It passes the winter in the egg stage, and the different species of *Euonymus* and the orange are attacked. It is shown on Plate II, b.

22. **SCURFY SCALE**—*Chionaspis furfura* Fitch.

The female shell is broadly pyriform, 3 mm in length, and white or light grey. See Plate IV, c. The male is much smaller, white, with sides parallel, and three ridges along the back. A single brood is formed each year, and the winter is passed in the egg stage. These eggs are oval in shape, purple in color, and hatch between May 20th and June 1st. Spraying with soap and water or kerosene emulsion soon after the eggs hatch will readily destroy the young. For a more complete history of this insect the reader is referred to Bulletin No. 143, or the Report of this Station for 1903, page 227.

23. **PINE LEAF SCALE**—*Chionaspis pinifoliae* Fitch.

Resembles the preceding, but is attached to the leaves or "needles" of the pine, spruce and other coniferous trees. It has been collected at South Manchester on *Pinus mughus* and at Hartford on white pine. There are two broods each year, and the winter is passed in the egg stage. See Plate II, c.

24. *Diaspis boisduvalii* Sign.

This scale, found on palms and various greenhouse plants, resembles the rose scale. The female is large, nearly circular, with the exuvium not in the center. The male is long and narrow, and both sexes are nearly white.

25. **ROSE SCALE**—*Aulacaspis rosae* Bouché.

A large white scale is sometimes seen on rosebushes, raspberry or blackberry canes, especially where growing in crowded rows or clumps. The female is nearly circular, 2.5 mm in diameter, and is shown on Plate V, a. The male is much smaller, long and narrow, with three parallel ridges running lengthwise of the shell. Professor John B. Smith of New Jersey finds that all stages from the egg to the mature female occur at the same time during the winter and throughout the season. Probably there are but three complete broods, but these overlap so that breeding is almost continuous.

As all stages of the insect occur at the same time remedial treatment is somewhat difficult, as the eggs are usually not killed by sprays, and sometimes survive even fumigation. The worst infested canes should be cut out and burned. Kerosene emulsion or soap and water should be used as a summer spray, and the lime and sulphur mixture may be applied to the dormant plants in winter.

26. *Epidaspis piricola* Del Guer.

A circular scale occurring under the edges of rough bark and covered with extraneous matter so as to be very inconspicuous. Found on pear twigs from New London.

27. **HEMLOCK LEAF SCALE**—*Aspidiotus abietis* Schr.

This species was found on hemlock at Norwalk. It is a small circular or elongated brown scale, and is sometimes found upon pine or fir.

28. **PUTNAM'S SCALE**—*Aspidiotus ancylus* Putnam.

This is a small circular scale, 2 mm in diameter, which occurs throughout the state on fruit trees, but perhaps most frequently upon currants, often killing the second year canes or shoots. The shells of this scale are usually not as nearly circular as the San José scale, but it is often difficult to distinguish them in the field. Apparently there is but one brood each year.

29. *Aspidiotus cyanophylli* Sign.

This is a small light colored circular scale often found infesting palms and orchids in greenhouses. Specimens in the Station collection were taken at New Haven, January 9th, 1904.

30. **CHERRY SCALE**—*Aspidiotus forbesi* Johnson.

This scale closely resembles the preceding, and though not so widely distributed, has been found upon fruit trees in Connecticut. It should be regarded as a serious enemy, and treated in the same way as the San José scale.

31. **WHITE SCALE; OLEANDER SCALE**—*Aspidiotus hederae* Vall.

This scale is a pest of greenhouses, where it attacks oleander, croton, ivy, palms, camellia and many other plants. It is nearly circular in shape, and white or light grey in color, making it conspicuous on the green leaves and stems. (See Plate II, a.) It probably breeds continuously in greenhouses. Fumigating the house with hydrocyanic acid gas, spraying the infested plants with either whale oil or common soap (1 lb. in 8 gallons of water) are the remedies for this scale.

32. **EUROPEAN FRUIT SCALE**—*Aspidiotus ostraeformis* Curtis.

This scale is not known to be established in Connecticut, but will doubtless become so, as it has been found on nursery trees sent into the state. It looks very much like the cherry, Putnam's, and San José scales, and can be distinguished from them only by means of the compound microscope. In fact these four species resemble each other so closely that the fruit grower cannot distinguish between them unless he is an entomologist. The European fruit scale attacks all kinds of orchard trees, and there is probably a single brood each year.

33. **SAN JOSE SCALE**—*Aspidiotus perniciosus* Comst.

This is a circular scale, light or dark grey in color, with concentric markings and a nipple in the center, which is usually darker in color than the surrounding portion of the shell. The winter is passed in a half-grown condition, and there are no

eggs. The breeding season begins soon after June 20 and ends about December 1 in Connecticut, three or four broods appearing in a season. For a full account of its life history and spread, see Bulletin No. 135 of this Station.

This scale is the worst pest of the fruit grower in Connecticut, and attacks all kinds of fruit trees, except the sour cherry (*Prunus cerasus*), and many kinds of shade trees and ornamental shrubs are attacked and sometimes killed. A list of trees and plants, showing their susceptibility to attack by this scale, was published in the Report of this Station for 1902, page 130. A thorough spraying in the fall after the leaves drop, or in the spring just before the buds start, using a lime and sulphur mixture, seems to be the best remedy for Connecticut. This mixture is usually prepared by boiling together 20 pounds quicklime and 14 pounds sulphur for 45 to 60 minutes in enough water to keep it a liquid. After boiling, water should be added to make 40 gallons, and the whole applied at once. Satisfactory mixtures can be made without boiling by using potassium or sodium sulphide, caustic soda or sal soda to aid in dissolving the sulphur. Some of these mixtures and the proper outfit for spraying are described in Bulletin No. 146, and reproduced in the Report of this Station for 1904, pages 240-252.

The illustration of the San José scale on Plate IV, a, will serve to show the appearance of the other kinds which so closely resemble it. All can be combated in the same way, viz: by spraying the dormant orchard trees with the lime and sulphur mixture, and by fumigating nursery stock with hydrocyanic acid gas.

34. **ELM ASPIDIOTUS**—*Aspidiotus ulmi* Johnson.

This is a small circular scale resembling the preceding, which is found on the smooth or inner bark in the crevices of the rough bark of the trunks and larger branches of elm trees. It seems to do very little damage, but may be found on most of the elm trees of New Haven, and doubtless occurs throughout the state.

35. **CIRCULAR SCALE: FIG SCALE**—*Chrysomphalus aonidum* Linn. (*ficus* Ash.).

Rubber plant, orange, palms, camellias and oleander in greenhouses are often infested by a round dark-colored scale which stands out prominently from the surface of the leaves. In fact it is almost conical in shape, reddish brown or nearly black, with an orange apex, and is shown on Plate V, b. Presumably it continues to breed throughout the year under glass, and continued spraying is necessary to keep it in check.

36. **RED ORANGE SCALE**—*Chrysomphalus aurantii* Mask.

A light grey or brown circular scale about 2 mm in diameter occurring on oranges and lemons in the markets and sometimes infesting citrus trees and palms in greenhouses. The scale is somewhat translucent, showing the reddish insect beneath. The female is reniform in shape. This scale causes much injury in the orange groves of California, and also occurs in Florida.

37. **MORGAN'S SCALE**—*Chrysomphalus dictyospermi* Morg.

This species is a serious pest of palms at Pierson's large commercial greenhouses, Cromwell, and it has also been taken in private plant houses in other parts of the state. It is of about the same color as the preceding species, but is flatter, and projects only slightly from the leaf. Mr. H. E. Hodgkiss studied this scale at the Massachusetts Agricultural College, and found that several generations are produced each year, but these overlap so as to become indistinct. The females bring forth living young, are parthenogenetic, and males are unknown. Fumigating the house with hydrocyanic acid gas, using 7.5 grams potassium cyanide for each 100 cubic feet of space, for forty minutes, after dark, with the plants free from moisture, is the treatment advised by Mr. Hodgkiss after making many experiments. It is probably a safe remedy for nearly all of the greenhouse scales. This species is shown on Plate VI, a.

38. **PURPLE SCALE**—*Lepidosaphes beckii* Newn.
(formerly known as *Mytilaspis citricola* Packard).

An elongated scale very commonly noticed on oranges and lemons in the markets. It has been sent to the station by correspondents, who took it to be the San José scale. It resembles the oyster shell scale, to which it is closely related, and is said to be one of the commonest orange scales in Florida. It is also found in California.

39. **OYSTER SHELL SCALE**—*Lepidosaphes ulmi* Linn.
(formerly *Mytilaspis pomorum* Bouché).

One of the most common and widely distributed of all coccids. It is a pest of fruit trees, especially apple, and many young sprouts and seedlings of birch, poplar, willow, ash and butternut are killed by it each year. Lilac is also infested. There is but one brood annually, and the insect winters in the form of oval white eggs under the female shells. The eggs hatch in Connecticut about the first of June, the young crawl for a few hours, then settle upon the bark and form shells, becoming mature in September. Eggs are laid about the first of October, and the females die. The female scale (or shell), is from 2 to 3 mm long, about the same color as the bark upon which it rests, elongated pyriform in shape, and more or less curved. It is shown on Plate IV, b. Male shells are much smaller and less curved than those of the female. The adult male has two wings, and is seldom seen. Spraying with kerosene emulsion or soap and water soon after the eggs hatch will hold this scale in check. For a more complete account see Bulletin 143, or the Report of this Station for 1903, page 229.

40. **THREAD SCALE**—*Ischnaspis longirostris* Sign.

This is a long narrow black scale attacking palms, pandanus and many other plants in greenhouses. It has been taken in Connecticut only at one greenhouse in New Haven, where it was quite abundant. Little is known of its life history, and the male is unknown. The female shell is from 2 to 3 mm long, and about eight times as long as broad, and more or less curved. (See Plate V, c.) The writer has had no experience in combating this scale, but the same treatment used for other greenhouse scales will doubtless hold it in check.

41. **CHAFF SCALE**—*Parlatoria pergandii* Comst.

This is common on various greenhouse plants, especially orange and lemon. It is oval in shape, with the molted skin at one end, and is light yellow in color. It is usually found in clusters. The common sprays used for greenhouse scales seem to be effective against this species.

THE GYPSY MOTH IN CONNECTICUT.

Ever since the gypsy moth became prevalent in Massachusetts it has seemed probable that the pest might at any time invade Connecticut. We have therefore been on the watch for it, though no systematic inspection has been made of the regions where the pest would be most liable to occur. Several times during the past five years reports of the presence in Connecticut of the gypsy moth or the brown tail moth have been brought to my attention, but investigation proved that some other insect was the cause of alarm in each case.

In compiling a list of Connecticut insects during the winter, I have corresponded with local collectors whose names appear in the Entomologists' Directory, in order to obtain records of their captures. On February 27th I received a letter from Mr. Ernst Frensch of Mystic, a collector of Lepidoptera, with records of some of the rarer species which he had taken, and this list included *Porthetria dispar* Linn., the gypsy moth. Mr. Frensch closed his letter with this sentence;—"Probably it will be new to you that *Porthetria dispar* has reached the town of Stonington."

I wrote at once, making an appointment with Mr. Frensch, and visited him at his home Tuesday, March 6th. He showed me a female which he had found on an apple tree in the yard of his brother, Karl Frensch, near the railroad, and not far from the velvet mill in Stonington. This specimen was taken July 30th, 1905, and is now in the Station collection. The attention of Mr. Frensch was first attracted by two males flying about in the tree, but as he did not have a net he could not catch them. On looking closer he found the female resting on the bark, and he put her in his cyanide jar. I was shown an egg-mass on the under side at the base of a large branch of a Norway maple growing in the yard. This was removed, and later put in a cyanide bottle to kill the eggs. Mr. Frensch also showed me an egg-mass which he found on a small twig in the brush-covered area close to the velvet mill. He suspected these to be gypsy moth eggs, but to make sure, he cut off the body of the female moth, and obtaining the eggs therein, compared them with those on the twig, and found them identical in size, shape and general appearance.

Mr. Karl Frensch also collected one female gypsy moth during the summer, and this was still in his cyanide jar at the time of my visit. The Frensch brothers have both collected insects, and Ernst has a good collection of butterflies and moths. He recognized the gypsy moth because he had been familiar with it in Germany.

On March 11th I again visited the place in company with my assistant, Mr. B. H. Walden, and we looked about the trees in the yard where the specimens were taken, but found no more fresh egg-masses. I found an old egg-mass on a pear tree in the adjoining yard. The eggs undoubtedly hatched last spring, and may have been the source of the entire infestation. I had telephoned on my arrival to Col. James F. Brown of North Stonington, Secretary of the State Board of Agriculture, and he joined us in the afternoon. In company with Mr. Karl Frensch we examined the brush-covered area just north of and close by the velvet mill. Here we found seven fresh egg-masses, which were immediately placed in cyanide bottles to kill the eggs. Rain and lack of time prevented an inspection of the whole area. As we passed through the streets of the village we watched for egg-masses on the trunks of the trees. Tussock moth eggs were abundant, but we did not see any gypsy moth eggs.

At the time of writing this report, the infested region seems to be a small one, restricted to the immediate vicinity of the velvet mill, but is being examined by a trained inspector who has had a long experience in this work in Massachusetts. Every effort will be made to stamp out the pest, and this may be possible if the insect has not already spread over a large area.

Outbreak and Distribution.

An outbreak of the gypsy moth in Eastern Massachusetts was met by an appropriation by the Legislature of that state for the purpose of suppressing the insect. Exterminative work was commenced in 1890 and kept up for ten years, when it was discontinued. During this period over $1,000,000 was expended and the insect was so far checked that it was doing little damage in 1900. In 1905 the pest had spread over so much territory and had become so troublesome that the commonwealth again took the matter in hand, and is endeavoring to control the insect under the superintendence of Mr. A. H. Kirkland, an appropriation of $300,000 being available to carry on the work until May, 1907.

At the present time the insect is found throughout the eastern portion of Massachusetts, southeastern New Hampshire, and a region in and about Providence, R. I., is known to have been infested for two years or more. It has recently been found in Stonington, Connecticut.

Life History and Injury.

The eggs are laid usually on the trunks and branches of trees, but sometimes on fences, buildings, etc., in July and August, in oval masses each containing about 500 eggs and covered with hair as shown in Figure 2 and on Plate X.

FIG. 2. Egg-mass of Gypsy moth on bark, natural size.

The eggs hatch about May 1st, and the young caterpillars soon begin to feed upon the expanding foliage, devouring all kinds of vegetation, even defoliating coniferous trees. All the damage is done in this stage. As the caterpillars approach maturity, they feed mostly at night, and seek shelter during the day on the shady side of the trunks, under fence rails, stones and rubbish, where they may often be found in large numbers.

When full-grown, the caterpillar is between two and three inches long, dark brown, with a pair of blue spots on each of the first five segments, and the same number of red spots on

each of the other six segments, making two rows of spots along the back; it is covered with long hairs, as is shown in Figure 3. The caterpillar usually reaches full size in July, and transforms to a pupa or chrysalis, usually spinning a few threads about itself, and is shown in Figure 4 and on Plate X. During the latter half of July the adult moths emerge, mate, and the females lay eggs. The brown male has a wing expanse of one and one-half inches, and flies about in the daytime in

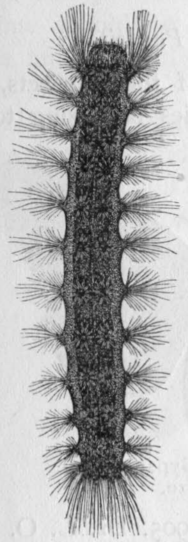


FIG. 3. Gypsy caterpillar, natural size.

FIG. 4. Chrysalis or pupa of Gypsy moth. Natural size.

a zigzag course. The female has a heavy body, and does not fly far, though furnished with wings which expand about two inches, and which are nearly white, with delicate black markings. See Figure 5. The male is shown in Figure 6. There is but one brood each season.

Means of Distribution.

As the caterpillars crawl about in going from one tree to another, they are very apt to invade freight cars on the siding, and be carried to other places. When young they have the habit of spinning down on slender threads from their food, trees, and may thus drop on carriages, automobiles or railroad cars, and be carried long distances into a part of the country heretofore uninfested.

Natural Enemies.

There are several species of parasitic Hymenoptera, Diptera and predaceous insects that attack both the gypsy and brown-tail moths in Massachusetts, and they are also devoured by birds, toads, and other insectivorous animals. But all of these working together do not control the pests.

Importation of Parasites.

In Europe, the native home of these insects, there are a larger number of parasitic enemies belonging to species not

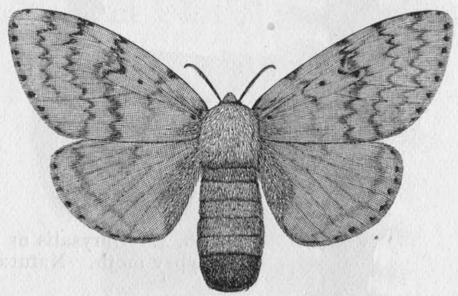


FIG. 5. Female Gypsy moth, natural size.

found in this country. During 1905, Dr. L. O. Howard, the Government Entomologist, in coöperation with the Massachusetts authorities, collected in Europe some of the parasites of the gypsy and brown-tail moths, and sent them to Massachusetts, where they will be reared and finally distributed in the infested region. Of course these parasites may not be able to thrive, or even to live, in this country, but it is an experiment worth trying, and we certainly hope for much benefit from it.

Remedial Measures.

One of the most effective means of controlling the gypsy moth is by destroying the egg-masses on the trunks and branches of trees, on fences, stones, or wherever they occur. A sponge, brush or swab is dipped in creosote mixture, and the egg-masses are saturated with it. A long pole can be

used to reach the egg-masses, but it is often necessary for men to climb about in the trees in order to reach them. Where brush land is badly infested, it is often best to cut and burn the brush between August and May to destroy the eggs. Spraying the foliage with arsenate of lead, using 5 pounds to 50 gallons of water, will of course save the trees from injury for the season. This poison adheres to the tree for a long time, and will not injure the leaves. Paris green can be used at the rate of one pound in 100 gallons of water, but two pounds of lime should be added to prevent injury to the foliage. This mixture will not adhere to the leaves as well as arsenate of lead.

The caterpillars can be gathered and destroyed while resting on the tree trunks or hiding under rubbish during the day. The chrysalids or pupae will be found in similar places, and can also be destroyed by heat or by crushing.

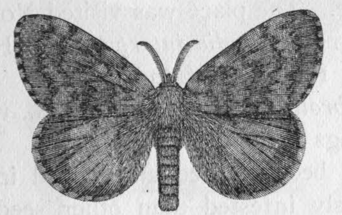


FIG. 6. Male Gypsy moth, natural size.

Coöperation Desired.

It is earnestly requested that any suspected eggs, caterpillars or adults be called to the attention of the State Entomologist, in order that he may identify them. He will investigate any locality suspected of being infested with either the gypsy or brown-tail moths, and every possible means will be taken to eradicate them if found. This is a matter so serious as to be exceedingly important, and the coöperation of every one is needed and desired.

DO NOT SEND LIVING INSECTS.

It is against the United States laws to send living insects by mail, and violations of the law are punishable by a heavy fine and imprisonment. Moreover it would be dangerous to send such pests as the gypsy or brown-tail moths in any stage of their existence, if alive.

All insect specimens should therefore be killed before sending them to be identified.

Eggs, pupæ and larvæ can be killed by dropping them into a jar of alcohol, benzine or gasoline and leaving them for a few hours. When removed the liquid evaporates and they are in good shape for identification. Beetles, bugs and scale insects can be treated in the same way. Moths and butterflies may be killed by the fumes of cyanide, chloroform, ether, carbon bisulphide, or they may be submerged in gasoline or benzine, which kills them quickly without injuring them for the purpose of identification. They should be packed in a tin, wood or strong pasteboard box which will not be crushed in transit.

RAVAGES OF THE INDIAN MEAL MOTH IN A SEED WAREHOUSE.

In November I learned that one of the large seed warehouses of Connecticut was infested with some insect that was causing considerable damage to corn, peas, lettuce and other seeds stored there. The place was visited November 17th, and the Indian meal moth, *Plodia interpunctella* Hubn., was found to be responsible for most of the damage. A few larvae of the cadelle, *Tenebroides mauritanicus* Linn., were also present, feeding in the bags of corn.

The seeds had been cleaned and stored in bags, and corn was more seriously infested than other seeds. Larvae were very abundant on the outside of some of the bags, where they had made a covering of their webs, which could be peeled off in large sheets. One of these webs with larvae is shown on Plate XI, b. The kernels of corn next to the bag were infested as shown in the illustration on Plate XI, a, but these were fastened to the bag by the web so that on emptying a bag several pounds of corn adhered to the bag. Some larvae were found in the center of the bag, but most of them were near the outside.

One room, partitioned off in the storehouse, seemed to be fairly tight, measured 16 × 30 feet and 9 feet high and contained 4,320 cubic feet. Some of the worst infested bags of corn were moved into this room, which was fumigated with hydrocyanic acid gas. Materials used were as follows:

Potassium cyanide	2¾ lbs.	
Sulphuric acid	5½ "	
Water	11 "	(5½ qts.)

The acid was placed in a stone china wash bowl, and properly diluted with the water. About 5 P. M. the cyanide was added and the room closed and remained so until November 20th, when its was opened up and aired. At first the owner thought that all of the larvae were dead. After a few hours, however, larvae were crawling about on the outside of the bags, having emerged from within, where the gas did not reach them. The webs on the outside of the bags doubtless prevented the gas from penetrating the bags, though it is doubtful if this gas would penetrate the grain to any great distance if the webs were absent.

The Indian meal moth is often a pest of dwellings, stores and warehouses, feeding upon all kinds of vegetable foods and products, and breeding throughout the year in heated

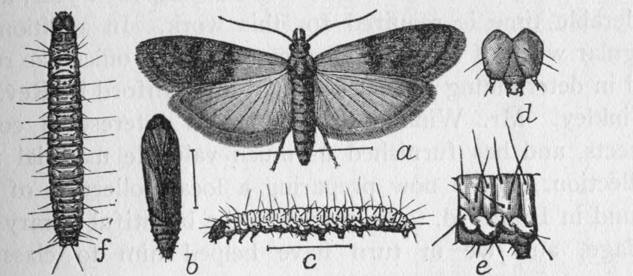


FIG. 7. Indian meal moth. *a*, adult; *b*, pupa; *c*, larva, side view; *d*, head of larva, front view; *e*, first abdominal segment of larva; *f*, larva, dorsal view—all greatly enlarged. (After Chittenden, Bur. of Ent., U. S. Dept. of Agriculture.)

buildings. From four to five weeks are required for the production of a brood. The eggs are small and white, and are laid in groups, each group containing from three to twelve eggs. As many as 350 may be laid by a single female. The caterpillars as they feed and travel spin a silken thread joining together the particles of food and their excrement. This habit renders worthless considerable material which, though infested, has not been devoured by them. They transform to chrysalids in small silken cocoon-like webs, and from these the adult moths emerge. The moth is light brown, with the outer half of each front wing dark brown. It has a wing-spread of from one-half to three-fourths of an inch. It is closely related to the common clothes moth, which it resembles except that it is much darker in color. The larva, pupa and adult are shown in Figure 7.

The best and cheapest remedial treatment is to place the loose seeds or grain in a tight bin and fumigate with carbon bisulphide, using about one pound of the liquid for each one hundred bushels, and placing it in a shallow dish on the top of the grain. It vaporizes quickly, and being a heavy gas, penetrates readily to the bottom of the bin. No fire should be brought where bisulphide is used, for the vapor is very explosive.

IDENTIFICATION OF INSECTS.

The identification of insects for correspondents, fruit growers, farmers, and others, is increasing each year, and considerable time is required for this work. In addition to the regular work of this sort, the entomologist's office has rendered aid in determining species collected in Branford by Rev. H. W. Winkley. Mr. Winkley has taken an interest in collecting insects, and has furnished us much valuable material for our collection. He is now preparing a local collection of species found in Branford, to be placed in the beautiful library in that village, and we in turn have helped him to classify his specimens.

Aside from Mr. Winkley's material, 174 samples have been received for identification during the year. For the determination of some of the species I am indebted to the Bureau of Entomology at Washington. A classified list of those which could be determined is here given.

INSECTS RECEIVED FOR IDENTIFICATION DURING 1905.

ORTHOPTERA.		
Ischnoptera pennsylvanica DeG.	Cockroach	Mt. Carmel.
Spharagemon saxatile Morse		Mt. Carmel.
Scudderia curvicauda DeG.		Hartford.
Ceutophilus grandis Scudd.	Camel Cricket	Mt. Carmel.
HEMIPTERA.		
Hæmatopinus vituli Linn.	Long-nosed ox louse	Lower Canada.
Cicada canicularis Harr.		New Haven.
Enchenopa binotata Say.		Middletown.
Phylloxera vastatrix Planch.	Grape phylloxera	Noroton.
Chermaphis abietis Linn.	Spruce gall louse	New Haven.
Pemphigus acerfolii Riley		Hartford.
Schizoneura americana Riley		Hartford.
Schizoneura pinicola Thos.		Middletown.
Schizoneura sp.		Greenwich.
Lachnus strobi (?) Fitch		Waterbury.
Callipterus betulæcolens Fitch		Hartford.
Aphis gossypii Glover (?)		Suffield.
Aphis pomi DeG.	3 samples	Farmington, Middletown, Guilford.
Myzus rosarum Walker (?)		Simsbury.
Nectarophora rudbeckiæ Fitch		Concord, Mass.
Aleyrodes vaporariorum Westw.	White fly, 2 samples	New Haven, Hartford.
Orthezia insignis Dougl.	The greenhouse orthezia	Hartford.
Asterolecanium pustulans Ckll.		Nicaragua.
Lecaniodiaspis rugosus Hemp. (?)		Nicaragua.
Phenacoccus acericola King	Woolly maple leaf scale, 3 samples	New Haven, Westport.
Pulvinaria innumerabilis Rathv.	Cottony maple scale	Norwich.
Pulvinaria sp		Black Hall.
Eulecanium probably *armeniacum* Craw.	Apricot scale, 3 samples	New Haven, Stamford.
Eulecanium nigrofasciatum Perg	Terrapin scale	Forestville.
Eulecanium tulipiferae Cook		Columbia.

Insects Received for Identification during 1905—*Continued.*

Chionaspis euonymi Comst.	Euonymus scale	Hartford.
Chionaspis furfura Fitch	Scurfy scale, 11 samples	From Woodbridge, Danbury, Brooklyn, Enfield, Newington, South Coventry, Montowese, New Haven, Norfolk, Meriden, Clinton.
Chionaspis pinifoliae Fitch	Pine leaf scale	Hartford.
Aulacaspis rosae	Rose scale, 2 samples	From Yalesville, Simsbury.
Aspidiotus hederae Vallot	White, or oleander scale	Hartford.
Aspidiotus perniciosus Comst.	San José scale, 31 samples	From New Haven, Greenwich, Farmington, Rockville, Branford, Woodbridge, Hartford, Stamford, Seymour, Danbury, North Stonington; West Dover, Ohio; Bridgeport, Lyme, Montowese, Meriden, Union City, Southport.
Lepidosaphes ulmi Linn.	Oyster shell scale, 11 samples	From Lyme, Woodbridge, Branford, Guilford, Danbury, North Sterling, New Haven, Montowese, Bethlehem.
Euschistus variolarius Beauv.		Southington.
Lopidea confluens Say.		New Haven.
Calocoris rapidus Say.		Bridgeport.
Lygus pratensis Linn.	Tarnished plant bug	Bridgeport.
Poecilocapsus lineatus Fab.	Four-lined leaf bug	Westport.
Belostoma americana Leidy	2 samples	New Haven, Greenwich.
	Neuroptera.	
Corydalis cornutus Linn.	Hellgrammite	Canada.
Chrysopa oculata Say.	Lace wing	Bridgeport.
Colobopterus excisus Hagen		Savin Rock.
	Lepidoptera.	
Tineola bisselliella Hummel	Clothes moth	New Haven.
Lithocolletes hamadryella Clem.	Oak leaf miner	Hartford.
Bucculatrix pomifoliella Clem.	Apple bucculatrix	Meriden.
Plodia interpunctella Hubn.	Indian meal moth	Canaan.

Insects Received for Identification during 1905—*Continued.*

Prionoxystus robiniae Peck	Carpenter worm	South Manchester.
Phobetron pithecium S. & A.	Hag moth	New Haven.
Sibine stimulea Clem.	Saddle-back caterpillar	Bridgeport.
Hemerocampa leucostigma S. & A.	White-marked tussock moth	Hartford.
Schizura concinna S. & A.	Red-humped caterpillar	Hartford.
Datana integerrima G. & R.	Walnut caterpillar	Middletown,
Datana ministra Drury	Yellow-necked caterpillar	New Haven.
Melalopha inclusa Hubn.		Greenwich.
Apatelodes torrefacta S. & A.		New Haven.
Tarache erastrioides Guen.		Bridgeport.
Euthisanotia sp (?)		Boston, Mass.
Papaipema nitela Guen.	Stalk borer	Branford.
Heliophila pseudargyria Guen.	False army worm	New Haven.
Mamestra picta Harr.	Zebra caterpillar, 2 samples	Whigville, New Haven.
Diacrisia virginica Fabr.	Virgin moth	New Haven.
Hyphantria cunea Dru.	Fall webworm	Hartford.
Ecpantheria deflorata Fabr.	Great leopard moth	New Haven.
Anisota senatoria S. & A.	Senator moth; Orange-striped oak worm	New Haven, Hartford.
Telea polyphemus Cram.	American silk worm, 2 samples	Westville.
Samia cecropia Linn.	Cecropia moth, 2 samples	West Hartford, Bridgeport
Ceratomia undulosa Walk.		Hartford.
Vanessa antiopa Linn.	Mourning cloak butterfly; spiny elm caterpillar	Phoenixville.
	Diptera.	
Chironomus sp.		New Haven.
Lasioptera vitis O. S.		New Haven.
Tabanus atrātus Forst.	Black horse fly	Hartford.
	Siphonaptera.	
Pulex serraticeps	Cat and dog flea	Oakville.

