State of Connecticut

PUBLIC DOCUMENT No. 24

TWENTY-EIGHTH ANNUAL REPORT

OF

The Connecticut Agricultural Experiment Station

FOR THE YEAR ENDING OCTOBER 31

1904

PRINTED BY ORDER OF THE LEGISLATURE

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1905

CONNECTICUT AGRICULTURAL EXPERIMENT STATION.

OFFICERS AND STAFF.

FOR THE YEAR ENDING OCTOBER 31, 1904.

STATE BOARD OF CONTROL.

Ex officio.

His Excellency ABIRAM CHAMBERLAIN, Meriden, *President.*
E. H. JENKINS, New Haven, *Director and Treasurer.*

	Term Expires
Appointed by Connecticut 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.	1905
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.*	1905

STATION STAFF.

Chemists.

Analytical Laboratory.

A. L. WINTON, PH.B., *Chemist in charge.*
E. MONROE BAILEY, PH.B.
A. W. OGDEN, PH.B.* M. SILVERMAN, PH.B.†
I. A. ANDREW, PH.B.‡ KATE G. BARBER, B.S.§

Laboratory for the Study of Proteids.

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

Botanist.

G. P. CLINTON, S.D.

Entomologist.

W. E. BRITTON, B.S.

Assistant to the Entomologist.

B. H. WALDEN, B.AGR.

In charge of Forestry Work.

AUSTIN F. HAWES, M.F.‖

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 Helpers.

HUGO LANGE. WILLIAM POKROB.¶

Sampling Agent.

V. L. CHURCHILL, New Haven.

* Till October 1, 1904. † Till December, 1903. ‡ From September 1, 1904.
§ From December 15, 1903. ‖ From July, 1904. ¶ Till July, 1904.

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ANNOUNCEMENT.

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

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, mildew, 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 each Post Office in this state, and to every citizen of the state who applies for them. 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 admit. Every Connecticut citizen who is concerned in agriculture, whether farmer, manufacturer, or dealer, has the right to apply to the station for any assistance that comes within its province to render, and the station will respond to all applications as far as lies in its power.

Instructions and Forms for taking samples 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, Abiram Chamberlain, Governor of Connecticut:

The Board of Control of the Connecticut Agricultural Experiment Station herewith respectfully submits its report for the year ending October 31, 1904:

The changes in the station staff during the year have been as follows:

On December 1, 1903, Mr. Silverman resigned to take a position as chemist with the New York Glucose Co., and on December 15th, K. G. Barber, a graduate of the Rhode Island Agricultural College, was appointed to fill his place.

On October 1, 1904, Mr. A. W. Ogden, who has been connected with this station as chemist for fourteen years, resigned to enter the employ of the United States Bureau of Chemistry. Mr. I. A. Andrew, a graduate of the Sheffield Scientific School of Yale University, was appointed to fill this vacancy.

On the first of July last, Mr. Walter Mulford, state and station forester, was given a year's leave of absence without pay, which he will spend in the study of forest work here and abroad.

In August, Mr. Austin F. Hawes was appointed assistant station forester, and in October, was appointed state forester.

Thirty-four firms or individuals have entered for sale in the state, in 1904, two hundred and forty-five distinct brands of fertilizers. During April, May and June, our sampling agent visited ninety-two towns and villages of the state and took five hundred and forty-seven samples of these commercial fertilizers.

Of some brands several samples were drawn and an analysis was made on a mixture of equal weights of the several samples. A considerable number of fertilizers and manurial waste products were sent for analysis by interested parties also, making the total number of fertilizer analyses executed five hundred and seven. These have all been reported to the manufacturers and those concerned in their sampling and sending. They have also been tabulated with appropriate discussion of the results, and are now in the printers' hands for early issue as Part I of the report for 1904.

The station agent, in his search for food products, visited twenty-six towns and villages and bought nine hundred and forty-six samples of these articles, all of which have been examined and the adulterated articles reported, as required by law, to the Dairy Commissioner, with whom rests the enforcement of the law. In addition to the above, two hundred and two samples of food products — chiefly of milk — have been examined for producers and purchasers. The detailed account of this work is nearly ready to print as Part II of the station report.

For the Dairy Commissioner have been examined four hundred and nineteen samples of molasses, two hundred and eighty-six samples of vinegar, and two of butter.

Within the year covered by this report there have been made three hundred and four analyses of feeds collected in the fall of 1903, and our sampling agent is now collecting samples which will be analyzed shortly so that the results may be of use to dairymen in buying feeds for the coming winter.

Mr. Winton has done all the microscopic work involved in the examinations above referred to, and the chemical work has been done by him and the other station chemists, Messrs. Ogden, Silverman, Bailey and Miss Barber.

The study of the vegetable proteids, which has been carried on by Dr. Osborne for many years, has been continued. From the castor bean has been prepared a large quantity of ricin, an extremely poisonous body, showing all the properties of a protein. A detailed study of this substance, in which Professor L. B. Mendel of Yale University is collaborating, promises interesting and valuable results.

A grant made to Dr. Osborne by the Carnegie Institution is being used in a study of the decomposition products of the proteins of the wheat kernel. Much valuable work had been previously done on the products yielded by proteins when decomposed with acids, the results of which are ready to publish.

Under the statute requiring the testing of Babcock apparatus, the station has examined ninety-one pieces of glassware for dairymen and others, and marked them as prescribed by law.

One hundred and ninety-four samples of field and garden seeds have been tested with reference to their vitality, at the request of seedsmen and others.

Dr. Clinton, the station botanist, has finished his extended monograph on the group *Ustilagineae*, or smuts, and it will come from the press in a few weeks. Material for a paper on the smuts found in Connecticut is in hand and will probably be published this winter.

The month of April was spent by Dr. Clinton in Porto Rico, on leave of absence without pay, studying diseases of the coffee plant at the request of Government officials.

During the summer spraying experiments on onions, melons and potatoes were carried out at farms where these crops were raised, and there was planted on the station grounds a small garden to show specimens of various crop diseases. A special study of the peach scab is being made.

Six addresses on subjects covered by Dr. Clinton's work have been made by him at Farmers' Institutes and meetings of pomological and horticultural societies, and also six exhibitions of fungus diseases have been made.

Considerable additions have been made to the station's collection of economic fungi of Connecticut.

The station entomologist, Dr. Britton, has made spraying experiments to combat the San José scale-insect in a number of places in the state, and has tested fifteen different mixtures, mostly of lime and sulphur. A bulletin giving the details and results of this work is now being printed.

A mosquito survey of the state has been commenced, the salt marshes of the coast examined from the New York state line to Rhode Island, and the breeding places mapped.

Similar examinations have also been made about Hartford, Middletown and Cheshire. Brief reports of the breeding areas, with maps, have been sent to the health officers of the towns in which they were found, with directions for remedial treatment. Duplicate copies have been furnished the State Board of Health, and are kept on file here. An adequate account of this mosquito work is now being prepared for publication in the forthcoming report of the entomologist.

The insect fauna of Connecticut has also been studied and extensive additions have been made to the station collection, which now contains about 2,000 species. Several species have been captured that were hitherto unrecorded from New England.

Connecticut insects were exhibited at the St. Louis Exposition and three formal exhibits have been made within the state, viz., at the meeting of the Board of Agriculture at Middletown in December, 1903, the Pomological Society at Hartford in February, 1904, and the Fruit Exhibit of the Pomological Society at Rockville in September.

Many valuable observations have been made on injurious insects, and one hundred and forty-eight specimens have been identified for farmers, fruit growers, etc.

The entomologist has delivered sixteen addresses, three of them illustrated, before granges, farm institutes, etc.

Thirty-five nursery inspections have been made and thirty-three certificates granted.

The entomologist has been assisted throughout the year by Mr. B. H. Walden, and until September 15th by Mr. Henry L. Viereck, a well-known entomologist of Philadelphia.

The forester, Mr. Mulford, and the assistant forester, Mr. Hawes, have nearly completed the experimental plantings of forest trees on the Lockwood Field. There are about forty-three acres planted, and three or four acres still left to be planted.

Several acres on the Mundy Hollow tract have been set with Scotch and white pine and yellow and red oak.

About one hundred acres have been added to the state forest near Portland, and about fifty acres of the tract have been thinned by improvement cutting.

An acre of tobacco has been planted under cloth in continuation of an experiment on improvement of the wrapper leaf by selection of seed.

The experiment in fertilizing peach orchards has been continued as before.

Five experiments in seeding with alfalfa have been made in as many different places.

The station has issued two bulletins during the year,—No. 145, Commercial Feeding Stuffs in the Connecticut Market, fifty-nine pages, and No. 146, San José Scale-Insect Experiments in 1904, thirty-two pages and four plates.

The annual report for the year 1903 is a volume of four hundred and eighty pages with twenty-eight plates and one colortype.

These publications have been distributed in editions of 12,000 each.

The correspondence of the station continues to increase. The number of letters and manuscript reports sent during the year by members of the staff on station business has exceeded fifty-one hundred.

During the year ending October 31, 1904, this Board has held four regular meetings, viz:—at the station in New Haven, November 24, 1903, present Messrs. Gold, Brewer, Hoyt, Jenkins and Webb; at Hartford, annual meeting, January 19, 1904, present Messrs. Gold, Atwater, Brewer, Collins, Hoyt, Jenkins and Webb; at the station, June 14, 1904, present Messrs. Gold, Atwater, Brewer, Hoyt and Jenkins; and at the station, October 13, 1904, present Messrs. Gold, Atwater, Brewer, Jenkins and Webb.

The Executive Committee has held two formal meetings, on March 5 and May 30, 1904, and several informal conferences.

The treasurer's accounts for the state financial year, which ends September 30, have been duly audited by the state auditors of accounts.

All of which is respectfully submitted.

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

NEW HAVEN, October 31, 1904.

REPORT OF THE TREASURER.

E. H. Jenkins, in account with the Connecticut Agricultural Experiment Station for the fiscal year ending September 30, 1904.

RECEIPTS.

Balance on hand October 1, 1903:			
Analysis Fees	$145.62		
Insect Pest Fund	885.24		$1,030.86
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		3,500.00	
Sale of Tobacco		28.00	
Miscellaneous Receipts		113.43	
From the Lockwood Estate		8,300.00	
			34,941.43
			$35,972.29

DISBURSEMENTS.

E. H. Jenkins, Salary	$2,800.00	
W. H. Brewer, "	100.00	
V. E. Cole, "	800.00	
L. M. Brautlecht, "	555.00	
A. L. Winton, "	2,000.00	
T. B. Osborne, "	1,800.00	
A. W. Ogden, "	1,605.56	
I. F. Harris, "	925.00	
Max Silverman, "	125.00	
E. Monroe Bailey, "	1,125.00	
Kate Barber, "	414.06	
I. A. Andrew, "	100.00	
W. E. Britton, "	1,500.00	
G. P. Clinton, "	1,833.33	
Walter Mulford, "	704.15	
Alfred Akerman, "	148.73	
Austin F. Hawes, "	233.33	
J. B. Olcott, "	800.00	
H. Lange, "	800.00	
Wm. Veitch, "	600.00	
V. L. Churchill, "	660.00	

Labor	$1,403.84	
Publications	1,034.52	
Postage	161.20	
Stationery	118.67	
Telephone and Telegraph	88.54	
Freight and Express	108.10	
Gas and Kerosene	220.65	
Coal	1,125.09	
Water	93.48	
Chemicals and Laboratory Supplies	1,100.96	
Agricultural and Horticultural Supplies	121.74	
Miscellaneous Supplies	225.74	
Fertilizers	124.36	
Feeding Stuffs	134.92	
Library	550.90	
Furniture and Fixtures	252.75	
Scientific Apparatus	81.98	
Traveling by the Board	75.50	
Traveling by the Staff	313.31	
Tobacco Experiment	1,553.14	
Fertilizer Sampling	169.62	
Food Sampling	326.49	
Insurance	112.50	
Insect Pest Appropriation to State Entomologist	3,435.24	
Contingent	172.09	
Lockwood Expenses and Forestry	1,495.04	
Repairs	482.77	
		$34,712.30
Analysis Fees on hand Sept. 30, 1904	$809.99	
Insect Pest Funds on hand Sept. 30, 1904	450.00	
		1,259.99
		$35,972.29

NEW HAVEN, CONN., Oct. 8, 1904.

This is to certify that we have examined the accounts of E. H. Jenkins, Treasurer of The Connecticut Agricultural Experiment Station, for the fiscal year ending September 30, 1904, compared said accounts with the vouchers therefor and found them correct.

JAMES P. BREE,
LESTER D. PHELPS,
Auditors of Public Accounts.

ERRATUM.

Page 201, fourteenth line from top, for 20,000, read 2,000.

COMMERCIAL FERTILIZERS.

DUTIES OF MANUFACTURERS AND DEALERS.

The General Statutes of Connecticut, sections 4581 to 4590, inclusive, make the following requirements regarding all commercial fertilizers "except stable manure, and the products of local manufacturers of less value than ten dollars per ton":

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 local 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 local 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 local 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 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.

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

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

In case of bone, fish, tankage, dried meat, dried blood, etc., the 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.

OBSERVANCE OF THE FERTILIZER LAW.

During 1904 thirty-four individuals or firms have entered for sale in this state two hundred and forty-five brands of fertilizers, viz.:

Special manures for particular crops	109
Other nitrogenous superphosphates	84
Bone manures and "bone and potash"	22
Fish, tankage, castor pomace and chemicals	30
Total	245

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, 1905:

Firm.	*Brand of Fertilizer.*
American Agricultural Chemical Co., The, 26 Broadway, N. Y. City.	High Grade Tobacco Manure.
	Complete Manure with 10% Potash,
	Grass and Lawn Top Dressing,
	Tobacco Starter and Grower,
	Complete Tobacco Manure,
	Southport XX Special,
	Church's Fish and Potash,
	Grass and Oats Fertilizer,
	Acid Phosphate,
	Castor Pomace,
	Dry Ground Fish,
	Fine Ground Bone,
	Nitrate of Soda,
	Muriate of Potash,

Firm.	*Brand of Fertilizer.*
American Agricultural Chemical Co., The,—*Continued.*	Bradley's Niagara Phosphate,
	" 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,
	Crocker's Potato, Hop and Tobacco Phosphate,
	" Ammoniated Corn Phosphate,
	Darling's Farm Favorite,
	" Potato Manure,
	" Dissolved Bone and Potash,
	" Tobacco Grower,
	" Blood, Bone and Potash,
	" General Fertilizer,
	East India Complete Potato Manure,
	" A. A. Ammoniated Superphosphate,
	Quinnipiac Market Garden Manure,
	" Phosphate,
	" Potato Manure,
	" " Phosphate,
	" Corn Manure,
	" Climax,
	Read's Practical Potato Special,
	" Standard Superphosphate,
	" Vegetable and Vine Fertilizer,
	Williams & Clark's High Grade Special,
	" " Americus Ammoniated Bone Superphosphate,
	" " Potato Phosphate,
	" " Americus Potato Manure,
	" " Americus Corn Phosphate,
	Great Eastern Northern Corn Special,
	" " Vegetable, Vine and Tobacco,
	" " General Fertilizer,
	Packers' Union Gardeners' Complete Manure,
	" " Animal Corn Fertilizer,
	" " Potato Manure,
	" " Universal Fertilizer,
	Wheeler's Corn Fertilizer,
	" Potato Manure,
	" Havana Tobacco Grower,
	" Bermuda Onion Grower.

Firm.	*Brand of Fertilizer.*
American Farmers' Fertilizer Co., 133-137 Front St., N. Y. City.	American Farmers Market Garden Special, " " Corn King, " " Complete Potato, " " Ammoniated Bone, " " Grain Grower.
Armour Fertilizer Works, The, Baltimore, Md.	Grain Grower, Bone, Blood and Potash, High Grade Potato, All Soluble, Ammoniated Bone with Potash, Bone Meal.
Berkshire Fertilizer Co., Bridgeport, Conn.	Berkshire Complete Fertilizer, " Potato and Vegetable Phosphate, " Fine Ground Bone, " Ammoniated Bone Phosphate.
Boardman, F. E., Route 1, Middletown, Conn.	Boardman's Complete Fertilizer for Potatoes and General Crops.
Bohl, Valentine, Waterbury, Conn.	Self-Recommending Fertilizer, Market Garden Complete Fertilizer.
Bowker Fertilizer Co., 81 New Street, N. Y. City.	Bowker's Stockbridge Special Corn Manure, " " Potato and Vegetable Manure, " " Grass Top Dressing, " Potato and Vegetable Fertilizer, " Potato and Vegetable Phosphate, " Hill and Drill Phosphate, " Farm and Garden Phosphate, or Ammoniated Bone, " Fisherman's Brand Fish and Potash, " Tobacco Starter, " " Ash Elements, " Complete Alkaline Tobacco Grower, " Sure Crop Phosphate, " Market Garden Fertilizer, " Corn Phosphate, " Early Potato Manure, " Fine Ground Dry Fish, " Fairfield Onion Grower, " 25% Ash Compound, " Fresh Ground Bone, " Canada Hard Wood Ashes, " Acid Phosphate, " Square Brand Bone and Potash, " Castor Pomace, " Gloucester Fish and Potash, " Middlesex Special,

Firm.	*Brand of Fertilizer.*
Bowker Fertilizer Co.,—*Continued.*	Nitrate of Soda, Muriate of Potash.
Clark, The Everett B., Co., Milford, Conn.	Special Mixture Fertilizer.
Coe, E. Frank, Co., 133-137 Front St., N. Y. City.	E. Frank Coe's H. G. Ammoniated Bone Superphosphate, " Red Brand Excelsior Guano, " Long Islander Market Garden Special, " Columbian Corn, " " Potato, " Celebrated Special Potato, " Fish Guano and Potash [FP], " XXX Bone, " Gold Brand Excelsior Guano, " Tobacco and Onion.
Connecticut Fat Rendering & Fertilizing Corporation, New Haven, Conn.	Tankage.
Connecticut Valley Orchard Co., The, Berlin, Conn.	C. V. O. Co.'s Complete High Grade.
Cooper's Glue Factory, Peter, 17 Burling Slip, N. Y. City.	Pure Bone Dust.
Dennis, George L., Stafford Springs, Conn.	Ground Bone.
Ellsworth, F., Hartford, Conn.	Shoemaker's Swift Sure Superphosphate for Potatoes, " Superphosphate for General Use, " Bone Meal.
Frisbie, L. T. Co., The, Hartford, Conn.	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.
Lister's Agricultural Chemical Works, Newark, N. J.	Lister's Potato Manure, " Special Corn and Potato, " " 10% Potato, " "Success", " "Standard" Bone Superphosphate, " Special Tobacco, " Pure Raw Bone Meal, " Animal Bone and Potash.

Firm.	*Brand of Fertilizer.*
Lowell Fertilizer Co., see Swift's Lowell Fertilizer Co.	
MacCormack, Wm., 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 Market Garden Fertilizer, " Complete Fertilizer, " Potato Phosphate, " Ammoniated Bone Phosphate, " Universal Phosphate, " Fish and Potash, " H. G. Special Tobacco Fertilizer, " Complete Tobacco Fertilizer, " Plain Superphosphate, " Dry Ground Fish.
New England Fertilizer Co., The, 43 North Market St., Boston, Mass.	New England Potato Fertilizer, " High Grade Potato Fertilizer, " Corn and Grain Fertilizer, " Superphosphate, " Perfect Tobacco Grower, " Ground Bone.
Niantic Menhaden Oil & Guano Co., Niantic, Conn.	Atlantic Coast Fish, Potash and Bone.
Ohio Farmers Fertilizer Co., Columbus, Ohio.	General Crop Fish Guano, Ammoniated Bone and Potash, Potato and Tobacco Special.
Olds & Whipple, Hartford, Conn.	O. & W. Complete Tobacco Fertilizer, " Vegetable Potash, " Special Phosphate, " Potato Fertilizer.

Firm.	*Brand of Fertilizer.*
Rogers & Hubbard Co., The, Middletown, Conn.	Hubbard's Oats and Top-Dressing, " Grass and Grain, " Soluble Corn, " " Potato, " " Tobacco, " All Soils, All Crops, " Corn Phosphate, " Potato Phosphate, " Raw Knuckle Bone Flour, " Strictly Pure Fine Bone.
Rogers Mfg. Co., The, Rockfall, Conn.	All Round Fertilizer, Complete Potato and Vegetable Fertilizer, H. G. Complete Corn and Onion Fertilizer, Fish and Potash Fertilizer, High Grade Soluble Tobacco Fertilizer, High Grade Oats and Top Dressing Fertilizer, " " Grass and Grain Fertilizer, " " Soluble Tobacco and Potato Fertilizer, Tobacco Starter, Pure Ground Bone, Knuckle Bone Flour.
Russia Cement Co., Gloucester, Mass.	Essex XXX Fish and Potash, " Corn Fertilizer, " 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, " Dry Ground Fish, " Fine Bone Meal.
Sanderson Fertilizer & Chemical Co., New Haven, Conn.	Sanderson's Potato Manure, " Corn Superphosphate, " Special with 10% Potash, " Formula A., " Formula B. for Tobacco, " Top Dressing for Grass and Grains, " Superphosphate with Potash, " Fine Ground Bone, " Blood, Bone and Meat, " Plain Superphosphate, Niantic Bone, Fish and Potash, Muriate of Potash, Nitrate of Soda, Sulphate of Potash, Kainit.

Firm.	Brand of Fertilizer.
Shay, C. M., Groton, Conn.	Mystic Gilt Edge Potato Manure, Corn Manure, Pure Ground Bone.
Shoemaker, M. L. & Co., see Ellsworth, F.	
Swift's Lowell Fertilizer Co., 44 No. Market St., Boston, Mass.	Swift's Lowell Bone Fertilizer, " " Potato Phosphate, " " Dissolved Bone and Potash, " " Animal Brand, " " Potato Manure, " " Empress Brand, " " Perfect Tobacco Grower, " " Market Garden Manure, " " Ground Bone.
Wilcox Fertilizer Works, The, Mystic, Conn.	Wilcox' 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.

DUTIES OF THE STATION.

The station is authorized to take samples from any lot of fertilizer in the possession of any dealer and is required to make and publish yearly one or more analyses of each brand or kind of fertilizer.

These analyses are chiefly useful as a guide in making purchases for the following 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 year's supply of fertilizers is for the most part shipped into the state just before planting time, much of it after river navigation is opened. Our agent finds that 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 more than two hundred and forty 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.

But when new brands are offered, or firms which have not previously done business here enter new brands of fertilizers, 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 or of cattle foods which are offered.

SAMPLING AND COLLECTION OF FERTILIZERS.

During March, April and May, Mr. V. L. Churchill, the sampling agent of this station, visited ninety-two 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	11
New London County	11
Middlesex County	7
New Haven County	18
Fairfield County	10
	92

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

The sampling agent could not find Lister's Bone Meal on sale and no sample was deposited by the manufacturer at the station. It was, therefore, impossible to make an analysis of it as provided by the fertilizer law.

With this exception 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 through the entire length of the bag or barrel.

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

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

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

ANALYSES OF FERTILIZERS.

During the year 508 samples of commercial fertilizers and manurial waste-products have been analyzed. A classified list of them is given on page 17 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.

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

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

THE ELEMENTS OF FERTILIZERS.

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

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

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

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

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

PHOSPHOROUS is found in fertilizers in the form of phosphates, usually those of calcium, iron and aluminum, or, in case of "superphosphates," to some extent, in the form of free phosphoric acid.

Water-soluble Phosphoric Acid is phosphoric acid (or a phosphate) that freely dissolves in water. It is the characteristic ingredient of superphosphates, in which it is produced by acting on "insoluble" (or "citrate-soluble") phosphates, with diluted sulphuric acid. Once well incorporated with the soil, it "reverts" and becomes insoluble, or very slightly soluble, in water.

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

Water-soluble and citrate-soluble phosphoric acid are, probably, about equally valuable as plant food, and of nearly equal commercial value. In some cases, indeed, the water-soluble gives better results on crops; in others, the "reverted" is superior. In most instances there is little to choose between them.

Insoluble Phosphoric Acid implies various phosphates insoluble both in water and in hot solution of neutral ammonium citrate. The phosphoric acid of Canadian "apatite," of South Carolina and Florida "rock phosphate," and of similar dense mineral phosphates, as well as that of "bone ash" and "bone black," is mostly insoluble in this sense, and in the majority of cases gives no visible good results when these substances, in the usual ground state, are applied to crops. They contain, however, a small proportion of citrate-soluble phosphoric acid, and sometimes, when they are reduced to extremely fine dust (floats) or applied in large quantities, especially on "sour soils," or in conjunction with abundance of decaying vegetable matter (humus), they operate as efficient fertilizers.

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

In commercial fertilizers, "available phosphoric acid" is frequently understood to be the sum total of the "water-soluble" and the citrate-soluble," with the exclusion of the "insoluble." The term is applied in the trade not only to the water-soluble and citrate-soluble phosphoric acid of superphosphates, but to that of all kinds of phosphatic material, and when so applied it has no necessary relation to the availability of such phosphates to farm crops.

The "insoluble phosphoric acid" in a commercial fertilizer costing $20 to $45 per ton has very little or no value to the purchaser, because the quantity of it which can commonly be put on an acre of land has no perceptible effect upon the crop and because its presence in the fertilizer excludes an equal percentage of more needful and much more valuable ingredients.

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

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

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

Potash signifies the substance known in chemistry as potassium oxide (K_2O), which is reckoned as the valuable fertilizing ingredient of "potashes" and "potash salts." In these it should be freely soluble in water. It is most costly in the form of carbonate and cheapest in the form of muriate (potassium chloride). In unleached ashes of wood and cotton-seed hulls it exists mainly as potassium carbonate.

VALUATION OF FERTILIZERS.

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.

Plaster, lime, stable manure and nearly all of the less expensive fertilizers have variable prices, which bear no close relation to their chemical composition, but guanos, superphosphates and similar articles, for which $20 to $45 per ton are paid, depend for their trade-value exclusively on the substances, nitrogen, phosphoric acid and potash, which are comparatively costly and steady in price. The trade-value per pound of these ingredients is reckoned from the current market prices of the standard articles which furnish them to commerce.

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

TRADE-VALUES OF FERTILIZER ELEMENTS FOR 1904.*

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 1903, were as follows:

* Adopted at a conference of representatives of the Connecticut, Massachusetts, New Jersey and Rhode Island stations held in March, 1904.

	Cents per Pound.
Nitrogen in nitrates	16
in ammonia salts	17½
Organic nitrogen, in dry and fine-ground fish, meat and blood, and in mixed fertilizers	17½
in fine* bone and tankage	17
in coarse* bone and tankage	12½
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 Superphosphates, Special Manures and Mixed Fertilizers of High Grade.

The Organic Nitrogen in these classes of goods is reckoned at the price of nitrogen in raw materials of the best quality,‡ 17½ cents.

* 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.

‡ This concession gives a dishonest manufacturer the opportunity to defraud the consumer, by "working off" inferior or almost worthless leather, bat guano, and similar materials which "analyze well," containing up to 8 or 9 per cent. of nitrogen, much or all of which may be quite inert; provided this inferiority is not discovered by the chemical examination. But since honest and capable manufacturers generally claim to use only "materials of the best quality," it would be unjust to them to assume that their fertilizers contain anything inferior. Farmers should satisfy themselves that they are dealing only with honest and with intelligent manufacturers. This can be done at little cost by such coöperation as Farmers' Clubs and Granges may practice, sending a competent and trusty agent to visit factories frequently and unexpectedly and to take samples of raw materials. Honorable manufacturers will be glad to show all their raw materials and processes to their customers, especially if such inspection is insisted on as a preliminary to business. Coöperation may thus insure satisfactory quality of goods, as well as reduced cost.

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

In most cases the valuation of the ingredients in superphosphates and specials falls below the retail price of these goods. The difference between the two figures represents the 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 investments, bad debts and, finally, profits.

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

In 1904 the average selling price of ammoniated superphosphates and guanos was $31.07 per ton, the average valuation was $20.69, and the difference $10.38, an advance of 50.1 per cent. on the valuation and on the wholesale cost of the fertilizing elements in the raw materials.

In case of special manures the average cost was $33.93, the average valuation $23.39 and the difference $10.54 or 45.0 per cent. advance on the valuation.

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

In case of *Ground Bone and Tankage,* the sample is sifted into the two grades just specified (see foot note, page 14), and we separately compute the nitrogen-value of each grade by multiplying the pounds of nitrogen per ton by the per cent. of each grade, 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 up the separate values of each grade thus obtained, together with the values of each grade of phosphoric acid, similarly computed, the total is the valuation of the sample of bone.

Uses and Limitations of Fertilizer Valuation.

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

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

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

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

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

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

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

For both of the above-named purposes, however, the intelligent purchaser can make a valuation of his own which will be much more reliable *for his individual case* than the average figures given in this report, because it applies specially to the time of his purchase and to the prices which he can get at that time. Thus he can learn by quotations given him by a number of dealers, the cheapest rates at which he can buy plant food, nitrogen, phosphoric acid and potash, in raw materials; also the rates at which he can buy these same things in ready-mixed goods. With these facts before him he has a basis of valuation, accurate for the time when he buys, the market in which he buys and the cash or credit system on which he buys.

Agricultural Value of Fertilizers.

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

CLASSIFICATION OF FERTILIZERS ANALYZED.

	No. of Analyses.
1. *Containing Nitrogen as the chief valuable ingredient.*	
Nitrate of soda	10
Sulphate of ammonia	1
Dried blood	3
Cotton seed meal	117
Castor pomace	2
Linseed meal	1
2. *Containing Phosphoric Acid as the chief valuable ingredient.*	
Phosphate rock	1
Dissolved rock phosphate	11
3. *Containing Potash as the chief valuable ingredient.*	
High grade carbonate of potash	14
Double carbonate of potash and magnesia	1
High grade sulphate of potash	2
Double sulphate of potash and magnesia	5
Muriate of potash	11
Kainit	2
"Domestic potash"	1
4. *Containing Nitrogen and Phosphoric Acid.*	
Bone manures	31
Slaughter house tankage	13
Dry ground fish	7
5. *Mixed Fertilizers.*	
Nitrogenous superphosphates	98
Special manures	130
Home mixtures	10
6. *Miscellaneous Fertilizers and Manures.*	
Tobacco stems	4
Tobacco dust	2
Vegetable ash compound	3
Wood ashes	15
Cotton hull ashes	4
Ashes from lime kilns and brick kilns	3
Ashes of birch brush	1
Lime	4
Plaster	1
Total	508

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, and is quite uniform in composition.

Nitrogen in form of nitrates is, under ordinary conditions, more quickly available to crops than in any other form. It may often be used with profit in spring on wheat or rye which has partly winter-killed or for any reason shows a poor stand. Experiment has shown that it is also profitably used in hastening the growth of such crops as tomatoes where early ripening increases greatly their market value.

Nitrates are, however, exposed to losses in the soil, by leaching and decomposition, greater than usually befalls organic forms. They should, therefore, be applied only when the crop is ready to assimilate them.

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

11671. Sold by American Agricultural Chemical Co., New York. Stock of J. G. Schwink, Meriden.

11797. Sold by Sanderson Fertilizer and Chemical Co., New Haven. Stock of Connecticut School for Boys, Meriden.

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

11702. Sold by Bowker Fertilizer Co., Boston. Stock of Bowker's Branch, Hartford.

11703. Sold by Bowker Fertilizer Co. Stock of E. E. Burwell, New Haven.

11608. Sold by Bowker Fertilizer Co. Stock of Andrew Ure, Hamden.

11846. Sold by Wilcox Fertilizer Works, Mystic. Sampled at factory.

11737. Stock of S. D. Woodruff & Sons, Orange.

11705. Sold by Sanderson Fertilizer and Chemical Co. Sampled at factory.

11704. Sold by American Agricultural Chemical Co. Stock of E. N. Austin, Suffield.

11701. Sold by Russia Cement Co., Gloucester, Mass. Stock of Spencer Bros., Suffield.

ANALYSES OF NITRATE OF SODA.

Percentage amounts of	11671	11797	11702	11703	11608	11846	11737	11705	11704	11701
Nitrogen found	15.60	15.36	15.68	15.96	15.84	15.56	15.60	15.48	15.40	15.64
Equivalent nitrate of soda	94.7	93.3	95.2	96.9	96.1	94.4	94.7	94.0	93.5	94.9
Nitrogen guaranteed .	15.8	15.8	....	15.0	....	15.0	....	15.8	15.8	....
Equivalent nitrate of soda guaranteed....	95.9	95.9	....	91.1	....	91.1	....	95.9	95.9	....
Cost per ton	$48.00	47.50	49.00	50.00	50.00	50.00	50.00	50.00	50.00	53.00
Nitrogen costs cents per pound.........	**15.4**	**15.5**	**15.6**	**15.7**	**15.8**	**16.0**	**16.0**	**16.1**	**16.2**	**16.9**

In the above table are two samples, 11797 and 11705, from stock of the Sanderson Fertilizer Co., representing small lots from a stock of 175 tons bought by this company on foreign analysis given below. More complete analyses of the two samples are also given:

Percentage amounts of	11797	11705	Cargo Analysis.
Water	2.24	1.31	2.44
Insoluble matters	trace	0.35	0.12
Sodium chloride	3.91	3.05	0.97
Sodium sulphate	0.53	0.56	0.31
Pure sodium nitrate	93.32	94.73	96.16
	100.00	100.00	100.00

The chief difference between the three analyses is in the amount of salt and consequently of pure nitrate. They illustrate the fact that buyers of chemicals in large lots cannot be sure that the composition of the whole is perfectly uniform and that buyers of small lots should make reasonable allowance therefor. A guaranty of 15.8 per cent. of nitrogen, however, such as was given with two of the lots analyzed this year cannot often be made good, for most of the nitrate sold in this state contains less than that amount.

All the samples examined this year, with the possible exception of 11797, were of good quality.

The average percentage of nitrogen in them is 15.61.

The cost of nitrogen ranged from 15.4 to 16.9 cents per pound, the average being 15.9 cents.

SULPHATE OF AMMONIA.

This material, which is made on a large scale as a by-product of gas works and coke ovens, usually contains over 20 per cent. of nitrogen, or the equivalent of 94-97 per cent. of pure ammonium sulphate.

11700. Sold by American Agricultural Chemical Co., New York. Stock of E. N. Austin, Suffield.

This sample is of rather low grade, containing 18.80 per cent. of nitrogen, equivalent to 22.8 per cent. of ammonia. It contains 5.47 per cent. of non-volatile mineral matter.

The cost per ton, $70.00, makes the cost of nitrogen 18.6 cents per pound. At this price it cannot, we believe, be profitably used as a fertilizer in preference to nitrates or organic forms of nitrogen.

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 $\frac{2.64}{16.5}$ or 16 cents.

11687. Sold by Swift's Lowell Fertilizer Co., Boston, Mass. Stock of E. E. Burwell, New Haven.

11688. Sold by American Agricultural Chemical Co., New York. Stock of E. N. Austin, Suffield.

11610. Sold by Bowker Fertilizer Co., New York. Stock of Andrew Ure, Hamden.

ANALYSES OF DRIED BLOOD.

	11687	11688	11610
Percentage amounts of			
Nitrogen found	9.62	12.48	9.99
Nitrogen guaranteed	8.24	16.00	12.00
Cost per ton	$40.00	53.00	45.00
Nitrogen costs cents per pound	**20.8**	**21.2**	**22.5**

Two of the three samples contain much less nitrogen than is guaranteed, and the cost of nitrogen in all of them is much higher than in other organic forms which are readily available to crops.

COTTON SEED MEAL.

This material is of two kinds, which are known in trade respectively as undecorticated and decorticated. In their manufacture cotton seed is first ginned to remove most of the fiber, then passed through a "linter" to take off the short fiber or lint remaining, then through machines which break and separate the hulls. The hulled seed is ground and the oil expressed. The ground cake from the presses is used as a cattle food and fertilizer. 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 food at the South, and now sell for this purpose at prices which forbid their use as a fuel.

The attention of buyers is called to the following 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.

RULE 16. "Cotton Seed Meal, Choice—must be the product from choice cotton seed cake, when finely ground, must be perfectly sound, sweet and light color (canary), free from excess of lint and hulls. Analysis must contain at least 8 per cent. ammonia."

RULE 17. "Prime—must be made from prime cake, finely ground, of sweet odor, reasonably bright in color, yellow, not brown or reddish, and free from excess of lint or hulls, and by analysis must contain at least 8 per cent." (of ammonia) "for meal from Texas and the Mississippi Valley and 7½ per cent. for meal from the South Atlantic States."

RULE 46. Meal. "Two ounces or more from a sack shall constitute a sample of meal and must be drawn so as to fairly represent the entire contents of the bag. Twenty samples from each carload or 50 sacks from each 100 tons, if not shipped in car lots, shall be sufficient to represent a shipment."

Hence 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.

It has been usual in past years for dealers to guarantee 7.0 per cent. of nitrogen, but the analyses show that this year between one-third and one-half of the samples had less than 7.0 per cent., while only eight of the one hundred and fourteen samples had less nitrogen than is required in choice or prime meal (6.59 per cent.).

In the table, pages 25–30, are analyses of one hundred and fourteen samples of cotton seed meal from stock bought chiefly, if not wholly, for use as a fertilizer.

These samples represent at least 68 car lots, or 1,417 tons of meal, all of which was used as a fertilizer, chiefly on tobacco. The amount of meal represented by a part of the samples is not known.

The percentage of phosphoric acid in cotton seed meal ranges from 2.69 to 3.44, and that of potash from 1.64 to 2.00, the average being 3.15 and 1.90, respectively. The cost per pound of nitrogen is determined in each case by deducting $4.42—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 meal.

The average ton cost of cotton seed meal has been $27.71, somewhat higher than in 1903.

The percentage of nitrogen found in the samples examined has ranged from 5.99 to 7.66, the average being 7.13, a shade higher than last year.

The cost of nitrogen ranged from 14.6 to 19.6 cents per pound, and the average was 16.5, half a cent higher than last year.

It was noticeable this year that, as a rule, the cotton seed meal received early in the year ranged higher in nitrogen than that which came about planting time.

Quite commonly 2,500 pounds of cotton seed meal are put on an acre of tobacco land. When bought at the best advantage this year the nitrogen applied has cost the grower $8.75 less than when bought at the most expensive rate.

The average cost per ton, percentage of nitrogen and cost per pound of nitrogen, as determined by our analyses during the last eight years, have been as follows:—

Year.	Cost.	Per cent of nitrogen.	Cost per pound of nitrogen.
1904	$27.71	7.13	16.5
1903	26.96	7.09	16.0
1902	27.64	7.08	16.0
1901	26.08	7.24	14.9
1900	25.20	7.26	14.3
1899	22.80	7.14	12.9
1898	21.50	7.44	11.5
1897	22.00	7.40	11.6

A few years ago the nitrogen of cotton seed meal was the cheapest form of quickly available nitrogen in our market. At present it costs as much as nitrogen in form of slaughter house fertilizers.

INFERIOR COTTON SEED MEAL.

Two samples of meal, Nos. **11974** and **12115**, from the same lot, sent by J. B. Parker of Poquonock, from stock bought of Daniels Mill Co., Hartford, for $27.50 per ton, contained respectively only 4.14 and 4.18 per cent. of nitrogen—almost three per cent. less than should be present. The meal is full of hulls, but is very different in appearance from the "undecorticated meal" formerly sold in the state. The hulls have been so finely ground that the powder is brown instead of black and the mixture of meal and hulls is not very different in appearance, to casual inspection, from meal of good quality. It has the appearance of a mixture made with fraudulent intent.

The Daniels Mill Co. state that it was bought by them from George B. Robinson, Jr., 18 Broadway, New York, for prime, bright meal, guaranteed 7 per cent. nitrogen.

A sample of meal, **11925**, sent by R. L. Greer of Suffield, was bought by him of the Daniels Mill Co. a year ago. The seller states that it was sold in 1903 as dark, off-color meal. It contained 6.08 per cent. of nitrogen.

As a rule the Station does not undertake analyses of goods which are left over from a previous season. An analysis should show the quality of the article, at or about the time of sale. The possibility of change in composition on storing, caused by the vicissitudes of the season and the exposure of the storeroom, impairs the value of the analysis, if it is used to determine the quality of the goods at the time of sale.

It sometimes happens, however, that the purchaser, recognizing the fact that the deterioration, if any, in the fertilizer is not the fault of the dealer, wishes to know the extent of the damage which has followed a year's storage, before applying the fertilizer.

In such cases the station will undertake the analysis. The sender should, however, in all cases state whether or not the sample represents fresh stock.

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 quickly available to plants, but the pomace is extremely poisonous to animals, which often eat it greedily when the opportunity offers.

11683. Sold by American Agricultural Chemical Co., New York City. Stock of F. S. Bidwell & Co., Windsor Locks.

12055. Sold by Bowker Fertilizer Co., New York City. Stock of Bowker's Branch, Hartford.

ANALYSES.

Percentage amounts of	11683	12055
Nitrogen found	4.91	4.38
Nitrogen guaranteed	....	4.12
Cost per ton	$23.00	23.00
Nitrogen costs cents per pound	**20.8**	**23.4**

ANALYSES OF COTTON SEED MEAL.

Station No.	Dealer.	Sampled or sent by	Per cent. of nitrogen.	Cost per ton.	Nitrogen costs cents per pound.
11484	Arthur Sikes, Suffield	Saml. Barr and H. D. Hastings, Suffield	7.58	$26.50	14.6
11548	" "	K. McCabe, Windsor Locks	7.56	26.50	14.6
11323	Frank M. Thompson, Warehouse Point, "off cars," Humphreys, Godwin & Co.	Fred. E. Lord, Warehouse Point	7.62	27.00	14.8
11592	Arthur Sikes, Suffield	D. I. King, Suffield	7.44	26.50	14.8
11578	Frank M. Thompson, Warehouse Point, Humphreys, Godwin & Co.	L. E. Dailey, Warehouse Point	7.58	27.00	14.9
11765	Arthur Sikes, Suffield	W. E. Russell, Suffield, and others	7.56	27.00	14.9
11630	" "	A. E. Holcomb, Windsor, and others	7.66	27.25	14.9
11545	" "	Samuel Orr, West Suffield	7.45	26.75	15.0
11674	" "	Bissell, Graves Co., Suffield	7.44	26.75	15.0
11594	" "	"	7.43	26.75	15.0
11662	" "	John Holzapfel, Suffield, and others	7.43	26.75	15.0
11621	" "	C. F. Tilden and C. T. Remington, Suffield	7.41	26.75	15.1
11852	F. M. Thompson, Warehouse Pt., "Dixie" Brand, Humphreys, Godwin & Co.	Arthur E. Pascoe, Warehouse Point	7.40	26.75	15.1
11626	Arthur Sikes, Suffield	Bissell, Graves Co., Suffield	7.40	26.75	15.1
11627	" "	"	7.39	26.75	15.1
11296	" "	Dwight Loomis, Springfield, Mass.	7.29	26.50	15.1
11581	" "	Bissell, Graves Co., Suffield	7.38	26.75	15.1
11711	" "	George Phelps and Robert Loomis, Suffield	7.36	26.75	15.2
11624	" "	Bissell, Graves Co., Suffield	7.36	26.75	15.2
11625	" "	"	7.36	26.75	15.2
11631	" "	A. E. Holcomb, Windsor, and others	7.52	27.25	15.2

Analyses of Cotton Seed Meal—*Continued.*

Station No.	Dealer.	Sampled or sent by	Per cent. of nitrogen.	Cost per ton.	Nitrogen costs cents per pound.
11593	Arthur Sikes, Suffield	Bissell, Graves Co., Suffield	7.34	$26.75	15.2
11806	Spencer Bros., Suffield	Edmund Halladay, Suffield	7.58	27.50	15.2
11902	E. N. Austin, Suffield, Am. Agl. Chem. Co.	Station Agent	7.50	27.50	15.4
11606	Spencer Bros., Suffield, Am. Cotton Oil Co.	James B. Rose, Jr., West Suffield	7.35	27.00	15.4
11563	Arthur Sikes, Suffield	David McComb and F. I. Chapell, Suffield	7.25	26.75	15.4
11602	" " "	Bissell, Graves Co., Suffield	7.25	26.75	15.4
11582	" " "	Wm. A. Soper, Suffield, and others	7.15	26.50	15.4
11802	" " "	Mrs. Tobin, Windsor Locks, and Robert Loomis, Suffield	7.49	27.50	15.4
11623	" " "	Bissell, Graves Co., Suffield	7.24	26.75	15.4
11636	Spencer Bros., Suffield, Am. Cotton Oil Co.	S. L. Wood, West Suffield	7.32	27.00	15.4
11724	Arthur Sikes, Suffield, off color	J. F. Merrill, Suffield, and others	7.32	27.00	15.4
11319	" " "	F. F. Ford, Mapleton, and others	7.14	26.50	15.5
11313	Meech & Stoddard, Middletown, Sledge & Wells Co.	J. W. Alsop, Avon	6.93	25.95	15.5
11620	Arthur Sikes, Suffield	James Colter and Cecil H. Fuller, Suffield	7.30	27.00	15.5
11656	" " "	Bissell, Graves Co., Suffield	7.21	26.75	15.5
11587	Spencer Bros., Suffield, Chapin & Co.	J. O. Haskins, Suffield	7.26	27.00	15.6
11306	Arthur Sikes, Suffield	C. P. Viets, East Granby	7.17	26.75	15.6
11764	" " " off color	C. A. Prout, Suffield, and others	7.25	27.00	15.6
11801	" " "	A. C. Ludden, Suffield, and others	7.47	27.75	15.6
11833	" " "	Ralph Moody, Suffield, and others	7.46	27.75	15.6
11868	" " "	N. A. Talmadge, West Suffield, and others	7.46	27.75	15.6
11723	" " " off color	W. H. Prout, Suffield, and others	7.20	27.00	15.7
11976	Newell St. John, Simsbury, Dixie Brand, Humphreys, Godwin & Co.	Station Agent	7.51	28.00	15.7

Analyses of Cotton Seed Meal—*Continued.*

Station No.	Dealer.	Sampled or sent by	Per cent. of nitrogen.	Cost per ton.	Nitrogen costs cents per pound.
11721	Arthur Sikes, Suffield	H. Weber and Daniel Laverty, Windsor	7.35	$27.50	15.7
11675	" " "	Henry Adams, Suffield, and others	7.37	27.75	15.8
11803	F. W. Brode & Co., Memphis, Tenn., Owl Brand	R. H. Ensign, Simsbury	7.57	28.50	15.9
12143	Broad Brook Lumber & Coal Co., Broad Brook	Broad Brook Lumber & Coal Co., Broad Brook	7.10	27.00	15.9
11958	Arthur Sikes, Suffield	Hugh Biggerstaff, Suffield, and others	7.36	28.00	16.0
11685	E. N. Austin, Suffield, Am. Agl. Chem. Co.	Station Agent	7.20	27.50	16.0
11994	Arthur Sikes, Suffield	Dwight Loomis, Springfield, and others	7.26	27.75	16.1
11899	" " "	Carey Bros. and Daniel Laverty, Windsor	7.19	27.50	16.1
11718	Spencer Bros., Suffield, J. E. Soper & Co.	S. R. Spencer, Suffield	7.46	28.50	16.1
11676	C. H. Dexter & Sons, Windsor Locks	E. S. Seymour, Windsor Locks	6.93	26.75	16.1
11588	Arthur Sikes, Suffield	R. Bawn, H. & J. Henshaw, Suffield	6.87	26,50	16.1
11993	" " "	John Cain, Suffield, and others	7.28	28.00	16.2
11605	Spencer Bros., Suffield, Am. Cotton Oil Co.	George N. Thompson, Suffield	7.10	27.50	16.3
11638	" " " J. E. Soper & Co.	H. C. Cone, Suffield	6.86	26.75	16.3
11837	J. N. Dickinson, East Granby, Old Gold Brand, T. H. Bunch	Patrick Connor, Poquonock	7.09	27.50	16.3
11959	Arthur Sikes, Suffield	W. K. Henry, Enfield, and others	7.12	27.75	16.4
11604	Spencer Bros., Suffield, J. E. Soper & Co.	H. C. Cone, Suffield	6.82	26.75	16.4
11677	C. H. Dexter & Sons, Windsor Locks	E. S. Seymour, Windsor Locks	6.80	26.75	16.4
11804	F. W. Brode & Co., Memphis, Tenn., Owl Brand	R. H. Ensign, Simsbury	7.36	28.50	16.4
12152	Arthur Sikes, Suffield	A. N. Graves, Springfield, Mass.	6.73	26.50	16.4

ANALYSES OF COTTON SEED MEAL—*Continued.*

Station No.	Dealer.	Sampled or sent by	Per cent. of nitrogen.	Cost per ton.	Nitrogen costs cents per pound.
11673	C. H. Dexter & Sons, Windsor Locks	E. A. Hatheway, Suffield	6.82	$26.75	16.4
12049	Arthur Sikes, Suffield	Luther A. Kent, Suffield	7.17	28.00	16.4
11637	Spencer Bros., Suffield, J. E. Soper & Co.	H. C. Cone, Suffield	6 78	26.75	16.5
12116		Hartford Tobacco Association, Tariffville	6.85	27.00	16.5
12054	Arthur Sikes, Suffield	John E. Chamberlain, Broad Brook	6.83	27.00	16.5
11942	" " " off color	Geo. Holloway, Suffield, and others	6.83	27.00	16.5
11619	T. G. Brigham, West Suffield	The Bissell, Graves Co., Suffield	6.52	26.00	16.6
12120	Arthur Sikes, Suffield	Geo. A. Harman, Suffield, and others	7.12	28.00	16.6
12030	" " "	Ralph Moody, Suffield, and others	7.09	28.00	16.6
11975	Olds & Whipple, Hartford, H. E. Bridges & Co.	Station Agent, stock of John DuBon, Poquonock	7.08	28.00	16.7
11781	Arthur Sikes, Suffield	L. C. Seymour, Windsor Locks, and others	7.00	27.75	16.7
12112	" " " off color	F. B. Hatheway, Suffield, and others	6.74	27.00	16.8
11716	Spencer Bros., Suffield, Am. Cotton Oil Co., Brinkley Mill	Oscar J. Hazard, Suffield	7.02	28.00	16.8
11710	H. K. Brainard, Thompsonville, J. E. Soper & Co.	F. W. Button, Thompsonville	7.01	28.00	16.8
11720	Spencer Bros., Suffield, Hunter Bros. Milling Co.	S. R. Spencer, Suffield	6.84	27.50	16.9
11780	Spencer Bros., Suffield, Am. Cotton Oil Co.	" " "	6.96	28.00	17.0
11900	Arthur Sikes, Suffield	A. N. Graves, Springfield, Mass.	6.73	27.25	17.0
11836	" " "	" " " "	6.73	27.25	17.0
11686	Spencer Bros., Suffield, J. E. Soper & Co., Memphis Mill	Station Agent	6.92	28.00	17.0

ANALYSES OF COTTON SEED MEAL—*Continued.*

Station No.	Dealer.	Sampled or sent by	Per cent. of nitrogen.	Cost per ton.	Nitrogen costs cents per pound.
12465	Meech & Stoddard, Middletown, Elephant Brand, Sledge & Wells Co.	Meech & Stoddard, Middletown	6.92	$28.00	17.0
11717	Spencer Bros., Suffield, Am. Cotton Oil Co.	S. R. Spencer, Suffield	7.06	28.50	17.1
11719	Spencer Bros., Suffield, J. E. Soper & Co.	H. C. Cone, Suffield	7.06	28.50	17.1
12464	Meech & Stoddard, Middletown, C. M. Cox & Co.	Meech & Stoddard, Middletown	6.88	28.00	17.1
12138	A. Pouleur, Windsor	Chas. A. Huntington, R. F. D., Windsor	7.02	28.50	17.2
12025	Daniels Mill Co., Hartford	P. P. Hickey, Burnside	6.72	27.50	17.2
11684	Spencer Bros., Suffield, Am. Cotton Oil Co., Brinkley Mill	Station Agent	6.87	28.00	17.2
11835	Arthur Sikes, Suffield	A. N. Graves, Springfield, Mass.	6.65	27.25	17.2
11575	Spencer Bros., Suffield, R. M. Biggs & Co.	Edmund Halladay, Suffield	6.86	28.00	17.2
12153	" " "	Thomas Noone, R. D. 2, Suffield	6.82	28.00	17.3
11576	" " " Am. Cereal Co.	Edmund Halladay, Suffield	6.79	28.00	17.4
11834	Arthur Sikes, Suffield	D. Harvey, Suffield, and others	6.69	27.75	17.4
11943	C. D. Clark, Granby, The Hunter Bros. Milling Co.	L. R. Griffin, Granby	6.77	28.00	17.4
11901	H. K. Brainard, Thompsonville, American Cotton Oil Co., Argenta Mill	G. A. Douglass, Thompsonville	6.66	27.75	17.5
11838	H. K. Brainard, Thompsonville	" " "	6.64	27.75	17.6
11944	American Cereal Co., The Hunter Bros. Milling Co.	Ackley, Hatch & Marsh, New Milford	6.82	28.50	17.6
11607	B. B. Broadbent, Highwood, Old Gold Brand, T. H. Bunch	Station Agent, stock of Andrew Ure, Highwood	6.93	29.00	17.7

ANALYSES OF COTTON SEED MEAL—*Continued.*

Station No.	Dealer.	Sampled or sent by	Per cent. of nitrogen.	Cost per ton.	Nitrogen costs cents per pound.
12011	John S. Wolfe Co., Pittsfield, Mass., Hunter Bros. Milling Co.	Ackley, Hatch & Marsh, New Milford	6.74	$28.50	17.9
12113	C. D. Clark, Granby, American Cotton Oil Co.	R. W. Griffin, Granby	6.70	28.50	18.0
11854	C. D. Clark, Granby, American Cotton Oil Co.	Alfred H. Griffin, Granby	6.65	28.50	18.1
11926	C. D. Clark, Granby, American Cotton Oil Co.	" "	6.64	28.50	18.1
12121	C. D. Clark, Granby, American Cotton Oil Co., Brinkley Mill	H. G. Viets, Granby	6.64	28.50	18.1
11603	American Cereal Co., Oliver Refining Co.	R. H. Ensign, Simsbury	6.62	28.50	18.2
12114	C. D. Clark, Granby, American Cotton Oil Co., Brinkley Mill	R. W. Griffin, Granby	6.58	28.50	18.3
12077	August Pouleur, Windsor	L. N. Lord, Poquonock	6.50	28.50	18.5
12140	Olds & Whipple, Hartford	T. R. Marcy, Poquonock	6.45	28.50	18.7
12010	L. C. Daniels Grain Co., Hartford, Hunter Bros. Milling Co.	Ackley, Hatch & Marsh, New Milford	6.44	28.50	18.7
11586	New Hartford Elevator Co., New Hartford, Green Diamond Brand	W. F. Kellogg, Box 205, New Hartford	6.77	30.00	19.0
11945	C. D. Clark, Granby, American Cotton Oil Co., Brinkley Mill	L. C. Spring, Granby	6.31	28.50	19.1
12050	Spencer Bros., Suffield	Edmund Halladay, Suffield	5.99	27.50	19.3
11898	" J. E. Soper & Co.	M. Doughney, Windsor Locks	6.02	28.00	19.6

Castor pomace, as appears from the determinations made at this station within the last few years, contains, on the average, 1.95 per cent. of phosphoric acid and 0.98 per cent. of potash. Valuing these at 4 and 5 cents per pound respectively, the cost of nitrogen per pound, in the samples noted on page 24, is 20.8 and 23.4 cents per pound. This is too high a price to pay for organic nitrogen for any crop.

LINSEED MEAL.

A single sample of linseed meal, No. **12048**, for use as a tobacco fertilizer, was sent by Clark Bros., Poquonock, from stock of Olds & Whipple, Hartford. It contained 5.96 per cent. of nitrogen. Linseed meal contains about 2.15 per cent. of phosphoric acid and 1.50 per cent. of potash.

Allowing 4 cents per pound for phosphoric acid and 5 cents per pound for potash, nitrogen in linseed meal, at $26.50 per ton, costs 19.3 cents per pound; nearly 3 cents more than in cotton seed meal. In our experiments for four years with linseed meal as a fertilizer compared with cotton seed meal, the former gave us better quality of leaf, on the average, than the latter.

II. RAW MATERIALS CHIEFLY VALUABLE FOR PHOSPHORIC ACID.

DISSOLVED ROCK PHOSPHATE OR ACID ROCK.

(ANALYSES ON PAGE 33.)

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.

11707, **11740**, **11668**, **11708**, and **12059** were sold by the American Agricultural Chemical Co., New York City.

11707. From stock of E. N. Austin, Suffield.

11740. From stock of S. D. Woodruff & Sons, Orange.

11668. From stock of J. G. Schwink, Meriden.

11708. From stock of Spencer Bros., Suffield.

12059. From stock of George Beaumont, Wallingford.

11706 and **11611** were sold by the Bowker Fertilizer Co., New York City.

11706. From stock of E. E. Burwell, New Haven.

11611. From stock of Andrew Ure, Hamden.

12061. Sold by the Wilcox Fertilizer Works, Mystic. Sampled at factory.

11709 and **11796**. Sold by Sanderson Fertilizer & Chemical Co., New Haven.

11709. Sampled at the factory.

11796. From stock of Connecticut School for Boys, Meriden.

12060. Sold by the National Fertilizer Co., Bridgeport. Stock of Gault Bros., Westport.

The prices quoted, under $16.00 per ton, are probably for car lots or mixed car lots.

The cost of "available" phosphoric acid in these samples has ranged from 4.2 to 7.1 cents per pound.

III. RAW MATERIALS OF HIGH GRADE CONTAINING POTASH.

CARBONATE OF POTASH.

(Analyses on Pages 34 and 35.)

Commercial carbonate of potash has taken the place of cotton hull ashes as a source of potash for tobacco lands, and it is quite likely that it will be used by growers in increasing quantity. 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.

Thus sample **11767** was drawn from a number of casks by a representative of the buyer, with no special precaution to prevent absorption of water by the sample. Afterwards samples **11812** and **11813** were drawn from the same lot by the station agent, using all care to cover the sample tightly as soon as it was drawn. In the first sample was found 58.13 per cent. of potash and in the other two samples 61.00 and 61.05. The water determinations, however, show that the difference was only in the amount of moisture, the first sample containing 9.78 per cent., the two others only 5.26 per cent.

Analyses of Dissolved Rock Phosphate.

	Am. Agl. Chem. Co.				Bowker.	Am. Agl. Chem. Co.	Wilcox.	Bowker.	Sanderson Fert. Co.		National Fert. Co.
	11707	11740	11668	11708	11706	12059	12061	11611	11709	11796	12060
Percentage amounts of											
Phosphoric acid, water-soluble	13.61	12.82	12.13	13.78	10.51	11.98	13.47	11.42	11.86	11.39	12.84
Phosphoric acid, citrate-soluble	2.90	3.05	3.65	2.65	2.82	3.06	2.63	2.25	1.99	2.27	2.38
Phosphoric acid, insoluble	0.29	0.24	2.05	0.29	2.69	1.31	0.66	1.90	0.67	0.58	1.16
Phosphoric acid, total	16.80	16.11	17.83	16.72	16.02	16.35	16.76	15.57	14.52	14.24	16.38
"Available" phosphoric acid found	16.51	15.87	15.78	16.43	13.33	15.04	16.10	13.67	13.85	13.66	15.22
"Available" phosphoric acid guaranteed	14.0	14.0	14.0	14.0	13.0	14.0	15.0	13.0	14.0	14.0	14.0
Cost per ton	$14.00	14.00	15.00	16.00	14.00	15.50	16.00	15.00	16.00	16.00	22.00
Available phosphoric acid costs cents per pound	4.2	4.4	4.8	4.8	4.8	4.9	4.9	5.2	5.7	5.8	7.1

Carbonate of Potash.

Station No.	Dealer.	Purchaser.
12053	August Pouleur, Windsor	Dr. T. K. Marcy, Poquonock
12029	August Pouleur, Windsor	J. S. Shaw, Poquonock
11316	T. Sisson & Co., Hartford	Sent by dealer
11767	Olds & Whipple, Hartford	L. P. Bissell, Suffield
11940	T. G. Brigham, West Suffield	O. E. Pitcher, Suffield
11813	Olds & Whipple, Hartford	L. P. Bissell, Suffield
11812	Olds & Whipple, Hartford	L. P. Bissell, Suffield
12133	Unknown	Hartford Tobacco Association, Tariffville
12125	A. Klipstein & Co., 122 Pearl St., New York	William Foster, East Granby
11905	Am. Agl. Chem. Co., New York	E. N. Austin, Suffield
11979	A. Klipstein & Co., 122 Pearl St., New York	G. A. Douglass, Thompsonville
12026	A. Klipstein & Co., 122 Pearl St., New York	P. P. Hickey, Burnside
12118	A. Klipstein & Co., 122 Pearl St., New York	J. E. Phelps, Suffield
11885	A. Klipstein & Co., 122 Pearl St., New York	A. E. Potwine, East Windsor

The best way to sample is to bore into the middle of the casks with a long auger, closing the hole later with a bung cork and putting the sample drawn *immediately* into a can with tight-fitting cover.

Of the fourteen samples in the table, two are low grade material, containing considerable sulphate and chloride. The others are high grade, the chief difference being in the amount of water which they contain. This becomes clear from the column which gives the percentage of potash in each sample calculated water-free. It will be seen that these percentages range from 64.2 to 68.3.

The cost of actual potash per pound in the twelve samples has ranged from 6.3 to 7.4 cents, the average being 6.8 cents.

DOUBLE CARBONATE OF POTASH AND MAGNESIA.

11908. A small lot, sold by Wilcox Fertilizer Works, Mystic, to M. E. Thompson, Ellington, contained

Potash soluble in water	19.85
Magnesia	23.49
Chlorine	0.57
Sulphuric acid	trace.

Analyses.

Station No.	Water-soluble potash found.	Potash guaranteed.	Chlorine.	Water.	Potash in the material calculated water-free.	Cost per ton.	Potash costs cents per pound.
12053	41.74	----	6.60	----	---	$63.00	7.5
12029	43.63	67.0	6.96	----	----	63.00	7.2
11316	54.80	----	0.75	15.86	65.1	75.00	6.9
11767	58.13	63.0	----	9.78	64.4	85.00*	7.3
11940	59.86	----	1.13	7.18	64.5	80.00	6.7
11813	61.00	63.0	1.13	6.03	65.9	85.00*	7.0
11812	61.05	63.0	1.20	5.26	64.5	85.00*	6.9
12133	61.22	----	0.75	4.70	64.2	82.00	6.7
12125	62.22	63.0	0.74	7.35	67.1	85.00	6.8
11905	63.84	65.0	0.64	6.53	68.3	95.00	7.4
11979	65.16	65.0	1.09	2.74	67.0	85.83*	6.6
12026	65.86	66.0	0.98	2.57	67.6	87.50*	6.7
12118	66.00	66.0	1.01	0.85	66.6	87.60*	6.7
11885	66.50	66.0	0.60	2.23	68.0	89.00*	6.7

* Ton lots at buyer's freight station.

HIGH GRADE SULPHATE OF POTASH.

This chemical should contain over 90 per cent. of pure potassium sulphate (sulphate of potash), or about 50 per cent. of potassium oxide, the same quantity as is supplied by muriate, and should be nearly free from chlorine.

The analyses of two samples appear in the table, pages 36 and 37.

As a source of potash in form of sulphate, the "low grade" or double sulphate of potash and magnesia seems to be preferred, although the average cost of actual potash is about as high in the "low grade" sulphate.

DOUBLE SULPHATE OF POTASH AND MAGNESIA.

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.

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

Station No.	Drawn from stock in possession of	Sampled and sent by	Percentages found. Chlorine.	Percentages found. Potash soluble in Water.	Percentages found. Equivalent Muriate.	Percentages found. Equivalent Sulphate.	Percentages guaranteed. Muriate.	Percentages guaranteed. Sulphate.	Cost per ton.	Potash costs cents per pound.
	High Grade Sulphate of Potash.									
11693	E. E. Burwell, New Haven	Station Agent	2.69	49.62	----	91.86	----	92.5	$49.00	4.9
11696	E. N. Austin, Suffield	" "	0.69	49.04	----	90.72	----	88.8	50.00	5.1
	Double Sulphate of Potash.									
11699	Sanderson Fertilizer & Chemical Co., New Haven	Station Agent	2.41	30.28	----	56.02	----	46.2	28.00	4.6
11692	E. E. Burwell, New Haven	" "	7.13	29.84	----	55.20	----	44.4	29.00	4.9
11799	Conn. School for Boys, Meriden	" "	2.25	26.92	----	49.80	----	46.2	27.50*	5.1
11669	J. G. Schwink, Meriden	" "	1.38	26.87	----	49.71	----	48.1	28.00	5.2
11848	Spencer Bros., Suffield	Bissell, Graves Co., Suffield	1.75	23.78	----	43.99	----	50.0	27.00	5.7
	Muriate of Potash.									
11800	Conn. School for Boys, Meriden, Sanderson's	Station Agent	----	50.72	80.14	----	79.0	----	41.50	4.1*
11670	J. G. Schwink, Meriden, from Am. Agl. Chem. Co.	" "	----	50.72	80.14	----	79.0	----	42.00	4.1
11909	W. L. Merwin, Milford, from E. F. Coe Co.	" "	----	51.51	81.39	----		----	42.00	4.1
11847	Wilcox Fertilizer Works, Mystic	" "	----	52.53	83.00	----	79.0	----	44.00	4.2
11698	Sanderson Fertilizer & Chemical Co., New Haven	" "	----	50.57	79.90	----	79.0	----	45.00	4.4
11738	S. D. Woodruff & Sons, Orange	" "	----	48.28	76.28	----	----	----	44.00	4.6
11697	E. N. Austin, Suffield, from Am. Agl. Chem. Co.	" "	----	50.17	79.27	----	79.0	----	46.50	4.6
11609	Andrew Ure, Highwood, from Bowker Fertilizer Co.	" "	----	49.44	78.12	----	79.0	----	45.00	4.6
11694	E. E. Burwell, New Haven, from Bowker Fertilizer Co.	" "	----	48.12	76.03	----	79.0	----	44.00	4.6
12028	Sanderson Fertilizer & Chemical Co., New Haven	E. C. Warner, Clintonville	----	48.51	76.65	----	79.0	----	45.00	4.6
11695	Spencer Bros., Suffield, from Mapes' F. & P. G. Co.	Station Agent	----	49.30	77.89	----	79.0	----	48.00	4.9
	Kainit.									
11691	E. E. Burwell, New Haven, from Bowker Fertilizer Co.	Station Agent	----	13.27	----	24.55	----	22.2	14.00	5.3
11798	Conn. School for Boys, Meriden, from Sanderson Fertilizer Co.	" "	----	12.61	----	23.33	----	22.2	14.00	5.6

* Mixed car lot.

Five analyses of this sulphate are given in the table above. One of these samples, **11848**, from Spencer Bros., Suffield, is inferior in quality and the potash found is much below what is guaranteed.

The cost of actual potash per pound in these samples ranged from 4.6 to 5.7 cents.

MURIATE OF POTASH.

Commercial muriate of potash contains about 80 per cent. of muriate of potash (potassium chloride), 15 per cent. or more of common salt (sodium chloride), and 4 per cent. or more of water.

In the table on pages 36 and 37 are given eleven analyses of muriate of potash.

All are of fairly good quality. The last four samples described in the table do not meet the sellers' guaranties.

The cost of actual potash in this form has ranged from 4.1 to 4.9 cents per pound, the average being 4.5 cents.

KAINIT.

Kainit is less uniform in composition than the other potash salts. It contains from 11 to 15 per cent. of potash, more than that quantity of soda, and rather less magnesia. These "bases" are combined with chlorine and sulphuric acid. Unless "calcined," it contains more water than 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 two samples analyzed, see table, pages 36 and 37, contain 12.61 and 13.27 per cent. of potash respectively, and at the prices quoted, potash costs 5.3 and 5.6 cents per pound.

"DOMESTIC POTASH."

A sample, **11330**, offered to D. A. Crowell, Middletown, under this name, contained

	Per cent.
Water-soluble potash	44.94
Chlorine	37.52
Sulphuric acid	1.71
Price per ton	$43.00
Potash costs cents per pound	4.8

IV. RAW MATERIALS CONTAINING NITROGEN AND PHOSPHORIC ACID.

BONE MANURES.

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

The method adopted for the valuation of bone manures, which takes account of their mechanical condition as well as chemical composition, is explained on page 15.

1. *Bone Manures Sampled by Station Agents.*

In the table on pages 40–41 are given twenty-one analyses of samples of this class.

GUARANTIES.

Seven of the samples contained less nitrogen or phosphoric acid than was guaranteed, but in most cases when the percentage of one ingredient was below the guaranty, that of the other was correspondingly high.

The following brands have failed to meet the guaranty in one or more particulars:

12098. Shay's Ground Bone. Nitrogen found 2.44, guaranteed 2.7.

12088. Bohl's Self-recommending Fertilizer. Nitrogen found 3.24, guaranteed 3.8. Phosphoric acid found 20.44, guaranteed 23.0.

11667. American Agricultural Chemical Co.'s Ground Bone. Nitrogen found 2.07, guaranteed 2.5.

12086. Rogers Manufacturing Co.'s Fine Ground Bone. Phosphoric Acid found 22.44, guaranteed 23.0.

12105. New England Fertilizer Co.'s Ground Bone. Nitrogen found 2.32, guaranteed 2.5.

12102. Russia Cement Co.'s Essex Fine Bone Meal. Nitrogen found 2.2, guaranteed 2.5.

12097. Sanderson's Fine Ground Bone. Phosphoric acid found 19.00, guaranteed 20.0.

Percentage Composition and Valuation of Bone Manures.

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 Analysis. Finer than 1-50 inch.	Coarser than 1-50 inch.
	Sampled by Station Agents.											
12100	Frisbie's Fine Bone Meal	The L. T. Frisbie Co. Hartford	Edward White, Rockville	$29.00	$29.03	0.1§	4.88	3.3	19.37	18.0	63	37
12098	Shay's Ground Bone	C. M. Shay, Groton	Manufacturer	28.00	27.77	0.8	2.44	2.7	27.20	25.0	70	30
			G. M. Williams Co., New London	28.00								
12088	Self-Recommending Fertilizer	Valentine Bohl, Waterbury	S. G. Wilson, Wolcott	25.00	24.08	3.8	3.24	3.8	20.44	23.0	53	47
12096	Pure Bone Dust	Peter Cooper's Glue Factory, New York	E. F. Strong, Colchester	26.00	24.94	4.3	1.04	0.9	31.24	26.0	50	50
12099	Wilcox' Pure Ground Bone	The Wilcox Fertilizer Works, Mystic	I. W. Dennison, Mystic	30.00	27.69	4.7	2.56	2.5	26.69	22.0	69	31
			Manufacturer	29.00								
11667	Ground Bone	Am'n. Agricultural Chemical Co., N. Y.	J. G. Schwink, Meriden	26.00	24.80	4.8	2.07	2.5	26.30	22.8	54	46
12086	Fine Ground Bone	The Rogers Mfg. Co., Rockfall	E. E. Burwell, New Haven	30.00	27.54	8.9	4.12	3.0	22.44	23.0	46	54
12105	New England Ground Bone	The New England Fertilizer Co., Boston	F. C. Benjamin, Danbury	32.00	27.71	10.0	2.32	2.5	27.54	22.0	71	29
			J. A. Lewis Estate, Willimantic	29.00								
				30.50								
12084	Swift-Sure Bone Meal	M. L. Shoemaker & Co., Phila., Pa.	John DuBon, Poquonock†	36.00	31.95	12.7	4.99	4.1	24.08	20.0	54	46
12089	Ground Bone	E. C. Dennis, Stafford Springs	Manufacturer	28.00	24.69	13.4	4.22	3.0	22.31	20.0	9	91
12101	Swift's Lowell Ground Bone	Swift's Lowell Fertilizer Co., Boston	J. P. Barstow & Co., Norwich	32.00	27.25	13.8	2.62	2.5	25.64	25.0	71	29
			J. O. Fox, Putnam	30.00								
				31.00								
12095	E. F. Coe's XXX Ground Bone	E. Frank Coe Co., New York City	A. A. Ennis, Danielson	30.00	26.05	15.2	3.10	2.5	23.94	19.0	52	48
12093	Ground Bone	Berkshire Fertilizer Co., Bridgeport	Manufacturer	30.00	25.72	16.6	3.12	2.5	22.35	20.0	62	38
12102	Essex Fine Bone Meal	Russia Cement Co., Gloucester, Mass.	Lightbourn & Pond Co., New Haven	30.00	25.67	16.9	2.20	2.5	25.47	24.0	69	31
12092	Armour's Bone Meal	Armour Fertilizer Co., Baltimore, Md.	J. M. Young & Co., Norwich	32.00	27.20	17.6	3.65	2.5	24.42	24.0	42	58
12104	Hubbard's Pure Raw Knuckle Bone Flour	The Rogers & Hubbard Co., Middletown	H. W. Andrews, Wallingford	35.00	29.76	17.6	3.92	3.5	25.01	24.5	58	42
12090	Fine Ground Bone	E. Frank Coe Co., New York City	W. L. Merwin, Milford	30.00	25.11	19.5	2.27	2.0	24.61	18.0	67	33
12103	Hubbard's Strictly Pure Fine Bone	The Rogers & Hubbard Co., Middletown	J. M. Page & Co., Naugatuck	32.50	25.69	26.5	3.88	2.9	22.26	22.0	33	67
			H. H. McKnight, Ellington	30.00								
12094	Bowker's Fresh Ground Bone	Bowker Fertilizer Co., New York City	W. B. Martin, Rockville	32.00	23.68	26.7	2.66	2.5	22.32	18.0	53	47
			Bowker's Branch, Southport	28.00								
				30.00								
12085*	Fine Knuckle Bone (Flour)	The Rogers Mfg. Co., Rockfall	H. E. Cleveland, East Winsted	35.00	27.24	28.5	4.22	3.6	25.73	25.0	14	86
12097	Sanderson's Fine Ground Bone	Sanderson Fertilizer & Chemical Co., New Haven	E. F. Strong, Colchester	26.00	22.10	35.7	3.26	2.5	19.00	20.0	38	62
			Manufacturer	30.00								
	Sampled by Purchasers and others.											
11840	Pure Bone Dust	Peter Cooper's Glue Factory, N. Y.	Arthur B. Lapsley, Pomfret Center†	20.00‡	25.55	21.7§	1.14	0.9	30.76	26.7	59	41
12024	Pure Bone Dust	" " " "	Russell Perkins, Pomfret Center†	20.00‡	25.06	20.2§	1.18	0.9	31.04	26.7	48	52
12117	Bone Meal		Hartford Tobacco Association, Tariffville†	24.75	25.79	4.0§	2.20	---	26.83	----	57	43
11839	Bone Dust	Peter Cooper's Glue Factory, N. Y.	G. A. Douglass, Thompsonville†	25.00	25.39	1.5§	1.14	0.9	31.06	26.7	54	46
12154*	Fine Knuckle Bone Flour	The Rogers Mfg. Co., Rockfall	Manufacturer	35.00	31.72	10.3	4.17	3.6	25.46	25.0	68	32
12081	Ground Bone	Sanderson Fertilizer & Chemical Co., New Haven	E. C. Warner, Clintonville†	28.00	25.45	17.9	2.45	2.0	25.82	20.0	52	48
				30.00								
12149	Ground Bone	Sanderson Fertilizer & Chemical Co., New Haven	O. G. Beard, Shelton†	27.00	25.09	19.6	2.30	2.5	24.08	20.0	71	29
				30.00								
12083	Bone	E. L. James, Warrenville	Manufacturer	29.00	22.90	26.6	4.04	4.0	20.94	20.0	3	97
11682	Ground Bone		The Elm City Nursery Co., New Haven†	26.00	20.41	27.4	4.00	---	13.66	----	35	65
12082	Mad River Strictly Pure Ground Bone	Wm. MacCormack, Wolcott	Manufacturer	32.00	23.81	34.4	4.05	---	19.87	----	23	77

* See special notice, page 42.

† Purchaser. ‡ f. o. b. New York City. § Valuation exceeds cost.

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.	Nitrogen. Guaranteed.	Phosphoric acid. Found.	Phosphoric acid. Guaranteed.	Mechanical Analysis. Finer than 1-50 inch.	Coarser than 1-50 inch.
	Sampled by Station Agents.										
11739	Unknown	S. D. Woodruff & Sons, Orange	----	$31.77	----	6.90	----	15.36	----	57	43
12087	Conn. Fat Rendering and Fertilizing Corp., New Haven	Manufacturer	$20.00	21.52	7.1*	3.82	----	17.73	----	19	81
11689	Swift's Lowell Fertilizer Co., Boston	E. E. Burwell, New Haven	26.00	27.52	5.5*	5.72	4.9	14.97	----	52	48
11666	The Am. Agricultural Chemical Co., N. Y. City	J. G. Schwink, Meriden	28.00	27.35	2.4	5 30	4.9	16.73	----	50	50
11614	Bowker Fertilizer Co., N. Y. City	Andrew Ure, Highwood	30.00	26.21	14.5	4.78	4.9	19.29	30.0	33	67
12091‡	Sanderson Fert. & Chem. Co., New Haven	Manufacturer	33.00	25.87	27.6	6.82	5.8	9.71	10.0	37	63
11690	E. E. Burwell, New Haven	" §	----	16.60	----	3.75	----	9.89	----	24	76
	Sampled by Purchaser.										
11841	Conn. Fat Rendering and Fertilizing Corp., New Haven	Manufacturer	20.00	22.31	10.4*	4.24	----	15.08	----	39	61
12009	New Haven Rendering Co., New Haven	P. K. Hoadley, Guilford	25.00	26.57	5.9*	4.27	----	21.34	----	38	62
12080	New Haven Rendering Co., New Haven	" " "	25.00	25.54	2.1*	5.00	----	17.10	----	35	65
11320	David J. Lederer, Yonkers, N. Y.	Andrew Ure, Highwood	30.00	30.05	0.2*	4.60	----	23.30	----	52	48
11321	Conn. Fat Rendering and Fertilizing Corp., New Haven	R. H. Nesbit, New Haven	20.00	18.69	7.0	3.48	----	13.02	----	38	62
11882‡	Sanderson Fertilizer & Chemical Co., New Haven	Conn. School for Boys, Meriden	33.00	24.60	34.1	5.66	5.8	10.76	10.00	55	45

‡ Blood, bone and meat. § For personal use.

* Valuation exceeds cost.

COST AND VALUATION OF BONE MANURES.

The price printed in full-faced type in the column showing cost per ton is the one used in calculating the percentage difference between cost and valuation.

The average cost of the bone manures is $30.14, the average valuation $26.46; showing that the station valuation is somewhat lower than the average selling price of ground bone in Connecticut.

Analyses Requiring Special Notice.

Regarding sample **12085**, Rogers' Fine Knuckle Bone Flour, the manufacturers wrote that this was knuckle bone and not flour, and that probably there had been shipped by mistake to Mr. Cleveland 500 pounds of the coarse knuckle bone which is used for case-hardening. The manufacturers sent a sample of flour, No. **12154**, the analysis of which appears in the table, page 40.

2. *Sampled by Purchasers and Others.*

In the table on pages 40–41 are ten analyses of samples of bone sent by manufacturers or purchasers and not drawn by the Station agent.

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 above are found seven analyses of this material made on samples drawn by the Station agent and six made on samples drawn by others.

These analyses show the usual differences in chemical composition.

Thus nitrogen ranges from 6.90 to 3.48 per cent. and phosphoric acid from 23.30 to 9.71 per cent.

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. Seven samples have been examined, as follows:—

11849. Sold by the American Agricultural Chemical Co., New York. Stock of Spencer Bros. and of E. N. Austin, Suffield.

12064. Made by Wilcox Fertilizer Works, Mystic. Stock of manufacturer and of M. E. Thompson, Ellington.

12062. Sold by the American Agricultural Chemical Co., New York. Stock of E. N. Austin, Suffield.

12063. Sold by the Bowker Fertilizer Co., New York. Stock of Bowker's Branch, Hartford, and of the J. A. Lewis Estate, Willimantic.

11766. Sold by the American Agricultural Chemical Co., New York. Stock of Spencer Brothers, Suffield.

11850. Made by Russia Cement Co., Gloucester, Mass. Stock of J. & H. Woodford, Avon, Spencer Bros., Suffield, and W. J. Cox, East Hartford.

12134. Sold by National Fertilizer Co., Bridgeport. Stock of G. A. Williams, East Hartford, J. N. Lasbury, Broad Brook, and G. Bostwick, Thompsonville.

All of the samples of fish practically meet the manufacturers' guaranties, and all are of good quality. It will be noticed that the valuations and selling prices are in all cases nearly alike, showing that fish has been a relatively cheap source of nitrogen and phosphoric acid during the past year.

PERCENTAGE COMPOSITION AND VALUATION OF DRY FISH.

	Am. Ag'l. Chem. Co's. 11849	Wilcox's 12064	Am. Ag'l. Chem. Co's. 12062	Bowker's. 12063	Am. Ag'l. Chem. Co's. 11766	Russia Cement Co's. 11850	National Fertilizer Co's. 12134
Nitrogen as ammonia	0.30	0.32	0.38	0.31	0.35	0.07	0.73
Organic nitrogen	8.56	8.37	7.72	8.09	8.52	8.55	7.66
Total nitrogen found	8.86	8.69	8.10	8.40	8.87	8.62	8.39
" " guaranteed	**8.24**	**8.50**	**8.24**	**8.00**	**8.24**	**8.00**	**8.24**
Soluble phosphoric acid	0.74	0.80	0.56	0.60	0.68	0.56	0.96
Reverted " "	4.23	5.08	4.77	6.51	3.92	7.19	5.48
Insoluble " "	1.89	1.21	1.53	2.08	2.37	4.38	0.98
Total phosphoric acid found	6.86	7.09	6.86	9.19	6.97	12.13	7.42
" " " guaranteed	...	**6.00**	**6.00**	**6.00**	**7.00**	**11.00**	**6.00**
Cost per ton	$35.00	35.00	34.00	37.00	37.00	40.00	37.00
Valuation per ton	35.82	35.68	33.28	35.99	35.75	38.18	35.00
Percentage difference between cost and valuation	2.3*	1.9*	2.2	2.8	3.5	4.8	5.7

* Valuation exceeds cost.

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 50–65, are given analyses of eighty-four samples belonging to this class, arranged according to the percentage difference between cost and valuation.

Guaranties.

Of the eighty-four analyses of nitrogenous superphosphates given in the table, fifteen, more than one-sixth of the whole number, are below the manufacturer's minimum guaranty in respect of one or more ingredients, one is deficient in two ingredients, and one in all three. In two cases there is a deficiency of nitrogen; in five cases, of phosphoric acid and in eleven cases, of potash.

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

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

11736. Woodruff's Home Mixture. Potash found 7.52, guaranteed 8.0.

12012. Armour's Bone, Blood and Potash. Nitrogen found 3.62, guaranteed 4.1. Phosphoric acid found 8.51, guaranteed 10.0. Potash found 5.61, guaranteed 7.0.

11755. Mapes Average Soil Complete Manure. Phosphoric acid found 7.75, guaranteed 8.0.

11864. American Agricultural Chemical Co.'s Complete Manure with 10 per cent. Potash. Potash found 9.84, guaranteed 10.0.

11828. American Farmer's Market Garden Special. Potash found 6.66, guaranteed 7.0.

12013. Wilson's Market Garden Complete. Potash found 5.83, guaranteed 6.0.

11758. Berkshire Complete Fertilizer. Phosphoric acid found 9.79, guaranteed 10.0.

11735. Swift's Lowell Market Garden Manure. Nitrogen found 3.91, guaranteed 4.1. Potash found 5.51, guaranteed 6.0.

11984. Rogers' All Round Fertilizer. Phosphoric acid found 9.72, guaranteed 10.0.

11857. Ohio Farmer's Fertilizer Co.'s Ammoniated Bone and Potash. Potash found 3.56, guaranteed 4.0.

12020. Great Eastern General Fertilizer. Potash found 3.76, guaranteed 4.0.

12036. Swift's Lowell Empress Brand. Phosphoric acid found 7.34, guaranteed 8.0.

11774. Swift's Lowell Bone Fertilizer. Potash found 2.85, guaranteed 3.0.

11871. Read's Standard Superphosphate. Potash found 3.61, guaranteed 4.0.

12042. Lister's Animal Bone and Potash. Potash found 1.67, guaranteed 2.0.

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 anaylsis, 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.

From the data thus obtained the average prices are computed.

Valuation.

The valuation has been computed in all cases in the usual manner, as explained on page 14.

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.

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

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

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

The average cost of the superphosphates is $31.07 per ton, the average valuation is $20.69 and the average percentage difference 50.1.

Last year the corresponding figures were:—Average cost, $30.39; average valuation, $21.10; percentage difference, 44.

How wide a range of composition there is in these 84 fertilizers and how widely different the cost of plant food in them is, may be seen from the following statement of the average amounts of nitrogen, phosphoric acid and potash which are purchasable for $30.00 spent in these factory mixed goods.

For $30.00 the following numbers of pounds of nitrogen, phosphoric acid and potash may be purchased:

	Average cost per ton.	Nitrogen, pounds.	Available phosphoric acid, pounds.	Potash, pounds.
In the first 10 samples in the table..........	32.25	83	168	115
In the next following 10 samples in the table	31.90	64	190	89
" " 11 " "	32.39	55	186	108
" " 10 " "	33.30	52	162	110
" " 9 " "	33.27	48	185	80
" " 10 " "	31.25	44	211	58
" " 9 " "	29.03	36	218	51
" " 11 " "	27.68	26	215	54

The purchaser who buys goods having the composition and prices of those at one end of the table pays *per ton* between three and four dollars more for his fertilizer, but for an outlay of $30.00 he gets 83 pounds of nitrogen, 168 of phosphoric acid and 115 of potash; while the man who buys goods having the composition and prices of those at the other end of the table gets only 26 pounds of nitrogen, 215 of phosphoric acid and 54 of potash for his $30.00. He is paying from two to three times as much for his fertilizers as he needs to pay.

There is no fraud in the matter. The composition of the low grade ferilizers 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 or four tons, the seller is not breaking the law in taking advantage of their obtuseness.

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.
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

* Total phosphoric acid.

2. *Sampled by Purchasers.*

On pages 64–65 are tabulated analyses of eleven samples of nitrogenous superphosphates which were sent by interested persons to the station for analysis. The station assumes no direct responsibility for the sampling of these articles.

Nitrogenous Superphosphates.

Station No.	Name or Brand.	Manufacturer.	Dealer.	Dealer's cash price per ton.	Valuation per ton.
	I. *Sampled by Station Agent.*				
11736	Woodruff's Home Mixture	S. D. Woodruff & Sons, Orange	Manufacturer	$27.00	$29.09
12016	Bone, Fish and Potash	E. R. Kelsey, Short Beach	Loomis Bros., Granby E. A. Ives, Cheshire	25.00 25.00	24.26
11775	Mapes' Top Dresser, Improved, full strength	Mapes F. & P. G. Co., New York	R. H. Hall, East Hampton Mapes' Branch, Hartford	48.00 48.00	44.22
11858	Wilcox' H. G. Fish and Potash	Wilcox Fertilizer Works, Mystic	W. C. Terry, Jewett City Manufacturer	28.00 28.00	23.68
11938	Complete H. G. Fertilizer	Conn. Valley Orchard Co., Berlin	Manufacturer	26.50	22.13
11730	Mapes' Vegetable Manure, Complete for Light Soils	Mapes F. & P. G. Co., New York	Spencer Bros., Suffield Mapes' Branch, Hartford	40.00 40.00	33.28
11914	E. F. Coe's Long Islander Market Garden Special	E. Frank Coe Co., New York	Edgar Brewer, Hockanum W. L. Merwin, Milford	36.00 33.00 34.00	27.55
11998	Quinnipiac Market Garden Manure	American Agricultural Chemical Co., N. Y.	Gault Bros., Westport C. Buckingham, Southport	33.50 32.00	25.73
11986	Wilcox' Fish and Potash	Wilcox Fertilizer Works, Mystic	I. W. Dennison, Mystic D. C. Spencer, Saybrook	23.00 25.00	19.49
12002	Southport XX Special	American Agricultural Chemical Co., N. Y.	Gault Bros., Westport	37.00	28.58
11928	E. Frank Coe's Gold Brand Excelsior Guano	E. Frank Coe Co., New York	W. L. Merwin, Milford Edgar Brewer, Hockanum Geo. Fairchild, Greens Farms	31.00 35.00 31.00 32.00	24.67
11999	Darling's Blood, Bone and Potash	American Agricultural Chemical Co., N. Y.	D. C. Peck, Plainville Latham & Chittenden, Granby	37.00 37.00	28.41
12035	Atlantic Coast Fish, Potash and Bone	Niantic Menhaden Oil and Guano Co., Niantic	Morse & Landon, Guilford	25.00	19.15
11823	E. F. Coe's Fish and Potash, F. P. Brand	E. Frank Coe Co., New York	S. V. Osborn, Branford A. L. Burdick, Westbrook	23.00 26.00 24.50	18.73

Analyses and Valuations.

Station No.	Percentage difference between cost and valuation.	Nitrogen.					Phosphoric Acid.							Potash.		
					Total Nitrogen.					Total.		Available.		Found.		
		As Nitrates.	As Ammonia.	Organic.	Found.	Guaranteed.	Soluble.	Reverted.	Insoluble.	Found.	Guaranteed.	Found.	Guaranteed.	As Muriate.	Total.	Guaranteed.
11736	7.2*	3.22	....	1.66	4.88	3.5	4.77	2.24	1.27	8.28	8.0	7.01	....	7.52	7.52	8.0
12016	3.1	---	0.67	2.81	3.48	2.5	3.30	3.97	0.47	7.74	5.0	7.27	4.0	0.33	5.78	4.0
11775	8.5	9.39	0.20	0.43	10.02	10.0	1.82	3.96	2.14	7.92	8.0	5.78	....	1.44	6.51	4.0
11858	18.2	---	0.20	3.52	3.72	3.3	3.57	3.65	1.16	8.38	6.0	7.22	....	4.31	4.72	4.0
11938	19.7	0.93	....	1.65	2.58	2.5	8.34	2.13	1.24	11.71	11.0	10.47	9.0	4.31	4.31	4.0
11730	20.2	5.43	0.18	0.61	6.22	4.9	2.50	3.67	1.99	8.16	8.0	6.17	6.0	1.38	7.35	6.0
11914	23.4	---	1.60	1.93	3.53	3.4	7.92	1.57	1.42	10.91	10.0	9.49	8.5	0.47	6.30	6.0
11998	24.4	0.06	1.01	2.21	3.28	3.3	6.80	1.85	1.10	9.75	9.0	8.65	8.0	7.32	7.32	7.0
11986	28.3	---	0.24	2.70	2.94	2.5	2.34	3.47	1.55	7.36	6.0	5.82	5.0	4.34	4.34	3.0
12002	29.5	0.52	1.10	2.51	4.13	4.1	5.55	2.84	1.35	9.74	8.0	8.39	7.0	7.61	7.61	7.0
11928	29.7	---	1.03	1.77	2.80	2.0	8.51	1.35	1.03	10.89	10.0	9.86	8.0	0.63	5.80	5.0
11999	30.2	0.31	1.12	2.81	4.24	4.1	6.27	2.05	1.11	9.43	8.0	8.32	7.0	6.99	6.99	7.0
12035	30.5	---	0.49	2.18	2.67	1.6	2.00	3.15	2.01	7.16	6.0	5.15	---	0.51	4.76	4.0
11823	30.8	---	0.10	1.88	1.98	2.0	7.10	3.34	1.96	12.40	7.0	10.44	6.0	2.31	2.31	2.0

* Valuation exceeds cost.

NITROGENOUS SUPERPHOSPHATES.

Station No.	Name or Brand.	Manufacturer.	Dealer.	Dealer's cash price per ton.	Valuation per ton.
	I. *Sampled by Station Agent.*				
11754	Swift-Sure Superphosphate for General Use	M. L. Shoemaker & Co., Philadelphia	F. S. Bidwell & Co., Windsor Locks	$35.00	$26.19
			Olds & Whipple, Hartford	34.00	
				34.50	
11851	Mapes' Dissolved Bone	Mapes F. & P. G. Co., New York	E. F. Strong, Colchester	31.00	23.03
			Mapes' Branch, Hartford	30.00	
				30.50	
12012	Armour's Bone, Blood and Potash	Armour Fertilizer Works, Baltimore, Md.	Daniels Mill Co., Hartford	**34.00**	25.68
11755	Mapes' Average Soil Complete Manure	Mapes F. & P. G. Co., New York	Mapes' Branch, Hartford	34.00	26.03
			Southington Lumber Co., Southington	35.00	
				34.50	
12014	Sanderson's Formula A	Sanderson Fertilizer & Chemical Co., New Haven	H. F. Potter, R. F. D., North Haven	**36.00**	27.10
11757	Mapes' Top Dresser, Improved, one-half strength	Mapes F. & P. G. Co., New York	Mapes' Branch, Hartford	**31.00**	23.15
			F. S. Bidwell & Co., Windsor Locks	32.00	
			Southington Lumber Co., Southington	32.00	
11824	E. F. Coe's Red Brand Excelsior Guano	E. Frank Coe Co., New York	C. W. & T. F. Atwood, Watertown	38.00	26.84
			A. L. Burdick, Westbrook	34.00	
				36.00	
11864	Complete Manure with 10% Potash	American Agricultural Chemical Co., N. Y.	D. B. Wilson Co., Waterbury	38.00	27.65
			D. L. Clark, Milford	36.50	
				37.25	
11828	American Farmers' Market Garden Special	American Farmers' Fertilizer Co., N. Y.	W. B. Martin, Rockville	**35.00**	25.90
			S. V. Osborn, Branford	35.00	
12072	American Farmers' Ammoniated Bone	American Farmers' Fertilizer Co., N. Y.	J. P. Kingsley & Son, Plainfield	**28.00**	20.71
			A. A. Ennis, Danielson	28.00	
11875	Wilcox' Complete Bone Superphosphate	Wilcox Fertilizer Works, Mystic	D. C. Spencer, Saybrook	**28.00**	20.64
			W. C. Terry, Jewett City	28.00	

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. Soluble.	Phosphoric Acid. Reverted.	Phosphoric Acid. Insoluble.	Phosphoric Acid. Total. Found.	Phosphoric Acid. Total. Guaranteed.	Phosphoric Acid. Available. Found.	Phosphoric Acid. Available. Guaranteed.	Potash. Found. As Muriate.	Potash. Found. Total.	Potash. Guaranteed.
11754	31.7	0.91	0.08	1.89	2.88	**2.8**	8.19	4.25	2.44	14.88	----	12.44	----	0.60	4.72	**4.5**
11851	32.4	---	0.22	2.69	2.91	**2.1**	6.06	8.78	0.92	15.76	----	14.84	**12.0**	----	----	---
12012	32.4	0.06	---	3.56	3.62	**4.1**	7.20	1.08	0.23	8.51	**10.0**	8.28	**8.0**	5.61	5.61	**7.0**
11755	32.5	3.63	0.22	0.54	4.39	**4.1**	2.33	3.30	2.12	7.75	**8.0**	5.63	**7.0**	1.09	6.32	**5.0**
12014	32.8	1.20	trace	2.32	3.52	**3.3**	1.95	5.97	2.53	10.45	**9.0**	7.92	**6.0**	1.04	7.75	**6.0**
11757	33.9	5.04	0.14	0.19	5.37	**4.9**	0.74	2.12	1.22	4.08	**4.0**	2.86	----	0.70	3.10	**2.0**
11824	34.1	---	1.48	1.85	3.33	**3.3**	8.06	1.78	1.46	11.30	**10.0**	9.84	**9.0**	0.28	5.97	**6.0**
11864	34.7	1.07	0.19	2.22	3.48	**3.3**	5.02	2.89	1.51	9.42	**7.0**	7.91	**6.0**	9.84	9.84	**10.0**
11828	35.1	---	0.97	2.39	3.36	**3.3**	7.45	1.21	1.77	10.43	**9.5**	8.66	**8.0**	6.11	6.66	**7.0**
12072	35.2	---	0.76	1.76	2.52	**2.0**	7.71	2.09	1.27	11.07	**9.5**	9.80	**8.0**	0.81	2.89	**2.0**
11875	35.7	---	----	2.48	2.48	**2.1**	4.40	4.91	2.46	11.77	**9.0**	9.31	----	3.64	3.64	**3.0**

NITROGENOUS SUPERPHOSPHATES.

Station No.	Name or Brand.	Manufacturer.	Dealer.	Dealer's cash price per ton.	Valuation per ton.
	1. *Sampled by Station Agent.*				
11860	Sanderson's Formula A	Sanderson Fertilizer & Chemical Co., New Haven	Manufacturer G. W. Eaton, Plainville	**$35.00** 35.00	$24.95
11759	Bowker's Fisherman's Brand Fish and Potash	Bowker Fertilizer Co., New York	W. T. McKenzie, Yalesville G. F. Walter, Guilford	28.00 24.00 **26.00**	18.45
12013	Wilson's Market Garden Complete Fertilizer	Valentine Bohl, Waterbury	Manufacturer	**32.00**	22.70
12018	Armour's All Soluble	Armour Fertilizer Works, Baltimore, Md.	E. A. Buck & Co., Willimantic E. H. Talcott. Torrington	33.00 32.00 **32.50**	22.72
11929	Chittenden's Complete Fertilizer	National Fertilizer Co., Bridgeport	G. A. Williams, East Hartford A. Y. Beach, Seymour	**38.00** 38.00	26.53
11930	Middlesex Special	Bowker Fertilizer Co., New York	Bowker's Branch, Southport A. Grulich, Meriden	28.00 25.00 **26.50**	18.43
12007	Darling's Dissolved Bone and Potash	American Agricultural Chemical Co., N. Y.	Spencer Bros., Suffield T. S. Loomis, Windsor Don. C. Peck, Plainville	37.00 34.00 **35.00**	24.20
11825	E. Frank Coe's H. G. Ammoniated Bone Superphosphate	E. Frank Coe Co., New York	C. W. & T. F. Atwood, Watertown A. L. Burdick, Westbrook	31.00 30.00 **30.50**	21.08
11982	Williams & Clark's High Grade Special	American Agricultural Chemical Co., N. Y.	R. H. Hall, East Hampton T. B. Atwater, Plantsville	38.00 37.00 **37.50**	25.81
11758	Berkshire Complete Fertilizer	Berkshire Fertilizer Co., Bridgeport	Manufacturer F. B. Newton, Plainville	32.00 34.00 **33.00**	22.59
12022	Fish and Potash	Rogers Mfg. Co., Rockfall	S. A. Billings, Meriden	---- **29.00**	19.77
11879	Hubbard's All Soils, All Crops Phosphate	The Rogers & Hubbard Co., Middletown	J. M. Page & Co., Naugatuck S. E. Frisbie, Milford	35.00 31.00 **33.00**	22.46

ANALYSES AND VALUATIONS—*Continued.*

Station No.	Percentage difference between cost and valuation.	Nitrogen.					Phosphoric Acid.							Potash.		
		As Nitrates.	As Ammonia.	Organic.	Total Nitrogen.		Soluble.	Reverted.	Insoluble.	Total.		Available.		Found.		Guaranteed.
					Found.	Guaranteed.				Found.	Guaranteed.	Found.	Guaranteed.	As Muriate.	Total.	
11860	40.3	0.77	0.09	2.44	3.30	**3.3**	3.74	4.14	2.58	10.46	**9.0**	7.88	**6.0**	5.46	6.74	**6.0**
11759	40.9	---	0.31	2.21	2.52	**2.5**	3.74	2.15	1.65	7.54	**5.0**	5.89	**4.0**	4.55	4.55	**4.0**
12013	41.0	1.48	----	1.74	3.22	**3.0**	none	2.83	8.38	11.21	**10.0**	2.83	----	----	5.83	**6.0**
12018	43.0	0.48	----	2.44	2.92	**2.8**	7.09	2.75	0.88	10.72	**10.0**	9.84	**8.0**	1.85	3.99	**4.0**
11929	43.2	0.37	0.33	2.87	3.57	**3.3**	6.91	2.29	0.78	9.98	**10.0**	9.20	**8.0**	6.80	6.80	**6.0**
11930	43.8	0.50	0.15	1.60	2.25	**2.1**	3.95	1.42	0.96	6.33	**6.0**	5.37	**4.0**	6.61	6.61	**6.0**
12007	44.6	0.10	0.66	1.86	2.62	**2.5**	4.85	2.04	1.32	8.21	**7.0**	6.89	**6.0**	10.03	10.03	**10.0**
11825	44.7	---	0.67	1.83	2.50	**1.9**	8.40	1.64	1.31	11.35	**10.0**	10.04	**9.0**	0.41	2.99	**2.3**
11982	45.3	1.07	0.59	1.84	3.50	**3.3**	5.07	3.49	1.10	9.66	**9.0**	8.56	**8.0**	7.16	7.16	**7.0**
11758	46.1	0.38	----	2.34	2.72	**2.5**	5.73	1.94	2.12	9.79	**10.0**	7.67	**8.0**	6.61	6.61	**6.0**
12022	46.7	1.11	----	2.33	3.44	**3.3**	2.32	2.44	1.65	6.41	**6.0**	4.76	**4.0**	3.95	3.95	**3.8**
11879	46.9	1.03	----	1.46	2.49	**2.3**	7.28	5.01	0.98	13.27	**12.0**	12.29	**10.0**	3.65	3.65	**3.0**

NITROGENOUS SUPERPHOSPHATES.

Station No.	Name or Brand.	Manufacturer.	Dealer.	Dealer's cash price per ton.	Valuation per ton.
	1. *Sampled by Station Agent.*				
11789	Sanderson's Special with 10% Potash	Sanderson Fertilizer & Chemical Co., New Haven	Manufacturer	$37.00	$24.32
			G. W. Eaton, Plainville	35.00	
				36.00	
12005	Packers' Union Gardeners' Complete Manure	American Agricultural Chemical Co., N. Y.	F. L. Mackey, Ellington	**36.00**	24.29
12076	O. & W. Special Phosphate	Olds & Whipple, Hartford	Manufacturer	**34.00**	22.86
12066	Armour's Ammoniated Bone with Potash	Armour Fertilizer Works, Baltimore, Md.	E. A. Buck & Co., Willimantic	30.00	19.36
			E. H. Talcott, Torrington	28.00	
				29.00	
11956	Chittenden's Fish and Potash	National Fertilizer Co., Bridgeport	G. A. Williams, East Hartford	32.00	21.65
			A. H. Cashen, Meriden	33.00	
				32.50	
11972	Chittenden's Market Garden Fertilizer	National Fertilizer Co., Bridgeport	F. Hallock & Co., Derby	36.00	22.92
			Latham & Chittenden, Granby	34.00	
				35.00	
11725	Bowker's Market Garden Fertilizer	Bowker Fertilizer Co., New York	Bowker's Branch, Hartford	35.00	23.43
			J. F. Silliman & Co., New Canaan	37.00	
				36.00	
11735	Swift's Lowell Market Garden Manure	Swift's Lowell Fertilizer Co., Boston	Spencer Bros., Suffield	38.00	25.60
			C. W. Lines Co., New Britain	42.00	
				40.00	
12074	Lister's Standard Pure Bone Superphosphate of Lime	Lister's Agric. Chem. Works, Newark, N. J.	A. I. Martin, Wallingford	**32.00**	20.46
11876	Bowker's Hill and Drill Phosphate	Bowker Fertilizer Co., New York	Young Bros. Co., Danielson	33.00	20.36
			Bowker's Branch, Southport	30.00	
			W. T. McKenzie, Yalesville	34.00	
				32.00	
11935	New England Superphosphate	New England Fertilizer Co., Boston	Hotchkiss & Templeton, Waterbury	38.00	22.90
			A. R. Manning & Co., Yantic	34.00	
				36.00	

ANALYSES AND VALUATIONS—*Continued.*

Station No.	Percentage difference between cost and valuation.	Nitrogen.			Total Nitrogen.		Phosphoric Acid.			Total.		Available.		Potash. Found.		
		As Nitrates.	As Ammonia.	Organic.	Found.	Guaranteed.	Soluble.	Reverted.	Insoluble.	Found.	Guaranteed.	Found.	Guaranteed.	As Muriate.	Total.	Guaranteed.
11789	48.0	0.30	0.15	2.03	2.48	**2.5**	3.62	3.16	1.51	8.29	**8.0**	6.78	**5.0**	9.25	10.72	**10.0**
12005	48.2	0.94	----	1.57	2.51	**2.4**	4.78	1.85	0.66	7.29	**7.0**	6.63	**6.0**	1.16	9.91	**10.0**
12076	48.7	0.68	----	3.44	4.12	**4.1**	3.73	2.20	0.34	6.27	----	5.93	**4.0**	2.57	3.77	**3.0**
12066	49 8	---	----	2.76	2.76	**2.5**	4.83	3.22	1.44	9.49	**7.0**	8.05	**6.0**	2.58	2.58	**2.0**
11956	50.1	---	----	3.05	3.05	**3.0**	5.73	1.65	0.68	8.06	**6.0**	7.38	----	1.58	4.46	**4.0**
11972	52.7	0.86	0.24	1.52	2.62	**2.5**	6.78	2.52	1.08	10.38	**9.0**	9.30	**8.0**	6.42	6.42	**6.0**
11725	53.6	0.43	0.22	1.79	2.44	**2.5**	5.01	1.64	1.41	8.06	**7.0**	6.65	**6.0**	10.16	10.16	**10.0**
11735	56.3	1.44	----	2.47	3.91	**4.1**	6.16	1.48	0.52	8.16	**8.0**	7.64	**7.0**	0.62	5.51	**6.0**
12074	56.4	0.10	0.24	2.14	2.48	**2.5**	8.21	2.64	1.09	11.94	**11.0**	10.85	**9.0**	2.20	2.20	**2.0**
11876	57.2	0.66	----	2.02	2.68	**2.5**	7.12	2.70	1.74	11.56	**10.0**	9.82	**9.0**	2.25	2.25	**2.0**
11935	57.2	0.53	----	2.30	2.83	**2.5**	6.21	3.65	1.37	11.23	**10.0**	9.86	**9.0**	4.81	4.81	**4.0**

NITROGENOUS SUPERPHOSPHATES.

Station No.	Name or Brand.	Manufacturer.	Dealer.	Dealer's cash price per ton.	Valuation per ton.
	1. *Sampled by Station Agent.*				
12037	Baker's A. A. Ammoniated Superphosphate	American Agricultural Chemical Co., N. Y.	Edward White, Rockville	$32.00	$20.05
11874	Wilcox' Special Superphosphate	Wilcox Fertilizer Works, Mystic	T. H. Eldredge, Norwich Manufacturer	27.00 24.00	14.99
11784	Niantic Bone, Fish and Potash	Sanderson Fertilizer & Chemical Co., New Haven	Manufacturer G.W.Eaton, Plainville	25.00 26.00 **25.50**	15.90
12040	Darling's Farm Favorite	American Agricultural Chemical Co., N. Y.	Latham & Chittenden, Granby	**30.00**	18.68
11785	Bradley's Farmers' New Method Fertilizer	American Agricultural Chemical Co., N. Y.	Wilson & Burr, Middletown Spencer Bros., Suffield	30.00 31.00 **30.50**	18.83
11779	Bradley's Superphosphate	American Agricultural Chemical Co., N. Y.	G. W. Eaton, Bristol Scofield & Miller, Stamford Spencer Bros., Suffield	**34.00** 34.00 34.00	20.84
11762	Mapes' Complete Manure, A Brand	Mapes F. & P. G. Co., New York	Mapes' Branch, Hartford F. S. Bidwell & Co., Windsor Locks Southington Lumber Co., Southington	33.00 **34.00** 34.00	20.77
12071	Lister's Success Fertilizer	Lister's Agric. Chem. Works, Newark, N. J.	D. C. Burnham, R. F. D., Colchester A.S. Bennett, Cheshire	27.00 28.00 **27.50**	16.68
11992	Williams & Clark's Americus Ammoniated Bone Superphosphate	American Agricultural Chemical Co., N. Y.	D. B. Wilson Co., Waterbury R. H. Hall, East Hampton	**34.00** 34.00	20.59
11734	Swift's Lowell Animal Brand	Swift's Lowell Fertilizer Co., Boston	Spencer Bros., Suffield C. W. Lines Co., New Britain	34.00 35.00 **34.50**	20.65
11984	All Round Fertilizer	Rogers Mfg. Co., Rockfall, Conn.	R. H. Hall, East Hampton H. E. Cleveland, East Winsted	28.00 30.00 **29.00**	17.24
11733	Essex XXX Fish and Potash	Russia Cement Co., Gloucester, Mass.	Lightbourn & Pond Co., New Haven C. W. Lines Co., New Britain	33.00 34.00 **33.50**	19.77

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.	Soluble.	Reverted.	Insoluble.	Total. Found.	Total. Guaranteed.	Available. Found.	Available. Guaranteed.	Found. As Muriate.	Found. Total.	Guaranteed.
12037	59.6	0.84	....	1.78	2.62	**2.5**	6.37	3.63	1.74	11.74	**11.0**	10.00	**9.0**	2.12	2.12	**2.0**
11874	60.1	--	....	1.34	1.34	**1.0**	4.27	4.91	2.01	11.19	**9.0**	9.18	...	2.04	2.04	**1.5**
11784	60.4	0.20	0.20	1.72	2.12	**1.6**	1.94	3.24	1.78	6.96	**6.0**	5.18	**4.0**	4.10	4.10	**4.0**
12040	60.6	0.56	0.12	1.46	2.14	**2.1**	5.70	3.21	1.68	10.59	**9.0**	8.91	**8.0**	3.52	3.52	**3.0**
11785	61.9	0.36	0.12	1.69	2.17	**1.7**	5.89	2.79	2.00	10.68	**9.0**	8.68	**8.0**	3.54	3.54	**3.0**
11779	63.1	---	....	2.55	2.55	**2.5**	8.90	1.79	1.40	12.09	**11.0**	10.69	**9.0**	2.25	2.25	**2.0**
11762	63.7	1.63	0.36	0.71	2.70	**2.5**	3.14	5.50	4.46	13.10	**12.0**	8.64	**10.0**	3.28	3.28	**2.5**
12071	64 9	0.06	0.24	1.24	1.54	**0.8**	7.18	2.77	1.88	11.83	**11.0**	9.95	**9.0**	2.21	2.21	**2.0**
11992	65.1	0.45	0.14	2.03	2.62	**2.5**	7.28	3.17	1.51	11.96	**11.0**	10.45	**9.0**	2.19	2.19	**2.0**
11734	67.1	---	....	2.38	2.38	**2.5**	7.22	2.17	1.50	10.89	**10.0**	9.39	**9.0**	4.09	4.09	**4.0**
11984	68.2	1.14	....	1.04	2.18	**1.7**	4.00	4.07	1.65	9.72	**10.0**	8.07	**8.0**	2.86	2.86	**2.0**
11733	69.4	0.42	....	2.11	2.53	**2.1**	6.21	2.85	3.16	12.22	**12.0**	9.06	**9.0**	2.25	2.25	**2.3**

Nitrogenous Superphosphates.

Station No.	Name or Brand.	Manufacturer.	Dealer.	Dealer's cash price per ton.	Valuation per ton.
	1. *Sampled by Station Agent.*				
11873	Quinnipiac Phosphate	American Agricultural Chemical Co., N. Y.	Young Bros. Co., Danielson	$32.00	$19.15
			The G. M. Williams Co., New London	34.00	
				33.00	
11954	Church's Fish and Potash	American Agricultural Chemical Co., N. Y.	Carlos Bradley, Ellington	28.50	16.86
			F. S. Bidwell & Co., Windsor Locks	30.00	
				29.25	
11877	Chittenden's Ammoniated Bone Phosphate	National Fertilizer Co., Bridgeport	J. Y. Thomas, Colchester	**30.00**	17.26
			Gault Bros., Westport	30.00	
11776	Bowker's Farm and Garden Phosphate.	Bowker Fertilizer Co., New York	W. O. Goodsell, Bristol	28.00	17.06
			J. F. Silliman & Co., New Canaan	32.00	
				30.00	
11857	Ammoniated Bone and Potash	Ohio Farmers' Fertilizer Co., Columbus, Ohio	R. A. Sherman, Oneco	24.00	14.78
			R. B. Witter, Brooklyn		
			R. H. Hall, East Hampton	28.00	
				26.00	
11991	Bradley's Eclipse Phosphate	American Agricultural Chemical Co., N. Y.	F. M. Cole & Co., Putnam	**28.00**	15.80
			E. C. Dennis, Stafford Springs	28.00	
11989	Quinnipiac Climax Phosphate	American Agricultural Chemical Co., N. Y.	J. P. Lathrop, Plainfield	**28.00**	15.66
			C. C. Pierce, R. D., Putnam	28.00	
11948	Berkshire Ammoniated Bone Phosphate	Berkshire Fertilizer Co., Bridgeport	Manufacturer	**28.00**	15.54
			Johnson Bros., Jewett City	28.00	
11985	Bowker's Square Brand Bone and Potash	Bowker Fertilizer Co., N. Y.	Young Bros. Co., Danielson	28.00	15.76
			H. A. Spaford, Turnerville	27.00	
			Ansonia Grain Co., Ansonia	32.00	
				29.00	
11827	Packer's Union Universal Fertilizer	American Agricultural Chemical Co., N. Y.	H. F. Porter, Hebron	30.00	15.70
			G. W. Eaton, Bristol	29.00	
				29.50	
12020	Great Eastern General Fertilizer	American Agricultural Chemical Co., N. Y.	A. E. Harvey, R. F. D. 2, Willimantic	**29.00**	15.37
11769	Swift's Lowell Dissolved Bone and Potash	Swift's Lowell Fertilizer Co., Boston	Spencer Bros., Suffield	**30.00**	15.77
			F. S. Bidwell & Co., Windsor Locks	30.00	

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. Soluble.	Phosphoric Acid. Reverted.	Phosphoric Acid. Insoluble.	Total. Found.	Total. Guaranteed.	Available. Found.	Available. Guaranteed.	Potash. Found. As Muriate.	Potash. Found. Total.	Potash. Guaranteed.
11873	72.3	0.67	....	1.86	2.53	**2.5**	6.08	2.96	2.06	11.10	**11.0**	9.04	**9.0**	2.17	2.17	**2.0**
11954	73.5	0.34	....	1.74	2.08	**2.1**	5.15	2.78	2.05	9.98	**7.0**	7.93	**6.0**	2.35	2.35	**2.0**
11877	73.8	---	....	1.94	1.94	**1.8**	7.25	1.61	1.14	10.00	**10.0**	8.86	**8.0**	2.58	2.58	**2.0**
11776	75.8	0.21	....	1.76	1.97	**1.7**	7.05	1.91	1.34	10.30	**9.0**	8.96	**8.0**	2.13	2.13	**2.0**
11857	75.9	---	....	0.86	0.86	**0.8**	5.28	3.76	2.26	11.30	**9.0**	9.04	**8.0**	3.03	3.56	**4.0**
11991	77.2	---	....	1.55	1.55	**1.0**	5.74	3.24	1.70	10.68	**10.0**	8.98	**9.0**	2.27	2.27	**2.0**
11989	78.8	---	....	1.53	1.53	**1.0**	5.36	3.53	1.87	10.76	**10.0**	8.89	**8.0**	2.25	2.25	**2.0**
11948	80.2	0.04	....	1.52	1.56	**0.8**	4.54	3.70	2.06	10.30	**10.0**	8.24	**8.0**	2.61	2.61	**2.0**
11985	84.0	0.10	0.10	1.55	1.75	**1.7**	3.89	3.96	2.72	10.57	**7.0**	7.85	**6.0**	2.24	2.24	**2.0**
11827	87.9	---	0.04	1.09	1.13	**0.8**	6.13	2.87	1.45	10.45	**9.0**	9.00	**8.0**	3.93	3.93	**4.0**
12020	88.7	---	0.08	1.10	1.18	**0.8**	5.12	3.71	1.15	9.98	**10.0**	8.83	**8.0**	3.76	3.76	**4.0**
11769	90.2	---	....	1.59	1.59	**1.6**	6.62	2.70	0.95	10.27	**10.0**	9.32	**9.0**	2.00	2.00	**2.0**

Nitrogenous Superphosphates.

Station No.	Name or Brand.	Manufacturer.	Dealer.	Dealer's cash price per ton.	*Valuation per ton.*
	1. *Sampled by Station Agent.*				
12036	Swift's Lowell Empress Brand	Swift's Lowell Fertilizer Co., Boston	J. O. Fox & Co., Putnam	**$25.00**	$13.13
11774	Swift's Lowell Bone Fertilizer	Swift's Lowell Fertilizer Co., Boston	J. C. Lincoln, Berlin Spencer Bros., Suffield	**30.00** 30.00	15.72
11950	General Crop Fish Guano	Ohio Farmers' Fertilizer Co., Columbus, Ohio	R. A. Sherman, Oneco R. B. Whitter, Brooklyn	**22.00** ----	11.29
11751	Gloucester Fish and Potash	Bowker Fertilizer Co., New York	Lightbourn & Pond Co., New Haven W. T. McKenzie, Yalesville	24.00 26.00 **25.00**	12.77
11871	Read's Standard Superphosphate	American Agricultural Chemical Co., N. Y.	J. A. Nichols, Danielson L. A. Fenton, Norwich Town	**30.00** 30.00	15.14
11878	Chittenden's Universal Phosphate	National Fertilizer Co., Bridgeport	J. Y. Thomas, Colchester F. C. Benjamin, Danbury Gault Bros., Westport	26.00 29.00 **28.00**	14.04
12041	Darling's General Fertilizer	American Agricultural Chemical Co., N. Y.	T. S. Loomis, Windsor	**30.00**	14.91
11881	Bradley's Niagara Phosphate	American Agricultural Chemical Co., N. Y.	Wilson & Burr, Middletown Phineas Platt, Milford	25.00 27.00 **26.00**	12.80
11949	Bowker's Sure Crop Bone Phosphate	Bowker Fertilizer Co., New York	H. A. Spaford, Turnerville A. R. Manning & Co., Yantic	26.00 29.00 **27.50**	13.41
12073	Essex A1 Superphosphate	Russia Cement Co., Gloucester, Mass.	F. C. Benjamin, Danbury W. O. Goodsell, Bristol	30.00 27.00 **28.50**	13.74
12042	Lister's Animal Bone and Potash	Lister's Agric. Chem. Works, Newark, N. J.	D. C. Burnham, R. F. D., Colchester A. I. Martin, Wallingford	**22.00** ----	10.58
12015	Sanderson's Superphosphate with Potash	Sanderson Fertilizer & Chemical Co., New Haven	E. F. Strong, Colchester T. H. Eldridge, Norwich	23.00 27.00 **25.00**	10.96

Analyses and Valuations—*Continued.*

Station No.	Percentage difference between cost and valuation.	Nitrogen.					Phosphoric Acid.							Potash.		
					Total Nitrogen.					Total.		Available.		Found.		
		As Nitrates.	As Ammonia.	Organic.	Found.	Guaranteed.	Soluble.	Reverted.	Insoluble.	Found.	Guaranteed.	Found.	Guaranteed.	As Muriate.	Total.	Guaranteed.
12036	90.4	---	----	1.40	1.40	**1.2**	6.13	1.05	0.16	7.34	**8.0**	7.18	**7.0**	2.13	2.13	**2.0**
11774	90.8	---	---	1.67	1.67	**1.6**	4.51	3.72	1.02	9.25	**9.0**	8.23	**8.0**	2.85	2.85	**3.0**
11950	94.9	---	----	0.72	0.72	**0.8**	1.53	6.62	3.12	11.27	**9.0**	8.15	**7.0**	0.74	0.95	**1.0**
11751	95.8	0.08	0.14	0.70	0.92	**0.8**	7.07	1.75	2.18	11.00	**9.0**	8.82	**8.0**	1.11	1.11	**1.0**
11871	98.2	---	----	1.15	1.15	**0.8**	4.30	4.01	1.92	10.23	**10.0**	8.31	**8.0**	2.31	3.61	**4.0**
11878	99.4	---	----	1.09	1.09	**0.8**	7.36	1.91	1.17	10.44	**10.0**	9.27	**8.0**	1.88	1.88	**1.0**
12041	101.2	---	---	1.32	1.32	**1.2**	4.27	3.36	1.52	9.15	**7.0**	7.63	**6.0**	3.70	3.70	**3.0**
11881	103.1	---	----	1.08	1.08	**0.8**	5.66	2.60	1.57	9.83	**8.0**	8.26	**7.0**	1.44	1.44	**1.0**
11949	105.1	0.18	----	0.83	1.01	**0.8**	5.44	3.46	1.21	10.11	**10.0**	8.90	**9.0**	2.08	2.08	**2.0**
12073	107.4	0.01	----	1.23	1.24	**1.0**	2.08	5.02	4.58	11.68	**9.0**	7.10	**7.0**	1.98	1.98	**2.0**
12042	107.9	---	----	---	---	----	6.90	3.27	0.82	10.99	**11.0**	10.17	**10.0**	1.67	1.67	**2.0**
12015	128.1	---	---	---	---	----	5.38	3.89	1.48	10.75	**9.0**	9.27	**9.0**	2.85	2.85	**2.5**

Nitrogenous Superphosphates.

Station No.	Name or Brand.	Manufacturer or dealer.	Sent by	Dealer's cash price per ton.	*Valuation per ton.*
	2. *Sampled by Purchasers and others.*				
11569	Home Mixture	S. D. Woodruff & Sons, Orange	Manufacturer	$26.00	$30.88
12046	Fish, Bone and Potash	E. R. Kelsey, Short Beach	E. C. Warner, Clintonville	22.00	24.78
12151	East India Fertilizer	American Agricultural Chemical Co., N. Y.	A. P. Wakeman, Fairfield	26.00	22.85
11794	C. V. O. Co.'s Complete High Grade Fertilizer	Conn. Valley Orchard Co., Berlin	George W. Spicer, Deep River	27.00	22.08
11897	C. V. O. Co.'s Fertilizer	Conn. Valley Orchard Co., Berlin	John L. Watrous, Kensington	27.50	22.38
12150	Special Mixture	Sanderson Fertilizer & Chemical Co., New Haven	O. G. Beard, Shelton	37.00	29.00
12110	Bone Phosphate	E. L. James, Warrenville	Manufacturer	30.00	21.03
11622	Complete Fertilizer	Valentine Bohl, Waterbury	Samuel Wilson, Wolcott	32.00	21.58
12045	Niantic Fish, Bone and Potash	Sanderson Fertilizer & Chemical Co., New Haven	E. C. Warner, Clintonville	25.00	16.49
11947	Crocker's New Rival	American Agricultural Chemical Co., N. Y.	L. C. Spring, Granby	35.00	16.28
11550	Fertilizer	Conn. Fat Rendering & Fertilizing Corporation, New Haven	W. T. Burton, Hamden	----	9.22

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 68 to 71.