Insects Received for Identification during 1905—*Concluded*.

Coleoptera.		
Scolytus rugulosus Ratz.	Fruit bark beetle	Wilton.
Xyleborus caelatus Eich		North Carolina.
Pissodes strobi Peck	White pine weevil	New Haven.
Epicauta vittata Fabr.	Striped blister beetle	Shelton.
Coptocycla aurichalcea Fabr.	Gold beetle	Boston, Mass.
Epitrix cucumeris Harr.	Cucumber flea beetle	Bridgeport.
Galerucella luteola Müll.	Elm leaf beetle	New Haven.
Saperda candida Fabr.	Round-headed apple borer	Yalesville.
Prionus laticollis Dru.	Broad-necked Prionus	New Haven.
Orthosoma brunneum Forst.	Lesser Prionus	South Manchester.
Parandra brunnea Fabr.		South Manchester.
Osmoderma scabra Beauv.		Hartford.
Lachnosterna fraterna Harr.	June beetle	Hartford.
Macrodactylus subspinosus Fabr.	Rose chafer	Westport.
Lasioderma testaceum Dufts.	Cigarette beetle, 2 samples	New Haven.
Phengodes laticollis Lec. (?)		Salem.
Byturus unicolor Say.		Mystic.
Chilocorus bivulnerus Muls.	Twice-stabbed lady beetle, 3 samples	Farmington, South Coventry, Waterbury.
Adalia bipunctata Linn.	Two-spotted lady beetle	Westville.
Necrophorus americana Oliv.		Hartford.
Pterostichus lucublandus Say.		Newington.
Hymenoptera.		
Emphytus canadensis Kby.	Violet saw fly	Westville.
Harpiphorus maculatus Norton	Strawberry saw fly	Cromwell.
Eriocampoides cerasi Peck	Cherry saw fly	Hartford.
Camponotus pennsylvanicus DeGeer	Carpenter ant	West Cromwell.
Vespa crabro Linn.	European giant hornet	New Haven.

NOTES.

Rose Chafer Injuring Peaches. The common rose chafer, *Macrodactylus subspinosus* Fabr., was very abundant in June, and attacked various kinds of plants. On June 16th, some young peaches about one-third grown were received from Norwich with the statement that they were injured by the rose chafer. Some of the fruits had holes eaten into them, and others were perhaps half eaten up, and are shown on Plate XII, b. The correspondent wrote that in some cases he saw "five or six of the beetles eating at one opening with heads close together, and with bodies radiating out from this comparatively small hole." He was afraid that the crop would be entirely ruined, and had the beetles picked by hand and dropped into a pail of hot water. Nearly two hundred were gathered from about forty trees.

In my own garden, rose chafers were very troublesome on peony blossoms, many fine flowers being spoiled soon after they opened. The beetles devour the petals, and on the white varieties they were more serious than on pink or red flowers because their work was more apparent, as they ate a portion of each flower and soiled the remaining portion, thus spoiling it. My only remedy was to keep a tomato can partially filled with kerosene in the garden, and whenever I saw a beetle on a flower I caught him and dropped him into the kerosene. This is a good way to manage with aster beetles in a small garden.

Lily of the Valley Attacked by a Beetle. On May 15th we noticed that the leaves of lily of the valley plants growing in the garden had been eaten in a peculiar manner. Notches had been eaten into the edges of the leaves, as is shown on Plate VI, d. A number of curculionid beetles were captured while at work on the leaves, and there is no doubt that they were responsible for the injury. Some plants were placed in the insectary, where the beetles continued to feed upon them. Through the kindness of Dr. L. O. Howard, this insect was identified at the Bureau of Entomology as *Hormorus undulatus* Uhler, and it is shown on Plate VI, c.

The Thistle Butterfly an Enemy of Hollyhocks. While inspecting the Elm City Nursery, September 8th, some larvae were noticed devouring the leaves of seedling hollyhocks growing in the nursery. A number of plants had lost nearly all of their leaves. Specimens were collected and taken to the laboratory, and some of these pupated on the 11th. On September 27th two butterflies had emerged. The thistle butterfly, *Vanessa cardui* Linn., is a common species in Connecticut.

Apple Maggot Infesting Huckleberries. During August, 1904, Mr. Walden found huckleberries with maggots in them from which adults were reared that proved to be the apple maggot fly, *Rhagoletis* (*Trypeta*) *pomonella* Walsh.

Privet Injured by Lilac Borer. A section of privet stem containing a borer was received from the Elm City Nursery Company during the summer. The stem was eaten partly off, and the larva had eaten along in the pith. From the material was reared a Sesiid moth which is known as the lilac borer, *Podosesia syringae* Harr. The injured stem and the adult insect with pupa case are shown on Plate XII, a. This species also attacks ash, mountain ash and pear.

Arsenate of Lead as a Dip for Plants. In the early summer tobacco plants were attacked by cutworms, and some fields had to be reset or perhaps planted over several times on account of their depredations. Some of the plants were cut off near the ground, but many were injured by having the leaves devoured. Some of the growers applied Paris green to the leaves in order to prevent injury. It occurred to me that at least some of the damage might be prevented by dipping the plants in arsenate of lead after they had been dug and before they were set in the field. Dipping the small plants is a very easy method of poisoning them, and is much more effective than any application of poison immediately after they are set in the field. At first we dipped the tops only, fearing injury if the roots were dipped, but a few were dipped roots and all, and no damage could be detected. On June 19th, 175 tobacco plants were set at Poquonock with the following treatment:

50 plants, tops dipped: ¾ oz. lead arsenate in 1 gal. water.
50 plants, tops dipped: ⅜ oz. lead arsenate in 1 gal. water.
25 plants, tops and roots dipped: ⅜ oz. lead arsenate in 1 gal. water.
50 plants, untreated.

No injury to these plants could be detected either from the effect of the treatment or by leaf-eating insects.

On June 23d tobacco plants set on the Station grounds were treated as follows:

25 plants, dipped tops: 1½ oz. lead arsenate in 1 gal. water.
20 plants, dipped tops and roots: 1½ oz. lead arsenate in 1 gal. water.
25 plants, dipped tops: ¾ oz. lead arsenate in 1 gal. water.
20 plants, untreated.

These plants were afterwards examined, and in no case did the poison cause the slightest injury to the plants. At Poquonock, on account of soil and location, those plants whose roots were dipped made the best growth and were the largest of all when examined on July 26th. Cutworms ceased their depredations about the time of the application, so that nothing was learned regarding the effectiveness of this treatment against them. Flea beetles caused considerable damage by eating the leaves of the untreated plants soon after setting, but the poisoned plants were absolutely free from this injury.

Tests of "American Disinfectant" as an Insecticide. A sample of this material was brought to the Station, and as claims were made for it as having considerable value as an insecticide in the Southern States, we were able to test it on a few plants. In all cases it was mixed with water in fifty per cent. strength, as recommended by the agent. The applications were made June 9th, with the following results:

Apple—dipped—tender leaves and shoots killed. *Aphis sorbi* Kalt. on the leaves were all killed.

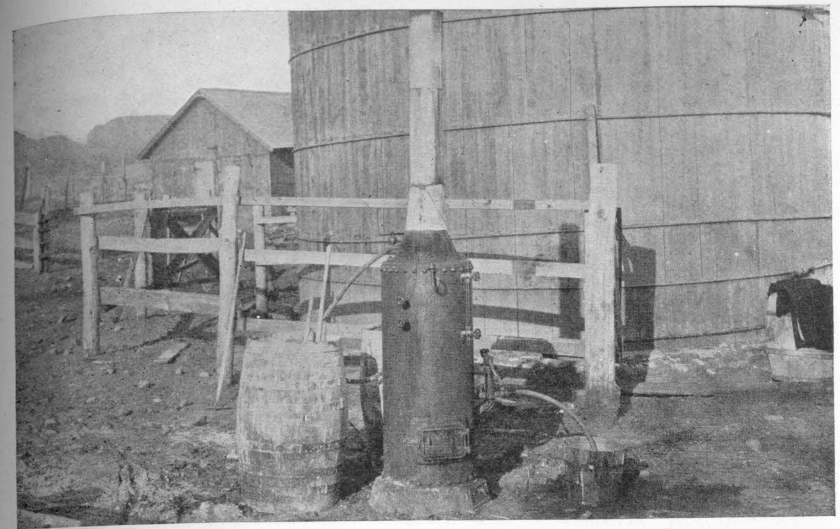
Sweet Cherry—dipped—leaves somewhat injured. Not infested.

Rose—dipped—leaves and shoots badly injured. Aphids all killed.

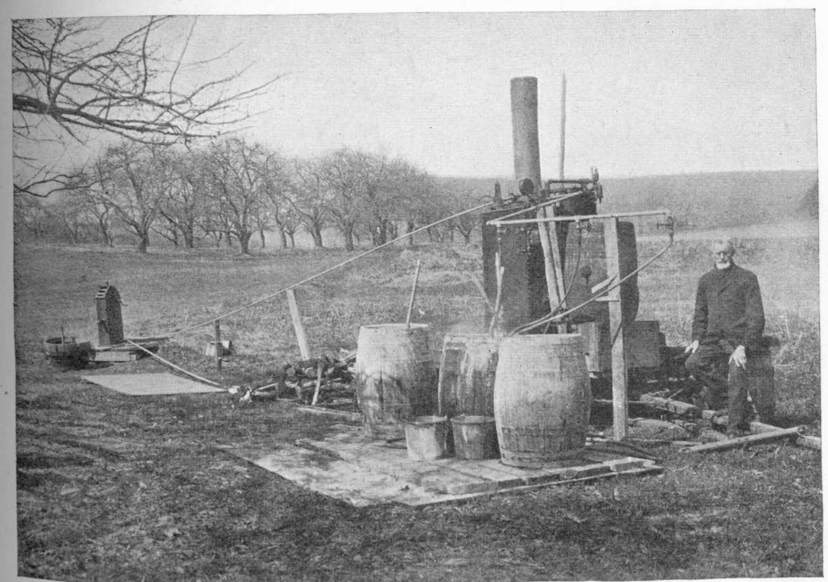
Willow—sprayed—no leaves injured. Only a small proportion of young oyster shell scales were killed.

On account of the injury to foliage, this material cannot be used safely in the proportions recommended.

A Rare Neuropteroid Insect. On February 24th, 1905, I received from Mr. H. J. Goodman of Westville a specimen which he had collected in July, 1904, at Savin Rock, West Haven, which is in the town of Orange. We were able to identify this as *Colobopterus excisus* Hagen., though not in our collection. A photograph was sent to Mr. Nathan Banks, of Washington, D. C., who is a specialist in this group of insects, and he confirmed our determination. We believe this to be the first record of the occurrence of this insect in Connecticut. One specimen is recorded from New Jersey, and it has been taken at Woods Hole, Mass. Mr. Banks writes that it is a rare but widely distributed species.



a. Small boiler used by Mr. W. N. Dunham, Southington.

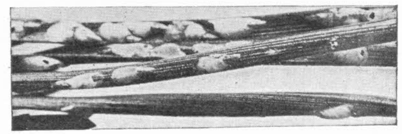


b. Portable steam engine boiler, showing method of drawing water from a well by means of an ejector. Outfit of Mr. E. Rogers, Southington.

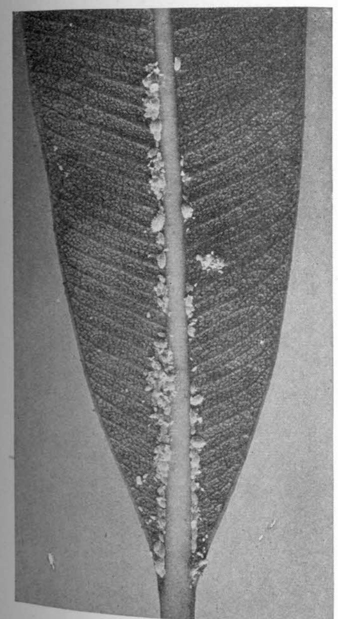
OUTFITS FOR MAKING THE LIME-SULPHUR MIXTURE.

a. White or oleander scale on croton leaf.

b. Euonymus scale on *Euonymus radicans*. The white shells are males. A few larger grey females are present.



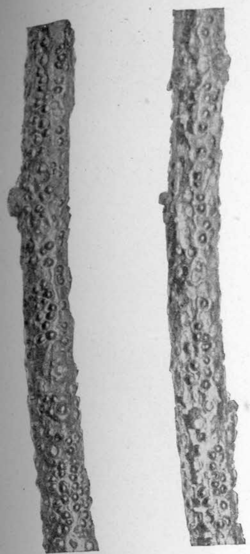
c. Pine leaf scale. Enlarged about twice.



d. Common mealy bug on oleander.

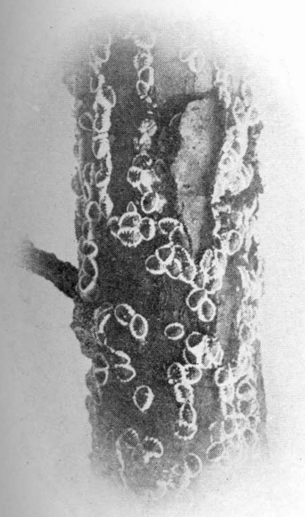
e. The greenhouse orthezia on lantana leaf. Twice natural size.

SCALE INSECTS OF CONNECTICUT.

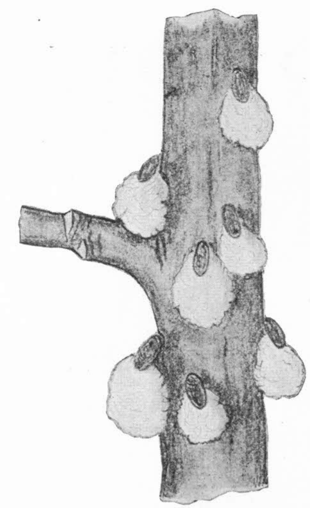


a. Pit-making oak scale.

b. Hemispherical scale on fern.

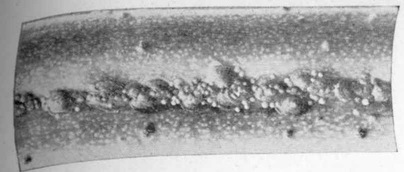


c. Elm scale.

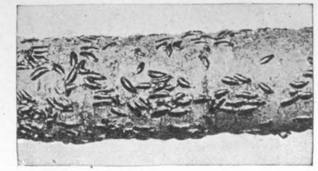


d. Cottony maple scale; females and egg-masses.

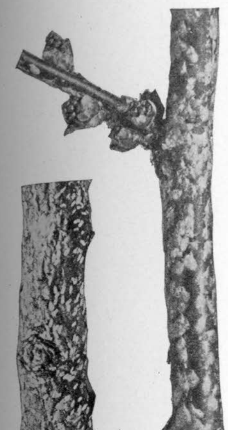
SCALE INSECTS OF CONNECTICUT.



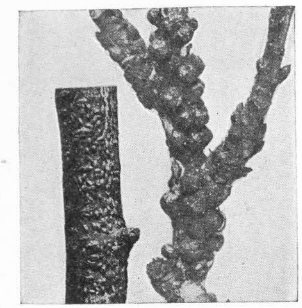
a. San José scale on peach twig. Twice natural size.



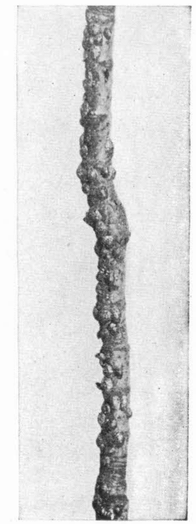
b. Oyster shell scale on poplar.



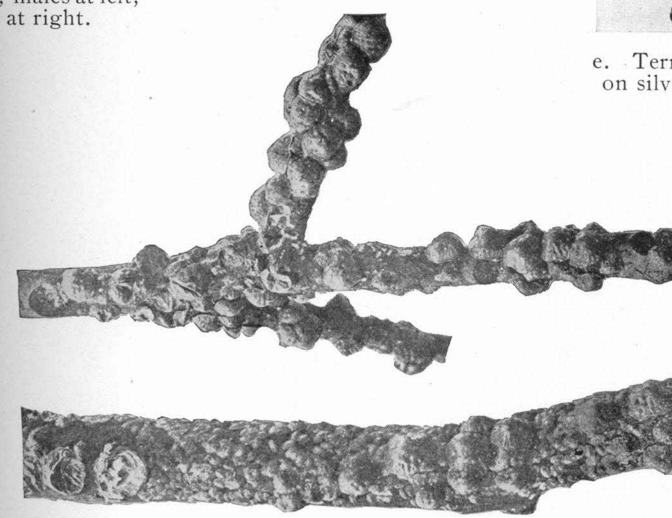
c. Scurfy scale on currant; males at left, females at right.



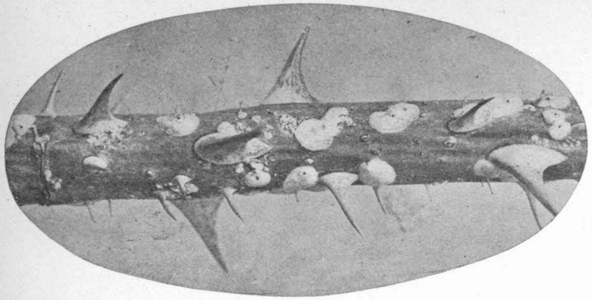
d. Apricot scale on plum; immature scales at left, old shells at right.



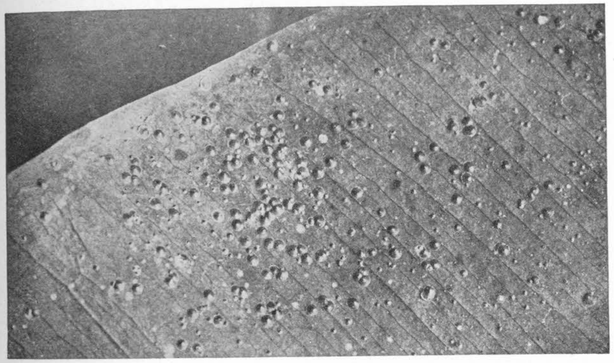
e. Terrapin scale on silver maple.



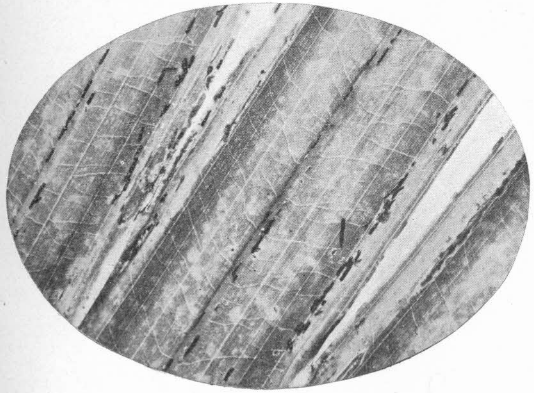
f. Tulip scale on tulip tree. Large females are shown above, and small male shells on lower twig.



a. Rose scale: twice enlarged.

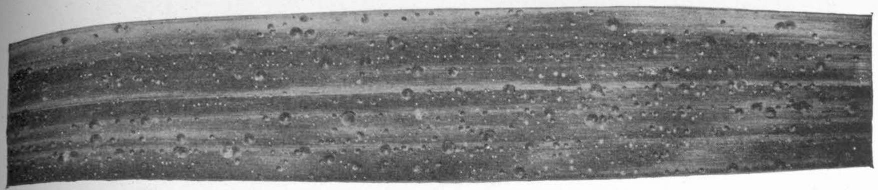


b. Circular or fig scale on rubber plant.

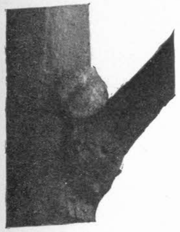


c. Thread scale on palm leaf.

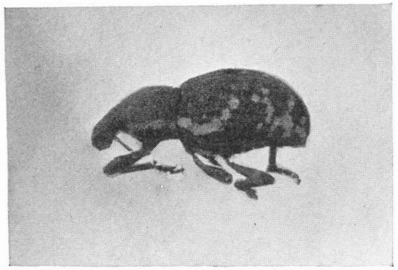
SCALE INSECTS OF CONNECTICUT.



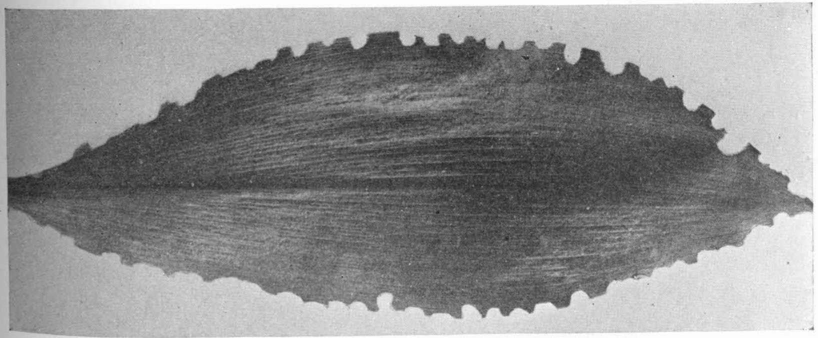
a. Morgan's scale, different stages on palm.



b. Oak gall scale.



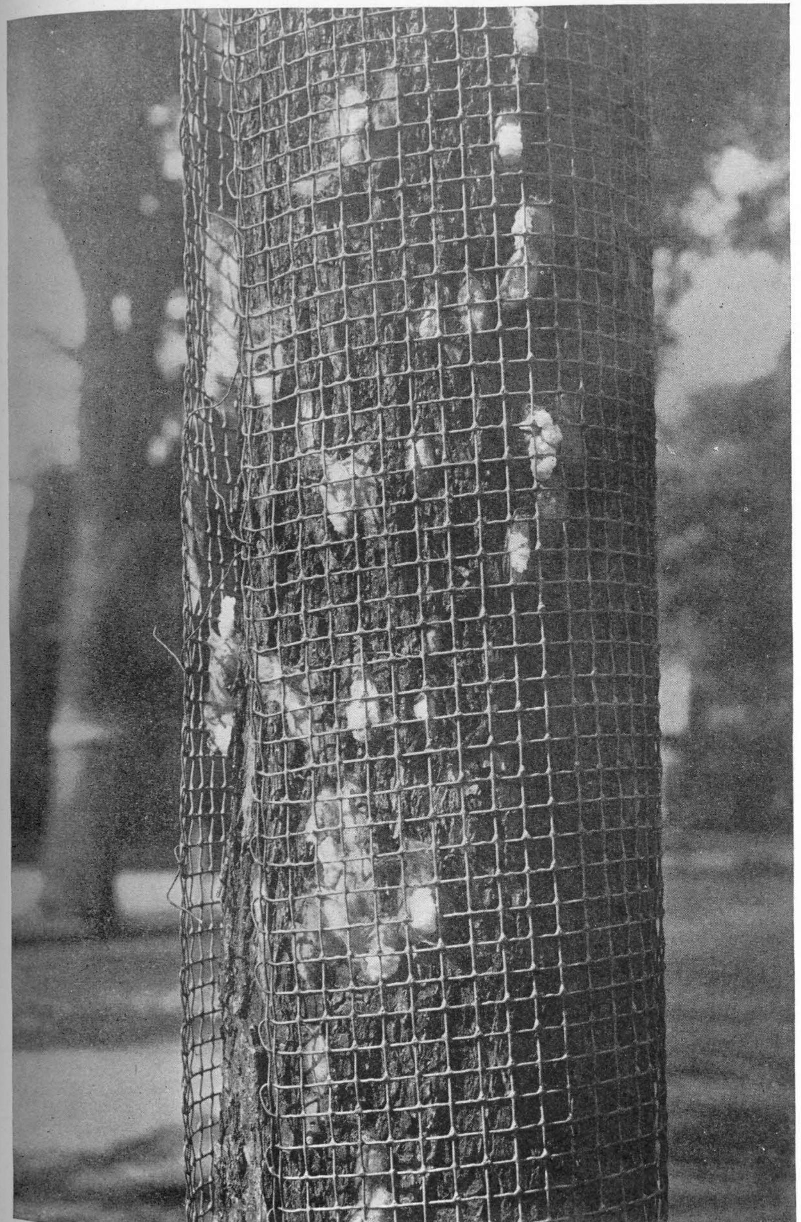
c. *Hormorus undulatus* Uhler.



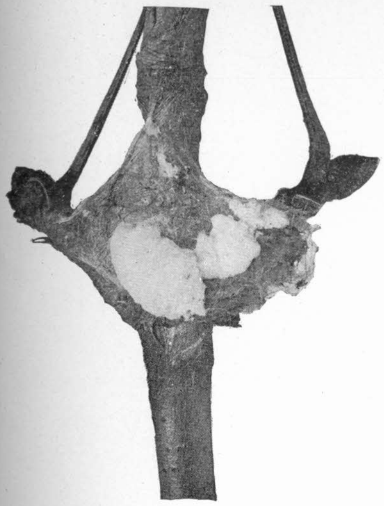
d. Lily of the valley leaf eaten by *Hormorus undulatus* Uhler.

SCALE INSECTS: HORMORUS UNDULATUS AND ITS INJURY TO LILY OF THE VALLEY.

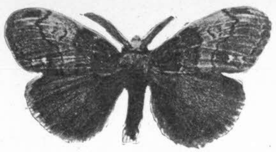
Woolly Maple Leaf Scale. Females with egg-masses and young on leaf. Male cocoons on bark.



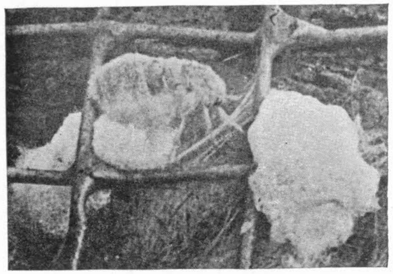
White-marked Tussock Moth. Cocoons and egg-masses.



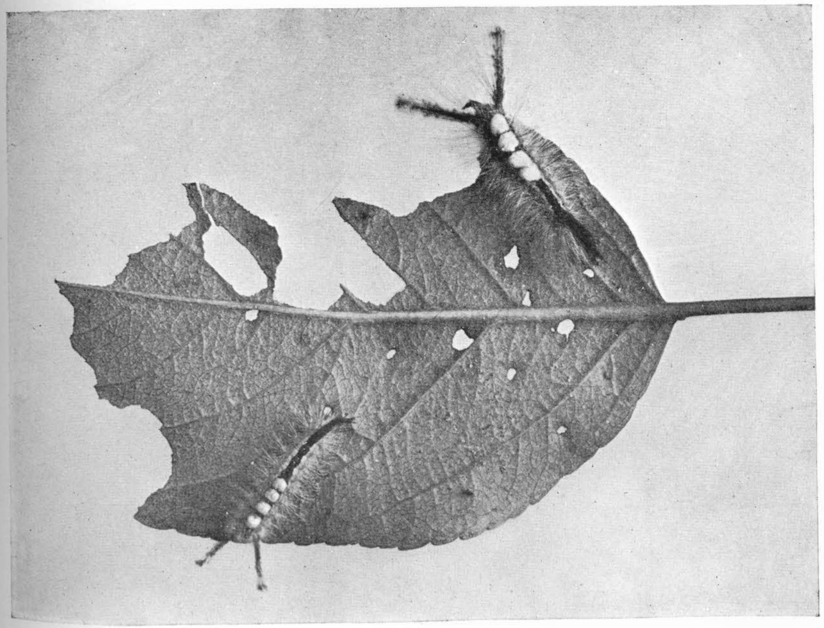
a. Egg-masses.



b. Male moth.



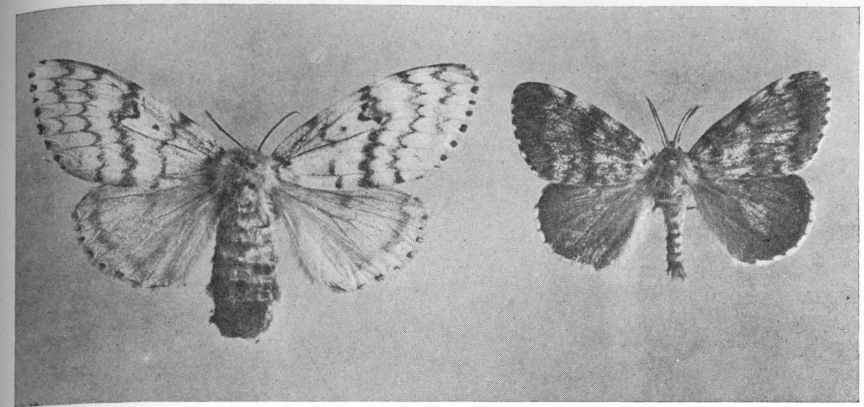
c. Female moth and egg-masses.



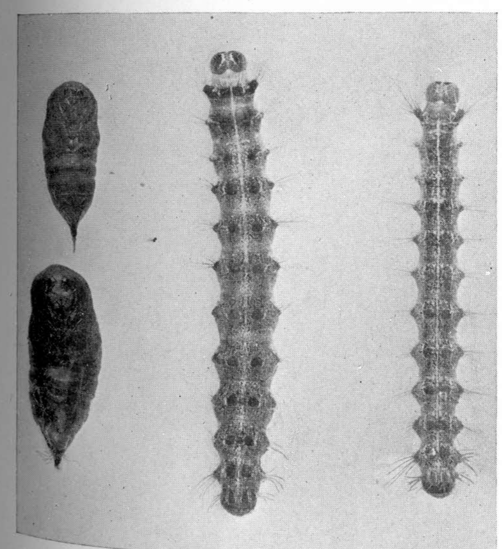
d. Caterpillars feeding on apple leaf.

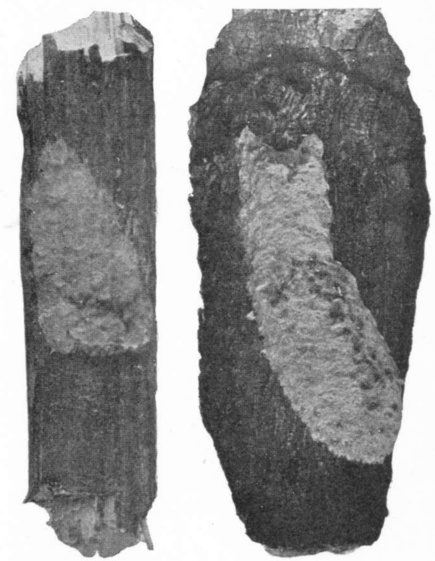
WHITE-MARKED TUSSOCK MOTH.