1. *Samples Drawn by Station Agent.*

In the table on pages 72–87 are given analyses of one hundred and five brands represented by samples drawn by the Station agents.

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. Soluble.	Phosphoric Acid. Reverted.	Phosphoric Acid. Insoluble.	Phosphoric Acid. Total. Found.	Phosphoric Acid. Total. Guaranteed.	Phosphoric Acid. Available. Found.	Phosphoric Acid. Available. Guaranteed.	Potash. Found. As Muriate.	Potash. Found. Total.	Potash. Guaranteed.
11569	15.8*	1.12	1.24	2.17	4.53	----	4.29	3.70	1.96	9.95	----	7.99	----	9.13	9.13	----
12046	11.2*	---	0.84	2.84	3.68	2.5	2.88	4.36	0.67	7.91	5.0	7.24	4.0	0.45	5.62	4.0
12151	13.8	---	0.60	2.02	2.62	2.5	7.71	1.48	1.15	10.34	8.0	9.19	----	4.89	5.83	6.0
11794	22.3	0.62	----	2.14	2.76	2.5	8.37	1.50	0.54	10.41	11.0	9.87	9.0	4.31	4.31	4.0
11897	22.9	0.62	----	2.00	2.62	2.5	8.79	1.71	0.53	11.03	11.0	10.50	9.0	4.60	4.60	4.0
12150	27.6	0.96	0.07	2.59	3.62	----	4.17	4.33	1.13	9.63	----	8.50	----	7.28	10.04	----
12110	42.7	---	----	2.50	2.50	----	2.08	7.06	5.15	14.29	----	9.14	----	3.18	3.18	----
11622	48.3	1.64	----	1.32	2.96	----	none	1.93	8.14	10.07	----	1.93	----	6.28	6.28	----
12045	51.6	0.22	0.30	2.03	2.55	----	2.16	3.05	1.10	6.31	6.0	5.21	4.0	3.30	3.30	4.0
11947	115.0	0.20	----	1.22	1.42	1.0	6.80	2.52	1.48	10.80	9.0	9.32	8.0	3.11	3.11	2.0
11550	----	---	----	1.65	1.65	----	none	0.57	0.53	1.10	----	0.57	----	0.33	2.82	----

* Valuation exceeds cost.

Guaranties.

Of the samples represented in the following tables, six failed to meet the maker's guaranty in respect of nitrogen, six in respect of phosphoric acid and ten in respect of potash, one was found deficient in respect of both phosphoric acid and potash; in all about one-fifth of the whole number of special manures examined.

The brands which thus failed to fully meet the minimum claims of the manufacturers by more than one-tenth per cent. were the following:—

11862. Rogers Manufacturing Co.'s H. G. Fertilizer for Oats and Top-Dressing. Nitrogen found 6.11 per cent., guaranteed 6.3 per cent.

12003. Sanderson's Top-Dressing for Grass and Grain. Potash found 6.38, guaranteed 7.0.

11918. Chittenden's High Grade Special Tobacco Fertilizer. Total phosphoric acid found 6.42, guaranteed 7.0.

11920. American Agricultural Chemical Co.'s High Grade Tobacco Manure. Potash found 9.38, guaranteed 10.0.

11965. Shoemaker's Swift-Sure Superphosphate for Potatoes. Nitrogen found 2.59, guaranteed 2.9.

12142. Mapes' Seeding Down Manure. Total phosphoric acid found 17.45, guaranteed 18.0.

12131. Hubbard's Grass and Grain. Total phosphoric acid found 14.74, guaranteed 16.0.

11963. Darling's Tobacco Grower. Nitrogen found 4.24, guaranteed 4.5.

11892. Chittenden's Complete Tobacco Fertilizer. Potash found 5.12, guaranteed 5.4.

12000. Lister's Potato Manure. Nitrogen found 3.41, guaranteed 3.7.

11917. Sanderson's Formula B for Tobacco. Potash found 5.83, guaranteed 6.0.

12106. Lister's Special 10 per cent. Potato. Potash found 9.69, guaranteed 10.0.

11889. New England H. G. Potato Fertilizer. Phosphoric acid found 8.80, guaranteed 9.0.

11866. Bradley's Complete for Potatoes and Vegetables. Potash found 6.88, guaranteed 7.0.

11772. Swift's Lowell Potato Phosphate. Potash found 5.84, guaranteed 6.0.

12108. Lister's Special Tobacco Fertilizer. Nitrogen found 1.72, guaranteed 2.0.

11829. American Farmers' Complete Potato Fertilizer. Potash found 5.47, guaranteed 6.0.

11967. Swift's Lowell Perfect Tobacco Grower. Potash found 5.87, guaranteed 6.0.

12067. American Agricultural Chemical Co.'s Grass and Lawn Top Dressing. Nitrogen found 3.78, guaranteed 3.9.

12017. Darling's Potato Manure. Potash found 4.76, guaranteed 5.0.

11821. New England Fertilizer Co.'s Potato Fertilizer. Phosphoric acid found 7.84, guaranteed 8.0. Potash found 3.67, guaranteed 4.0.

11773. Swift's Lowell Potato Manure. Phosphoric acid found 7.24, guaranteed 8.0.

11791. Sanderson's Corn Superphosphate. Phosphoric acid found 8.38, guaranteed 9.0.

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 14.

The average cost per ton of the one hundred and five special manures included in the tables was $33.93, the valuation, $23.39, and the percentage difference, 45.0.

In 1903 the corresponding figures were: Average cost, $33.30; valuation, $23.53; percentage difference, 41.5.

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.
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

* Total phosphoric acid.

In 1904 the percentages of nitrogen and potash have averaged somewhat lower and the price somewhat higher than in the two previous years.

Without regarding the station's valuations, a study of the tables of analyses and selling prices shows that the number of pounds of nitrogen, phosphoric acid and potash purchasable for thirty dollars in the special manures, was as follows:—

	Ton price.	Nitrogen.	Phosphoric acid.	Potash.
In the first 13 samples in the table....	$38.61	77	129	139
" next 18 " "	35.11	58	143	133
" " 13 " "	34.50	50	149	130
" " 13 " "	34.85	51	141	109
" " 13 " "	32.80	47	167	82
" " 11 " "	32.23	44	162	80
" " 11 " "	31.90	42	167	66
" " 11 " "	31.02	33	174	60
" " 3 " "	30.00	30	125	81

Nothing could show better than the foregoing table the fact that low priced and low grade mixed fertilizers really cost more than the most expensive, and no one can afford to purchase and use them. Thus in the more costly special manures, for which over $38.00 per ton is charged, more than twice as much nitrogen and potash could be bought *for the same money* as could be bought in those selling for seven dollars less per ton.

Analyses requiring special notice.

An analysis of Hubbard's Grass and Grain Grower, **11890**, made on a mixture of two samples, drawn by our agent from stock of Jonas Johnson, Woodstock, and from the factory at Middletown, had the following composition:—

Nitrogen	2.56
Soluble and reverted phosphoric acid	9.76
Total phosphoric acid	15.29
Potash, as muriate	14.71

The manufacturer wrote that the amount of potash was very considerably above the guaranty and the phosphoric acid slightly below; that probably the different ingredients had separated after mixing, and asked that another sample be drawn, as he believed the above did not fairly represent the average composition of the brand. This was done, and the analysis appears, **12131**, in the table, pages 74–75.

Tobacco Manures claimed to contain Potash in form of Carbonate.

On pages 88 and 89 are given twenty-four analyses, representing eight different brands.

The American Agricultural Chemical Co.'s Complete Tobacco Manure is guaranteed to contain 5.5 per cent. of potash. The percentages of water-soluble potash found in the two samples were 4.94 and 5.26. In both samples most of the potash is certainly present as carbonate.

Bowker's Complete Alkaline Tobacco Grower. The general agent for the manufacturer states that no muriate or sulphate of potash is used in it, the potash being all in form of carbonate

and the phosphoric acid derived from sources free from sulphuric acid.

The analysis of sample **11973** was unsatisfactory to the general state agent, who claimed that it did not fairly represent the brand. Two other samples were accordingly drawn and analyzed. One of these is below guaranty as regards both nitrogen and potash, the other is below guaranty as regards potash. In both, the larger part of the potash is certainly present as carbonate.

Bowker's Tobacco Ash Elements. This brand is guaranteed "to be composed principally of wood ashes and bone ash and containing potash in the form of carbonate, and the phosphoric acid largely in available form." Ten analyses appear in the table, showing uniformity of composition and agreement with the guaranty as regards the amount of potash present. The goods contain, on the average, 12.5 per cent. of sulphuric acid, or 250 pounds in the ton. Wood ashes contain only about 1 per cent. of sulphuric acid and bone ash contains much less than that. The ash elements therefore must contain a considerable quantity of some material, not named in the guaranty, which contains sulphates.

Mapes Tobacco Manure, Wrapper brand. The two samples drawn by the station agent fully meet the guarantees as far as percentages of nitrogen, phosphoric acid and potash are concerned. The potash present is guaranteed to be mostly as carbonate. The analyses do not show the contrary, but show the presence of a considerable amount of sulphates. The same is true of the Tobacco Ash Constituents made by the same firm, and also of Olds & Whipple's Complete Tobacco Fertilizer and the New England Fertilizer Co.'s Perfect Tobacco Grower.

All of these mixtures, claimed to contain potash chiefly in form of carbonate and with a guaranty of "available" phosphoric acid, are difficult to analyze, the analyses are not easy to interpret and their meaning has been the subject of much dispute. The term "available phosphoric acid" is an unfortunate trade name which leads to confusion. It is fairly used only with reference to phosphates which have been treated with an acid. "Available phosphoric acid" in these cases means the phosphoric acid which can be extracted by water, taken together with the amount which can be extracted by a perfectly neutral solution of ammonium citrate under certain prescribed conditions.

With the phosphates above mentioned, where the amount of "reverted" phosphoric acid (that is, the portion not soluble in water, but soluble in ammonium citrate) is relatively small, the "available" phosphoric acid as shown by analysis probably bears some relation to the amount which is "available" to farm crops. But 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 little or no use in fixing the value of the fertilizer.

Regarding the guaranty of carbonate of potash in these fertilizers, in many cases a chemical analysis cannot certainly prove or disprove the statement that potash is present in that form. As was said in our last report, 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 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.

That it is perfectly possible to make a mixture of tobacco ash constituents nearly free from sulphates and chlorides may be seen from the formula and analysis of a home-mixture, **11981**, made by G. A. Douglass, which are given on page 90.

A mixture of 444 pounds of bone meal, 444 of high grade carbonate of potash and 1,112 of Canada ashes, was found to contain 0.32 per cent. of chlorine and 0.39 per cent. of sulphuric acid, while the water-soluble potash was 14.99 per cent. and the cost $29.60 per ton.

Special Manures, Sampled by the Station.

Station No.	Name or Brand.	Manufacturer.	Dealer.	Dealer's cash price per ton.	Valuation per ton.
11863	Special Mixture for Seed and Potato Crops	E. B. Clark Co., Milford	Manufacturer	$28.00	$29.11
11939	Shay's Potato Manure	C. M. Shay, Groton	Manufacturer	28.00	26.40
11969	H. G. Soluble Tobacco Fertilizer	Rogers Mfg. Co., Rockfall	Arthur Sikes, Suffield Manufacturer	43.00 40.00	36.73
11792	Hubbard's Oats and Top Dressing	The Rogers & Hubbard Co., Middletown	H. W. Andrews, Wallingford R. H. Hall, East Hampton	50.00 48.00 **49.00**	42.85
11887	Boardman's Complete Fertilizer for Potatoes and General Crops	F. E. Boardman, R. F. D., Middletown	Manufacturer	32.00	27.70
11968	H. G. Grass and Grain Fertilizer	Rogers Mfg. Co., Rockfall	Manufacturer	40.00	33.75
11862	H. G. Fertilizer for Oats and Top Dressing	Rogers Mfg. Co., Rockfall	R. H. Hall, East Hampton R. E. Davis, Guilford	45.00 41.00 **43.00**	36.17
11932	Wilcox' Grass Fertilizer	Wilcox Fertilizer Works, Mystic	M. E. Thompson, Ellington Manufacturer	34.00 **34.50**	28.39
11970	Hubbard's Soluble Tobacco Manure	The Rogers & Hubbard Co., Middletown	H. W. Andrews, Wallingford	45.00	36.61
12003	Sanderson's Top Dressing for Grass and Grain	Sanderson Fertilizer & Chemical Co., New Haven	A. R. Ford, Suffield	------ **35.00**	28.31
11787	Essex Special Tobacco Manure	Russia Cement Co., Gloucester, Mass.	Spencer Bros., Suffield J. & H. Woodford, Avon	44.00 45.00 **44.50**	35.87
11918	Chittenden's H. G. Special Tobacco Fertilizer	National Fertilizer Co., Bridgeport	J. N. Lasbury, Broadbrook Rob't Graham, Suffield	44.00 44.00	35.41
11768	Hubbard's Soluble Potato Manure	The Rogers & Hubbard Co., Middletown	H. W. Andrews, Wallingford R. H. Hall, East Hampton	40.00 38.00 **39.00**	31.15
11952	Shay's Corn Manure	C. M. Shay, Groton	Manufacturer	24.00	19.08
11920	High Grade Tobacco Manure	American Agricultural Chemical Co., N. Y.	E. N. Austin, Suffield	44.00	34.89
11997	Bowker's Fairfield Onion Fertilizer	Bowker Fertilizer Co., New York	Bowker's Branch, Southport	33.00	26.15
11965	Swift-Sure Superphosphate for Potatoes	M. L. Shoemaker & Co., Phila., Pa.	A. N. Clark, Milford Loomis Bros., Granby	35.00 34.00 **34.50**	27.28

Analyses and Valuations.

Station No.	Percentage difference between cost and valuation.	Nitrogen.					Phosphoric Acid.							Potash.		
		As Nitrates.	As Ammonia.	Organic.	Total Nitrogen. Found.	Total Nitrogen. Guaranteed.	Soluble.	Reverted.	Insoluble.	Total. Found.	Total. Guaranteed.	Available. Found.	Available. Guaranteed.	Found. As Muriate.	Found. Total.	Guaranteed.
11863	3.8*	1.63	0.17	2.19	3.99	**3.7**	4.61	5.09	1.74	11.44	**9.0**	9.70	----	7.88	7.88	**7.0**
11939	6.1	0.70	0.10	2.81	3.61	**3.0**	3.15	6.03	2.36	11.54	**9.0**	9.18	**8.0**	5.16	6.14	**5.0**
11969	8.9	1.89	---	3.21	5.10	**5.0**	1.95	6.29	1.32	9.56	**8.0**	8.24	**6.0**	0.85	12.25	**11.0**
11792	14.4	7.96	---	1.26	9.22	**8.5**	none	5.55	2.77	8.32	**8.0**	5.55	**3.9**	8.73	8.73	**8.0**
11887	15.5	---	---	3.34	3.34	**2.8**	5.52	2.29	1.12	8.93	**8.0**	7.81	----	10.31	10.31	**10.0**
11968	18.5	0.01	---	3.15	3.16	**3.0**	0.08	11.57	6.31	17.96	**16.0**	11.65	----	12.75	12.75	**12.5**
11862	18.9	4.24	0.14	1.73	6.11	**6.3**	0.75	9.14	2.66	12.55	**9.0**	9.89	**7.0**	8.23	8.23	**7.5**
11932	21.5	1.60	---	3.05	4.65	**4.1**	3.28	5.01	2.90	11.19	**7.0**	8.29	----	5.26	5.26	**5.0**
11970	22.9	2.61	0.26	2.33	5.20	**5.0**	0.77	8.51	3.27	12.55	**10.0**	9.28	**7.0**	0.93	10.52	**10.0**
12003	23.6	1.05	---	3.55	4.60	**4.0**	3.12	3.81	2.15	9.08	----	6.93	**7.0**	3.88	6.38	**7.0**
11787	24.1	1.23	---	3.65	4.88	**4.5**	4.78	2.63	1.55	8.96	**7.5**	7.41	**5.5**	1.20	12.31	**12.0**
11918	24.3	---	1.34	4.37	5.71	**5.7**	5.28	0.73	0.41	6.42	**7.0**	6.01	**5.0**	0.97	10.08	**10.0**
11768	25.2	2.84	0.07	2.26	5.17	**5.0**	1.20	6.90	4.14	12.24	**10.0**	8.10	**7.0**	1.21	5.82	**5.0**
11952	25.8	---	---	2.22	2.22	**1.7**	2.77	5.27	5.46	13.50	**9.0**	8.04	**8.0**	2.85	2.85	**2.5**
11920	26.1	1.47	0.21	4.14	5.82	**5.8**	5.39	0.86	0.34	6.59	**6.0**	6.25	**5.0**	0.68	9.38	**10.0**
11997	26.2	0.52	0.08	2.98	3.58	**3.3**	6.72	2.06	1.05	9.83	**9.0**	8.78	**8.0**	6.66	6.66	**6.0**
11965	26.5	0.83	---	1.76	2.59	**2.9**	6.56	4.05	1.47	12.08	----	10.61	----	10.27	10.27	**7.0**

* Valuation exceeds cost.

Special Manures, Sampled by the Station.

Station No.	Name or Brand.	Manufacturer.	Dealer.	Dealer's cash price per ton.	Valuation per ton.
11732	Essex Complete Manure for Potatoes, Roots and Vegetables	Russia Cement Co., Gloucester, Mass.	Lightbourn & Pond Co., New Haven	**$40.00**	$31.58
			W. J. Cox, East Hartford	39.00	
			C. W. Lines Co., New Britain	42.00	
11859	Wilcox' Potato, Onion and Vegetable Manure	Wilcox Fertilizer Works, Mystic	W. C. Terry, Jewett City	**34.00**	26.28
			I. W. Dennison, Mystic	32.00	
			Olds & Whipple, Hartford	36.00	
12109	Stockbridge Grass Top Dressing	Bowker Fertilizer Co., New York	Bowker's Branch, Hartford	**38.00**	29.29
12142	Mapes' Seeding Down Manure	Mapes F. & P.G. Co., New York	Mapes' Branch, Hartford	**39.00**	30.01
12001	Olds & Whipple's Potato Manure	Olds & Whipple, Hartford	Manufacturer	**32.00**	24.34
12044	American Farmers' Grain Grower	American Farmers' Fertilizer Co., N. Y.	J. E. Leonard & Son, Jewett City	**21.00**	15.96
12021	Wilcox' Potato Fertilizer	Wilcox Fertilizer Works, Mystic	D. C. Spencer, Saybrook	**27.50**	20.87
11756	Mapes' Economical Potato Manure	Mapes F. & P. G. Co., New York	Southington Lumber Co., Southington	35.00	26.09
			Mapes' Branch, Hartford	34.00	
				34.50	
12146	E. Frank Coe's Tobacco and Onion Fertilizer	E. Frank Coe Co., New York	Edgar Brewer, Hockanum	**37.00**	27.96
12131*	Hubbard's Grass and Grain	The Rogers & Hubbard Co., Middletown	Manufacturer	**40.00**	30.14
11963	Darling's Tobacco Grower	American Agricultural Chemical Co., N. Y.	J. B. Parker, Poquonock	41.00	30.30
			Latham & Chittenden, Granby	40.00	
				40.50	
11892	Chittenden's Complete Tobacco Fertilizer	National Fertilizer Co., Bridgeport	Rob't Graham, R. F. D., Suffield	36.00	26.05
			Thos. Cavanaugh, Gildersleeve	------	
				35.00	
12000	Lister's Potato Manure	Lister's Agric. Chem. Wks., Newark, N. J.	D. C. Burnham, R. F. D., Colchester	**38.00**	28.10
11971	H. G. Soluble Tobacco and Potato Manure	Rogers Mfg. Co., Rockfall	Manufacturer	**40.00**	29.59
11891	H. G. Complete Corn and Onion Manure	Rogers Mfg. Co., Rockfall	Manufacturer	36.00	25.47
			R. E. Davis, Guilford	33.00	
				34.50	
12004	East India Complete Potato Manure	American Agricultural Chemical Co., N. Y.	Edward White, Rockville	**36.00**	26.55

* See special mention, page 68.

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: Soluble.	Phosphoric Acid: Reverted.	Phosphoric Acid: Insoluble.	Phosphoric Acid: Total: Found.	Phosphoric Acid: Total: Guaranteed.	Phosphoric Acid: Available: Found.	Phosphoric Acid: Available: Guaranteed.	Potash: Found: As Muriate.	Potash: Found: Total.	Potash: Guaranteed.
11732	26.7	0.76	---	3.19	3.95	**3.7**	6.74	2.85	2.88	12.47	**9.0**	9.59	----	0.60	8.58	**8.5**
11859	29.4	0.97	0.06	2.65	3.68	**3.3**	4.40	3.46	1.81	9.67	**8.0**	7.86	**7.0**	5.62	7.08	**6.0**
12109	29.7	0.02	1.33	3.90	5.25	**4.3**	4.19	1.46	0.76	6.41	**6.0**	5.65	**4.0**	6.68	6.68	**6.0**
12142	30.0	2.12	0.29	0.48	2.89	**2.5**	0.16	9.54	7.75	17.45	**18.0**	9.70	----	11.36	11.36	**10.0**
12001	31.5	0.75	---	2.11	2.86	**2.5**	4.58	3.32	0.52	8.42	**5.0**	7.90	----	1.73	7.82	**7.0**
12044	31.6	---	0.14	1.17	1.31	**0.8**	8.19	1.91	3.13	13.23	**8.0**	10.10	**6.0**	1.44	1.44	**1.0**
12021	31.8	---	0.17	2.16	2.33	**2.1**	2.88	5.35	2.13	10.36	**7.0**	8.23	----	3.86	5.57	**4.5**
11756	32.2	2.39	0.26	0.86	3.51	**3.3**	2.13	3.80	1.58	7.51	**6.0**	5.93	**4.0**	1.29	9.12	**8.0**
12146	32.3	---	1.22	2.12	3.34	**3.0**	5.88	1.88	1.13	8.89	**7.0**	7.76	**6.0**	0.49	9.10	**8.0**
12131	32.7	0.16	0.32	2.39	2.87	**2.2**	0.32	9.94	4.48	14.74	**16.0**	10.26	----	11.89	11.89	**12.0**
11963	33.7	0.67	1.85	1.72	4.24	**4.5**	3.00	2.86	0.41	6.27	**5.0**	5.86	**4.0**	4.95	11.25	**10.0**
11892	34.4	---	0.48	3.04	3.52	**3.3**	7.61	1.93	0.85	10.39	**10.0**	9.54	**8.0**	0.78	5.12	**5.4**
12000	35.2	0.65	1.06	1.70	3.41	**3.7**	8.19	1.86	1.43	11.48	**9.0**	10.05	**8.0**	0.96	7.07	**7.0**
11971	35.2	1.93	---	1.99	3.92	**3.5**	3.68	5.33	0.39	9.40	**9.0**	9.01	**7.0**	0.94	8.85	**8.8**
11891	35.5	1.70	---	2.10	3.80	**3.5**	3.42	2.84	3.37	9.63	**8.0**	6.26	**6.0**	7.04	7.04	**7.0**
12004	35.6	1.19	---	2.04	3.23	**3.3**	3.60	3.42	1.97	8.99	**7.0**	7.02	**6.0**	10.39	10.39	**10.0**

Special Manures, Sampled by the Station.

Station No.	Name or Brand.	Manufacturer.	Dealer.	Dealer's cash price per ton.	Valuation per ton.
11788	Essex Complete Manure for Corn, Grain and Grass	Russia Cement Co., Gloucester, Mass.	E. N. Pierce & Co., Plainville W. J. Cox, East Hartford	$38.00 39.00 38.50	$28.37
11761	Bowker's Early Potato Manure	Bowker Fertilizer Co., New York	Bowker's Branch, Hartford W. T. McKenzie, Yalesville	36.00 38.00	26.26
11917	Sanderson's Formula B for Tobacco	Sanderson Fertilizer & Chemical Co., New Haven	M. Doughney, Suffield Manufacturer	31.50 35.00	25.49
11731	Mapes' Potato Manure	Mapes F. & P. G. Co., New York	Spencer Bros., Suffield Mapes' Branch, Hartford	39.00 37.00 38.00	27.45
11886	Armour's H. G. Potato Fertilizer	Armour Fertilizer Co., Baltimore, Md.	J. M. Young & Co., Norwich E. A. Buck & Co., Willimantic	34.00 33.00 33.50	23.92
11962	Wheeler's Havana Tobacco Grower	American Agricultural Chemical Co., N. Y.	J. R. Morgan, Bethel F. M. Loomis, North Granby	38.00 35.00 36.50	25.90
12106	Lister's Special 10 per cent. Potato	Lister's Agric. Chem. Wks., Newark, N. J.	J. C. Wilcoxson, Stratford	35.00	24.57
11830	American Farmers' Corn King	American. Farmers' Fertilizer Co., N. Y.	W. B. Martin, Rockville S. V. Osborn, Branford	31.00 30.00 30.50	21.38
11793	Sanderson's Potato Manure	Sanderson Fertilizer & Chemical Co., New Haven	Manufacturer G. W. Eaton, Plainville	30.00 30.00	20.98
11933	Hubbard's Potato Phosphate	The Rogers & Hubbard Co., Middletown	S. E. Frisbie, Milford Jonas Johnson, Woodstock H. W. Andrews, Wallingford	31.00 32.00 31.00	21.64
11771	Essex Tobacco Starter	Russia Cement Co., Gloucester, Mass.	W. J. Cox, East Hartford J. & H. Woodford, Avon	34.00 34.00	23.50
11990	Bradley's Complete for Top Dressing Grass and Grain	American Agricultural Chemical Co., N. Y.	F. M. Cole, Putnam E. C. Dennis, Stafford Springs	36.50 37.00	25.06
12065	Tobacco Starter	Rogers Mfg. Co., Rockfall	Manufacturer R. A. Hardin, Glastonbury	35.00 35.00	23.97

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. Soluble.	Phosphoric Acid. Reverted.	Phosphoric Acid. Insoluble.	Phosphoric Acid. Total. Found.	Phosphoric Acid. Total. Guaranteed.	Phosphoric Acid. Available. Found.	Phosphoric Acid. Available. Guaranteed.	Potash. Found. As Muriate.	Potash. Found. Total.	Potash. Guaranteed.
11788	35.7	0.96	---	2.53	3.49	3.3	5.10	3.82	1.93	10.85	9.5	8.92	7.0	9.43	9.43	9.5
11761	37.1	0.84	0.11	2.53	3.48	3.3	6.59	1.70	1.23	9.52	8.0	8.29	7.0	7.69	7.69	7.0
11917	37.3	0.87	---	2.76	3.63	3.3	1.86	4.81	4.77	11.44	10.0	6.67	6.0	1.40	5.83	6.0
11731	38.4	3.01	0.24	0.58	3.83	3.7	3.25	4.62	1.90	9.77	8.0	7.87	8.0	1.25	7.48	6.0
11886	40.1	0.13	---	1.71	1.84	1.7	6.91	2.48	0.65	10.04	10.0	9.39	8.0	8.52	10.33	10.0
11962	40.9	0.05	0.58	1.94	2.57	2.5	5.92	1.38	0.47	7.77	7.0	7.30	6.0	1.25	10.49	10.0
12106	42.5	---	---	1.85	1.85	1.7	7.31	2.67	1.23	11.21	8.0	9.98	----	5.40	9.69	10.0
11830	42.7	---	0.59	1.85	2.44	2.4	8.08	1 52	1.36	10.96	9.5	9.60	8.0	2.26	4.14	4.0
11793	43.0	0.10	0.17	2.17	2.44	1.7	2.43	4.77	2.47	9.67	8.0	7.20	5.0	6.42	6.42	6.0
11933	43.3	0.95	---	1.17	2.12	2.0	6.97	4.37	0.57	11.91	10.0	11.34	9.0	5.29	5.29	5.0
11771	44.7	1.56	---	1.18	2.74	2.5	7.87	4.11	1.67	13.65	12.0	11.98	9.0	0.56	3.42	2.5
11990	45.6	5.14	---	0.18	5.32	5.0	1.94	3.81	1.00	6.75	6.0	5.75	5.0	0.72	2.89	2.5
12065	46.0	0.79	---	2.31	3.10	2.5	4.11	3.84	1.85	9.80	8.0	7.95	6.0	0.52	5.92	5.0

SPECIAL MANURES, SAMPLED BY THE STATION.

Station No.	Name or Brand.	Manufacturer.	Dealer.	Dealer's cash price per ton.	Valuation per ton.
11921	Tobacco Starter and Grower	American Agricultural Chemical Co., N. Y.	E. N. Austin, Suffield Carlos Bradley, Ellington	$34.00 35.00 34.50	$23.62
11889	N. E. H. G. Potato Fertilizer	New England Fertilizer Co., Boston	A. R. Manning & Co., Yantic J. A. Lewis' Estate, Willimantic	35.00 33.00 34.00	23.14
11790	Hubbard's Soluble Corn and General Crops Manure	The Rogers & Hubbard Co., Middletown	R. H. Hall, East Hampton H. W. Andrews, Wallingford	35.00 35.00	23.76
12006	Mapes' Fruit and Vine Manure	Mapes F. & P. G. Co., New York	Mapes' Branch, Hartford	38.00	25.69
11983	E. F. Coe's Sp'l Grass and Grain Fertilizer	E. Frank Coe Co., New York	W. L. Merwin, Milford	28.00	18.90
11753	Mapes' Corn Manure	Mapes F. & P. G. Co., New York	Mapes' Branch, Hartford F. S. Bidwell & Co., Windsor Locks Southington Lumber Co, Southington	33.00 34.00 34.00	22.23
12039	E. F. Coe's Columbian Potato	E. Frank Coe Co., New York	A. L. Burdick, Westbrook	27.00	18.15
11777	Stockbridge Special Corn Manure	Bowker Fertilizer Co., New York	W. H. Scott & Co., Pequabuck W. B. Martin, Rockville	40.00 40.00	26.65
11866	Bradley's Complete Manure for Potatoes and Vegetables	American Agricultural Chemical Co., N. Y.	P. Schwartz, New London W. B. Martin, Rockville	38.00 39.00 38.50	25.64
11729	Stockbridge Potato & Vegetable Fertilizer	Bowker Fertilizer Co., New York	J. F. Silliman & Co., New Canaan Bowker's Branch, Hartford	42.00 38.00 40.00	26.63
11772	Swift's Lowell Potato Phosphate	Swift's Lowell Fertilizer Co., Boston	Spencer Bros., Suffield G. S. Jennings, Southport Edward White, Rockville E. E. Burwell, New Haven	35.00 32.00 34.00 33.00 33.50	22.29
11826	E. F. Coe's Columbian Corn Fertilizer	E. Frank Coe Co., New York	A. L. Burdick, Westbrook C. W. & T. F. Atwood, Watertown	27.00 29.00 28.00	18.53

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.	Soluble.	Reverted.	Insoluble.	Total. Found.	Total. Guaranteed.	Available. Found.	Available. Guaranteed.	Found. As Muriate.	Found. Total.	Guaranteed.
11921	46.1	0.50	0.32	2.51	3.33	3.3	4.61	4.18	1.33	10.12	9.0	8.79	8.0	1.05	4.25	4.0
11889	46.9	0.33	0.12	2.33	2.78	2.5	6.06	2.23	0.51	8.80	9.0	8.29	8.0	0.85	6.20	6.0
11790	47.3	1.21	---	1.45	2.66	2.5	2.56	5.27	2.24	10.07	8.0	7.83	6.0	8.69	8.69	8.0
12006	47.9	1.30	0.26	0.83	2.39	1.7	2.19	5.02	1.16	8.37	7.0	7.21	5.0	1.58	11.50	10.0
11983	48.1	---	0.36	1.58	1.94	0.8	7.84	1.54	1.30	10.68	10.0	9.38	8.5	0.60	3.39	1.5
11753	48.4	1.49	0.25	0.83	2.57	2.5	2.91	4.97	3.17	11.05	10.0	7.88	8.0	6.82	6.82	6.0
12039	48.8	---	---	1.77	1.77	1.2	8.83	1.34	1.04	11.21	10.0	10.17	8.5	0.55	2.59	2.0
11777	50.1	0.92	---	2.42	3.34	3.0	5.17	4.33	1.95	11.45	8.0	9.50	7.0	7.47	7.47	7.0
11866	50.2	1.58	---	1.87	3.45	3.3	4.67	4.16	1.62	10.45	9.0	8.83	8.0	6.88	6.88	7.0
11729	50.2	0.69	---	2.63	3.32	3.3	5.17	1.97	1.30	8.44	7.0	7.14	6.0	9.95	9.95	10.0
11772	50.3	---	---	2.54	2.54	2.5	5.33	2.95	1.23	9.51	9.0	8.38	8.0	0.61	5.84	6.0
11826	51.1	---	0.09	1.75	1.84	1.2	8.76	1.48	1.08	11.32	10.0	10.24	8.5	0.52	2.67	2.5

SPECIAL MANURES, SAMPLED BY THE STATION.

Station No.	Name or Brand.	Manufacturer.	Dealer.	Dealer's cash price per ton.	Valuation per ton.
12038	Packer's Union Animal Corn Fertilizer	American Agricultural Chemical Co., N. Y.	Otto Ljunblad, R. F. D., New Britain	------ **$31.00**	$20.40
11896	Great Eastern Vegetable, Vine & Tobacco	American Agricultural Chemical Co., N. Y.	S. A. Post, Westbrook A. E. Harvey, R. D. 2, Willimantic	34.00 32.00 **33.00**	21.71
11951	Hubbard's Corn Phosphate	The Rogers & Hubbard Co., Middletown	H. W. Andrews, Wallingford S. E. Frisbie, Milford	26.00 28.00 **27.00**	17.72
11936	Potato and Tobacco Special	Ohio Farmers' Fertilizer Co., Columbus, Ohio	R. H. Hall, East Hampton R. A. Sherman, Oneco	30.00 26.00 **28.00**	18.26
11752	Mapes' Tobacco Starter, Improved	Mapes F. & P. G. Co., New York	F. S. Bidwell & Co., Windsor Locks Mapes' Branch, Hartford	35.00 34.00 **34.50**	22.43
12108	Lister's Special Tobacco Fertilizer	Lister's Agric. Chem. Wks., Newark, N. J.	Allen Willey, Hadlyme	**32.00**	20.70
11966	Stockbridge Potato Manure	Bowker Fertilizer Co., New York	A. R. Manning, Yantic	**41.00**	26.44
11829	American Farmers' Complete Potato Fertilizer	American Farmers' Fertilizer Co., N. Y.	W. B. Martin, Rockville S. V. Osborn, Branford	31.00 30.00 **30.50**	19.59
11888	Chittenden's Potato Phosphate	National Fertilizer Co., Bridgeport	F. Hallock Co., Derby J. Y. Thomas, Colchester	36.00 34.00 **35.00**	22.33
11967	Swift's Lowell Perfect Tobacco Grower	Swift's Lowell Fertilizer Co., Boston	F. S. Bidwell & Co., Windsor Locks Loomis Bros., Granby	41.00 40.00 **40.50**	25.85
11937	Williams & Clark's Potato Manure	American Agricultural Chemical Co., N. Y.	D. B. Wilson Co., Waterbury J. G. Schwink, Meriden	32.00 31.00 **31.50**	20.09
11861	Complete Potato and Vegetable Fertilizer	Rogers Mfg. Co., Rockfall	S. A. Billings, Meriden R. E. Davis, Guilford	35.00 31.00 **33.00**	20.96
11856	E. F. Coe's Special Potato Fertilizer	E. Frank Coe Co., New York	J. R. Babcock, Mystic A. L. Burdick, Westbrook	32.00 30.00 **31.00**	19.58

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.	Soluble.	Reverted.	Insoluble.	Total. Found.	Total. Guaranteed.	Available. Found.	Available. Guaranteed.	Found. As Muriate.	Found. Total.	Guaranteed.
12038	52.0	0.57	---	1.83	2.40	**2.5**	7.89	2.36	1.26	11.51	**11.0**	10.25	**9.0**	3.15	3.15	**2.0**
11896	52.0	0.73	---	1.52	2.25	**2.1**	6.59	2.58	1.84	11.01	**10.0**	9.17	**8.0**	6.26	6.26	**6.0**
11951	52.4	0.09	---	1.21	1.30	**1.0**	6.88	4.69	0.58	12.15	**10.0**	11.57	**8.0**	3.55	3.55	**3.5**
11936	53.3	---	---	1.77	1.77	**1.6**	4.75	4.55	2.02	11.32	**10.0**	9.30	**8.0**	3.92	3.92	**4.0**
11752	53.8	3.48	0.25	0.59	4.32	**4.1**	2.24	4.14	3.28	9.66	**8.0**	6.38	**6.0**	1.14	1.87	**1.0**
12108	54.6	---	---	1.72	1.72	**2.0**	9.20	3.19	1.12	13.51	**10.0**	12.39	----	2.59	3.79	**3.0**
11966	55.1	1.18	---	2.14	3.32	**3.3**	4.80	2.04	1.35	8.19	**7.0**	6.84	**6.0**	10.21	10.21	**10.0**
11829	55.7	---	0.16	1.73	1.89	**1.6**	5.92	2.09	2.40	10.41	**8.5**	8.01	**7.0**	3.07	5.47	**6.0**
11888	56.7	0.85	0.07	1.46	2.38	**2.1**	7.82	1.73	1.23	10.78	**10.0**	9.55	**8.0**	6.28	6.28	**6.0**
11967	56.7	1.51	---	2.46	3.97	**4.1**	4.08	3.41	0.66	8.15	**8.0**	7.49	**7.0**	0.78	5.87	**6.0**
11937	56.8	---	0.16	2.13	2.29	**2.1**	7.95	1.96	1.37	11.28	**9.0**	9.91	**8.0**	3.29	3.29	**3.0**
11861	57.4	1.35	---	1.02	2.37	**2.3**	6.05	2.86	1.98	10.89	**10.0**	8.91	**8.0**	5.34	5.34	**5.0**
11856	58.3	---	0.58	1.52	2.10	**1.7**	7.90	1.19	0.76	9.85	**9.5**	9.09	**8.0**	0.54	3.95	**4.0**

SPECIAL MANURES, SAMPLED BY THE STATION.

Station No.	Name or Brand.	Manufacturer.	Dealer.	Dealer's cash price per ton.	*Valuation per ton.*
11987	Armour's Grain Grower	Armour Fertilizer Wks., Baltimore, Md.	J. M. Young & Co., Norwich E. A. Buck & Co., Willimantic	$28.00 25.00 **26.50**	$16.72
12067	Grass and Lawn Top Dressing	American Agricultural Chemical Co., N. Y.	S. A. Billings, Meriden Gault Bros., Westport	38.00 34.00 **36.00**	22.59
11996	Read's Vegetable and Vine Fertilizer	American Agricultural Chemical Co., N. Y.	L. M. Childs, North Grosvenordale	**34.00**	21.30
11726	Quinnipiac Potato Manure	American Agricultural Chemical Co., N. Y.	Gault Bros., Westport J. F. Silliman & Co., New Canaan	32.00 34.00 **33.00**	20.54
11727	Quinnipiac Corn Manure	American Agricultural Chemical Co., N. Y.	J. F. Silliman & Co., New Canaan Gault Bros., Westport	30.00 29.00 **29.50**	18.33
11931	Williams & Clark's Potato Phosphate	American Agricultural Chemical Co., N. Y.	R. H. Hall, East Hampton Geo. Beaumont, Wallingford	33.00 34.00 **33.50**	20.75
12070	Lister's Corn and Potato Fertilizer	Lister's Agric. Chem. Wks., Newark, N. J.	D. C. Burnham, R. F. D., Colchester A. S. Bennett, Cheshire	**28.00** 30.00	17.30
11770	Essex Market Garden and Potato Manure	Russia Cement Co., Gloucester, Mass.	E. N. Pierce & Co., Plainville C. W. Lines Co., New Britain J. & H. Woodford, Avon	**35.00** 36.50 34.00	21.59
11778	Bradley's Potato Manure	American Agricultural Chemical Co., N. Y.	G. W. Eaton, Bristol Scofield & Miller, Stamford Spencer Bros., Suffield	**34.00** 34.00 34.00	20.94
11880	Bradley's Potato Fertilizer	American Agricultural Chemical Co., N. Y.	Wilson & Burr, Middletown D. L. Clark, Milford	32.00 29.00 **30.50**	18.72
12017	Darling's Potato Manure	American Agricultural Chemical Co., N. Y.	D. C. Peck, Plainville J. B. Parker, Poquonock	32.00 33.00 **32.50**	19.88
11912	Packer's Union Potato Manure	American Agricultural Chemical Co., N. Y.	F. L. Mackey, Ellington H. F. Porter, Hebron	33.00 34.00 **33.50**	20.40

ANALYSES AND VALUATIONS—*Continued.*

Station No.	Percentage difference between cost and valuation.	Nitrogen.					Phosphoric Acid.							Potash.		
		As Nitrates.	As Ammonia.	Organic.	Total Nitrogen.		Soluble.	Reverted.	Insoluble.	Total.		Available.		Found.		Guaranteed.
					Found.	Guaranteed.				Found.	Guaranteed.	Found.	Guaranteed.	As Muriate.	Total.	
11987	58.5	---	---	1.68	1.68	**1.6**	7.31	2.50	0.81	10.62	**10.0**	9.81	**8.0**	2.28	2.28	**2.0**
12067	59.4	2.23	1.20	0.35	3.78	**3.9**	6.34	1.68	1.00	9.02	**6.0**	8.02	**5.0**	3.02	3.02	**2.0**
11996	59.6	0.64	0.06	1.44	2.14	**2.1**	6.56	2.98	1.56	11.10	**10.0**	9.54	**8.0**	6.00	6.00	**6.0**
11726	60.7	0.48	---	1.97	2.45	**2.5**	5.78	1.55	2.00	9.33	**7.0**	7.33	**6.0**	5.72	5.72	**5.0**
11727	60.9	---	---	2.06	2.06	**2.1**	7.92	1.89	1.72	11.53	**9.0**	9.81	**8.0**	2.10	2.10	**1.5**
11931	61.4	0.29	0.20	2.11	2.60	**2.5**	5.23	2.33	1.88	9.44	**7.0**	7.56	**6.0**	5.19	5.19	**5.0**
12070	61.8	---	0.19	1.52	1.71	**1.7**	6.85	2.47	1.40	10.72	**9.0**	9.32	**8.0**	3.06	3.06	**2.0**
11770	62.1	0.66	---	1.77	2.43	**2.0**	5.86	3.37	2.31	11.54	**10.5**	9.23	**8.5**	5.17	5.17	**5.0**
11778	62.4	0.33	0.35	1.94	2.62	**2.5**	5.90	1.47	1.96	9.33	**7.0**	7.37	**6.0**	5.40	5.40	**5.0**
11880	62.9	0.34	---	1.81	2.15	**2.1**	6.45	2.53	1.77	10.75	**9.0**	8.98	**8.0**	3.23	3.23	**3.0**
12017	63.5	0.41	0.20	1.87	2.48	**2.5**	5.55	2.01	1.66	9.22	**7.0**	7.56	**6.0**	4.76	4.76	**5.0**
11912	64.2	0.70	---	1.35	2.05	**2.1**	5.55	2.87	1.62	10.04	**9.0**	8.42	**8.0**	6.45	6.45	**6.0**

SPECIAL MANURES, SAMPLED BY THE STATION.

Station No.	Name or Brand.	Manufacturer	Dealer.	Dealer's cash price per ton.	*Valuation per ton.*
12069	Crocker's Ammoniated Corn Phosphate	American Agricultural Chemical Co., N. Y.	W. L. Wellwood, So. Coventry F. M. Loomis, No. Granby	$32.00 29.00 **30.50**	$18.50
11955	Bowker's Tobacco Starter	Bowker Fertilizer Co., New York	R. A. Hardin, Glastonbury Bowker's Branch, Hartford	35.00 34.00 **34.50**	20.82
11831	Wheeler's Potato Manure	American Agricultural Chemical Co., N. Y.	J. R. Morgan, Bethel R. I. Sanford, R. F. D., Seymour A. H. Post, Gilead	35.00 29.00 **32.00**	19.09
11728	Bowker's Potato and Vegetable Phosphate	Bowker Fertilizer Co., New York	Bowker's Branch, Hartford Lightbourn & Pond Co., New Haven	**30.00** 33.00	17.80
12107	Great Eastern Northern Corn Special	American Agricultural Chemical Co., N. Y.	U. H. Reynolds, R. F. D. 30, Stamford	**34.00**	20.16
11786	Bradley's Corn Phosphate	American Agricultural Chemical Co., N. Y.	W. B. Martin, Rockville W. H. Scott & Co., Pequabuck Scofield & Miller, Stamford	33.00 30.00 **32.00**	18.96
11872	Quinnipiac Potato Phosphate	American Agricultural Chemical Co., N. Y.	J. P. Lathrop, Plainfield G. M. Williams Co., New London	30.00 32.00 **31.00**	18.35
11934	Berkshire Potato and Vegetable Phosphate	Berkshire Fertilizer Co., Bridgeport	Manufacturer Johnson Bros., Jewett City	31.00 30.00 **30.50**	17.98
11822	Mapes' Cereal Brand	Mapes F. & P. G. Co., New York	A. N. Clark, Milford E. F. Strong, Colchester	**28.00** 28.00	16.46
12019	Bowker's Potato and Vegetable Fertilizer	Bowker Fertilizer Co., New York	J. F. Silliman & Co., New Canaan	**36.00**	21.10
11988	Williams & Clark's Soluble Corn Phosphate	American Agricultural Chemical Co., N. Y.	J. G. Schwink, Meriden Geo. Beaumont, Wallingford	31.00 32.00 **31.50**	18.39
11957	Essex Corn Fertilizer	Russia Cement Co., Gloucester, Mass.	W. J. Cox, East Hartford A. R. Manning & Co., Yantic	**34.00** 34 00	19.67

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.	Soluble.	Reverted.	Insoluble.	Total. Found.	Total. Guaranteed.	Available. Found.	Available. Guaranteed.	Found. As Muriate.	Found. Total.	Guaranteed.
12069	64.9	0.32	---	2.04	2.36	**2.1**	5.63	3.94	1.66	11.23	**9.0**	9.57	**8.0**	1.72	1.72	**1.5**
11955	65.7	0.58	0.48	1.34	2.40	**2.5**	6.72	3.56	2.01	12.29	**9.0**	10.28	**8.0**	0.67	2.99	**3.0**
11831	67.6	0.68	---	1.54	2.22	**2.1**	6.80	2.57	1.61	10.98	**9.0**	9.37	**8.0**	3.18	3.18	**3.0**
11728	68.5	0.14	---	1.80	1.94	**1.7**	7.47	2.09	1.44	11.00	**10.0**	9.56	**9.0**	2.45	2.45	**2.0**
12107	68.7	---	---	2.30	2.30	**2.5**	7.50	1.83	1.17	10.50	**10.0**	9.33	**9.0**	4.03	4.03	**2.0**
11786	68.8	0.23	0.20	1.94	2.37	**2.1**	6.56	2.65	1.88	11.09	**9.0**	9.21	**8.0**	2.31	2.31	**1.5**
11872	68.9	0.04	---	2.09	2.13	**2.1**	5.84	2.79	1.85	10.48	**10.0**	8.63	**8.0**	3.14	3.14	**3.0**
11934	69.6	0.04	---	2.28	2.32	**2.0**	4.37	2.12	1.48	7.97	**8.0**	6.49	**6.0**	4.29	4.29	**4.0**
11822	70.1	1.13	0.09	0.74	1.96	**1.7**	2.88	3.86	2.73	9.47	**8.0**	6.74	**6.0**	3.72	3.72	**3.0**
12019	70.6	0.56	---	1.92	2.48	**2.5**	7.74	2.13	1.23	11.10	**9.0**	9.87	**8.0**	4.04	4.04	**4.0**
11988	71.3	---	0.27	1.92	2.19	**2.1**	7.44	2.30	1.62	11.36	**9.0**	9.74	**8.0**	1.80	1.80	**1.5**
11957	72.9	0.32	---	1.84	2.16	**2.0**	4.80	5.44	2.51	12.75	**10.5**	10.24	**8.5**	2.99	2.99	**3.0**

Special Manures, Sampled by the Station.

Station No.	Name or Brand.	Manufacturer.	Dealer.	Dealer's cash price per ton.	Valuation per ton.
12068	Crocker's Potato, Hop and Tobacco Phosphate	American Agricultural Chemical Co., N. Y.	W. L. Wellwood, So. Coventry	$34.00	$18.79
			F. M. Loomis, No. Granby	31.00	
				32.50	
12043	Grass and Oats	American Agricultural Chemical Co., N. Y.	R. I. Sanford, R. F. D., Seymour	22.00	12.43
			Thos. Richmond, New Milford	------	
			Otto Ljunblad, R. F. D., New Britain	------	
			A. H. Post, Gilead	23.00	
				22.50	
11870	Wheeler's Corn Fertilizer	American Agricultural Chemical Co., N. Y.	R. I. Sanford, R. F. D., Seymour	30.50	16.68
			J. R. Morgan, Bethel	33.00	
				31.75	
11953	Wheeler's Bermuda Onion Grower	American Agricultural Chemical Co., N. Y.	W. Smith & Son, Canterbury	28.00	15.71
			J. R. Morgan, Bethel	32.00	
				30.00	
11821	Potato Fertilizer	New England Fertilizer Co., Boston	G. T. Clark, North Westchester	32.00	16.23
			Rockville Milling Co., Rockville	30.00	
				31.00	
11760	Bowker's Corn Phosphate	Bowker Fertilizer Co., New York	J. F. Silliman & Co., New Canaan	33.00	16.76
			W. T. McKenzie, Yalesville	32.00	
				32.50	
11773	Swift's Lowell Potato Manure	Swift's Lowell Fertilizer Co., Boston	F. S. Bidwell & Co., Windsor Locks	32.00	15.99
			J. C. Lincoln, Berlin	31.00	
				31.50	
11791	Sanderson's Corn Superphosphate	Sanderson Fertilizer and Chemical Co., New Haven	Manufacturer	30.00	14.71
			G. W. Eaton, Plainville	28.00	
				29.00	
11865	Read's Practical Potato Special	American Agricultural Chemical Co., N. Y.	J. A. Nichols, Danielson	32.00	15.35
			L. A. Fenton, Norwich Town	**31.00**	
			J. F. Silliman & Co., New Canaan	31.00	
11832	New England Corn and Grain Fertilizer	New England Fertilizer Co., Boston	Rockville Milling Co., Rockville	28.00	14.15
			F. C. Benjamin, Danbury	28.00	
			Hotchkiss & Templeton, Waterbury	33.00	
				30.00	

Analyses and Valuations—*Continued.*

Station No.	Percentage difference between cost and valuation.	Nitrogen.					Phosphoric Acid.							Potash.		
					Total Nitrogen.					Total.		Available.		Found.		
		As Nitrates.	As Ammonia.	Organic.	Found.	Guaranteed.	Soluble.	Reverted.	Insoluble.	Found.	Guaranteed.	Found.	Guaranteed.	As Muriate.	Total.	Guaranteed.
12068	73.0	0.61	---	1.55	2.16	**2.1**	6.48	3.03	1.47	10.98	**9.0**	9.51	**8.0**	3.02	3.02	**3.0**
12043	81.0	---	---	---	---	---	9.09	2.58	1.12	12.79	**12.0**	11.67	**11.0**	2.05	2.05	**2.0**
11870	90.3	---	0.16	1.53	1.69	**1.7**	7.46	1.61	1.25	10.32	**9.0**	9.07	**8.0**	2.66	2.66	**2.0**
11953	91.0	---	---	1.10	1.10	**0.8**	6.08	3.10	1.31	10.49	**9.0**	9.18	**8.0**	3.99	3.99	**4.0**
11821	91.0	---	0.21	1.56	1.77	**1.6**	4.14	3.00	0.70	7.84	**8.0**	7.14	**7.0**	0.35	3.67	**4.0**
11760	93.9	0.20	0.18	1.51	1.89	**1.7**	7.01	1.71	1.60	10.32	**9.0**	8.72	**8.0**	2.21	2.21	**2.0**
11773	97.0	---	---	1.63	1.63	**1.6**	5.07	1.65	0.52	7.24	**8.0**	6.72	**7.0**	0.23	4.22	**4.0**
11791	97.1	---	0.22	1.76	1.98	**1.7**	3.06	2.61	2.71	8.38	**9.0**	5.67	**7.0**	2.19	2.19	**2.0**
11865	102.0	---	0.04	1.05	1.09	**0.8**	2.69	2.18	1.19	6.06	**5.0**	4.87	**4.0**	8.11	8.11	**8.0**
11832	112.0	---	---	1.43	1.43	**1.2**	5.30	2.86	0.99	9.15	**8.0**	8.16	**7.0**	1.98	1.98	**2.0**

Tobacco Fertilizers Containing Carbonates.

Analyses and Valuations.

Station No.	Name or Brand.	Manufacturer.	Dealer.	Nitrogen. Nitrogen as Nitrates.	Nitrogen. Nitrogen as Ammonia.	Nitrogen. Nitrogen Organic.	Nitrogen. Total. Found.	Nitrogen. Total. Guaranteed.	Phosphoric Acid. Water Soluble.	Phosphoric Acid. Citrate Soluble.	Phosphoric Acid. Insoluble.	Phosphoric Acid. Total. Found.	Phosphoric Acid. Total. Guaranteed.	Phosphoric Acid. Available. Found.	Phosphoric Acid. 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.
11919	Complete Tobacco Manure	Am'n Agricultural Chemical Co., New York	E. N. Austin, Suffield	---	---	4.82	4.82	**4.5**	0.59	6.62	6.17	13.38	**4.0**	7.21	**3.0**	**5.5**	4.94	0.74	0.78	3.42	0.56	0.66	$33.00	$32.05
11946	Complete for Tobacco	Am'n Agricultural Chemical Co., New York	A. B. Phelps,[1] Granby	---	---	4.82	4.82	**4.5**	0.67	6.60	5.83	13.10	**4.0**	7.27	**3.0**	**5.5**	5.26	0.70	0.54	4.02	0.53	0.46	35.00	32.65
11973	Bowker's Complete Alkaline Tobacco Grower	Bowker Fertilizer Co., N. Y.	Bowker's Branch, Hartford	0.02	---	3.03	3.05	**4.0**	0.17	3.99	2.26	6.42	**5.0**	4.16	**4.0**	**5.0**	3.73	1.44	2.29	---	1.08	2.86	34.00	18.42
12123	Bowker's Complete Alkaline Tobacco Grower	" " "	Seth Viets,[2] West Suffield	---	---	3.70	3.70	**4.0**	0.64	7.32	4.99	12.95	**5.0**	7.96	**4.0**	**5.0**	4.17	0.40	0.94	2.83	0.30	0.80	34.00	27.20
12127	Bowker's Complete Alkaline Tobacco Grower	" " "	Bowker's Branch, Hartford Seth Viets, West Suffield W. H. Prout, Suffield	0.05	---	4.13	4.18	**4.0**	0.59	6.00	3.17	9.76	**5.0**	6.59	**4.0**	**5.0**	4.10	0.39	0.92	2.79	0.29	0.78	35.00 34.00 33.00	26.93
11585	Bowker's Tobacco Ash Elements	Bowker Fertilizer Co., N. Y.	Bowker's Branch, Hartford	---	---	---	---	----	0.22	5.71	3.46	9.39	---	5.93	**6.0**	**15.0**	15.09	1.27	13.82	---	0.96	12.51	31.00	21.05
11855	Bowker's Tobacco Ash Elements	" " "	Seth Viets,[3] West Suffield	---	---	---	---	---	0.10	4.69	2.35	7.14	---	4.79	**6.0**	**15.0**	15.21	1.01	14.20	---	0.76	12.58	30.50	19.84
11924	Bowker's Tobacco Ash Elements	" " "	" [4] "	---	--	---	---	----	0.14	4.86	2.00	7.00	---	5.00	**6.0**	**15.0**	16.06	1.08	14.98	---	0.81	13.97	32.50	20.72
11960	Bowker's Tobacco Ash Elements	" " "	" [5] "	---	---	---	---	----	0.13	4.75	2.28	7.16	---	4.88	**6.0**	**15.0**	15.79	0.88	14.91	---	0.66	13.39	30.50	20.49
11961	Bowker's Tobacco Ash Elements	" " "	" [6] "	---	---	---	---	----	0.13	4.48	2.32	6.93	---	4.61	**6.0**	**15.0**	15.30	1.12	14.18	---	0.84	12.61	30.50	19.76
11978	Bowker's Tobacco Ash Elements	" " "	J. R. Hayes & Son, Granby	---	---	---	---	--	0.11	4.75	2.27	7.13	---	4.86	**6.0**	**15.0**	15.71	0.92	14.79	---	0.69	13.42	33.00	20.38
12047	Bowker's Tobacco Ash Elements	" " "	Seth Viets,[7] West Suffield	---	---	---	---	----	0.32	4.97	4.05	9.34	---	5.29	**6.0**	**15.0**	14.65	1.03	13.41	0.21	0.77	11.40	30.50	20.52
12122	Bowker's Tobacco Ash Elements	" " "	" [8] "	---	---	---	---	---	0.06	3.87	3.23	7.16	---	3.93	**6.0**	**15.0**	15.32	0.92	14.40	---	0.69	13.05	30.50	19.62
12126	Bowker's Tobacco Ash Elements	" " "	Bowker's Branch, Hartford Fish & Kent, Suffield Seth Viets, West Suffield C. H. Wells, Suffield H. W. Prout, Suffield	---	---	--	---	---	0.27	3.73	4.88	8.88	---	4.00	**6.0**	**15.0**	15.35	0.59	14.01	0.75	0.44	11.91	30.00 30.50 30.50 30.50 30.50	20.88
12139	Bowker's Tobacco Ash Elements	Bowker Fertilizer Co., N. Y.	Seth Viets,[9] West Suffield	---	---	---	---	----	0.62	3.79	7.13	11.54	---	4.41	**6.0**	**15.0**	14.89	0.96	12.38	1.55	0.72	10.53	30.50	22.12
11591	Mapes' Tobacco Manure, Wrapper Brand	Mapes F. & P. G. Co., N. Y.	Spencer Bros.,[10] Suffield	5.02	0.08	1.48	6.58	**6.18**	---	3.77	1.91	5.68	**4.5**	3.77	---	**10.5**	10.21	1.98	8.23	---	1.49	7.29	46.00	35.21
11913	Mapes' Tobacco Manure, Wrapper Brand	" " " "	Mapes' Branch, Hartford Spencer Bros., Suffield	4.89	0.08	1.73	6.70	**6.18**	---	2.87	2.52	5.39	**4.5**	2.87	---	**10.5**	10.50	1.72	6.59	2.19	1.29	5.60	45.00 46.00	36.85
12130	Mapes' Tobacco Manure, Wrapper Brand	" " " "	Mapes' Branch, Hartford	4.64	0.06	1.81	6.51	**6.18**	---	4.51	0.84	5.35	**4.5**	4.51	---	**10.5**	11.10	1.61	5.57	3.92	1.21	4.74	45.00	38.56
11590	Mapes' Tobacco Ash Constituents	" " " "	Spencer Bros.,[11] Suffield	0.08	---	0.60	0.68	**0.50**	---	3.25	2.97	6.22	**5.7**	3.25	---	**15.0**	14.60	1.62	12.98	---	1.22	15.28	32.00	20.51
11893	Mapes' Tobacco Ash Constituents	" " " "	Spencer Bros., Suffield	0.07	---	0.61	0.68	**0.50**	---	1.87	4.00	5.87	**5.7**	1.87	---	**15.0**	14.56	2.14	12.42	---	1.61	14.59	32.00	19.70
12128	Mapes' Tobacco Ash Constituents	" " " "	F. S. Bidwell & Co., W. Locks Mapes' Branch, Hartford	0.04	---	0.58	0.62	**0.50**	---	1.63	4.11	5.74	**5.7**	1.63	---	**15.0**	14.83	2.47	12.36	---	1.86	11.06	32.00 31.00	19.56
12129	Mapes' Tobacco Starter, Improved	" " " "	Mapes' Branch, Hartford	2.85	0.34	0.95	4.14	**4.12**	2.67	4.94	1.69	9.30	**8.0**	7.61	**6.0**	**1.0**	2.02	1.20	0.82	---	0.90	7.56	34.00	22.51
12075	O. & W.'s Complete Tobacco Fertilizer	Olds & Whipple, Hartford	D. F. Remington, Suffield Manufacturer	0.41	0.29	4.42	5.12	**4.53**	0.27	4.85	0.83	5.95	---	5.12	**3.0**	**5.5**	6.33	1.61	4.72	---	1.21	4.05	---- 35.00	28.34
11964	N. E. Perfect Tobacco Grower	N. E. Fertilizer Co., Boston	J. A. Lewis Estate, Willimantic Loyal Higley, Canton	1.77	0.17	2.32	4.26	**4.12**	2.77	4.11	0.57	7.45	**8.0**	6.88	**7.0**	**6.0**	5.50	0.96	4.54	---	0.72	11.95	36.00 37.00	25.75

[1] Sampled and sent by L. C. Spring, Granby.
[2] Sampled and sent by H. W. Prout, Suffield.
[3] Sampled and sent by W. H. Prout, Suffield.
[4] Sampled and sent by Fish & Kent, Suffield.
[5] Sampled and sent by C. H. Wells, Suffield.
Sampled and sent by Oscar J. Hazard, Suffield.
[7] Purchased by Jewett Wright, Suffield.
[8] Sampled and sent by H. W. Prout, Suffield.
[9] Purchased by Fish & Kent, Suffield.
[10] Sampled and sent by S. R. Spencer, Suffield.
[11] Sampled and sent by S. R. Spencer, Suffield.

HOME MIXTURES. FORMULAS,

Station No.	Made by	Nitrate of Soda.	Saltpeter Waste.	Tankage.	Bone Meal.	Acid Phosphate.	Carbonate of Potash.	Wood Ashes.	High Grade Sulphate of Potash.
		Formulas. Pounds per Ton of							
11612	Andrew Ure, Hamden	---	---	---	---	---	---	---	---
11613	" " "	---	---	---	---	---	---	---	---
11795	A. C. Lake, Bethlehem	200	---	700	---	500	--	---	---
11894	Conn. School for Boys, Meriden	500	---	500	---	400	---	---	---
11895	" " " " "	100	---	750	---	750	---	---	---
11915	W. L. & S. T. Merwin, Milford	---	---	---	---	---	---	---	---
11922	A. H. Pomeroy, R.D., Rockville	325	---	---	---	1306	---	---	---
11923	Andrew Kingsbury, Coventry	400	600	---	400	600	--	---	---
11981	G. A. Douglass, Thompsonville	---	---	---	444	---	444	1112	---
12111	J. G. Schwink, Meriden	100	---	750	---	750	---	---	---

HOME MIXTURES.

In the above table are given analyses of ten home-mixed fertilizers, with the formulas by which they were made. The samples were, in most cases, drawn by the makers of the mixtures and sent to the station for analysis.

As regards mechanical condition and chemical composition, these articles are not inferior to good factory-mixed fertilizers. The mixtures show a wide range of composition, but the average of all, excluding the tobacco ash mixture, **11981**, is

Nitrogen	3.95
Phosphoric acid	9.05
Potash	8.34

The average cost is $27.46 per ton, which in some cases probably covers only the cost of the ingredients unmixed. Adding to average cost $2.54 for cost of mixing, it appears that in these home-mixtures for $30.00 are bought, nitrogen 79 pounds, phosphoric acid 181 pounds, potash 166 pounds.

On page 48 it appears that in factory-mixed nitrogenous superphosphates, of average composition, at dealer's prices, there could be bought for $30.00, 51 pounds of nitrogen, 192 pounds of phosphoric acid and 83 pounds of potash.

ANALYSES AND VALUATIONS.

Mixture. Low Grade Sulphate of Potash.	Mixture. Muriate of Potash.	Mixture. Kainit.	Analyses. Nitrogen as Nitrate.	Analyses. Nitrogen as Ammonia.	Analyses. Nitrogen, Organic.	Analyses. Total Nitrogen.	Analyses. Soluble Phosphoric Acid.	Analyses. Reverted Phosphoric Acid.	Analyses. Insoluble Phosphoric Acid.	Analyses. Total Phosphoric Acid.	Analyses. Potash.	Cost (Unmixed) and Valuation. Cost per ton.	Cost (Unmixed) and Valuation. Valuation per ton.	Percentage difference between cost and valuation.
---	---	---	2.73	---	2.86	5.59	2.32	4.46	3.62	10.40	4.23	----	$29.46	----
---	---	---	---	0.33	2.19	2.52	3.60	2.52	1.38	7.50	4.79	$30.00	18.71	60.3
150	450	---	1.54	---	2.38	3.92	2.59	2.90	1.16	6.65	13.60	28.50	30.08	5.3*
---	250	350	3.75	---	1.45	5.20	2.19	2.69	0.86	5.74	8.80	28.74	29.02	1.0*
200	200	---	0.73	0.06	2.07	2.86	4.16	2.50	3.00	9.66	8.16	24.47	23.77	3.0
---	---	---	3.26	0.10	1.16	4.52	1.18	8.64	4.66	14.48	6.99	----	30.61	----
---	369	---	2.25	---	0.17	2.42	8.32	0.92	0.18	9.42	9.36	27.55	24.06	14.5
---	---	---	4.16	---	0.76	4.92	2.74	2.39	1.94	7.07	12.17	28.00	31.47	11.0*
---	---	---	---	---	0.34	0.34	tr.	3.18	3.43	6.61	14.99	29.60	28.49	----
200	200	---	1.18	---	2.40	3.58	4.19	4.47	1.93	10.59	6.98	25.00	26.26	4.8*

* Valuation exceeds cost.

TOBACCO STEMS.

These are the midribs of tobacco leaves, removed in the process of manufacture and used as a fertilizer for tobacco and also as a fertilizer and winter mulch for lawns.

11618. Sampled by the Bissell-Graves Co., Suffield. From stock of H. Frasier & Co., Boston. About 20 per cent. of water lost in air-drying.

11599. Stock of F. M. Thompson, Warehouse Point. Bought in New York. Sample from a car-load shipped to A. D. Ellsworth.

11598. Stock of F. M. Thompson, bought in New York. Sample from a car-load shipped to C. Bishop.

12132. Stock of S. J. Stevens, Glastonbury. Sampled and sent by L. H. Brewer, Hockanum.

ANALYSES.

	11618	11599	11598	12132
Percentage amounts of				
Nitrogen	2.45	1.98	2.08	1.86
Phosphoric acid	0.60	0.54	0.33	0.41
Potash	6.08	5.79	3.79	4.39
Cost per ton	$7.00	11.50	11.50	13.00

These analyses show the usual range of composition. If the nitrogen, phosphoric acid and potash are valued at 17½, 4 and 5 cents respectively, the average valuation per ton of these tobacco stems would be about $12.70.

WOOD ASHES.

PERCENTAGE COMPOSITION.

Station No.	Dealer or Purchaser.	Sampled or sent by	Total potash.	Potash soluble in water.	Phosphoric acid.	Lime.	Magnesia.	Chlorine.	Sand and soil.	Charcoal.	Sulphuric acid.	Cost per ton.
	Bowker's—											
11629	Conn. Valley Orchard Co., Berlin	J. T. Molumphy, Berlin	6.07	5.48	1.21	24.06	2.24	0.25	10.18	1.90	1.75	$ 9.25
11665	Newell St. John, Simsbury	E. F. Jennison, Hartford	5.62	4.85	1.22	25.22	2.39	0.17	12.37	3.37	2.21	9.50
11807	Bowker's Branch, Hartford	F. M. Thompson, Warehouse Pt.	5.52	4.80	1.34	25.18	2.48	0.22	13.43	4.69	1.99	10.75
11853	" "	A. E. Pascoe, Warehouse Pt.	6.56	5.85	1.25	23.72	2.51	0.19	14.70	4.06	1.99	9.75
11927	R. S. Griswold, Wethersfield	E. F. Jennison, Hartford	6.34	5.36	1.28	26.44	2.83	0.17	16.54	3.81	2.14	9.50
12574	Bowker's Branch, Hartford	A. G. Smith, Hartford	4.00	3.40	1.27	27.61	2.54	0.16	12.52	1.94	0.72	10.00
12031	Theodore Hauser, Suffield	E. N. Austin, Suffield	2.33	2.05	1.27	34.37	2.12	0.04	7.77	0.97	0.31	12.00
12027	" "	T. H. Hauser, Suffield	4.00	3.55	1.38	32.74	1.94	trace	17.65	4.34	1.03	12.50
	John Joynt, Lucknow, Can.—											
11906	F. S. Bidwell, Windsor Locks	Station Agent	7.35	6.37	1.48	24.45	2.60	0.02	9.65	1.07	0.81	13.50
12008	" "	H. W. Prout, Suffield	5.50	4.82	1.18	29.10	3.25	0.12	12.56	3.37	1.94	12.50
11869	G. H. Reynolds, Mansfield Depot	G. H. Reynolds, Mansfield Depot	3.72	3.18	1.06	29.64	1.86	0.08	5.65	1.72	0.56	9.45
12032	E. N. Austin, Suffield	E. N. Austin	5.10	4.57	1.36	26.88	3.43	0.08	12.83	2.65	1.11	11.00
12577	Coe Brass Co., Torrington	J. E. Perkins, Suffield	1.64	1.38	1.35	20.33	2.04	0.03	3.01	10.07	0.11	....
	G. L. Monroe, Oswego, N. Y.—											
12124	A. M. Shepard, Simsbury	A. M. Shepard, Simbury	0.53	0.32	1.00	33.90	1.80	0.02	11.82	1.83	0.08	9.75
12490	E. H. Latimer, Avon	E. H. Latimer, Avon	1.67	1.16	1.23	39.76	2.34	0.08	12.08	1.84	0.26	9.75

TOBACCO DUST.

11681. Sampled and sent by E. E. Burwell, New Haven.

10869. Stock of T. W. Wood, Richmond, Va. Sampled from stock bought by E. E. Burwell, New Haven, for an insecticide.

ANALYSES.

Percentage amounts of	11681	10869
Nitrogen	2.26	0.82
Phosphoric acid	0.96	0.19
Potash	7.83	0.70
Cost per ton	$20.00	....

11681 has the composition of tobacco stems and would be valuable either as a fertilizer or an insecticide.

10869 has very little value as a fertilizer, and probably no more value as an insecticide than any other kind of fine dust.

VEGETABLE ASH AND ASH COMPOUNDS.

Under these names a number of mixtures are in the market claimed to consist chiefly or exclusively of the ashes of various vegetable matters and to contain potash chiefly in the form of carbonate.

12056. Bowker's 25 per cent. Ash Compound. Made by Bowker Fertilizer Co., New York. Sampled from stock of G. A. Austin, Mapleton. Guaranty, 25 per cent. potash.

11977. Vegetable Potash. Sold by Olds & Whipple, Hartford. Sampled from stock of J. A. DuBon, Poquonock. Guaranty, 25 per cent. of potash.

11941. Vegetable Potash. Sold by Olds & Whipple, Hartford. Sampled from stock of J. C. Eddy, Simsbury. Guaranty, 25 per cent. of potash.

ANALYSES.

Percentage amounts of	12056	11977	11941
Citrate-soluble phosphoric acid	0.89 }	0.55	....
Insoluble phosphoric acid	0.41 }		
Potash soluble in water	22.58	24.80	27.07
Chlorine	0.54	2.10	....
Sulphuric acid	1.73	3.27	....
Lime	....	21.68	....
Magnesia	....	10.07	....
Sand	....	3.34	....
Charcoal	....	1.40	....
Cost per ton	$33.00	40.00	40.00
Potash costs cents per pound	7.1	8.1	7.4

The analyses show that the potash is, as claimed, chiefly in form of carbonate. Sample **12056** contains considerably less potash than is guaranteed.

WOOD ASHES.

In the table, pages 92–93, are given analyses of fifteen samples of wood ashes. Three of the number are clearly not unleached ashes and are of very inferior value. These are No. **12031**, from T. Hauser, and **12124** and **12490**, from G. L. Monroe. No. **12124** contained nearly 20 per cent. of moisture. Another, **12577**, was very wet, and inferior on that account, but probably not leached.

Excluding these four samples, the percentage of total potash ranges from 7.35 to 3.72, and of lime from 32.74 to 23.72.

The other eleven have the following average composition:

Potash total (soluble in acid)	5.43
Potash soluble in water	4.75
Phosphoric acid	1.28
Lime	26.83

The average percentages of these four ingredients are considerably lower than last year.

The average price per ton this year has been $10.70, about a dollar less than last year. If water-soluble potash is valued at 8 cents per pound and phosphoric acid at 4 cents, lime in ashes of average composition has cost, this year, about 35 cents per 100 pounds.

The lime in slaked stone lime and to some extent in lime-kiln ashes is in form of hydrate, while in wood ashes it is in form of carbonate. Probably slaked lime would act more promptly and effectively in correcting soil acidity than a pulverized carbonate,—ground limestone for example,—but the carbonate of lime in wood ashes is in a very much finer condition than this, and quite probably it is about as efficient in neutralizing the acid of the soil as the hydrate.

COTTON HULL AND COTTON BOLL ASHES.

This material, which only a few years ago was the chief source of potash in our tobacco fertilizers, has now almost entirely disappeared from our market. The four samples mentioned below are of very ordinary quality as compared with the cotton hull ashes formerly received.

11280. Stock of W. F. Fletcher, Southwick, Mass. Sampled and sent by A. H. Griffin, Granby.

11712. Sold as "Cotton Boll Ashes," by the American Cotton Oil Co., New York. Stock of Spencer Bros., Suffield. Sampled and sent by O. B. Phillips, Suffield.

11995. Stock of Olds & Whipple, Hartford. Sampled and sent by Dexter A. Woodworth, Suffield.

11279. Stock of W. F. Fletcher, Southwick, Mass. Sampled and sent by John B. Cannon, Granby.

ANALYSES.

Percentage amounts of	11280	11712	11995	11279
Water-soluble phosphoric acid	1.50	0.16	1.44	1.38
Citrate-soluble phosphoric acid	8.25	5.64	6.74	8.17
Insoluble phosphoric acid	0.68	0.95	0.76	0.75
Total phosphoric acid	10.43	6.75	8.94	10.30
Total potash	24.60	24.83	21.76	21.86
Water-soluble potash	19.24	20.95	18.30	16.38
Sulphuric acid	2.08	4.11	5.73	2.53
Chlorine	0.19	0.08	0.90	0.14
Cost per ton	$41.00	46.00	44.00	44.00
Potash costs cents per pound	**8.6**	**9.8**	**10.1**	**10.9**

ASHES FROM LIME KILNS AND BRICK KILNS.

The ashes of wood used in such kilns is necessarily mixed with much earth, sand, or lime, and on account of this mixture of foreign matters show low percentages of potash.

11541. Lime-Kiln Ashes. Sent by L. H. Warncke, Cannon Station. Price 12½ cents per bushel and $1.00 per ton freight. Calling 70 pounds the equivalent of a bushel, the cost, delivered, is about $4.63 per ton.

11907. Lime-Kiln Ashes. Made by New England Lime Co., Canaan. Sampled from stock of E. N. Austin, Suffield.

11299. Brick-Kiln Ashes. From Stiles Brick Co., North Haven. Sampled and sent by J. F. Barnard, North Haven.

ANALYSES.

Percentage amounts of	11541	11907	11299
Potash, total	1.95	1.79	2.99
Potash, water-soluble	1.38	1.00	1.47
Lime	31.89	29.17	36.30
Magnesia	15.31	9.35	3.15
Phosphoric acid	0.55	1.06	1.65
Sulphuric acid	0.09	0.09	....
Chlorine	trace	trace	trace
Sand	1.13	3.09	32.97
Charcoal	5.32	3.06	0.56
Cost per ton	$4.63	6.00	....
Lime costs cents per 100 pounds*	.35	.68	....

* Allowing 8 cents and 2 cents per pound respectively for water-soluble potash and phosphoric acid.

ASHES OF BLACK BIRCH BRUSH.

A sample of these ashes, No. **12147**, was sent by Mr. L. J. Platts, of Deep River, who states that they come from the burning of the birch twigs, none of them probably over two inches in diameter at the butt.

The composition of this ash is as follows:—

Potash, total	5.09
Potash, water-soluble	4.61
Lime	37.75
Magnesia	4.68
Phosphoric acid	4.52
Sulphuric acid	0.53
Chlorine	trace
Sand	3.26
Charcoal	0.66

The percentage of potash is about the same as found in commercial "hardwood ashes." The percentages of both lime and phosphoric acid are, however, much higher than in commercial ashes, because twigs contain much higher percentages of these elements than mature wood.

LIME.

There is considerable use made of stone lime and oyster shell lime as an application to tobacco lands. It corrects any sourness of the soil and supplies a necessary element of plant food which is likely to be lacking on tobacco soils, and of which the crop needs a considerable quantity annually. An average crop takes from the soil in stalks and leaves nearly one hundred pounds of lime.

For other lands than these, an occasional dressing of lime, half a ton to a ton per acre, may yield remarkable results, bringing in meadow grasses on fields where they did not thrive before and making them respond to applications of fertilizers where they did not respond before liming.

Four samples of lime have been examined, as follows:—

11713. From the Sherman Lime Co., Glens Falls, N. Y. Sampled and sent by the Bissell, Graves Co., Suffield.

11679. Sold by T. G. Brigham, West Suffield. Sent by the Bissell, Graves Co., Suffield.

11678. Sold by J. F. Merrill, Suffield. Sampled and sent by F. B. Hatheway, Suffield.

12057. Oyster Shell Lime. Made by the H. A. Stevens Coal Co., New Haven. From stock of Latham & Chittenden, Granby.

ANALYSES OF LIME.

Percentage amounts of	11713	11679	11678	12057
Lime	89.56	92.89	49.89	57.90
Magnesia	1.22	0.65	35.59	0.75
Cost per ton	$7.20	11.00	6.00	10.00
Pure lime costs cents per 100 pounds	.40	.59	.60	.86

Nos. **11713** and **11679** are quite pure, containing about 90 per cent. of lime. No. **11678** is evidently made from magnesian limestone, the kind which is principally found in the western part of this state. Only half of it is pure lime. The three samples represent quick lime, which is to be slaked before spreading. No. **12057** is oyster-shell lime, in a fine powder, already slaked and ready to spread.

LAND PLASTER.

12058. Sold by Olds & Whipple, Hartford. Sampled from stock bought by J. A. DuBon, Poquonock. Price $9.00 per ton.

ANALYSIS.

Percentage amounts of	12058
Water	20.27
Sand	4.18
Lime	32.16
Sulphuric acid	43.39
	100.00

This sample contains over 95 per cent. of pure hydrated plaster. The use of plaster as a fertilizer or amendment, formerly quite common in the state, has been almost abandoned; possibly because the extensive use of superphosphates, in which plaster is always present, has made the separate use of plaster of no effect.

REVIEW OF THE FERTILIZER MARKET,

For the Year Ending September 30, 1904.

By E. H. Jenkins.

Nitrogen.

Nitric Nitrogen.

The *wholesale* New York quotation of nitrogen in form of nitrate, which was 13.7 cents per pound in November, 1903, fell to 13.2 in February, 1904, and rose to 14.3 in September, the average quotation for the six months ending with August, 1904, being 13.7 and the quotation for the previous six months being 13.6.

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

Year	1904*	1903	1902	1901	1900	1899	1898	1897
Average quotation, cents per pound for nitrogen, *wholesale*	13.7	13.2	13.4	11.9	11.8	10.5	11.0	11.4

Nitrate nitrogen has been sold to farmers in this state during the past season for from 15.4 to 16.9 cents per pound, or from $48.00 to $53.00 per ton for nitrate of soda.

Ammonic Nitrogen.

The *wholesale* New York quotation of nitrogen in this form was 14.7 cents per pound in November, 1903. The quotation for nitrogen in form of sulphate of ammonia from bone, for future delivery, has been quite steady, ranging from 15.0 to 14.5 cents.

The average monthly quotations for a number of years have been as follows:

Year	1904	1903	1902	1901	1900	1899	1898	1897
Average quotation, cents per pound for nitrogen, *wholesale*	14.4	14.9	14.2	13.3	13.9	14.0	11.9	10.5

Scarcely any sulphate of ammonia is used by farmers for home mixing, as the present price is prohibitive for use as a fertilizer.

* October 1st to October 1st.

Organic Nitrogen.

The *wholesale* New York quotation of nitrogen in low grade blood has been quite steady, ranging from 15.0 to 15.8 cents per pound, the average of the last eleven months being 15.4 cents.

The *wholesale* quotation of nitrogen in dried fish has ranged from 14.6 to 15.3 cents per pound, the average of the last eleven months being 14.4 cents.

The *wholesale* quotation of nitrogen in high grade blood has ranged from 16.2 to 17.7 cents per pound, the average for the last eleven months being 16.9 cents.

The *wholesale* quotation of nitrogen in tankage (9 and 20) has ranged in the last nine months from 15.5 to 16.6 cents per pound, the average being 16.0 cents.

The nitrogen of cotton seed meal at wholesale has cost about 15.5 cents per pound, fully as much as nitrogen in form of blood, and considerably more than the nitrogen of dried fish, which has been the cheapest source of organic nitrogen of approved agricultural form.

At retail in Connecticut the nitrogen of cotton seed meal has cost about 16.5 cents per pound. The retail prices named for dried blood and castor pomace have been too high to admit of their profitable purchase by the farmer, but probably very little of these goods has been bought at retail; bone, tankage, cotton seed meal and nitrates supply most of the nitrogen in home mixures.

Phosphatic Materials.

The nominal quotation of ground Charleston rock has remained the same through the year.

Ground steamed bone, quoted at $22.25 per ton in November, 1903, fell to $21.50 in August last, at which price it is still quoted.

Bone black, which was quoted at $19.25 in November, 1903, fell to $14.50 in May, and has been quoted at that price ever since.

The *wholesale* quotation of acid phosphate has remained the same through the year, at 63¾ per unit, equivalent to 3.19 cents per pound for "available" (soluble and reverted) phosphoric acid.

Potash.

The *wholesale* quotations of potash salts, which are regulated within narrow limits by the German Kali Works, show but little fluctuation. In March the syndicate fixed the prices for the coming year, which in the case of double sulphate of potash and magnesia are the same, and in the case of high grade sulphate and muriate are a shade lower than last year.

Muriate of Potash.

The *wholesale* New York price, as fixed by the syndicate, is 3.65 as against 3.74 cents in 1903.

At retail, in this state, potash as muriate has cost from 4.1 to 4.9 cents per pound.

Double Sulphate of Potash and Magnesia.

The *wholesale* New York price has been the same as in 1903; 4.28 cents per pound for potash, and it has been bought at retail in this state at prices ranging from 4.6 to 5.7 cents per pound.

High Grade Sulphate of Potash.

The *wholesale* New York price of potash in this form has been 4.31 cents per pound as against 4.36 cents in 1903. It has been bought at retail in this state during 1904 at prices ranging from 4.9 to 5.1 cents per pound.

EXPLANATIONS OF MARKET QUOTATIONS.

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

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

Acid phosphate is usually quoted at so much "per unit" of "available"—that is, soluble and reverted—phosphoric acid. The meaning of the term "unit" is explained below. Tankage is sometimes sold with a quotation "per unit of bone phosphate." The amount of bone phosphate may be calculated by multiplying

the amount of phosphoric acid by 2.18. On the other hand, the amount of phosphoric acid is calculated from bone phosphate by multiplying the latter by the decimal 0.459.

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

Blood, azotin and concentrated tankage are quoted at so much "per unit of ammonia." To reduce ammonia to nitrogen, multiply the per cent. of ammonia by the decimal 0.824 (or multiply the per cent. of ammonia by 14 and divide that product by 17). A "unit of ammonia" is one per cent., or 20 pounds per ton. To illustrate: if a lot of tankage has 7.0 per cent. of nitrogen, equivalent to 8.5 per cent. of ammonia, it is said to contain $8\frac{1}{2}$ units of ammonia, and if quoted at $2.25 per unit, a ton of it will cost $8\frac{1}{2} \times 2.25 = \$19.13$.

Tankage and fish scrap are sometimes sold at a price, based on analysis, which regards both the nitrogen and phosphoric acid which the product in question contains.

For example: "Tankage, 9 & 20, quoted at 2.49 and 10 per unit," means that a given lot of tankage contains somewhere in the neighborhood of 9 units of ammonia and 20 units of bone phosphate and is offered at $2.49 per unit of ammonia and 10 cents per unit of bone phosphate.

A unit of ammonia, twenty pounds, is equivalent to $(20 \times 0.824 =)$ 16.5 pounds of nitrogen, and is quoted at $2.49. One pound of nitrogen, therefore, costs $(\frac{2.49}{16.5} =)$ 15.1 cents.

A unit of bone phosphate, twenty pounds, is equivalent to $(20 \times 0.459 =)$ 9.16 pounds of phosphoric acid and is quoted at 10 cents. One pound of phosphoric acid, therefore, costs $(\frac{10}{9.16} =)$ 1.1 cents.

Hence it appears that in a tankage containing 9 per cent. of ammonia and 20 of bone phosphate and quoted at "2.49 and 10 per unit" the nitrogen costs 15.1 cents per pound and the phosphoric acid 1.1 cents per pound.

The cost of such a tankage will be that of 9 units of ammonia at $2.49 per unit, $22.41, plus that of 20 units of bone phosphate at 10 cents per unit, $2.00, or $24.41 per ton.

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

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

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

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

if quoted at	3.3	cents per pound, Nitrogen costs	15.9	cents per lb.
"	3.2	" " "	15.4	"
"	3.1	" " "	14.9	"
"	3.0	" " "	14.4	"
"	2.9	" " "	13.9	"
"	2.8	" " "	13.4	"
"	2.7	" " "	12.9	"
"	2.6	" " "	12.5	"
"	2.5	" " "	12.0	"

Commercial Nitrate of Soda averages 93.7 per cent of pure sodium nitrate, or 15.7 per cent. of nitrogen.

If quoted at	2.5	cents per pound, Nitrogen costs	15.9	cents per lb.
"	2.4	" " "	15.3	"
"	2.3	" " "	14.7	"
"	2.2	" " "	14.0	"
"	2.1	" " "	13.3	"
"	2.0	" " "	12.7	"
"	1.9	" " "	12.1	"
"	1.8	" " "	11.5	"
"	1.7	" " "	10.8	"
"	1.6	" " "	10.2	"
"	1.5	" " "	9.6	"

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

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

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

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

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

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

The following table shows the fluctuations in the wholesale prices of a number of fertilizing materials in the New York market during the last eleven months. The price given for each month is the average of the weekly quotations for that month. Sulphate of ammonia is assumed to contain 20.8 per cent. and nitrate of soda 15.7 per cent. of nitrogen; muriate of potash 50½ per cent., high grade sulphate 49.2 per cent., and double manure salt 26.5 per cent. of actual potash.

As New York quotations of high grade dried blood and tankage are not accessible to us, we have taken the Chicago quotations. Freight from Chicago to New York is at present $5.00 per ton. Red blood contains 14 per cent. or more of nitrogen, so that an addition of 30 cents per unit to Chicago prices will represent fairly the New York cost of this article. This is equivalent to an addition of 1.8 cents per pound of nitrogen.

In case of tankage the difference between New York and Chicago quotations is about 50 cents per unit of ammonia, or 3 cents per pound of nitrogen.

WHOLESALE PRICE OF FERTILIZING MATERIALS.

	Wholesale cost of Nitrogen—Cents per pound, in						Wholesale cost of Potash—Cents per pound, in			Wholesale cost per pound of "available" Phosphoric Acid in acidulated rock phosphate.
	Nitrate of Soda	Sulphate of Ammonia.	Red Blood.*	Black Blood.	Tankage, 9 and 20.†	Dry Fish Scrap.	High Grade Sulphate of Potash.	Low Grade Sulphate of Potash.	Muriate of Potash.	
1903—November	13.7	14.7	17.5	15.0	----	14.9	4.36	4.28	3.74	3.19
December	13.6	15.0	17.7	15.8	----	14.7	4.33	4.28	3.68	3.19
1904—January	13.3	14.9	17.0	15.2	16.2	15.1	4.31	4.28	3.65	3.19
February	13.2	14.9	17.6	15.4	16.6	15.3	4.26	4.19	3.60	3.19
March	13.5	14.9	17.6	15.4	16.6	14.9	4.31	4.28	3.65	3.19
April	13.7	14.8	16.7	15.6	16.0	14.6	4.31	4.28	3.65	3.19
May	13.7	14.6	16.5	15.6	15.5	14.6	4.31	4.28	3.65	3.19
June	13.5	14.5	16.3	15.3	15.5	14.6	4.31	4.28	3.65	3.19
July	13.9	14.6	16.2	15.3	15.5	14.6	4.31	4.28	3.65	3.19
August	14.0	14.5	16.2	15.3	15.8	14.6	4.31	4.28	3.65	3.19
September	14.3	14.6	16.6	15.3	15.8	14.9	4.31	4.28	3.65	3.19

* Chicago quotations plus 1.8 cents per pound of nitrogen. See above.
† " " " 3.0 " " " "

NINTH

REPORT ON FOOD PRODUCTS.

NEW HAVEN, December 15, 1904.

To His Excellency, Abiram Chamberlain, Governor of Connecticut:

As required by law, I herewith respectfully submit to you the Ninth Report of the Connecticut Agricultural Experiment Station on Food Products for the year ending July 31, 1904.

The work which has been done during the year is reported, in the following pages, by Mr. Winton, in charge of the chemical laboratory, and by the assistant chemists.

There are on the statute book a very considerable number of laws forbidding the adulteration of various food products, but the only one which places any responsibility upon this station is included in Sections 2573 to 2578. Under these provisions of the general statutes the station is charged with the duty of collecting and analyzing food products, publishing the results and reporting the adulterated samples to the Dairy Commissioner, to whom is committed the duty of bringing prosecutions.

In the last nine years the station has examined 5,983 samples of 61 different kinds of food; of which 2,052, or a little more than one-third, are, in our opinion, adulterated. The qualification of this last statement is necessary, for until the law has been tested in court it is not possible to know whether certain things, which seem clearly to us to constitute adulteration, will be so regarded by the courts.

Certain staple articles, such as flour, cheese, condensed milk, sugar and tea, we have not found adulterated, though some of them have been found adulterated in other states.

Other food products we find occasionally and still others quite regularly adulterated.

Many forms of this adulteration are quite innocuous as far as health is concerned, though they are of course fraudulent and punishable under the law. Certain other forms are unquestionably dangerous to health.

We note especially the extensive and indiscriminate use of borax, formaldehyde and other preservatives in food. Particularly criminal is the use of preservatives in milk, a practice which is now quite common and increasingly prevalent, as well as the more common practices of watering and skimming.

The watering, skimming and "preserving" of milk are, without doubt, at present the cause of much sickness and death among infants.

For some years the examination of food products and publication of the results in these reports, along with the publicity given to them in the course of business competition, seemed to have a deterrent effect on makers of adulterated or misbranded articles, but this effect has now, apparently, ceased to follow.

Ample opportunity having been given dealers to inform themselves of the quality of the different brands of food products sold in the state, it is now proposed to prosecute in cases where there is wilful violation of the law.

In the Fifth Report, for 1900, I called attention to certain apparent defects in the law which, in my opinion, should be remedied, and as soon as prosecutions are begun no doubt other things will develop requiring amendment in order to make the law effective.

Very respectfully,

E. H. JENKINS, *Director*.

STANDARDS OF PURITY FOR FOOD PRODUCTS.

Section 2575 of the General Statutes of Connecticut provides that this station "may fix standards of purity, quality or strength, when such standards are not specified by law."

The station adopts and fixes, so far as its authority extends, the following standards of purity, quality and strength, with the related definitions. These standards have been already adopted by the Secretary of Agriculture of the United States, acting under authority conferred by act of Congress, approved June 3, 1902, and are the official standards of these food products for the United States of America.

PRINCIPLES ON WHICH THE STANDARDS ARE BASED.

1. The standards are expressed in the form of definitions, with or without accompanying specifications of limit in composition.

2. The main classes of food articles are defined before the subordinate classes are considered.

3. The definitions are so framed as to exclude from the articles defined substances not included in the definitions.

4. The definitions include, where possible, those qualities which make the articles described wholesome for human food.

5. A term defined in the schedules has the same meaning wherever else it is used in any of the schedules.

6. The names of food products herein defined usually agree with existing American trade or manufacturing usage, but where such usage is not clearly established or where trade names confuse two or more articles for which specific designations are desirable, preference is given to one of the several trade names applied.

7. Standards are based upon data representing materials produced under American conditions and manufactured by American processes or representing such varieties of foreign articles as are chiefly imported for American use.

8. The standards fixed are such that a departure of the articles to which they apply, above the maximum or below the minimum limit prescribed, is evidence that such articles are of inferior or abnormal quality.

9. The limits fixed as standards are not necessarily the extremes authentically recorded for the article in question, because such extremes are commonly due to abnormal conditions of production and are usually accompanied by marks of inferiority or abnormality readily perceived by the producer or manufacturer.

STANDARDS OF PURITY FOR FOOD PRODUCTS.

I. ANIMAL PRODUCTS.

A. Meats and the Principal Meat Products.

a. meats.

1. *Meat* is any sound, dressed, and properly prepared edible part of animals in good health at the time of slaughter. The term "animals," as herein used, includes not only mammals, but fish, fowl, crustaceans, mollusks, and all other animals used as food.

2. *Fresh meat* is meat from animals recently slaughtered or preserved only by refrigeration.

3. *Salted, pickled,* and *smoked meats* are unmixed meats preserved by salt, sugar, vinegar, spices, or smoke, singly or in combination, whether in bulk or in packages.

b. manufactured meats.

1. *Manufactured meats* are meats not included in paragraphs 2 and 3, whether simple or mixed, whole or comminuted, in bulk or packages, with or without the addition of salt, sugar, vinegar, spices, smoke, oils, or rendered fat. If they bear names descriptive of composition they correspond thereto and when bearing such descriptive names, if force or flavoring meats are used, the kind and quantity thereof are made known.

c. meat extracts, meat peptones, etc.

(Schedule in preparation.)

d. lard.

1. *Lard* is the rendered fresh fat from slaughtered, healthy hogs, free from rancidity and contains not more than one (1) per cent. of substances, other than fatty acids, not fat, necessarily incorporated therewith in the process of rendering.

2. *Leaf lard* is the lard rendered at moderately high temperatures from the internal fat of the abdomen of the hog, excluding that adherent to the intestines, and has an iodine number not greater than sixty (60).

3. *Neutral lard* is lard rendered at low temperatures.

B. Milk and its Products.

a. milks.

1. *Milk (whole milk)* is the lacteal secretion obtained by the complete milking of one or more healthy cows, properly fed and kept, excluding that obtained within fifteen days before and five days after calving and contains not less than twelve (12) per cent. of total solids, not less than eight and one-half (8.5) per cent. of solids not fat, and not less than three and one-quarter (3.25) per cent. of milk fat.

2. *Blended milk* is milk modified in its composition so as to have a definite and stated percentage of one or more of its constituents.

3. *Skim milk* is milk from which a part or all of the cream has been removed and contains not less than nine and one-quarter (9.25) per cent. of milk solids.

4. *Buttermilk* is the product that remains when butter is removed from milk or cream in the process of churning.

5. *Pasteurized milk* is milk that has been heated below boiling, but sufficiently to kill most of the active organisms present and immediately cooled to fifty degrees (50°) Fahr. or lower to retard the development of their spores.

6. *Sterilized milk* is milk that has been heated at the temperature of boiling water or higher for a length of time sufficient to kill all organisms present.

7. *Condensed milk* is milk from which a considerable portion of water has been evaporated and contains not less than twenty-eight (28) per cent. of milk solids, of which not less than one-fourth is milk fat.

8. *Sweetened condensed milk* is milk from which a considerable portion of water has been evaporated and to which sugar (sucrose) has been added and contains not less than twenty-eight (28) per cent. of milk solids, of which not less than one-fourth is milk fat.

9. *Condensed skim milk* is skim milk from which a considerable portion of water has been evaporated.

b. milk fat or butter fat.

1. *Milk fat or butter fat* is the fat of milk and has a Reichert-Meissl number not less than twenty-four (24) and a specific gravity not less than 0.905 (40° C. /40° C.).

c. cream.

1. *Cream* is that portion of milk, rich in butter fat, which rises to the surface of milk on standing, or is separated from it by centrifugal force and contains not less than eighteen (18) per cent. of milk fat.

2. *Evaporated cream* is cream from which a considerable portion of water has been evaporated.

d. butter.

1. *Butter* is the product made by gathering in any manner the fat of fresh or ripened milk or cream into a mass, which also contains a small portion of the other milk constituents, with or without salt, and contains not less than eighty-two and five-tenths (82.5) per cent. of butter fat. By acts of Congress approved August 2, 1886, and May 9, 1902, butter may also contain additional coloring matter.

2. *Renovated or process butter* is the product made by melting butter and reworking, without the addition or use of chemicals or any substances except milk, cream or salt, and contains not more than sixteen (16) per cent. of water and at least eighty-two and five-tenths (82.5) per cent. of butter fat.

e. CHEESE.

1. *Cheese* is the solid and ripened product made by coagulating the casein of milk by means of rennet or acids, with or without the addition of ripening ferments and seasoning. By act of Congress, approved June 6, 1896, cheese may also contain additional coloring matter.

2. *Whole milk or full cream cheese* is cheese made from milk from which no portion of the fat has been removed, and contains, in the water-free substance, not less than fifty (50) per cent. of butter fat.

3. *Skim-milk cheese* is cheese made from milk from which any portion of the fat has been removed.

4. *Cream cheese* is cheese made from milk and cream, or milk containing not less than six (6) per cent. of fat.

f. MISCELLANEOUS MILK PRODUCTS.

1. *Ice cream* (Schedule in preparation).

2. *Whey* is the product remaining after the removal of fat and casein from milk in the process of cheese-making.

3. *Kumiss* is the product made by the alcoholic fermentation of mare's or cow's milk with or without the addition of sugar (sucrose).

II. VEGETABLE PRODUCTS.

A. Grain Products.

a. GRAINS AND MEALS.

1. *Grain* is the fully matured, clean, sound, air-dry seed of wheat, maize, rice, oats, rye, buckwheat, barley, sorghum, millet or spelt.

2. *Meal* is the sound product made by grinding grain.

3. *Flour* is the fine, sound product made by bolting wheat meal, and contains not more than thirteen and one-half (13.5) per cent. of moisture, not less than one and twenty-five one-hundredths (1.25) per cent. of nitrogen, not more than one (1.0) per cent. of ash and not more than fifty one-hundredths (0.50) per cent. of fiber.

4. *Graham flour* is unbolted wheat meal.

5. *"Whole wheat flour," "entire wheat flour,"* improperly so-called, is fine wheat meal from which a part of the bran has been removed.

6. *Gluten flour* is the product made from flour by the removal of starch, and contains not less than five and six-tenths (5.6) per cent. of nitrogen and not more than ten (10) per cent. of moisture.

7. *Maize meal, corn meal or Indian corn meal* is meal made from sound maize grain, and contains not more than fourteen (14) per cent. of moisture, not less than one and twelve one-hundredths (1.12) per-cent. of nitrogen and not more than one and six-tenths (1.6) per cent. of ash.

8. *Rice* is the hulled and polished grain of *Oryza sativa.*

9. *Oatmeal* is meal made from hulled oats, and contains not more than eight (8) per cent. of moisture, not more than one and five-tenths (1.5) per cent. of crude fiber, not less than two and twenty-four

hundredths (2.24) per cent. of nitrogen and not more than two and two-tenths (2.2) per cent. of ash.

10. *Rye flour* is the fine, sound product made by bolting rye meal, and contains not more than thirteen and one-half (13.5) per cent. of moisture, not less than one and thirty-six one-hundredths (1.36) per cent. of nitrogen, and not more than one and twenty-five hundredths (1.25) per cent. of ash.

11. *Buckwheat flour* is bolted buckwheat meal, and contains not more than twelve (12) per cent. of moisture, not less than one and twenty-eight one-hundredths (1.28) per cent. of nitrogen and not more than one and seventy-five one-hundredths (1.75) per cent. of ash.

B. Fruits and Vegetables.

(Schedule in preparation.)

C. Sugars and Related Substances.

a. SUGAR AND SUGAR PRODUCTS.

Sugars.

1. *Sugar* is the product chemically known as sucrose (saccharose) chiefly obtained from sugar cane, sugar beets, sorghum, maple, or palm.

2. *Granulated, loaf, cut, milled, and powdered sugars* are different forms of sugar, and contain at least ninety-nine and five-tenths (99.5) per cent. of sucrose.

3. *Maple sugar* is the solid product resulting from the evaporation of maple sap.

4. *Massecuite, melada, mush sugar,* and *concrete* are products made by evaporating the purified juice of a sugar-producing plant, or a solution of sugar, to a solid or semi-solid consistence in which the sugar chiefly exists in a crystalline state.

Molasses and Refiners' Sirup.

1. *Molasses* is the product left after separating the sugar from massecuite, melada, mush sugar, or concrete, and contains not more than twenty-five (25) per cent. of water and not more than five (5) per cent. of ash.

2. *Refiners' sirup ("treacle")* is the residual liquid product obtained in the process of refining raw sugars, and contains not more than twenty-five (25) per cent. of water and not more than eight (8) per cent. of ash.

Sirups.

1. *Sirup* is the product made by purifying and evaporating the juice of a sugar-producing plant without removing any of the sugar, and contains not more than thirty (30) per cent. of water and not more than two and five-tenths (2.5) per cent. of ash.

2. *Sugar-cane sirup* is sirup made by the evaporation of the juice of the sugar cane or by the solution of sugar-cane concrete.

3. *Sorghum sirup* is sirup made by the evaporation of sorghum juice or by the solution of sorghum concrete.

4. *Maple sirup* is sirup made by the evaporation of maple sap or by the solution of maple concrete.

5. *Sugar sirup* is sirup made by dissolving sugar to the consistence of a sirup.

b. GLUCOSE PRODUCTS.

1. *Starch sugar* is the solid product made by hydrolyzing starch or a starch-containing substance until the greater part of the starch is converted into dextrose. Starch sugar appears in commerce in two forms, anhydrous and hydrous. The former, crystallized without water of crystallization, contains not less than ninety-five (95) per cent. of dextrose and not more than eight-tenths (0.8) per cent. of ash. The latter, crystallized with water of crystallization, is of two varieties. 70 sugar, also known as brewers' sugar, contains not less than seventy (70) per cent. of dextrose and not more than eight-tenths (0.8) per cent. of ash. 80 sugar, climax or acme sugar, contains not less than eighty (80) per cent. of dextrose and not more than one and one-half (1.5) per cent. of ash.

The ash of all these products consists almost entirely of chlorids and sulphates.

2. *Glucose, mixing glucose, or confectioners' glucose* is a thick sirupy colorless product made by incompletely hydrolizing starch or a starch-containing substance, decolorizing and evaporating the product. It varies in density from forty-one (41) to forty-five (45) degrees Baumé, at a temperature of one hundred (100) degrees F. (37.7° C.), and conforms in density, within these limits, to the degree Baumé it is claimed to show, and for a density of forty-one (41) degrees Baumé contains not more than twenty-one (21) per cent and for a density of forty-five (45) degrees not more than fourteen (14) per cent. of water. It contains on a basis of forty-one (41) degrees Baumé not more than one (1) per cent. of ash, consisting chiefly of chlorids and sulphates.

3. *Glucose sirup* or *corn sirup* is glucose unmixed or mixed with sirup, molasses or refiners' sirup, and contains not more than twenty-five (25) per cent. of water and not more than three (3) per cent of ash.

c. CANDY.

1. *Candy* is a product made from a saccharine substance or substances, with or without the addition of harmless coloring, flavoring, or filling materials, and contains no terra alba, barytes, talc, chrome yellow, or other mineral substances or poisonous colors or flavors or other ingredients injurious to health.

d. HONEY.

1. *Honey* is the nectar and saccharine exudations of plants gathered, modified and stored in the comb by honey bees (*Apis mellifica*). It is laevo-rotatory, contains not more than twenty-five (25) per cent. of water, not more than twenty-five one-hundredths (0.25) per cent. of ash and not more than eight (8) per cent. of sucrose.

2. *Comb honey* is honey contained in the cells of the comb.

3. *Extracted honey* is honey which has been separated from the uncrushed comb by centrifugal force or gravity.

4. *Strained honey* is honey removed from the crushed comb by straining or other means.

D. CONDIMENTS (EXCEPT VINEGAR).

a. SPICES.

1. *Spices* are aromatic vegetable substances used for the seasoning of food and from which no portion of any volatile oil or other flavoring principle has been removed and which are sound and true to name.

2. *Allspice or pimento* is the dried fruit of *Pimento officinalis* Lindl., and contains not less than eight (8) per cent. of quercitannic acid;* not more than six (6) per cent. of total ash; not more than five-tenths (0.5) per cent. of ash insoluble in hydrochloric acid, and not more than twenty-five (25) per cent. of crude fiber.

3. *Anise* is the fruit of *Pimpinella anisum* L.

4. *Bay leaf* is the dried leaf of *Laurus nobilis* L.

5. *Capers* are the flower buds of *Capparis spinosa* L.

6. *Caraway* is the fruit of *Carum carvi* L.

CAYENNE AND RED PEPPERS.

7. *Red pepper* is the red, dried, ripe fruit of any species of *Capsicum*.

8. *Cayenne pepper or cayenne* is the dried, ripe fruit of *Capsicum fastigiatum* DC., *Capsicum frutescens* L., *Capsicum baccatum* L., or some other small-fruited species of *Capsicum*, and contains not less than fifteen (15) per cent. of non-volatile ether extract; not more than six and five-tenths (6.5) per cent. of total ash; not more than five-tenths (0.5) per cent. of ash insoluble in hydrochloric acid; not more than one and five-tenths (1.5) per cent. of starch, and not more than twenty-eight (28) per cent. of crude fiber.

9. *Celery seed* is the dried seed of *Apium graveolens* L.

10. *Cinnamon* is the dried bark of any species of the genus *Cinnamomum* from which the outer layers may or may not have been removed.

11. *True cinnamon* is the dried inner bark of *Cinnamomum zeylanicum* Breyne.

12. *Cassia* is the dried bark of various species of *Cinnamomum*, other than *Cinnamomum zeylanicum*, from which the outer layers may or may not have been removed.

13. *Cassia buds* are the dried immature fruit of species of *Cinnamomum*.

14. *Ground cinnamon or ground cassia* is a powder consisting of cinnamon, cassia or cassia buds, or a mixture of these spices, and con-

*Calculated from the total oxygen absorbed by the aqueous extract.

tains not more than eight (8) per cent of total ash and not more than two (2) per cent. of sand.

15. *Cloves* are the dried flower buds of *Eugenia caryophyllata,* Thunb. (*Caryophyllus aromaticus* L.), which contain not more than five (5) per cent. of clove stems; not less than ten (10) per cent. of volatile ether extract; not less than twelve (12) per cent. of quercitannic acid;* not more than eight (8) per cent. of total ash; not more than five-tenths (0.5) per cent. of ash insoluble in hydrochloric acid, and not more than ten (10) per cent. of crude fiber.

16. *Coriander* is the dried fruit of *Coriandrum sativum* L.

17. *Cumin seed* is the fruit of *Cuminum cyminum* L.

18. *Dill seed* is the fruit of *Peucedanum graveolens* Benth. & Hook.

19. *Fennell* is the fruit of *Fœniculum vulgare* Gaertn.

20. *Ginger* is the washed and dried, or decorticated and dried, rhizome of *Zingiber officinale* Roscoe, and contains not less than forty-two (42) per cent. of starch, not more than eight (8) per cent. of crude fiber, not more than eight (8) per cent. of total ash, not more than one (1) per cent. of lime and not more than three (3) per cent. of ash insoluble in hydrochloric acid.

21. *Limed or bleached ginger* is whole ginger coated with carbonate of lime and contains not more than ten (10) per cent. of ash, not more than four (4) per cent. of carbonate of lime, and conforms in other respects to the standard for ginger.

22. *Horse-radish* is the root of *Cochlearia armoracia* L., either by itself or ground and mixed with vinegar.

23. *Mace* is the dried arillus of *Myristica fragrans* Houttuyn, and contains not less than twenty (20) nor more than thirty (30) per cent. of non-volatile ether extract, not more than three (3) per cent. of total ash, not more than five-tenths (0.5) per cent. of ash insoluble in hydrochloric acid, and not more than ten (10) per cent. of crude fiber.

24. *Macassar or Papua mace* is the dried arillus of *Myristica argentea* Warb.

25. *Bombay mace* is the dried arillus of *Myristica malabarica* Lamarck.

26. *Marjoram* is a mixture of the leaves, flowers, and branches of *Origanum majorana* L.

27. *Mustard seed* is the seed of *Sinapis alba* L. (white mustard), *Brassica nigri* Koch (black mustard), or *Brassica juncea* Coss. (black or brown mustard).

28. *Ground mustard* is a powder made from mustard seed, with or without the removal of the hulls and a portion of the fixed oil, and contains not more than two and five-tenths (2.5) per cent. of starch and not more than eight (8) per cent. of total ash.

29. *Nutmeg* is the dried seed of *Myristica fragrans* Houttuyn, deprived of its testa, with or without a thin coating of lime, and contains not less than twenty-five (25) per cent. of non-volatile ether extract, not more than five (5) per cent. of total ash, not more than five-tenths (0.5) per cent. of ash insoluble in hydrochloric acid, and not more than ten (10) per cent. of crude fiber.

*Calculated from total oxygen absorbed by the aqueous extract.

30. *Macassar, Papua, male, or long nutmeg* is the dried seed of *Myristica argentea* Warb. deprived of its testa.

31. *Paprica* is the dried ripe fruit of *Capsicum annuum* L., *Capsicum longum* DC., or some other large-fruited species of *Capsicum.*

PEPPER.

32. *Black pepper* is the dried immature berry of *Piper nigrum* L., and contains not less than six (6) per cent. of non-volatile ether extract, not less than twenty-five (25) per cent. of starch, not more than seven (7) per cent. of total ash, not more than two (2) per cent. of ash insoluble in hydrochloric acid, and not more than fifteen (15) per cent. of crude fiber. One hundred parts of the non-volatile ether extract contain not less than three and one-quarter (3.25) parts of nitrogen.

Ground black berry is the product made by grinding the entire berry, and contains the several parts of the berry in their normal proportions.

33. *Long pepper* is the dried fruit of *Piper longum* L.

34. *White pepper* is the dried mature berry of *Piper nigrum* L., from which the outer coating, or the outer and inner coatings, have been removed and contains not less than six (6) per cent. of non-volatile ether extract, not less than fifty (50) per cent. of starch, not more than four (4) per cent. of total ash, not more than five-tenths (0.5) per cent. of ash insoluble in hydrochloric acid, and not more than five (5) per cent. of crude fiber. One hundred parts of the non-volatile ether extract contain not less than four (4) parts of nitrogen.

35. *Saffron* is the dried stigma of *Crocus sativus* L.

36. *Sage* is the leaf of *Salvia officinalis* L.

37. *Savory,* or *summer savory* is a mixture of the leaves, blossoms and branches of *Satureia hortensis* L.

38. *Thyme* is a mixture of the leaves and ends of blooming branches of *Thymus vulgaris* L.

b. FLAVORING EXTRACTS.

(Schedule in preparation.)

c. EDIBLE VEGETABLE OILS.

(Schedule in preparation.)

d. SALT.

(Schedule in preparation.)

E. BEVERAGES (AND VINEGAR).

a. TEA.

(Schedule in preparation.)

b. COFFEE.

(Schedule in preparation.)

c. COCOA AND COCOA PRODUCTS.

1. *Cocoa beans* are the seeds of the cacao tree, *Theobroma cacao* L.

2. *Cocoa nibs*, or *cracked cocoa*, is the roasted, broken cocoa bean freed from its shell or husk.

3. *Chocolate, plain or bitter, chocolate liquor*, is the solid or plastic mass obtained by grinding cocoa nibs without the removal of fat or other constituents except the germ, and contains not more than three (3) per cent. of ash insoluble in water, three and fifty one-hundredths (3.50) per cent. of crude fiber and nine (9) per cent. of starch and not less than forty-five (45) per cent. of cocoa fat.

4. *Sweet chocolate* and *chocolate coatings* are plain chocolate mixed with sugar (sucrose), with or without the addition of cocoa butter, spices, or other flavoring materials, and contain in the sugar- and fat-free residue no higher percentage of either ash, fiber, or starch than is found in the sugar- and fat-free residue of plain chocolate.

5. *Cocoa or powdered cocoa* is cocoa nibs, with or without the germ, deprived of a portion of its fat and finely pulverized, and contains percentages of ash, crude fiber, and starch corresponding to those in chocolate after correction for fat removed.

6. *Sweet or sweetened cocoa* is cocoa mixed with sugar (sucrose), and contains not more than sixty (60) per cent. of sugar (sucrose) and in the sugar- and fat-free residue no higher percentage of either ash, crude fiber or starch than is found in the sugar- and fat-free residue of plain chocolate.

d. FRUIT JUICES—FRESH, SWEET AND FERMENTED.

I. FRESH AND 2. SWEET.

(Schedules in preparation.)

3. FERMENTED FRUIT JUICES.

1. *Wine* is the product made by the normal alcoholic fermentation of the juice of sound ripe grapes, and the usual cellar treatment,* and contains not less than seven (7) nor more than sixteen (16) per cent. of alcohol, by volume, and, in one hundred (100) cubic centimeters, not more than one-tenth (0.1) gram of sodium chloride nor more than two-tenths (0.2) gram of potassium sulphate; and for red wine not more than fourteen one-hundredths (0.14) gram and for white wine not more than twelve one-hundredths (0.12) gram of volatile acids derived from fermentation and calculated as acetic acid. *Red wine* is wine containing the red coloring matter of the skins of grapes. *White wine* is wine made from white grapes or the expressed fresh juice of other grapes.

2. *Dry wine* is wine in which the fermentation of the sugars is practically complete and which contains in one hundred (100) cubic centimeters less than one (1) gram of sugars and for *dry red wine* not less than sixteen one-hundredths (0.16) gram of grape ash and not less than one and six-tenths (1.6) gram of grape solids, and for *dry white wine* not less than thirteen one-hundredths (0.13) gram of grape ash and not less than one and four-tenths (1.4) gram of grape solids.

*The subject of sulphurous acid in wine is reserved for consideration in connection with the schedule preservatives and coloring matters.

3. *Fortified dry wine* is dry wine to which brandy has been added, but which conforms in all other particulars to the standard of dry wine.

4. *Sweet wine* is wine in which the alcoholic fermentation has been arrested, and which contains in one hundred (100) cubic centimeters not less than one (1) gram of sugars, and for sweet red wine not less than sixteen one-hundredths (0.16) gram of grape ash, and for sweet white wine not less than thirteen one-hundredths (0.13) gram of grape ash.

5. *Fortified sweet wine* is sweet wine to which wine spirits have been added.

By act of Congress, "sweet wine" used for making fortified sweet wine and "wine spirits" used for such fortification are defined as follows:

Section 43. Act of October 1, 1890 (26 Stat. 567), as amended by section 68, Act of August 28, 1894 (28 Stat. 509). "That the wine spirits mentioned in section 42 of this act is the product resulting from the distillation of fermented grape juice and shall be held to include the product commonly known as grape brandy; and the pure sweet wine which may be fortified free of tax, as provided in said section, is fermented grape juice only, and shall contain no other substance of any kind whatever introduced before, at the time of, or after fermentation, and such sweet wine shall contain not less than four per centum of saccharine matter, which saccharine strength may be determined by testing with Balling's saccharometer or must scale, such sweet wine, after the evaporation of the spirit contained therein, and restoring the sample tested to original volume by addition of water: *Provided*, That the addition of pure boiled or condensed grape must, or pure crystallized cane or beet sugar to the pure grape juice aforesaid, or the fermented product of such grape juice prior to the fortification provided for by this Act for the sole purpose of perfecting sweet wines according to commercial standard, shall not be excluded by the definition of pure, sweet wine aforesaid: *Provided further*, That the cane or beet sugar so used shall not be in excess of ten per cent. of the weight of wines to be fortified under this Act."

6. *Sparkling wine* is wine in which the after part of the fermentation is completed in the bottle, the sediment being disgorged and its place supplied by wine or sugar liquor, and which contains, in one hundred (100) cubic centimeters, not less than twelve one-hundredths (0.12) gram of grape ash.

7. *Sugar wine* is the product made by the addition of sugar to the juice of sound ripe grapes and subsequent alcoholic fermentation with the usual cellar treatment.

8. *Raisin wine* is the product made by the alcoholic fermentation of an infusion of dried or evaporated grapes, or of a mixture of such infusion or raisins with grape juice.

e. VINEGAR.

1. *Vinegar, cider vinegar, apple vinegar* is the product made by the alcoholic and subsequent acetous fermentations of the juice of apples, is laevo-rotatory and contains not less than four (4) grams of acetic acid, not less than one and six-tenths (1.6) grams of apple solids and not less than twenty-five one-hundredths (0.25) gram of apple ash in one hundred (100) cubic centimeters. The water-soluble ash from one hundred cubic centimeters of the vinegar requires not less than thirty (30) cubic centimeters of decinormal acid to neutralize the acidity and contains not less than ten (10) milligrams of phosphoric acid (P_2O_5).

2. *Wine vinegar, grape vinegar,* is the product made by the alcoholic and subsequent acetous fermentations of the juice of grapes and contains, in one hundred (100) cubic centimeters, not less than four (4) grams of acetic acid, not less than one and four-tenths (1.4) grams of grape solids and not less than thirteen one-hundredths (0.13) gram of grape ash.

3. *Malt vinegar* is the product made by the alcoholic and subsequent acetous fermentations, without distillation, of an infusion of barley malt, or cereals whose starch has been converted by malt, and is dextro-rotatory and contains in one hundred (100) cubic centimeters not less than four (4) grams of acetic acid, not less than two (2) grams of solids and not less than two-tenths (0.2) gram of ash.

The water-soluble ash from one hundred (100) cubic centimeters of the vinegar requires not less than four (4) cubic centimeters of decinormal acid to neutralize its alkalinity and contains not less than nine (9) milligrams of phosphoric acid (P_2O_5).

4. *Sugar vinegar* is the product made by the alcoholic and subsequent acetous fermentations of solutions of a sugar, syrup, molasses, or refiners' syrup, and contains in one hundred (100) cubic centimeters, not less than four (4) grams of acetic acid.

5. *Glucose vinegar* is the product made by the alcoholic and subsequent acetous fermentations of solutions of starch, sugar, glucose, or glucose syrup, is dextro-rotatory and contains in one hundred (100) cubic centimeters not less than four (4) grams of acetic acid.

6. *Spirit vinegar, distilled vinegar, grain vinegar,* is the product made by the acetous fermentation of dilute distilled alcohol and contains in one hundred (100) cubic centimeters not less than four (4) grams of acetic acid.

f. MEAD, ROOT BEER, ETC.

(Schedule in preparation.)

g. MALT LIQUORS.

(Schedule in preparation.)

h. SPIRITUOUS LIQUORS.

(Schedule in preparation.)

i. CARBONATED WATERS, ETC.

(Schedule in preparation.)

III. PRESERVATIVES AND COLORING MATTERS.

(Schedule in preparation.)

EXAMINATION OF FOOD PRODUCTS SOLD IN CONNECTICUT.

By A. L. Winton, E. M. Bailey, A. W. Ogden and Kate G. Barber.

MILK.

Milk bought of Milkmen by the Station.

Analyses on pages 125 to 131.

During the months of July and August of the present year, 316 samples were collected and examined, the plan of the investigation being essentially the same as was followed in 1900, 1901, and 1902.

Collection of Samples.

The agent was provided with a bicycle, carrying in the frame a case containing 18 cans for samples. This case is similar in construction to those used by bicycle tourists for carrying traveling necessities, but is divided into compartments for the cans, and the whole of one side opens so that any one of the cans can be removed without disturbing the others.

The cans are of tin, 2¼ inches square and 3¼ inches high, not including the screw cap. Filled to the brim, they have a capacity of 280 cc., or a little more than half a pint. The screw cap is 1½ inches in diameter, thus allowing easy access to the interior for washing, and is lined with a disk of thick paraffined paper, insuring a water-tight joint. They were made to order, but cans like these, except that the caps are of smaller diameter, are kept in stock by The American Can Co., Brooklyn, N. Y. The general appearance of the bicycle and its attachment, as well as the arrangement of the sampling cans, is shown in Plate I, facing page 120.

The sampling agent, between the hours of four and seven A. M., rode from street to street and bought a pint of milk of each milkman whom he met, without making known the object of his errand. He also noted the name of the milkman or his dairy as given on the wagon, or if not thus given he asked the driver for the name of the man who carried on the business.

The agent thoroughly mixed the sample of milk and filled one of the tin cans with it. He also filled out a numbered blank describing the sample and attached a duplicate number to the can.

The samples thus collected were brought as soon as possible to the station laboratory, where they were examined.

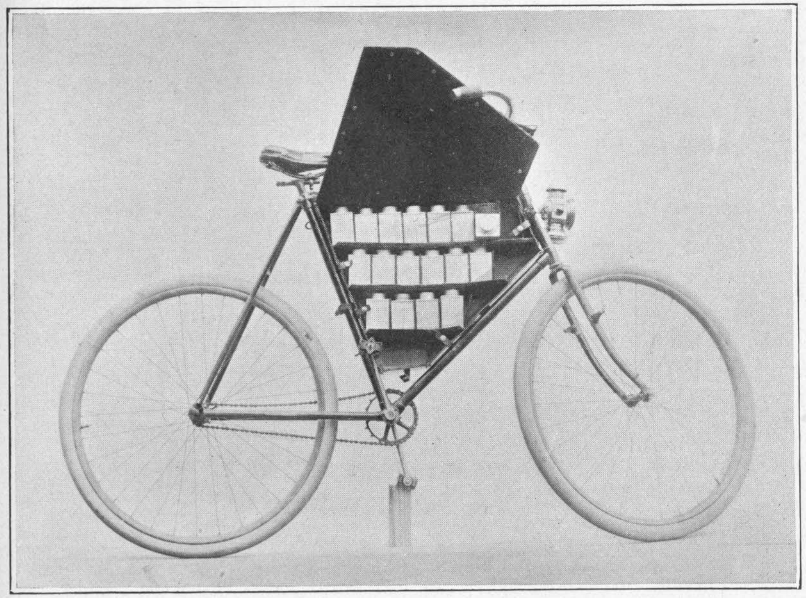
Examination of Samples.