PLATE X.



a. Female and male gypsy moths, natural size.



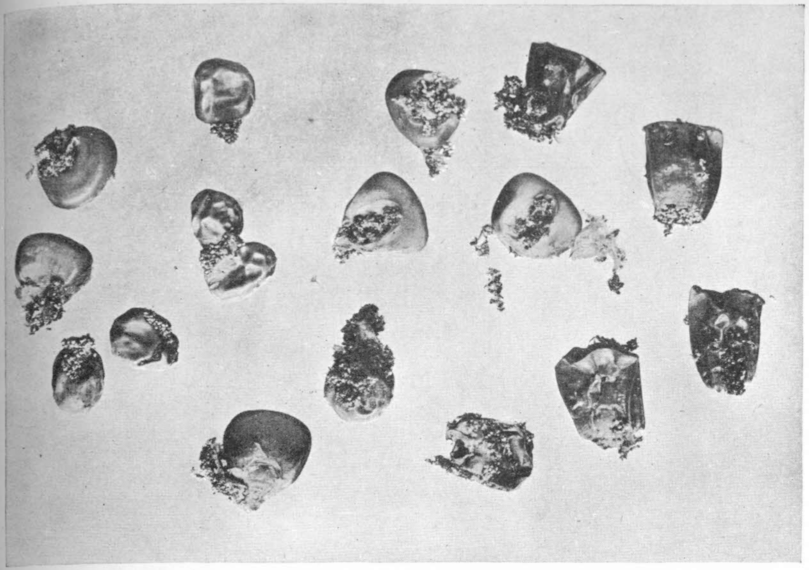


b. Pupæ, both sexes, natural size.

c. Caterpillars, natural size.

d. Egg-masses, natural size.

THE GYPSY MOTH IN ALL ITS STAGES.

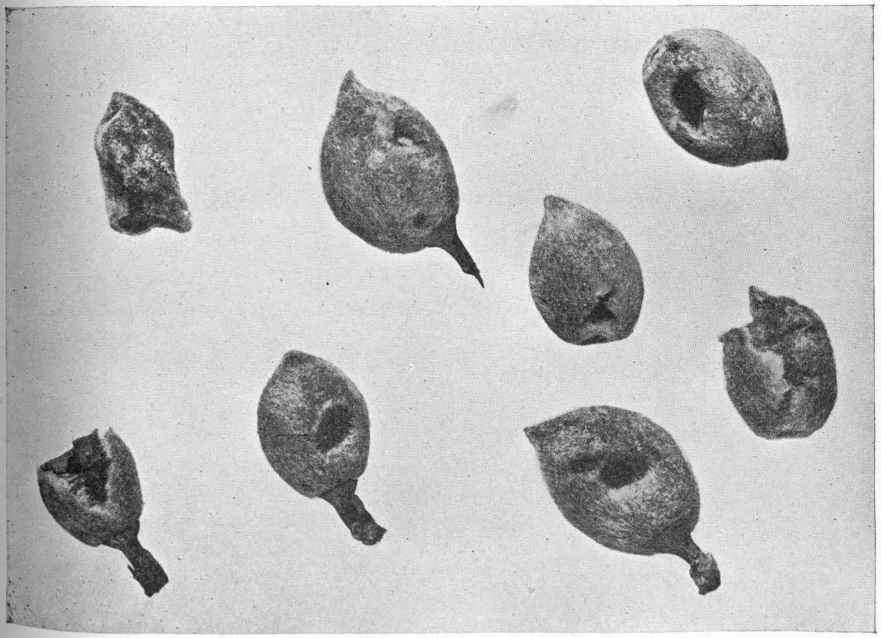


a. Infested kernels of corn.

b. Larvæ and web peeled from outside of bag.

THE INDIAN MEAL MOTH.

a. Adult and pupa of lilac borer and its injury to privet.



b. Peaches eaten by the rose chafer.

WORK OF ROSE CHAFER AND LILAC BORER.

REPORT OF THE BOTANIST.

NOTES ON FUNGOUS DISEASES, ETC., FOR 1905.

Fungous diseases during the year 1905, on the whole, were less troublesome to cultivated plants in Connecticut than for several years past. This was due to the comparatively dry growing season up to the first part of August. From this time on, however, the weather was sufficiently moist to develop a few troublesome diseases, belonging chiefly to the downy mildew group. The more important of these were as follows:

Brown rot of peach, *Sclerotinia fructigena,* probably took off a third of the crop and was much worse than usual, being one of the most serious fungous outbreaks of the year. The injury was induced by the rainy weather coming on just about harvest time. The loss from rot was felt most seriously in the Wallingford district. Plums, also, were injured but less noticeably.

The downy mildew of grapes, *Plasmopara viticola,* was more abundant than usual this year but no especial complaints were received concerning it.

Muskmelons, though not now so generally planted because of injury from fungous enemies, were largely a failure, partly because of the attacks of the leaf mold, *Alternaria Brassicae* var. *nigrescens,* and of the downy mildew, *Peronoplasmopara Cubensis.* The latter fungus was also injurious to the cucumber, though the injury was not so great as in 1901 and 1902.

The downy mildew of lima beans, *Phytophthora Phaseoli,* was more destructive than it has been since 1897. The oospores of the fungus were found for the first time, though the writer and others had previously looked for them very carefully. The fungus is discussed in detail in a special article later in this report. The rust of string beans, *Uromyces appendiculatus,* also seemed to be more prevalent than usual.

The downy mildew, or blight, of potatoes did not appear until after the middle of August. By that time the combined injuries of potato bugs, flea beetles, dry weather, and early blight (this last being more prominent than usual) had killed the potatoes in many fields, so that these, missing the blight on the foliage, did not suffer subsequently from rot of the tubers. Those fields, however, that were still green when the blight did appear were gradually killed by it and the tubers often rotted considerably. Thus, while there was considerable complaint of rotten potatoes, this injury was not as great as in 1904, and the blight injury to the foliage was still less conspicuous.

Point-rot of tomato did some damage to the fruit—more than has been noticed for several seasons. It was not determined whether this trouble was due to bacteria or fungi, but superficial observations seemed to indicate both as primary agents of the disease.

NEW DISEASES.

The following troubles were not necessarily especially injurious in 1905 but are briefly described here because they have not been mentioned before (see Reports of Botanist for years 1903 and 1904) as occurring in Connecticut.

APPLE, *Pirus Malus.*

FRUIT SPECK, *Fungus undet.* Plate XIII, a. In February, 1905, Mr. E. M. Ives of Meriden gave to the writer for examination specimens of apples showing superficial small spots or specks scattered over the skin. This trouble, while observed by Mr. Ives at harvest time, did not develop conspicuously until some time after storage. The same trouble has been observed by the writer the present winter on apples in the New Haven markets and also on specimens of the Tallman variety at the mid-winter exhibition of the Connecticut Pomological Society. These areas of brownish dead tissue usually varied from the size of a pin head to a quarter of an inch in diameter and extended but slightly into the flesh. The diseased spots in some cases were even more thickly placed than on the Tallman Sweet in the illustration given here. Frequently one could see at the center of the specks small ruptures, as if made by insect-puncture, or possibly the trouble started at the lenticels and these were of that nature. Cultures in test tubes were made at different times by taking diseased tissue beneath

the epidermis with a sterilized knife and these all developed a fungous growth but in some cases mixed with bacteria. As the fungus was apparently the same in all the cultures, presumably it was the primary cause of the trouble, but it cannot be a very aggressive parasite since the spots remained so small and developed so slowly even on the stored fruit. Nevertheless it is a serious pest for certain varieties in that it greatly mars their appearance and possibly later opens the way for more extended and deep-seated rotting. According to Mr. Ives, Tallman Sweet was the variety most seriously affected, Northern Spy suffered less, while Baldwin was injured but little. From this it would appear that the more tender or earlier maturing winter varieties were more susceptible of attack. Mr. Ives also informs the writer that these apple trees were sprayed in 1905 and the disease did not trouble the crop of that year. No reference in literature has been seen that relates to this trouble, which apparently is a common one.

BEAN, LIMA, *Phaseolus lunatus.*

POD AND LEAF BLIGHT, *Phoma subcircinata* E & E. Plate XIII, b. Halsted in 1892 briefly mentioned in the 12th Ann. Rep. of N. J. Agr. Exp. Stat., p. 287, under the name of *Phyllosticta* sp., a fungus collected on the pods and leaves of Lima beans. In 1893 Ellis also described, in the Proc. Phil. Acad. Nat. Sci., a new fungus on the pods of Lima beans, calling it *Phoma subcircinata* E. & E. In a more detailed description in Bull. 151 of the N. J. Agr. Exp. Stat., p. 24-5, Halsted identifies Ellis' fungus as the one to which he had previously referred. The past year the writer found a fungus, apparently the same as described and illustrated by Halsted, on the leaves of Lima beans in the vicinity of New Haven. It was not observed on the pods but may have escaped notice because it was not especially looked for there. While attacking leaves here and there on the plants, the injury was not especially conspicuous in the field. The fungus produced large subcircular, or more irregular, brown, often bordered, spots that gave evidence of their development through faint, elevated, concentric rings of growth. The spore receptacles showed as numerous small black specks immersed in the tissues. In time the dead tissues cracked more or less and wore away, leaving holes in the leaves. Our specimens do not agree exactly with those issued by Ellis (N. A. F. No. 2840) on the pods, since their spores average larger, 5–12μ by 2.5–3.5μ, and are occasionally septate. This might be considered by some sufficient to place the fungus under the genus *Ascochyta,* and Saccardo has described a species, *A. Phaseolorum,* with spores 10 by 3μ, that possibly may be the same as this.

BUTTERNUT, *Juglans cinerea.*

WHITE MOLD, *Microstroma Juglandis* (Berang.) Sacc. This is not an uncommon parasite of butternut leaves, forming white moldy growths more or less thickly on their under sides. Presumably it is not a serious pest. Dr. Britton collected specimens on wild butternuts the past summer at New Canaan.

CATALPA, JAPANESE, *Catalpa Kempferi.*

LEAF SPOT, *Macrosporium Catalpae* E. & M. Plate XIV, a. This trouble was conspicuous during the past summer on a Japanese catalpa at the Experiment Station. Reddish brown, bordered spots, 5 to 10 mm. in diameter, are formed more or less abundantly on the leaves. The tissues of these spots are dead and often crack apart, sometimes falling out. When the trouble is serious the trees are partially defoliated. It has been observed on different species of catalpa in various parts of the United States and has been discussed most extendedly in the Ann. Rep. U. S. Dept. Agr. for 1887, pp. 364-5. Experiments are reported there in which spores of this fungus, and also of another found with it, failed to produce these spots when sown on catalpa leaves. From what the writer saw of the disease he has been led to believe that possibly the Macrosporium (Alternaria) develops on the leaves as a consequence and not as the cause of these dead spots. The fungus belongs to a genus whose species are more often saprophytic than parasitic and are apt to occur on dead tissues. The spores were found only sparingly on the dead spots and sometimes did not seem to be present. No other fungus, however, was observed on these, and so if they were not caused by the Macrosporium they probably were not the result of injury by any other fungus. Further study of the trouble is needed to definitely determine its cause.

CELERIAC, *Apium graveolens* var. *rapaceum.*

LEAF SPOT, *Septoria Petroselini* var. *Apii* Br. & Cav. Plate XIV, b. Celeriac is merely a variety of celery having a swollen base. It is not largely grown in Connecticut, but specimens raised for the New Haven market were found to be injured by the leaf trouble which so frequently occurs here on celery (see Report of this Station for 1903, p. 314).

DANDELION, *Taraxacum officinale.*

RUST, *Puccinia Taraxaci* Plow. This rust, so common on dandelions as weeds, was also observed on dandelions cultivated by a Highwood market gardener; but it was not causing serious injury. The spores form dusty reddish brown outbreaks, about the size of a small pin-head, scattered more or less thickly over either surface of the leaves.

MAPLE, SUGAR, *Acer saccharum.*

Leaf Scorch. Plate XV, a. During the past summer and fall maple leaves similar in appearance to that shown in the illustration were sent to the Experiment Station from different parts of the state with inquiry as to the cause of the trouble. Similar specimens and requests have been received in years past. The leaves die at the margins, forming irregular brown patches extending inward a greater or less distance. Sometimes isolated spots are formed wholly surrounded by healthy tissue. In time there often appears a more or less conspicuous blackish growth of saprophytic fungi on the dead tissues. The appearance of affected leaves moreover is very similar to that produced by a true fungous parasite of the maple, namely *Glœosporium saccharinum.* In no case, however, was this fungus found on the leaves sent in for examination. The trouble is undoubtedly a physiological one, such as has been described by Stone of Massachusetts and Stewart of New York as occurring in those states. For some reason (due probably to drought or winter injury to the roots) the leaves under certain weather conditions are not able to replace the water in their tissues from the roots as rapidly as it is lost through transpiration, and the death of the tissues from the margin inward results. According to Stone the trouble may be produced by unusually favorable conditions for the transpiration of water, such as high winds on clear warm days, when the available water supply of the roots is small. Most observers report the trouble as appearing suddenly. A somewhat similar injury to elm leaves, apparently due to the same causes, has also been reported frequently in the state.

NECTARINE, *Prunus Persica* var. *necturina.*

BROWN ROT, *Sclerotinia fructigena* (Pers.) Schröt. The nectarine is only occasionally grown in the state, but these few trees seem to suffer considerably from fungous attacks as well as from winter injury. Specimens of the mummied fruit collected in January showed abundance of the Monilia stage of the brown rot fungous. While this is very common on other species of Prunus in the state, it has not been reported before for this host though apparently not uncommon on it.

SCAB, *Cladosporium carpophilum* Thm. Plate XV, b. In September specimens of nectarines were received from Thompson, Conn., that were badly injured by the scab fungus which is so common in Connecticut on the peach. As the nectarine is a smooth fruit, the injury more nearly resembles that produced by scab on plums than that on the peach. The skin becomes more or less thickly covered with the circular, brownish scab colonies which occasionally merge together. The fungus incites the formation of a corky growth of tissues and causes more or less cracking in these. The badly infected fruit is said to drop prematurely or else mature imperfectly. As in the plum, the injury to the tissues is more conspicuous than the fungus, while on the peach it is the olive fungous growth that forms the conspicuous spots, the hairy covering no doubt protecting the fruit somewhat and at the same time permitting a more vigorous external growth of the parasite. An examination of the twigs seemed to indicate that the fungus carried over the winter on these as it does on the peach. The preventive measures are the same as those for peach scab (see Report 1903, p. 340).

OKRA, *Hibiscus esculentus.*

WILT, *Neocosmospora vasinfecta* (Atk.) Sm. Plate XVI, a-b. This fungus is very injurious to cotton in the south and was first described by Atkinson (Bull. Ala. Agr. Exp. Stat., 41: 19-24) in 1892. He mentions in this bulletin, p. 25, that okra, which is botanically related to cotton, is sometimes attacked. Smith (Bull. U. S. Dep. Agr., Div. Path., 17: 31) and Orton (*Ibid,* Bull. 27: 6) both mention okra as having a wilt disease which they consider the same as that of cotton though their identity has not been absolutely proved. Okra is a salad plant occasionally grown in private gardens in this state. Some plants in the Experiment Station grounds the past year showed unmistakable signs of the disease in August and September. The year before some cotton had been grown in the garden a short distance from where the okra was situated. If the disease occurred on this, however, it escaped notice. There are a number of these wilt troubles of cultivated plants that have been described as distinct, such as wilts of cotton, cucurbits, potato, tomato, flax, etc. Several of these occur in this state and the tomato trouble has been especially bad in the Experiment Station greenhouse for years. As they are all caused by Fusarium soil fungi (of which the mature stage has been observed only in one or two cases) and these act much the same on all of the hosts, there may be some question whether they are really caused by different species or merely strains of the same semi-parasitic soil fungus.

The diseased okra plants when first seen by the writer in September looked as if they had been partially killed by the frost; see Plate XVI, a. The trouble showed first on the lower leaves, gradually affecting those above in succession. They became yellowish in irregular streaks from the margin inward and eventually brown and dead. In time the whole leaf is killed and it is usually dehisced at the customary place on the node; see Plate XVI, a. Thus a badly diseased plant may gradually drop all of its mature leaves and finally begin to die at the tip of the stem. The character of the disease is shown on cutting transverse or longitudinal sections of the stem. The woody layer which occupies a prominent band between the central pith and the outside bark appears in these cases plainly diseased, having a dark brown color; see Plate XVI, b. This discoloration of the wood even shows when the outside of the stem appears normally green and healthy. Microscopic sections demonstrate that the diseased condition is caused by the presence of the Fusarium stage of the fungus which develops vigorously in the vascular bundles, more or less completely filling the water-carrying ducts and causing disease of their walls and the surrounding tissues. The fungus even penetrates eventually into the bundles of the leaf petioles. Thus the water supply of the leaf is gradually cut off and the blade finally dies.

These wilt fungi apparently develop to a certain extent on decaying rubbish in the ground and thus become more troublesome from year to year if the land is used consecutively or continuously for plants liable to infection. In some cases, as unquestionably with the tomato wilt, the seeds from diseased plants may carry the trouble and serve as a means of infection. The continued use of the same soil in hot beds favors the establishment of the fungus there, when it becomes a means of infecting the young plants of tomatoes and egg plants. Egg plants, especially when transplanted to apparently uninfected fields, often suffer seriously, even though they showed no sign of the disease in the young plants transferred from the hot-bed. All these points must be taken into consideration in combatting wilt troubles. Spraying, because of the infection of the plants through the underground parts, is of little use. Apparently soil treatment with chemicals will usually be of little practical value though based on good theoretical grounds. Orton was successful, with cotton, in rearing plants that were wilt proof through selection of wilt resistant individuals in the infected fields.

ONION, *Allium Cepa.*

BRITTLE, *Fusarium?* Plate XVII, a. Early in June, 1905, the writer, with Dr. Britton, examined an onion field owned by Mr. Burton W. Bishop of Guilford to determine the cause of a disease which is a serious menace to the onion industry in that region. According to Mr. Bishop, at least one hundred acres of desirable onion land in the vicinity of Guilford are not available for growing onions because of this trouble. It usually starts in some section of a field and spreads in area from year to year, as the onions are generally grown continuously on the same land. In Mr. Bishop's field the disease had appeared the year before near a stone fence and this year was occupying a considerably larger area. In a neighbor's field the trouble apparently started from a spot on which a manure pile had

recently stood. A report from Mr. Bishop after the onion season was over showed that the disease did not progress much later in the season, thus indicating that it is chiefly injurious to the young plants. At the time of the visit the onions in the main part of the field examined were several inches high and well beyond the dampening off stage. In the infected areas they averaged much smaller and the stand was very poor. Mr. Bishop stated that the weeds in these infected areas usually made a poor growth, but this was not evident, at this time, to the writer.

One of the most general characteristics of the disease is the brittleness of the onion leaves, from which character the disease takes its name. Another very evident character is the peculiar curling of the leaves of some of the plants. In exaggerated cases these leaves had developed spiral coils of two to three turns, as is shown in the illustration. Frequently the leaves are unevenly thickened or constricted and show somewhat indefinite yellowish spots. The general appearance of the plants suggested that possibly the disease resulted from insect injury of some kind, but neither Dr. Britton nor the writer could find any evidence to support this theory. Neither was there any evidence of a fungus attack on the parts above ground. Usually the roots appeared normal when the plants were pulled up and later examination in the laboratory showed no sign of any external fungus at work on them. However, when the plants were taken very carefully from the ground without breaking off the smaller roots, examples were found in which some of the roots, especially toward the extremities, showed slight irregular swellings, and these roots were more brittle than normally but otherwise appeared perfectly healthy.

Microscopical sections of these roots, even in places not enlarged, showed the presence of an internal mycelium of some fungus. The mycelial threads were most evident in the intercellular spaces around the parenchymatous cells and not infrequently sent conspicuous irregular branches into these, causing plasmolysis of their protoplasmic contents, but, so far as observed at this stage, no evident injury to the cell walls. Apparently the presence of the fungus caused an unusual local multiplication of the parenchyma cells, resulting in the irregular swellings of the roots. No sign of the mycelium was found in the tissues above ground even when their malformation was conspicuous. Probably this injury resulted in some way from the stimulating or irritating action of the mycelium in the roots. Whether later in the season the fungus penetrated into the leaf tissues or caused further disease of the roots was not determined. Specimens of the infected onions left exposed for a few days in a moist chamber developed growths of several, apparently saprophytic, fungi, but no special growth showed on the enlarged roots. The most conspicuous of these external fungous growths was that of a species of Fusarium.

Soil from an infected field was brought to the Experiment Station greenhouse and placed in two boxes and a third box was filled with the soil used in the greenhouse. Onion seed was planted in each of these, but in one of the boxes of Guilford soil a heavy coating of a mixture of lime and sulphur was scattered over the seed in the rows before covering. The young plants in the untreated Guilford soil dampened off considerably more than in either of the other two boxes, but none of the plants in any of the boxes developed the peculiar malformation or brittleness observed on the diseased onions in the fields. The plants were kept under observation several months. Those grown in the treated soil made the least growth, as undoubtedly too much lime and sulphur was used for their best development; those in the untreated Guilford soil had a poorer stand but made a slightly better growth; while those in the greenhouse soil made by far the best growth. This might indicate that the Guilford soil was somewhat deficient in plant food, but Mr. Bishop states that it had been liberally fertilized.

Everything considered, the trouble seems to be caused by some soil fungus, possibly a Fusarium, as the mycelium observed in the roots could easily belong to such a fungus and it is known that this genus furnishes several soil fungi. Its development in the onion fields seems to be due to the practice of growing onions continuously on the same land and using manure as a fertilizer. Probably the disease would cease to be troublesome if a proper rotation of crops on the land was followed, such as corn, onions, rye and clover, using stable manure only the year the land was in corn and commercial fertilizers at other times, especially when in onions. Possibly when infected land is used the trouble could be lessened by isolating the infected part by a ditch from the remainder of the field and by the use of chemicals, such as sulphur and lime, in the drills in the infected area.

PLUM, *Prunus* sp.

BACTERIAL BLACK SPOT, *Pseudomonas Pruni* Sm. Plate XVII, b. In the summer of 1904 Mr. F. L. Perry of Bridgeport brought to the Station green plums showing a disease, apparently of bacterial origin, but which was not definitely determined at that time. The past summer similarly diseased plums were received from Rhode Island, and at our request Mr. Perry sent specimens from Bridgeport. This trouble, apparently, occurs only on the Jananese plums, but may attack any of the varieties of these, according to growers. The green plums show conspicuous black-purple spots which are often slightly sunken. These spots vary in size up to half an inch in diameter. There are not many on a single plum and these are usually isolated. The diseased tissue does not extend much below the skin, so the injury is quite superficial. Usually only a few plums scattered over the tree show the trouble, but occurring on the green fruit one is apt to fear that later it will develop into a very serious pest. This does not happen, as the trouble becomes less conspicuous and vigorous on the ripening fruit and fails to spread further. Specimens of the nearly grown but green fruit when placed in a moist chamber in the laboratory did not show any further progress of the disease though kept for some time under observation. Cultures made from diseased tissue from the interior uniformly gave growths of a yellow motile organism, thus showing bacteria to be the cause.

So far as found by the writer, this disease has been described only by Erwin F. Smith in short notes (Science, **17**: 456-7, 1903, *Ibid.*, **21**: 502, 1905) from his extended studies of the disease, which he found on Japanese plums in Michigan. Dr. Smith states that the disease also occurs on the leaves forming numerous small water-soaked spots which finally may end in shot holes. The writer has not had the opportunity to examine infected trees to see whether the disease affected the leaves here, but the correspondents have not complained of injury to these. In the Report of this Station for 1903, page 337, the writer called attention to a bacterial spot of peach leaves about which nothing at that time had been written. The general appearance of these leaves seems to be similar to that described by Smith for the diseased plum leaves. No cultures were attempted from the peach leaves, so it is impossible to state definitely whether their disease was caused by the same organism as the plum disease. Smith discovered in his investigations with the plum spot that the bacteria gained entrance into the leaves and fruit through the stomates and for some time confined their development to the substomatic cavities. He also found that the disease was chiefly of meristematic tissue, which accounts for its failure to progress with the maturity of the leaves and fruit. While the disease in its present condition is not very serious, one can not assume that it will remain so since it may spread to other varieties and become more virulent. Though of bacterial origin, it is quite different from the bacterial blight that has been found occasionally on the plum and commonly on the pear, etc., in this state.

RASPBERRY, *Rubus* sp.

GREY MOLD, *Botrytis patula* Sacc. & Berl. This fungus was collected at the Frisbie farm, Southington, in July, 1902, on the fruiting canes. These were dying prematurely, apparently from the attack of some fungus. While this fungus was by far the most conspicuous one found in the stems, it may not have been the primary cause of the injury, as the cane wilt fungus, *Leptosphaeria Coniothyrium,* was also present. The Botrytis formed a greyish growth which broke out in small sori on the epidermis, but these were often so closely placed that they formed a conspicuous felt-like mat, resembling considerably that of a vigorous downy mildew. The spores are large and look more like those of the Peronosporeae than they do those of Botrytis. The fungus is certainly not a typical Botrytis and possibly does not belong to that genus, but further study with fresh material would be necessary to determine its exact relationship, as it is difficult to say from the old material how the spores are borne. This species was described in 1885 by Saccardo and Berlese from specimens sent by Ellis from New Jersey. In the Syll. Fung. **4**, p. 25, the host is given as *Salix* (?) which is apparently a mistake,* as specimens collected by Ellis

* In the host index, volume 13 of the Syll. Fung., both *Salix* sp. and *Rubus strigosus* are given as hosts.

at Vineland, N. J., June 28, 1884, and which the writer has examined, through the kindness of Dr. Underwood, from the N. Y. Bot. Gard., are labeled "on living red raspberry canes." Apparently the fungus has been very rarely collected.

SPINACH, *Spinacia oleracea.*

LEAF MOLD, *Heterosporium variabile* Cke. Plate XVIII, a. Halsted, of New Jersey, who has issued a bulletin on the fungi which attack spinach, does not give this fungus in his list, though he does mention other molds that appear on the old leaves. It was described originally by Cooke, of England, in Grevillea, **5**, p. 123, in 1877, and the host was given as "languishing leaves of Spinacia." The specimens collected by the writer were on leaves of spinach obtained in the New Haven market in January. Usually only the outer two or three leaves of each head were attacked by the fungus. These leaves showed subcircular dead spots, about a quarter of an inch or less in diameter, which were more or less densely covered above and also usually below with a conspicuous olive-black moldy growth. When the spots were thickly placed the intervening tissue was a sickly yellowish color and the leaf worthless. Even when the spots were not so abundant the market value of the spinach was lessened because of its appearance. The fungus may or may not be a true parasite, as the writer has often seen spinach leaves in the fields with spots on them but with no sign of fungous growth. That it is not a very vigorous parasite was shown by its presence being limited largely to the older leaves. A species of *Alternaria* which produces a general appearance very similar to this fungus has also been observed on the older leaves of spinach in the market.

SQUASH, *Cucurbita Pepo.*

DOWNY MILDEW, *Peronoplasmopara Cubensis* (B. & C.) Clint. The squash is a host not before reported for this fungus in Connecticut. The appearance of the infected leaves was so different from that of the usual hosts that the writer did not recognize the trouble at the time of collecting it but mistook it for a bacterial leaf spot. The leaves were thickly covered with small angular brown spots which were more conspicuous on the upper than on the lower side and much smaller than those ordinarily seen on the musk melons and cucumbers. There was no evident growth of the fungus and the microscopic examination revealed the presence of only a few conidiophores. The spores, apparently, averaged smaller than on some of the other hosts.

STRAWBERRY, *Fragaria* sp.

Leaf Scorch. About the last of June, 1905, Dr. Britton and the writer visited Mansfield Bros.' farm at West Hartford to determine the cause of an unusual trouble of their strawberry plants. Many of these were drying up and dying. The older plants suffered more than the younger and the older leaves before the newer leaves on the same plant. The leaves turned purplish and then gradually dried up and died. No sign of insect or fungous work was visible on them and an examination of the roots and crowns gave no indication of any special pest as the cause of the injury. The plants suffered most where the matted row method of culture was used. As the early summer had been unusually dry, the writer finally came to the conclusion that this was largely responsible for the trouble, though this injury did not show prominently until the very dry weather was past. Possibly the trouble was aggravated by winter injury of the roots and the method of culture, which was not so well adapted to dry weather.

POWDERY MILDEW, *Sphaerotheca Humuli* (D. C.) Burr. Plate XVIII, b. This mildew had not been collected in the state until last June, when Dr. Britton found, at Poquonock, a few infected plants in a field near a manure pile. It is a trouble, however, that is rarely reported injurious to the strawberries. The leaves become covered on either surface, but showing most conspicuously on the upper, with a mealy white growth of the fungus. This is the conidial or summer stage and the winter spore stage is rarely formed on this host.

TOBACCO, *Nicotiana Tabacum.*

DAMPENING OFF, *? Sclerotinia* sp. Plate XIX, a-b. Several seed-bed troubles of tobacco have been described by Selby in a recent bulletin, No. 156, of the Ohio Experiment Station, but apparently the one mentioned here is different from any described by him. In appearance, Plate XIX, b, the injured plants were very similar to those figured by Selby for a bed-rot injury caused by a Rhizoctonia fungus, but examination of the specimens received here did not reveal the presence of this fungus. The disease showed on the young plants at the base of the stem as a conspicuous dead area or a complete girdle. Often the injury was so severe as to cause the death of the plant. When placed in a moist chamber the infected plants produced a growth of a sterile white fungus at the injured part. Plate XIX, a, shows cultures of this fungus growing on potato agar. These cultures never produced any spores but instead formed the numerous small sclerotia similar to some of those described by Smith for the Sclerotinia drop fungus of lettuce, which is also a soil fungus.