Determinations of specific gravity, fat and total solids, and tests for preservatives and colors were made in each sample immediately after its arrival. A summary of the results obtained will be found in Table I; the names of the dealers and the analyses in Table II. The name which was on the milk cart was copied, but where no name appeared it was obtained from the driver. All names obtained in this latter way are marked with asterisks. The table also gives the specific gravity of the milk at 60° F., the first two figures, which are the same in all cases, being omitted. Thus 25.3 signifies a specific gravity of 1.0253. Next follow the percentages of fat and total solids. Percentages of solids below 12.0, of solids not fat below 8.5 and of fat below 3.25 are given in full-faced type.

These figures for solids, solids not fat, and fat are the standards of milk adopted by the Association of Official Agricultural Chemists, by the U. S. Secretary of Agriculture and by this Station, as provided in Section 2575 of the General Statutes. Lastly, the table shows which of the samples were preserved with borax or formaldehyde, and which were colored with anatto or a coal-tar dye.

The price paid in nearly every case was 3 cents per pint.

Skimmed and Watered Milk. Percentages printed in full-faced type indicate that the samples are of inferior quality in those respects, but not necessarily that they have been adulterated. It is well known that genuine milk has a very wide range of composition, caused by differences of breed, feed, period of lactation and many other things, and it is also true that milk which has not been skimmed or watered is sometimes so poor as to be unfit for sale as whole milk. Laws regulating the sale of milk should be so devised as to exclude the sale of milk, as of standard quality, which is very inferior in its food value, even if it has not been adulterated.



Bicycle with case for use in collecting samples of milk.

Again it should be noted that the pint samples were taken from milk cans by the milkmen and not by our agent. Milkmen do not always mix the contents of their cans before dipping and the result of this carelessness is that some customers get more than their share of cream, while others get an inferior milk. The results given in the table represent the exact quality of the samples and not necessarily that of the whole contents of the milk can. They also represent what a customer, who paid the price of whole milk, received for his money.

Whole milk generally has a specific gravity at 60° F. between 1.029 and 1.033. Exceptionally rich milk with a high percentage of fat, however, may have a specific gravity lower than 1.029, and by that test alone would be unjustly condemned. Addition of water to milk lowers and skimming raises the specific gravity. Low percentages of fat, solids not fat and total solids and low specific gravity indicate that the milk has been watered, but when a deficiency of fat and total solids is associated with a normal percentage of solids not fat and a high specific gravity, the milk has probably been skimmed. Samples which have been both skimmed and watered and which are very deficient in fat and solids may have a normal specific gravity, as the two operations have opposite effects on this physical property of milk.

There are then two reasons why a sample should not be judged by its specific gravity alone; first, exceptionally rich milk might be condemned, and, second, milk which has been both skimmed and watered might pass as genuine. Taken in connection with the results of chemical analysis, the determination of specific gravity is, however, of great value.

Preservatives. The addition of borax or formaldehyde to milk is a serious menace to the health of consumers, particularly infants and invalids, and can not be too strongly condemned. This form of adulteration is dangerous not only because of the physiological action of the chemicals themselves, but because their use becomes a substitute for the cleanliness and sanitary precautions which are so essential to the healthfulness of the product.

Artificial Coloring Matter. In the Report of the Massachusetts Board of Health for some years past Leach has called attention to the coloring of milk with anatto, coal-tar dyes and caramel, and during the past few years we have detected anatto and coal-tar dyes in milk sold in Connecticut. These colors give to "blue" milk, whether skimmed or of naturally inferior quality, a yellow tint resembling that of rich milk, thus producing directly the opposite effect of indigo or other blue colors which are used in the laundry to destroy the yellowish tinge in linen or cotton. Anatto, a well-known vegetable product, has for years served as a butter color. The coal-tar dye commonly used in milk is soluble in water, thus differing from the related dye used as a butter color, which is insoluble in water but soluble in oil. There are in market proprietary

The General Quality of the Milk Supply in July and August, 1904.

The following samples, drawn by our Sampling Agent, are unquestionably adulterated:

Station No.	Location.	Dealer.	Remarks.
12436	Ansonia	George Bergen*	Contains borax.
12510	"	G. Lagella*	Watered.
12170	Bridgeport	G. A. Barhite	"
12541		E. L. Hoyt, Long Hill	
12175	"	H. W. Parks, Trumbull	Contains formaldehyde.
12538	"	" "	" "
12218	"	S. Thorpe, Hillside Farm	Watered, dyed, contains formaldehyde.
12341	Hartford	E. J. McNamara, No. 193	Skimmed.
12412	Middletown	H. E. Merrill, Cromwell	Contains borax.
11424	New Haven	J. D. Bremner, Westville	Watered.
11415	"	F. J. Buck, 44 Judson Ave.	"
12359	"		"
12169	"	Clover Dairy Creamery	"
11414	"	" "	"
12275	"	W. H. Davis, 9 Audubon Place	Dyed with anatto.
11421	"	E. W. Klebe, North Haven	Watered.
11420	"	S. Lancel, No. 19	"
12277	"	E. F. Loveland	"
12356	"	G. B. Mix, 27 Munson St.	Dyed with anatto.
11417	"	R. N. Noble, 1500 Quinnipiac Ave.	" "
12370	"	" "	" "
12276	"	S. H. Rice, 58 Lombard St.	Skimmed, dyed with aniline orange, contains formaldehyde.
12368	"	John Shepard, Woodbridge*	Dyed with anatto.
12381	New London	Ocean View Farm	Skimmed.
12268	Norwalk	David Jenks*	Watered skim-milk.
12192	Stamford	Robt. Tryon	Contains formaldehyde.
12190	"	J. F. Wynn	Watered.
12251	Waterbury	H. B. Russell, Oakville	"

*Statement of Driver.

articles containing such a dye in solution, one of which is described as a "harmless, tasteless, and wonderful vegetable coloring for producing the natural, rich shade in milk, skim milk and separator milk."

Excluding eighteen analyses of milk which had certainly been watered or skimmed, the average percentages of solids and of fat in the remaining 298 analyses are 12.44 and 4.05 respectively.

The averages for several years have been the following:

	Solids.	Fat.	Percentage of adulterated samples.
Summer of 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

Besides the samples which were certainly adulterated by watering or skimming, or by the addition of dyes or preservatives, thirty other samples, nearly ten per cent. of the whole number examined, were of very inferior quality. This inferior quality may have been the result of moderate skimming or watering, or it may have been the fault of the cows or their feeding and keeping.

One hundred and one of the samples tested this year fell, in two or more particulars, below the milk standard fixed by the United States government and adopted by this station.

In some cases this may be due to the carelessness of the man on the milk route who dips the milk from the can without any stirring, and in this way may serve very rich milk to one patron and nothing better than skimmed milk to another. But for this sort of thing the seller, not the purchaser, is responsible, and the figures given in the tables, while they may not show accurately the average quality of the milk from a given dairy, do accurately show what the owner of the dairy, or his agent, sold to the public for milk at the standard ruling price. It is clear, from the results of our work that as regards chemical composition alone, the milk supply of our cities is in an unsatisfactory state and that much inferior and adulterated milk is sold in them. A larger proportion of such samples have been found in Bridgeport and New Haven than in other places.

The prevention of fraud in the sale of milk can only be accomplished by the local authorities. The work above described has been done with the object of showing what need there is for efficient work on the part of local boards of health. At the present time the public health is affected by the quality of the milk supply far more than by that of any other food product. It is the helpless portion of the community whose health and life are seriously threatened by impure and adulterated milk.

TABLE I.—SUMMARY OF ANALYSES OF MILK BOUGHT OF MILKMEN, 1904.

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.
Ansonia	6	2	3	1	1	0	0	0
Bridgeport	43	12	27	3	0	3	0	1
Bristol	14	0	6	0	0	0	0	0
Danbury	15	9	11	0	0	0	0	0
Derby	8	4	6	0	0	0	0	0
Hartford	30	13	17	4	0	0	0	0
Meriden	9	2	5	1	0	0	0	0
Middletown	18	1	11	0	1	0	0	0
New Britain	18	8	11	4	0	0	0	0
New Haven	48	26	34	10	0	1	5	1
New London	10	1	2	1	0	0	0	0
Norwalk	8	2	4	1	0	0	0	0
Norwich	9	3	5	0	0	0	0	0
Rockville	8	2	4	1	0	0	0	0
South Norwalk	10	3	3	0	0	0	0	0
Stamford	17	6	10	1	0	1	0	0
Wallingford	10	1	6	1	0	0	0	0
Waterbury	23	10	12	2	0	0	0	0
Willimantic	12	3	8	1	0	0	0	0
Total	316	108	185	31	2	5	5	2

TABLE II.—MILK BOUGHT OF MILKMEN.

Station No.	Sampled.	Dealer.	Specific gravity at 60° F.	Total solids.	Solids not fat.	Fat.	Preservative.	Color.
		Ansonia.		%	%	%		
12436	Aug. 2	George Bergen*	31.0	12.46	8.56	3.9	Borax	Natural.
12434	2	Herman Karnarth*	29.7	13.27	**8.47**	4.8	None	"
12510	2	G. Lagella*	23.6	**9.43**	**6.43**	**3.0**	"	"
12433	2	P. B. S.	29.4	**11.37**	**7.57**	3.8	"	"
12435	2	J. F. W.	29.0	13.89	8.59	5.3	"	"
12437	2	Weakley & Jergerson*	31.2	12.33	8.73	3.6		
		Bridgeport.						
12170	July 6	G. A. Barhite	24.2	**10.49**	**6.79**	3.7	"	"
12212	11	Frank Campbell*	29.8	12.59	8.59	4.0	"	"
12186	6	Ed. Clark, Trumbull*	27.1	12.59	**8.49**	4.1	"	"
12185	6	William Colby*	27.3	14.41	8.81	5.6	"	"
12182	6	B. B. Curtiss*	29.9	12.79	8.79	4.0	"	"
12211	11	Will Disbrow*	30.3	13.35	8.75	4.6	"	"
12542	Aug. 5	Evergreen Farm Dairy	30.8	12.65	8.65	4.0	"	"
12222	July 11	John Flynn*	26.6	**11.50**	**8.00**	3.5	"	"
12187	6	D. W. Fuller*	29.1	12.04	**8.44**	3.6	"	"
12183	6	T. B. Green	30.0	12.04	8.74	3.3	"	"
12184	6	A. O. Gregory*	29.9	12.04	**8.34**	3.7	"	"
12219	11	A. O. Gregory*	29.5	12.01	**8.41**	3.6	"	"
12173	6	A. W. Hall, Plattsville*	26.3	12.50	**7.80**	4.7	"	"
12223	11	Chess. Hayes*	26.1	**11.04**	**7.64**	3.4	"	"
12228	11	A. C. Howard & Son	28.9	**11.97**	**8.27**	3.7	"	"
12541	Aug. 5	E. L. Hoyt, Pleasant View Farm, Long Hill	23.6	**9.57**	**6.57**	**3.0**	"	"
12227	July 11	E. L. Hoyt, Pleasant View Farm, Long Hill	19.8	14.59	**7.39**	7.2	"	"
12226	11	Imperial Dairy	28.0	12.04	**8.04**	4.0	"	"
12171	6	Luther Johnson*	30.9	13.09	8.69	4.4	"	"
12224	11	Chas. Ketchen*	27.8	12.36	**7.96**	4.4	"	"
12539	Aug. 5	Fred Ketchum*	29.7	13.03	**8.43**	4.6	"	"
12220	July 11	F. C. Kuhen, Long Hill	29.4	**11.89**	**8.09**	3.8	"	"
12178	6	K. W. Laufer, Chestnut Hill	26.9	**11.19**	**7.79**	3.4	"	"
12213	11	Ambrose Marsh	30.1	13.05	8.55	4.5	"	"
12216	11	G. Marsh*	27.3	12.30	**8.30**	4.0	"	"
12180	6	Wm. McClellan, Nichols	28.4	13.37	**8.37**	5.0	"	"
12177	6	J. E. McDonald & Son	30.5	12.31	8.61	3.7	"	"
12543	Aug. 5	Mitchell Dairy, Washington	29.6	13.13	**8.33**	4.8	"	"
12540	5	Monhabie Farm Dairy	30.1	13.44	8.54	4.9	"	"
12175	July 6	H. W. Parks, Trumbull	29.7	12.64	8.64	4.0	Formaldehyde	"
12538	Aug. 5	H. W. Parks, Trumbull	28.0	12.44	**8.24**	4.2	"	"
12174	July 6	E. Patchen, Star Farm Dairy	29.6	**11.92**	8.52	3.4	None	"
12217	11	E. Patchen, Star Farm Dairy	26.7	12.49	**8.29**	4.2	"	"
12221	11	Howard Randall*	28.8	12.08	**7.88**	4.2	"	"
12214	11	Roger Farm Dairy	30.1	12.55	8.55	4.0	"	"
12172	6	G. Ross, Fairfield*	31.3	12.84	9.24	3.6	"	"
12176	6	E. E. Sherman	30.0	13.56	8.86	4.7	"	"
12179	6	Geo. H. Sherwood*	29.7	**11.78**	**8.38**	3.4	"	"
12215	11	Walter Sherwood	29.3	13.09	8.99	4.1	"	"
12218	11	S. Thorpe, Hillside Farm	24.1	**9.68**	**6.58**	**3.1**	Formaldehyde	Aniline orange.

* 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.
		Bridgeport.		%	%	%		
12225	July 11	S. S. Walker, Long Hill Dairy	26.3	**11.56**	**7.96**	3.6	None	Natural.
12181	6	John Weller, Trumbull*	28.0	**11.02**	**8.02**	**3.0**	"	"
12544	Aug. 5	George Wolf*	29.3	12.32	**8.42**	3.9	"	"
		Bristol.						
12296	July 19	A. B. Brewer, Hillside Farm	30.8	12.83	8.83	4.0	"	"
12298	19	J. D. Burgess*	30.4	14.83	9.13	5.7	"	"
12302	19	A K. Chapin	28.1	12.83	8.53	4.3	"	"
12293	19	T. Holt, Maple View Farm	29.9	12.32	**8.42**	3.9	"	"
12301	19	Holt & Bradbury	29.5	12.73	8.63	4.1	"	"
12300	19	Manchester Bros., Fern Hill Dairy	31.5	12.94	8.84	4.1	"	"
12294	19	J. B. Maynard, Maple Lawn Farm	29.7	12.43	**8.43**	4.0	"	"
12292	19	George Miles*	31.5	13.65	8.75	4.9	"	"
12295	19	Charles Miller*	27.0	13.08	**7.98**	5.1	"	"
12299	19	S. D. Newell	31.2	13.26	8.96	4.3	"	"
12303	19	John Peterson*	29.9	12.69	**8.49**	4.2	"	"
12297	19	A. G. Root	30.5	13.49	8.59	4.9	"	"
12304	19	A. G. Root	29.4	12.86	**8.46**	4.4	"	"
12305	19	J. L. Wilcox, Clover Hill Stock Farm	30.0	12.66	**8.36**	4.3	"	"
		Danbury.						
12240	July 12	T. A. Banks, R. F. D. 20	29.1	12.04	**8.34**	3.7	"	"
12234	12	Danbury Milk Sterilizing Co.	28.9	**11.64**	**8.14**	3.5	"	"
12235	12	Disbrow's Home Dairy	30.0	**11.66**	**8.26**	3.4	"	"
12233	12	C. M. Downes	29.0	**11.96**	**8.36**	3.6	"	"
12238	12	Geo. Felton*	28.1	**11.35**	**7.85**	3.5	"	"
12239	12	J. F. Hall	28.1	13.11	**8.41**	4.7	"	"
12232	12	L. Jacobs*	26.3	**11.41**	**7.71**	3.7	"	"
12230	12	L. T. Jennings, Hayestown Dairy	30.9	**11.87**	**8.37**	3.5	"	"
12231	12	O. A. Johnson*	29.4	**11.98**	**8.18**	3.8	"	"
12229	12	Geo. Merritt*	30.9	**11.76**	**8.36**	3.4	"	"
12241	12	Geo. Merritt*	30.1	12.30	8.50	3.8	"	"
12236	12	A. Mishico*	30.5	12.54	8.54	4.0	"	"
12243	12	Pembroke Dairy*	28.6	15.09	8.79	6.3	"	"
12242	12	Chas. Rider, 11 New st.	30.7	12.12	8.62	3.5	"	"
12237	12	Geo. Rundell*	28.3	**11.19**	**7.89**	3.3	"	"
		Derby.						
12513	Aug. 2	D. H. Clark, No. 3	29.8	12.28	**8.48**	3.8	"	"
12511	2	F. B. Dimon, Cloverdale Dairy	30.1	12.56	**8.36**	4.2	"	"
12517	2	M. W. Johnson, Sound View Dairy, Monroe	30.4	12.80	8.70	4.1	"	"
12518	2	McConney Bros.*	29.4	**11.74**	**8.24**	3.5	"	"
12514	2	W. W. Sanders, No. 42	28.7	**11.57**	**7.87**	3.7	"	"
12512	2	A. F. Schummrick, 17 Sandy Hook*	31.4	13.77	9.07	4.7	"	"
12515	2	A. V. Werder	28.4	**11.89**	**7.99**	3.9	"	"
12516	2	E. C. Wooster, Nichols*	29.7	**11.38**	**8.08**	3.3	"	"
		Hartford.						
12338	July 21	J. F. Anglum	30.5	**11.82**	**8.42**	3.4	"	"
12346	22	Geo. D. Bexter, South Wethersfield	29.5	12.84	8.54	4.3	"	"
12339	21	A. Becker, Wilson	27.7	**11.19**	**7.69**	3.5	"	"

* Statement of the 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.		%	%	%		
12336	July 21	C. J. Christensen, Bloomfield	31.1	12.61	8.61	4.0	None	Natural.
12335	21	John Donahue, Windsor	26.8	**11.97**	**7.77**	4.2	"	"
12337	21	Wm. Dooley, Bloomfield	28.3	13.57	8.77	4.8	"	"
12342	22	H. I. Epstein	30.0	12.18	**8.18**	4.0	"	"
12234	21	Louis Farnham, Bloomfield*	30.8	12.89	8.79	4.1	"	"
12340	21	J. J. Felth, West Hartford	27.6	12.00	**8.00**	4.0	"	"
12329	21	Wm. P. Francis, Bloomfield	30.4	12.69	8.69	4.0	"	"
12352	22	A. Griggs, West Hartford	29.9	13.00	8.50	4.5	"	"
12326	21	Hartford Dairy Co., No. 17	30.5	12.55	**8.35**	4.2	"	"
12331	21	Hartford Dairy Co., No. 4	30.2	12.60	8.50	4.1	"	"
12343	22	Hartford Dairy Co., No. 7	29.0	12.37	**8.37**	4.0	"	"
12332	21	H. W. Holcomb, Bloomfield	27.9	**10.94**	**7.44**	3.5	"	"
12345	22	J. A. Jensen, Wethersfield	30.1	12.58	8.78	3.8	"	"
12350	22	Hans Jepsen, West Hartford	29.8	**11.12**	**7.92**	**3.2**	"	"
12349	22	M. King	29.9	**11.97**	**8.27**	3.7	"	"
12348	22	T. Kullakowski, West Hartford	30.0	**11.85**	**8.35**	3.5	"	"
12347	22	A. Marshall, Bloomfield	28.0	**11.52**	**7.82**	3.7	"	"
12341	21	E. J. McNamara, No. 193, Rocky Hill	33.6	**10.96**	8.76	**2.2**	"	"
12333	21	J. W. Merrill, No. 58	30.9	12.55	8.55	4.0	"	"
12328	21	J. W. Merrill, No. 58	29.3	12.26	**8.26**	4.0	"	"
12353	22	W. B. Miller, West Hartford	25.2	**11.65**	**7.25**	4.4	"	"
12330	21	F. G. Pinney, Bloomfield	30.0	12.75	**8.45**	4.3	"	"
12327	21	F. T. Roche, No. 11	32.2	**11.60**	8.60	**3.0**	"	"
12325	21	R. Romano, No. 197	30.3	**11.20**	**8.00**	**3.2**	"	"
12324	21	C. H. Rosen	32.2	13.05	8.95	4.1	"	"
12351	21	N. Swenson, Elmwood	29.7	**11.95**	**8.45**	3.5	"	"
12344	22	J. T. Tilden, West Hartford	31.0	12.22	8.62	3.6	"	"
		Meriden.						
12287	18	B. F. Deming, 61 Orient st.	29.9	13.97	8.87	5.1	"	"
12286	18	Dickerman Bros.	25.6	12.94	**7.64**	5.3	"	"
12291	18	F. A. Disbrow	29.4	14.38	8.98	5.4	"	"
12289	18	A. Greenback*	29.0	12.00	**8.20**	3.8	"	"
12290	18	D. Higgins, 17 Butler st.	30.5	12.36	**8.36**	4.0	"	"
12283	18	D. Higgins, 17 Butler st.	30.7	12.74	8.94	3.8	"	"
12288	18	Geo. Holmes*	26.0	12.82	**7.72**	5.1	"	"
12284	18	Wilbur Hyatt	29.9	**11.75**	**8.15**	3.6	"	"
12285	18	G. Quigley*	31.3	**11.61**	8.61	**3.0**	"	"
		Middletown.						
12416	29	F. B. Ashton	29.7	12.57	**8.27**	4.3	"	"
12417	29	Cold Spring Dairy	30.9	12.43	8.63	3.8	"	"
12420	29	Damon Mott*	29.4	12.70	8.50	4.2	"	"
12408	29	Daniels Bros., Millbrook Dairy	30.0	12.87	**8.47**	4.4	"	"
12405	29	Daniels Bros., Millbrook Dairy	30.0	12.85	8.55	4.3	"	"
12413	29	Chas. T. Davis	30.5	13.22	8.62	4.6	"	"
12415	29	R. Davis, Oak Grove Dairy	28.9	12.53	**8.23**	4.3	"	"
12410	29	James Dripps	25.9	**11.81**	**7.41**	4.4	"	"
12422	29	Robert Hubbard	30.2	13.46	8.76	4.7	"	"
12409	29	W. G. Johnson & Son	31.0	12.54	8.54	4.0	"	"
12421	29	Frank Jones*	30.5	12.07	**8.37**	3.7	"	"
12411	29	Lee Bros.	29.7	12.09	**8.29**	3.8	"	"
12419	29	C. Longworth*	26.4	12.14	**7.74**	4.4	"	"

* Statement of the 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.
		Middletown.		%	%	%		
12412	July 29	H. E. Merrill, Utopia Farm, Cromwell	29.1	12.57	8.17	4.4	Borax	Natural.
12418	29	C. C. Plum	30.0	12.04	8.24	3.8	None	"
12414	29	E. H. Plum	30.4	12.67	8.37	4.3	"	"
12406	29	F. S. Scoville	29.0	13.32	8.52	4.8	"	"
12407	29	Fred Zens	30.6	12.06	8.46	3.6	"	"
		New Britain.						
12315	20	Chas. Allen*	29.9	11.90	8.20	3.7	"	"
12314	20	J. E. Avery*	26.0	11.43	7.23	4.2	"	"
12312	20	H. P. Batty, Fair View Farm	30.3	12.92	8.62	4.3	"	"
12320	20	Cedar Hill Farm	30.1	12.51	8.41	4.1	"	"
12313	20	Cedar Hill Farm	29.8	12.22	8.32	3.9	"	"
12309	20	C. Daley, City Farm	31.0	11.39	8.29	3.1	"	"
12322	20	Hooker's Brookside Farm	30.5	11.34	8.34	3.0	"	"
12319	20	C. L. Luce, Red Rock Farm, Newington	29.5	12.29	8.29	4.0	"	"
12306	20	John Martin*	29.6	12.64	8.54	4.1	"	"
12307	20	T. S. McMahon	30.7	11.54	8.14	3.4	"	"
12310	20	I. J. Newton, West Hartford	31.8	11.68	8.68	3.0	"	"
12317	20	William Phillips*	31.6	12.43	8.73	3.7	"	"
12311	20	C. Rosenberg	32.3	11.96	8.76	3.2	"	"
12316	20	Seibert's Center View Farm, Berlin	29.2	12.97	8.27	4.7	"	"
12321	20	Spring Dale Dairy	30.3	12.04	8.34	3.7	"	"
12318	20	G. A. Wall, Maple Grove Farm	30.5	12.58	8.68	3.9	"	"
12308	20	Axel Wellin	29.4	11.56	8.16	3.4	"	"
12323	20	J. H. Weymouth, Cedar Valley Farm, Newington	30.4	12.87	8.57	4.3	"	"
		New Haven.						
12281	15	W. M. Andrew, Orange	31.2	11.42	8.22	3.2	"	"
12365	25	W. M. Andrew, Orange	28.9	11.50	7.90	3.6	"	"
11424	5	J. D. Bremner, Westville	24.9	9.93	7.13	2.8	"	"
11413	5	C. W. Brock, Whitneyville Creamery	30.3	11.99	7.99	4.0	"	"
11415	5	F. J. Buck, 44 Judson ave.	26.3	10.57	7.57	3.0	"	"
12359	25	F. J. Buck, 44 Judson ave.	24.8	9.91	6.81	3.1	"	"
11426	5	Cherry Hill Dairy	26.4	12.70	8.20	4.5	"	"
12169	5	Clover Dairy Creamery	29.4	10.59	7.99	2.6	"	"
11414	5	Clover Dairy Creamery	26.7	10.50	7.30	3.2	"	"
11423	5	J. T. Cotter	27.9	11.24	7.94	3.3	"	"
12358	25	W. L. Crawford, 990 Dixwell ave.	30.1	11.69	8.19	3.5	"	"
12275	15	W. H. Davis, 9 Audubon pl.	28.9	11.70	8.00	3.7	"	Anatto.
12367	25	H. J. Fabrique	28.9	11.41	7.91	3.5	"	Natural.
11425	5	Granniss Corner Dairy	28.1	12.32	8.42	3.9	"	"
11422	5	W. E. Granniss	28.6	12.44	8.44	4.0	"	"
12274	15	Greene Bros.	29.1	11.88	8.18	3.7	"	"
12272	15	R. Hanrahan,* No. 43	29.9	11.55	8.15	3.4	"	"
12354	25	L. G. Hemingway	31.0	12.26	8.46	3.8	"	"
12273	15	W. R. Hoggatt	30.8	12.42	8.52	3.9	"	"
12357	25	A. Husinsky,* No. 1047	30.9	13.12	9.02	4.1	"	"
11421	5	E. W. Klebe, North Hill Farm, North Haven	26.7	10.51	7.31	3.2	"	"

* Statement of the 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 Haven.		%	%	%		
11420	July 5	S. Lancel, No. 19	25.5	9.37	6.67	2.7	None	Natural.
12277	15	E. F. Loveland	26.8	11.03	7.33	3.7	"	"
12360	25	H. G. Meserole, East Haven	30.6	12.20	8.50	3.7	"	"
12356	25	G. B. Mix, 27 Munson st.	30.8	13.06	8.76	4.3	"	Anatto.
12361	25	J. F. Moran, No. 231	29.9	11.85	8.25	3.6	"	Natural.
11427	5	New England Dairy	30.5	12.52	8.82	3.7	"	"
12278	15	New England Dairy	30.4	12.66	8.66	4.0	"	"
12364	25	R. H. Nesbit Co., Rose Hurst Farm	30.4	12.41	8.51	3.9	"	"
11417	5	R. N. Noble, 1500 Quinnipiac ave.	29.8	11.99	8.59	3.4	"	Anatto.
12370	25	R. N. Noble, 1500 Quinnipiac ave.	30.4	12.22	8.42	3.8	"	"
11418	5	L. C. Palmer	29.7	11.52	7.72	3.8	"	Natural.
12279	15	L. C. Palmer	30.9	13.08	8.58	4.5	"	"
12276	15	S. H. Rice, 58 Lombard st.	30.8	10.52	8.32	2.2	Formaldehyde	Analine orange.
12369	25	C. W. Russell, Tyler City	31.7	12.47	8.87	3.6	None	Natural.
11428	5	W. G. Schilf	28.9	11.81	8.11	3.7	"	"
12271	15	R. A. Scholz	30.0	12.14	8.84	3.3	"	"
12368	25	John Shepard, Woodbridge*	30.3	11.81	8.41	3.4	"	Anatto.
12280	15	John Smith*	30.0	12.18	8.28	3.9	"	Natural.
12372	25	A. L. Sperry, Woodbridge	30.4	12.34	8.34	4.0	"	"
12355	25	C. E. Thatcher	30.0	12.81	8.51	4.3	"	"
11416	5	W. F. Thompson	28.3	11.38	7.98	3.4	"	"
12366	25	F. A. Vining, Whitneyville	27.5	13.49	7.69	5.8	"	"
12362	25	M. Walley, 267 Washington ave.	30.9	13.22	8.82	4.4	"	"
12363	25	J. H. Webb, Spring Glen Farm	30.4	13.03	8.73	4.3	"	"
12270	15	F. L. Wildmore	30.0	11.31	8.11	3.2	"	"
12282	15	H. Winstein*	30.0	12.70	8.40	4.3	"	"
11419	5	No. 43	27.1	11.59	8.19	3.4		
		New London.						
12382	26	A. T. Avery, Waterford	30.5	14.14	9.14	5.0	"	"
12376	26	S. P. Brown, Four Winds Farm	30.8	12.84	8.64	4.2	"	"
12373	26	John Carlson*	30.9	14.41	9.11	5.3	"	"
12377	26	F. L. Dimmock*	31.8	12.31	8.71	3.6	"	"
12379	26	J. Hedding*	29.4	12.43	8.53	3.9	"	"
12374	26	H. C. Lamphere, Pleasant View Farm	30.7	13.07	8.87	4.2	"	"
12380	26	C. G. Newbury	29.6	13.43	8.53	4.9	"	"
12381	26	Ocean View Farm	34.5	10.27	9.07	1.2	"	"
12375	26	J. W. Reardon, Cohanzie	28.7	12.67	8.27	4.4	"	"
12378	26	G. Snelitzkie*	27.5	12.51	7.91	4.6		
		Norwalk.						
12263	14	Mrs. Ella R. Aiken, Silver Mine Dairy	31.0	12.37	8.77	3.6	"	"
12262	14	Chas. H. Hawxhurst	30.4	12.56	8.66	3.9	"	"
12267	14	W. I. Hawxhurst*	27.3	10.76	7.36	3.4	"	"
12266	14	Chas. E. Hoyt, Hillside Dairy	28.6	12.08	8.08	4.0	"	"
12268	14	David Jenks*	27.5	8.45	6.95	1.5	"	"
12264	14	R. Loudon, Sear Hill Dairy	30.9	13.09	8.79	4.3	"	"
12269	14	F. R. Waters, White Oak Shade	29.9	12.44	8.54	3.9	"	"
12265	14	A. Wellnitz	29.0	13.26	8.46	4.8		

* Statement of the 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.
		Norwich.		%	%	%		
12389	July 27	Mrs. H. F. Davis	31.2	13.04	8.54	4.5	None	Natural.
12384	27	W. S. DeWolf*	30.3	14.14	9.04	5.1	"	"
12386	27	Fred Kingsley*	31.2	11.81	8.51	3.3	"	"
12390	27	J. F. Lester, Sunny Side Farm	27.9	12.62	8.12	4.5	"	"
12388	27	J. D. Lyman*	30.4	11.77	8.37	3.4	"	"
12385	27	Fred Palmer*	29.0	13.16	8.36	4.8	"	"
12387	27	John Peckham*	27.4	11.23	7.83	3.4	"	"
12383	27	W. T. Rogers*	30.9	12.40	8.60	3.8	"	"
12391	27	John Sherwin*	28.6	12.64	8.24	4.4	"	"
		Rockville.						
12530	Aug. 4	John Daley	28.0	10.50	7.50	3.0	"	"
12534	4	M. C. Dimmick	28.3	13.29	8.49	4.8	"	"
12537	4	C. Lanz*	29.1	14.89	8.79	6.1	"	"
12536	4	Henry Martin*	27.0	13.27	8.17	5.1	"	"
12532	4	Will Pinney*	27.0	11.10	7.70	3.4	"	"
12531	4	C. T. Slater, Spring Brook Dairy	29.5	13.11	8.71	4.4	"	"
12533	4	Wm. C. Vinton, Hillside Dairy	30.9	12.80	8.60	4.2	"	"
12535	4	C. T. Wooster*	29.8	13.35	8.55	4.8	"	"
		South Norwalk.						
12205	July 8	W. E. Barnes	31.4	11.86	8.56	3.3	"	"
12260	14	J. H. Crosby*	29.8	12.78	8.58	4.2	"	"
12207	8	Chas. H. Hawxhurst	26.8	11.61	7.81	3.8	"	"
12206	8	Chas. H. Hawxhurst*	27.5	11.66	7.66	4.0	"	"
12259	14	Chas. E. Hawxhurst*	29.3	12.65	8.55	4.1	"	"
12258	14	W. D. Keeler, Ridgewood Farm	31.4	13.20	8.90	4.3	"	"
12261	14	G. J. Schaller, Comstock Hill Dairy	31.7	14.63	9.13	5.5	"	"
12208	8	South Norwalk Milk Delivery	29.3	12.22	8.42	3.8	"	"
12209	8	F. R. Waters	30.5	13.70	8.80	4.9	"	"
12210	8	Arthur Webb*	29.3	12.77	8.57	4.2	"	"
		Stamford.						
12198	7	J. H. Bedell, Long Ridge Dairy	28.5	12.60	8.50	4.1	"	"
12189	7	J. H. Bedell, Long Ridge Dairy	30.8	13.18	9.08	4.1	"	"
12196	7	W. Bliss*	28.0	11.15	7.75	3.4	"	"
12202	7	F. A. Bouton*	30.7	12.14	8.54	3.6	"	"
12197	7	H. I. Dann, Mount Pleasant Dairy	31.0	12.25	8.85	3.4	"	"
12204	7	H. I. Dann, Mouut Pleasant Dairy	27.2	12.09	8.09	4.0	"	"
12194	7	H. I. Dann, Mount Pleasant Dairy	28.6	11.79	8.19	3.6	"	"
12199	7	P. Larkin, Glen Brook Dairy	28.4	12.78	8.78	4.0	"	"
12200	7	Noroton Dairy	27.7	11.22	7.82	3.4	"	"
12193	7	Westover Dairy, H.L.Palmer, Supt.	29.0	12.49	8.69	3.8	"	"
12203	7	Ridge Brook Farm Dairy	26.8	11.78	7.58	4.2	"	"
12195	7	South Stamford Dairy	27.6	12.39	7.99	4.4	"	"
12188	7	S. Thompkins*	29.1	12.76	8.36	4.4	"	"
12192	7	Robert Tryon, Sarr's Milk Wagon	29.4	11.28	8.18	3.1	Formaldehyde	"
12191	7	W. F. Waterbury	30.6	13.19	8.89	4.3	None	"
12201	7	Emmett L. Weed	24.1	12.50	7.50	5.0	"	"
12190	7	J. F. Wynn	25.6	10.62	7.32	3.3	"	"

* Statement of the 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.
		Wallingford.		%	%	%		
12429	Aug. 1	A. A. Blakesley*	27.1	12.38	8.08	4.3	None	Natural.
12430	1	T. F. Greenslitt*	28.4	12.66	8.26	4.4	"	"
12425	1	L. W. Hitchcock*	30.0	12.00	8.40	3.6	"	"
12428	1	Riverside Farm	26.5	12.33	7.83	4.5	"	"
12427	1	F. H. Robinson,* O. P. M.	29.5	12.56	8.36	4.2	"	"
12423	1	B. R. Tyler*	30.4	12.26	8.56	3.7	"	"
12424	1	J. D. W.	29.4	13.22	8.62	4.6	"	"
12426	1	Geo. Williams*	29.6	12.63	8.23	4.4	"	"
12432	1	H. S. Williams	30.5	12.61	8.71	3.9	"	"
12431	1	Louis Williams*	31.9	11.71	8.51	3.2		
		Waterbury.						
12256	July 13	F. R. Allen, No. 44	31.6	12.21	8.61	3.6	"	"
12527	Aug. 3	Atwood Bros., Mountain View Farm	29.7	13.47	8.97	4.5	"	"
12252	July 13	G. L. Atwood	31.1	12.82	8.72	4.1	"	"
12254	13	J. E. Brant*	30.4	11.63	8.53	3.1	"	"
12525	Aug. 3	Buckingham Bros.	32.2	13.71	9.11	4.6	"	"
12526	3	F. P. Clough, Spring Meadow	30.3	12.94	8.54	4.4	"	"
12522	3	J. K.	27.0	13.54	8.24	5.3	"	"
12529	3	J. W. Laughlin, Watertown Road	29.6	12.23	8.63	3.6	"	"
12253	July 13	W. M.	29.8	12.56	8.56	4.0	"	"
12524	Aug. 3	J. F. Manthey	29.0	11.92	8.12	3.8	"	"
12519	3	John Nagel	29.1	11.27	7.97	3.3	"	"
12249	July 13	E. H. Oviatt, White Clover Dairy	29.8	12.80	8.50	4.3	"	"
12246	13	W. J. Munson, Watertown	29.3	12.66	8.36	4.3	"	"
12255	13	A. J. Pierpont	27.3	11.62	8.12	3.5	"	"
12520	Aug. 3	F. C. Porter	29.0	11.93	7.93	4.0	"	"
12244	July 13	Geo. Rasmussen*	29.7	11.61	8.21	3.4	"	"
12245	13	Hans Rasmussen, Park Dairy	27.4	11.38	7.68	3.7	"	"
12250	13	C. C. Rogers, Maple ave.	28.5	11.75	8.05	3.7	"	"
12523	Aug. 3	D. M. Rogers	28.3	11.45	7.85	3.6	"	"
12521	3	J. N. Rose, Watertown Road	29.1	12.33	8.43	3.9	"	"
12248	July 13	L. A. Rose	29.6	12.67	8.57	4.1	"	"
12251	13	H. B. Russell, Oakville	22.8	8.27	6.07	2.2	"	"
12528	Aug. 3	Spring Hill Farm, Watertown Road	29.8	12.75	8.65	4.1		"
		Willimantic.						
12403	July 28	G. H. Andrews, Crystal Spring Dairy	28.8	12.86	8.36	4.5	"	"
12402	28	Brindamour Bros.	29.3	12.69	8.29	4.4	"	"
12394	28	S. P. Brown, Homestead Farm	30.1	14.09	8.79	5.3	"	"
12395	28	J. M. Daggett & Son	30.0	13.27	8.47	4.8	"	"
12392	28	F. W. Edgerton	30.1	13.96	8.66	5.3	"	"
12398	28	J. H. Griggs, Pleasant Valley Farm	30.0	12.93	8.43	4.5	"	"
12400	28	C. H. Hoxie	29.1	11.98	8.28	3.7	"	"
12396	28	G. A. Jacobs, Mansfield City Dairy	29.9	12.85	8.25	4.6	"	"
12401	28	C. B. Pomeroy, Jr.	29.0	13.06	8.46	4.6	"	"
12397	28	G. W. Rapellyea	32.5	11.97	8.77	3.2	"	"
12404	28	F. Rosebrooks	30.9	13.28	8.78	4.5	"	"
12399	28	J. H. Stearns, Mountain Mills Farm	30.1	11.89	8.29	3.6		

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

Milk from a Producer, Sampled by the Station.

On March 7, M. B. & F. S. Hubbell, milk dealers, New Haven, submitted a sample of milk (**11595**) with the statement that it fairly represented the product sold them by Mr. J. H. Handy, Totoket. On examination the milk was found to be badly watered. Four days later, at the request of the above firm, a sample was taken by a representative of the Station at the farm of Mr. Handy from each of two cans of milk before they were loaded on the collecting wagon. Analyses of these samples (**11600** and **11601**) showed that the milk in both cans was unquestionably watered.

Analyses of the three samples follows:

Sample No.	Sampled by	Specific Gravity at 60° F.	Total Solids. Per cent.	Solids not Fat. Per cent.	Fat. Per cent.
11595	M. B. & F. S. Hubbell	24.6	9.7	6.6	3.1
11600	Station Agent	25.9	9.69	6.69	3.0
11601	"	21.5	8.85	5.85	3.0

Milk Sampled by Public Officers.

A sample of milk from a Bridgeport dealer was sent by Dr. E. A. McLellan, health officer of that city, because of the complaint of a purchaser who stated that a sediment resembling corn starch deposited from the milk. No starch was found in the sample, but the analysis which follows shows that it was grossly adulterated by watering.

Specific Gravity at 60° F.	Total Solids.	Solids not Fat.	Fat.
23.1	9.07%	6.47%	2.60%

Dr. C. H. Borden, health officer, Stamford, submitted for analysis during the month of July, 31 samples of milk from Stamford dealers. Of these 1 contained boric acid and 4 were, in our opinion, watered, as appears from the following analyses:

Sample No.	Dealer.	Specific Gravity at 60° F.	Total Solids. Per cent.	Solids not Fat. Per cent.	Fat. Per cent.	Preservative.
12441	H. L. Palmer	30.8	12.33	8.53	3.8	Boric acid.
12442	W. F. Waterbury	27.7	10.62	7.52	3.1	None.
12450	John Conners	30.9	10.69	7.79	2.9	"
12448	Fred Herman	24.6	10.41	6.81	3.6	"
12469	Wm. Olmstead	29.4	10.68	7.38	3.3	"

Mr. Waterbury, whose milk as shown in the foregoing table was watered, later sent 13 samples drawn from his supply by Mr. W. Ferris Waterbury, town clerk of Stamford, all of which were of good quality. The percentages of total solids in these samples ranged from 12.25 to 14.26 per cent. and of fat from 3.2 to 5.4 per cent.

Milk sampled by Producers, Dealers and Consumers.

Of 132 samples submitted for analysis by private parties only the following are of public interest:

11210. Sent by J. J. Merwin, Orange, who stated that the sample was from a lot sold by L. F. Andrew. It contained boric acid.

11714. Sent by H. A. Loveland, New Haven, who stated that the sample was market milk from C. W. Barker.

Specific Gravity at 60° F.	Total Solids.	Solids not Fat.	Fat.
27.9	11.04%	7.64%	3.40%

CREAM.

Seventeen samples examined for dealers and consumers contained from 18.40 to 47.64 per cent. of fat. Only the following was found adulterated.

11286. Sent by M. B. & F. S. Hubbell, New Haven, who stated that the sample was from a lot sold by the Westerly Cream Co. The sample contained boric acid.

SWEETENED CONDENSED MILK.

This product is prepared from fresh milk by evaporation and addition, during the process, of a certain amount of cane sugar. The evaporation is conducted in vacuum pans at a temperature considerably below that of boiling water, thus avoiding a disagreeable cooked taste. The product is commonly sold in hermetically sealed tins containing a little less than one pound.

The composition of the product depends (1) on the composition of the milk used, (2) on the proportion of sugar added and (3) on the degree of concentration.

The only common form of adulteration practiced by manufacturers is the use of skimmed milk in the place of whole milk.

Addition of water is obviously disadvantageous to their interests, as the excess of water would necessitate longer boiling in the vacuum pans. Borax or boric acid, if contained in the milk supplied to the manufacturer, will also be contained in the finished product, but there is no incentive to the manufacturer to add preservatives, as the product is thoroughly sterilized before sealing, and furthermore, the large amount of sugar present prevents fermentation. Formaldehyde, if present in the original milk, is largely or entirely removed by the process of concentration.

In Table III are given analyses of 28 brands of sweetened condensed milk purchased by the station. The table shows not only the percentages of total solids, cane sugar, milk solids and milk constituents in the material as purchased, but also the percentages of milk constituents in the dry, sugar-free material, or, in other words, in the milk solids. These latter results are particularly instructive because they show the relative proportion of the milk constituents in the original milk and furnish evidence as to whether or not the milk was skimmed to any appreciable extent.

According to the standards adopted by the Association of Official Agricultural Chemists, sweetened condensed milk should contain not less than 28 per cent. of milk solids, of which not less than one-fourth (25 per cent.) is milk fat.

None of the samples examined contain less than the standard amount of milk solids, but four samples are deficient in the amount of fat in the milk solids as follows:

Station No.	Brand.	Per cent. of fat in the milk solids.
1959	Scranton Condensed Milk Co's Red Line	21.97
10750	Andresen's Best	21.82
1975	The Clark's Summit Dairy and Condensing Co's Apple Blossom	23.30
1955	Allen-Ditchett Co's, The Best	20.66

METHODS OF ANALYSIS.

Preparation of the Material. Open the can and weigh with contents. Transfer the contents to a 1000 cc. flask by means of tepid water, dry the empty can, weigh and deduct this weight from the first, thus obtaining the weight of the contents.

Make the material up to 1000 cc. at room temperature and use the diluted solution for the various determinations.

Total Solids. In an aluminum dish 8 cm. in diameter, weighing about 12 grams, place a glass rod, sufficient ignited quartz sand to bring the total weight up to 40 grams and 5 cc. of the diluted condensed milk prepared as above described. Evaporate on a water bath, with continued stirring to avoid the formation of large lumps, dry twelve hours in a boiling water oven, cool in a desiccator and weigh.

Ash. Evaporate in a platinum dish 5 cc. of the diluted material and burn in a muffle to a white ash at a heat below redness.

Protein. Determine nitrogen by the Kjeldahl method in 3 cc. of the diluted material and calculate the protein, using the factor 6.37.

Lactose. To 20 cc. of the diluted material contained in a graduated 500 cc. flask add 10 cc. of copper sulphate solution (34.64 grams made up to 500 cc. with water) and 2.4 cc. half normal potassium hydrate. Make up to the mark, shake and filter through a dry paper.

Determine the lactose in 100 cc. of the filtrate by Sohxlet's method as follows:

In a beaker of 350 cc. capacity, mix 25 cc. of copper sulphate solution prepared as above described, with 25 cc. of alkaline Rochelle salt solution (173 grams Rochelle salts and 50 grams sodium hydrate made up to 500 cc. with water) and heat to boiling. To the boiling liquid add 100 cc. of the filtered milk solution, heat again to boiling and continue the boiling six minutes. Collect the copper suboxide on a Gooch crucible with a closely packed felt of woolly asbestos, dry at 100° C. and weigh. Calculate by Sohxlet's table.

This method gives results somewhat too high owing to the presence of sucrose, but the error is in favor of the manufacturer. Experiments are now in progress to determine the errors for different proportions of the two sugars.

Fat. (*Leach's Method.*) In a Babcock milk bottle with a mark on the bulb showing a volume of 17.6 cc. place 25 cc. of the diluted material, add 4 cc. of copper sulphate solution (prepared as above described) and water nearly to the neck. Shake thoroughly and whirl (without heat) in a centrifugal machine until the precipitated proteids, carrying with them the fat, have entirely settled.

In our experience there is little difficulty in securing an absolutely clear supernatant liquid if the contents of the bottle after adding the copper sulphate solution are allowed to stand some minutes before shaking.

Pour off the liquid, add water nearly to the neck, agitate by shaking, breaking up the lumps with a wire, and whirl again. Decant a second time and repeat once again the addition of water, agitation, whirling and decantation. Finally add water up to 17.6 cc., mix thoroughly and proceed as with milk. To obtain the percentage of fat, multiply the reading by 18 and divide by the grams of condensed milk in the aliquot taken.

Sucrose. This is obtained by subtracting the sum of the percentages of ash, protein, lactose and fat from the percentage of total solids.

Milk Solids. The difference between the percentages of total solids and sucrose is the percentage of milk solids.

TABLE III.—ANALYSES OF

Station No.	Brand.	Dealer.
1958	Michigan Condensed Milk Co., N. Y. Peninsular	*Bridgeport:* Coe & White, 1256 Main St.
1959	Scranton Condensed Milk Co., Scranton, Pa. Red Line	National Grocery and Provision Co., 46 Cannon St.
1974	The Dr. Hand Condensed Milk Co., Ubly, Mich. Dr. Hand's	*Derby:* The N. Y. Grocery Co., 217 Main St.
1954	Bennett, Sloan & Co., N. Y. Valley Farm	*Greenwich:* S. A. Moshier, Greenwich Ave.
1960	Borden's Condensed Milk Co., N. Y. Winner	*Hartford:* Wise, Smith & Co., Main St.
10750	C. Andresen & Co., N. Y. Andresen's Best	*Meriden:* Meriden Tea and Coffee Co., 77 E. Main St.
1973	United States Condensed Milk Co., Deansboro, N. Y. Upper Ten	*New Britain:* W. H. Pierce & Son, 72 W. Main St.
1963	The Great Atlantic and Pacific Tea Co., N. Y. Grandmother's A. & P.	*New Haven:* Atlantic and Pacific Tea Co., 384 State St.
10752	Borden's Condensed Milk Co., N. Y. Magnolia	*New Haven:* Bradley Bros., Church St.
1979	Borden's Condensed Milk Co., N. Y. Baby	C. T. Curtis, 932 State St.
1975	The Clark's Summit Dairy and Condensing Co., Clark's Summit, Pa. Apple Blossom	Frederick Bros., 253 Davenport Ave.
10751	Borden's Condensed Milk Co., N. Y. Daisy	N. A. Fullerton, Chapel and Temple Sts.
1964	United States Condensed Milk Co., Deansboro, N. Y. Empire State	The 3 G's Cash Grocery, 23–27 Edwards St.
1978	Borden's Condensed Milk Co., N. Y. Eagle	J. J. Hugo, 92 Nicoll St.
1962	American Condensed Milk Co., Jackson, Mich. Blue Bell	The Mohican Co., 18–22 Church St.
1965	Wisconsin Condensed Milk Co., Burlington, Wis. Arrow	Union Supply Co., 442 State St.
1966	Borden's Condensed Milk Co., N. Y. Defiance	*New London:* R. B. Burrows, 723 Bank St.
1967	Borden's Condensed Milk Co., N. Y. Dirigo	J. W. Miner, 51 Huntington St.
1968	Borden's Condensed Milk Co., N. Y. O. K.	The Mohican Co., 261 State St.
1953	Mohawk Condensed Milk Co., Rochester Sweet Clover	*Norwalk:* Grand Central Grocery, 21 Main St.
1969	Borden's Condensed Milk Co., N. Y. Stag	*Norwich:* Jas. Conners & Son, 72 Water St.
1970	Borden's Condensed Milk Co., N. Y. Challenge	W. A. Smith, 139 Main St.
1957	Henri Nestlé, Vevey, Switz. and Fulton, N. Y. Nestlé's	*So. Norwalk:* Central Food Co., Washington St. and R. R. Ave.
1956	Scranton Condensed Milk Co., Scranton, Pa. Gilt Edge	Lorenzo Dibble, 13 N. Main St.
1955	Allen-Ditchett Co., N. Y. The Best	G. E. Freidrich, R. R. Ave.
1977	Borden's Condensed Milk Co., N. Y. Tip Top	*Torrington:* The Torrington Co-operative Co., 135 Main St.
1971	American Condensed Milk Co., Jackson, Mich. Anchor	*Willimantic:* Chagnon & Bacon, 40 Jackson St.
1972	United States Condensed Milk Co., Deansboro, N. Y. Regal	Frank Larrabee, 20 Church St.

SWEETENED CONDENSED MILK.

Station No.	Price per can, cents.	Weight of contents of can, ounces.	In the Material as Sold.								In the Milk Solids.			
			Water.	Total Solids.	Cane Sugar.	Milk Solids.	Ash.	Protein.	Milk Sugar.	Fat.	Ash.	Protein.	Milk Sugar.	Fat.
			%	%	%	%	%	%	%	%	%	%	%	%
1958	10	14.8	26.38	73.62	41.72	31.90	1.86	8.60	13.20	8.24	5.83	26.96	41.38	25.83
1959	10	13.0	27.45	72.55	39.60	32.95	1.93	8.98	14.80	7.24	5.86	27.25	44.92	21.97
1974	18	15.6	26.97	73.03	38.63	34.40	2.16	9.36	14.07	8.81	6.28	27.21	40.90	25.61
1954	10	15.5	24.86	75.14	42.13	33.01	1.91	9.12	13.28	8.70	5.79	27.63	40.23	26.35
1960	9	14.8	25.26	74.74	42.34	32.40	1.81	8.87	12.06	9.66	5.59	27.38	37.22	29.81
10750	10	14.9	24.69	75.31	41.62	33.69	2.10	9.81	14.43	7.35	6.23	29.12	42.83	21.82
1973	10	13.0	27.88	72.12	38.47	33.65	1.85	8.34	14.66	8.80	5.50	24.79	43.57	26.14
1963	10	15.5	27.27	72.73	40.09	32.64	1.87	8.88	13.53	8.36	5.73	27.21	41.45	25.61
10752	10	15.2	27.17	72.83	42.24	30.59	1.78	7.95	12.52	8.34	5.82	25.99	40.93	27.26
1979	17	12.4	25.00	75.00	39.97	35.03	1.87	8.71	14.42	10.03	5.34	24.86	41.16	28.64
1975	9	13.0	27.65	72.35	32.01	40.34	1.88	8.46	20.60	9.40	4.66	20.97	51.07	23.30
10751	13	15.6	29.32	70.68	40.47	30.21	1.75	7.82	12.13	8.51	5.79	25.89	40.16	28.16
1964	9	12.7	26.09	73.91	40.80	33.11	1.83	8.14	14.11	9.03	5.53	24.59	42.61	27.27
1978	15	16.1	25.99	74.01	42.93	31.08	1.86	8.15	12.35	8.72	5.98	26.22	39.73	28.07
1962	9	13.9	26.50	73.50	37.94	35.56	1.95	9.50	14.80	9.31	5.48	26.71	41.62	26.19
1965	8	12.7	26.83	73.17	42.02	31.15	1.79	8.49	12.87	8.00	5.74	27.25	41.31	25.70
1966	10	13.2	26.75	73.25	39.81	33.44	1.93	8.99	13.09	9.43	5.77	26.88	39.14	28.21
1967	10	14.9	24.91	75.09	41.22	33.87	1.90	9.03	13.06	9.88	5.61	26.66	38.56	29.17
1968	9	13.0	25.78	74.22	36.56	37.66	1.89	8.72	17.30	9.75	5.02	23.15	45.94	25.89
1053	10	14.8	24.07	75.93	43.09	32.84	1.87	8.71	12.95	9.31	5.69	26.52	39.44	28.35
1969	10	11.4	23.67	76.33	43.70	32.63	1.97	9.16	12.54	8.96	6.04	28.07	38.43	27.46
1970	10	13.3	24.84	75.16	43.42	31.74	1.92	8.57	13.02	8.23	6.05	27.00	41.02	25.93
1957	10	14.9	25.76	74.24	38.70	35.54	1.90	8.70	15.37	9.57	5.35	24.48	43.25	26.92
1956	9	15.3	25.48	74.52	41.13	33.39	1.85	8.72	13.86	8.96	5.54	26.12	41.51	26.83
1955	10	13.6	28.03	71.97	38.57	33.40	1.90	9.12	15.48	6.90	5.69	27.30	46.35	20.66
1977	12	14.7	21.67	78.33	41.76	36.57	2.15	9.35	15.00	10.07	5.88	25.57	41.02	27.53
1971	10	12.4	26.97	73.03	37.88	35.15	1.97	9.28	14.44	9.46	5.60	26.40	41.08	26.92
1972	10	12.8	27.02	72.98	40.33	32.65	1.85	7.96	13.91	8.93	5.67	24.38	42.60	27.35
Maximum			29.32	78.33	43.70	40.34	2.16	9.81	20.60	10.07	6.28	29.12	51.07	29.81
Minimum			21.67	70.68	32.01	30.41	1.75	7.82	12.06	6.90	4.66	20.97	37.22	20.66
Average			**26.08**	**73.92**	**40.32**	**33.60**	**1.90**	**8.77**	**14.07**	**8.86**	**5.68**	**26.17**	**41.76**	**26.39**

NOODLES.

Noodles are prepared by European housewives and some manufacturers from flour, with the addition of a certain amount of eggs and salt. The dough is rolled into sheets and cut into strips or fanciful shapes.

Most of the noodles on the market, however, although of a golden yellow color, are not made with eggs, but have about the same composition as macaroni, being dyed either with a vegetable color (commonly turmeric) or a coal-tar dye (tropeolins, dinitrocresol, Martius yellow, naphthol yellow S, etc.).

Examination of Samples Collected by the Station.

Samples Collected in 1901. Thirty-seven samples of macaroni, eight of spaghetti, ten of vermicelli and twenty-eight of noodles purchased in Connecticut were analyzed and tested for dyes at this station in 1901.

None of the samples of macaroni or spaghetti was artificially colored, but two samples of vermicelli and twelve of noodles contained coal-tar dyes and ten samples of noodles contained turmeric. The coal-tar dyes, except in one sample which contained a nitro-color, were azo-colors related to, if not identical with, the orange dye commonly used as a butter color.

Only four of the samples of noodles contained appreciable amounts of eggs.

The maxima, minima and average results of the analyses of noodles follows:

	Water.	Ash.	Protein.	Nitrogen-free extract and fiber.	Fat.
Maximum	13.84	3.15	16.69	74.21	5.70
Minimum	12.03	0.46	12.19	61.32	0.22
Average	**12.94**	**0.88**	**13.46**	**71.89**	**0.83**

Samples Collected in 1904. Twenty-two samples of noodles collected during the present year have been analyzed, with the results given in Table IV, pages 142 and 143.

All of the samples contain foreign coloring matter, which in twelve cases was turmeric and in ten cases was an azo-color. As artificial colors convey the impression that water noodles are made with eggs, or that egg noodles contain a greater amount of eggs than was actually used, their presence without a declaration is obviously illegal.

The percentage amounts of lecithin-phosphoric acid and fat show that only the following three brands contain any considerable amounts of eggs or egg-yolks: C. F. Mueller & Co.'s White Leghorn Egg Noodles (**10718** and **10470**), The Anger Baking Co.'s Golden Seal German Egg Noodles (**10672** and **10829**) and A. Regensburger's Egg Nudeln (**10674**). According to Juckenack's standards none of these brands, except possibly the first, contain appreciably more than one egg or the yolk of one egg per pound of flour.

Methods of Analysis.

Water, ash, protein and fat are determined by the methods of the Association of Official Agricultural Chemists.

Tests for Dyes. Turmeric and nitro colors are extracted from the finely ground materials by long-continued shaking with alcohol, and are identified by the usual tests.

The orange coal-tar dyes commonly employed are not dissolved by this treatment but are readily extracted by shaking with a mixture of 10 parts of alcohol and one part of hydrochloric acid. The dye designated "tropeolin" in the table is soluble in the acid alcohol, the filtered liquid being a rich orange color, which on evaporation at a gentle heat, changes to a rose red. After a time this rose red color also appears on the edges of the filter and in the extracted (but not washed) starchy residue. It disappears on addition of alcohol but reappears on drying. Ammonia changes the color of the extract to a golden yellow.

The color dyes wool a dirty yellow by Arata's test, which changes to rose red on addition of acid. Concentrated hydrochloric acid added to the powdered material imparts a rose red coloration. These reactions indicate that the dye is an azo-color closely related to methyl orange and is probably the same as Geissler* and Crampton find in butter colors.

The following analytical scheme applies to the colors thus far detected at this station in noodles and similar products:

I. Yellow color extracted by 95% alcohol.
  A. Filter paper dipped in the concentrated alcoholic solution and dried becomes on moistening with dilute boric-hydrochloric acid and drying, cherry red, changing to blue-black with ammonia .... *Turmeric.*
  B. No cherry-red color obtained on the filter paper when treated as under A, or else the color is not changed to blue-black with ammonia.
    (1). Yellow color after evaporation of alcoholic solution is soluble in water; solution partially decolorized by hydrochloric acid .... *Nitro-colors.*
    (2). Yellow color after evaporation of alcoholic solution is insoluble in water........................ *Egg color.*

* J. Amer. Chem. Soc., **20**, 110.

II. No yellow color extracted by 95% alcohol but an orange color extracted by a mixture of 10 parts of 95% alcohol and 1 part of concentrated hydrochloric acid. Filter paper moistened with the acid-alcohol extract, on drying at room temperature, becomes rose-red ....Azo-color ("Tropeolin").

*Juckenack's Method for Determination of Lecithin-Phosphoric Acid.** Extract 30 grams of the finely ground material for 10 hours with absolute alcohol in a Soxhlet extractor at a temperature, inside the extractor, not below 55°–60° C. The extraction flask should be provided with a small quantity of pumice stone to prevent bumping during the boiling and the extractor enclosed by asbestos paper if the desired temperature is not readily maintained. After the extraction is completed, add 5 cc. of alcoholic solution of potash (prepared by dissolving 40 grams of phosphorus-free caustic potash in 1000 cc. alcohol) and distill off all the alcohol. Transfer the residue to a platinum dish by means of hot water, evaporate to dryness on a water bath, and char over asbestos. Treat the charred mass with dilute nitric acid, filter and wash with water. Return the residue with the paper to the platinum dish and burn to a white ash. Treat again with nitric acid, filter and wash, uniting the filtrates. Determine phosphoric acid by the usual method.

Juckenack† in his first paper calculated the percentages of ash, total phosphoric acid, lecithin-phosphoric acid and protein (N × 6¼) in noodles containing per pound of flour one to twelve eggs and one to twelve egg-yolks, assuming an average weight of the eggs and an average composition of both the eggs and the flour. Beythien and Wrampelmeyer,‡ also Sendtner,§ later called attention to the importance of determining fat, as this constituent is present in but small amount in flour and the addition of only a single egg increases the percentage more than twofold. Juckenack and Pasternack|| in a recent paper have substituted for the protein column in Juckenack's original table, which because of the variation of this constituent in the flour is of little value, a column giving the percentages of fat (ether extract).

The table on page 141 is compiled from figures given in the tables named.¶

According to Jaeckle's experiments** the lecithin-phosphoric in noodles decreases considerably on long standing. For example, in water noodles the percentage decreased in eight months from 0.0220 to 0.0119, in noodles made with three eggs per pound of flour from 0.1226 to 0.0607,

* Ztschr. f. Unters. Nahr.-u. Genussm., 1900, 3, 13.
† *Loc. cit.*
‡ *Ibid.*, 1901, 4, 145.
§ *Ibid.*, 1902, 5, 1018.
|| *Ibid.*, 1904, 8, 94.
¶ The German pound used in this calculation is approximately 468 grams. The avoirdupois pound is 454 grams.
** Ztschr. f. Unters. Nahr.-u. Genussm., 1904, 7, 513.

Number of eggs per pound of flour.	Composition of the dry matter.					Number of egg yolks per pound of flour.	Composition of the dry matter.				
	Ash.	Total phosphoric acid.	Lecithin-phosphoric acid.	Ether extract.	Protein (N x 6¼).		Ash.	Total phosphoric acid.	Lecithin phosphoric acid.	Ether extract.	Protein (N x 6¼).
	%	%	%	%	%		%	%	%	%	%
0	0.460	0.2300	**0.0225**	**0.66**	12.00	0	0.460	0.2300	**0.0225**	**0.66**	12.03
1	0.565	0.2716	**0.0513**	**1.56**	12.99	1	0.488	0.2720	**0.0518**	**1.57**	12.37
2	0.664	0.3110	**0.0786**	**2.42**	13.92	2	0.516	0.3127	**0.0801**	**2.47**	12.73
3	0.758	0.3482	**0.1044**	**3.24**	14.81	3	0.542	0.3520	**0.1075**	**3.33**	13.07
*	*	*	*	*	*	*	*	*	*	*	*
12	1.426	0.6123	**0.2875**	**7.94**	21.09	12	0.745	0.6533	**0.3171**	**8.64**	15.71

and so on. On the other hand, the iodine number of the fat and also the percentages of fat increased with time, the latter, however, but slightly.

Juckenack and Pasternack's and Sendtner's experiments do not bear out Jaeckle's conclusions, at least as applied to the commercial product, but a final verdict can not be reached until numerous experiments now in progress in European laboratories are completed.

Owing to lack of material, we are unable to report results bearing on this point except on one sample (No. 10718). In the finely ground sample analyzed early in February, 1904, we found 0.0461 per cent. of lecithin-phosphoric acid, while in the same ground sample, kept in the meantime in a glass stoppered bottle, we obtained, late in October of the same year, 0.0431 per cent. These results indicate that no appreciable loss of lecithin-phosphoric acid was sustained on standing nearly nine months during the warmest seasons.

Since Jaeckle's experiments show that the percentage of fat is not considerably altered on standing, and since the analyses made by Sendtner and more recently by Juckenack and Pasternack indicate that flour used for noodles may contain as high as 0.0533 per cent. of lecithin-phosphoric acid, there is little fear of injustice to the manufacturers if the percentages of lecithin-phosphoric acid and fat are both taken into consideration in judging commercial noodles. It should, however, be remembered that fat may be added to noodles in some form other than in eggs.

BUCKWHEAT FLOUR.

For years various mixtures of buckwheat flour with wheat middlings, maize flour or other cereal products have been commonly sold under the name of buckwheat flour. Griddle cakes made from the mixtures are lighter colored than those made from pure buckwheat flour and have a very different flavor.

TABLE IV.—ANALYSES OF NOODLES.

Station No.	Brand.	Dealer.	Price per pound, cents.	In the Air-Dry Material. Water.	Ash.	Protein.	Nitrogen-free extract and fiber.	Fat.	Lecithin-phosphoric acid.	In the Water-Free Material. Ash.	Protein.	Nitrogen-free extract and fiber.	Fat.	Lecithin phosphoric acid.	Color.
				%	%	%	%	%	%	%	%	%	%	%	
10767	Sold in bulk	*Bridgeport.*—A. Merten, 263 State St.	20	12.79	0.69	14.94	69.41	2.17	0.025	0.79	17.12	79.59	2.50	0.029	Tropeolin.*
10569	" "	R. Wundrack, 1277 Main St.	20	13.16	0.51	12.87	73.15	0.31	0.024	0.59	14.82	84.23	0.36	0.028	"
10368	Maas Baking Co., New York, Homemade Egg Noodles	*Danbury.*—R. Krakow, 71 White St.	20	12.66	0.66	15.19	70.47	1.02	0.028	0.76	17.39	80.68	1.17	0.032	"
10781	Sold in bulk	*Derby.*—Schuessler's Delicatessen, Bridge St.	16	11.78	1.00	14.12	72.65	0.45	0.017	1.14	16.01	82.35	0.50	0.019	Turmeric.
10798	" "	*Meriden.*—G. A. Bauer, 73 W. Main St.	12	12.57	1.05	12.31	73.59	0.48	0.023	1.20	14.08	84.17	0.55	0.026	"
10759	" "	Delicatessen, 213 Pratt St.	10	13.03	1.00	12.81	72.88	0.28	0.023	1.15	14.73	83.80	0.32	0.027	Tropeolin.*
10760	" "	C. F. Fox, 24 E. Main St.	16	13.16	1.09	12.50	72.71	0.54	0.022	1.28	14.39	83.72	0.61	0.025	Turmeric.
10797	" "	Meriden Tea & Coffee Co., 19 E. Main St.	10	12.49	0.53	13.06	73.37	0.55	0.021	0.61	14.92	83.84	0.63	0.024	Tropeolin.*
10717	" "	*New Britain.*—Theo. Maurer, 91 Arch St.	16	11.98	1.13	13.81	72.62	0.46	0.021	1.29	15.69	82.51	0.51	0.024	Turmeric.
10718	C. F. Mueller & Co., Jersey City, White Leghorn Egg Noodles	Union Trading Co., 61 Arch St.	20	12.84	0.87	15.75	68.51	2.03	0.046	1.00	18.07	78.60	2.33	0.053	"
10672	The Anger Baking Co., New York, Golden Seal German Egg Nudeln	*New Haven.*—F. J. Boese, 960 State St.	20	12.91	0.57	15.31	69.62	1.59	0.040	0.65	17.57	79.95	1.83	0.046	Tropeolin.*
1981	Sold in bulk	Delicatessen, 146 George St.	10	11.42	1.09	12.69	74.26	0.54	0.021	1.23	14.33	83.83	0.61	0.023	Turmeric.
1980	" "	Hartman & Miller, 805 Grand Ave.	10	12.10	1.00	13.75	72.90	0.25	0.017	1.14	15.65	82.93	0.28	0.019	"
10784	" "	S. J. Hugo, 120 Crown St.	16	11.96	0.96	13.94	72.68	0.46	0.019	1.09	15.84	82.55	0.52	0.022	"
10785	" "	Phoelin's Delicatessen, 367 Congress Ave.	10	12.76	1.03	14.25	71.48	0.48	0.017	1.18	16.34	81.93	0.55	0.019	"
10674	A. Regensburger's Egg Nudeln, New York	*New London.*—J. W. Kopp & Son, 133 Bank St.	24	13.59	0.63	14.00	70.10	1.68	0.031	0.73	16.21	81.12	1.94	0.036	Tropeolin.*
10675	Sold in bulk	*Norwich.*—Gus Thumm, 73 Franklin St.	16	13.62	0.53	13.37	71.88	0.59	0.019	0.61	15.48	83.22	0.69	0.022	"
10568	C. F. Mueller & Co., Jersey City, Egg Noodles	*So. Norwalk.*—Conrad Becker, 141 Washington St.	14	13.66	1.03	12.56	72.19	0.56	0.013	1.19	14.53	83.63	0.65	0.015	Turmeric.
10473	Sold in bulk	G. E. Freidrick, R. R. Ave.	15	12.27	1.06	12.56	73.51	0.60	0.020	1.21	14.32	83.79	0.68	0.023	"
10374	" "	*Stamford.*—H. Newstad & Co., 39 Pacific St.	10	13.02	0.43	12.12	74.11	0.32	0.016	0.49	13.92	85.20	0.39	0.018	Tropeolin.*
10470	C. F. Mueller & Co., Jersey City, White Leghorn Egg Noodles	Stamford Cash Grocery, 88 Pacific St.	20	12.36	0.90	15.62	69.11	2.01	0.050	1.02	17.82	78.87	2.29	0.058	Turmeric.
10829	The Anger Baking Co., New York, Golden Seal German Egg Nudeln	*Waterbury.*—The White Simmons Co., 163 Bank St.	20	12.72	0.61	13.25	71.79	1.63	0.035	0.69	15.18	82.26	1.87	0.040	Tropeolin.*

*Coal-tar dye.

While it may be true that some of these mixed flours cost as much to prepare as clear buckwheat flour and are preferred by some consumers, it is also true that many prefer clear buckwheat flour to the mixtures. But the matters of personal preference and cost of production are aside from the real issue.

To sell as buckwheat flour, without any qualification, a flour which contains a considerable amount of wheat or corn meal is, in our judgment, a violation of the pure food law. Under a strict construction of the law, probably the word "prepared" on the label is not sufficient to indicate that the article referred to is a mixture or compound.

Prepared or self-raising buckwheat flour contains the proper proportions of baking powder and salt so that it can be prepared for cooking by simply mixing with water or milk. In addition to buckwheat flour all the brands we have examined also contain wheat flour or corn flour or both, and some of them may have contained rice or barley flour. The constituents are in some, though not in all, cases stated on the package.

Examination of Samples Collected by the Station.

The extent to which mixed and prepared buckwheat flour is sold is indicated by the results of our examination of samples during 1900 and the past year (1904), a summary of which follows:

	1900.	1904.
Number of samples not found adulterated	63	41
Number of samples adulterated with wheat flour, corn flour or both	44	16
Per cent. of samples adulterated	41	28
Number of samples of self-raising or prepared buckwheat flour	8	15

The details with regard to the samples examined in 1904 are given in Tables V, VI and VII, pages 145, 146, 147.

BAKING POWDERS.

The leavening of bread products, whether by yeast or baking powder, is accomplished by an evolution throughout the whole mass of dough of carbonic acid gas, which in escaping makes the baking bread light and porous.

Yeast introduces into the dough microscopic plants which cause alcoholic fermentation and thus split up the sugars originally present, or formed during the process, into carbonic acid and alcohol, both of which escape, in large part, during the baking.

Baking powders, on the other hand, evolve carbonic acid in the dough, by the chemical reaction of bicarbonate of soda with cream of tartar, acid phosphate, alum or other chemicals, and leave, in the dough, the non-volatile products of the reaction, consisting partly or wholly of mineral matters.

The same chemical action results when bicarbonate of soda is used by the cook in conjunction with cream of tartar, sour milk or molasses.

Consumption of Baking Powder. In the memorial of the American Baking Powder Association, issued in 1900, it is stated that the sale of baking powder in the United States aggregates, approximately, 118,500,000 pounds per annum, or about one and one-half pounds *per capita.* These figures are conclusive proof of the national fondness for cake, griddle cakes, soda biscuit and other bread products made with baking

Table V.—Buckwheat Flour not found Adulterated.

Station No.	Dealer.	Price per pound, cents.
	Bridgeport.	
11458	E. L. Sullivan, 1142 E. Main St.	4
11454	E. E. Wheeler, 1135 Main St.	3
	Danbury.	
11474	Danbury Grocery Co., 293 Main St.	4
11473	Ehle's Cash Grocery, 5 West St.	4
11471	M. McPhelemy, 44 White St.	4
11470	N. Y. Cash Grocery, 309 Main St.	4
	Hartford.	
11495	Citizen's Grocery, 267 Main St.	4
11494	City Hall Grocery, 42 State St.	4
11488	C. N. Dodge, 338 Main St.	4
11492	C. J. Dow, 2 Church St.	3
11496	H. Griswold, 547 Main St.	4
11493	P. S. Kennedy, 1040 Main St.	5
11491	C. H. Strong, 131 Main St.	4
11483	The Smith & Clapp Grocery, 187 Asylum St.	4
11490	A. H. Tillinghast, 341 Main St.	4
	Meriden.	
11467	A. Y. Berg, 61 W. Main St.	4
11466	M. W. Borth, 41 E. Main St.	5
11465	H. E. Bushnell, 75 W. Main St.	4
11464	Kapitzke Bros., 80 E. Main St.	5
	New Britain.	
11468	Wm. Foulds, 236 Park St.	4
	New Haven.	
11449	C. F. Curtis, 932 State St.	4
11448	J. P. Hugo, 92 Nicoll St.	4
11442	F. J. Markle, 105 Broadway	4
	New London.	
11509	J. R. Avery, 19 Broad St.	5
11508	Wm. A. Holt, 50 Main St.	5
11570	Keefe, Davis & Co., 125 Bank St.	4
	Norwich.	
11507	E. F. Burlingame, W. Main and Thames St.	4
11505	W. H. Cardwell, Market St.	5
11506	Wheeler Bros., 2 Cliff St.	4
11504	Thos. Wilson, 78 Franklin St.	5
	Stamford.	
11459	C. Andresen & Co., 592 Main St.	4
11460	Fitch A. Hoyt, Atlantic Square	4
	Waterbury.	
11479	W. H. Fudge, 446 S. Main St.	4
11480	G. W. McGregor, 411 S. Main St.	4
11477	The White Simmons Co., 165 Bank St.	5
11478	The Woodruff Grocery, 40 N. Main St.	4
	Willimantic.	
11500	D. F. Blish & Son, 66 Church St.	5
11499	City Grocery, 877 Main St.	5
11498	Hall's Cash Store, 15 Union St.	5
11501	Frank Larrabee, 20 Church St.	5
11497	Reade Bros., 709 Main St.	5

Table VI.—Adulterated Buckwheat Flour.

Station No.	Dealer.	Price per pound, cents.	Foreign starch or flour.
	Bridgeport.		
11455	The Coe & White Co., 1256 Main St.	4	Wheat.
11457	Village Store Co., 1624 Main St.	3	Maize.
11456	Village Store Co., 244 State St.	3	Maize.
	Danbury.		
11472	W. D. Baldwin, 93 White St.	4	Wheat.
11475	Village Store Co., 236 Main St.	3	Wheat, maize.
	Meriden.		
11463	Boston Grocery, 17 Colony St.	5	Wheat.
	New Britain.		
11469	Sidney Oldershaw, 250 Park St.	3	Wheat.
	New Haven.		
11441	S. S. Adams, State and Court Sts.	4	Wheat.
11447	R. I. Blakeslee, 40 Grand Ave.	4	Maize.
11445	A. Duhan, 1134 State St.	3	Wheat.
11435	Logan Bros., 406 Congress Ave.	3	Wheat.
11436	H. M. Tower, 379 Congress Ave.	4	Wheat.
11446	A. H. Waterbury, Grand and Poplar St.	4	Maize.
11434	D. M. Welch, 28 Congress Ave.	4	Wheat.
	Stamford.		
11461	R. T. Woodbury, 107 Pacific St.	4	Wheat.
	Waterbury.		
11481	Public Market. 163 S. Main St.	4	Wheat.

powder, and justify a careful study of the brands on the market.

Constituents of Baking Powders.

Two ingredients are essential in a baking powder: (1) a carbonate which contains the carbonic acid gas necessary to raise the dough, and (2) an acid constituent, or its equivalent, which, in the presence of moisture, liberates carbonic acid from the carbonate. Nearly every brand on the market also contains a "filling," consisting usually of starch or flour, which improves the keeping quality of the baking powder by hindering the reaction of the acid and alkali within the package.

Bicarbonate of Soda. The chief, and in nearly every case the only, source of carbonic acid gas in the baking powders of to-day is bicarbonate of soda, also known as baking soda. A

Table VII.—"Prepared" or "Self-Raising Buckwheat Flour."

Sample No.	Brand.	Dealer.	Price per package, cents.	Weight per package, pounds.	Flour other than Buckwheat.
		Bridgeport.			
11453	Atlantic & Pacific Tea Co. Grandmother's Self-Raising Buckwheat Flour	Atlantic & Pacific Tea Co., 957 Main St.	10	2	Wheat.
11451	Eureka Milling Co., N.Y. Eureka Prepared Buckwheat Flour	H. Isenberg & Co., 111 and 115 State St.	15	3	Wheat, maize.
11452	Bridgeport Public Market. Prepared Buckwheat	Public Market, 110 State St.	10	3	Wheat.
		Danbury.			
11476	Gansevoort. Extra Prepared Buckwheat	City Grocery, 147 Main St.	10	3	"
		Hartford.			
11265	Borst & Burhans, Cobleskill, N. Y. 20th Century Dime Self-Raising Buckwheat Flour	Hills & Co., 372 Asylum St.	10	--	Wheat, maize.
11489	The Pieser-Livingstone Co. Uncle Jerry's New England Self-Rising Buckwheat Flour, Compound.*	S. Vogel, 361 Main St.	10	--	" "
		New Haven.			
11450	The H. O. Co.'s Self-Raising Buckwheat †	3 G's Cash Store, 23 Edwards St.	10	2	" "
11443	Prepared Staple Buckwheat	Kohn Bros., 55 George St.	12	3	Wheat.
11438	Barber & Bennett, Albany, N. Y. IXL Prepared Buckwheat Flour‡	New Eng. Grocery Co., 298 Congress Ave.	10	2	Wheat, maize.
11444	S. H. Street & Co., New Haven. Street's Perfection Prepared Buckwheat Flour §	E. Schoenberger & Son, 92 George St.	15	--	Wheat.
11437	The Mohican Co. Prepared Buckwheat	The Mohican Co., 22 Church St.	12	3	"
		Norwich.			
11503	Borst & Burhan's, Cobleskill, N. Y. Sure Rising Buckwheat Flour‖	Appley & Gordon, 86 W. Main St.	15	3	Wheat, maize.
11502	Hecker-Jones-Jewell Milling Co., New York. Hecker's Self Raising Buckwheat ¶	A. Francis & Son, W. Main and Thames St.	17	3	" "
		Stamford.			
11462	Atlantic Mills Best Prepared Buckwheat	Empire State Tea Co., 301 Main St.	13	3	" "
		Waterbury.			
11482	"Ever Ready" Prepared Buckwheat Flour	The Hewett Grocery Co., 16 N. Main St.	15	3	" "

* 70% buckwheat flour, 20% wheat flour, 10% corn flour.

† 84% buckwheat, 8½% wheat, 7½% white corn flour, and necessary seasoning and leavening.

‡ 85% buckwheat flour, 8% wheat flour, 7% white corn flour, and necessary seasoning and leavening.

§ Mixture of pure flour and wholesome phosphatic leavening material.

‖ 77% buckwheat flour, 15% wheat flour, 8% tart. soda and salt.

¶ Mixture of pure flour and wholesome phosphatic leavening materials.

few years ago, a number of brands on the market contained, in addition to bicarbonate of soda, a small percentage of carbonate of ammonia, but it is stated that owing to popular, although perhaps unjust criticism, the use of this chemical has been largely discontinued. Pure bicarbonate of soda contains over 52 per cent. of carbonic acid.

Filling. The presence of a harmless material, such as starch or flour, in a baking powder of good leavening power is not regarded as an adulterant, but rather as an ingredient essential for the proper keeping of the product. The manufacturers of a certain brand which contains no "filling" claim, however, that starch is not necessary to insure the keeping qualities, provided the powder is properly prepared in a dry climate. Our analyses of this brand seem to justify this claim.

Sulphate of lime (gypsum or land plaster), which in small amount is unavoidably introduced into phosphate and alum-phosphate powders, as an impurity of the acid phosphate, is separately added as a "filling." It is slightly soluble in water and, although it has no decided toxic properties, is a highly undesirable addition to food products.

Another mineral filling, more dangerous than gypsum, which has been found in a single brand of baking powder sold in Connecticut, is the material known as argolite, which consists of a ground mixture of talc (soapstone) and asbestos-like tremolite.

Acid Materials. The chemical used to liberate gas from the bicarbonate may be: (1) a true acid (tartaric acid), (2) an acid salt (cream of tartar, acid phosphate of lime, etc.), or (3) a neutral salt having the power of reacting with the bicarbonate (alums, aluminum sulphate, etc.). Baking powders are usually classified according to the kind of acid material which they contain.

A consideration of these acid materials and the residues left after their reaction with the bicarbonate is essential for a proper understanding of the wholesomeness of the powders in which they are contained.

The efficiency of a powder as a leavening agent depends on the amount of gas it evolves in the dough and must be considered apart from the wholesomeness of the residues.

Classes of Baking Powders.

Tartaric Acid Baking Powder. Tartaric acid is a colorless crystalline substance, readily soluble in water. It is the chief acid constituent of grapes and is contained in all grape wines. Like cream of tartar, it is prepared from the settlings of the wine casks known as argols. The residue left in the dough by a tartaric acid powder consists of tartrate of soda, which is a salt acting with a power equal to that of sulphate of magnesia (Epsom salts) in the dose of ten drachms (one and one-quarter ounces).* A dozen biscuits made with a quart of flour and 2 teaspoonfuls (0.18 ounce) of a good tartaric acid powder contain about one-fifteenth of an ounce of tartrate of soda, or less than one-nineteenth of a medicinal dose.†

Cream of Tartar Baking Powder. Cream of tartar, the commercial name for bitartrate of potash, is a colorless crystalline salt, with an agreeable acid taste. Unlike tartaric acid, it is difficultly soluble in water. It is the chief ingredient of argols, from which it is prepared by recrystallization. The fixed product of its reaction with bicarbonate of soda is Rochelle salts (tartrate of soda and potash), which in doses of from half an ounce to an ounce is a well known purgative.‡ About one-sixth ounce of Rochelle salts, or less than one-quarter the average dose, is formed in a batch of twelve biscuits made from a quart of flour and two teaspoonfuls (0.22 ounce) of a tartrate baking powder.

Phosphate Baking Powders. The acid ingredients of these powders is a purified acid phosphate of lime commonly obtained by the action of sulphuric acid on bone ash or some other form of phosphate of lime. It usually contains a certain amount of sulphate of lime as an impurity incidental to the process of manufacture.

The residual products of a phosphate powder are phosphate of lime (chiefly dibasic phosphate), phosphate of soda, and sulphate of lime (gypsum or plaster).

* U. S. Dispensatory, 17th ed., p. 1744.

† The officinal teaspoon holds one fluid drachm, but when used to measure powders it is customary to heap the spoon so that it contains twice as much as when level full. Two teaspoonfuls (heaped in this way) of samples representing the different classes of baking powders were weighed in the laboratory and the weights thus obtained were used in the calculations of the amount of salts left after baking.

‡ U. S. Dispensatory, p. 1095.

Dibasic phosphate of lime is a white, crystalline solid, almost insoluble in water, but soluble in dilute mineral acid and probably in gastric juice. It is not mentioned in the Pharmacopoeia or Dispensatory.

Phosphate of soda is a colorless crystalline salt, readily soluble in water. "In doses of from 1 to 2 ounces it is a mild purgative, and, from its pure saline taste, it is well adapted to the cases of children and of persons of delicate stomachs." Administered with each meal in doses of from 3 to 10 grains, it is useful in infantile bilious disorders.*

Sulphate of lime is not used internally in medicine.

Twelve biscuits made from one quart of flour and two teaspoonfuls (0.25 ounce) of a good phosphate baking powder contain about one-sixth ounce crystallized phosphate of soda, together with a variable amount of phosphate and sulphate of lime.

The manufacturers of phosphate powder claim that "it restores the phosphates, so essential to health, which are removed from flour in bolting, and on this account is recommended by physicians." Phosphorus, it is true, is an essential ingredient of foods, but it is chiefly valuable in organic combination and the phosphorus of inorganic phosphates is believed by physiologists to play only a subordinate part in animal nutrition. While it is doubtful whether the residue left by phosphate baking powders adds to the nutritive value of bread products, it is probably as unobjectionable as the residues left in bread by tartaric acid and cream of tartar powders.

Alum and Alum-Phosphate Baking Powders. The acid material in brands known as alum or "straight" alum powders is entirely alum, whereas in alum-phosphate powders it is a mixture of alum and acid phosphate of lime.

Alum is a somewhat indefinite term applied to a number of double sulphates (usually of alumina and an alkali), all of which are much alike in chemical and physical properties. Three of these double salts, known as potash alum, ammonia alum and soda alum, have been used in the manufacture of baking powders. At present soda and ammonia alums are usually employed, although sulphate of alumina, a salt with the valu-

* *Ibid.*, p. 1256.

able, as well as the objectionable, properties of the alums, is said to be preferred by some manufacturers.

"Alum is a powerful astringent, with very decided irritant qualities, owing to which, when taken internally in sufficient quantity, it is emetic and purgative and may even cause fatal gastro-intestinal inflammation."*

But in a properly mixed baking powder the alum is largely, if not entirely decomposed, during the making of the bread.

By the reaction of soda alum or sulphate of alumina and bicarbonate of soda, hydrate of alumina and Glauber's salts (sulphate of soda) are produced. If ammonia alum is present, instead of soda alum, the residue contains, in addition to hydrate of alumina and Glauber's salts, a certain proportion of sulphate of ammonia.

The alumina in the residue from an alum-phosphate powder is partly at least in the form of phosphate, and in addition all the salts contained in the residues of both phosphate and alum powders may be present, the exact composition of this residue being determined by the proportion of ingredients in the powder.

Hydrate and phosphate of alumina in a moist condition are white gelatinous substances, insoluble in water, but soluble in dilute hydrochloric acid and presumably in the gastric juice. The phosphate is not used in medicine, the hydrate but rarely and then only as an external application.

Glauber's salts, in doses of from one-half ounce to an ounce, is an efficient hydragogue cathartic; in smaller doses, an aperient and diuretic.†

A batch of twelve biscuits, made from a quart of flour and two teaspoonfuls (0.19 ounce) of a "straight" alum powder of good leavening power, contains about seven and one-half grains of hydrate of alumina and one-eighth ounce of Glauber's salts. Owing to the variable composition of alum-phosphate powders no satisfactory calculation can be made of the amount of salts in the residues.

Regarding the wholesomeness or unwholesomeness of the several kinds of baking powders the opinions of experts as well as of the public differ widely.

* U. S. Dispensatory, p. 144.
† U. S. Dispensatory, p. 1260.

All baking powders, without exception, leave in the finished bread certain salts, named in preceding paragraphs, which are foreign to the flour and which are used in medicine as active cathartics. Common sense indicates that were it not for the great convenience and saving of time which is secured by using baking powders, the introduction into foods of these salts would be generally condemned, because of their physiological effects.

The use of alum or any alumina salt in baking powder is open to much more serious objection. Alum itself is a powerful astringent with irritant qualities, the use of which in any article of food is dangerous and should not be tolerated.

It is claimed, however, that alum is wholly decomposed in the processes of bread-making, so that no trace of it is left, but in its place only the hydrate and phosphate of alumina.

But it is not certain that the alum in a baking powder is wholly decomposed—if present in excess it cannot be—and under any circumstances it is very doubtful whether in the process of bread-making a complete reaction between the ingredients of baking powders can be secured.

There is also good reason to believe that both the hydrate and the phosphate of alumina are soluble in the muriatic acid of the gastric juice and may have a physiological action similar to that of alum.

A careful study of the chemical nature and physiological action of the ingredients of baking powders leads to the conclusion that, while as a class they are not generally regarded as unwholesome, all of them are objectionable in that they introduce into bread salts having a decided medicinal action, but that alum in baking powders is much more likely to be injurious than any other active ingredient which is at present commonly used.

Examination of Samples Collected by the Station.

In 1900 complete analyses were made at this station of 76 brands of baking powder collected in various parts of the state, the results of which were published in the report for that year. During the present year over 100 samples were collected, but of these a considerable number were of brands which had been examined in 1900 and which it was thought unnecessary to

reëxamine. The remaining samples, 60 in number, were partially analyzed, with the results given in Table VIII, page 154.

The samples examined in 1900 and 1904 may be classified as follows:

	1900.	1904.	Total brands.
Tartaric Acid Powders	1	0	1
Cream of Tartar Powders	5	2	7
Cream of Tartar-Tartaric Acid Powders	8	4	12
Phosphate Powders	3	2	5
Alum Powders	15	5	20
Alum-Phosphate Powders*	44	47	91
Total	76	60	136

Adulterated Baking Powders. Three of the alum powders and seven of the alum-phosphate powders examined during the present year contain large amounts of calcium sulphate or gypsum, showing either that they were made from very impure acid phosphate of lime or that sulphate of lime had been purposely added. The purified acid phosphate of lime such as is present in all of the five brands of phosphate powders we have examined, and also in many of the brands of alum-phosphate powder, contain but a small amount of this impurity and there is no valid excuse for the presence of the large amounts in the samples in question.

A list of the brands of baking powder found to contain excessive amounts of sulphate of lime follows:

Alum Powders. Barnett's; Becker's Twin City; Snow Flake.

Alum-Phosphate Powders. Carlson's; Empress; Manhattan; Harrison & Lautzenheiser's; Mulcunry's; Otham Bros.' Reliable; Quaker.

* Some of these contained in addition to alum and acid phosphate of lime a small amount of tartaric acid.

Table VIII.—Baking Powder.

Station No.	Brand.	Dealer.	Price per ½ pound, cents.	Lime.	Alumina.	Oxide of Iron.	Sulphuric acid.	Phosphoric acid.
	Cream of Tartar Powders.			%	%	%	%	%
10421	T. K. Orton, Bridgeport. Excellent	*Bridgeport*—Geo. Rivers, 1659 Main St.	10*	0.00	0.00	0.00	0.00	trace
10638	D. & L. Slade Co., Boston. Congress	*Norwich*—A. T. Otis & Son, 261 Main St.	15	0.00	0.00	0.00	0.00	trace
	Cream of Tartar—Tartaric Acid Powders.							
10658	Wm. Howard Hoople, N. Y. Hoople's	*Ansonia*—P. W. Fogarty, 13 High St.	5*	0.00	0.00	0.00	0.00	trace
10402	John L. Mahoney. Brunswick J. L. M.	*Greenwich*—J. L. Mahoney, Greenwich Ave.	10*	0.00	0.00	0.00	0.03	trace
10627	The Mohican Co. Pure Cream Tartar	*New Haven*—The Mohican Co., 22 Church St.	19	0.00	0.00	0.00	0.00	trace
10404	Sea Foam Bak'g Powder Co., N. Y. Gantz Sea Foam	*Greenwich*—Knapp & Studwell, Greenwich Ave.	25†	0.00	0.00	0.00	0.00	0.00
	Phosphate Powders.							
10622	Independent Baking Powder Co., Chicago. Solar	*New Haven*—McGovern Bros., 240 Lombard St.	10	4.62	0.00	0.13	0.28	18.24
10620	Ralston Purina Co., St. Louis. Ralston Health	*Hartford*—Wise, Smith & Co., Main St.	15	8.58	0.20	0.40	0.39	20.61
	Alum Powders.							
10405	C. Andresen & Co., New York. Excelsior	*Stamford*—C. Andresen & Co., Main St.	8	0.01	6.30	0.20	18.69	0.08
10409	R. T. Barnett. Barnett's	R. T. Barnett, 303 Main St.	10†	6.12	3.68	0.13	18.47	0.47
10415	Conrad Becker. Becker's Twin City	*So. Norwalk*—C. Becker, 141 Washington St.	10	8.98	3.08	0.40	23.19	0.13
10401	London Baking Powder Co., N. Y. London	*New Milford*—Ackley, Hatch & Marsh	10†	0.25	5.33	0.27	16.93	0.46
10389	Snow Flake Baking Powder Co. Snow Flake	*Danbury*—R. E. Church, 147 Main St.	10†	6.52	3.61	0.07	19.78	0.08
	Alum—Phosphate Powders.							
10395	C. Beers. Superior	*Danbury*—C. Beers, 101 White St.	18†	3.25	4.22	0.60	14.20	5.96
10649	The Wm. Boardman & Sons Co., Hartford. Crest	*Middletown*—O. Thompson & Co., 592 Main St.	25†	3.87	3.69	0.27	15.10	4.90
10665	Carlson's Coffee and Butter Store. Carlson's Best	*Naugatuck*—Carlson's Tea Store, 162 Church St.	15	11.40	3.91	0.13	25.53	3.72
10656	Climax Baking Powder Co., New York. Snow Ball	*Meriden*—Grant's Tea Store, 20 E. Main St.	13	3.25	4.66	0.54	14.91	6.14
10418	The Coe & White Co. Superior	*Bridgeport*—Coe & White, 1256 Main St.	15†	3.30	4.44	0.60	14.89	5.98
10661	G. H. Crook. Crook's	*Derby*—G. H. Crook, 194 Elizabeth St.	10	2.01	3.74	0.13	10.27	5.56
10396	The Danbury Grocery Co. Snow Flake	*Danbury*—Danbury Grocery Co., Main St.	10†	3.23	4.60	0.60	14.82	6.03
10412	D. S. Davenport. White Rose	*So. Norwalk*—D. S. Davenport, 20 N. Main St.	15†	1.25	4.21	0.27	12.84	2.74
10667	The J. T. Doyle Co. Yale Club	*Waterbury*—M. J. Corcoran, 38 Scoville St.	10	3.63	4.17	0.34	12.17	6.59
10625	Eastern Tea Co., New Haven. Eastern	*New Haven*—D. R. Dingwall, 393 Grand Ave.	25†	1.42	3.01	0.20	9.37	4.30
10392	David W. Ehle	*Danbury*—Ehle's Cash Grocery, 3 West St.	18†	3.46	4.42	0.67	14.64	6.14
10654	Fairy Baking Powder Co., N. Y. Fairy	*New Britain*—Am. Importing Tea Co., 95 Arch St.	10	1.74	3.66	0.20	11.15	5.42
10400	The Farmers' Trading Co. Waramaug	*New Milford*—Farmers Trading Co., Church St.	25†	2.06	3.49	0.27	11.28	5.59

* Price per ¼ pound. † Price per pound.

Table VIII.—Baking Powder—*Continued.*

Station No.	Brand.	Dealer.	Price per ½ pound, cents.	Lime.	Alumina.	Oxide of Iron.	Sulphuric acid.	Phosphoric acid.
				%	%	%	%	%
0639	I. Fiedler, Norwich. Manhattan	*Norwich*—Manhattan Tea Store, 6 Main St.	25†	11.24	3.82	0.20	25.50	3.33
0642	The R. T. French Co., Rochester. Sunshine Dime	*Danielson*—A. H. Armington, Main St.	10†	2.73	2.73	0.27	11.85	3.81
0633	The 3 "G." Cash Grocery. 3 "G."	*New Haven*—The 3 G. Cash Grocery, 23 Edwards St.	10	1.84	3.38	0.60	11.01	5.44
0423	Harrison & Lautzenheiser	*Bridgeport*—Harrison & Lutzenheiser, 1197 Main St.	30†	6.32	3.86	0.27	19.35	2.74
0397	Higgins. Standard	*Danbury*—Village Store Co., 236 Main St.	7	3.26	4.60	0.54	14.96	6.04
0403	Alex. J. Howell, New York. Gem	*Greenwich*—Geo. A. Ferris, Greenwich Ave.	10	3.13	4.05	0.27	12.36	10.01
0390	Hoyt & Scott	*Danbury*—Hoyt & Scott, 7 West St.	20†	2.58	3.73	0.20	13.61	5.29
0643	Hudson Val. Pres. Co., Glens Falls, N. Y. The Superb	*Putnam*—E. T. Tucker, Union St.	15	3.85	1.92	0.20	6.99	10.43
0422	Isenburg Bros., Irvington, N. J. White Lily	*Bridgeport*—H. Isenburg, 109 State St.	20†	1.96	3.58	0.20	10.82	5.41
0655	Jacques Mfg. Co., Chicago, I. C. 10 oz. 10 cts.	*New Britain*—C. M. Oquist, 239 Elm St.	10‡	1.43	4.20	0.13	13.16	2.96
0414	F. D. Lawton & Co., Lawton & Co's. Superior	*So. Norwalk*—F. D. Lawton & Co., 22 S. Main St.	10†	3.31	4.67	0.60	14.57	6.19
0660	E. J. Malumphy. Best	*Derby*—E. J. Malumphy, 8 Elizabeth St.	10	2.78	3.77	0.34	12.47	3.59
0623	P. McKeon. Empress	*New Haven*—P. McKeon, 168 Chapel St.	8	7.38	3.69	0.20	20.14	2.78
0398	Monarch Mfg. Co., New York. Monarch	*Norwalk*—New York Grocery, 35 Main St.	10	2.19	3.65	0.27	11.87	6.31
0837	Wm. Mulcunry. Mulcunry's	*Torrington*—Wm. Mulcunry, 16 S. Main St.	10	11.33	3.83	0.13	25.31	3.25
0636	H. D. Norton & Co., New Haven. Norton's Best	*New Haven*—The Peoples Store, 748 State St.	8	3.59	3.69	0.20	13.63	5.24
0650	Olin I. Oldershaw. Oldershaw's High Grade	*New Britain*—Sidney Oldershaw, 250 Park St.	10	2.02	3.58	0.20	10.66	5.52
0411	Otham Bros. Reliable	*Norwalk*—Otham Bros., 53 Main St.	20†	12.07	3.53	0.27	26.59	3.19
0413	Quaker Baking Powder Co., New York. Quaker	*So. Norwalk*—L. Joseloff, 72 N. Main St.	20†	9.06	3.54	0.13	23.04	1.02
0419	Rose & Wills. Superlative	*Bridgeport*—Rose & Wills, 1894 Main St.	20†	1.97	3.20	0.54	10.09	5.41
0657	H. F. Rudolph. Rudolph's	*Meriden*—H. F. Rudolph, 48 E. Main St.	10	3.14	4.84	0.34	14.87	6.06
0645	The T. R. Sadd Co. Sadd's Pure	*Willimantic*—The T. R. Sadd Co., 760 Main St.	25†	1.92	3.55	0.20	10.14	5.29
0652	Star Tea Co. Frazier's Star	*New Britain*—Star Tea Co., 227 E. Main St.	25	2.04	3.26	0.20	10.64	5.55
0666	Stuart & DeMouth, N. Y. Pearl	*Waterbury*—Public Market, 163 S. Main St.	14	3.28	4.87	0.54	14.86	6.25
0417	E. L. Sullivan	*Bridgeport*—E. L. Sullivan, 1142 E. Main St.	15†	3.35	4.57	0.54	14.25	6.17
0663	Swan & Babcock. Delicious	*New Haven*—Swan & Babcock, 27 Dixwell Ave.	25†	3.38	4.13	0.40	14.99	6.13
0838	The Torrington Co-op. Co. Co-operative	*Torrington*—The Torrington Co-op. Co., 135 Main St.	9	3.26	4.81	0.54	14.87	6.12
0619	Union Grocery. Old Glory	*Hartford*—Union Grocery Co., 1026 Main St.	15	3.41	2.60	0.27	11.24	4.12
0634	The Union Supply Co. Jewel	*New Haven*—Union Supply Co., 442 State St.	25	3.32	4.62	0.60	14.86	6.18
0651	The Union Tea Co.	*New Britain*—Union Tea Co., 317 Main St.	45†	3.42	4.06	0.13	14.27	4.37
0647	Wabash Baking Powder Co. Spencer's Monogram	*Middletown*—W. K. Spencer, 96 Main St.	5*	2.91	4.89	0.27	16.66	4.62
0659	Walsh Bros.	*Ansonia*—Walsh Bros., 246 Main St.	50†	3.23	4.94	0.27	14.87	6.14
0407	J. M. Wassing. Wassing's	*Stamford*—J. M. Wassing, 568 Atlantic St.	15†	2.22	3.43	0.13	10.24	5.34
0621	Waterbury Cash Grocery Co., New Haven. Domestic	*New Haven*—R. F. Copeland, 1208 State St.	18	2.09	3.43	0.54	11.39	5.57

* Price per ¼ pound. † Price per pound. ‡ Price per 10 ounces.

CREAM OF TARTAR.

Ninety-one samples collected by the station have been examined as follows:

Not found adulterated	72	samples.	(Table IX.)
Adulterated	19	"	(Tables X and XI.)
Total	91		

Three of the adulterated samples contain no cream of tartar whatever and sixteen samples from 8.75 to 90.30 per cent.

All the adulterated samples contain maize (corn) starch (0.61–27.61 per cent.) and all but one, acid-phosphate of lime. In addition to the adulterants named, eleven contain gypsum, ten alum, and two tartaric acid.

The amount of gypsum present in several cases is over 25 per cent.

As F. A. Hoyt, of Stamford, protested against our findings in sample **10481**, another sample was purchased later from the same dealer. This latter sample, like the first, was found to be adulterated.

Wise, Smith & Co., Hartford, on being notified that the cream of tartar purchased from them was adulterated, stated that they no longer had any of that lot in stock. A sample from the lot they were then carrying (**11307**), submitted by them for analysis, was found to be pure.

A sample (**11658**), submitted by Hunt & Miller, New Milford, was found to contain large amounts of phosphate and sulphate of lime. Another sample (**11485**) sent by Miner, Read & Garrette, New Haven, contains phosphate of lime.

GROUND COFFEE.

By far the larger part of the coffee now on sale in Connecticut is in the bean and is either ground by the grocer as purchased, or by the housewife in a domestic mill. The adulteration of whole coffee with artificial coffee beans moulded from dough, which was extensively practiced some years ago, has been entirely discontinued, and the less skillful frauds of mixing coffee beans with artificial coffee in broken lumps, rolled peas, chicory, etc., are also seldom practiced. All the adulterants named can be readily detected by our agents on careful

TABLE IX.—CREAM OF TARTAR NOT FOUND ADULTERATED.

Station No.	Brand.	Dealer.	Price per ¼ lb., cents.
10775	Sold in bulk	*Ansonia*—G. E. May & Son, 2 High St.	12
10769	" "	D. M. Welch & Son, 188 Main St.	12
10510	E. R. Durkee & Co., New York. Gauntlet	*Bridgeport*—C. K. Bishop, E. Washington & E. Main St.	12
10517	Sold in bulk	H. Isenburg, 109 State St.	8
10508	" "	National Grocery & Provision Co., 46 Cannon St.	10
10511	David Trubee & Co., Bridgeport. Seaside Mills	N. Y. Grocery, 857 Kossuth St.	10
10512	Lincoln, Seyms & Co. Pure	Rose & Wills, 1894 Main St.	15
10507	Sold in bulk	J. B. Sullivan, 589 E. Main St.	5
10502	" "	Village Store Co., 1624 Main St.	8
10506	" "	William St. Cash Grocery, 486 William St.	15
7809	" "	*Danbury*—C. Beers, 101 White St.	10
7811	" "	R. E. Church, 147 Main St.	10
7810	" "	N. Y. Cash Grocery, 309 Main St.	9
10615	" "	*Danielson*—W. N. Arnold & Co., 185 Main St.	10
10617	" "	Quinnebaug Store, Main St.	10
10783	Austin, Nichols & Co., New York. Blue Ribbon	*Derby*—G. H. Crook, 194 Elizabeth St.	10
10777	Sold in bulk	R. F. Cuddihy, Anson and 6th Sts.	8
10782	Clark, Chapin & Bushnell., New York. Reliable	James McEnerney, 72 Elizabeth St.	12
10779	Sold in bulk	N. Y. Grocery Co., 217 Main St.	13
10474	" "	*Greenwich*—A. W. Avery, Greenwich Ave.	14
10476	" "	John L. Mahoney, Greenwich Ave.	12
10475	" "	S. A. Moshier, Greenwich Ave.	12
10573	F. H. Leggett & Co., New York. Leggett's Best	*Hartford* — Boston Grocery, Main St.	10
10803	Sold in bulk	Buckley & Reardon, 559 Main St.	12
10804	" "	Citizen's Grocery & Prov. Co., 267 Main St.	13
10574	Seyms & Co., Hartford. Colonial Pure	P. S. Kennedy, Main and Morgan Sts.	12
10799	Sold in bulk	Public Market, 611 Main St.	10
10793	" "	*Meriden* — Boston Grocery, 17 Colony St.	10
10795	" "	Meriden Tea & Coffee Co., 19 E. Main St.	10
10695	" "	*Middletown* — D. J. Hartman, 530 Main St.	10
10696	" "	Middletown Cash Grocery, 354 Main St.	10
10698	" "	New England Tea Co., 442 Main St.	10
10697	" "	O. Thompson & Co., 592 Main St.	10
10808	" "	*Naugatuck*—W. F. Brennan, 178 Church St.	10
10712	The Williams & Carlton Co., Hartford. Williams' Pure	*New Britain* — C. M. Oquist, 239 Elm St.	10

TABLE IX.—CREAM OF TARTAR NOT FOUND ADULTERATED—*Continued.*

Station No.	Brand.	Dealer.	Price per ¼ lb., cents.
10709	Sold in bulk	Public Market, 373 Main St.	10
10707	" "	W. W. Walker, 238 Main St.	10
10580	Stickney & Poor's Pure, Boston.	*New Haven* — A. Basserman, Grand and Ferry St.	10
10576	D. & L. Slade Co., Boston. Slade's Pure	R. F. Copeland, 1208 State St.	10
10791	Sold in bulk	S. Sax, 579 Grand Ave.	10
10579	" "	D. M. Welch & Son, 8 Grand Ave.	8
10584	" "	D. M. Welch & Son, 28 Congress Ave.	10
10591	" "	*New London*—J. R. Avery, 19 Broad St.	15
10588	" "	W. M. Lucy, 193 Bank St.	10
10589	" "	N. Y. Cash Grocery, 179 Bank St.	10
10587	" "	A. M. Stacy, 123 State St.	13
7813	" "	*Norwalk*—Atlantic & Pacific Tea Co., 41 Main St.	10
7815	" "	Grand Central Grocery, 21 Main St.	10
10491	" "	Raymond Grocer, 11 Main St.	12
10603	Bugbee & Brownell, Providence. Pure 99%	*Norwich*—C. W. Hills & Son, 147 Franklin St.	13
10606	Sold in bulk	J. P. Holloway, 317 Main St.	10
10610	Equitable Mills, F. R. Farrington & Co., New York	Geo. Lepan, 252 Franklin St.	10
10607	Sold in bulk	A. F. Otis & Son, 261 Main St.	12
10609	Dwinell-Wright Co., Boston. Genuine 99½% Pure	H. D. Rallion, 45 Broadway	13
10601	Sold in bulk	John S. Spicer, 116 Water St.	10
10682	" "	*Putnam*—W. H. Mansfield & Co., Main St.	15
10684	Haskell, Adams & Co., Boston. Rival	Edward Mullen, 25 Main St.	10
10681	Sold in bulk	J. E. Sullivan, Main St.	10
10679	" "	E. T. Tucker, Union St.	10
10499	" "	*So. Norwalk*—Central Food Co., Washington and R. R. Ave.	10
10497	" "	L. Joseloff, 70 N. Main St.	12
10496	" "	F. D. Lawton, 22 S. Main St.	12
10493	" "	N. Y. Cash Grocery, 118 Washington St.	13
10484	" "	*Stamford*—O. S. Brown, 54 Park Row	10
10482	" "	G. A. Ferris, 446 Main St.	10
10835	" "	*Torrington* — Austin Beckwith, 8 Main St.	13
10820	Boardman's Pure	*Waterbury*—D. J. McGrath, 777 Bank St.	13
10819	Miner, Read & Garrette, New Haven. Pure	The Turnbull Co., 139 E. Main St.	10
10692	Sold in bulk	*Willimantic*—D. F. Blish & Son, 66 Church St.	13
10691	" "	Chagnon & Bacon, 40 Jackson St.	15
10690	" "	City Grocery Store, 877 Main St.	12
10689	" "	Frank Larrabee, 20 Church St.	13

TABLE X.—ADULTERATED CREAM OF TARTAR.

Station No.	Brand.	Dealer.	Price per ¼ pound, cents.	Pure cream of tartar. %	Adulterants.
10774	Sold in bulk	*Ansonia*—P. W. Fogarty, 13 High St.	12	46.04	Acid phosphate of lime, gypsum, maize starch
10503	Sold in bulk	*Bridgeport*—Centennial Tea Co., 1688 Main St.	9	85.34	Acid phosphate of lime, gypsum, maize starch
10611	J. Smith Brockway Co., Boston. Queen Quality	*Danielson*—A. H. Armington, Main St.	10	8.75	Alum, acid phosphate of lime, tartaric acid, gypsum, maize starch
10571	Sold in bulk	*Hartford*—Dow & Hatch, 2 Church St.	8	9.31	Alum, acid phosphate of lime, gypsum, maize starch
10800	Sold in bulk	Hills & Co., 372 Asylum St.	15	82.99	Acid phosphate of lime, gypsum, maize starch
10572	Sold in bulk	Wise, Smith & Co., Main St.	10	42.77	Alum, tartaric acid, maize starch
10699	Sold in bulk	*Middletown*—W. K. Spencer, 96 Main St.	10	15.34	Alum, acid phosphate of lime, maize starch
10810	Sold in bulk	*Naugatuck*—Moulthrop & Gray, 265 Water St.	12	84.46	Acid phosphate of lime, gypsum, maize starch
10706	Sold in bulk	*New Britain*—J. E. Murphy, 500 Main St.	10	0.00	Alum, acid phosphate of lime, gypsum, maize starch
10704	Sold in bulk	S. Oldershaw, 250 Park St.	12	8.95	Acid phosphate of lime, gypsum, maize starch
10844	John P. Augur, New Haven. Crescent Mills	*New Haven*—C. F. Curtis, 932 State St.	9	52.56	Alum, acid phosphate of lime, maize starch
10786	Sold in bulk	J. V. Rattlesdorfer, 95 Green St.	12	0.00	Alum, acid phosphate of lime, gypsum, maize starch
7820	Sold in bulk	*New Milford* — Farmers Trading Co., Church Street	10	64.06	Acid phosphate of lime, maize starch
10602	Sold in bulk	*Norwich*—J. Connors & Sons, 72 Water St.	10	9.35	Alum, acid phosphate of lime, gypsum, maize starch
10600	Sold in bulk	Wheeler Bros., 2 Cliffe St.	15	9.15	Alum, acid phosphate of lime, gypsum, maize starch
10605	Sold in bulk	Thos. Wilson, 78 Franklin St.	15	51.20	Acid phosphate of lime, maize starch
10481	Sold in bulk	*Stamford*—F. A. Hoyt, Atlantic Square	15	84.03	Acid phosphate of lime, maize starch
10836	Sold in bulk	*Torrington* — Torrington Cash Grocery, 36 Water St.	10	90.30	Acid phosphate of lime, maize starch
10818	Sold in bulk	*Waterbury*—W. J. Corcoran, 38 Scoville St.	10	0.00	Alum, acid phosphate of lime, maize starch

TABLE XI.—ANALYSES OF ADULTERATED CREAM OF TARTAR.

Station No.	Sand (ash insoluble in HCl.)	Potash.	Soda.	Lime.	Magnesia.	Alumina.	Oxide of iron.	Oxide of Ammonia.	Phosphoric acid.	Sulphuric acid.	Starch.
	%	%	%	%	%	%	%	%	%	%	%
10774	0.05	11.53	0.59	13.04	0.10	0.00	0.00	0.00	13.64	11.27	6.03
10503	0.06	21.37	0.24	3.14	0.14	0.00	0.00	0.00	3.66	3.18	0.76
10611	0.09	2.19	0.30	7.59	0.22	5.19	0.14	2.21	10.11	20.26	26.33
10571	0.20	2.33	0.44	16.35	0.33	3.52	0.14	1.69	12.90	24.19	11.71
10800	0.15	20.78	0.11	3.75	0.23	0.00	0.00	0.00	4.06	3.65	1.33
10572	0.31	10.71	4.22	0.13	0.03	8.47	0.25	0.00	0.04	25.71	1.27
10699	0.18	3.84	1.20	11.11	0.55	3.86	1.54	1.02	19.62	13.73	13.47
10810	0.04	21.15	0.34	3.92	0.14	0.00	0.00	0.00	3.44	4.09	1.06
10706	0.13	0.19	2.69	11.75	0.11	4.90	0.32	0.00	12.63	27.06	21.46
10704	0.43	2.24	0.35	25.06	1.00	0.00	0.63	0.00	30.23	19.73	0.61
10844	0.15	13.16	1.40	5.54	0.22	2.08	0.56	0.00	9.93	7.59	8.36
10786	0.09	0.08	2.46	19.48	0.44	3.13	0.49	0.00	15.43	26.08	15.50
7820	0.06	16.04	0.42	2.98	1.08	0.00	0.00	0.00	11.36	0.34	10.37
10602	0.09	2.34	0.37	7.82	0.25	5.47	0.35	2.41	10.84	22.37	27.51
10600	0.07	2.29	0.58	11.34	0.26	5.72	0.14	2.27	8.78	26.88	23.84
10605	0.06	12.82	0.42	11.78	0.25	0.00	0.00	0.00	14.94	0.63	6.74
10481	0.00	21.04	0.32	3.54	0.10	0.00	0.00	0.00	4.23	1.83	2.09
10836	0.01	22.61	0.32	2.23	0.08	0.00	0.00	0.00	2.89	1.13	1.35
10818	0.43	0.78	1.63	16.76	1.14	2.27	2.17	0.00	45.36	2.57	2.13

inspection in the store, thus rendering the purchase of numerous samples unnecessary.

During the present year no adulterated whole coffee was found on sale.

The limited amount of ground coffee now on the market is, for the most part, sold in one or two pound packages, each bearing on the label the name of the brand and also of the importer, wholesaler or retailer. As samples of nearly all the brands on sale in Connecticut have been examined within the past few years, only those brands previously found to be adulterated and brands recently introduced have been collected during the present year.

Four samples of ground coffee in labelled packages were found to be adulterated.

Ready-ground coffee in bulk is still very commonly adulterated, ten samples out of the fifteen purchased and examined containing chicory, together, in seven cases, with imitation coffee made from wheat middlings, and in three cases with peas or a pea product. Fortunately little ground coffee in bulk is now on the market.

TABLE XII.—COFFEE NOT FOUND ADULTERATED.

Station No.	Brand.	Dealer.	Price per pound, cents.
	Ground Coffee.	*Bridgeport.*	
11262	The Coe & White Co. Seaside Brand	The Coe & White Co., 560-562 Main st.	25
		Danbury.	
10839	Sold in bulk	The Danbury Grocery Co., 291 Main st.	25
		Hartford.	
10917	Brown, Thomson & Co. Pure Coffee	Brown, Thomson & Co., Main street	25
11266	Chas. Yauch. Superior Brand, Fancy Blend	Charles Yauch, 379 Main st.	25
		New Haven.	
11439	Sold in bulk	The Union Supply Co., 115 Congress ave.	30
11440	The Union Supply Co. Jewel Coffee, Mocha & Java Blend	The Union Supply Co., 442 State st.	30
		New Milford.	
10372	Bennett, Sloan & Co., N. Y. Puritan Blend	Farmers' Trading Co., Church street	25
		Norwich.	
10677	W. A. Castle, Springfield, Mass. Castle's Queen	E. F. Burlingame, Thames and West Main st.	25
		Southington.	
1984	Reliance Coffee	S. J. Griffin, Main st.	25
1983	Neale & Guernsey. Premium Blend	Neale & Guernsey, Main st.	25
1982	Sold in bulk	The Finch & Laity Co., Center street	20
		Stamford.	
10843	Sold in bulk	C. Andressen & Co., 492 Main street	25
		Wallingford.	
10915	Sold in bulk	Union Tea Co., 7 Hall ave.	25
		Waterbury.	
11264	Miner, Read & Garrette, New Haven. Sunrise Breakfast Coffee	W. H. Fudge, 446 South Main street	25
		Willimantic.	
10686	Mullen & St. Onge. Java and Mocha Coffee	Mullen & St. Onge, 130 Jackson street	25

TABLE XIII.—ADULTERATED COFFEE.

Station No.	Brand.	Dealer.	Price per pound, cents.	Adulterants.
	Ground Coffee.	*Bridgeport.*		
10766	Sold in bulk	Ford & Jones, 1362 Main street	15	Chicory, imitation coffee.*
10763	Sold in bulk	The Village Store Co., 746 E. Main st.	25	Chicory, imitation coffee.*
10764	Sold in bulk	The Village Store Co., 1624 Main st.	25	Chicory, imitation coffee.*
10765	Sold in bulk	The Village Store Co., 244 State st.	25	Chicory, imitation coffee.*
		Danbury.		
10840	Sold in bulk	The Atlantic and Pacific Tea Co., 163 Main st.	25	Chicory, imitation coffee.*
10841	Sold in bulk	The Village Store Co., 238 Main st.	25	Chicory, imitation coffee.*
		Hartford.		
10916	Sold in bulk	The Standard Tea House, 1019 Main st.	25	Chicory, peas.
		New Britain.		
10758	The American Java Coffee Co., N. Y.	Thos. McCabe, 591 Main street	25	Chicory, peas.
		New London.		
10673	Special Blend, Mocha & Java	A. Caracausa, 2 Truman street	25	Chicory, imitation coffee.*
		New Milford.		
10373	One Pound XXX Ground Coffee	Danbury Grocery Co., Railroad st.	18	Peas.
		Stamford.		
10842	Sold in bulk	Empire State Tea Co., 303 Main st.	25	Chicory, imitation coffee.*
		Waterbury.		
10824	Sold in bulk	J. F. Phelan, 42 E. Main street	25	Chicory, pea hull pellets.†
10826	Sold in bulk	The N. Y. & China Tea Co., 181 S. Main st.	25	Chicory, pea hull pellets.†

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

The samples purchased by agents of the station were as follows:

Not found adulterated (Table XII)	15	samples.
Adulterated (Table XIII)	13	"
Total	28	"

A sample of ground coffee sent by the Department of Charities, Bridgeport, consisted largely of ground chicory and peas.

GROUND SPICES.

SAMPLES COLLECTED BY THE STATION.

Particulars with regard to the examination of 176 samples of ground spices sampled by station agents are given in Tables XIV and XV; a summary of the results follows:

	Number of samples not found adulterated.	Number of samples adulterated or below standard.	Foreign matter.
Black pepper	34	28	Cocoanut shells, buckwheat hulls, olive stones, wheat flour, wheat screenings, biscuit, maize meal, turmeric, cayenne, sand.
White pepper	7	8	Buckwheat middlings, maize meal, biscuit, olive stones.
Cayenne pepper	11	6	Maize, turmeric.
Cinnamon	28	3	Cocoanut shells, wheat product.
Cloves	18	5	Clove stems, cocoanut shells, dirt.
Allspice	20	8	Clove stems, cocoanut shells, pea meal, dirt.
Total	118	58	

Of the 28 samples of black pepper classed as adulterated or below standard, 9 were condemned solely because of their high percentages of ash and sand, indicating either that the pepper was adulterated with pepper shells or else was of such poor quality as to be unfit for consumption. In judging these samples, the analytical results obtained by the methods of the Association of Official Agricultural Chemists were compared with the standards adopted by the same Association.

A sample (1986) labelled "Cayenne Pepper Compound, Windsor Mills, N. Y.," contained a maize product and turmeric.

The sale of adulterated spices in Connecticut still continues notwithstanding the efforts of food officials and reputable spice grinders.

The profits of this illegal traffic must be large, at least for the manufacturers, as spices are among the most expensive food products, whereas the common adulterants are waste products which unground have little commercial value, and even ground and otherwise prepared ready for mixing with spices, cost but a few cents per pound.

TABLE XIV.—SPICES NOT FOUND ADULTERATED.