Mr. W. E. Frost of Bridgewater, who sent the diseased tobacco plants, wrote in part as follows: "Is there anything that can be done to stop the rotting of tobacco plants in the seed beds? Where they rotted last year they are doing so this year. Can anything be done so that it will not appear in the same beds another year? Would it be safe to set plants from beds where there is some rot if the plants appear all right when taken up?" Fungous troubles in seed beds are chiefly due to two conditions: first, keeping the plants too moist by improper watering, insufficient ventilation or crowding the plants too closely together; second, fertilizing with manure or using the same soil in the beds year after year, thereby establishing in these special injurious soil fungi. When the trouble is of the second sort, as in the present case, the soil should be changed or new beds made and where feasible only artificial fertilizers should be used. Applications of lime and sulphur to infected soil possibly in some cases may prove of benefit. In answer to the last question asked by Mr. Frost, it may be stated that the writer set out some of the least diseased plants received and these did not develop the trouble any further and did fairly well during the whole season. There are some diseases, however, contracted in the seed beds, as the wilt of egg plants, where the infected individuals do poorly the whole season.

DOWNY MILDEW, *Phytophthora Phaseoli* Thaxt., OF LIMA BEANS.

In the Botanical Gazette (18) and the Annual Report of this Station (19) for 1889, Professor Thaxter, then botanist of the Station, recorded the discovery of the Lima bean mildew, which he found doing damage in Connecticut. Besides giving a general and scientific description of the fungus, Thaxter described and illustrated in detail the parasitic, or summer stage, but he was not successful in discovering the oospores, or winter stage. His successor, Dr. Sturgis, also in the Botanical Gazette (16) and the Reports of the Station (15, 17) added to our knowledge of the fungus by describing its methods of infection, especially that accomplished by the aid of insects, and recorded successful spraying experiments. He, too, failed to find the oospores, though special search was made for them. The writer adds, in this paper, his contribution to the knowledge of the fungus in a description of the missing oospores and of artificial cultural experiments. Practically all that is known of the mildew, except its limited distribution, has resulted from the work of the botanists of this Station. It is fitting, therefore, that a detailed account of the fungus, its injury and methods of prevention, be given in this place.

PARASITIC, OR SUMMER STAGE.

Relationships. The Lima bean mildew belongs to the small genus, *Phytophthora,* which is especially characterized among the downy mildews by the nodular swellings on the conidiophores (spore-bearing threads) that mark the position of the successively developed spores. The genus includes serious parasitic pests, the most conspicuous of which is the downy mildew, or blight, of potato. This is the only other species that occurs in Connecticut. Another species, found in the East Indies, has tobacco for its host, and a fourth is injurious to seedlings of beech, Coniferae, etc. One or two other species have been described recently. Apparently the mildew of Lima beans is most closely related botanically to the species that occurs on tobacco.

Distribution. Thaxter first found the Lima bean mildew in September of 1889 at Hamden, Conn., near New Haven, where it had been injurious at least two years before his discovery. In the Report for 1890 (20) he writes: "This mildew (*Phytophthora Phaseoli*) described and figured in last year's report, has been again destructive this year and has made its appearance in a number of new localities in the neighborhood of New Haven. So far as ascertained it extends from New Haven to Hartford and west to South Norwalk, but has not yet been discovered outside of Connecticut." So far as recorded, Sturgis' work and observations on the fungus were in the vicinity of New Haven (East Haven, Westville, etc.). The writer's experience, too, has been limited to this vicinity, though complaint of it has been received from Green's Farms. Probably the fungus has appeared in Connecticut (in a more or less conspicuous way) each year since its discovery. Thaxter collected specimens in 1889 and 1890. Sturgis records it as being injurious "for some years" in 1893 but failed to find it that year in localities where it had always been abundant; he also records it for the years 1897 and 1898 and states it was prevalent for two or three years previous. Rorer collected specimens in 1901 and the writer made collections in 1902, 1903 and 1905.

Outside of Connecticut the fungus was first reported in New Jersey by Halsted (4) in 1897, and he has found it several times since in the same state. It was also reported about this time by Speschnew (13) from Tiflis, Russia, and has been found by other Russian botanists. Smith (12) states it was injurious in 1903 in Delaware. So far as the writer has learned, these are the only published records of distribution. Thinking that possibly it had been noticed but not reported in other of our eastern states, where the chances for its introduction and development seemed favorable, information on this point was asked of the Division of Vegetable Pathology and Physiology of the U. S. Department of Agriculture and of the Experiment Station botanists of fourteen states, chiefly those bordering on the Atlantic coast. Letters received from these showed that the mildew had not been observed in any other states than those mentioned except in two cases. Mr. Stewart, of the Geneva Station, N. Y., reports the receipt of specimens from Long Island once each in 1904 and 1905, and Mr. Woods, of the Division of Vegetable Pathology and Physiology at Washington, states that the fungus was very injurious in Frederick county, Maryland, in 1905.

Injury to host. So far as reported, only the Lima bean, *Phaseolus lunatus,* is subject to the attacks of this mildew. The writer has seen it on both the pole and dwarf varieties, though rarely on the latter. The dwarf varieties are not usually grown on a commercial scale in Connecticut and probably do not present so favorable conditions, as regards moisture, for the spread of the fungus, though Sturgis has reported a case where they were severely injured. The pods are the parts of the host most subject to attack, but the fungus also occurs to a limited extent on the young leaves, vines and flowers.

The growth of the fungus on the pods, Plate XXII, a-b, is often very conspicuous, forming a dense pure white felt of the conidiophores in irregular patches, or sometimes spreading over the entire surface, on one or both sides. Both Thaxter and Sturgis have noted that the mildew often at first is present only on one side of a pod, and the latter states that this is usually the side furthest from the vine and least protected by the leaves. The injury to the pod generally shows but little beyond the area covered by the fungus, though the green of the healthy tissue may be separated from the diseased by a more or less distinct purplish border. As a pod becomes more and more severely injured it wilts and gradually dies, shriveling up in the irregular form shown in the illustration. The fungus eventually penetrates into the interior of the pod, causing the tissues to become sunken, and the mycelium may enter the seeds. Many pods are attacked so vigorously in their infancy that they are killed outright and others are injured so they never mature. The injury to the large pods varies with the abundance of the fungus, but even when not preventing maturity of the seeds it may still affect their market value by injuring their appearance. The mildew opens the way for further injury to the pods and seeds by other fungi, so that quickly following its prime development there appear such fungi as Fusarium, Alternaria, Cladosporium, etc. The growths of these eventually discolor the pure white of the mildew.

The attack of the fungus on the flowers is not usually very conspicuous, though it is through insect visitation to these, as shown by Sturgis, that the infection of the young pods often takes place. So, too, the leaves, petioles and vines are generally not much injured and apparently are infected only

in their young state. The infected leaves often show an irregular injury of the tissues with more or less of a purplish discoloration, especially on the veins, and there is no very evident growth of the fungus showing on them. See Plate XXI, b.

Financial loss. In this state a few Lima beans are usually grown by each farmer for home consumption and most gardeners grow the pole varieties in quantities for the market. They are probably raised most extensively around New Haven, though each large city has more or less grown in its vicinity. The largest grower in the state, A. N. Farnham of Westville, often plants twelve or more acres and sometimes most of these are in a single large field. The financial loss due to injury by the mildew comes chiefly on the market gardeners and is greatest in those localities where the beans are grown extensively. Thaxter's statement, based on his observations at Hamden, that the mildew "bids fair to become the most serious obstacle yet encountered in the cultivation of this vegetable," especially in the Atlantic seaboard states, was not exaggerated. Sturgis wrote that "during the summer of 1897 the conditions were such that in many places the effects of the fungus have been most disastrous." In 1898, in a number of counts in a certain field, he found that the percentage of pods attacked by the mildew varied from 36 to 53 per cent. of the total number produced during the season. The writer's observations on the disease began in 1902, when the fungus did considerable damage, especially in the lower, more moist places in the fields. During the next two years there was comparatively little injury, but in 1905 the loss caused by it was the greatest since 1897. In one of the largest fields in the state, the grower estimated that the yield was cut down about one-third by this pest.

Halsted (4) states that the mildew was so serious in New Jersey in 1897 that "few or no pods were picked from some of the fields." He also reports numerous complaints of it in that state in 1902. Smith (12) records the mildew as injurious in Delaware in 1903; and Woods in a letter to the writer states that, in Frederick county, Maryland, in 1905, "it is said to have destroyed from 25 to 90 per cent. of the crop."

Relation to weather. The prevalence of most parasitic fungi is largely influenced by the character of the weather, particularly in regard to moisture. This is especially true of the downy mildews. An abundance of rainy or cloudy weather at certain periods of the year determine whether or not these troubles will be injurious. July, August, and to a less degree September, are the months in which unusual moisture develops the downy mildew of the Lima bean, just as it does the downy mildew, or blight, of the potato. So far as yet ascertained, the middle of July is the earliest that the Lima bean mildew has been found in this state and frequently it does not appear until the middle of August. After its appearance it can be found more or less abundant, according to the weather, up to the time the vines die. Halsted (6) notes the fungus as late as October 24 on green pods, after the leaves had been killed by frost, and the past year the writer collected it in several fields on October 4 under the same conditions. Sturgis reports, however, that in 1897 "for some reason not wholly clear, perhaps because of lessened insect activity, the mildew ceased spreading about September 10th."

From the published data it seems quite certain that trouble from the mildew may generally be expected in very moist years. Halsted (5), writing on this point, says: "The year 1897 had its counterpart in that of 1889. During the past ten years there have been in the Eastern States two Julys noted for their excess of rainfall (1889 and 1897). . . . In connection with what has been said above concerning the influence of copious rainfall upon the unusual development of the potato rot, it is in order to report that another member of the genus Phytophthora [the Lima bean mildew] has been complained of bitterly during the season of 1897. . . Particular emphasis is placed upon the date of the discovery [1889] and the fact that it was very abundant at the time it was taken, because that was the year in which the three months of July, August and September gave a total rainfall of 27.33 inches for New Jersey and presumably as wet in Connecticut; which is 9.54 inches more than the average of those three months for the past ten years." Besides in 1889 and 1897, the mildew was unusually abundant in 1902, which year was characterized by cold damp weather in July and August, and again in 1905, which though dry previous to the middle of August was rather moist the remainder of the month and during the first part of September.

The middle Atlantic seaboard states apparently offer the best conditions for the development of the fungus, and as it has spread into most of these, there may be expected increasing trouble from the pest in their market garden districts in years with very moist weather during July or August. Not many Lima beans are grown in New England north of Connecticut. In the drier middle and western states less injury may be expected should the fungus become introduced, except possibly in localities affected, as to moisture, by the Great Lakes.

Methods of distribution. The means by which the fungus spreads over the vines after it once gets started in a field and presumably by which it is carried to some extent from one field to another, have been discussed somewhat in detail by Sturgis. He found that both insects and wind were important agents in its distribution. Rains also aid greatly by washing the spores from the infected parts over the same plant.

Concerning insects as agents of distribution, we quote from Sturgis (15) as follows:

"The occurrence of the mildew on the pods at a very early stage of their growth, led to the supposition that insects were responsible in a measure for the spread of the fungus. Examination of the flowers served to confirm this supposition, and a few words regarding the structure of the bean flower will explain how infection takes place. The conspicuous portions of the bean flower consist of an upright petal known as the standard; two narrower petals, distinct, projecting forward below the standard and known as the wings; and two petals in the form of a closed, spirally coiled tube occupying a position between the standard and the wings, and called the keel. (Fig. 8,[1]) At the base of the keel is the ovary or young pod surrounded by the stamens and prolonged upwards into the style. The long stamens and style are completely enclosed in and protected by the keel. Under such conditions cross-fertilization would seem to be impossible, especially as the pollen is shed abundantly from the anthers which are borne upon the stamens in close proximity to the upper portion of the style, and neither the stigma nor the anthers appear beyond the end of the tube in which they are enclosed. But the wings form a convenient resting place for visiting bees in search of nectar, and in case a bee lights upon them his weight deflects them and at the same time draws the keel down and backward, thus causing the stigma and the hairy portion of the style covered with pollen to protrude from the mouth of the tube. (Figs. 8,[2,3]) As the insect plunges his head into the flower, the stigma and pollen-laden style come into contact with his abdomen and cross-fertilization is assured by subsequent visits to other flowers. But fungous infection is assured with hardly less certainty, provided the bee has previously had contact with the spores of the fungus. In that case we should expect to find the first attack of the fungus at the two points where the bee, in his search for nectar, touched the more moist and delicate tissues of the flower; viz. on the style and at the base of the ovary or pod. A large number of flowers was examined and this supposition was

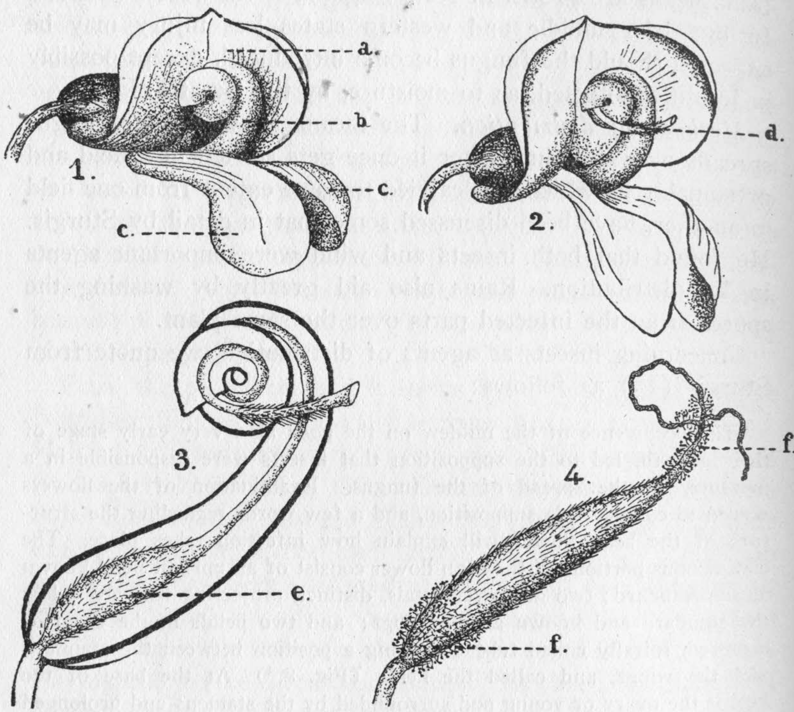


Fig. 8. Showing details of bean blossom with reference to infection with mildew by bees. 1. Parts of blossom: a. standard, b. keel, c. wings. 2. Showing how the weight of a bee alighting on the wings causes protrusion of style, d. 3. An enlarged keel in cross-section, showing enclosed pistil with young ovary or pod at its base, e. 4. Pistil showing growths of mildew (f.) at base and apex of the young pod resulting from spore inoculation by bee visitation during blossoming period. (1–2 after Gray; 3–4 after Sturgis.)

strikingly confirmed. The mildew was found in many of the flowers, and in every case it occurred on the spots above mentioned and nowhere else. (Fig. 8, [4]) It seems certain, therefore, that the spread of this mildew is largely due to the agency of insects, particularly of bees, and this view is further confirmed by the fact that in the case of young pods the mildew almost always appears first at the base or tip and very rarely in the middle."

The influence of wind on the distribution of the fungus in a field is shown by the following account, also quoted from Sturgis:

"The Lima beans on the Station grounds are on high land composed of a light sandy soil, and have never been affected with mildew. The rows run east and west. Directly south of them at a distance of about one hundred feet, but separated from them by a pile of lumber and a few trees, are two rows of bush Limas running north and south. On August 14th, when the mildew had been abundant in the neighborhood for a month or more, the Station vines were examined and found to be entirely free from the fungus. A few mildewed pods were brought from a distance, and the spores from one of them were rubbed and dusted on the surface of a sound and nearly ripe pod at the east end of each row of the pole Limas. Within a few days the mildew made its appearance on the infected pods, and from this point of vantage, the prevailing winds at the time being from the northeast and north, it swept down both rows and in two weeks the whole patch was completely mildewed. The spores had also been carried over a distance of one hundred feet to the bush Limas, and the mildew, beginning at the north end of the rows, that is, at the point nearest to the pole beans, spread rapidly down the rows. It

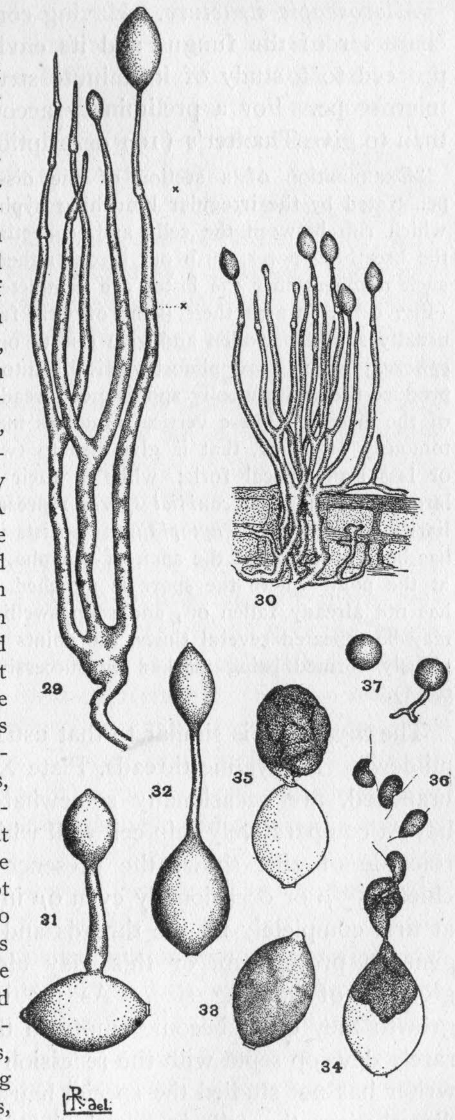


FIG. 9. Details of conidial stage. (After Thaxter.)

is evident then, that spores placed upon the surface of a sound Lima bean pod were enabled to start the disease, which thereupon spread with great rapidity in the direction of the prevailing wind."

Microscopic structure. Having considered the more general character of the fungus and its environmental factors, let us proceed to a study of its minute structure as revealed by the microscope. For a preliminary account we can do no better than to give Thaxter's (19) description:

"Examination of a section of the diseased tissue shows it to be penetrated by the irregular branching hyphæ of the fungus [*mycelium*] which run between the cells and, collecting in the air spaces beneath the breathing pores, push out through them into the air (Fig. 9,[30]) in such numbers that the latter are completely obliterated. These hyphæ (Fig. 9,[29]), just at their point of exit from the breathing pores, are usually slightly swollen and give rise to one or more branches [*conidiophores*] which grow almost vertically into the air, and, taken together, produce the white woolly appearance already mentioned as characteristic of the disease. These vertical branches may themselves be once dichotomously branched, that is give rise to two branches, forming a more or less symmetrical fork; while at their tips they swell out into the large, terminal, oval *conidial spores* represented in the figure. A peculiarity of the genus *Phytophthora* consists in the fact that after a spore has been produced at the apex of a hypha, the hypha continues to grow at the point where the spore is attached, pushing it to one side if it has not already fallen off, and soon swelling into another spore. This may be repeated several times, the points where spores have been previously formed being marked by successive vesicular swellings (Fig. 9,[29 x])."

The *mycelium* is similar to that usually formed by the downy mildews. Its hyaline threads, Plate XX, 1–6, are more or less branched, are occasionally somewhat irregular in shape and have a comparatively thin cell wall which on staining with chloroiodide of zinc shows the presence of cellulose. They are chiefly 5-7μ or occasionally even 9μ in diameter. The contents at first completely fill the threads and consist of a very homogeneous protoplasm, or this may also contain numerous oil globules of varying size. As the threads advance in their growth they often become empty in their older parts and also rarely develop septa with the recession of the protoplasm. The writer has not studied the special haustorial branches that push directly into the cells in search for food, and Thaxter simply states that the mycelial hyphae rarely penetrate the cells of the host by irregular haustoria.

The *conidiophores* of this mildew are much longer than those produced by the potato mildew. In the figures shown here from Thaxter, Fig. 9,[29, 30,] the young conidiophores have not reached their full length. In fact they usually become so long and lax that they form an interwoven mat rather than erect distinct threads. They also differ from the conidiophores of the potato mildew (which give off two to several simple branches along the apical third of their length) in that they are simple or more rarely dichotomously branched, usually near their base. Some conidiophores were found having over a dozen swollen nodes, thus indicating the formation of as many spores, but usually they have less than half a dozen, which may be scattered or grouped toward the terminal end. Occasionally it is difficult to detect any nodal swellings on a thread. From these statements it is seen that the conidiophores are not so differentiated into spore-bearing organs as in the potato mildew. For this reason it is hard to tell whether the white matted growth that covers the exterior of the pods is composed entirely of conidiophores or partly of mycelium from which the conidiophores develop. The latter, however, are often found growing directly from the stomates in clusters which sometimes contain a dozen individuals but more frequently about half that many. Thaxter does not give the length of the conidiophores and it is difficult in the old matted growths to separate out single ones for measurements. Specimens were measured that varied from 300 to 475μ but these were probably not extreme lengths. In an examination of artificial cultures, one fruiting thread that was traced measured over 1200μ in length. The diameter of the conidiophores is usually about 5 or 6μ, rarely 8.5μ, at their lower end, and they taper to about 2.5 or 3μ at the apical extremity. The swollen nodes generally vary from 4 to 6μ in width. At first the conidiophores are filled with protoplasm, but as spore production proceeds their contents are limited to the distal end and finally they may become entirely empty. Their walls are thicker than those of the mycelial threads and give a stronger reaction in the test for cellulose, as do also the spore walls. Very rarely septa are seen in the empty conidiophores.

The *conidia,* or spores, of the Lima bean mildew, Fig. 9,[29, 33,] are similar to those of the potato mildew, but larger. The spores of the latter vary from 17 to 35μ in length by 11 to 20μ in width, while those of the Lima bean mildew are chiefly 28 to 42μ in length by 17 to 27μ in width, and Thaxter records some even 50μ in length. They are hyaline, elliptical to chiefly ovoid in shape or rarely even broadly ovoid to subspherical. The papilla of dehiscence is very evident at their apical end, and when shed from the conidiophores the basal end is usually marked by a short hyphal plug showing the point of detachment. Protoplasmic contents fill the spores usually without special differentiation, though sometimes at germination faint areolations appear.

Germination of spores. The spores do not germinate readily unless perfectly fresh. The germination of such spores placed in a drop of water in a Van Tiegham cell takes place in a few hours and can be easily watched under the microscope. Thaxter's excellent description of their germination is as follows:

"The germination takes place in two ways. In the one case a single hypha of germination is produced, which may enter the host plant directly or give rise to another, or secondary spore like itself (Fig. 9, [31, 32]) which germinates in its turn like the ordinary conidia. In the second case, which is by far the most common, the content of the spore becomes very faintly lobular, as shown in Fig. 9, [33] and suddenly and rapidly begins to make its exit, through the ruptured apex of the spore, Fig. 9, [34] in the form of a continuous chain of spindle-shaped bodies, consisting of naked protoplasm; the orifice alternately expanding and contracting as each body is, as it were, squeezed out by the pressure from within. In some cases the whole content of the spore makes its exit thus, the chain winding itself into a round or oval mass above the apex of the conidium as in Fig. 9, [35]. Usually, however, the chain breaks in the course of its discharge and almost instantly a rapid motion begins, at the point of separation, which draws the spindle-shaped bodies successively apart. The motion is due to a slender thread or cilium, drawn out by the pulling apart of the narrow zone connecting two adjacent bodies, and the rapid vibration of this thread gives rise to the motion just mentioned. The spindle-shaped bodies, as soon as they are free, move irregularly for a moment, changing their shape the while, till they become contracted, the two extremities being drawn together on one side towards a small clear spot, usually present in bodies of this nature, so that in one view the outline is slightly crescent or bean-shaped (Fig. 9, [36]). After or during this change of shape the motion of the cilia becomes very rapid, and the bodies, which are known as *zoöspores*, dart away in the surrounding water. After swarming for a certain time, usually about half an hour, the zoöspores come to rest, assume a spherical shape, swell considerably, become surrounded by a thin cell wall and very soon begin to germinate (Fig. 9, [37]) by giving rise to a hypha which makes its way into the tissues of the host plant, thus infecting it with the disease. The whole process, owing to the minute size of the zoöspores which are less than $\frac{3}{10,000}$ of an inch in diameter, may take place upon the moist surface of a leaf or other portion of the host plant, the thinnest pellicle of water being sufficiently deep for them to swim in. The usual number of zoöspores formed from spores of average size is about fifteen, so that each spore may give rise to fifteen distinct points of infection."

Perpetuation of the fungus. The zoospores just described are very short lived, lasting so far as known but a few hours. The conidial spores, too, are of a temporary nature, retaining their power of germination but a comparatively short time even under favorable conditions and in dry weather perishing in a few days or even hours. The conidiophores and mycelium are more persistent, but as the Lima bean is an annual it is impossible for the mycelium to live over the winter (except in the seeds) as a dormant parasite. It may be thought, possibly, that the mycelium survives in the rubbish of the diseased beans and in the spring as a saprophyte gives rise to the conidial spores. This, however, is contrary to the known habits of the downy mildews and against all evidence that the writer can find after a careful examination of this species. Invariably the Lima bean mildew suffers in development by the decay of the infected pods and is at a decided disadvantage in competition with bacteria and saprophytic fungi that follow in its wake. So far as observed, it then gradually ceases to form conidial spores and fails entirely to spread further, at least in this spore stage. If the mycelium does develop as a saprophyte, which we doubt, it would most likely produce an entirely different kind of spores—the oospores.

Sturgis made some observations and experiments to determine if the mildew survived the winter in the refuse of a mildewed crop by means of "resting spores, a perennial mycelium or any other form." In his search through such material that had been kept out doors over winter he failed to find "any trace of a vegetative or reproductive body which could be even remotely associated with the Phytophthora causing the mildew." Seeds taken from this refuse and planted all rotted but one, which produced a perfectly healthy plant. The refuse was used as a mulch on ground at the Experiment Station and planted with Lima beans, but the beans came up through the mulch without apparent infection and remained free from the mildew until near the close of the season, when some did appear. In judging of the results of this experiment one must remember that Sturgis found no sign of oospores in the refuse he used and presumably they did not occur in it abundantly if at all. The writer, however, has found them recently under similar conditions though mostly in poor shape due to attack of other fungi on them before they were matured. It must be taken into account, too, that the mildew did appear on these beans toward the end of the season, but possibly it was brought in by insects, though the Experiment Station grounds are far from any other place where Lima beans are commonly grown and the mildew has rarely appeared on beans planted there. Sturgis evidently considered the experiment largely a failure because "diseased plants" were not produced from diseased seed and because the mildew did not appear out of season and in abundance from primary infections.

In a preceding paragraph it was stated that as the Lima bean was an annual plant it was impossible for the parasitic mycelium to be carried over from one year to another by it except in the seeds. We believe this is sometimes done and in the report of the Station for 1903, p. 308, expressed the belief that it was the ordinary way the fungus perpetuated itself. From our examinations of the past year we now know positively that the mycelium does often penetrate from the pods into the seeds. If the pod is badly diseased the seeds are destroyed, or at least injured so they will not germinate, by this and other fungi that follow it. There are, however, probably all gradations between seeds destroyed and those in which the mildew barely gains entrance. Experiments made by the writer go to show that diseased seeds that germinate do not produce "diseased plants"; that is, the mycelium does not pass from the seed into the young plant and produce a conspicuously injured plant from which the fungus is eventually spread by conidial spores to other plants. There is reason, however, for believing that the dormant mycelium may be carried over the winter in the seeds (just as is the potato mildew in the tubers) and that on the living tissue of the seed when planted it may form a few of its conidial spores (as can the potato mildew on the cut surface of the seed tuber) or that possibly in some cases a delayed production of the oospores takes place in the cotyledons. In either case the writer believes that the primary infection of the plants takes place by the germination of the conidial spores or the oospores into zoospores and these latter infect the parts of the plant brought into contact with them in the moist earth. That the mycelium is sometimes present in apparently sound seed is shown by the following case, in which nearly matured seeds were taken from diseased pods in the fall and placed in a damp chamber on moist cotton. These seeds were taken away from the diseased part of the pods and to the naked eye showed no sign of disease or evidence of the mildew. Yet in less than a week some of them were developing abundance of oospores in their tissues and some few had a slight conidial development on the outside. The only point not determined was how long the mycelium would have lived had the seeds been dried out; or in other words, if it could have passed the winter in them and then have gone through the same development when they were planted in the ground in the spring.

Mention has been made several times of *oospores*. Such spores are of an entirely different character from the temporary conidial spores. They are thick-walled and are usually produced by the mycelium within the tissues of the host. They do not, as a rule, germinate when formed but are for the purpose of carrying the fungus over the unfavorable winter period and on germinating the next season produce the primary infections of their hosts. Oospores are characteristic of the downy mildews, but until discovered recently by the writer were not known for the Lima bean mildew. Let us now pass to a consideration of this stage of the fungus.

OOSPORES, OR WINTER STAGE.

Where and when found. Although Thaxter, Sturgis and the writer made especial search for the oospores they escaped notice until September, 1905, at which time the mildew was unusually abundant in the region of New Haven. There may be two reasons why the oospores were not found before; namely, either they did not occur commonly or they were not looked for at the proper place and time. The latter reason more likely explains the failures to find them. Judging from the experience of the past year, the oospores should be looked for toward the end of the season and in the *seeds* of the pods badly infected with the mildew. Sturgis searched especially for them in the pods and the decaying rubbish. The writer also looked for them chiefly in these places and in fact actually collected pods in 1902 which a recent examination shows had immature oospores in the seeds that escaped detection. Not all of the seeds from infected pods contain oospores and there is no sure way of determining whether they are present or not except by microscopical examination. Often after the mycelium of the downy mildew penetrates from the pods into the seeds, the mycelia of other fungi, especially that of Fusarium, develop so abundantly as to seriously interfere with the further growth of the Phytophthora. Frequently, too, the mycelia of these other fungi form the more conspicuous growth both outside and inside of the seeds. Plate XXI, a, shows in the lower row several dried seeds, containing oospores, that were taken from badly mildewed pods. So far the oospores have been found in the seed coats and cotyledons of the seeds and to a limited extent in the tissues of the pods, but not in the leaves or the stems.