Station No.	Brand.	Dealer.	Price per ¼ lb., cents.	Ash.	Sand.
	Black Pepper.	*Ansonia.*		%	%
10771	Walsh Bros.	Walsh Bros., Main st.	10	5.82	
		Bridgeport.			
10513	J. & W. Cahill & Co.	J. & W. Cahill & Co., 1157 Main st.	7	6.85	
10516	Sparhawk, Poole & Co., London	Empress Tea Co., 1046 Main street	8	6.94	
10514	Miner, Read & Garrette, New Haven	E. L. Sullivan, 1142 E. Main street	8	4.74	
		Bristol.			
10905	Edwin J. Gillies & Co., New York	J. Coverty Bros., 103 North Main st.	10	5.80	
		Danbury.			
7808	Sold in bulk	Atlantic & Pacific Tea Co., 163 Main st.	7	6.68	
7806	Sold in bulk	Ehle's Cash Grocery, 3 West street	8	6.93	
7816	Sold in bulk	M. McPhelemy, 44 White street	10	6.74	
		Greenwich.			
7822	Sold in bulk	Gilbert M. Ritch, Greenwich avenue	6	4.55	
		Hartford.			
10928	Sold in bulk	L. Bernard, 121 Windsor avenue	8	5.82	
10801	Sold in bulk	Hills & Co., 372 Asylum st.	10	6.96	
		Meriden.			
10761	Sold in bulk	Grant Tea Store, 20 E. Main street	8	5.52	
		Naugatuck.			
10806	Sold in bulk	G. H. Silvernail & Co., 3 Church st.	10	6.57	
		New Britain.			
10705	Sold in bulk	Wm. Foulds, 236 Park st.	8	6.81	
10701	Sold in bulk	Thos. McCabe, 591 Main st.	10	6.36	
10714	W. H. Montanye & Co., New York	Union Tea Co., 317 Main st.	10	5.37	
		New Haven.			
10851	The Carlson Tea and Butter Co.	The Carlson Tea and Butter Co., 488 State st.	10	6.20	
10585	Sold in bulk	Gilson Tea Co., Court and State sts.	5	5.66	

TABLE XIV.—SPICES NOT FOUND ADULTERATED—*Continued.*

Station No.	Brand.	Dealer.	Price per ¼ lb., cents.	Ash.	Sand.
	Black Pepper.	*New London.*		%	%
10594	Sold in bulk	J. M. Miner, 51 Huntington street	10	4.66	
		Norwalk.			
10492	Sold in bulk	Grand Central Grocery, 19 Main st.	8	5.35	
		Putnam.			
10683	W. H. Mansfield & Co., Monogram Brand	W. H. Mansfield & Co., Main st.	10	4.86	
10685	Haskell, Adams & Co., Boston. Rival Brand	Edward Mullan, Main st.	10	5.70	
		South Norwalk.			
10494	Sold in bulk	Conrad Becker, 141 Washington st.	8	5.79	
10500	D. & L. Slade Co., Boston	Central Food Co., Washington and Railroad ave.	10	4.40	
10495	Sold in bulk	L'Hommedieu Bros., Washington st.	10	5.38	
		Stamford.			
10490	Sold in bulk	C. Andressen & Co., Main street	9	6.94	1.20
10487	Stamford Tea Co.	Stamford Tea Co., 72 Pacific street	10	5.83	
10485	Sold in bulk	J. M. Wassing, 568 Atlantic street	10	5.19	
		Waterbury.			
10816	John P. Augur, New Haven. Crescent Mills	Fancy and Staple Groceries, 899 Bank st.	10	4.50	
10815	Sold in bulk	Penn. Merchandise Co., 120 E. Main st.	10	4.66	
10827	B. Fischer & Co., New York. Fischer Mills	The N. Y. China Tea Co., 181 S. Main st.	10	6.23	
		Willimantic.			
10694	D. & L. Slade Co., Boston	H. C. Hall, 17 Union st.	10	4.65	
10687	The T. R. Sadd Co.	The T. R. Sadd Co., 760 Main st.	10	6.30	
10693	Sold in bulk	A. A. Trudeau, 945 Main st.	10	4.33	
	White Pepper.	*Bridgeport.*			
10768	Sold in bulk	The Village Store Co., 746 E. Main st.	6	2.01	
		Bristol.			
10892	Sold in bulk	South Side Cash Grocery, 30 Main st.	10	2.02	

TABLE XIV.—SPICES NOT FOUND ADULTERATED—*Continued.*

Station No.	Brand.	Dealer.	Price per ¼ lb., cents.	Ash.	Sand.
	White Pepper.	*Hartford.*			
10575	E. R. Durkee & Co., N. Y. Durkee's Gauntlet Brand	City Hall Grocery, 42 State street	13	% 1.62	%
		New Haven.			
10850	The Carlson Tea and Butter Co.	The Carlson Tea and Butter Co., 488 State st.	10	2.67	
10855	Sold in bulk	C. F. Curtiss, 932 State st.	9	1.76	
		Southington.			
10886	Stickney & Poor, Boston	Neale & Guernsey, Main st.	15	1.45	
10888	Upson Bros.	Upson Bros., Center st.	15	1.59	
	Cayenne Pepper.	*Ansonia.*			
10773	Miner, Read & Garrette, New Haven	P. W. Fogarty, 13 High st.	10	6.98	0.41
		Bristol.			
10894	Sold in bulk	L. G. Merick, Main and Prospect sts.	10	5.08	
10891	Sold in bulk	Union Tea Store, 43 North Main st.	10	6.63	0.89
		Danbury.			
7807	Sold in bulk	D. E. Ketchum, 33 Elm st.	15	6.91	0.54
		Hartford.			
10934	Grand Union Tea Co., New York	Grand Union Tea Co., 74 Asylum st.	12	5.61	
11192	The Williams & Carleton Co.	E. M. Palmer, 324 Albany avenue	10	6.47	0.78
11193	Sold in bulk	E. M. Palmer, 324 Albany avenue	10	6.04	
		Meriden.			
10796	Sold in bulk	M. Keegan, 288 W. Main st.	10	6.88	0.75
		Naugatuck.			
10811	Sold in bulk	The Grant Grocery Co., 5 Main st.	8	4.95	
		Norwich.			
10608	D. & L. Slade Co., Boston	Thos. Wilson, 78 Franklin street	10	5.77	
		Torrington.			
10831	Sold in bulk	The Torrington Cooperative Co., 135 Main st.	13	6.43	
	Cinnamon.	*Ansonia.*			
10770	Sold in bulk	D. W. Welch & Son, 188 Main st.	10	5.37	

TABLE XIV.—SPICES NOT FOUND ADULTERATED—*Continued.*

Station No.	Brand.	Dealer.	Price per ¼ lb., cents.	Ash.	Sand.
	Cinnamon.	*Bridgeport.*			
10509	Sold in bulk	Logan Bros., Main & George streets	5	% 6.12	%
		Bristol.			
10904	Edwin J. Gillies & Co., New York	J. Coverty Bros., 103 North Main st.	10	4.35	
10895	Sold in bulk	L. G. Merick, Main and Prospect st.	15	2.29	
10893	Sold in bulk	South Side Cash Grocery, 30 Main st.	10	3.97	
		Danbury.			
7805	Sold in bulk	Village Store Co., 246 Main street	10	3.35	
		Danielson.			
10613	Sold in bulk	Waldo Bros., Main st.	10	4.83	
		Derby.			
10780	Sold in bulk	E. J. Malumphy, 8 Elizabeth street	8	4.09	
		Hartford.			
10919	Sold in bulk	Brown, Thomson & Co., Main st.	9	2.07	
10918	Sold in bulk	Cady & Lombard, 163 Albany avenue	10	3.25	
10924	Sold in bulk	Cowles & Howard, 160 Windsor ave.	12	3.76	
10931	J. H. McGuire	The Standard Tea House, 1019 Main st.	10	4.35	
		Meriden.			
10794	Sold in bulk	Meriden Tea and Coffee Co., 19 E. Main st.	10	3.60	
		Naugatuck.			
10809	Sold in bulk	Moulthrop & Gray, 265 Water st.	10	2.82	
		New Britain.			
10713	W. H. Montanye & Co., New York. Half Saigon	Union Tea Co., 317 Main street	10	4.47	
		New Haven.			
10581	Sold in bulk	M. C. Dingwall, 391 Grand avenue	8	4.14	
10857	Sold in bulk	Maher Bros., 731 Grand ave.	9	3.42	
10852	Sold in bulk	The Carlson Tea and Butter Co., 488 State st.	8	3.67	

TABLE XIV.—SPICES NOT FOUND ADULTERATED—*Continued.*

Station No.	Brand.	Dealer.	Price per ¼ lb., cents.	Ash.	Sand.
	Cinnamon.	*New London.*		%	%
10597	Keife, Davis & Co.	Keife, Davis & Co., 125 Bank st.	13	4.84	
		New Milford.			
7818	Sold in bulk	C. J. Leach, Church st.	10	2.58	
		Southington.			
1988	Sold in bulk	The Finch & Laity Co., Center st.	10	3.45	
10887	Upson Bros.	Upson Bros., Center st.	12	3.54	
		Stamford.			
10479	Sold in bulk	W. W. Waterbury, 499 Main street	6	3.32	
		Torrington.			
10830	Sold in bulk	G. W. Main, 71 Main st.	10	3.80	
		Wallingford.			
10907	Sold in bulk	Miner & Bridgett, 68 Center street	10	3.50	
10914	The Wm. Boardman & Sons Co., Hartford. Saigon	Union Tea Co., 7 Hall ave.	10	7.36	
		Waterbury.			
10813	Sold in bulk	Fancy and Staple Groceries, 899 Bank st.	10	2.10	
10821	Archibald & Lewis, New York	The Hewitt Grocery Co., 20 North Main st.	15	2.27	
	Cloves.	*Ansonia.*			
10772	Union Pacific Tea Co., N. Y., Pure Sovereign Spices	Union Pacific Tea Co., 204 Main st.	10	7.66	
		Bridgeport.			
10504	Sold in bulk	Coe & White	15	6.70	
		Bristol.			
10906	Edwin J. Gillies & Co., New York	J. Coverty Bros., 103 North Main st.	10	5.62	
10897	Sold in bulk	C. A. Lane, N. Main st.	10	7.17	
10901	Sold in bulk	G. S. Reed, N. Main and Pond st.	10	7.27	
		Derby.			
10776	Sold in bulk	D. M. Welch & Son., 312 Main st.	10	7.33	
		Hartford.			
10927	Sold in bulk	L. Bernard, 121 Windsor avenue	8	6.66	
10933	Grand Union Tea Co., N. Y.	Grand Union Tea Co., 74 Asylum st.	12	6.37	

TABLE XIV.—SPICES NOT FOUND ADULTERATED—*Continued.*

Station No.	Brand.	Dealer.	Price per ¼ lb., cents.	Ash.	Sand.
	Cloves.	*Meriden.*		%	%
10762	Sold in bulk	H. F. Rudolph, 48 E. Main street	10	6.89	
		New Haven.			
10854	Sold in bulk	Thos. Kilbride, 254 Wallace street	10	7.40	
10582	Stickney & Poor, Boston, Mass.	Philip Mayrand, 48 East Chapel st.	10	6.58	0.58
		Southington.			
11194	Sold in bulk	The Finch & Laity Co., Center st.	15	7.10	
		Torrington.			
10833	Swain, Earle & Co., Boston, Mass.	W. A. Miller, 70 Water st.	5	7.43	
10832	Sold in bulk	Wm. Mulcunry 16 S. Main street	10	6.97	
		Wallingford.			
10911	The F. C. Bushnell Co., New Haven	E. T. Carter, 22 Center st.	10	7.23	
10913	The Wm. Boardman & Sons Co., Hartford	Union Tea Co., 7 Hall ave.	10	6.72	
		Waterbury.			
10812	Sold in bulk	Foote's Cash Grocery, 470 West Main st.	10	6.95	
10823	Sold in bulk	J. F. Phelan, 42 E. Main st.	10	7.18	
	Allspice.	*Bristol.*			
10900	Sold in bulk	G. S. Reed, N. Main st.	10	4.57	
10890	Sold in bulk	Union Tea Store, 43 N. Main Street	10	5.80	
		Danielson.			
10616	Sold in bulk	Quinnebaug Store, Main st.	10	4.89	
		Hartford.			
10522	Sold in bulk	Boston Grocery, Main st.	5	5.45	
10923	Sold in bulk	N. Y. Butter and Grocery, 236 Albany ave.	8	4.93	
11191	Lincoln, Seyms & Co. Capitol Mills	The Center Grocery, 14 Center st.	10	5.07	
10805	The A. Colburn Co., Phila., Pa. Colburn's Spices	The Lathrop Co., 310 Asylum street	10	4.46	
10925	Sold in bulk	W. K. Smith & Co., 1111 Main st.	10	4.10	
		Naugatuck.			
10807	Sold in bulk	Carlson's Tea Store, 162 Church st.	8	5.33	

TABLE XIV.—SPICES NOT FOUND ADULTERATED—*Continued.*

Station No.	Brand.	Dealer.	Price per ¼ lb., cents.	Ash.	Sand.
	Allspice.	*New Haven.*		%	%
10586	The A. Colburn Co., Phila., Pa. Colburn's Spices	Boston Grocery, Chapel and Temple sts.	10	3.86	
10853	D. & L. Slade Co., Boston. Slade's Pure Spices	Geo. W. Cooper, Grand ave. and Artizan st.	10	4.65	
10583	Sold in bulk	Logan Bros., Grand ave. and Lloyd st.	5	4.10	
10856	Sold in bulk	S. Sax, 579 Grand ave.	8	4.72	
10788	Sold in bulk	Swan & Babcock, 27 Dixwell avenue	10	4.51	
		New Milford.			
7817	Sold in bulk	Danbury Grocery Co., Railroad st.	4	4.56	
		Southington.			
1985	The Wm. Boardman & Sons Co., Hartford	S. J. Griffin, Main st.	10	5.89	
10889	Upson Bros.	Upson Bros., Center st.	10	4.71	
		Stamford.			
10486	Sold in bulk	C. M. Slater, 287 Main st.	10	5.39	
		Wallingford.			
10909	Sold in bulk	Laden Bros., 102 Center st.	10	4.45	
		Willimantic.			
10688	The T. R. Ladd Co.	The T. R. Ladd Co., 760 Main st.	10	4.11	

The manufacturers of the fraudulent products are, for the most part, located in other states and cannot therefore be prosecuted by Connecticut courts; furthermore as their goods are usually sold in bulk, not in labelled packages, their names cannot be obtained for publication in the station report in connection with other particulars regarding the samples.

TABLE XV.—SPICES, ADULTERATED OR BELOW STANDARD.

Station No.	Brand.	Dealer.	Price per ¼ lb., cents.	Ash.	Sand.	Foreign Matter.
	Black Pepper.	*Bridgeport.*		%	%	
10515	J. T. Doyle Co., New Haven	J. H. Dellmuth, 1602 Main st.	10	8.89	2.66	Excess of ash.
10518	Wm. J. Stitt & Co., Knickerbocker	Harrison & Lautgenheiser, 1197 Main st.	10	10.78	4.42	Turmeric, ginger, excess of ash.
10501	Sold in bulk	George Rivers, 1659 Main st.	10	7.65	1.65	Excess of ash.
		Bristol.				
10899	Sold in bulk	Healy & Co., 161 N. Main st.	9	2.63	----	Cocoanut shells, wheat product, maize product.
		Danielson.				
10612	Sold in bulk	Waldo Bros.	10	11.10	3.46	Excess of ash.
		Derby.				
10778	Sold in bulk	R. F. Cuddihy, Anson and 6th st.	8	3.04	----	Cayenne, wheat screenings.
		Greenwich.				
10478	Wm. A. Leggett & Co., New York, Rajah Brand	John Boles, Greenwich ave.	10	4.92	----	Cooked starchy matter.
7821	Sold in bulk	Geo. A. Finch, Greenwich ave.	6	5.55	----	Maize product, cocoanut shells.
		Hartfora.				
10920	Sold in bulk	Brown, Thomson & Co., Main st.	8	7.84	1.47	Excess of ash.
10802	" "	Buckley & Reardon, 559 Main st.	8	9.56	1.80	Excess of ash.
10521	" "	Dow & Hatch, 2 Church st.	5	3.26	----	Wheat product, cocoan't sh'lls.
10932	Grand Union Tea Co., New York	Grand Union Tea Co., 74 Asylum st.	10	7.44	2.57	Excess of ash.

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

Station No.	Brand.	Dealer.	Price per ¼ lb., cents.	Ash.	Sand.	Foreign Matter.
	Black Pepper.	*Hartford.*		%	%	
10922	Sold in bulk	N. Y. Butter & Grocery, 236 Albany ave.	8	4.61	-----	Cocoanut shells, maize product.
10926	Sold in bulk	G. W. Squires, 261 High st,	10	12.47	6.14	Maize product, turmeric.
		New Britain.				
10711	Knickerbocker Mills Co., New York, Royal Standard	American Importing Tea Co., 95 Arch st.	10	14.17	7.65	Turmeric, ginger, excess of ash.
10700	Sold in bulk	W. H. Pierce & Son, 72 W. Main st.	10	5.55	-----	Cocoanut shells, olive stones, biscuit.
10710	" "	Public Market, 373 Main st.	5	13.56	1.31	Biscuit, cocoanut shells, excess of ash.
10703	" "	Star Tea Co., 227 E. Main st.	9	7.43	2.04	Excess of ash.
		New Haven.				
10789	Sold in bulk	Frederick Bros., 253 Davenport ave.	8	9.14	4.87	Biscuit, excess of ash.
10790	" "	F. J. Markle, 105 Broadway	7	5.58	-----	Wheat product, buckwheat hulls, weed seed.
10787	" "	S. Sax, 579 Grand ave.	5	3.79	-----	Cocoanut shells, maize product, leguminous product, cayenne.
10577	" "	D. M. Welch, 8 Grand ave.	7	9.25	2.45	Excess of ash.
		New Milford.				
7819	Sold in bulk	Ackley, Hatch & Marsh, Railroad st.	8	7.60	1.24	Excess of ash.

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

Station No.	Brand.	Dealer.	Price per ¼ lb., cents.	Ash.	Sand.	Foreign Matter.
	Black Pepper.	*Norwich.*		%	%	
10599	Sold in bulk	Manhattan Tea Store, 6 Main st.	10	3.13	-----	Cocoanut shells, maize product, wheat product.
		Southington.				
1987	Edwin J. Gillies & Co., New York, Standard Spices	S. J. Griffin, Main st.	10	8.64	2.52	Excess of ash.
		Stamford.				
10489	Columbia Tea Co.	Columbia Tea Co., Main st.	8	11.11	3.88	Excess of ash.
		Waterbury.				
10814	Sold in bulk	Fruin's Grocery, 465 W. Main st.	10	12.04	5.71	Corn starch, turmeric, ginger, excess of ash.
10822	Archibald & Lewis, New York	The Hewitt Grocery Co., 20 N. Main st.	10	7.92	1.99	Excess of ash.
	White Pepper.	*Bristol.*				
10896	Sold in bulk	C. A. Lane, N. Main st.	10	1.38	-----	Maize product, wheat product.
		Hartford.				
10921	Sold in bulk	Cowles & Howard, 160 Windsor ave.	15	6.15	1.29	Excess of ash.
10930	The Standard Tea House, John H. McGuire	The Standard Tea House, 1019 Main st.	10	4.40	0.49	Buckwheat product.
		New Britain.				
10708	The Frazier Tea Co.	Star Tea Co., 227 E. Main st.	15	4.50	0.39	Excess of ash.

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

Station No.	Brand.	Dealer.	Price per ¼ lb., cents.	Ash.	Sand.	Foreign Matter.
	White Pepper.	*New Haven.*		%	%	
10847	J. & W. Cahill & Co., Cahill's Pure Spices	J. & W. Cahill & Co., Church and George sts.	10	2.64	......	Maize product.
		Torrington.				
10834	Miner, Read & Garrette, New Haven	Torrington Cash Grocery, 36 Water st.	10	4.04	0.07	Excess of ash.
		Wallingford.				
10912	The F. C. Bushnell Co.	E. T. Carter, 22 Center st.	10	5.05	0.75	Excess of ash.
10910	Sold in bulk	Laden Bros., 102 Center st.	10	2.10	......	Biscuit, olive stones.
	Cayenne Pepper.	*Bridgeport.*				
10505	Sold in bulk	Atlantic & Pacific Tea Co., 707 E. Main st.	9	10.54	2.00	Excess of ash.
		New-Haven.				
10848	J. & W. Cahill & Co., Cahill's Pure Spices	J. & W. Cahill & Co., Church and George sts.	10	6.04	......	Maize product, turmeric.
10578	Sold in bulk	McGovern Bros., Lombard st.	10	4.08	......	Maize product, turmeric.
		Southington.				
10885	Sold in bulk	Neale & Guernsey, Main st.	15	7.76	0.92	Excess of ash.
		South Norwalk.				
10498	Sold in bulk	D. S. Davenport, 20 N. Main st.	10	6.31	......	Starchy matter.

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

Station No.	Brand.	Dealer.	Price per ¼ lb., cents.	Ash.	Sand.	Foreign Matter.
	Cayenne Pepper.	*Wallingford.*		%	%	
10908	Sold in bulk	Miner & Bridgett, 68 Center st.	10	6.37	0.26	Maize product, turmeric.
	Cinnamon.	*Bristol.*				
10898	Sold in bulk	Healy & Co., 161 N. Main st.	10	3.60	......	Cocoanut shells.
		Stamford.				
10483	Sold in bulk	R. T. Barnett, 303 Main st.	10	5.47	......	Wheat product.
10480	" "	E. M. Purdy, West Park	12	6.19	......	Cocoanut shells.
	Cloves.	*Bristol.*				
10902	Wm. A. Leggett & Co., New York, Rajah Brand	J. E. Edman, 17 Prospect st.	12	8.28	1.47	Stems, dirt.
		Hartford.				
10520	Sold in bulk	Atlantic & Pacific Tea Co., 979 Main st.	7	8.34	0.59	Stems.
		New London.				
10592	Sold in bulk	J. R. Avery, 19 Broad st.	10	4.25	......	Cocoanut shells.
10593	" "	J. M. Miner, 51 Huntington st.	10	9.30	1.60	Stems, dirt.
		Norwich.				
10598	Sold in bulk	Manhattan Tea Store, 6 Main st.	10	9.10	3.19	Stems, dirt.

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

Station No.	Brand.	Dealer.	Price per ¼ lb., cents.	Ash.	Sand.	Foreign Matter.
				%	%	
	Allspice.					
10519	Wm. J. Stitt & Co., New York, Knickerbocker	*Bridgeport.* Hanicon & Lautzenheiser, 1197 Main st.	10	6.81	0.76	Stems, dirt.
10903	Wm. A. Leggett & Co., New York, Rajah Brand, Jamaica	*Bristol.* J. E. Edman, 17 Prospect st.	12	6.03	0.58	Stems.
10929	J. H. McGuire	*Hartford.* J. H. McGuire, 1019 Main st.	10	9.70	2.42	Stems, dirt.
10702	Sold in bulk	*New Britain.* C. M. Oquist, 239 Elm st.	10	6.00	0.47	Stems.
10849	J. & W. Cahill & Co., Cahill's Pure Spices	*New Haven.* J. & W. Cahill & Co., Church and George sts.	10	6.75	1.08	Stems, dirt.
7814	Sold in bulk	*Norwalk.* Atlantic & Pacific Tea Co., 41 Main st.	7	4.22	......	Cocoanut shells.
10680	Howard & Co., New York	*Putnam.* E. T. Tucker, Union st.	10	7.15	0.59	Dirt.
10817	Sold in bulk	*Waterbury.* J. F. Cronan, 793 Bank st.	10	2.79	......	Pea meal.

SAMPLES OF SPICES SENT BY DEALERS AND CONSUMERS.

The Knickerbocker Mills Co., New York, stated that the excess of ash in the sample of their black pepper (10518) was possibly due to the small percentage of pepper shells which they had added but that they were unable to explain the presence of turmeric and ginger. At our request they submitted a sample of the pepper in question, which, like the sample purchased by our agent, was found, on examination, to contain turmeric, ginger and an excess of ash (10.94 per cent.).

Another sample submitted by them, stated to be ground from high grade "Sumatra" pepper, contained 7.60 per cent. of ash.

W. H. Pierce & Son, New Britain, after being informed that the sample of black pepper (10700) purchased from them was adulterated, submitted a sample from the stock that they were then selling. This latter sample was pure pepper.

Mr. J. H. McGuire, from whom sample 10930 of white pepper was purchased, sent for examination another sealed package (11544) put up and labelled the same as the first. The contents of this package was pure pepper.

Later still another sealed package (11574), externally the same as the other two, was sent to the station. This last sample, like the first, was adulterated with a buckwheat product.

It is evident that, although all the packages were put up and labelled exactly alike, some contained pure pepper, and others a mixture of pepper and a buckwheat product.

Two samples of ginger sent by The Charles W. Whittlesey Co. and one of cinnamon sent by Miner, Read & Garrette, both of New Haven, were not found adulterated.

PREPARED MUSTARD.

The Association of Official Agricultural Chemists have not as yet adopted a definition for prepared mustard (also known as German mustard, French mustard, etc.) but the Association of Dairy and Food Departments define it as a mixture of mustard, vinegar and spices. This definition is good, so far as it goes, although unfortunately salt is not included as a legitimate constituent and the terms "ground mustard" and "spices" are not perhaps sufficiently explicit. It is uncertain whether ground

TABLE XVI.—PREPARED MUSTARD.

Station No.	Dealer.	Dealer.	Price per bottle, cents.	Acidity calculated as acetic acid.	Total solids.	Total ash.	Common salt.	Constituents other than mustard flour, vinegar, salt and spices.
	Mustard.			%	%	%	%	
10570	Ernst Eulert, New York, Sanssouci Mustard	*Bridgeport.*—R. Wundrack, 1277 Main st.	10	3.25	20.95	3.39	2.23	
10369	Wolff & Reessing, Anchovy Mustard	*Danbury.*—Danbury Grocery Co., 289 Main st.	8	2.76	20.39	3.93	2.99	Coal-tar dye.*
10370	Bester Düsseldorf Tafel Senf*	Doran's Cash Grocery, 150 Main st.	5	2.58	19.92	3.98	3.33	Maize product, salicylic acid, coal-tar dye.†
10678	Lutz & Schramm Co., Allegheny, Pa.	*Danielson.*—W. N. Arnold & Co., 185 Main st.	10	3.03	22.09	3.82	2.85	Turmeric.
10716	F. C. Gould, East Hartford, The Silver Lane Pickle Factory	*New Britain.*—A. Bonander, 22 Park st.	10	2.99	18.42	3.65	2.85	Coal-tar dye,* salicylic acid.
10715	H. J. Heinz Co., Pittsburg, Pa., Heinz Prepared Mustard	W. W. Walker, 238 Main st.	10	3.36	22.56	2.66	1.83	
10670	The American Preserve Co., Phil., Pa., Schimmel's Prepared German Mustard	*New Haven.*—F. J. Boese, 960 State st.	10	3.73	19.04	2.94	2.34	Maize product, coal-tar dye.‡
10668	The Williams Bros. Co., Detroit, Mich., Compound Prepared Mustard†	R. F. Copeland, 1208 State st.	5	2.96	19.29	2.38	1.65	Wheat product, maize product, turmeric.
10671	Huntington Maple Syrup & Sugar Co., Providence, R. I., Monarch Compound Mustard‡	The People's Store, 748 State st.	8	3.49	16.78	2.52	1.93	Maize product, coal-tar dye.‡
10669	Exley, Watkins & Co., W. Va., Exwaco Brand §	A. H. Waterbury, 250 Grand avenue	5	2.52	17.86	2.57	1.96	Cereal starchy matter, coal-tar dye.*
10371	H. J. Voss, Jersey City, N. J., Voss's XXX German Mustard	*Norwalk.*—N. Y. Grocery, 35 Main st.	5	2.60	17.83	4.03	3.42	Starchy matter, coal-tar dye, salicylic acid.§
10676	Cruikshank's Bros. Co., Allegheny, Pa.	*Norwich.*—J. P. Holloway, 317 Main st.	10	3.93	19.91	3.27	2.26	Turmeric, benzoic acid.
10471	Excelsior Mustard Mills, N. Y., French Mustard	*South Norwalk.*—Lorenzo Dibble, 13 N. Main st.	10	2.87	16.14	2.99	2.21	Turmeric, salicylic acid.
10472	Excelsior Prepared Mustard	G. E. Freidrich, Railroad ave.	6	3.04	17.28	3.03	2.16	Turmeric.

* " Vinegar, spices, turmeric, mustard."
† " Vinegar, spices, herbs, mustard seed, salt."
‡ " Vinegar, spices, turmeric, mustard, salt."
§ " White wine vinegar, cereals, mustard, salt, spices, herbs."

* A tropeolin.
† Probably nitro-color.
‡ Reactions of metanil yellow.
§ Reactions of a nitro-color.

mustard means the ground whole seed or mustard flour prepared from mustard seed with the separation of a portion of the oils and hulls, and also whether the addition of ground mustard hulls as practiced by some manufacturers constitutes an adulteration. Again it is not clear whether turmeric should be regarded as a coloring substance or a spice. The chief use of turmeric in food products is unquestionably as a yellow dye, but it has a characteristic spicy flavor, and for that reason may be classed with the spices.

Accepting the broadest interpretation of the definition, which allows the admixture of mustard hulls, turmeric and salt, only 4 of the 14 brands examined during the year can be classed as genuine, as each of the others contain either a chemical preservative, a coal-tar dye or some form of starchy matter, and most of them contain two or three of these constituents. Four are preserved with salicylic acid, 1 with benzoic acid, 7 are colored with coal-tar dyes, and 6 contain products of wheat, maize or some other cereals. Further particulars are given in Table XVI.

The detection of mustard hulls presents some difficulties. As appears from Leach's* analyses of authenticated samples of mustard flour,

* Leach: Food Inspection and Analysis, New York, 1904, 356; also J. Amer. Chem. Soc. 1904, **26**, 1203.

mustard hulls and whole mustard seed, the hulls contain much more crude fiber and copper-reducing matters but less fat and nitrogen than either the flour or the whole seed. The amounts of fat in both the hulls and the flour are, however, so variable owing to the commercial processes employed in their separation and the amounts of reducing matters are so influenced by the addition of flour and other starchy matter and by the presence of starch in the spices, that determinations of these constituents are often of little value in the detection of mustard hulls. Determinations of nitrogen, while of somewhat more value, are also unsatisfactory, because the average amount of nitrogen in the flour is less than one per cent. more than is found in the hulls.

The differences between the percentages of crude fiber in the hulls on the one hand and the flour and ground seed on the other, are much more striking and suggest the determination of this constituent as a means of detecting the presence of hulls in prepared mustard. The average amount found by Leach in the hulls was 15.20 per cent., in the ground seed 5.04 per cent., and in the flour 2.42 per cent.

An attempt was made by us to determine the fiber in the samples of prepared mustard, but certain difficulties in the process were encountered which rendered the results valueless for the purpose. These difficulties were overcome by later experiments, but not until our supply of the samples in question was exhausted. More complete analyses have since been made on new samples, which together with a consideration of the methods of analysis will be published in the next report.

The manufacturers of four of the brands named in the foregoing table give on the label the constituents of which the articles are made. In one case "Vinegar, spices, turmeric and mustard" are named, but a corn product, salicylic acid and a coal-tar dye, found in the article, are omitted from the manufacturer's statement.

Another names "vinegar, spices, herbs, mustard and salt." Wheat, corn and turmeric, which were found in the goods, might all be included perhaps under "spices and herbs," but it may be doubted if a Connecticut court would be impressed with such a view of the matter.

In the two other samples no reference is made on the label to the presence of coal-tar dyes.

The four labels are all incomplete and misleading.

TOMATO CATSUP, CHILI SAUCE, AND OTHER SAUCES.

Tomato Catsup or Ketchup is the most popular of the bottled table sauces on our market. It is found on the tables of nearly every hotel and restaurant and is consumed in large quantities in families.

When made in the household, ripe tomatoes are pared, cored, boiled down to the desired consistency and strained through a sieve to remove seeds. The strained pulp is cooked for a time with vinegar, spices and other flavoring matters.

Chili Sauce is prepared in a similar manner from tomatoes, peppers (chillies), vinegar, spices, etc., but unlike catsup is not usually strained.

Both of these sauces are bottled hot and closed to exclude germs, but while the sterilization or the sealing is not always perfect, the contents of the bottles are kept from spoiling, during storage as well as during use, by virtue of the spices and vinegar.

Commercial Catsup, Chili Sauce, etc. Some of the catsups and chili sauces on the market are made from good materials, but others are said to contain refuse of tomato canneries or pumpkin pulp or starch paste and most of them are colored with dyes and preserved with chemicals.

Among the colors used are eosin, ponceau, tropeolin, magenta and others made from coal-tar, also cochineal, cudbear, and possibly others of vegetable origin. They impart to the sauces a brilliant red color which those who are unaware that the uncolored products have usually a dull red or brown color, believe is the natural color of the fruit. The objection to their use are: first, they deceive the purchasers while they in no way improve the quality of the sauce; second, they may serve to hide inferior material; third, they are possibly injurious to health; and fourth, they put genuine uncolored goods to a disadvantage in the market.

Benzoate of soda is now almost universally used as a preservative in commercial catsup and chili sauce, in place of salicylic acid, which a few years ago was used for the purpose. By the action of the free acid of the catsup on the benzoate of soda, benzoic acid, the active preserving principle, which, like salicylic acid, is probably injurious to health, is liberated.

The use of any chemical preservative in catsups and sauces without a declaration is a violation of the Connecticut pure food law.

EXAMINATION OF SAMPLES SOLD IN CONNECTICUT.

Forty-one brands of catsup were examined in 1897, and 106 brands of catsup, chili sauce and other sauces were examined in 1901. Only tests for preservatives were made in the samples collected in 1897, while in those collected in 1901 tests were made for both dyes and preservatives. During the past year 66 brands of catsup and 15 of chili sauce have been tested for both dyes and preservatives with the results given in Table XVII.

A summary of the tests made in 1897, 1901 and 1904 follows:

	1897	1901	1904
Preserved with salicylic acid	27	18	1
" " benzoic acid	8	67	76
No preservative detected	6	21	4
Total number of brands	41	106	81
Artificially colored		86	71
No artificial color detected		20	10
Total number of brands		106	81

Although 4 samples examined during the past year contain no preservative and 10 samples contain no artificial coloring matter, not a single sample is free from both preservative and artificial coloring matter.

MISCELLANEOUS MATERIALS SENT BY PRIVATE INDIVIDUALS.

The following samples were sent to the station for examination by physicians, consumers and dealers. Most of the samples were not in original packages and the names of the manufacturers and dealers are those given by the senders.

11301. *Diabetic Flour,* bought of D. M. Welch & Co., New Haven, sent by R. B. Goodyear, M.D., North Haven. Contains 14.13 per cent. of protein.

11566. *Farwell & Rhines' Special Diabetic Food,* sent by R. B. Goodyear, M.D., North Haven. Contains large amount of starch and 13.50 per cent. of protein.

TABLE XVII.—CATSUP AND CHILI SAUCE.

Station No.	Brand.	Dealer.	Price per bottle, cents.	Capacity of bottle, fluid ounces.	Color.	Preservative.
	Tomato Catsup or Ketchup.					
11336	American Relish Co., Indianapolis. Yankee Doodle	*New Haven:* Logan Bros., 406 Congress ave.	10	15	Artificial	Benzoic acid.
11371	C. Andresen & Co. Long Island	*Stamford:* C. Andresen & Co., 492 Main st.	10	16	Artificial	Benzoic acid.
11394	Austin, Nichols & Co., New York. Republic	*Danbury:* Ehle's Cash Grocery, 5 West st.	15	16	Artificial	Benzoic acid.
11349	A. C. Blenner & Co., New Haven. The Acme	*New Haven:* J. J. Sullivan, Nash and Eagle sts.	5	9	Artificial	Salicylic acid.
11382	Blue Ridge Packing Co., Wilkes-Barre. North Branch	*Meriden:* City Meat Market, 21 E. Main st.	10	8	Artificial	Benzoic acid.
11401	The Wm. Boardman & Sons Co., Hartford. Star Brand	*Hartford:* Pearl Street Grocery, 119 Pearl st.	10	15	Artificial	Benzoic acid.
11364	The Wm. Boardman & Sons Co., Hartford. Star Brand	*Bridgeport:* Cash Grocery, 1366 Main st.	10	15	Artificial	Benzoic acid.
11396	P. F. Bowe, Waterbury, Conn. Private Stock	*Waterbury:* The White, Simmons Co., 165 Bank street	10	17	Artificial	Benzoic acid.
11389	Brown & Co., New Haven. East Rock Blend	*New Britain:* Public Market, 385 Main st.	10	25	Artificial	Benzoic acid.
11407	Brownell & Field Co., Providence, R. I. Our Own	*Willimantic:* Hall's Cash Store, 15 Union st.	10	14	Artificial	Benzoic acid.
11370	Burton & Davis, N. Y. Supreme Brand	*Stamford:* Jordon & McGee, 410 Main st.	10	16	Artificial	Benzoic acid.
11392	Joseph Campbell Preserve Co., Camden, N. J. Campbell's	*Danbury:* W. D. Baldwin, 93 White st.	10	9	Natural	Benzoic acid.
11406	W. A. Castle, Springfield, Mass. Edgewood Brand	*Willimantic:* Main Street Cash Market, 921 Main st.	10	16	Artificial	Benzoic acid.
11410	The Columbia Conserve Co., Indianapolis. Columbia*	*Norwich:* Appley & Jordan, 86 W. Main st.	20	18	Natural	Benzoic acid.
11351	Crescent Preserving Co., Camden, N. J. Surprise†	*New Haven:* D. M. Welch, 8 Grand ave.	10	14	Artificial	Benzoic acid.

* "Absolutely pure, free from coloring matter." † "Compound artificially colored."

TABLE XVII.—CATSUP AND CHILI SAUCE—*Continued.*

Station No.	Brand.	Dealer.	Price per bottle, cents.	Capacity of bottle, fluid ounces.	Color.	Preservative.
	Tomato Catsup or Ketchup.					
11345	Cruikshank Bros. Co., Allegheny, Pa.	*New Haven:* E. E. Nichols, 378 State st.	10	10	Natural	Benzoic acid.
11379	Curtice Bros. Co., Rochester, N.Y. Blue Label*	*South Norwalk:* N. Y. Grocery Co., 118 Washington st.	13	8		Benzoic acid.
11359	Lewis DeGroff & Son, N. Y. Red Jacket	*Bridgeport:* E. L. Sullivan, 1142 E. Main st.	10	14	Artificial	Benzoic acid.
11333	The John T. Doyle Co., New Haven. Country Club	*New Haven:* Poehlin's Delicatessen, 367 Congress ave.	10	11	Artificial	Benzoic acid.
11373	The John T. Doyle Co., New Haven. Blue Bell	*Stamford:* R. T. Woodbury, 107 Pacific st.	9	16	Artificial	Benzoic acid.
11386	Eagle Preserving Co., N. Y. "Now we have it."	*New Britain:* Union Trading Co., 61 Arch st.	10	14	Artificial	Benzoic acid.
11358	Exley Watkins & Co., Wheeling, W. Va. Standard†	*Bridgeport:* G. Englehardt, 587 E. Main st.	10	15	Artificial	Benzoic acid.
11383	Farnham Canning Co., Farnham, N. Y. Our Favorite	*Meriden:* Block & Behrens, 74 E. Main st.	10	12	Artificial	Benzoic acid.
11398	Ransom N. Fitzgerald, Hartford. Bon Ton	*Hartford:* Hill Grocery, 558 Asylum st.	10	15	Artificial	Benzoic acid.
11385	Flaccus Bros., Wheeling, W. Va. Steer's Head	*New Britain:* City Market, 318 Main st.	20	15	Natural	Benzoic acid.
11337	The Garret Bergen Co., Brooklyn. Pride of Long Island	*New Haven:* D. M. Welch, 28 Congress ave.	15	16	Artificial	Benzoic acid.
11374	The Garret Bergen Co., Brooklyn. Bergen's Home Made Quaker‡	*Stamford;* C. M. Slater, 282 Main st.	10	14	Artificial	Benzoic acid.
11368	The Great Atlantic and Pacific Tea Co. A. & P.	*Bridgeport:* Atlantic and Pacific Tea Co., 957 Main st.	15	15		Benzoic acid.
11378	E. C. Hazard & Co., N. Y. Hazard's Shrewsbury§	*Norwalk:* Finney & Benedict, 43 Wall st.	25	15	Natural	Benzoic acid.
11341	H. J. Heinz Co., Pittsburg. Heinz's	*New Haven:* E. Shoenberger & Son, 92 George st.	10	9	Artificial	Benzoic acid.
11402	Hills & Co. Gold Seal	*Hartford:* Hills & Co., 372 Asylum st.	25	16	Artificial	Benzoic acid.
11365	Chas. L. Hirsh & Co., N.Y. Hirsh's Long Island‖	*Bridgeport:* Logan Bros., 1705 Main st.	5	10	Artificial	Benzoic acid.

* "Prepared with cochineal and benzoate of soda."
† "Absolutely pure and complies with the pure food laws."
‡ "Warranted to contain no chemical coloring or adulterations."
§ "Guaranteed free from artificial coloring or chemical preservatives."
‖ "Made from tomatoes, pure spices, harmless color and benzoate soda."

TABLE XVII.—CATSUP AND CHILI SAUCE—*Continued.*

Station No.	Brand.	Dealer.	Price per bottle, cents.	Capacity of bottle, fluid ounces.	Color.	Preservative.
	Tomato Catsup or Ketchup.					
11344	Chas. L. Hirsh & Co., N. Y. Crescent*	*New Haven:* Kohn Bros., 55 George st.	10	16	Artificial	Benzoic acid.
11387	Edward B. Hosier, N. Y. Buckeye†	*New Britain:* Deutsche Consum-Verein, 85 Arch st.	10	15	Artificial	Benzoic acid.
11372	W. A. Leggett & Co., N. Y. Liberty	*Stamford:* G. A. Ferris, 446 Main st.	10	15	Artificial	Benzoic acid.
11399	Chas. F. Loudon, Cincinnati. Lowdon's‡	*Hartford:* Newton, Robertson & Co., 338 Asylum st.	25	16	Artificial	Benzoic acid.
11356	Mansfield, Witham & Co., Lowell, Mass. Spindle City	*New Haven:* C. F. Curtiss, 932 State st.	9	15	Artificial	Benzoic acid.
11395	M. J. & H. J. Meyer & Co., N. Y. Eclipse Brand§	*Danbury:* M. McPhelemy, 44 White st.	10	21	Artificial	
11332	The Mohican Co. Mohican Brand	*New Haven:* The Mohican Co., 22 Church st.	10	14	Natural	Benzoic acid.
11380	J. T. Pillman & Co., Ayer, Mass. Sunbeam Brand	*Meriden:* City Meat Market, 21 East Main st.	10	14	Artificial	Benzoic acid.
11360	E. Pritchard, N. Y. Pride of the Farm	*Bridgeport:* Atlantic and Pacific Tea Co., 707 E. Main st.	10	14	Artificial	Benzoic acid.
11376	E. Pritchard, N. Y. Eddy's	*Stamford:* N. Y. Provision Co., 206 Atlantic st.	10	10	Artificial	Benzoic acid.
11343	Reliance Ketchup Co., Mich. Reliance	*New Haven:* F. J. Markle, 101 Dixwell ave.	5	10	Artificial	Benzoic acid.
11377	Savoy Ketchup Co., N. Y. Savoy	*Norwalk:* Cash Grocery, 53 Main st.	10	15	Artificial	Benzoic acid.
11362	M. Schoenberg & Co., N. Y. White Label	*Bridgeport:* Centennial Tea Co., 23 Washington ave.	10	14	Artificial	Benzoic acid.
11369	Shadyside Catsup Co., Shadyside, N. J.	*Bridgeport:* H. Isenberg & Co., 111 & 115 State st.	12	16	Artificial	
11411	Roger I. Sherman, Boston. Lawson Pink Brand	*Norwich:* Welcome A. Smith, 137 Main st.	20	16	Artificial	
11405	Skinner & Loudon, Cincinnati. Home Brand	*Hartford:* Public Market Co., 611 Main st.	10	12	Artificial	

* "Compound artificially colored."
† "Absolutely pure and complies with the pure food laws."
‡ "Small amount of harmless coloring and benzoate of soda."
§ "Guaranteed free from artificial coloring or chemical preservatives."

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TABLE XVII.—CATSUP AND CHILI SAUCE—*Continued.*

Station No.	Brand.	Dealer.	Price per bottle, cents.	Capacity of bottle, fluid ounces.	Color.	Preservative.
	Tomato Catsup or Ketchup.					
11375	T. A. Snider Preserve Co., Cincinnati. Snider's Home Made	*Stamford:* Fitch A. Hoyt, Atlantic Sq.	15	8	Artificial	Benzoic acid.
11397	Standard Packing Co., Indianapolis. Berkshire	*Waterbury:* E. H. Plumb, 113 S. Main st.	15	15	Artificial	Benzoic acid.
11353	Standard Packing Co., Indianapolis. Bordeaux	*New Haven:* R. F. Copeland, 1208 State st.	10	15	Artificial	Benzoic acid.
11350	Stoddard, Gilbert & Co., New Haven. High Grade	*New Haven:* A. H. Waterbury, Grand ave. and Poplar st.	9	16	Artificial	Benzoic acid.
11347	Swan & Babcock, New Haven. Imperial*	*New Haven:* Swan & Babcock, 27 Dixwell ave.	9	13	Artificial	Benzoic acid.
11409	J. E. Thomson. Thomson's New Process	*Norwich:* H. D. Rallison, 45 Broadway	10	9	Artificial	Benzoic acid.
11355	The Tip Top Ketchup Co., Cincinnati. Sunny Side	*New Haven:* 3 G's Cash Store, 23 Edward st.	10	15	Artificial	Benzoic acid.
11412	The Tip Top Ketchup Co., Cincinnati. Newport	*New London:* The Mohican Co., 261 State st.	4	7	Artificial	Benzoic acid.
11334	H. M. Tower's	*New Haven:* H. M. Tower, 379 Congress ave.	10	15	Artificial	Benzoic acid.
11340	The Union Supply Co. Jewell*	*New Haven:* Union Supply Co., 115 Congress ave.	10	13	Artificial	Benzoic acid.
11400	Van Camp Packing Co., Indianapolis. Van Camp's	*Hartford:* The Smith Clapp Grocery, 187 Asylum st.	18	17	Artificial	Benzoic acid.
11404	Van Lill Preserving Co., Baltimore. Sunset	*Hartford:* Union Grocery, 1030 Main st.	15	15	Artificial	Benzoic acid.
11366	Village Store Co. Village Store	*Bridgeport:* Village Store Co., 244 State st.	10	14	Artificial	Benzoic acid.
11388	W. W. Walker Co., Hartford	*New Britain:* W. W. Walker, 238 Main st.	20	16	Artificial	Benzoic acid.
11352	The Williams Bros. Co., Detroit, Mich. Waldorf	*New Haven:* A. Duhan, 1134 State st.	9	12	Artificial	Benzoic acid.
11354	Richard Jastrow, New Haven. Jastrow's Special Brand	*New Haven:* J. P. Hugo, 92 Nicoll st.	10	17	Artificial	Benzoic acid.
11384	Pure Unexcelled, manufacturer not stated	*Meriden:* Meriden Tea and Coffee Co., 77 E. Main st.	5	9	Artificial	Benzoic acid.
11408	Manufacturer not stated	*Norwich:* E. Tracy, 127 W. Main st.	5	9	Artificial	Benzoic acid.

* "Guaranteed to be an article of the very highest merit, and to comply with all pure food laws."

TABLE XVII.—CATSUP AND CHILI SAUCE—*Continued.*

Station No.	Brand.	Dealer.	Price per bottle, cents.	Capacity of bottle, fluid ounces.	Color.	Preservative.
	Chili Sauce.					
11339	Joseph Campbell Preserve Co., Camden, N. J. Campbell's	*New Haven:* D. M. Welch, 28 Congress ave.	10	8	Natural	Benzoic acid.
11346	Cruikshank Bros. Co., Allegheny, Pa. Cruikshank's	*New Haven:* E. E. Nichols, 378 State st.	10	8	Natural	Benzoic acid.
11335	The John T. Doyle Co., New Haven. Doyle's Country Club	*New Haven:* H. M. Tower, 379 Congress ave.	10	9	Artificial	Benzoic acid.
11363	Eastman Bros.	*Bridgeport:* Centennial Tea Co., 23 Washington ave.	10	11	Artificial	Benzoic acid.
11391	The Garret Bergen Co., Brooklyn. Bergen's Quaker	*Danbury:* N. Y. Cash Grocery, 309 Main st.	12	12	Artificial	Benzoic acid.
11357	F. C. Gould, Silver Lane, Conn.	*New Haven:* C. F. Curtiss, 932 State st.	9	10	Artificial	Benzoic acid.
11390	H. J. Heinz Co., Pittsburg, Pa. Heinz	*New Britain:* H. A. Hall, 212 Main st.	25	12	Natural	Benzoic acid.
11338	Hudson Preserving Co., N. Y. Lion Brand	*New Haven:* The Mohican Co., 22 Church st.	10	8	Artificial	Benzoic acid.
11381	Chas. Israel & Bros., N. Y. Sceptre Brand	*Meriden:* H. E. Bushnell, 75 W. Main st.	13	10	Artificial	Benzoic acid.
11348	The Mullen-Blackledge Co., Indianapolis. Columbia	*New Haven:* Delicatessen, 960 State st.	20	18	Artificial	Benzoic acid.
11361	E. Pritchard, N. Y. Pride of the Farm	*Bridgeport:* Atlantic and Pacific Tea Co., 707 E. Main st.	10	12	Artificial	Benzoic acid.
11367	The T. A. Snider Preserve Co., Cincinnati	*Bridgeport:* E. E. Wheeler, 1135 Main st.	15	9	Artificial	Behzoic acid.
11393	The Tip Top Ketchup Co., Cincinnati. Sunny Side	*Danbury:* Village Store Co., 236 Main st.	9	8	Artificial	Benzoic acid.
11342	The Tip Top Ketchup Co., Cincinnati. Sunny Side	*New Haven:* E. Schoenberger & Son, 92 George st.	10	8	Artificial	Benzoic acid.
11403	The West Va. Preserving Co., Wheeling. Fort Henry Brand	*Hartford:* C. J. Dow, 2 Church st.	10	9	Artificial	Benzoic acid.

11577. *Farwell & Rhines' Gluten Flour,* sent by A. P. Bergman, M.D., New Haven. Contains large amount of starch and but 9.37 per cent. of protein.

11597. *Gum Gluten Flour,* made by the Pure Gluten Food Co., New York City, sent by A. P. Bergman, M.D., New Haven. Contains 54.3 per cent. of protein.

10756. *Gluten Flour,* bought of Johnson Bros., New Haven, sent by R. B. Goodyear, M.D., North Haven. Contains small amount of starch and 41.44 per cent. of protein.

10755. *Gluten Flour,* bought of D. M. Welch & Co., New Haven, sent by R. B. Goodyear, M.D., North Haven. Contains large amount of starch and but 10.81 per cent. of protein.

11659. *Starch,* sent by David Trubee & Co., Bridgeport. Has the microscopical characters of tapioca (Manihot or cassava) starch.

11583. *Chopped Meat,* sent by Health Department, Bridgeport. Preserved with boric acid and colored with red coal-tar dye.

11205. *Olive Oil,* sent by W. R. Kirkwood, Board of Health, New Haven. Contains small amount of sesame oil.

11486. *Salad Oil,* sent by W. R. Kirkwood, Board of Health, New Haven. Largely or entirely cotton seed oil.

10720. *Olive Oil,* sent by W. F. Hasselbach, New Haven. Not found adulterated.

11565. *Pure Blossom Nectar (Honey),* put up by Wm. A. Selser, Jenkintown, Pa., sent by Prof. Geo. B. Adams, New Haven. Not found adulterated.

11657. *Warranted Pure Honey,* from the apiary of H. W. Cooley, Westport, sent by W. P. Wakeman, Southport. Not found adulterated.

11512. *Choice Honey,* W. D. Foote, Westville, bought of E. E. Hall & Co., New Haven. Not found adulterated.

11511. *Pure Orange Honey,* W. J. Lamb, Somerville, Mass. Not found adulterated.

11715. *Honey,* sent by W. B. Glover, Meriden. Not found adulterated.

11632. *Honey,* sent by S. W. Hurlburt Co., New Haven. Not found adulterated.

11298. *Honeysuckle Brand Pure California Honey,* sent by Edwin S. Todd, Milldale. Not found adulterated.

11331. *Molasses,* sent by John J. Ryburn, Bridgeport. Not found adulterated.

11883. *Amcehat Brand Tomatoes;* 11843, *Noreca Brand Quince;* 11842, *Amcehat Fresh Ruby Beets;* 11844, *Amcehat Brand Royal Home Made Red Raspberry Jam.* All four from Acker, Merrall & Condit Co., New York, sent by S. W. Hurlburt Co. Benzoic acid was detected in 11844, but neither preservative nor artificial color was found in any of the other samples.

10563. *Apricots,* sent by Robert P. Wakeman, Southport. Bleached with sulphurous acid.

11189. *Vinegar,* sent by John T. Mortimer, Naugatuck. Total solids 0.29 per cent., acidity 4.08 per cent. Not cider vinegar.

11291. *Watkins Salt,* sent by Meech & Stoddard, Middletown. Matter insoluble in water 0.02 per cent., lime 0.48 per cent., magnesia 0.01 per cent., sulphuric acid 0.56 per cent.

FOOD PRODUCTS EXAMINED FOR THE DAIRY COMMISSIONER IN THE YEAR ENDING JULY 31, 1904.

The following samples were referred to this station for examination by the Dairy Commissioner:

Butter. Five samples were examined, all of which were found to be unadulterated.

Molasses. Four hundred and nineteen samples were examined, and of these eight were found to be adulterated with glucose.

Vinegar. Two hundred and seventy-four samples were examined. Of these fifty-one contain less than the four per cent. of acidity, calculated as acetic acid, which is required by the law regarding vinegar.

TABLE XVIII.—SUMMARY OF THE RESULTS OF EXAMINATIONS OF FOOD PRODUCTS IN 1904.

	Not found Adulterated.	Adulterated or below standard.	Compounds.	Total number examined.
Sampled by the Station.				
Milk	288	28	----	316
Condensed Milk	24	4	0	28
Noodles	0	22	0	22
Buckwheat Flour	41	16	15	72
Baking Powder	50	10	0	60
Cream of Tartar	72	19	0	91
Coffee	15	13	0	28
Spices	118	58	1	177
Prepared Mustard	4	10	0	14
Catsup and Chili Sauce	0	81	0	81
Total	612	261	16	889
Sampled by Individuals.				
Milk	170	10	0	180
Cream	16	1	0	17
Spices	6	2	0	8
Miscellaneous	20	6	0	26
Total	212	19	0	231
Sampled by the Dairy Commissioner.				
Butter	5	0	0	5
Molasses	411	8	0	419
Vinegar	----	----	----	274
Total	416	8	0	698
Total number of samples examined	----	----	----	1,818

THE ANATOMY OF THE PEANUT WITH SPECIAL REFERENCE TO ITS MICROSCOPIC IDENTIFICATION IN FOOD PRODUCTS.

By A. L. WINTON.

Formerly the peanut (*Arachis hypogaea* L.) was thought to be a native of the old world, but more recent investigations indicate that it is a Brazilian plant which was introduced into other regions in early colonial times.

At the present time, peanuts are grown in Africa, Southern Europe, India, China, Japan and the Islands of the Pacific, largely for the production of oil and oil cake, the latter serving as food for man and cattle, and in the United States for consumption, chiefly as roasted peanuts and in peanut confectionery. Peanut hay, consisting of the stalks, leaves and immature pods, is utilized as a cattle food. Handy* states that about 4,000,000 bushels of peanuts are annually consumed in the United States, the larger part being roasted and sold on the street.

The African variety, grown not only in Africa but also in India and other parts of the eastern hemisphere as well as in North Carolina, yields a small pod with seeds rich in oil. A variety with larger pods (often 4-5 cm. long) but less oily seeds, is extensively grown in Virginia, yielding the nuts commonly roasted by venders. Tennessee produces two varieties, the white and the red. A small podded variety is grown in Spain, partly for the production of oil and partly for the cake, which mixed with chocolate and spices, is a common food for the lower classes. The Spanish peanut is also cultivated to a limited extent in America.

Peanuts of the varieties named usually contain two seeds, less often one, rarely three. Costa Rica produces a variety with long pods containing four to five seeds. A variety grown in the Argentine Republic has pods of a deep orange color.

The peanut belongs to a small group of legumes which ripen their fruit below ground. Shortly after blooming the flower stalks bend downward until the young fruit is completely buried in the soil. If for any reason this does not occur the fruit fails to ripen.

* Peanuts: Culture and Uses. U. S. Dept. Agr., Farmers Bulletin, No. 25, Washington, 1895.

The dry pod or pericarp is brittle and easily broken with the fingers. Ten or more longitudinal ridges with anastomosing branches form more or less distinct reticulations on the outer surface (Fig. 1). Beneath the surface is a spongy tissue (Fig.

FIG. 1.—Peanut. Natural size.

2, m), further inward a thin but hard woody coat (f) and still further inward, forming the lining of the pod, a papery tissue with a silky lustre (p). In the early stages of ripening the seeds completely fill the pod and, as a result of this crowding, their adjacent surfaces are flattened in a diagonal plane. This flattened surface is at the hilum end of the upper seed, at the chalaza end of the lower seed. When ripe the seeds only partly fill the cavity. The united testa and perisperm (Fig. 2, S) forms a thin skin, red or brown on the outer, colorless or yellow on the inner surface, in which are veins formed by the raphe, and five branches radiating from it at the chalaza. The elongated cotyledons (Fig. 2, C) are longitudinally grooved on the inner surface.

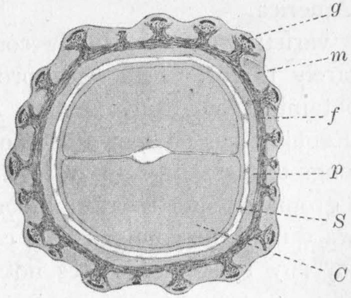

FIG. 2.—Peanut. Transverse section. m mesocarp, f fiber layer and p parenchyma of the pericarp; g fibro-vascular bundle; S testa; C Cotyledon. × 4.

Histology.

Moeller,* Vogl† and T. F. Hanausek‡ have ably described and illustrated the structure of the peanut seed, but have quite neglected the pericarp. Of the authors who have studied the pericarp, Kobus§ gives a cut but no description; Uhlitzsch|| confines his attention largely to a general description, illustrated by diagrammatic figures, and Böhmer¶ describes briefly some of the elements useful in diagnosis. My own work has corroborated the conclusions of other investigators as to the structure of the testa, and, in addition, has brought to light certain interesting tissues of pericarp.**

THE PERICARP (Fig. 3) or shell of a peanut, while mor-

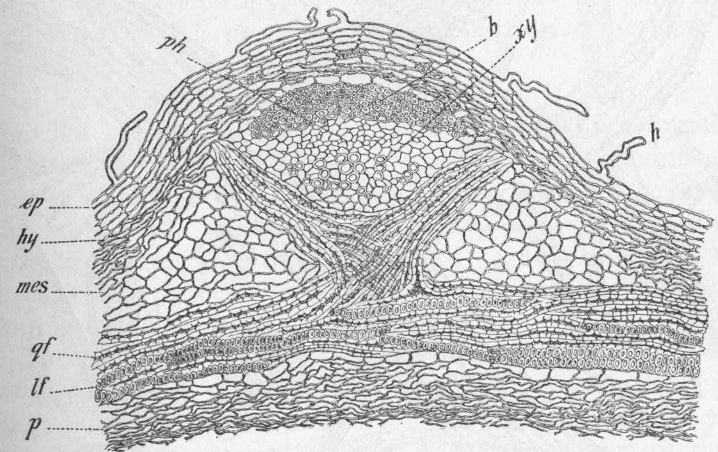

FIG. 3.—Peanut. Pericarp in transverse section. ep epicarp with hairs h; hy hypoderm; mes mesocarp; qf transversely elongated fibers; lf longitudinally elongated fibers; p parenchyma; b bast fibers, ph phloem and xy xylem of a fibro-vascular bundle. × 80.

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* Mikroskopie der Nahrungs- und Genussmittel. Berlin, 1886, 239.

† Die wichtigsten vegetabilischen Nahrungs- und Genussmittel. Berlin and Wien, 1899, 321.

‡ Lehrbuch der Technischen Mikroskopie. Stuttgart, 1901, 384; also in Wiesner: Die Rohstoffe des Pflanzenreisches, II Bd. Leipzig, 1903, 734.

§ Kraftfutter u. seine Verfälschung, Landw. Jahrb, 1884, **13**, 813.

|| Rückstande d. Erdnussölfabrikation, Landw. Vers.-Stat. 1892, **41**, 385.

¶ In Koenig: Die Untersuchung landwirthschaftlich und gewerblich wichtiger Stoffe. Berlin, 1898, 284.

** Since this paper was prepared for publication, Collin's admirable work "Les residues industriels" has appeared in print. In the chapter on the peanut (p. 222) are given figures illustrating the microscopic characters of both the pericarp and seed. No mention is made of hairs on the pericarp.

phologically corresponding with the pod of other legumes, exhibits some remarkable peculiarities, traceable partly at least to the conditions encountered while ripening in the soil. Not only is it deprived of all chlorophyl and consequently of the photosynthetic power of the leaf, but on the other hand it is provided with root hairs, and presumably possesses to some degree the absorptive function of a true root. In other words,

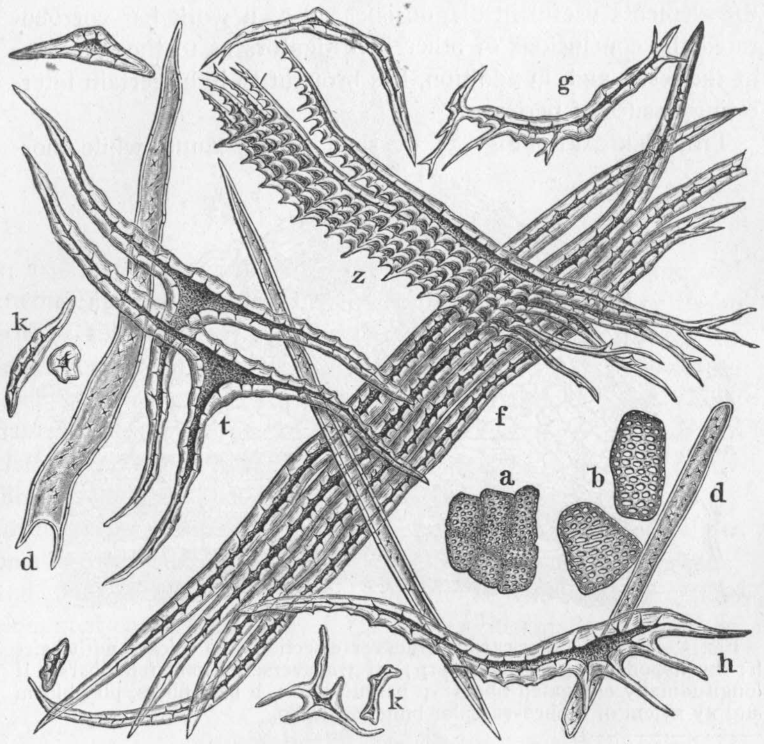


FIG. 4.—Peanut. Isolated elements of the pericarp. a and b cells of the hypoderm; f, z, k, h, t, d and g cells of the fiber layer. × 160.

the pericarp, although morphologically a leaf, acts physiologically as a root.