If the oospores generally occur only in those seasons when the mildew is unusually abundant, it has occurred to the writer that this might be explained on the supposition that there exist two mycelial strains of the fungus, possibly sexual in nature, and that the production of oospores can only result when these strains occur together on the same pods. Naturally a season very favorable for the spread of the fungus would multiply the chances of these occurring together. This idea of distinct mycelial strains is discussed further in this report in the following article dealing with the potato downy mildew, where are given the writer's reasons for believing that such strains may exist among the downy mildews, as has recently been demonstrated for the related family of the Mucoraceae.

Description of oogonia, etc. The downy mildews, or the Peronosporeae as they are called scientifically, have a characteristic oosporic stage which has been observed for many of the species and is supposed to exist for all. One of the chief functions of these spores is to carry the fungus over the unfavorable winter period. The oospores differ essentially in structure from the temporary conidial spores in that, as resting spores, they have thick walls, and are formed singly inside a special envelope called the *oogonium,* and further differ from them in origin in that they are the result of the conjugation of differentiated sexual branches of the mycelium developing usually within the tissues of the host. The male cell of the mycelium is known as the *antheridium* and after its contents are emptied into the special female cell, the *oosphere* (immature oospore), it often withers away.

The characters of the oogonia, oospores and antheridia of the Lima bean mildew, as found by the writer, are as follows: Oogonia (Plate XX, 22-25) inter- or intracellular in seed coats or cotyledons of seeds, occasionally in tissues of pods and more rarely imbedded in mycelium on surface of seeds and pods, with rather thin scarcely folded walls loosely enclosing oospore, at first hyaline or slightly tinted but finally reddish brown, subspherical, chiefly 23-38μ in diameter. Oospores (Plate XX, 22-25) spherical or sometimes subspherical, with apparently smooth and moderately thick walls (2.5-4μ, chiefly 3μ in thickness), hyaline or light yellowish, 18-26μ, chiefly 19.5-22.5μ in diameter. Antheridia (Plate XX, 8, 9, 12-17b) temporary, hyaline, variable, sometimes irregular but chiefly ovoid to ovate, usually applied to oogonia near their place of attachment to the mycelium, chiefly 8.5-11.5μ in width by 14-17μ in length.

Development of oogonia, etc. It is not easy to make out exactly the stages of development of the oogonia even from living material. This is because the mycelium forms a matted growth within the tissues, often obscuring details. The very general notes given here were obtained partly by teasing into fine bits pieces of the seeds known to contain oospores and examining this material under the microscope and partly from microscopic examination of cultures of the fungus grown on artificial media in test-tubes, though some fixed and stained sections were also prepared for examination. No attempt was made to study the cytological phenomena. Apparently when the oospores are to be formed the mycelium becomes more abundant and is often crowded into matted growths of threads which are more variable and irregular in shape than normally. The mature oospores, therefore, are likely to occur more thickly in certain places rather than to be scattered uniformly in the tissues or cultures. So far as could be determined the antheridia and oogonia are developed on distinct mycelial threads. It was not possible to trace these threads far, as the mycelium by the tearing apart is more or less torn, but also it becomes less distinct on the differentiation of these organs, through loss of contents. These fertile threads possibly ultimately have origin on a common mycelium, but more probably they represent distinct mycelial strains mixed together whose combined presence is necessary for the production of oospores. The writer is inclined to the latter view, but was unable to determine any very distinctive characters by which an antheridial developing mycelium can be told from that bearing oogonia, if such really exist. Very often the mycelial threads had swollen places in them (Plate XX, 4) as if these might be tentative antheridia but which because of the absence of oogonial contact had run out again into threads, perhaps developing similar swelling further on. It seemed to be true, however, that the antheridia are not usually entirely differentiated on the thread until after contact with the oogonium. Likewise there were not found many isolated young swollen cells that represented the early stages of the oogonia. From this one would expect that, if there be distinct strains, their mycelia would not show, when grown separately, any development of antheridia or oogonian but would both form conidiophores. This would agree with DeBary's statement that, "In all known Peronosporeae and Saprolegnieae the antheridia are not formed until after the extremity of the branch which supports them, and from which they are afterward separated by a septum, has attached itself to the oogonium and this attachment takes places in the early stage of both organs."

In a preceding paragraph the mature antheridia were described. They are formed as a swollen cell (Plate XX, 12b) at the end of a mycelial thread or a short mycelial branch as circumstances determine, so that there are no characteristic antheridial threads. A basal septum (Plate XX, 14b) soon separates the swollen end of the mycelial thread into a distinct terminal cell, the walls of which remain thin. Usually the contents of the antheridia did not seem to be so sharply marked off from the cell wall as those of the oogonia, often appearing empty because of this lack of contrast. This was probably because oil drops are not so prominent a constituent as in the oogonia. Often after the antheridia are cut off the threads bearing them are empty of contents and difficult to trace any distance. Some of the antheridia showed, when isolated from the oogonium, a prominent protuberance (Plate XX, 8) but nothing was seen like a distinct fertilization tube which penetrated into the oogonium and through which the contents were emptied into it, as has been described for some species.

The oogonium also starts as a swelling (Plate XX, 10c) at the end of a mycelial thread or a short branch or in some cases is intercalary. It gradually enlarges and assumes a subspherical shape. It is thin-walled, filled with protoplasm and oil drops, and after emptying the thread from which it originates of the contents is separated from this by a septum (Plate XX, 13c). Usually before the oogonium has reached large size a young antheridial branch has reached it and the antheridium is formed at the base of the oogonium, that is, where it is joined to the mycelial thread. Soon after the application of the antheridium the oogonium reaches full size and a further step in its development appears in the transfer of its principal contents into a central denser mass, the *ooplasm* (Plate XX, 15, 16), which a less conspicuous marginal *periplasm* surrounds. This central ooplasmic body is soon further marked off by the formation of a thin limiting wall and is then known as the *oosphere* (Plate XX, 19). Though not observed, presumably by this time the antheridial contents have passed into the oosphere by means of a fertilization tube. From now on the contents of the oosphere show changes of development the character and sequence of which were not definitely made out. At the same time the wall of the oogonium becomes slightly thicker and eventually has a reddish brown tint. The periplasm does not seem to be prominent but probably assists in the formation of the wall of the oospore. This gradually thickens until 2.5 or 3μ thick (Plate XX, 22) and is uniform, smooth hyaline or slightly yellowish tinted and consists of a single evident layer, but outside of this the periplasm apparently forms an amorphous envelope which probably serves as a protection against absorption of water out of season. A large oil drop often occupies the center of the mature oospore and this is surrounded by a dense uniform layer of protoplasm. The oogonial wall permanently invests the mature oospore (Plate XX, 23, 24) as a loose envelope, but all signs of the antheridium are often obliterated by this time.

Germination of oospores. The germination of the oospores was tried several times, but they have failed to germinate up to the first of April of the year following their development. The germination of spores in pure cultures left out-doors during the greater part of the winter will be tried later, since they too failed to germinate as early as April.

Artificial cultures. This is the first time the downy mildew of Lima beans has been reported as grown in artificial cultures, and apparently the first report of the production of oospores of any mildew in cultures of this character. The writer has grown the downy mildew of the potato in artificial cultures during the past two years and even previous to this two French botanists had published accounts of its growth under similar conditions. The downy mildew of tobacco is said to have been grown in the same way. Apparently these three fungi, all belonging to the genus Phytophthora, are the only species of the Peronosporeae that have been grown in this manner.

The vigorous development of the Lima bean mildew in the fall of 1905 suggested that perhaps it could be grown on various media under control in the laboratory, as had been done with the potato mildew. As certain precautions are necessary to secure growths, a short account of the methods are given. In the first place a culture cannot be obtained by transference of spore material to a test tube from a growth on the pods. This is because of sure contamination with other fungi or bacteria which will stop or seriously interfere with the development of the comparatively slow-growing mildew. Neither can cultures be obtained from the spores by the Petrie dish separation method, because of their slow growth and more natural germination by zoospores instead of by germ tubes. The best method for securing pure cultures is to transfer into the culture tubes pieces of the tissue, or better whole seeds, which contain mycelium of the fungus, taking these from the interior of pods showing the freshest and least contaminated external growth of the mildew. Care should be taken in breaking or cutting open the pods and a sterilized knife or forceps are necessary to remove the tissue or seeds from the interior. The first attempts seemed to indicate that cultures could be easily obtained in this way but later experience showed that many of these became impure with age. Other fungi, especial Fusarium, closely follow the development of the mildew, and unless seeds or tissues in a very early stage of infection are selected some mycelium of these or bacteria will also be included and eventually spoil the cultures.

In the test tube cultures the following media were used: (1) Living beans on moist cotton. These cultures were obtained in two ways. (a) Beans were taken with aseptic precautions from diseased pods and placed in the test tubes. As these beans were usually already inoculated with the mycelium penetrating into them from the pod, the subsquent development of the fungus could be determined by examination from time to time. (b) Beans were removed from perfectly healthy pods with the same aseptic care and after placing in the test tubes were inoculated with a culture of the fungus or tissue from a diseased bean. The beans, especially the (a) cultures, usually formed a more or less evident, though not luxuriant, external growth of the conidial stage, but the greatest development was in the production of oospores within the tissues. The beans generally turned reddish brown, indicating enzymal action, and in some cases there was practically no external growth of the conidial stage. Plate XXI, a*, shows a bean artificially infected in which oospores were produced abundantly but on which practically no conidial growth occurred; at a** is shown a perfectly healthy bean. Most of the successful cultures were made on these living beans, as there was less interference from bacteria and other fungi when the cultures were impure. (2) Sterilized bean tissues, of which the following combinations were tried; (a) whole beans on moist cotton, (b) a mixture of ground green beans and pods, and (c) a combination of (b) the corn meal. These were fairly good media, but bacteria, yeasts and fungi bothered considerably if they were not inoculated with perfectly pure material. Both the conidial and the oogonial stages are formed. (3) Agar agar, usually made with (a) potato juice water but in some cases (b) with sugar, and peptone and certain salts. The mildew developed poorly in most of these trials, but both conidia and oogonia occurred to some extent. (4) Corn meal which was made up with (a) potato juice, (b) peptone, sugar and certain salts, and (c) ground beans and pods. Corn meal is a good medium when once the fungus gets started, and in these trials also both stages occurred. Because of oogonial production the fungus did not penetrate as deeply into the medium as expected.

Cultures of the mildew were kept going from the middle of September to the middle of November. At first there was a more luxuriant growth of the conidial stage than toward the end of the period and finally this stage seemed to so run out that it was practically impossible to continue cultures. At all times it was easier to start cultures from inoculated tissue than from tufts of the fungus transferred by needle from one tube to another. There was required, too, a certain degree of moisture in the culture to insure the best growth. By far the best results were obtained on the living bean cultures. Fungi, bacteria and yeast bothered considerably, especially on the sterilized media. It was very difficult to get cultures that did not finally develop such impurities, though a number of these were obtained. The growths of the Lima bean mildew were in marked contrast with those obtained of the potato mildew in that the development of the conidiophores was inconspicuous while the reverse is true in nature. No doubt the formation of oospores greatly interferes with the conidial development, and if this latter could have been secured alone, as it was with the potato mildew, a much more luxuriant external growth would have been made. One of the most interesting questions connected with the cultures of these two mildews is why in one case oospores were always produced and never in the other. This question is discussed more fully in the following article on the potato mildew.

PREVENTIVE MEASURES.

From the preceding discussion one can see that there are certain conditions that favor the introduction and spread of the mildew in the Lima bean fields. Some of these factors can be controlled, at least to a certain extent, by the grower. In the following paragraphs are given briefly the means by which he may hope to prevent or lessen the injury inflicted by this parasite.

Selection of seed. It has been shown how the dormant mycelium and the oospores carry the fungus over from one year to another in the seed. If possible, therefore, the seed should be gathered from a field entirely free from the disease. Where this is impossible a very careful selection should be made from pods that show no sign of the mildew and from these only the best and least shriveled should be used.

Rotation. It will do no good to select disease-free seed if this is planted on land that bore a diseased crop the year before, as the old seed rotting in the soil will probably furnish oospores for infection. Each year the beans should be planted on a different piece of ground, so that three or four years pass before it is again used for this crop. This is a practice not always followed, as one large grower in the state, at least, has planted beans year after year on the same land and his beans are sure to be attacked by the mildew if any are that year.

Destruction of rubbish. Where rotation is faithfully followed each year perhaps little good will be accomplished by destroying the old vines, as the oospores probably will not live in the ground more than a year or two. Where, however, the grower deems it very essential to use the same land the next year for Lima beans, the chances for infection will probably be lessened by gathering and burning in the fall all of the rubbish of the old crop. It should be borne in mind in this work that the pods and seeds are the parts it is most necessary to destroy.

Methods of planting, etc. The Lima beans are usually planted to climb upright poles and these are set in rows to allow cultivation in one direction. They should be set a sufficient distance apart in the rows (say three to three and a half feet) and the rows should be of sufficient width (about four and a half feet) to allow free entrance of the sunshine to dry off the foliage and prevent the enclosed air from being too damp. Neither should more than two or three vines be grown to a pole for the same reason. Low moist spots in the field favor the first infections and the spread of the mildew afterwards, so it is desirable if such exist to plant some other crop on these spots. So, too, considering injury from the mildew only, it is more advantageous to use a high dry field than a lower more moist one.

Spraying. Sturgis is the only investigator who has reported spraying experiments for the prevention of this mildew. His first experiments were made in 1893 with a number of fungicides, but as the mildew did not appear in this field even on unsprayed vines no conclusions could be drawn, except that the fungicides did not injury the foliage in any case. In 1897 he made further trials using Bordeaux mixture, ammoniacal solution of copper carbonate, potassium sulphide, and sulphur as the fungicides. The best results were obtained with a row that was sprayed three times with Bordeaux and twice with Amm. Sol. Cop. Car., as this yielded 296 marketable pods against 25 on an adjacent unsprayed row. Sturgis says, "The conclusion to be drawn from this experiment is that even in a season most favorable to the Lima bean mildew, thorough treatments of the vines with the Bordeaux mixture will ensure a crop."

While the writer has conducted no spraying experiments for the prevention of this mildew, he has watched certain fields in the vicinity of New Haven that have been sprayed. From these observations and the results of Sturgis' work the following suggestions are offered: Spraying need not be commenced before the middle of July, or possibly in very wet seasons about the first of this month. Bordeaux mixture is the most satisfactory fungicide and in later sprayings need not be replaced by Ammo. Sol. of Cop. Car. or potassium sulphide if the marketable pods are picked before each spraying. Even if some sediment does still adhere to the pods when picked, this can do no possible injury unless prejudice militates against their sale. The spray should be directed chiefly to the young parts of the vines and should be delivered in a fine mist. It is most important that the spray reach the pods and least important that the foliage be covered. Three or four thorough sprayings with Bordeaux mixture will probably be sufficient for most seasons. Most of the spraying observed by the writer has been partially ineffectual because it was done too early in the season and because the leaves were the parts chiefly protected.

Factors beyond control. Season is the chief factor in determining the amount of injury by the mildew. As stated before, very wet weather from July to September is favorable for the development of the trouble. Of course the weather can not be controlled, but where one has taken the preceding precautions his loss should be much less than one who has not. A second factor not under control is insect visitation. As shown by Sturgis, bees may spread the disease in a field and we have reason to believe that they may carry it to a certain extent from one field to another. This being the case, one who makes the preceding precautions to keep the disease out of his field should also isolate it, as far as possible, from other fields, especially from those that are likely to be seriously troubled. Where the fields are very close together not only insects but also the wind may help to carry the disease from one to another.

EXSICCATI.

Specimens of the Lima bean mildew have been issued in the following exsiccati, all the specimens having been collected in the vicinity of New Haven on *Phaseolus lunatus:* Seym. & Earle Eco. Fungi, 9 (Thaxter, Sept. Oct., 1889); Ellis & Ev. N. A. F., 2707 (Thaxter, Sept., 1890); Bri. & Car. Fung. Par., 351 (Rorer, Sept., 1901); Ell. Ev. Barth. Fungi Col., 1949 (Clinton, Aug. 29, 1902).

LITERATURE.

The following references to the literature of this mildew include all of any importance that the writer has been able to find. Even some of these contain only data taken from Thaxter and Sturgis.

1. **Berlese, A. N.** *Phytophthora Phaseoli* Thaxt. Riv. Pat. Veg., **9:** 41-4. 1902.
   Gives scientific description and general notes on this fungus, which he lists only from New Haven, Conn., drawing his data from Thaxter and Sturgis.
2. **Briosi, G. and Cavara, F.** *Phytophthora Phaseoli* Thaxt. Fung. Par. No. 351. [Illustr.]
   Issue specimens from New Haven collected by Rorer and give figures and descriptions taken from Thaxter.
3. **Clinton, G. P.** Downy Mildew, *Phytophthora Phaseoli* Thaxt. Ann. Rep. Conn. Agr. Exp. Stat., **1903:** 307-8. 1904. [Illustr.]
   Gives short general account of the fungus and suggestions for its prevention.
4. **Halsted, B. D.** Notes upon Mildew of Lima Beans. Ann. Rep. N. J. Agr. Exp. Stat., **1897:** 297-9. 1898. [Illustr.]
   Reports this very serious in Bergen Co., N. J., in 1897; mildew worst on low land that had Lima beans on it the year before.

5. **Halstead, B. D.** The Phytophthora of Lima Beans. Bull. Torr. Bot. Club, **25:** 161–2. 1898. [Illustr.]

Notes this fungus as serious in New Jersey in 1897, which was a wet season.

6. **Halsted, B. D.** Late Growth of Bean Mildew—*Phytophthora Phaseoli* Thaxt. Bull. Torr. Bot. Club, **26:** 20. 1899.

Notes late growth of the fungus, Oct. 24, on the green pods after the leaves had been killed by frost.

7. **Halsted, B. D.** The Downy Mildew of Lima Beans. Bull. N. J. Agr. Exp. Stat., 151: 18–24. 1901. [Illustr.]

Gives a general account of this fungus, which has proved a serious trouble of Lima beans in New Jersey in wet seasons.

8. **Halsted, B. D.** The Mildew of Lima Beans. Ann. Rep. N. J. Agr. Exp. Stat., **1902:** 399–403. 1903. [Illustr.]

Reports troublesome in New Jersey in 1902 and gives extracts concerning it from Bull. 151 of the New Jersey Station.

9. **Jaczewski, A de.** *Phytophthora Phaseoli.* Bull. Torr. Bot. Club, **29:** 649. 1902.

Salmon quotes portions of a letter from above botanist, who notes presence of this fungus in Russia.

10. **Orton, W. A.** *Phytophthora Phaseoli* Thaxt. Yearbook U. S. Dep. Agr., **1903:** 554. *Ibid.*, **1904:** 584.

Lists the fungus as injurious in Connecticut, New Jersey and Delaware in 1903; but in 1904 it is reported only from New Jersey.

11. **Saccardo, P. A.** *Phytophthora Phaseoli* Thaxt. Sacc. Syll. Fung., **9:** 341. 1891.

Gives scientific description taken from Thaxter and lists only from New Haven, Conn.

12. **Smith, C. O.** Mildew of Lima Bean. Bull. Dela. Agr. Exp., 63: 23–4. 1904.

Deals briefly with this fungus and notes its appearance in Delaware from July on in 1903.

13. **Speschnew, N. N.** Les parasites vegetaux de la Cakhetie. Arb. Bot. Gart. Tiflis, lief. 2, 1897. [Review: Zeitsch. Pflanzenk., **11:** 113.]

Lists *Phytophthora Phaseoli* Thaxt. from the Gouvr. Tiflis (Kaukasus).

14. **Sturgis, W. C.** Mildew of Lima Beans. Ann. Rept. Conn. Agr. Exp. Stat., **1893:** 77. 1894.

Used several fungicides but as the fungus was not present in the sprayed field their value was not determined.

15. **Sturgis, W. C.** The Mildew of Lima Beans (*Phytophthora Phaseoli* Thaxt.). Ann. Rep. Conn. Agr. Exp. Stat., **1897:** 159–66. 1898. [Illustr.]

Gives a general account of the fungus and shows how bees spread the fungus to the flowers; gives results of successful spraying experiments with Bordeaux mixture, etc.

16. **Sturgis, W. C.** On some aspects of Vegetable Pathology and the Conditions which influence the Dissemination of Plant Diseases. Bot. Gaz., **25:** 191–4. 1898. [Illustr.]

Shows how insects and wind are influential in the spread of *Phytophthora Phaseoli.*

17. **Sturgis, W. C.** Mildew of Lima Beans. Ann. Rep. Conn. Agr. Exp. Stat., **1898:** 236–41. 1899.

Made experiments to determine effect of thin and thick planting an upright and slanting poles on amount of mildew, which was very bad this season; looked especially for means by which it carried over winter in old rubbish but found nothing.

18. **Thaxter, R.** A new American Phytophthora. Bot. Gaz., **14:** 273–4. 1889.

Gives a general and a scientific description of this new species, *Phytophthora Phaseoli* Thaxt.

19. **Thaxter, R.** Mildew of Lima Beans (*Phytophthora Phaseoli* Thaxt.). Ann. Rep. Conn. Agr. Exp. Stat., **1889:** 167–71. 1890. [Illustr.]

Includes a general description of the fungus, an account of its germination, its relation to other species and methods for its prevention.

20. **Thaxter, R.** Mildew of Lima Beans. Ann. Rep. Conn. Agr. Exp. Stat., **1890:** 97–8. 1891.

Notes distribution of fungus in Connecticut, especially during this year.

21. **Thaxter, R.** *Phytophthora Phaseoli* Thaxt. Journ. Myc., **7:** 279. 1893.

Gives scientific description and references to literature of this fungus.

DOWNY MILDEW, OR BLIGHT, *Phytophthora infestans* (Mont.) DeBy., OF POTATOES. II.

In the Report of this Station for 1904 the writer gave the first installment of his work with the potato blight. This included a short general account of the life history of the fungus, so far as known, and of spraying experiments looking toward the most practical methods for controlling the disease. The investigations of the past year, reported in this article, have been made chiefly to determine more minutely and accurately points in the life history of the fungus in the hope that when this is definitely and completely known, prevention of its ravages will be an easier task to those who take advantage of this knowledge. The points that need especial elucidation are the way or ways by which the fungus *first* infects the vines in the summer (that is the primary infections), its history, if any, in the soil, and the means by which it is carried over from year to year. To gain such information the writer made careful observations of the very first appearance of the disease in various fields, examined the plants and tubers in all conditions of health and decay, carried on indoor inoculation experiments and grew the fungus in artificial culture for two years. We are not yet satisfied with what is known of the fungus and hope later to make additional reports concerning it.

Primary Infections.

Diseased plants. What conditions do the very first infections of the year in a given region or field require? We know that the disease has never appeared, or at least has never been recorded, in Connecticut before the first week of July, and sometimes it is not found before the middle of August, and that the more rainy, cloudy and foggy these months are the quicker it gets a start and the more rapidly it spreads. Smith and DeBary also report that the blight is seldom seen in Europe before July or August, though rarely it has been found even in May or June. The common belief, or at least the one advocated by DeBary concerning the advent of the fungus in a field, is that it comes from "diseased plants."

Perhaps DeBary's (2) views can be best shown by the following quotation: "The facts which have been observed establish that there are two methods by which the conidia may pass from the tuber to the foliage. *First,* it is known that the mycelium of the fungus in the tuber, even when in the ground, is able to produce conidiophores bearing conidia directly from the tuber. We can easily see how the conidia thus produced could reach the foliage—they might be carried up either by the growing plant which may have touched them, or by small animals which frequent both situations. Neither of these methods can be easily detected. Moreover, the formation of conidia in the soil cannot be very frequent. There should therefore perhaps be little weight attached to this method. The *second* method can be easily observed and with great exactness. It consists in the mycelium growing from the tubers in and with the young plants and producing conidia on them in the usual way; and these [diseased plants!] of course extend the fungus to the healthy plants beside them. In 1861 I called attention to the fact that tubers containing Phytophthora when they are growing, not unfrequently send out shoots into which the fungus passes from the tubers. The fungus advancing slowly in its growth at last kills the shoots, which for the most part were always in a sickly condition. The same tubers, as is known, may also send out healthy shoots at the same time. I further showed that under special circumstances the fungus in these diseased shoots develops conidia. These were not conjectures, but facts observed in experiments. The observations, however, were not made in the open field, but in the house and laboratory, and had not been confirmed by myself or observed by others in the open field." DeBary tried to demonstrate this second theory by planting tubers he infected through the eyes outdoors along with healthy ones, and observing if, upon the growth of the plants, the disease spread to the leaves of all the plants. In his first trial, although he grew a diseased plant, the fungus never fruited on this and so did not spread the disease. In the second trial the healthy and diseased tubers were planted out early in the garden in a box and several diseased shoots appeared which in time developed a fruiting condition of the fungus, so that before the end of May the blight had spread to many of the leaves of all of the plants. This was long before its appearance elsewhere in the neighborhood.

The writer, thinking that DeBary's "diseased plants" might offer the best explanation of the first appearance of the blight, made special search for them in different fields after the vines were above ground at various times up to the general appearance of the disease, but was not successful in finding such plants. True, one sometimes finds plants stunted by the bacterial stem rot and also those with cankered areas on the parts below ground caused by the Rhizoctonia fungus, but no sign of any disease like or unlike these containing outbreaks of the blight fungus. For two or three years efforts also have been made in the greenhouse to produce blight diseased plants from tubers known to contain the mycelium of the blight fungus. The badly diseased tubers often failed entirely to grow; others, less diseased, produced plants, sometimes making a poorer growth than usual, but never showing any signs of the blight. Thinking that possibly the greenhouse conditions were not favorable for determining this point, as the atmosphere there was usually rather dry, a more extended experiment was conducted outdoors in the spring of 1905. Through the kindness of some thirty Connecticut potato growers who had suffered from rot of tubers in 1904, a few potatoes showing disease were obtained from each. While these growers were requested especially for tubers showing the reddish superficial rot characteristic of blight, the potatoes sent showed the Rhizoctonia, scab, and Fusarium rot troubles as much or more than they did the blight. The tubers were divided into five lots and planted in five rows, as follows: (1) tubers freest from disease, also treated with formalin; (2) same as (1) but not treated; (3) tubers badly scabbed; (4) tubers with abundance of Rhizoctonia; (5) tubers with Fusarium or blight rots, or both. In the last case some of the tubers were badly rotted and the plants in this row came up somewhat slower and less uniformly than in the others, but there were no blight diseased plants seen at any time and the first blight that appeared was on leaves of a plant in the row whose tubers had been selected as freest from disease and then treated with formalin! Neither did the tubers produce any more rot in the fifth row than those in the other rows, while the row of scabby tubers produced a crop badly scabbed and the Rhizoctonia row one with that trouble very prominent. Other experimenters (Smith, DeBary) have also reported cases in which perfectly sound plants were grown from blight-diseased tubers.

The only instance in which the writer has seen anything like a blight-diseased plant, as recorded by DeBary, was in the greenhouse, where a healthy tuber, planted in a crock with the top just above the surface of the soil, was inoculated with the blight fungus on one of the young buds, which was then covered with moist cotton and a small bell jar. This bud was finally killed and the reddish brown rot of the blight extended in time down into the tissues of the tuber about a quarter of an inch and spread for some distance beneath the skin, reaching another eye from which eventually was grown a stem several inches long. This stem, see Plate XXIV, b, about thirty or forty days after the inoculation showed a reddish brown discoloration on the exterior from the base to the tip and the conidial spores of the blight fungus were produced sparingly upon it. The interior tissues of the stem, however, seemed to be perfectly healthy and free from the fungus, and so if the disease came from the mycelium in the tuber growing up into the stem, this growth occurred in the external tissues rather than through the bundles, as one might expect. There was a possibility, even in this case, that the disease was inoculated externally by lice carrying spores from the inoculated place on the tuber, since perfectly healthy stems grew out of the sides of this diseased one. So far as the writer can judge from reports in literature and his own experience, *DeBary's "diseased plant" method of primary infection does not seem to have sufficient support so far to justify the belief that it is the common method in nature.*

Contact of leaves with ground. But if the blight does not generally first spread from a diseased plant, how does it start in a field? There is offered here an explanation which our observations of the past year seem to indicate as the ordinary method of infection. Possibly this idea has been advanced before, since the writer has not carefully examined the literature to determine this point. In support of our observations that the blight does not usually start from diseased plants, let us first quote the following from Smith (6, p. 293): "It is obvious that if the potato disease is annually reproduced by diseased tubers containing perennial mycelium, the disease must invariably begin in the seed tuber and ascend the stem; but it is known by experience that in the vast majority of instances this is not the case, but that the disease first invades the leaves." This corresponds with our observations of the past summer; namely, that the disease first appeared on a few leaflets, often on the outermost leaves, of the fully grown, perfectly healthy plants, and these conditions of its appearance preclude the belief that the disease came by the mycelium in the diseased tubers ascending the stems and growing out into the leaves, all without causing any injury or evidence of its presence until finally it produced the characteristic black spots on the isolated leaflets! But Smith does not state definitely how the disease came on the leaflets in these cases. We believe it comes *by contact of the leaves with the ground at the critical wet periods of July and August when the germs of the blight are probably first generally available in the soil for infection, and that this is the usual method of primary infections in the fields.*

In support of the preceding statement we give the following evidence: The season of 1905 was dry during midsummer, so the blight was backward in its appearance. A number of fields, chiefly in the vicinity of New Haven, were examined from time to time to note the very first signs of blight. Weather favorable for this trouble came on about August 9th to the 16th and the first blighted leaves found anywhere, August 11th, were in an isolated field at Southington that had not been examined before. This field of two or three acres had been in potatoes the year before but was greener and in a better condition than many fields at this time, as the drought and other agents had been very injurious. After a careful search of the field the attempt to find any blighted leaves was about to be given up when two plants near together were found on which a dozen leaflets showed a single blight spot each. *Two of these leaflets were still in contact with the moist ground and half of the others showed by the dirt on them that they had recently been in contact with the soil.* Of course it is possible that some of these spots may have come from secondary infections, as the fungus was already fruiting on these leaves. There was no sign of a diseased plant in the field so far as observed and certainly none in the vicinity of the outbreak, and an examination of the two plants having the diseased leaflets showed no sign of the fungus on their stems. The later development of the blight in this

field was not observed. The second place where the blight was found was on August 12th, in the small isolated plat at the Experiment Station, previously mentioned, where the tubers showing different kinds of disease were planted. In this case they were in sod land that had not been in potatoes before. The plat was carefully watched, so that a diseased plant could not have escaped observation. Here, too, no such plant occurred and the blight first appeared on a healthy plant which had about ten leaflets with single blight spots, in fruiting condition, when found. Two of these leaflets were still in contact with the soil and two thirds of them showed dirt on their under surface, indicating recent contact with it. There were no outbreaks anywhere on the stem of this plant or even on the parts below the ground so far as could be observed. The disease afterward gradually appeared throughout the plat. The third case found was in an isolated field of half an acre in Whitneyville, by which the writer often passed and stopped to look for the blight. This was first found August 16th, when after a careful search a plant was discovered with a single leaf showing the blight. While this leaf was then off from the ground, the dirt on its under side again showed recent contact with it. A photograph of this leaf is shown in Plate XXIII, a; only the badly diseased leaflet was producing conidial spores. No sign of the blight was found on any other part of the plant, though looked for carefully. In a second place in the field, but removed from this, another plant was found with several blight spots on the leaves, some of which were still in contact with the ground. Here the blight had spread, in some cases, from the blades onto the pedicles and petioles, but these were always near the blight spots and all of the petioles were perfectly free from the disease at their base. There was again absolutely no sign of the fungus on the stem of the plant. Later the blight gradually spread over the field. Other fields examined up to this time had shown no blight, but by the 22d of August it was found appearing generally in a number, so that from this time on the disease was not uncommon in fields still green.

Planting potatoes without rotation. It is not an uncommon practice for farmers in this state to grow potatoes two consecutive years on the same land and there is at least one field in the vicinity of New Haven that has had potatoes on it for several years in succession. While the writer has not yet determined from his own observations whether the fungus can carry over the winter in the old tubers in the soil, Massee (3) of England makes the following very definite statement: "I have observed the important fact that, when the diseased potatoes are planted, after the crop has been lifted, the remains of the old seed potatoes when brought to the surface of the ground will produce a crop of the fungus bearing myriads of spores. If such old seed potatoes are kept buried in soil until the following year and then exposed to light, under favorable conditions, fungus fruit is still produced, and continues to grow so long as a scrap of the old potato remains. I have now in the laboratory at Kew Gardens scraps of last year's seed potatoes covered with the fungus, and with the spores thus produced have successfully inoculated the leaves of young potato plants." If Massee's statement is true, then fields used two years in succession should, as a rule, develop the blight earlier and spread it more rapidly than fields not in potatoes before for some time. As the writer knew of three fields which had produced a badly diseased crop the year before and were used again last year for potatoes, these were examined to see if this was so. The one most carefully watched was in Westville and had abundant rotten tubers from the preceding crop left on it. In this case, however, the vines were practically dead before any blight appeared in the neighborhood, so that all that could be determined was that its use a second year did not cause an unusually early appearance of blight in it. The other two fields were at Green's Farms and so could not be watched so closely. When first examined on August 19th they both showed blight more prominently than other fields in the neighborhood. This was especially true of the earlier plant field, in which the blight was very prominent, while another field on the same farm isolated from this, but on land not in potatoes for years, was at this time practically free from blight—only a single blighted leaf being found there. On August 28th at Hamden a fourth field was examined that was said to have had potatoes on it several years in succession, and this showed more blight in it than had been seen in any field up to that time in the vicinity of New Haven. Other fields examined generally showed an earlier or a more vigorous start of the blight if they had been in potatoes the year before. *We do not wish to state positively, from these observations, that the blight starts earlier and more vigorously in a field that bore a blight-diseased crop the year before,* as such factors as situation of the land, earliness of planting, etc., may need consideration here, *but so far as they go they seem to point to this conclusion.*

SECONDARY INFECTIONS.

By secondary infections are meant all those that take place from and after the original infections (the outbreaks on a diseased plant, if such exists, or on leaves infected from contact with the ground), and thus generally spread the disease to the leaves of these plants, to those throughout the field or even to other fields. The means cited here (rain, wind, and insects) have usually been considered agents for the distribution of the blight spores, though few special observations have been published showing them to be such or indicating how far the disease may be carried by them. To determine these points more fully the following observations and experiments were made the past year.

Rain. The testimony of all who have written concerning blight shows that rainy or moist, muggy weather is absolutely essential to the development and spread of blight in the fields. This is especially necessary for this fungus because the spores on germination usually form swimming spores, *zoospores,* which are the common agents of infection. Not only is moist weather necessary for infection, but dry bright weather following the infection largely stops the spread and even the development of the fungus already within the leaves. The moist blackened tissues then dry up, and though the disease may seem to have suddenly caused great damage, it is not progressing into the healthy green tissues beyond as it would have done had the weather remained moist. Rain not only induces the formation and germination of the spores, but it serves as an agent in distributing them over the infected plants and also washes them down into the soil to the tubers. It can not of course be of much service in carrying spores from one plant to another unless they overlap, and therefore by itself could only very slowly spread the disease throughout a field if there had been but a single starting point.

Wind. It is not so easy to prove that wind serves as a means of distribution, but it no doubt acts as a carrying agent of the spores to vines in the same field or to fields situated closely together. The fungus, however, is not especially adapted for dispersal by the wind, since the spores are borne on the under side of the leaves and on the whole are not produced in great abundance. The dry winds of bright weather would be of little value, as it is in such weather that the spores rapidly lose their power of germination and would find least opportunity for germination, even if carried into a field. It does not seem likely, therefore, that wind is a common agent in carrying the spores from one isolated field to another. The case cited in a previous paragraph—the field the second year in potatoes at Green's Farms in which blight developed vigorously and early—seems to indicate that wind may be a prominent agent of dispersal for short distances, since the prevailing winds were from the direction of the infected field toward an adjoining one, which also soon became infected with the blight.

Insects. Apparently insects are a common agent in the distribution of the spores throughout a field, and the chief means of conveying them from one field to another somewhat remote. In other words, if it were not for insects, the selection of an isolated field which had not been used recently for growing potatoes and which was planted with tubers free from the disease should give a crop exempt from blight. The most common insects in the potato fields of Connecticut are the flea beetle and the common potato bug, or Colorado beetle. The latter is well adapted for carrying spores, since the under side of the tarsi of the legs, especially the third tarsus, is provided with a stiff brush of hairs that would easily retain spores temporarily as the insect crawled over an infected leaf. The only insect examined to determine this point did not actually have the spores of the blight fungus on the brushes of hairs, but these did have spores of other fungi, showing they could serve such a purpose. The soft, somewhat moist body of the larvae of the potato beetle, too, possibly aids in distributing the spores. Just how helpful to the fungus the flea beetles are in this work is not known.

To determine whether insects could carry the blight from one isolated field to another, an experiment was conducted last year at Mr. Burr's place near Green's Farms. The potatoes were planted in a garden on soil that had not contained potatoes for at least five years. The garden was isolated and well surrounded by trees, etc., and was not situated so that wind would blow from another field toward it. The nearest potatoes were at least an eighth of a mile away and the badly diseased field mentioned before, about half a mile. The seed tubers were obtained from Colorado on the recommendation of Mr. Orton of the Division of Vegetable Pathology of Washington that this was a region of the United States exempt from blight. So far as could be learned, the grower of these potatoes had never been troubled with this disease and Professor Paddock of the Colorado Experiment Station writes that he has never identified the blight in that state. These potatoes were examined the same time, August 19th, that the writer looked through the other fields on Mr. Burr's farm. After a searching examination a couple of leaves showing the blight were found, and Mr. Burr wrote in the fall that eventually these potatoes suffered from the blight about as badly as the others. Without much question the potato bug was the means of introducing spores for the first infection, after which the blight spread from this throughout the plot. Part of the Colorado potatoes were planted on land not recently in potatoes, but very close to the badly blighted field mentioned before, and these on August 19th showed considerable blight on the leaves. Both the wind and insects were no doubt the carrying agents here. Some potato seed was also obtained from this Colorado grower and planted in the greenhouse during the winter and the young seedlings set out later on the Experiment Station grounds about five rods from ordinary garden potatoes. These seedlings, too, became infected with the blight, but not until sometime after it appeared on the garden potatoes. The potato bug was again the most probable carrying agent. From this experience, the writer concludes that *the grower can not depend upon isolation of a field and absolute freedom of soil and tubers from the fungus to secure a crop free from blight* since insects are very likely to carry in the disease, *though the more isolated the field the less likelihood of infection.* Such conditions, however, will insure a later appearance of the blight in the field, but whether retarding the invasion will prove of any practical value will depend upon how long the infection is delayed and the weather conditions thereafter.

Artificial Infections.

By this is meant indoor infections produced by the writer, chiefly with pure artificial cultures of the blight fungus. To secure infection it is necessary that the cultures be in fresh spore-producing condition and that the inoculated plants be kept moist or in a moist atmosphere, not only during the infection period, but also afterwards if the fungus is expected to appear in its fruiting stage on the surface of the infected parts. The few experiments tried were made to determine how easily infection takes place under different conditions and how soon the conidial stage appears after the spores are applied. Both leaves and tubers were used as subjects for infection.

With the leaves. DeBary showed that the germ tubes of the zoospores of potato blight can enter the leaves either through the stomates or by penetrating directly through the epidermis. The usual method in the latter case is for the germ tube to push its way down between the walls where two cells come together and then grow down into the intercellular spaces of the leaf beneath, but DeBary also observed cases in which the germ tubes bored directly into the epidermal cells themselves. The ability of the fungus to gain entrance in these various ways greatly aids its spread over its hosts. The stomates are more numerous on the under surface of the leaf, but most of the infections probably take place from the upper surface, as the spores are most likely to be carried here from the conidiophores borne on the under surface of leaves above.

In our infection experiments after the spores were placed on the upper surface of the young leaves, usually by the end of three days it could be determined if the inoculation was successful by the slight discoloration of the tissues. By the end of the fourth day this discoloration was more evident and conidiophores were beginning to protude through the stomates, and by the end of the fifth day the diseased spot was well marked and a few mature conidiophores and conidial spores were present. As these spores can germinate immediately, secondary infections could take place within five days after the primary. Perhaps the development of the fungus can be shown best by a detailed account of the infection of the plant shown in Plate XXIV, a, which was photographed ten days after the spores were applied. Its history is as follows: *January 11th*, placed spores in water on three lower leaves, covered each with a small piece of moist cotton and the plant with a small bell jar. *January 14th* (3 days), the two lower leaves showed slight discoloration at points where spores were placed. *January 16th* (5 days), the spots were well marked and conidiophores and spores were formed in small numbers. *January 18th* (7 days), about two thirds of the two lower leaves were plainly diseased (yellowish, limp and partly blackened) and the conidiophores were developing over the greater part of this area, but most abundantly on lower surface; two diseased streaks showed on the stem but had few conidiophores on them; petiole of one leaf was covered with conidiophores, but showed little discoloration. *January 21st* (10 days, see illustration), the two lower leaves were dead and hanging limp; the third leaf showed yellowish discoloration over apical half and was producing conidiophores; the fourth leaf (apparently a secondary inoculation by lice) had a few conidiophores on it, but no injury to its tissues showed as yet; several blackish streaks showed on the stem where the fungus had gained a foothold from the diseased leaves above.

With the tubers. There are a number of different conditions under which inoculation of the living tissues of the tubers may be tried; namely, on the cut surface in a moist atmosphere, on various uninjured parts (eyes, buds, skin) before or after removal of the tuber from the plant, or on these same places after mechanical injury to them. In the experience of the writer the development of the fungus varies greatly under these dissimilar conditions. It grows most luxuriantly, at least externally, on the cut surface of the tuber in a moist atmosphere. Before inoculation it is always desirable to soak the whole tuber in a 2 per cent. formalin bath for half an hour and to use a sterilized knife in cutting it, in order to limit as much as possible the development of other fungi and bacteria which easily crowd out the Phytophthora. Discoloration of the tissues, at least for some time, does not follow the development of the fungus on the cut surface of the tuber; this probably indicates very superficial penetration into the tissues.

DeBary states that he secured infection of the tubers very readily through the terminal eyes. Presumably the buds were slightly developed in the tubers he used. Our experiments, at least, seemed to indicate that it is very much easier to secure successful inoculation through the very young buds than it is at the eyes of a perfectly dormant tuber in which no bud is yet evident. These experiments, too, go to show that inoculations on the uninjured skin of a dormant tuber are not likely to be successful, while at the same spot if the skin is first injured by a knife puncture the inoculation succeeds. Likewise, in the single experiment tried, the inoculations were not very successful on the uninjured skin of very young tubers still attached to the plant, and scarcely more so when the tissues were injured before inoculation. Possibly some of these results were partly due to the age of the cultures used, but even then there seems to be no doubt that there is greater variability and difficulty in securing infection of the tubers than of the leaves.

Three of these inoculation experiments with the tubers are recorded here: *1, November 19th,* tried to inoculate five dormant tubers, using artificial cultures of the blight. Each tuber was buried in the soil of a crock so that a single lateral, deeply indented eye, showing no sign of bud formation, was exposed above the surface of the soil. These uninjured eyes served as a cavity into which the spores and water were placed, when they were then covered with watch crystals lined with moist paper to retain the moisture. The tubers, however, were so thoroughly seasoned that the water in the eyes was rapidly absorbed and had to be replaced many times during the next few days, though the soil around the tubers was also kept moist. Possibly this dying out influenced the result, for not a single inoculation was effective, and at the end of 32 days the tubers were still perfectly sound at these eyes. *2, December 21st,* used the same tubers but placed the spores away from the eyes on a small spot where the skin had been injured by a knife. On examination ten days later rots showed at all of the points of puncture. Some of these were the characteristic dry reddish brown rot of the Phytophthora, with or without the conidiophores showing slightly at the punctured point, while in other cases bacteria were also agents of the decay. January 9th one of the tubers was half rotted and a short shoot from it had been killed by Phytophthora and bacteria, having, apparently, become inoculated externally by lice. February 21st, took up all of the tubers and the plants that had developed from them. All of the seed tubers were entirely rotted, showing more or less of the characteristic reddish brown dry rot of the Phytophthora, especially near the outside, but all but one had produced plants and small tubers. None of these new tubers showed any sign of rot; neither were any of the plants diseased. Cross sections of the stems close to the old seed tubers and of the underground shoots running from these to the new tubers in no case showed any sign that the mycelium of the blight fungus had passed or was passing from the diseased tubers into these. *3, February 21st,* inoculated four young tubers (about one inch in diameter, growing in greenhouse bench) with culture of the blight fungus,—two with and two without injury to tissues. February 23d the injured spots showed evident but very slight rot, while the uninjured showed doubtful start. March 20th the injured spots had rotted but little, being only ¼ of an inch in diameter and extending but slightly into the flesh; while the uninjured spots were only about ⅛ of an inch in diameter and still more superficial. The fungus did not fruit at any of these places and bacteria may have been partially responsible for the rot, though in the case of the check tuber, injured but not inoculated, no rot appeared.

Artificial Cultures.

So far as known to the writer, the reports of Matruchot and Molliard (4, 5) made in 1900 and 1903 are the only ones so far published concerning pure artificial cultures of the blight fungus. The work reported here was begun in the fall of 1904, before learning of the investigations of these French botanists, and has been carried on now for about two years. Growth of the fungus on various media in test-tubes was undertaken chiefly to see if this would not throw some new light on the life history of the fungus, especially with regard to the missing oospores. The general results obtained agree with those of the French investigators, though the details of methods and media used were not altogether the same.

How obtained. Pure cultures of the blight fungus are not so easily obtained as are those of many fungi, since because of their slow growth they are easily crowded out in competition with other fungi, and because the ordinary Petrie dish separation method is not available with their spores, which prefer a fluid medium for germination. Matruchot and Molliard apparently made most of their cultures by exposing the cut surface of an infected tuber in a moist chamber until the fungus ran out on this in its fruiting stage, when material from the growth was transferred by a sterilized needle to test tubes containing various media. Such growths on the tubers are nearly always contaminated and usually only a few of the cultures made from them remain pure. If the tubers are first sterilized on the outside by a bath in formalin and cut with a sterilized knife, better results will be obtained. It is desirable, too, if possible, to use only tubers showing a superficial decay of the Phytophthora rot. On the whole, the writer was most successful in obtaining cultures when the reddish brown diseased tissue from the interior of a tuber next the healthy tissue was removed in small pieces, about a third of an inch in diameter, by a sterilized knife and then inserted on the medium in the test tube. In this case the mycelium from the diseased tissue in time runs out onto the medium and often produces a pure growth of the fungus. Where infected tubers are not available for cultural work, the fungus can be started on the freshly cut surface of a sterilized tuber by suspending over it a leaflet containing a vigorous, fresh outbreak of the blight. The spores falling on the cut surface soon start a growth of the fungus, from which material may be transferred to the test tubes. Here, too, contaminations usually prevail in spite of precautions. Plate XXIII, b, shows a nearly pure growth of the fungus started in this way. One of the most common fungous interlopers is a species of Fusarium and it is often impossible to distinguish between the growths of this and the Phytophthora and they soon become intermingled. Microscopical examination is usually necessary to determine which part of the growth on the cut surface of the potato presents the blight fungus in a pure condition.

Media, appearance, etc. Altogether twenty-five to thirty different cultural media and modifications of the same medium were tried to determine the most satisfactory ones and also to see if the fungus could be induced, under different conditions, to develop any unknown stage. These media fall in four general classes; viz., 1. Plugs of living plant tissue, 2. Sterilized plant products, 3. Agar agar media, 4. Earth and manure. The results are discussed briefly in the following paragraphs.

1. The writer found, as did Matruchot and Molliard, that plugs of living tissue taken with antiseptic precautions from the interior of a potato, and to a less extent from the pumpkin, offered a very favorable medium for the growth of the fungus. These plugs were cut from the interior of a sterilized tuber with a knife, which had been sterilized with heat and allowed to cool so as not to sear the tissue, and after slicing off the sides a second time were placed in the test tubes on a sterilized cushion of cotton saturated with water. With proper care these plugs can usually be obtained free from organisms and if the atmosphere of the tube is kept sufficiently moist upon inoculation the mildew forms a very favorable growth. This is more or less luxuriant, apparently, according to the conditions of moisture and the success with which the original infection took place. Sometimes a scanty growth of normal conidiophores producing numerous spores occurs or again a conspicuous pure white felt develops, of which a large part is made up of mycelial threads. Plate XXV, a, shows (b) a rather scanty and (c) a very luxuriant growth of the fungus, (a) being a check or uninoculated tube. On the other hand, similar plugs taken from the sweet potato, apple, and cucumber gave practically no growths.

2. Sterilized corn meal properly mixed with water was the best medium used. The chief difficulty lies in inoculating these tubes, as the top of the corn meal usually dries out in a short time into a hard mass and this may prevent the fungus getting a proper start. On the other hand, the mechanical conditions allow the fungus, when once started, to gradually work down toward the more moist base of the tube. To facilitate inoculations and removal of tufts of the fungus, it is best to have the corn meal in a slant at its upper end. Plate XXV, b, shows a growth of the mildew on corn meal, of the same age as those shown on the potato plugs. In the few trials made, a mixture of ground green Lima bean pods and seeds with corn meal gave very satisfactory growths and probably this medium without the corn meal would do as well. Sterilized potato plugs, however, gave scarcely any growth, and according to Matruchot

and Molliard this is due to the mechanical interference of the swollen starch grains in preventing the spread of the fungus.

3. Agar agar cultures, with various ingredients added, were tried, but on the whole were less satisfactory than the preceding media. Most of these cultures gave slight growths, while, in all, the fungus was slow in developing. Usually a slight growth of the mycelium penetrated the medium and a more or less conspicuous development of conidiophores and mycelium was formed on the surface. Potato and pumpkin juice agar media were as satisfactory as any tried. Plate XXV, c, shows an old culture on pumpkin juice agar, in which the development was more prominent than usually obtained on agar media.

4. Sterilized manure, earth, mixtures of these and of these with other ingredients were used to a limited extent to see if they would furnish proper media for the development of the fungus. It was thought that if this was the case there might be some ground for believing that the fungus made some such development in nature. In all of these trials the growths made were very slight or there was none at all. The very poor growths noticed were due, in some cases, to the medium added with the fungus on inoculation. So far as could be learned from these cultures there is no reason for believing that the fungus makes any unknown growth in the soil.

Results. These investigations showed that the fungus can be grown in artificial cultures rather readily under favorable conditions. The cultures can be kept alive for some time, especially on a medium, as corn meal, allowing the fungus to spread slowly through it. By occasional re-inoculations the fungus, apparently, can be kept indefinitely in culture. In some cultures and under some conditions, there is a more luxuriant development of the fungus than in others. The most conspicuous growths usually indicate a more vigorous mycelial than conidial development. No sign of an oogonial or other unknown stage appeared in any of the cultures. In one case, however, there was a very slight growth from the pieces of an infected tuber inserted in agar tubes and in this medium some peculiar swollen bodies were formed whose nature was not definitely determined. They resembled somewhat the immature so-called oospores that Smorawski (7) has figured. A few cross inoculations were tried with cultures obtained from different sources, but nothing unusual occurred. These trials were made with the hope that different mycelial strains might be discovered whose growth together would result in the production of oospores. As the different cultures were few in number and were obtained chiefly from the same vicinity, but during two different years, it is not desirable to draw even a negative conclusion from the results.

Perpetuation of the Fungus.

The known vegetative and reproductive states of downy mildews in general are mycelium, conidial spores, zoospores and oospores. The conidial spores and zoospores are so short lived that these fungi, so far as known, have to depend on the mycelium and oospores to carry them over the unfavorable winter period. In the following paragraphs is discussed how the potato blight is, or possibly may be, perpetuated.

Dormant mycelium in tubers. So far, this is the only way in which it is positively known that the fungus survives the winter. The disease caused by its presence in the tuber does not need to be conspicuous, and in fact the more diseased the tuber the less capable this is of germinating and so, presumably, the less likely it will be of perpetuating the mildew. The fungus may be present in the tuber and yet escape notice, as the rot is sometimes very superficial and slight; in fact DeBary records a case where the fungus grew out on the cut surface of a tuber he was using for an experiment on the supposition that it was entirely free from the fungus. This being true, it is doubtful if much good would result where tubers were selected to avoid diseased ones, though it is not advisable, of course, to use those showing a superficial or even deep-seated reddish brown dry rot. The mycelium in the tubers seems to be much less active in the spring than when the tubers are first dug. Ordinarily in the fall if the cut surface of a diseased tuber is exposed in a damp chamber the fungus will spread more or less over this surface. On the other hand, of the thirty samples obtained from Connecticut growers and tested in this way in the spring, the fungus developed on only two lots, yet most of those tried had the appearance of blight tubers. This decreased activity or vigor of the fungus is apparently due to the drying out of the tissues of the tuber, which induces a hibernating condition of the mycelium, and in some instances where the tubers have been stored in unusually dry places no doubt the mycelium does not survive.

Two views are advanced to explain how the mycelium in the infected tubers planted in the spring perpetuates the fungus. First, by growing up from the tuber into the stem, it produces a "diseased plant." This view has been previously discussed in the paper. We believe that the mycelium rarely passes up into the plants in this way, and just as rarely passes down from the plants after infection into the new tubers, as was formerly believed by some investigators. Second, the mycelium forms the conidial stage on the cut surface of the tubers or rarely in tufts through punctures in the skin, and the conidial spores or their zoospores, on being carried to the buds of the tuber or later to older parts, cause infection. The chief objection to this view is that infection in this way probably could only take place during a short time in the spring (the writer's and DeBary's experience indicates that the mycelium forms the conidial spores only on the living and not on the badly diseased tissue of the tubers) whereas the first visible outbreaks, so far as known, do not appear until July or August. Could it be possible that owing to the rapid growth of the young plants these primary infections remain isolated in the tissues and do not develop further until the growth of the host ceases and favorable blight weather appears?

Heterœcism. This means that a fungus has different stages of its development on different hosts, as is the case of the wheat rust with two stages on barberry plants and later two more on wheat. DeBary, who first demonstrated this life cycle of the wheat rust, has discussed the possibility of the potato mildew being heterœcious. He concluded that there was no likelihood of this being so, though at one time false rumors stated he had found a different stage on another host. There are absolutely no data in favor of such a supposition for the potato mildew and no evidence of heterœcism has ever been found for any of the downy mildews.

Unknown stages. Various writers, often to support some theory, have suggested possible or probable stages of the potato mildew, not known for other downy mildews, but no real evidence of their existence has yet been produced. For instance, Smith (6, p. 292) writes: "It is not unreasonable to imagine that some other condition of the parasite, at present quite unknown to and unsuspected by us, might be brought to light. The fungus may exist in inconceivably fine dust-like particles or in the condition of a mucous fluid." This was an entirely theoretical suggestion, but a Scotchman, A. S. Wilson (8), advocated a more definite unknown stage. His theory was as follows: 'Certain bodies were found on the under side of leaves, in all parts of the stem, especially at the nodes, and in the tubers, especially around the eyes. These he originally called sclerotiets (analogous to sclerotia) but later named them granules of mucoplasm. They are translucent, microscopic globular bodies coated with oxalate of lime. His observations caused him to believe that these, on germination, gave rise to the mycelium of the potato mildew and that thus the disease could break out on any part of the host without translocation. As the resting spores are not parasitic but live and germinate in the soil or in any dead matter, it is contact with the mucoplasm exuded from their fresh mycelium which originates the parasitism in the potato. As the tubers are infected, especially at the eyes, with mucoplasm granules, the general elements of the parasite are carried over from one race of potatoes to the following and from one season and country to another, not requiring invasion from without for a new display of the disease.' This is apparently a case where there is too much theory and too little exact observation and no experimentation to back it.

Oospores. These are thick-walled sexual spores often produced by the downy mildews and constitute the common means by which they are carried over from one season to another. Several investigators claim to have found these spores for the downy mildew of potato, but in no case have they produced sufficient evidence to satisfy botanists in general of their reality. Different suggestions have been advanced to account for the absence or rarity of these spores, and these, briefly summarized, are as follows: 1. That the oospores have never existed for the potato mildew. 2. That this mildew has lost the power to produce these bodies. 3. That they may occur only in certain regions of the world. 4. That they are produced only in certain hosts,—the potato mildew having been found on a number of other plants. 5. That they are formed in the potato more as a saprophyte than as a parasite. 6. That possibly these spores are formed only on the union of distinct mycelial strains which do not commonly occur together—a suggestion by the author.

The more the writer looks into this matter the more he is inclined to believe that oospores of the potato mildew do exist, especially since he has recently demonstrated their presence for the closely related species occurring on the Lima bean. Therefore, so far as he is concerned, the first two suggestions given above may be dismissed as unsatisfactory. Those persons who suggest special regions where the oospores may be found name Chili, the original home of the potato, as a possible locality or region where the genus Solanum occurs in a wild state. This mildew has been recorded on a number of the Solanaceae, more especially on the genus Solanum, and even on a couple of the Scrophulariaceae family. The writer has not had opportunity to study the blight to any extent outside of Connecticut, and, besides the potato, has collected it only on the tomato. Specimens of the latter, collected both in Connecticut and Porto Rico, did not throw any light on the oospores. The question of hosts and distribution cannot, therefore, be discussed on the basis of personal experience. The fifth and sixth suggestions, however, have had our attention during the past two years and may be discussed further.

Are oospores produced in decaying potato tissues? Worthington Smith, of England, was the most prominent advocate of the existence of oospores and claimed to have found them commonly in that country in the decaying leaves and tubers. The Royal Horticultural Society awarded him a gold medal for his alleged discovery. While his investigations were made twenty to thirty years ago, they have never been substantiated unquestionably. At the same time he was at work, DeBary, of Germany, the most able mycologist of his time, was also undertaking a study of the potato disease at the request of the Royal Agricultural Society of England. He was unable to find any positive evidence of oospores and he criticized Smith's work severely and apparently on good grounds. There is no doubt that Smith did not always record accurate observations, and there is little doubt that in his study of the developing "oospores" he dealt with more than one fungus. The chief question is, however, did he have under consideration at any time true oospores of this fungus. Unfortunately the writer can not give a positive opinion on this question, as he has not seen Smith's specimens and has so far been unable to confirm his results. The drawings he gives of the mature spores in his book (6) resemble such spores, but other of his drawings are questionable. But even DeBary (2) does not deny that some of the bodies Smith described might have been oospores, for he says, "The warty bodies are possibly its oospores." In another place in this same article DeBary also says: "Ever since the oospores of a Peronospora were discovered, innumerable searches have been made for those of Phytophthora. I have myself looked for them in the stalks, leaves, flowers, fruit and tubers of the potato. In July of the present year (1875), when the fungus appeared in this district in sad abundance, I obtained a very large amount of material for study and at the same time secured the kindly assistance of two botanists experienced in researches of this kind, Dr. Rostafinski and Dr. Stahl. But again only negative results were arrived at." Since Smith's time, Smorawski and others have claimed to have found the oospores, but these claims always lack positive proof. However, most botanists probably believe with DeBary that they will be found sometime. He said, "That they will be regularly found somewhere or other is assumed, for our knowledge of the habits of numerous allied fungi make this more than probable."

Smith stated that it was an easy matter to obtain the oospores by merely placing a number of diseased leaves overlapping each other in a moist chamber and examining them as they rotted down. The writer has tried his method a number of times but never succeeded in finding spores that were decidedly suspicious. True, one frequently finds various kinds of rounded, usually isolated, bodies in such leaves, some of which are apparently spores of fungi and others merely encysted stages of the lower animals. Even if one were to find the oospores under these conditions, it would be a difficult matter to accurately trace their development because of probable confusion at times with other things. After considerable search in the dying and dead leaves and stems, it finally seemed to the writer that the diseased tubers offered the most likely place for the formation of the oospores. Consequently these have been searched in all stages of infection and decay and at various times of the year. While some suspicious bodies have been seen from time to time, no very definite evidence has been gained that the fungus produces oospores even here. If they are formed in the tubers it is only in the decayed parts, as the healthy tissue offers little opportunity for their development and no suspicious signs have been found there. Examination of tubers decayed from a dry reddish brown rot usually shows the presence of the peculiar short haustoria of the blight fungus and these seem to become more prominent and develop thick, swollen walls with the advance of the decay. Often two of these haustoria are seen standing side by side in a cell, and while they indicate a living mycelium, even in advanced stages of rot and disintegration of the tuber, nothing definite concerning any further development of them or the mycelium has been made out. Resting spores with thick walls and somewhat of the type of oospores have been seen, but there was never any evidence that they were formed from the mycelium of the blight fungus. The potato tuber before its final dissolution in the ground is the workshop of many different fungi, as well as of the lower animals, hence the necessity of caution in forming decided opinions of forms found there. These tubers finally, through the work of the animal life, are more or less scattered through the soil, so that if oospores are formed they would secure more or less of a local distribution in the soil, probably about the time the blight appears in the fields.

Mycelial strains. In recent papers Blakeslee* has shown that in a related family, Mucoraceae, certain species possess mycelial strains, apparently of a sexual nature, that produce zygospores only when these grow together. Securing artificial cultures of the two strains, which he calls + and —, of such a species, he was able to produce the zygospores at will merely by inoculating the same cultural tube with both forms. In the study of various downy mildews it has occurred to the writer that possibly similar conditions are true for certain of these fungi, and in our Report for 1904 this was suggested as a possibility for the

* Science, 19: 864–6. 1904. Proc. Amer. Acad. Arts Sci., 40: 203–321. 1904.

potato mildew. Some effort, as stated previously, has been made to secure such strains in pure cultures and prove the theory by cross inoculations, but as yet no evidence has been secured in this way. While no positive proof has been gained for this belief, there are yet certain facts, as given in the next paragraph, that may be considered at least favorable to it.

In the first place the oospores of the Peronosporeae, like the zygospores of the Mucoraceae, are not commonly found in nature. There are species, other than the potato mildew, for which they have never been found; others for which they have been rarely found; some for which they have been found only on certain of their hosts; and finally, some in which they are not uncommon if looked for at the proper time and place. All of these facts are in favor, rather than against, distinct mycelial strains (heterothallic forms) except the last, which might indicate a homothallic form (one which contains both antheridia and oogonia on the same mycelium). Secondly, our culture experiments with the Lima bean and potato mildews, both species of Phytophthora, is in accord with this theory. The potato mildew cultures never produced oospores under any condition, possibly because there was but one strain present, and our cultures of the Lima bean mildew ran to the production of oospores, possibly because the cultures were obtained from material containing both strains. The potato mildew cultures often gave a very evident aerial growth of the mycelium and conidiophores, while this development in cultures of the Lima bean mildew was usually inconspicuous, though in nature its conidial stage is much more prominent than that of the potato mildew. Thirdly, Smith, in a drawing of the development of his supposed oospores of the potato mildew, shows two different mycelia side by side, one producing oogonia and the other antheridia. DeBary at first criticized this on the ground that the oogonia and antheridia were not on threads in anatomical relation with each other, but later, according to Smith, withdrew this criticism. Smith, of course, may have shown in this drawing something having no connection with the potato mildew, yet in all of the drawings, seen by the writer, of DeBary (1) and others showing the development of oogonia of various mildews, the antheridia and oogonia are always figured on threads having no connection with each other. It is true that only a short piece of each thread is shown in these drawings, but it is usually difficult to trace these further. In our study of the Lima bean mildew effort was made to follow these threads as far as possible, and the evidence, so far as obtained, pointed to their independent origin, so that they could easily have been borne on two different mycelia closely interwoven.

Delayed appearance of blight. It is not as yet definitely known why the blight does not appear earlier in the potato fields. The weather in May and sometimes in early June is as favorable for its development as that of July and August, when it does first appear. On the face this would indicate that the germs for infection were not generally available so early in the year, and yet this is the very time when the mycelium* in the seed tubers underground is best situated for producing the conidial stage on them. DeBary possibly explains this delayed appearance in the following statement: "From large experience I consider it probable that Phytophthora grows more easily on a plant at the height of its development than on young stalks and leaves. It would be interesting, but not easy, to establish this clearly by experiment." In the writer's experiments already given it was found possible to easily infect young leaves and stems, but whether the subsequent development of the fungus was more or less vigorous than on old tissues was not a point at issue. Possibly the point previously suggested in this article explains the late appearance; viz., that the mycelium from primary infections on young, rapidly growing tissue remains localized until after vegetative growth of the host ceases and then renews its activity on the appearance of favorable blight weather. If the primary infections, however, usually take place, as the writer believes, by contact of the leaves with the ground, this is best accomplished in the full grown plants. The young plants are rigid and shoot straight up out of the ground, and by the time they have attained any considerable growth and are likely to lop over on the ground, the wet weather of the spring is largely past. If it were known definitely that oospores were produced, the most feasible explanation would be that these did not germinate until the wet weather of July and August and then their zoospores in the moist earth infected the leaves that were washed down in contact with them by the rains. This would agree perfectly with what the writer has been able to ascertain so far, of the primary infections in the fields.

* According to DeBary's and our experience the *mycelium* will produce its conidial stage only in the living tissues of the tubers, but Massee, on the other hand, reports this stage in the old diseased tubers even a year after they have rotted; if the fruiting stage found by him was developed by the germination of *oospores*, this apparent conflict of observations might be explained.

LITERATURE.

The botanical and general agricultural literature dealing with the potato mildew is perhaps more extensive than that for any other fungus. There are given here merely a few articles, to which reference has been made in the preceding discussions.

1. **DeBary, A.** Recherches sur le développement de Quelques Champignons Parasites. Ann. Sci. Nat. Bot. IV, **20:** 5-148. 1863. [Illustr.]

Deals in this paper especially with the Peronosporeae and gives considerable information, with illustrations, of the potato mildew.

2. **DeBary, A.** Researches into the Nature of the Potato Fungus, *Phytophthora infestans.* Journ. Bot., n. s., **5:** 105-26, 149-54. 1876. [Illustr.]

Gives in this excellent paper the life history of the fungus, so far as known, and treats especially of his studies made for the Roy. Agr. Soc. of England and a criticism of Worthington Smith's so-called oospores.

3. **Massee, G.** Diseases of the Potato. Journ. Roy. Hort. Soc., **29:** 139-41. 1904.

Gives short general account of the mildew and makes two recommendations, based on field and laboratory observations, for keeping it in check; namely, collection of the diseased and old seed tubers at harvest time and use of seed tubers showing no sign of disease.

4. **Matruchot, L. and Molliard, M.** Sur la culture pure du *Phytophthora infestans* DeBary, agent de la maladie de la pomme de terre. Bull. Soc. Myc. Fr., **16:** 209-10. 1900.

Note that they have been able to grow this fungus on living and sterilized media in pure and artificial cultures.

5. **Matruchot, L. and Molliard, M.** Sur le *Phytophthora infestans.* Ann. Myc., **1:** 540-3. 1903.

Give further more extended notes on the artificial cultures of this fungus on living and sterilized slices of potato and pumpkin;

note that the fungus does not discolor the living plugs of potato if grown pure; found no oospores.

6. **Smith, W. G.** Potato Disease, I, II. Diseases of Field and Garden Crops: 275-329. 1884. [Illustr.]

   Makes an extended report on *Phytophthora infestans* in both its active and passive state; discusses in detail his discovery of oospores.

7. **Smorawski, J.** Zur Entwicklungsgeschichte der *Phytophthora infestans* (Montagne) DeBy. Landwirthsch. Jahrb., 19: 1-12. 1890. [Illustr.]

   Gives a general account of the investigations of others and records observations and experiments of his own; describes and illustrates immature oospores that he connects with this fungus.

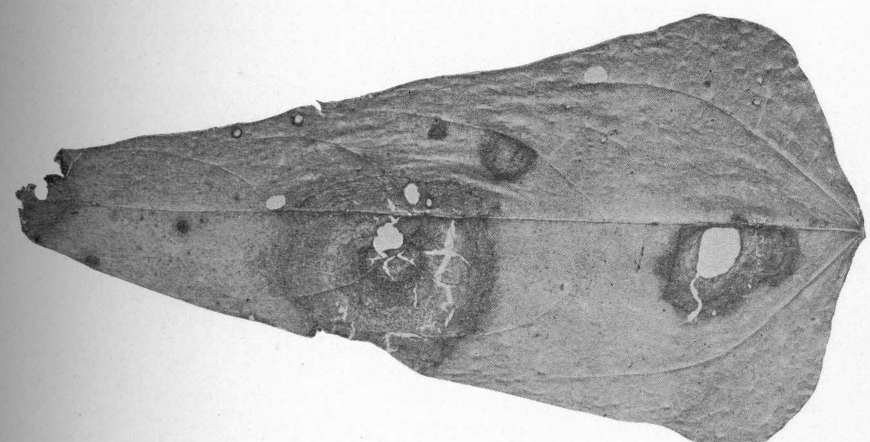
8. **Wilson, A. S.** Potato Disease and Parasitism. Trans. Proc. Bot. Soc. Edinburgh, 19: 656. 1891.

   Explains his mucoplasm theory, by which he accounts for the spread of the blight.

Apple.

a. Fruit Speck, p. 264.

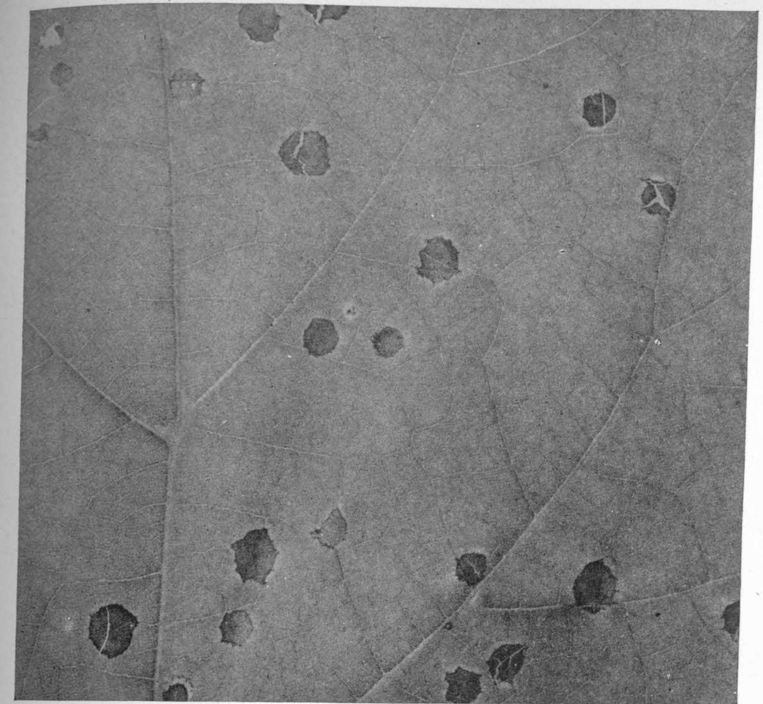
Lima Bean.



b. Leaf Blight, p. 265.

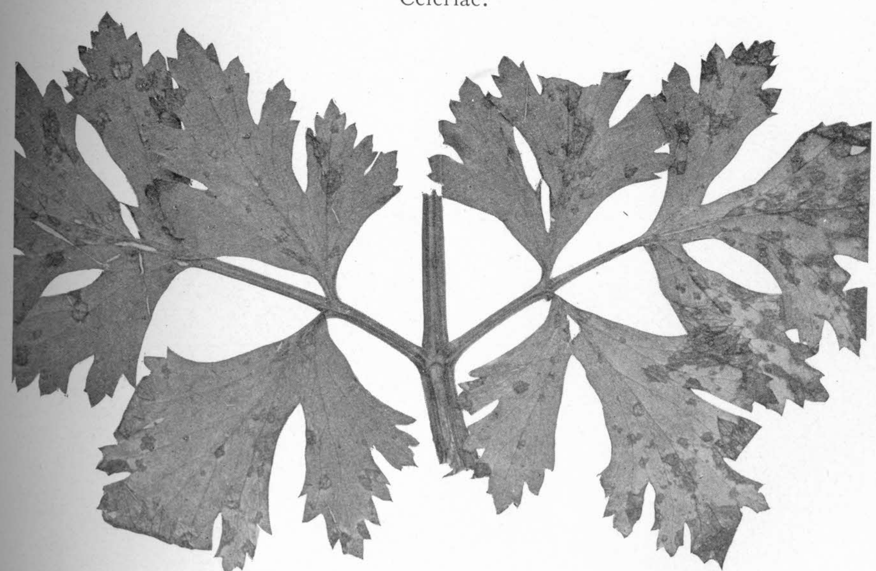
FUNGI OF APPLE AND LIMA BEAN.

Catalpa.



a. Leaf Spot, p. 266.

Celeriac.



b. Leaf Spot, p. 267.

FUNGI OF CATALPA AND CELERIAC.

Maple.

a. Leaf Scorch, a physiological trouble, p. 267.

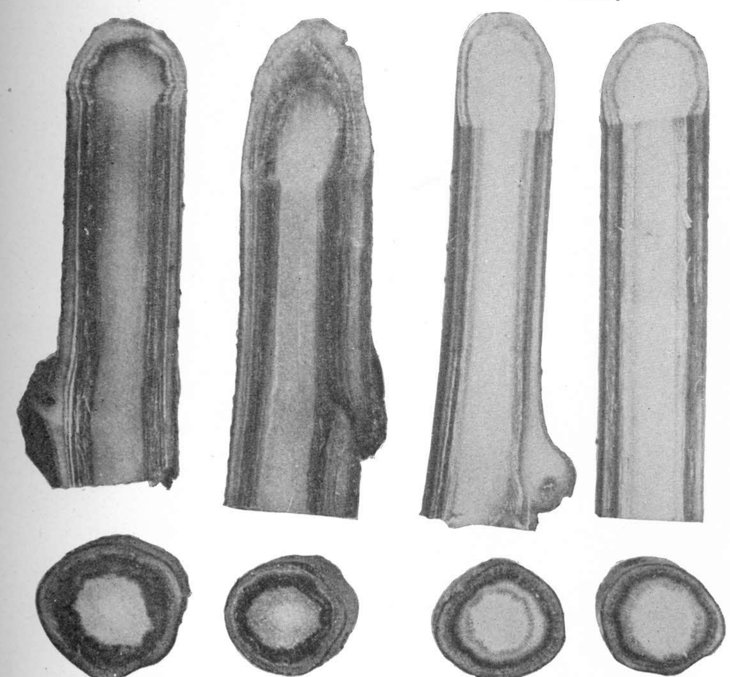
Nectarine.

b. Scab, p. 268.

DISEASES OF MAPLE AND NECTARINE.

a. Showing upward progress of disease by character of leaves.

Diseased. Healthy.



b. Longitudinal and cross sections of stems, showing how tissues are injured.

WILT OF OKRA, p. 268.

a. Onion Brittle, showing peculiar malformation of leaves, p.270.

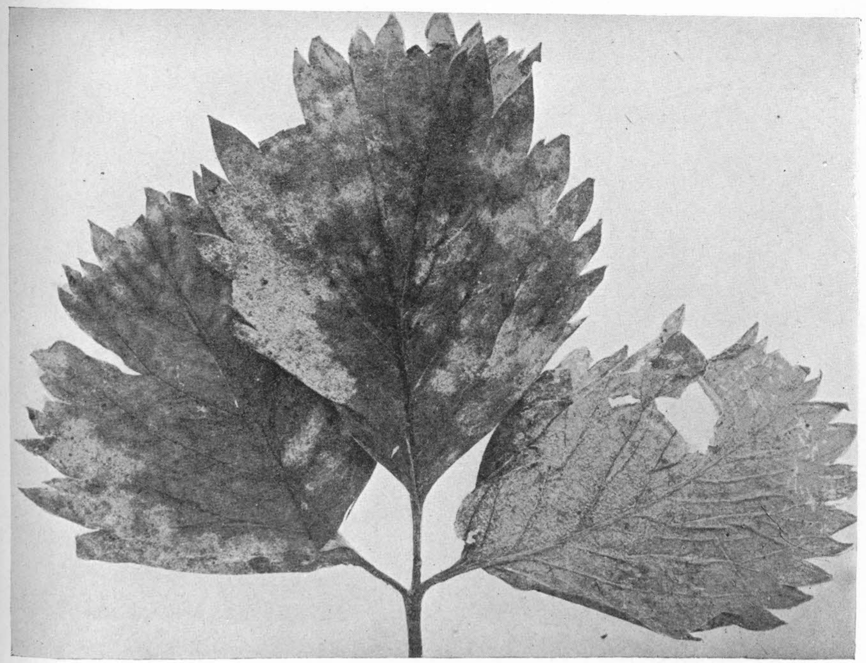
b. Bacterial Black Spot of Plum, p. 273.

DISEASES OF ONION AND JAPANESE PLUM.

Spinach.

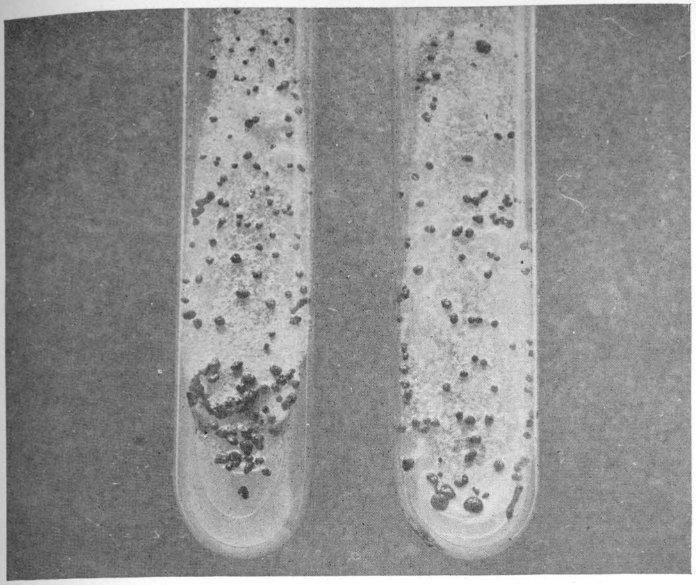
a. Leaf Mold, p. 275.

Strawberry.



b. Powdery Mildew, p. 276.

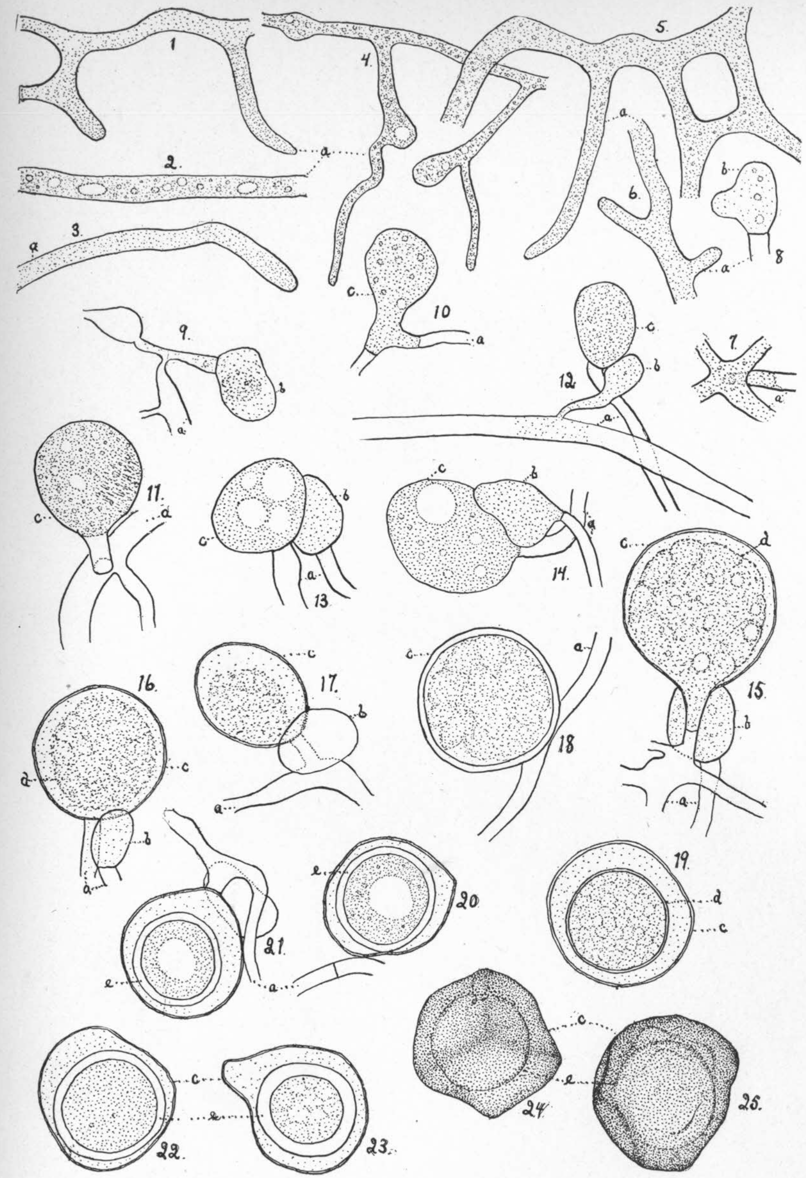
FUNGI OF SPINACH AND STRAWBERRY.



a. Cultures of the fungus on potato agar, showing sclerotia.

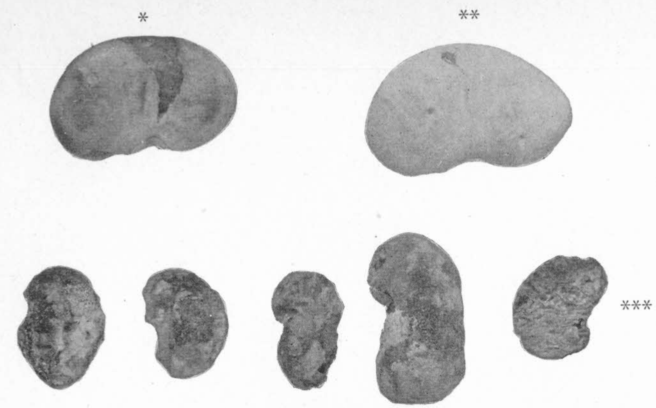
b. Showing how the fungus injures base of stems.

DAMPENING OFF FUNGUS OF YOUNG TOBACCO PLANTS, p. 276.



a, mycelium; *b*, antheridium; *c*, oogonium; *d*, oosphere; *e*, oospore. Figs. 1–7, showing character of mycelium. Figs. 8–21, antheridia and oogonia and their development. Figs. 22–25, mature oogonia and oospores. Magnified about 600 diameters.

DEVELOPMENT OF MYCELIUM AND OOSPORES OF LIMA BEAN MILDEW, *Phytophthora Phaseoli*.



a. Diseased seed containing oospores, except healthy one at **, pp. 292, 297.

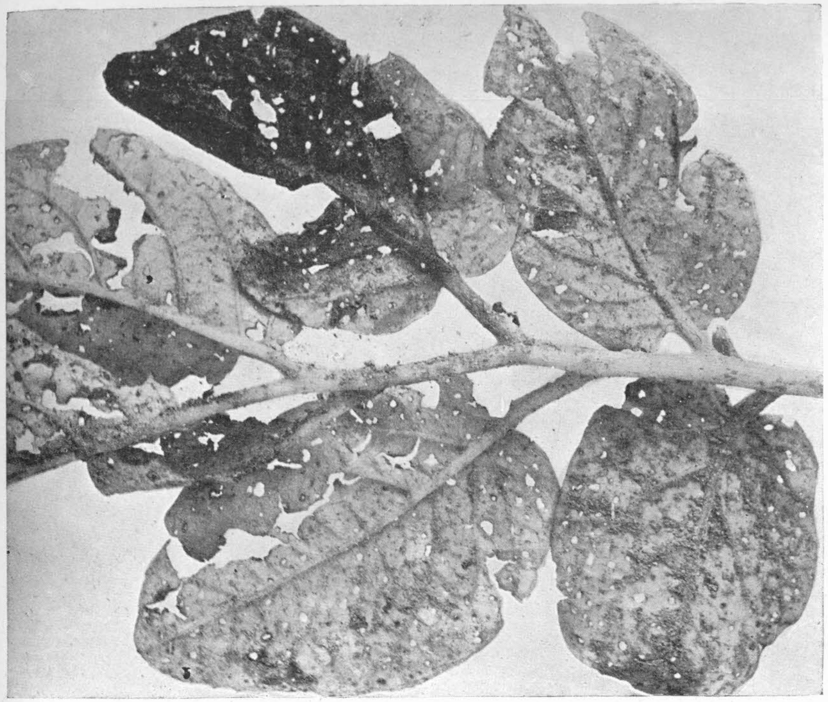
b. Showing injury to young stems and leaf, p. 281.

DOWNY MILDEW OF LIMA BEAN, *Phytophthora Phaseoli*.

a. Showing mildew in young and old state on pods.

b. Showing portion of infected pod enlarged two diameters.

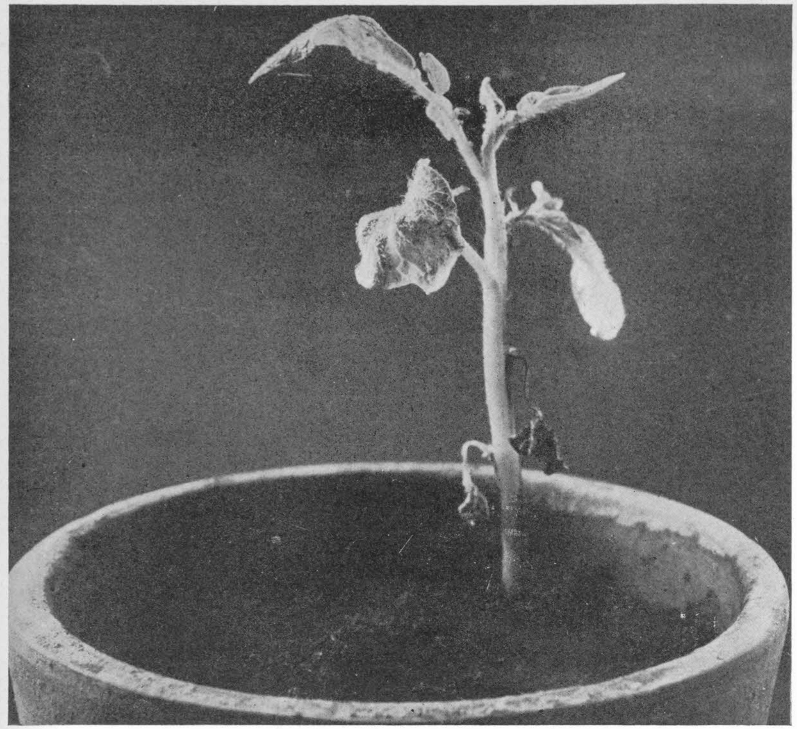
DOWNY MILDEW OF LIMA BEAN, *Phytophthora Phaseoli*, p. 280.



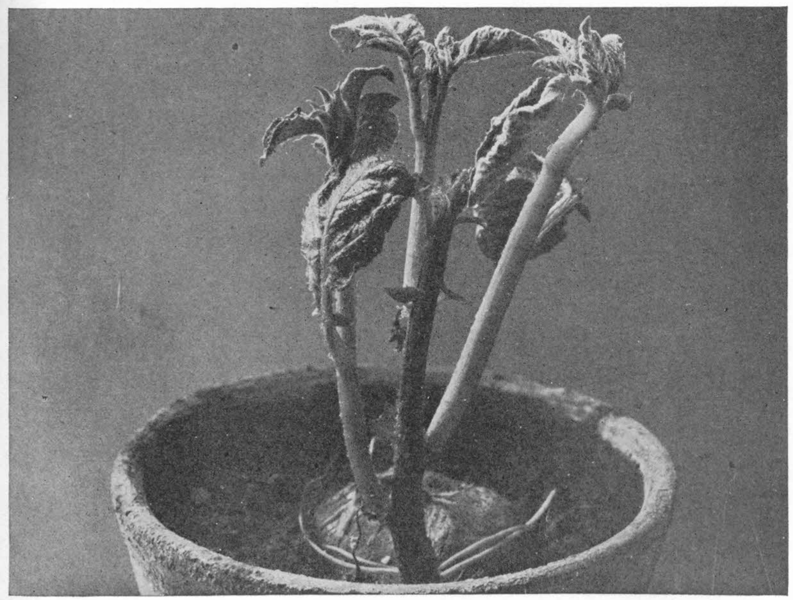
a. Showing primary infection from contact with ground, p. 309.

b. Artificial infection of the mildew on cut surface of tuber, p. 318.

DOWNY MILDEW OR BLIGHT OF POTATO, *Phytophthora infestans*.

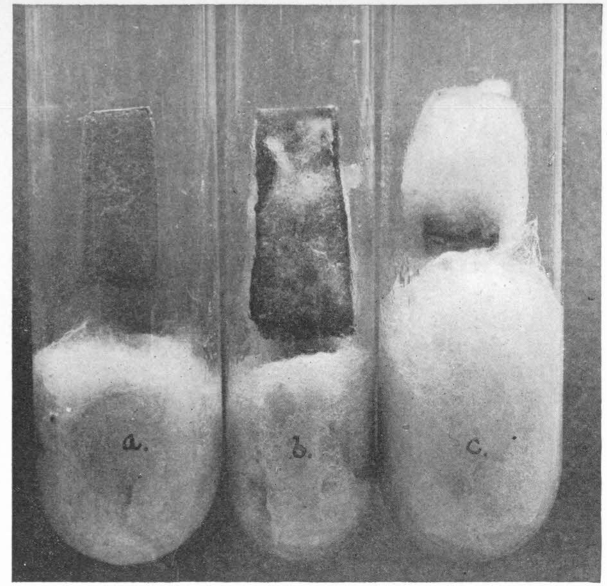


a. Two lower and tip of third leaf killed by fungus, 10 days after inoculation, p. 315.

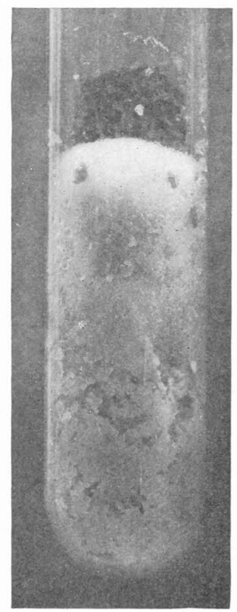


b. Central diseased shoot grown from an inoculated tuber, p. 307.

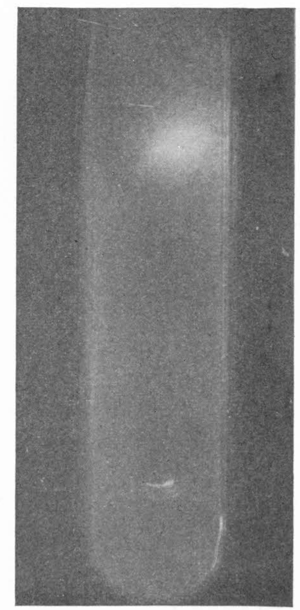
INFECTION EXPERIMENTS WITH *Phytophthora infestans*.



a. On plugs of living potato. *a*, check.



b. On corn meal.



c. On pumpkin agar.

ARTIFICIAL CULTURES OF *Phytophthora infestans*, p. 317.

PART VI—(CONCLUSION).

Tobacco Breeding Experiments in Connecticut.

By A. D. Shamel.

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Introduction.

The experiments on the improvement of tobacco by breeding and seed selection carried on by the Bureau of Plant Industry of the United States Department of Agriculture in coöperation with the Connecticut Agricultural Experiment Station, the past season, have included the continuation of certain experiments begun in 1903, together with others begun in 1904 and 1905. This report presents a brief review of some of the results obtained from these investigations, the details of which, together with a more complete record of these experiments, will be found in the publications of the Bureau of Plant Industry and separate bulletins of the Connecticut Agricultural Experiment Station.

The practical value and importance of these tobacco breeding experiments can best be shown, perhaps, by concrete illustrations of increased profits to the growers by reason of greater yield or improved quality of the crops, obtained by systematic breeding and seed selection.

The production of strains of Connecticut Havana seed tobacco bearing one more leaf on every plant than plants of the present varieties would mean an increased yield of about one hundred pounds of cured tobacco per acre, which, other things being equal, would give the grower an additional return of about fifteen dollars. This increase would be practically all profit, because it costs little more to grow plants bearing a large number of leaves than plants bearing but few leaves. The modification and improvement in the size and shape of leaves by seed selection and breeding, particularly in the production of strains of plants bearing broad, round leaves, with fine veins standing out at right angles to the midribs, and with uniform texture from the tip to the base, make it possible for cigar manufacturers to cut more wrappers from every leaf than they can cut from the large, long and rather pointed leaves borne by the plants of the present varieties. This increased number of wrappers which can be cut from the individual leaves is bound to result in higher prices to the grower, so that such improvement is beneficial to both grower and manufacturer. In strains where the large and destructive sucker branches have been bred off the plants by systematic seed selection, the lessened cost of growing the crop by reason of the lessened expense of suckering, as well as the better quality of leaves produced by such plants, is additional evidence of the importance of this line of work. The most important phase of this subject, however, is the production of seed which will yield plants of uniform quality, in this way increasing the yield of the more valuable grades of tobacco and reducing the cost of sorting.

It costs but little, if any, more to grow uniform plants producing a desirable type of tobacco than to grow plants lacking uniformity and yielding but a small proportion of the best grades. When such uniform strains, adapted to his conditions of soil and market demands, can be secured by every grower with little or no extra expense, by seed selection, it certainly devolves upon every grower to give this matter earnest attention.

The Practice of Sprouting Seed.

It is a common practice of tobacco growers in Connecticut and other northern tobacco-growing sections to sprout a part, at least, of the seed used for sowing the seed beds. This is usually done by mixing the seed thoroughly with moist rotted apple-tree fibre, or "punk," or rotted cocoanut fibre, and keeping this mixture in glass jars or pans in a warm room for a few days. When the sprouts begin to appear, an equal amount of dry seed is added to the sprouted seed, and the mixture sowed in the seed bed. The reason urged by the growers following this practice for sprouting the seed is that the sprouted seed apparently produces the earliest seedlings for transplanting.

In experiments conducted to compare plants raised from dry and sprouted seed, the results of these exact comparisons did not support the conclusion that the sprouted seed produced the best plants. It is true that the sprouted seed under *favorable* conditions produced the earliest plants for transplanting, but upon following the plants raised from the sprouted seed, from the seed bed to the field, it was found that the plants raised from the dry seed quickly overtook the plants raised from the sprouted seed, and eventually produced the best developed plants.

In many cases where the sprouted seed was sowed in the seed beds, a slightly unfavorable condition, such as hot sun, or a dry surface of the seed bed, seriously injured, if not entirely destroyed, the tender young plants. The young plants from the dry seed were more hardy and able to withstand the injurious effects of slightly unfavorable conditions. When the seed is mixed with the sprouting medium, either "punk" or cocoanut fibre, it is a common practice to shake or stir the material frequently so as to give as uniform conditions as possible under the circumstances for sprouting all of the seed. However, it frequently happens that some of the seed, most favorably located, produces long sprouts before it is sowed in the seed beds. These plants are liable to injury in sowing, and such injuries are likely to result in inferior, dwarfed and undesirable plants.

Whenever the condition of the soil permits, the dry seed can safely be sowed several days earlier than the sprouted seed, and with this advantage will, in most cases, produce as early, if not earlier plants, for transplanting, as the sprouted seed. In the case of hot-beds, whether warmed by manure, steam, hot water, or other means, there is no good reason for sprouting the seed before sowing, and the practice is not only unnecessary and somewhat expensive, but, as pointed out in the preceding paragraphs, likely to seriously injure the development of the tobacco beds.

It is recommended that growers demonstrate the matter for themselves by sowing this year a portion of the seed bed or beds with dry seed, that is, without any sprouted seed, in order to make a comparison of the two methods of sowing seed. It can be safely said that the dry seed will produce better plants in the field than the sprouted seed, and if proper methods of sowing are pursued, will produce equally early plants for transplanting.

Seed Separation.

Large, heavy tobacco seeds produce the best plants. As a rule, the large seeds begin to germinate more slowly than those which are small, light, or immature, but after they begin to develop, the young plants from the heavy seed make rapid and vigorous growth. At the time of harvest, the plants grown from heavy seed are usually several days earlier than the plants from the light seed. This difference in rate of growth becomes more apparent as the season advances, although in seasons very favorable for plant growth plants from light seed seem to overcome, in part at least, the unfavorable conditions of growth of the fore part of the season. On the whole, however, the observations of the writer in the comparison of plants raised from light and heavy seed have shown that the heavy seed produces the earliest, most productive and valuable tobacco plants.

The small, light, and particularly the immature seeds tend to produce irregular, so-called "freak plants," which, in some cases, at least, are more subject to the attack of fungous and other diseases than normal healthy plants. In view of the fact that the light seeds sprout earlier than the heavy seeds, it is probable that many of the plants grown from such seed are set out in the field by the growers and are responsible for a part, at least, of the undesirable plants in the field. The mosaic or calico disease, which, according to the best evidence obtainable, is due to faulty nutrition, affects plants raised from light and immature seed more extensively than plants raised from heavy seed. In Connecticut in the past season, certain crops raised from heavy seed were almost free from calico, while adjoining crops raised from the same variety of seed but not separated, and under very similar conditions of culture, contained from 15 to 40 per cent. of calico plants. The same facts have been reported from other tobacco-growing regions. For instance, in the tobacco-breeding experiments conducted by the Bureau of Plant Industry in coöperation with the Maryland Experiment Station in Maryland, a portion of a certain sample of seed was separated and the heavy seed retained for

planting, while the other portion of the seed was not separated. The plants raised from the heavy seed were almost wholly free from calico, while adjoining rows of plants raised from the unseparated seed contained as high as 60 per cent. of calico plants. It is reasonable to suppose that the thrifty and vigorous plants raised from the heavy seed more easily resist or throw off the attacks of certain diseases or, at least, recover more quickly from the effects of injuries caused by diseases or unfavorable conditions, than the slower growing and weaker plants raised from the light seed.

Owing to the minute size of tobacco seed and the consequent slight differences in size and weight of the light and heavy seed, it has been difficult to effect a practical separation of the light from the heavy seed. It has long been recognized that the heavy seed were in all probability the best for planting, but no simple or practical means was devised for securing the heavy seed. In the course of the experiments in tobacco breeding conducted by the writer, it was early recognized that the invention of a practical seed separator was a matter of great importance to the tobacco grower. After several experiments, a machine was devised which, with subsequent improvements, has proved to be admirably adapted for this purpose. A picture of this machine is given in Figure 10, and a description of it can be found in the Yearbook of the Department of Agriculture for 1904.

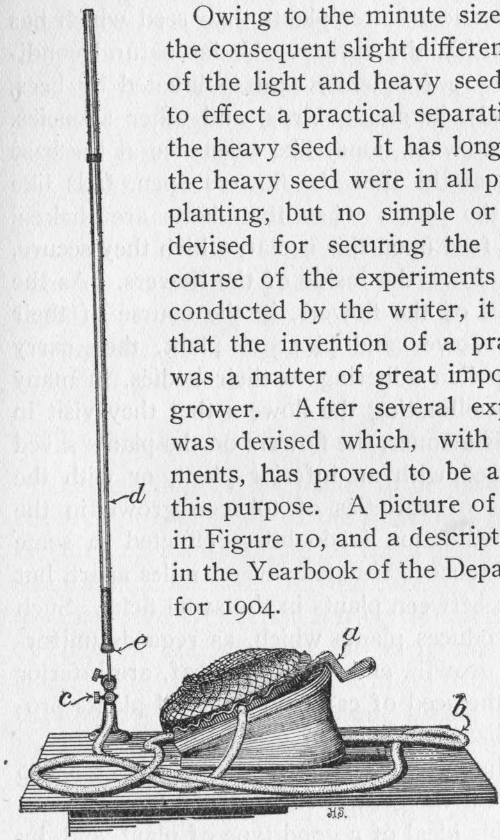


Fig. 10. Tobacco Seed Separator.

Following the invention of this machine, other seed separators, some of which doubtless are improvements, in some respects at least, upon this separator, have been devised by tobacco growers in Connecticut and elsewhere. One of these, invented by Mr. D. P. Cooley of Granby, Connecticut, has come into general use and proven to be very satisfactory for the purpose.

The small bulk of tobacco seed required to sow the seed beds makes it a small and inexpensive matter to separate the seed even for the most extensive plantations. In view of the important and profitable results obtained as a result of this attention, it is incumbent upon every grower to carefully separate out the heavy seed for planting and discard the light and inferior seed.

The Value of Self-fertilized Seed.

Inbred or self-fertilized tobacco seed, like the seed of certain other exotic plants, produces better plants than seed which has been cross-fertilized within the variety. Under natural conditions, tobacco flowers are frequently cross-pollinated by bees, insects of various kinds, humming birds, and other agencies. These flowers secrete a sweet, honey-like substance at the base of the corolla, which, at the time the flowers open, falls like drops of rain about the plants when the plants are shaken. Bees and other insects feed upon this nectar, which they secure, as a rule, by crawling down the inside of the flowers. As the insects pass in and out of the flowers, in the course of their visits from flower to flower and plant to plant, they carry about with them the pollen adhering to their bodies, in many cases, no doubt, cross-pollinating the flowers that they visit in search of food. In this manner, the flowers on the plants saved for seed may be crossed with an inferior plant, or with the plants of other strains of varieties of tobacco grown in the vicinity. This cross-pollination is doubtless effected in some cases between fields of tobacco situated several miles apart, but most frequently occurs between plants in the same field. Such cross-fertilized seed produces plants which, as regards uniformity of type, vigor of growth, and quality of leaf, are inferior to plants raised from the seed of carefully selected plants protected from cross-fertilization.

This striking and important characteristic of the tobacco plant makes it possible for the grower to select the type of plant he desires, that fulfils his ideal of a good type of plant, and, by protecting the flowers of this plant from cross-fertilization, to propagate this valuable type in succeeding crops. No one thing in the course of these experiments has stood out so clearly as the wonderful uniformity of the progeny of plants the seed of

which has been saved under bag and thus protected from cross-fertilization. The reason that this characteristic of strong transmitting power is so striking and makes such a strong impression on the observer is because the characteristics that are important in the production of a high grade cigar wrapper tobacco, such as size and shape of leaves, number of leaves and suckers borne by the individual plants, size and arrangement of veins, and color of leaves, are prominent and can be easily noticed even by the most casual observer. Therefore, in looking over a row or plat of plants, the progeny of a parent whose flowers were protected from cross-fertilization,—a row or plat in which every plant is alike, the number, shape and size of leaves the same, the height of plants, number and size of suckers alike, the color of leaves and size of veins uniform as regards every plant,—the observer must be forcibly struck by the faithfulness with which the characteristics of the parent plant have been transmitted to all the progeny. Of course, the season, the system of culture and other factors exert a strong influence on the crop, but, in any case, the effect of using self-fertilized seed and the benefits to be derived from following the practice of saving seed in this manner are plainly evident under all conditions.

The Selection of Seed Plants and Methods of Saving Seed.

The selection of the plants to be saved for seed production requires careful study of the individual plants in the field from the time of transplanting to the topping process. In order to illustrate the necessity for the careful observation of the plants used for seed production during the early as well as later stage of growth, the selection for early maturing strains may be cited. The difference in earliness between individual plants is more noticeable in the young plants than in the older ones. In Plate XXVI, a, is shown an illustration of the great variability in rate of growth, correlated with earliness and lateness of ripening of the tobacco on different plants of Connecticut Broadleaf tobacco. In previous experiments it has been demonstrated that by selecting the early plants,—such as the large early plant in the illustration,—and saving the seed under bag,—it is possible to produce an early maturing strain of tobacco, a matter of great importance in northern sections. This difference in rate of growth and earliness of maturing is not so easily noted when the plants are nearer maturity.

In the case of the Havana Seed and Broadleaf varieties of tobacco, the ideal type of plant is one producing the largest possible number of leaves consistent with good curing and other considerations of handling the plant. The leaves should be broad and round, with fine veins standing out at almost a right angle with the midrib. The texture of the leaf should be uniform from the tip to the base so that as much of the leaf as possible shall be available for cutting out cigar wrappers with the least possible waste. The leaves should be uniform from the top to the bottom of the plant in shape, size and all other characteristics, more particularly in time of ripening. The plant should have but few and small suckers, and the leaves should be set very closely together on the stalk. These characteristics will usually be found to be correlated with small production of seed.

With a clear conception of the type of plant desired, the grower should carefully study the plants in the field in order to pick out the plants most nearly approaching the desired type and to save them for seed. When a plant is found that at a preliminary examination seems suitable for seed production, it can be marked with a rag or some kind of tag. During the topping process these plants must be marked very prominently in order to avoid accidental topping. As soon as the flowers begin to develop, the plant should be pruned for the application of the bag.

In preparing the plant for the bag, all of the top leaves and sucker branches should be carefully pinched, or better, trimmed off with a small pair of scissors or with the pocket-knife. This process is most important, because if the top leaves are allowed to grow within the bag, the water constantly transpired by them favors the development of mold within the bag and the injury of the seed by it. Neglect of this detail has been the most fruitful cause, in fact, so far as the writer is aware, the sole cause of poor seed under bag. The writer has lost hardly a single head of seed from thousands of seed heads saved under bag.

The best kind of bag is a very light but strong paper bag, of at least twelve-pound size. If desired, needle holes can be punched in the bag, although so far as the writer knows there is no reason for so doing. In no case should heavy coarse bags be used, because they absorb moisture, dry out slowly, and by their heavy weight tend to bend and in some cases injure the plant.

The bag should be put on before any flowers open, or if any of the flowers open before the bag can be applied, they should be pinched off and discarded. The bag should be tied loosely about the stalk below the flower head and slipped up occasionally to allow for the rapid development of the growing stalk. During the past season, the writer observed one or two cases out of the many "bagged" fields where the growers had put on the bag, then carelessly left the plants, never touching them again until ready to harvest the seed. As a result, the big sucker developed in the plant, appropriating the nourishment that otherwise might have gone to the production of better seed, and in some cases suckers growing within the bag simply pushed out through the bottom of it, in the meantime crushing and injuring, if not wholly destroying, the seed pods in the bag.

After the seed has been fertilized and the pods have begun to swell, the bags can be removed, if desired. Such practice may be advisable, particularly during a long damp season, but is not recommended as a rule. The writer does not remove the bags at all, and for three seasons, with a little attention and care to every plant, has had no difficulty in getting the normal supply of excellent seed. If the bags are removed, all the flower buds and every flower not yet fertilized must be carefully picked off and thrown away.

Plate XXVI, b, shows a field in which high-bred tobacco seed is being grown on a commercial scale, by the method just described.

When the pods have turned brown, indicating maturity, the seed heads should be cut off, hung in a dry, airy place, and allowed to dry out very thoroughly. As soon as completely dry, the seed can be shelled, the light seed blown out with a seed separator, and the heavy seed stored in dry glass jars placed in a safe place. Under such conditions the vitality of tobacco seed will remain almost wholly unimpaired for a considerable term of years.

If the grower wishes to breed tobacco more carefully, the leaves from the seed plants should be picked off when they become ripe, and the leaves from each plant strung on a separate lath, so numbered as to correspond with the seed head of the same plant. These laths of tobacco should be hung in the curing shed, under normal conditions, and sweat with the bulk of the crop. A study of the cured tobacco may reveal characters and qualities undiscovered in the green leaves in the field. The seed from the plants producing the best tobacco can then be used for planting, and the seed from the plants producing the poor tobacco discarded. This method of selection is of particular value and importance where the selections are made on the basis of burn, as it enables the grower to pick out the plants producing good burning tobacco. The test for burn can be made in the usual manner or with apparatus described in a bulletin of the Bureau of Plant Industry which is in course of preparation. The usual test with a match, or wrapping on a cigar, however, will suffice, under ordinary circumstances, for the making of an intelligent selection.

Two New Varieties Produced by Hybridization.

In the season of 1903 the writer made a number of crosses of varieties of tobacco, in one case using Connecticut Havana as the mother parent, and Cuban, Sumatra, Broadleaf and other varieties as male parents. In another set of crosses the Connecticut Broadleaf was used as the mother parent, and Cuban, Sumatra, Havana Seed and other varieties as male parents. In 1904 the progeny of these crosses were planted in separate rows or plats in experimental fields. In 1905 selections of seed from the best plants produced in 1904 were set out in separate rows or plats, from which seed was obtained for general distribution in 1906. As a result of these crosses, two hybrids have been secured of particular merit and value, possessing the acclimated and high qualities of the native New England varieties, combined with some of the finer qualities of the standard imported varieties. Other new types were secured which give promise of being of value, but, in order to fully demonstrate their possibilities, further careful tests in the experimental field are necessary. The two varieties which have been considered fixed and worthy of distribution are to be considered simply as improvements on the native New England varieties. They are adapted to the same methods of culture, harvesting

and handling in the curing sheds and warehouses, in fact, are simply modified strains of the Havana Seed and Broadleaf varieties. The general characteristics of these hybrids are, broad, short, round leaves with fine veins; uniform quality and texture of leaf from tip to base; large number of leaves borne by the individual plants; fine, light and even colors in the cured tobacco; good, even and regular burn; considerable stretch or elasticity and strength; vigorous growth of plants, indicating as a rule early maturity; and an appearance when wrapped on cigars of a high grade cigar wrapper tobacco.

The Cooley Hybrid.

Havana Seed ♀ × *Sumatra* ♂

This new variety was obtained by crossing the Havana Seed variety grown by Mr. D. P. Cooley of Granby, Conn. with Sumatra tobacco. The pollen for pollination was obtained from plants grown from Florida Sumatra tobacco seed. This Florida Sumatra had been grown in the Connecticut valley for two seasons and was partially acclimated. Carefully selected plants were used for both the female and male parents, or for dam and sire. Typical leaves from the parent plants are shown in Plate XXVII, a. In this hybrid, little breaking up of type has been observed during the first or second generation, which is apparently contrary to the experience of plant breeders in other lines of work, but agrees with the general experience of tobacco growers concerning the so-called accidental hybrids. However, there has been more or less variation, giving opportunity for selection, which has been carried on rigidly the past two seasons.

The description of the Cooley hybrid in the field is as follows:—number of leaves, 16; length of leaves, 27 inches; width of leaves, 17½ inches; shape of leaves, very round; uniformity of leaves, very good; color of leaves, deep green; spots, none; rust, none; maturity, early; position of leaves, partly erect; height of stem, 29 inches; circumference of stem, 2¾ inches; length of internode, 2 inches; number of suckers, 2; size of suckers, medium to small.

The Cooley hybrid cured tobacco has been pronounced by buyers and manufacturers to be a very greatly improved

Havana Seed tobacco and worthy of careful trial by Connecticut tobacco growers. In order to propagate the variety, the seed of selected plants must be saved under bag in order to prevent cross-fertilization with other tobacco and possible deterioration. A typical plant of this hybrid is shown in Plate XXVIII, a.

The Brewer Hybrid.

Connecticut Broadleaf ♀ × *Cuban* ♂

The Brewer hybrid is the result of a cross made in 1903 between a mother plant of Connecticut Broadleaf tobacco (grown by Mr. N. S. Brewer of Hockanum, Conn.) and a Cuban plant as the male parent. The pollen for pollination was secured from plants grown for two seasons in the Connecticut valley from seed imported from Cuba. The striking characteristics of the Brewer hybrid are short broad leaves, very fine veins, even grain and texture from tip to base of leaves, large number of leaves borne by the individual plants, partly erect habit of growth of the leaves, and light even color of the cured and fermented tobacco. Typical leaves from the parent plants of this hybrid are shown in Plate XXVII, b. There is no doubt, after most careful inspection by growers and manufacturers, that this variety is a most valuable acquisition to the valuable varieties of tobacco.

The description of the Brewer hybrid in the field is as follows:—number of leaves, 21; length of leaves, 27½ inches; width of leaves, 19¾ inches; shape of leaves, very round; uniformity of leaves, very good; color of leaves, deep green; spots, none; rust, none; maturity, medium to early; position of leaves, partly erect; venation, very fine; height of stem, 42 inches; circumference of stem, 2½ inches; length of internodes, 2 inches; number of suckers, 2; size of suckers, small.

The suckering habit in this hybrid has a tendency to break out in individual plants, but by reason of analogy in the production of suckerless types of other varieties, it is believed that this habit can be controlled, if not eradicated, by careful selection of suckerless seed plants. Seed should always be saved under bag, in order to prevent cross-fertilization with other varieties. A typical plant of this hybrid is shown in Plate XXVIII, b.

EXAMINATION OF BABCOCK TEST APPARATUS.

Pursuant to the requirements of Section 4887 of the general statutes, the station has tested within the year 293 pieces of glass-measuring apparatus for the creameries and dairymen of the state, making the total number tested since the passage of the law, 4067.

There were tested in 1905

	Tested.	Found inaccurate.
Pipettes for cream	4	0
Cream-test bottles	216	0
Milk-test bottles	73	4
	293	4

Percentage found inaccurate in 1901	2.3
" " " " 1902	1.0
" " " " 1903	0.0
" " " " 1904	0.7
" " " " 1905	1.4

TESTS OF GUERNSEY COWS FOR ADVANCED REGISTRY.

On request of the Guernsey Cattle Club the station has made monthly tests of the weights of milk and butter-fat given by a number of thoroughbred Guernseys entered for advanced registry.

Within the year, the twelve months' tests of nine cows have been completed. The year's records of three of those, as given by the Guernsey Cattle Club, are as follows:

	Pounds milk.	Pounds butter-fat.	Age years.
Washita's Coquette, No. 11492, owned by R. & H. Scoville, Chapinville......	7632	346	5½
Lodovia, No. 14647, owned by H. B. Tuttle, Naugatuck	4768	279	3½
Lidigia Lenfestey, No. 14642, owned by H. B. Tuttle, Naugatuck	4462	267	2½

The records of the other six cows have not yet been published. Three cows are now under test.

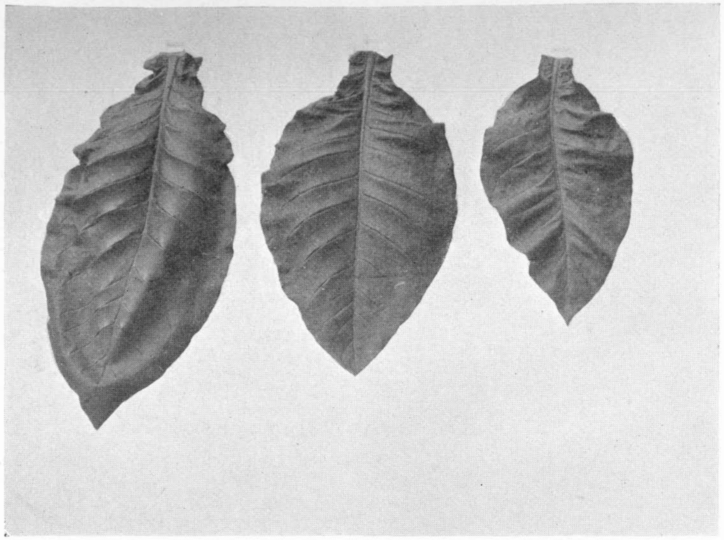
NOTICE BY THE DIRECTOR.

As this report is limited, by order of the State Board of Control, to 375 pages, papers or summaries of the Station's work on the following subjects cannot be printed:—

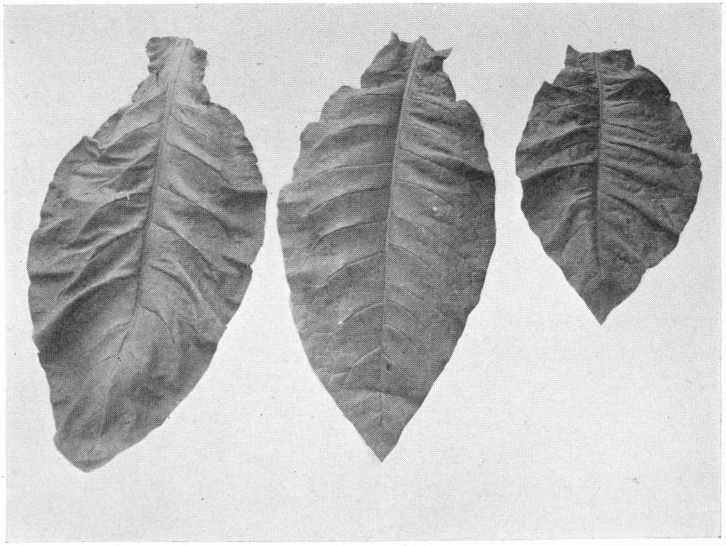
Tests of the Vitality of Vegetable Seeds, Notices of the work on Corn, Breeding, Forestry, Cover Crops and the Introduction of Alfalfa into Connecticut.

a. Variation in growth of tobacco plants set at the same time, some maturing ten days earlier than others. This is typical of variations found in all fields.

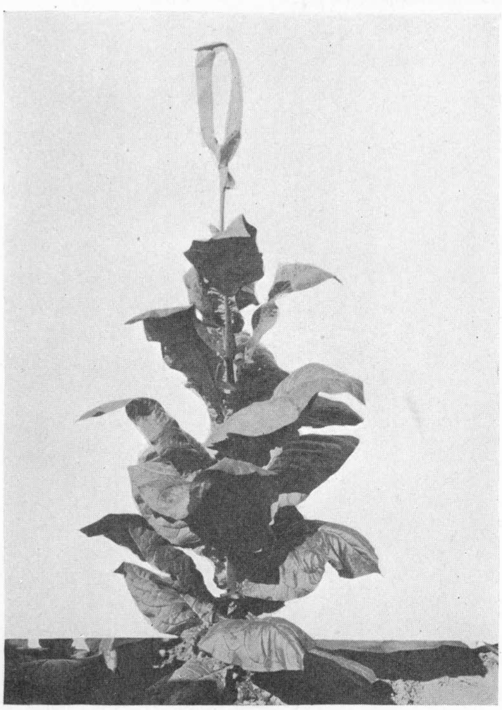
b. Commercial raising of highly bred tobacco seed saved under bag.



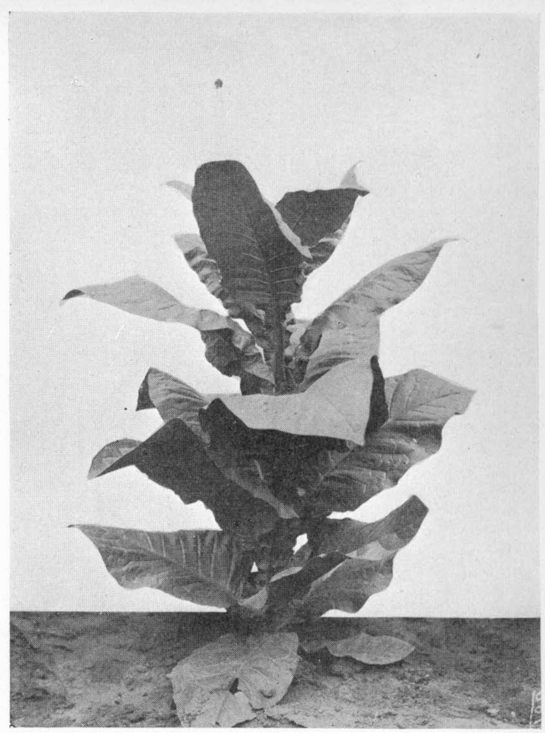
a. Typical Havana seed mother parent on left.
Typical Sumatra male parent on right.
Typical Hybrid leaf in center.



b. Typical Broadleaf mother parent on left.
Typical Cuban male parent on right.
Typical Hybrid leaf in center.



a. The Cooley Hybrid.



b. The Brewer Hybrid.

INDEX.