1. *The Epidermal Cells* (Fig. 3, ep) are so thin-walled that they are seen with difficulty in surface view. In cross section, especially after staining with saffranin, the presence of typical root hairs (h) arising from the center of many of the epidermal cells, is evident. I have been unable to find these

hairs on the peanuts sold by venders, due probably to their previous removal by cleaning or by friction of one against the other in the bags, but I have found them on specimens grown in the garden of this Station and also carefully cleaned specimens grown in North Carolina and kindly furnished by Prof. Kilgore of the North Carolina Station.

2. *Hypoderm* (Fig. 3, hy, Fig. 4, a and b). The cells of one or more layers beneath the epidermis have thin non-porous walls, but further inward the walls are thick and conspicuously porous. Owing to these pores as well as their quadrilateral shape, the cells are readily identified in powdered shells.

3. *The Mesocarp* (Fig. 3, mes), or more properly the outer parenchyma layer, consists of thin-walled cells which become obliterated to a large extent on ripening. Over the bundles this layer is thin or lacking.

4. *Fiber Layer* (Fig. 2, f; Fig. 3, qf and lf; Fig. 4). A thin but hard coat of fibers extended in different tangential directions gives rigidity to the pericarp. Many of these fibers bear rows of saw teeth (Fig. 4, z) between which lie the crossing fibers of an adjacent layer. At the end they are often branched, giving rise to halberd-shaped (h) and other curious forms. Many other remarkable cells, varying greatly in size, form and wall-thickness, occur in this layer.

The ridges forming the reticulations of the nut are but channeled outgrowths of this layer formed by remarkable T- (Fig. 4, t) and L-shaped fibers. Often in partially macerated specimens one finds a series of these angled fibers, part of each belonging in the fiber layer proper, the remainder to the ridges.

In the channels of these outgrowths run the fibro-vascular bundles (Fig. 2, g., Fig. 3) with well marked bast fibers (b), phloem (ph), and xylem (xy).

5. *Inner Parenchyma* (Fig. 3, p). Cross sections of partly ripe seeds show a thick inner layer of pith-like cells, with triangular intercellular spaces at the corners. At full maturity, especially after drying the seed, the compressed cells of this layer form the papery lining of the shell.

THE TESTA (Fig. 5, S; Fig. 6) and perisperm (N) form a thin dry skin which may be readily separated and sectioned either dry in paraffine or wet between pieces of pith. As recommended by T. F. Hanausek, sections should be treated either with hydrochloric acid and caustic alkali or with Javelle water, in order to make the inner epidermis of the testa evident.

1. *The Outer Epidermis* (Figs. 5 and 6, aep) corresponds with the palisade layer of other legumes, although the two appear at first sight to have nothing in common. The cells are 15-25μ high and 25-50μ broad. Cross sections show that the inner walls are thin but that the radial walls increase in thickness from within outward and as a consequence the cavities are more or less triangular in shape.

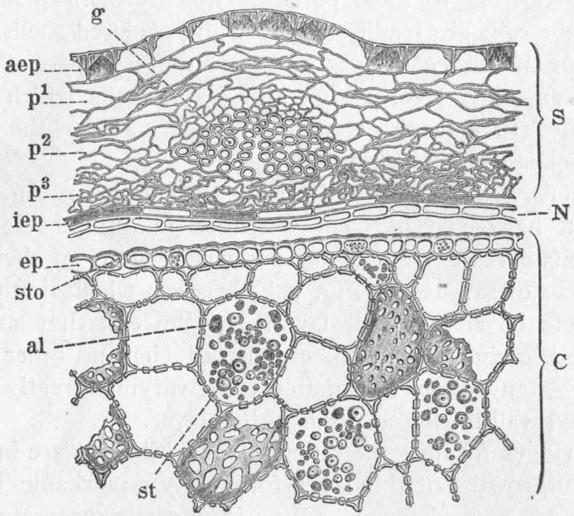


FIG. 5.—Peanut. Seed in transverse section. S testa consisting of the outer epidermis aep, the parenchyma p^1, the spongy parenchyma p^2 and p^3 and the inner epidermis iep; g fibro-vascular bundle; N perisperm; C cotyledon consisting of the epidermis ep with stoma sto and the porous parenchyma cells with starch grains st and aleurone grains al. × 160.

Radially elongated pores pierce the thickened portion of the walls, forming ribs. Examined in surface view, the sharply polygonal cells with thickened, porous walls present a characteristic appearance.

When it is considered that the palisade cells of nearly all legumes are polygonal in surface view and have ribbed radial walls increasing in thickness from within outward, it is evident that these cells differ from the type merely in that they are broader, higher and have a broader lumen.

2. *Hypoderm* (Figs. 5 and 6, p^1). Column cells such as characterize other legumes are not present, the hypodermal layer being of thin-walled parenchyma cells without intercellular spaces.

3. *Parenchyma* (Figs. 5 and 6). The character of the cells varies from ordinary parenchyma (p^1) in the outer layers to spongy parenchyma with moderate-sized intercellular spaces in the middle layers (p^2) to a very striking spongy parenchyma with narrow branching cells and relatively large intercellular spaces in the inner layers (p^3). These latter aid in identification.

Strongly developed vascular elements occur in the raphe bundles and its branches.

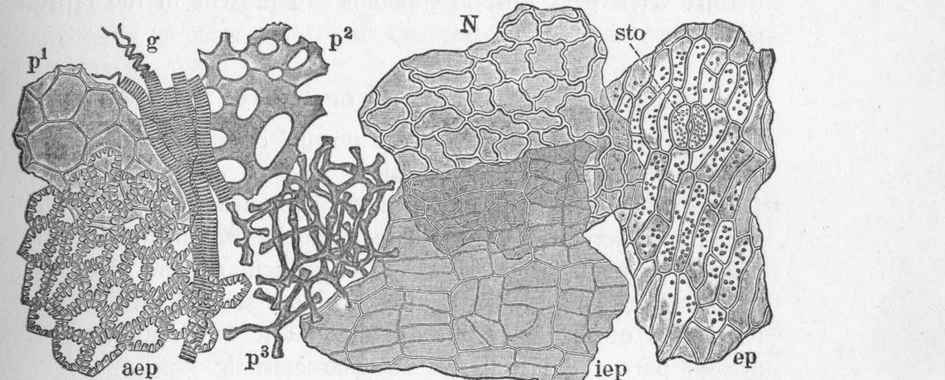


FIG. 6.—Peanut. Elements of the seed in surface view. Significance of the letters same as in Fig. 5. × 160.

4. *Inner Epidermis* (Figs. 5 and 6, iep). Treatment of sections with Javelle water brings into evidence the inner epidermis. In surface preparations treated in the same manner and stained with saffranin the cells may be seen to be quadrilateral, usually elongated, with often marked evidence of division and subdivision of the mother cells.

PERISPERM (Figs. 5 and 6, N). A single layer of moderately thick-walled cells with somewhat wavy contour forms the inner coat of the skin. The contents, according to T. F. Hanausek, are granules consisting sometimes of corroded crystals.

THE EMBRYO comprises two large cotyledons (Fig. 5, C) and a relatively small radicle.

1. *The Epidermal* cells (Figs. 5 and 6, ep) of the cotyledons are characterized by their elongated form and thick outer walls. Small aleurone grains are present in all the cells and small starch grains occur in abundance in the guard cells of the stomata (sto).

2. *Mesophyl.* Cells of large size containing aleurone grains (al), starch grains (st) and fat make up the large bulk of the cotyledons. Their double walls pierced by large pores range up to 6μ in thickness, being separated at the angles to form small intercellular spaces. The starch grains (up to 15μ) are globular and have a central hilum. The aleurone grains vary greatly in shape and size, some of them being about the size of the largest starch grains, most of them, however, only half or a third as large. Several globoids are present in the largest grains.

Microscopic Examination of Peanut Products.

Peanut shells (pericarp) are a normal constituent of peanut cake made from unhulled peanuts and of cattle food made from damaged or immature fruits. They are identified by the pitted hypoderm cells (usually of quadrilateral form) and the various elements of the fiber layer, particularly the T-shaped, the L-shaped, the toothed and the halberd-shaped forms. The root hairs of the epidermis are difficult to find and the compressed parenchyma cells are not characteristic.

Products containing only the seed include peanut cake, peanut confectionery, peanut butter (a paste prepared from the seed after removal of the pericarp and testa) and the mixtures of chocolate and peanut cake prepared in Spain and possibly in other countries. These products contain not only the starch, fat and proteids of the seed but also, in greater or less amount, the tissues of the testa of which the porous, sharply polygonal cells of the outer epidermis, and the spongy parenchyma cells, often with narrow arms, are most useful in diagnosis. Fragments of the testa, brown or red on the outer, yellow on the inner surface, can often be picked out under the dissecting microscope.

FOURTH REPORT

OF THE

STATE ENTOMOLOGIST OF CONNECTICUT

To the Director and Board of Control of the Connecticut Agricultural Experiment Station:

I hereby transmit my fourth annual report as is required by Section 4387 of the General Statutes. Following the system adopted in previous reports, the period covered is the calendar year of 1904, except for the financial statement, which is arranged to correspond with the State fiscal year ending September 30, 1904.

Respectfully submitted,

W. E. Britton,

State Entomologist.

Report of the Receipts and Expenditures of the State Entomologist from October 1st, 1903, to September 30th, 1904.

Receipts.

From E. H. Jenkins, Treasurer		$3,655.17
G. P. Clinton, for mileage		.48
		$3,655.65

Expenditures.

Field, office and laboratory assistance	$1,720.87	
Printing and illustrations	421.04	
Postage	13.49	
Stationery	8.25	
Telephone and telegraph	3.35	
Express, freight and cartage	26.50	
Library	311.15	
Laboratory apparatus and supplies	552.41	
Spraying apparatus and supplies	82.72	
Office supplies	8.56	
Traveling expenses	374.54	
	$3,522.88	
Balance, cash on hand	132.77	
		$3,655.65

Memorandum—This account of the State Entomologist has been duly audited by the State Auditors of Public Accounts.

Insect Pest Law.

As there has been no change in the law during the year it is omitted from this report. Persons wishing to examine it are referred to Sections 4386 to 4390 of the General Statutes, or to the Report of this Station for 1903, page 200. Copies of the law will be sent on application to this office.

Publications.

During 1904 the following publications were issued from the entomological department:

Third Report of the State Entomologist (Part III of the Report of the Station) was printed in an edition of 12,000 copies, and distributed in March. This report contains 80 pages, 16 figures and 8 plates.

Bulletin 146, San José Scale-Insect Experiments in 1904, 32 pages, 4 plates, contains the results of the spraying experiments to kill this pest in 1904. Twelve thousand copies were distributed in November. This bulletin in slightly emended form is reproduced in this report.

A press bulletin on the habits, life-histories and breeding places of mosquitoes together with remedial treatment was issued June 13th, and printed in nearly all the newspapers of the state.

A circular giving information about the draining of mosquito breeding pools on the salt marshes was printed in July, and a small number of copies were distributed only to those interested in this work. Circular letters urging work in mosquito control were sent to about 150 proprietors of hotels and summer resorts along the shore, about September 1st.

Organization and Equipment.

Assistance.—Mr. B. H. Walden has assisted the State Entomologist throughout the year; he has helped in the spraying experiments, has done most of the photographic work and now is in charge of the collection of insects. Mr. Henry L. Viereck was first employed to rearrange the specimens in the collection, but he helped in the spraying work and was continued on the

mosquito investigations during the summer until September 15th. Mr. Viereck examined the salt marsh region of Connecticut from New York to Rhode Island, bred several species of mosquitoes and aided in the general collecting and curatorial work. Both Messrs. Walden and Viereck have aided in preparing this report. Mr. P. L. Butrick, a high school student, was employed through July and August to collect and mount insects. A laborer was employed for a month during March and April to help about the spraying work. Miss Anna Davis Clark was employed as stenographer for part of each day after November 7th. All of these assistants have performed their duties faithfully and acceptably.

Collection of Insects.—The insect collection contains about 20,000 named species and 15,000 specimens of Connecticut insects; 7,000, or nearly half, were additions made during 1904, and which have not yet been identified. The whole collection is now in Schmitt boxes enclosed in metal cases, which is a safe method of keeping the specimens.

Library.—The library of the entomological department has received several additions during the year. Chief among these are complete sets of the Proceedings of the Entomological Society of Philadelphia, 1861–1867, 6 vols.; Bulletin of the Brooklyn Entomological Society, 7 vols.; Papilio, 4 vols.; Riverside Natural History, 6 vols.; Forstinsektenkunde, by Judeich and Nitsche, 2 vols., and a number of reports, monographs and single volumes.

A set of the cards pertaining to entomology, published by the Office of Experiment Stations, has been bought and arranged for ready reference.

Microscope.—A new Bausch & Lomb microscope outfit with one-twelfth oil immersion objective has been added to the laboratory equipment.

Exhibits and Lectures.

Exhibits.—At the annual meeting of the Connecticut Pomological Society at Hartford in February, and at the fruit exhibit of the same society at Rockville in September, injurious and beneficial species of insects were shown, as well as various insecticides, photographs of spraying operations, mosquito breeding places, etc. At Rockville a jar of mosquito larvae or wrigglers attracted considerable attention. During the summer similar jars were placed in three stores on Chapel street, New Haven, and in one Hartford store, where they could be seen from the street. Each jar was fitted with an explanatory label and many persons stopped daily to watch the contents of these jars.

Lectures.—Eighteen lectures have been given at farmers' institutes, grange meetings and village improvement societies by the State Entomologist during the season. Three of these lectures have been illustrated with lantern slides.

Correspondence.

The work of the office has included the writing of 867 letters. Sixty packages, including mosquito maps, have been sent out by mail and express. One hundred and fifty circular letters have also been mailed.

Nursery Inspection.

During the season 34 nurseries have been inspected. The San José scale is found in most of these; not only in those growing fruit trees but also where there is ornamental stock of kinds liable to be infested. The entomologist requires the owner to destroy all this infested stock before issuing certificate. Most nurserymen are ready to do this, though sometimes under protest. Where a large area of fruit stock or ornamental stock liable to be infested grows near infested trees, or if portions of the stock in the large areas are found infested, the owners are usually required to fumigate with hydrocyanic acid gas the remaining stock before selling it.

All of the large nurseries handling fruit stock and some of the small nurseries which handle only ornamental stock are now fitted with fumigating houses and make a practice of fumigating certain kinds of trees and shrubs when dug for shipment. The form of certificate granted is the same as last year (see Third Report for 1903, page 206).

The accompanying list gives the names of firms receiving certificates during the season:

List of Nursery Firms Receiving Certificates in 1904.

Name of Firm.	Location.	Inspection Finished.	Certificate Number.
Allen, Chas. I.	Terryville	Oct. 29,	160
Atwater, C. W.	Collinsville	Oct. 10,	148
Barnes Bros. Nursery Co.	Yalesville	Oct. 14,	152
Beers, S. Perry	Greenfield Hill	Nov. 7,	168
Bowditch, J. H.	Pomfret Center	Oct. 11,	149
Bridgeport Nursery	Bridgeport	Oct. 20,	156
Burr & Co., C. R.	Manchester	Sept. 23,	142
Comstock & Lyon	Norwalk	Oct. 13,	150
Conine, F. E.	Stratford	Oct. 14,	151
Conn. Agricultural College	Storrs	Nov. 2,	164
Conn. Valley Orchard Co.	Berlin & Deep River	Nov. 21,	173
Conway, W. B.	New Haven	Nov. 12,	170
Dehn & Bertolf	Greenwich	Nov. 4,	167
East Rock Park Nursery	New Haven	Nov. 1,	163
Elizabeth Park Nursery	Hartford	Oct. 17,	153
Elm City Nursery Co.	New Haven	Sept. 20,	140
Gardner's Nurseries	Cromwell	Nov. 3,	165
Gurney & Co., H. H.	New Canaan	Oct. 5,	145
Hale, J. H.	So. Glastonbury	Oct. 21,	157
Holcomb, Irving	Granby	Oct. 7,	146
Hoyt's Sons Co., Stephen	New Canaan	Oct. 5,	144
Hunt & Co., W. W.	Hartford	Oct. 19,	155
Keney Park Nursery	Hartford	Oct. 24,	158
Kirk, Hugh	Hartford	Sept. 30,	143
Longden, C. E.	North Haven	Nov. 3,	166
Norton, A. F.	New Britain	Oct. 29,	161
Pierson, A. N.	Cromwell	Sept. 22,	141
Platt Co., The Frank S.	New Haven	Nov. 16,	171
Purington, C. O.	Hartford	Oct. 31,	162
Ryther, O. E.	Norwich	Nov. 10,	169
Vidbourne & Co., J.	Hartford	Oct. 8,	147
Wallace, W. E.	Hartford	Oct. 19,	154
Woodruff, C. V.	Orange	Oct. 28,	159
Woodruff & Sons, S. D.	Orange	Nov. 19,	172

Examination of Orchards, Gardens and Greenhouses.

In addition to the work of inspecting nurseries, the State Entomologist and his assistant have made fifty-four examinations of orchards, gardens and greenhouses to see if pests were present or to advise treatment. Most of these were made at the request of the owner or some other interested party, though the

State Entomologist has made a number of inspections when not requested to do so.

Compulsory Destruction and Treatment of Infested Trees.

In one case it has been necessary for the State Entomologist to make use of the authority given him by Section 4387 of the Statutes regarding the destruction and treatment of infested trees where they had been neglected by orchardists and had become a menace to adjoining owners. The situation was a peculiar one. An orchard of peach, plum and apple trees owned by one man was operated by another under a lease for a period of several years. After the bargain was made the trees were found to be infested with San José scale. While it seemed the duty of the operator to care for the trees according to his agreement, he claimed that the scale was a factor wholly outside of the agreement, and therefore did nothing. Most of the trees were ruined, but were propagating the scale to the great detriment of a nearby orchard. After consulting legal authority, the State Entomologist served notices on both owner and operator to destroy these worthless trees and spray the few remaining trees that were deemed worth saving. The orders were finally obeyed.

Chief Lines of Research.

San José Scale Experiments.—Spraying experiments to control the San José scale have occupied the attention of the working force of the department. Over 4,000 trees in six different localities were sprayed in the experiments. Spraying mixtures made after fifteen different formulas were used. An account of the experiments will be found elsewhere in this report. Advice was given to many orchardists who practiced spraying.

Mosquito Investigations.—Mosquitoes were collected in both the adult and larval stages and the entire salt marsh area of the state examined for breeding places, which were marked on maps of the region. A detailed report of each town was prepared and sent to the health officer of that town, accompanied by a map showing the location of the breeding areas.

So far about twenty species of mosquitoes have been found in Connecticut, but the number is sure to be increased upon further investigation. The inland region has not yet been systematically examined. An account of the work accomplished will be found in the last half of this report.

Insect Fauna of Connecticut.—Especial attention has been given to collecting and rearing specimens of Connecticut insects for the collection. There is probably not a collection in existence which fairly and adequately represents the insect fauna of our state, though certain orders and families are well represented in several collections. Most of our collecting, however, has been done along the coast and chiefly near New Haven. The northern part of the state and especially the high altitudes should be visited, and collecting trips will probably be made to these localities during the coming season.

Tobacco Insects.—Observations on insects attacking tobacco in Connecticut have been continued, though very few species were found during 1904. Cutworms were about the only tobacco insects that were really abundant during the season.

General Observations on Injurious Insects.—Notes and observations have been made on a large number of fruit, garden, field and shade-tree insects causing injury to plants, crops and trees.

Insects Sent for Identification.

Each year specimens of insects are received from farmers, fruit-growers, florists and others for identification. This is very necessary work, though sometimes considerable study is required to identify rare or introduced species. But it is useful work and our common pests, of course, can be easily identified. Insects sent by mail should be enclosed in a strong box which will not be crushed in the mail and several specimens with food plants should be sent when possible. During 1904, the State Entomologist has received for identification 140 samples of insects, which are given in the following list:

INSECTS RECEIVED FOR IDENTIFICATION.

DATE.	NAME.	HOST.	LOCALITY.	REMARKS.
1904				
Jan. 2	San José Scale, *Aspidiotus perniciosus* Comst.	Apple	Gales Ferry	Twigs moderately infested.
	" " "	Japan Plum	Shelton	Tree badly infested.
" 19	Hemispherical Scale, *Sassetia hemisphaerica* Targ.-Tozz.	Fern	Terryville	An adult and several young on fronds.
" 28	San José Scale *Aspidiotus perniciosus* Comst.	Pear	Hanover	Twigs moderately infested.
Feb. 17	Pear Psylla, *Psylla pyricola* Först.	"	Cheshire	Twigs covered with sooty mold in which were cast skins of nymphs.
" 23	San José Scale, *Aspidiotus perniciosus* Comst.	Apple	East Hartford	Twigs thoroughly covered.
" 27	" " "	Peach	Hartford	A few specimens around buds.
" 29	" " "	Apple	Thompson	One twig thoroughly infested.
	Mite, *Bryobia pratensis* Gar.	"	"	Eggs on same twigs as preceding.
	Bean Weevil, *Bruchus obtectus* Say.	White-podded Adzuki	New Haven	In jar of seeds.
Mar. 10	San José Scale, *Aspidiotus perniciosus* Comst.	Apple, Pear	Southington	A few specimens on twigs.
" 14	" " "	Peach	Cannon Station	Small piece of bark thoroughly coated.
" 18	" " "	Peach, Plum	Vernon	Pieces of bark coated with scales.
" 22	Hickory Borer, *Cyllene pictus* Dru.		Norwich	Found in house.
	San José Scale, *Aspidiotus perniciosus* Comst.	Japan Plum	Windsorville	Twigs well infested.
	Tent Caterpillar, *Malacosoma* (*Clisiocampa*) *americana* Fabr.	Apple	Litchfield	Egg shells of last year.
	San José Scale, *Aspidiotus perniciosus* Comst.	Apple, Pear, Currant	Highwood	Twigs completely encrusted.
" 24	" " "	Apple	Hartford	Mortality percentage determined.
" 25	" " "	Japan Plum	Cromwell	Mortality percentage determined. All were dead—had been fumigated.
" 27	" " "	"	New Haven	Twig dead. Thoroughly infested.
" 31	" " "	Currant	Hartford	
	Megilla fuscilabris Muls.		"	Thought to be feeding on San José scale.
April 1	Scurfy Scale, *Chionaspis furfura* Fitch	Apple	Glastonbury	A few specimens on twigs.
" 18	Pear Psylla, *Psylla pyricola* Först.	Pear	Wolcott	Dead skins and black fungus on twigs.
" 21	Apple Aphis, probably *Aphis pomi* DeG.	Apple	Warehouse Point	Eggs around the buds.

INSECTS RECEIVED FOR IDENTIFICATION—*Continued.*

DATE.	NAME.	HOST.	LOCALITY.	REMARKS.
1904				
April 27	San José Scale, *Aspidiotus perniciosus* Comst.	Apple	Meriden	Bark completely covered.
" 29	" " "	Peach	Lebanon	Twigs thoroughly coated.
May 4	Borer, *Xyleborus dispar* Fabr.	Grape	New Milford	Found boring in the stems, causing them to bleed.
	Hickory Borer, *Cyllene pictus* Dru.	Hickory	New Haven	Found crawling around house and cellar where hickory wood was stored.
" 7	Oyster Shell Scale, *Lepidosaphes ulmi* Linn. (*Mytilaspis pomorum* Bouché)	Apple	Watertown	Twig well covered: egg stage.
	Tulip Scale, *Eulecanium tulipiferæ* Cook	Tulip Tree	Suffield	A few old shells on twigs.
" 10	Mite, probably *Bryobia pratensis* Gar.		Thomaston	Eggs, web and cast skins on a piece of coal.
	Hemispherical Scale, *Sassetia hemisphærica* Targ.-Tozz.	*Myrta*	New Haven	A few specimens on leaves.
" 11	Oyster Shell Scale, *Lepidosaphes ulmi* Linn. (*Mytilaspis pomorum* Bouché)	Lilac	New Haven	Dead twig covered with old shells.
	Thrips	Chrysanthemum	Westville	Injuring leaves of cuttings.
" 21	San José Scale, *Aspidiotus perniciosus* Comst.	*Akebia quinata*	Stratford	Vine killed to the ground. Thoroughly covered.
	" " "	Pear	Meriden	Twig well covered.
" 26	Oyster Shell Scale, *Lepidosaphes ulmi* Linn. (*Mytilaspis pomorum* Bouché)	?	New Haven	Living eggs under the shells.
June 2	Maple Leaf-spot Gall, *Sciara ocellaris* O. S.	Red Maple	Columbia	A large number on a single leaf.
" 6	Plum Curculio, *Conotrachelus nenuphar* Hbst.	Apple	Meriden	Young apples infested. Eggs and crescent marks.
	Codling Moth, *Carpocapsa pomonella* Linn.	"	"	In same fruit as preceding.
" 7	——— ———	Peach	Avon	Male scales abundant on bark.
" 9	Spruce Gall Louse, *Chermaphis abietis* Linn.	Norway Spruce	Pomfret Center	Galls on new growth of hedge.
	——— Scale, *Eulecanium sp.*	Japan Plum	Bristol	Twig well covered; white eggs under shells.
" 10	Woolly Aphis, probably *Chermaphis laricifoliæ* Fitch	Larch	New Haven	Infesting leaves.

INSECTS RECEIVED FOR IDENTIFICATION—*Continued.*

Date.	Name.	Host.	Locality.	Remarks.
1904				
June 10	Rose Leaf-hopper, *Typhlocyba rosæ* Linn.	Rose	Yalesville	On under sides of leaves.
" 11	Cucumber Flea-beetle. *Epitrix cucumeris* Harr.	Tomato	North Windham	Eating small holes in leaves.
" 14	Zebra Caterpillar *Mamestra picta* Harr.	Black Raspberry, Peas	Bridgeport	Half grown larvæ devouring leaves.
	Rose Leaf-hopper, *Typhlocyba rosæ* Linn.	Rose	New Haven	On leaves.
	Rose Aphis *Nectarophora rosæ* Linn.	Rose	New Haven	
" 15	Stalk Borer *Papaipema nitela* Guen.	Corn	Springdale	Larva said to be causing much injury to corn.
	Pear Psylla, *Psylla pyricola* Först.	Pear	Hartford	A few specimens on twigs.
	?	Rose	New Haven	Green caterpillar feeding on bud.
	Spittle insect, Cercopid	Grass	So. Wethersfield	Common on grass. Immature.
" 16	Round-Headed Apple Borer, *Saperda candida* Fabr.	Quince	New Haven	Fresh adult specimen: just emerged.
" 20	Firefly, *Photuris pennsylvanica* DeG.		New Haven	Found resting in grass.
	——— *Sphinx luscitiosa* Clem.		"	" "
	——— *Estigmene acræa* Dru.		"	" "
	Black Long-Sting, *Thalessa atrata* Fabr.		So. Canterbury	Adult female resting on plum tree.
	Woolly Elm Aphis, *Schizoneura americana* Riley	Elm	New Haven	Injuring elm trees on College street.
" 21	Hickory Stem Gall Louse, *Phylloxera caryæcaulis* Fitch	Hickory	Norwalk	Galls on leaf stems. *Phylloxera* in galls.
" 22	San José Scale, *Aspidiotis perniciosus* Comst.	Apple, Japan Plum	Stamford	Plum and one apple twig coated with living scales.
	Scurfy Scale, *Chionaspis furfura* Fitch	Apple	"	Young scales established on twig.
" 24	Apricot Scale, *Eulecanium armeniacum* Craw.	Honey Locust	South Norwalk	Twigs thoroughly covered with brown shells filled with eggs.
	?	Currant	Stamford	Berries had been infested. No insect found in them.
" 25	Stalk Borer, *Papaipema nitela* Guen.	Pea	Westville	Two larvæ boring in the pods.
	Grape Gall, *Lasioptera vitis* O. S.	Grape	Wallingford	Fleshy swellings on shoots of grapevine. Adults have emerged.

INSECTS RECEIVED FOR IDENTIFICATION—*Continued.*

Date.	Name.	Host.	Locality.	Remarks.
1904				
June 30	Oriental Cockroach, *Blatta orientalis* Linn.		So. Canterbury	Found in dirty milk cans.
	Black Carpet Beetle, *Attagenus piceus* Oliv.		"	In dwelling house.
	Lace Wing, *Chrysopa sp.*		Chapinville	A number of stalked eggs on plum twig.
	Fly, *Elachiptera longula* Loew.	Japanese Iris	New Haven	Small maggots and pupæ in leaves and stems.
July 6	——— ———	Hawthorn	Bridgeport	Small woolly aphids at base of leaf stems.
	San José Scale, *Aspidiotus perniciosus* Comst.	"	"	On same twigs as preceding.
	Larva of beetle	Man	New York City	Said to have been voided by a person.
" 8	Scurfy Scale, *Chionaspis furfura* Fitch	Apple	Shelton	Males and females, partially grown.
	Oyster Shell Scale *Lepidosaphes ulmi* Linn. (*Mytilaspis pomorum* Bouché)	Lilac	"	Partially grown young and old shells on bark.
	Currant Aphis, *Myzus ribis* Linn.	Currant	"	Leaf well infested.
" 11	Poplar Stem Gall, *Pemphigus populicaulis* Fitch	Carolina Poplar	Hartford	Galls on leaf petioles.
	Rudbeckia Aphis, *Nectarophora rudbeckiæ* Fitch	Rudbeckia Golden Glow	Whitneyville	Stem covered with red lice.
	Tarnished Plant Bug, *Lygus pratensis* Linn.	Tobacco	Poquonock	Said to cause portions to drop from leaves.
" 12	Lesser prionus, *Orthosoma brunneum* Först	Decayed wood	New Haven	Received as a pupa and reared.
" 13	Red Spider, *Tetranychus telarius* Linn.	Phlox	West Haven	Injuring leaves.
" 15	Mites ———	Larkspur		Small white mites injuring flowers.
" 16	San José Scale, *Aspidiotus perniciosus* Comst.	Apple, Plum	Hartford	Dead twigs moderately infested.
	Grape Gall, *Lasioptera vitis* O. S.	Grape	Stratford	Galls on new shoots and leaves.
	——— *Psocus sp.*	"	"	Crawling on twigs.
" 25	Oyster Shell Scale, *Lepidosaphes ulmi* Linn. (*Mytilaspis pomorum* Bouché)	Lilac	Branford	Old shells and young scales on twigs.
" 26	Lady-beetle, *Brachyacantha ursina* Fabr.	Dahlia	Norwalk	Found on injured dahlia. Supposed to have caused the injury. Buds fell off.
	——— *Harpalus caliginosus* Fabr.		Hartford	Sent for identification.
	——— *Pholisora catullus* Fabr.		"	" "
	——— *Xylophasia arctica* Boidv.		"	" "

Insects Received for Identification—*Continued.*

Date.	Name.	Host.	Locality.	Remarks.
1904				
July 26	Lady-beetle, *Spogostylum simson* Fabr.		Hartford	Sent for identification.
	Carpenter Ant, *Camponotus pennsylvanicus* DeGeer		"	" "
	—— *Pteronarcys nobilis* Hagen		"	" "
" 27	Codling Moth, *Carpocapsa pomonella* Linn.	Apple	Shelton	A single larva found in infested apples.
	Aphis, *Aphis rumicis* Linn.?	Lima Beans	Madison	Plant completely covered with black lice.
" 28	Grape Gall, *Lasioptera vitis* O. S.	Grape	New Haven	Galls on new shoots.
	Red Spider, *Tetranychus telarius* Linn.	Apple	"	On leaves of new growth.
	San José Scale, *Aspidiotus perniciosus* Comst.	Pear	Meriden	Dead twigs well covered.
	Tarnished Plant Bug, *Lygus pratensis* Linn.	Dahlia	Norwalk	Injuring buds causing them to drop.
	Oyster Shell Scale, *Lepidosaphes ulmi* Linn. (*Mytilaspis pomorum* Bouché)	Ash	New Haven	Stem completely covered.
" 30	American Silk Worm Moth, *Telea polyphemus* Cramer		"	Adult.
Aug. 1	Sawfly —— ——	Willow	Fairfield	Larvæ eating leaves.
	Galls —— ——	"	"	Hymenopterous galls on leaves.
" 2	—— ——	Shad Bush	West Cornwall	Galls on leaves.
	Mossy Rose Gall, *Rhodites rosae* Linn.	Rose	"	Spherical mossy galls on twigs.
" 4	Tomato Worm, *Phlegethontius*	Potato	New Haven	Larva feeding upon potato plant.
" 8	—— ——	Grape	Sound View	Galls on leaves.
" 9	Sawfly, —— ——	Pansy	Norwalk	Larvæ eating leaves.
" 15	—— *Phenacoccus acericola* King	Maple	South Norwalk	White cottony cases on under side of leaves.
" 16	San José Scale, *Aspidiotus perniciosus* Comst.	Apple	West Haven	Twigs and leaves well infested.
" 18	Dog Day Harvest Fly, *Cicada canicularis* Harr.		New Haven	Pupa skin, with adult just emerged.
" 24	Tulip Scale, *Eulecanium tulipiferæ* Cook	Tulip Tree	Wilton	Adult females and eggs.
" 25	Saddle Back Caterpillar, *Sibine stimulea* Clem.	Rose	Kensington	Larvæ devouring leaves.
	Scurfy Scale, *Chionaspis furfura* Fitch	Plum	East Norwalk	Males abundant.
	San José Scale, *Aspidiotus perniciosus* Comst.	"	"	On bark with preceding.
" 29	Sawfly, —— ——	Pine	Governors Island	Single larva.
" 31	Fall Web Worm, *Hyphantria cunea* Dru.	Apple	New Haven	Branch with web and young larvæ.

Insects Received for Identification—*Continued.*

Date.	Name.	Host.	Locality.	Remarks.
1904				
Aug. 31	Milkweed Butterfly, *Anosia plexippus* Linn.		New Haven	Chrysalis on twig.
Sept. 8	Cecropia, *Samia cecropia* Linn.			Larva found crawling on the ground.
" 9	Milkweed Butterfly, *Anosia plexippus* Linn.		So. Canterbury	
	Fall Web Worm, *Hyphantia cunea* Dru.		"	Nests reported numerous.
	Uhler's Plant Bug, *Halticus uhleri* Giard	Smilax	Southport	Causing great injury to smilax under glass.
	Borer, *Saperda ?*	European White Birch	New Haven	Larva boring in trunk of small tree.
" 11	Cecropia, *Samia cecropia* Linn.	Witch Hazel	"	Larva.
	Bumble Flower Beetle, *Euphoria inda* Linn.		"	Adult found in dwelling house.
" 12	Io Caterpillars, *Automeris io* Fabr.		Mystic	Larvæ probably parasitized.
	Oyster Shell Scale, *Lepidosaphes ulmi* Linn. (*Mytilaspis pomorum* Bouché)	Lilac	New Haven	
" 14	—— *Psocus sp.?*	Apple	Noroton	Single adult badly crushed.
" 21	Scurfy Scale, *Chionaspis furfura* Fitch	"	Middletown	Twig completely covered with males. Tree about dead.
" 22	Chain Dotted Geometer, *Cingilia catenaria* Cram.		New Haven	Adult specimen, emerged from cocoon on purple aster.
" 26	Hag Moth, *Phobetron pithecium* S. & A.	Maple	"	Young larva with few lateral projections.
" 27	Blister Beetle, *Meloe angusticollis* Say		West Stafford	Pair of adults.
Oct. 6	Euonymus Scale, *Chionaspis euonymi* Comst.?	*Euonymus*	Phila., Pa.	Leaf completely covered. Mostly males.
	—— *Typophorus canellus* Fabr.	Strawberry	So. Manchester	Leaves eaten by beetles.
" 12	—— *Creophilus villosus* Grav.		Hartford	Found in house.
Nov. 10	San José Scale, *Aspidiotus perniciosus* Comst.	European Beech	New Haven	Trunk well infested.
" 17	Borer, *Podosesia syringæ* Harris	*Ligustrum ibota*	"	Larva boring in stem near the ground.
Dec. 15	Cave Cricket, *Ceutophilus sp.?*		"	Found in cellar.
" 21	Mites, probably *Bryobia pratensis* Gar.	Camellia	Warehouse Point	Many globular red eggs on leaves in greenhouse.
" 29	San José Scale, *Aspidiotus perniciosus* Comst.	Japan Plum	Groton	Twigs quite thoroughly coated.

Entomological Features of 1904.

Perhaps the most distinctive feature of the season that would tend to influence insect life was the very severe winter. A prolonged period of low temperature is generally supposed to prove less disastrous to most forms of insect life than sudden and wide variations in temperature. But a larger proportion of the over-wintering San José scales were killed than has previously been observed in Connecticut. Ordinarily about 25 per cent. are winter-killed, but in examining twigs last spring in connection with our spraying experiments described on page 221 of this report we found at least 50 per cent. killed, and in some cases the mortality was even greater. Of course the survivors multiplied rapidly the latter part of the season, covering the trees in many cases. Yet the pest was considerably checked in its spread by the winter.

The Colorado potato beetle, *Doryphora decemlineata* Say, which was comparatively scarce during 1903, was not abundant early in 1904, but late in the season it was very common. After the potato fields had ripened, adult beetles could be found everywhere, devouring tomato, tobacco and other solanaceous plants. An abundance of these beetles may be expected next season.

Cutworms were abundant and caused much damage in the fields and gardens in early summer. Some of these were collected, but the adults have not yet been obtained. The use of poisoned bait to kill cutworms has not yet become general in Connecticut, and considerable injury results each year. A sweetened mash made of wheat middlings and containing a little Paris green or some other arsenical poison, scattered about over the field a week or ten days before the plants are set or before the seedlings appear, will do much to prevent injury by poisoning the cutworms.

The apple aphis, *Aphis pomi* De Geer, was scarce during the season and therefore caused little damage.

The codling moth, *Carpocapsa pomonella* Linn., was fully as common as usual, and unsprayed apples were greatly injured.

Notes.

Galls on Honey Locust.—On June 15th some young trees of honey locust, *Gleditschia tricanthos*, growing upon the station grounds presented a peculiar appearance. Each leaflet of the compound leaves was rolled up, swollen and much distorted. Inside of each was found one or more maggots. Material was gathered, and as some of the maggots were full grown they soon pupated, and the adults emerged in a few days. This gall-forming insect proved to be *Cecidomyia gleditchiae* O. S., a species closely allied to the Hessian fly. There are several species of *Cecidomyia* which form galls upon plants.

During the latter part of June the writer observed large honey locust trees at Middlefield which had been attacked in the same manner and presumably by the same insect.

The leaves only are affected, and their function not seriously impaired, so that little real damage is done to the tree, but the galls render it more or less unsightly. There is probably no remedy. The galls are shown on plate II, b.

Pear Psylla Held in Check by Lime and Sulphur Spray.—The pear trees at the station have been injured somewhat each season for several years by the pear psylla, *Psylla pyricola* Först. During the past summer, after spraying these trees with lime and sulphur mixtures to kill San José scale, it was noted that the pear psylla was scarce, though the insect was several times observed in other localities where it caused more or less injury.

Dr. E. P. Felt, State Entomologist of New York, informs us that he has found the insect checked by the lime and sulphur spray, and A. E. Plant & Son of Branford have a pear orchard which has been infested with psylla for several years. This orchard has recently become infested with San José scale, and was thoroughly sprayed last April with the boiled lime and sulphur mixture. Mr. A. B. Plant states that it was very difficult to find a psylla in the orchard during the summer. The pear psylla has been a difficult pest to control, and as it passes the winter as an adult it is quite probable that the spraying in early spring may destroy the adults before they lay their eggs. There will be an added satisfaction in spraying to control the scale if we can expect to also check some other serious pests.

Fall Web Worm Double-Brooded in Connecticut.—This insect has been rather abundant for many years, but was especially so in this state in 1901, and less so each year since. The first nest of the season was found in Westville, June 23d on a pear tree. This was brought to the laboratory, and the caterpillars, fed upon pear leaves, grew rapidly, and by July 29th nearly all had pupated. On August 1st two adults had appeared, and on the morning of the 5th, thirty adults representing both sexes had emerged. All of these had immaculate wings. Two masses of eggs had also been laid on the side of the breeding cage. These were bright green in color instead of golden yellow, which is the usual color, according to most writers. The eggs had hatched on August 15th, and the larvae were reared until nearly full-grown, but as we were busy inspecting nurseries, and did not supply them with food, all of them died. These observations indicate that the species is partially double-brooded in this latitude, and though it has long been known to be double-brooded south of New York City, only one brood occurs in Massachusetts. These early nests were very rare, and most of the injury to trees came during August and September, so that probably there is but one complete brood as a rule in Connecticut.

Onion Maggot, Phorbia ceparum Bouché.—This insect has been unusually abundant the past season, causing much injury to the onion crop. At Greens Farms and Southport large fields were attacked and in some cases one-fourth to one-third of the plants killed. The highest and dryest portion of the field seemed to be preferred by the pest, for in such places the most serious damage occurred. Around New Haven, observations indicate that the crop was injured in much the same manner and degree. No satisfactory remedy seems to have been discovered by the growers. Some recommend a sprinkling of salt along the rows; others declare that it does no good. Covering the surface of the ground around the plants with sand treated with kerosene appears to be a preventive. Perhaps the kerosene could be sprayed upon the surface of the soil with equally good results.

An Enemy of Japanese Iris.—On June 30th some plants were brought to the laboratory from a nearby nursery. At the base of the leaves a number of maggots were at work, and the plants looked sickly. The leaves were even beginning to decay at the point of injury. The maggots were yellow and about 3 mm. in length. Some of them soon pupated, and the puparium measured 3 mm. in length and about .5 mm. in width in the middle, tapering towards both ends. The insect proved to be *Elachiptera longula* Loew.

Books Injured by Cockroaches.—While employed at the station, Mr. H. L. Viereck roomed in a new six-story building having a restaurant on the top floor. This restaurant was overrun with Croton bugs or cockroaches, *Blattella germanica* Linn. A man who was employed to destroy them visited the place at intervals and distributed roach powder on the top floor of the building, which drove the roaches down the steam pipes into other parts of the building. A number of Mr. Viereck's book bindings were ruined by the roaches, and one of these is shown in plate III, b.

These insects are especially fond of the paste and sizing used in book-binding. Usually they feed upon waste food materials both animal and vegetable. Crumbs and cereals are often devoured, and occasionally leather and cloth are injured by them.

Pyrethrum powder, sulphur and borax are used as repellants to drive away roaches; it is difficult to make them eat bait poisoned with arsenic, as they seem able to detect the poison even when present in very small quantities. Flour paste containing phosphorus is known to be a fairly effective material for destroying these insects, and it also acts as a repellant.

Where a house or room can be closed tightly, fumigating with hydrocyanic acid gas is doubtless the most satisfactory remedy, as it destroys all forms of animal life therein.

Caterpillars Devouring Geranium Leaves.—During a visit to a greenhouse in January it was observed that green caterpillars were eating the foliage of geranium cuttings that were put out on the cutting bench to be rooted. The gardener stated that considerable injury resulted from the attacks of these caterpillars, and that it had been found necessary to look over the cuttings every day to destroy the larvae. Specimens were taken to the laboratory and fed on geranium leaves. They soon reached their larval maturity and spun white cocoons among the leaves in which they pupated. On February 1st the adults emerged. The insect proved to be *Autographa biloba* Steph.

Severe Injury to Strawberries by the Strawberry Root Borer.—During October specimens of beetles were received from South Manchester, where they were reported to be causing considerable injury to strawberry fields, having just destroyed two acres of plants. The beetles were feeding upon the leaves, and

Paris green had been used without apparent success. The beetle was recognized as the strawberry root borer *Typophorus canellus* Fabr., formerly placed in the genus *Paria*. The larvae of this beetle are borers in the roots of the plants, and the adults appear in late summer and fall and feed upon the leaves. Stronger mixtures of Paris green or arsenate of lead were advised. The damage is usually greater on old fields, and there is very little about this insect in the literature of economic entomology.

The Apple or Currant Leaf Hopper, Empoasca mali LeB.—Small light-green leaf hoppers are often seen on the under sides of the leaves of young apple trees, and occasionally considerable injury is done by them. They feed by sucking out

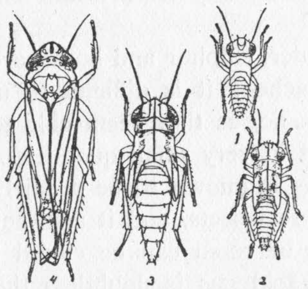


FIG. 7.—The apple leaf hopper, *Empoasca mali* LeB., in its different stages. (After Washburn, 9th Report State Entomologist of Minnesota.)

the juices of the plant, and infested leaves show white spots or patches where attacked. Like other leaf hoppers, this insect does not pass through the four distinct stages common to most kinds of insects, but by a more gradual development and increase in size it passes into the adult stage. The apple leaf hopper is sometimes a serious pest in nurseries, and combative measures must be employed. In Missouri, and the past season in Minnesota, this insect has been so injurious to nursery trees that a special spraying apparatus was devised for treating several rows at once, kerosene emulsion being used. This leaf hopper also attacks currants, and plate III, a, shows the appearance of an injured leaf; beside it is shown a healthy leaf for comparison. The grape-vine leaf hopper, *Typhlocyba comes* Say., is closely related to *E. mali*, which also attacks the grape, and is combatted in the vineyards of New York State

by catching the adults upon sticky shields in early June. The young hoppers are readily killed by a spray of whale-oil soap (one pound to ten gallons of water) or with kerosene emulsion. The adults may be killed by first knocking them to the ground with a spray of whale-oil soap and then quickly covering them with a spray of 25 per cent. kerosene emulsion, which would be too strong for the foliage of the vines.* See Fig. 7.

Sawfly on Ash.—On May 31st, white and green ash trees at the station were covered with sawfly larvae of different sizes. The smallest were about three-eighths of an inch long,

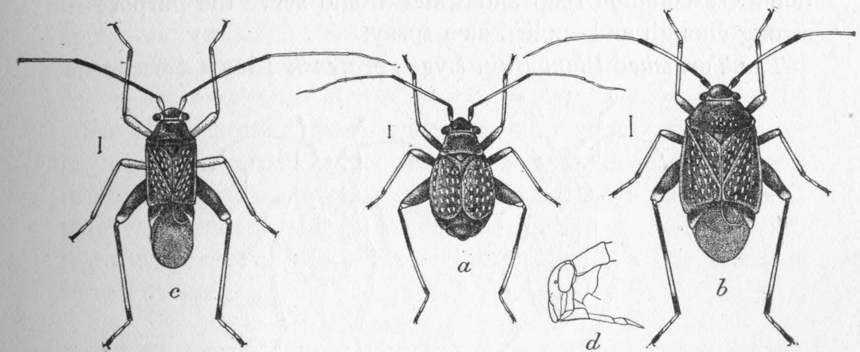


FIG. 8.—The garden flea hopper, *Halticus uhleri* Giard: a. brachypterous female: b. full-winged female: c. male: d. head of male, side view. All much enlarged. (After Chittenden, Bulletin 33, Bureau of Entomology, U. S. Department of Agriculture.)

while the largest ones were nearly twice this length. The larva is pale greenish white on the back, with a darker green median stripe. Head and legs are black. The first two thoracic segments are yellowish green, and this color extends along each side of the body, and on the pro-legs. A few individuals were marked somewhat differently, having a light-green dorsal stripe on either side of the dark stripe. These larvae had light heads and legs. The adults have not been obtained, but some of the larvae entered the ground June 6th to pupate. The larvae are shown on plate III, c.

Garden Flea Hopper Injuring Smilax.—During September some specimens were received from Southport with the statement that much injury to smilax growing under glass was being done by this insect. The insect in question was *Halticus*

* M. V. Slingerland, Bull. 215, Cornell Experiment Station, page 102.

uhleri Giard, a small black bug which has caused much injury to various plants in various parts of the country. The plants attacked are beans, beets, red clover, cow pea, potato, chrysanthemum, morning-glory, egg-plant, cabbage and pumpkin. The accompanying figure shows the appearance of this insect in its different stages. The wingless form resembles some of the flea beetles. Tobacco fumes were employed in the smilax house, but did not kill the flea hoppers; hydrocyanic acid gas was next tried with greater success. Spraying with kerosene emulsion has been recommended as a remedy, and doubtless common soap and water would serve the purpose if strong enough and applied as a spray.

The Tarnished Plant Bug, Lygus pratensis Linn.—Specimens

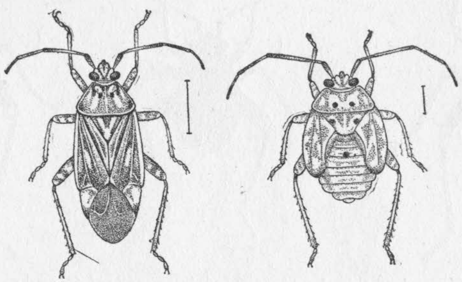


FIG. 9.—The tarnished plant bug, *Lygus pratensis* Linn: adult at left: last stage of nymph at right. Enlarged about four times. (After Chittenden, Bulletin 43, Bureau of Entomology, U. S. Department of Agriculture.)

of this insect were received in July from Norwalk, where they were injuring dahlias by sucking the juices from the buds and their stems, causing them to drop before opening. The same species was thought to be injuring tobacco at Poquonock in June. Portions of the leaves turned brown and dropped out, giving the leaves a ragged appearance. These bugs were found upon the plants, but it is not certain that they were responsible for the injury, though it is quite probable. The tarnished plant bug is known to attack a very large number of different plants, including fruit and vegetable crops, nursery trees, and even weeds. It is one of the commonest of those sucking insects which are known as the true bugs, and may be found on plants from early in spring until the cold weather of autumn drives it into winter quarters, where it lives as an

adult. The adult insect is about one-fifth of an inch long, of a greyish brown color varying greatly from a light brown to nearly black. There are obscure markings of black, red and yellow, also variable. The immature bugs are perhaps oftenest seen upon the plants, and are yellowish green in color, with undeveloped wings. The adults are very active, and when disturbed they dodge about or fly away from the plant, and are difficult to capture. The injury which they do consists in sucking the juices from the buds and new growths, often causing the same to wither and turn black. As the insect attacks so many different kinds of plants, remedial treatment is difficult to apply successfully. Kerosene emulsion is one of the best sprays, but must be applied thoroughly and frequently to hold the insect in check. Sometimes it is necessary to spray the other plants around those which we wish to protect. Sweeping over the garden plants and weeds with an insect net will result in capturing a great many specimens in a short time if they are abundant, and this is one of the best methods of holding the species in check in the house garden. The insect is shown in figure 9.

APPLES SERIOUSLY INJURED BY PLUM CURCULIO.

For several seasons it has been apparent that much injury to the apple crop resulted from the attack of the plum curculio *Conotrachelus nenuphar* Hbst., yet it was thought that spraying with poisons would prevent serious damage. During 1904, the trouble seemed to be much worse than at any time during the past ten years, and many of the young apples showed the characteristic crescent-shaped mark where the eggs are laid. The photograph reproduced on plate II, a, shows this mark and the many scars where the injury has partially healed. Where the fruit does not fall, the injury heals over, but a hard woody streak or vein runs through the flesh of the apple, and the fruit is gnarled and irregular in external appearance. I believe that in former years we have attributed much of this injury to the apple curculio *Anthonomus quadrigibbus* Say., a species that is probably not sufficiently abundant to cause so much injury.

Until recently, however, very little has been known regarding this plum curculio injury to apples, and a bulletin from the Missouri station by Professor J. M. Stedman is therefore very welcome and timely, and I have drawn upon it freely in what follows.

Professor Stedman states that the adult curculios attack the apples while they are about the size of cherries, which is not far from the middle of May in Missouri. Both sexes puncture the fruit for food, but in addition to this the female makes punctures for the purpose of depositing eggs, each egg being placed in the hole and a crescent cut through the skin of the apple around the egg, so that it may not become injured by the pressure of the rapidly growing fruit. The feeding punctures are more numerous than the egg punctures, and either is liable to be the starting point of the various kinds of fungi and bacteria causing decay. If the fruit does not decay, it becomes knotty, irregular and greatly injured in quality as well as in appearance. While each female is capable of laying from 300 to 400 eggs, few of the eggs hatch in the apple. Professor Stedman examined thousands of apples in Missouri and found eggs in only about half of the egg punctures, even where crescents were made around them. Of the eggs deposited not more than 15 per cent. hatch on the average, and of those which hatch only 24 per cent. reach the full grown larval stage. The larvae seem to nearly always die if the apple remains on the tree, but if it falls when the grub is half grown or smaller, the latter may reach maturity. Only about 2 per cent. of the eggs laid in the apple ever produce insects that reach the adult or beetle stage. The apple, then, furnishes an abundance of food for the beetles, but is not a successful breeding place compared with the plum or the cherry. The eggs are white, and oval in shape. These hatch in about a week, and the larva, a white footless grub, begins to eat its way into the pulp of the apple, going in a zigzag course, but finally reaching the core, and becoming full grown in about three weeks if the apple falls from the tree. It then enters the ground one or two inches below the surface, where it transforms to the pupa stage in a little cell. From fifteen to twenty days later the adult curculio is formed, but it does not emerge for about ten days, when it leaves the soil and seeks its food on the fruit, where it feeds until fall, when it crawls into a sheltered place to pass the winter. The adult is a brown beetle with a long snout or proboscis, and is shown in figure 10. There is but one brood each year. Apples received from Meriden on June 6th were badly injured on account of feeding and egg punctures, some of which were nearly healed. Apples growing upon the station grounds showed similar injury.

At a meeting of the American Association of Economic Entomologists at Philadelphia in December, 1904, Professor S. A. Forbes of Illinois read a paper on the results of his experiments in spraying with arsenate of lead to prevent injury by this curculio. While the spraying gave a larger quantity of perfect fruit, the minimum amount of injured fruit still remained about 28 per cent., which seems a large proportion.

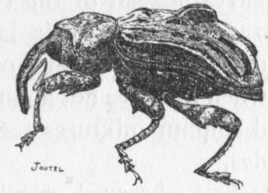


Fig 10.—The plum curculio, *Conotrachelus nenuphar* Hbst. Adult beetle. About six times natural size.

Professor Forbes explained this by saying that the beetles could not be killed by the poison unless they fed upon the fruit or leaves covered with it; and in doing an amount of eating sufficient to be poisoned they injured 28 per cent. of the fruit.

In Missouri similar results were obtained from spraying, but it was found that a combination of spraying, cultivation and the destruction of fallen fruit was the most satisfactory method of combating the insect. Arsenical poisons applied early, the destruction of windfalls, and shallow cultivation of the soil under the trees from July 15th to August 15th is therefore recommended as a treatment to prevent injury to apples from the attacks of the plum curculio.

SAN JOSÉ SCALE-INSECT EXPERIMENTS IN 1904.*

By W. E. Britton and B. H. Walden.

Bulletin 144 of this station contains an account of the experimental spraying work against the San José scale-insect for 1903. In December of that year tests were made in Bridgeport to

*This was published as Bulletin 146 and distributed in November. It is here reproduced with slight emendations.

determine whether fall or early winter spraying with lime and sulphur could be depended upon to hold the scale in check in Connecticut. About 770 trees, mostly Japan plum, with a few peach and pear trees, were treated. A few trees in New Haven were also sprayed in the fall.

In the spring of 1904, spraying experiments were conducted at New Haven, Westville, Wallingford, Milford and Southington. The boiled mixture did not seem to adhere to the trees as well as last year, doubtless owing to the different climatic conditions. Wherever the lime and sulphur mixtures are used there is a decided tendency for the young scales to set upon the fruit and leaves instead of the twigs that have been covered with the spray mixture. This is doubtless the case where any adhesive mixture is used, and often the fruit is disfigured by the scales when they are not abundant on the twigs.

All of the lime and sulphur mixtures seem to have considerable value as fungicides.

Young scales were first observed crawling on June 25, at New Haven.

The whole number of trees and plants treated in these experiments was approximately as follows:

Bridgeport	772	December treatment.
New Haven	14	
Westville	150	Spring treatment.
Wallingford	130	
Milford	481	
Southington	2552	
New Haven	35	
Total	4134	

The effects of the winter on the trees make it impracticable in many cases to express the results of the spring treatment in exact figures, as was done in bulletin 144. In some cases, however, this can be done, and we consider the general results to be of sufficient value for publication, and so present them in the following pages:

Effect of the Winter on the Trees.

It would be manifestly unfair to give any account of experimental spraying work against the San José scale-insect without mentioning the very unusual effect of the season in causing injury to trees and orchards. The extraordinary winter killed

many peach and plum trees in Connecticut, and thousands were seriously injured. Scale-infested trees, as a rule, were the first to show this injury and thousands of such trees in peach orchards went into the winter in a weakened condition never to leaf out again. But the damage was by no means confined to infested trees. In some places young and vigorous peach trees were frozen and killed to the snow line and had to be cut away, while in many orchards, especially on the lower levels, the fruit buds were entirely destroyed. In some instances trees leafed out, but soon withered and died. Large apple trees in different parts of the state appeared sickly in June and July and some of the branches withered and died. An examination failed to show the presence of any parasitic trouble, and their condition could be ascribed only to winter injury. On the whole, Connecticut orchards suffered a vast amount of damage, from which some of them will not recover in several years, if ever.

At the time of cutting twigs to examine the insects prior to spraying, the best looking infested twigs were selected, but the extent of this winter injury could not then be determined. But in many cases the infested wood was injured or dead and most or all of the scale-insects were dead in consequence, before the spray was applied.

In June, when the twigs were cut for the second examination to show the effect of the treatment, the trees were in leaf and it was easy to distinguish the living from the dead branches. Only living branches, of course, were examined at this time, and in some cases the number of living insects after the treatment exceeded the number found on the injured branches at the first examination.

Effect of the Winter on the Insects.

Ordinarily we find that a portion of San José scale-insects are killed each winter—probably by the climatic conditions. Twenty-five per cent. is about the average mortality, and 75 per cent. of living insects is about the number that we expect to find when we cut twigs for examination in March or April. The past winter proved to be an exception to this rule, the mortality being much greater than usual. Seldom did we find 50 per cent. of the scale-insects alive, even on healthy twigs.

So many of the twigs were injured that much less than 50 per cent. of the whole number of scale-insects actually survived the winter.

Materials Used in Spraying.

Various materials prepared after 15 different formulas were used in these experiments. The formulas are given below, each with a separate number, by which it is designated in the following pages. The details of preparing each are given on pages 240–247.

Boiled Mixtures.

Formula	Preparation
1.—14 lbs. lime. 14 lbs. sulphur. 40 galls. water.	Flowers of sulphur made into a paste and slaked with lime. Mixture boiled 30 minutes with steam.
2.—14 lbs. lime. 14 lbs. sulphur. 40 galls. water.	Light sulphur flour not made into a paste but added dry to the slaking lime. Boiled 45 to 60 minutes.
3.—20 lbs. lime. 14 lbs. sulphur. 40 galls. water.	Light sulphur flour not made into a paste but added dry to the slaking lime. Boiled 45 to 60 minutes.

Mixtures not Boiled.

Formula	Preparation
4.—20 lbs. lime. 20 lbs. potassium sulphide. 40 galls. water.	Lime slaked and potassium sulphide dissolved separately and then put together with the proper quantity of water.
5.—20 lbs. lime. 20 lbs. sodium sulphide. 40 galls. water.	Fused sodium sulphide broken into small lumps and added to the slaking lime.
6.—20 lbs. lime. 10 lbs. sodium sulphide. 40 galls. water.	Fused sodium sulphide broken into small lumps and added to the slaking lime.
7.—20 lbs. lime. 6 lbs. sulphur. 6 lbs. sodium sulphide. 40 galls. water.	Light sulphur flour, sulphide in lumps, both added to slaking lime.
8.—20 lbs. lime. 11 lbs. sulphur. 11 lbs. sodium sulphide. 40 galls. water.	Light sulphur flour, sulphide in lumps, both added to slaking lime.
9.—14 lbs. lime. 6 lbs. sulphur. 6 lbs. sodium sulphide. 40 galls. water.	Flowers of sulphur, sulphide in lumps, both added to slaking lime.
10.—14 lbs. lime. 11 lbs. sulphur. 11 lbs. sodium sulphide. 40 galls. water.	Flowers of sulphur, sulphide in lumps both added to slaking lime.
11.—20 lbs. lime. 14 lbs. sulphur. 6 lbs. sodium sulphide. 40 galls. water.	Flowers of sulphur, sulphide in lumps, both added to slaking lime.

Formula	Preparation
12.— 8 lbs. caustic soda. 40 galls. water.	Dissolved soda in cold water and applied.
13.— 7 lbs. caustic soda. 40 galls. water.	Dissolved soda in cold water and applied.
14.—14 lbs. lime. 14 lbs. sulphur. 7 lbs. caustic soda. 40 galls. water.	Light sulphur flour and caustic soda added to the slaking lime.
15.—20 lbs. lime. 14 lbs. sulphur. 5 lbs. caustic soda. 40 galls. water.	Light sulphur flour and caustic soda added to the slaking lime.

Early Winter Spraying.

On account of the unfavorable weather and the rush of work in late winter and spring, it would frequently be more convenient for orchardists to spray in the fall. Ordinarily in Connecticut the San José scale-insect continues breeding until about December 1. Last fall the young were observed crawling on December 2. We believe that if the spraying can be done as soon as the leaves drop or during November, that a large proportion of the young will be killed, and that they are much more susceptible to the effect of the sprays than after they are partially grown and better protected by their shells or armor. The mature insects die naturally, before spring, and it is only the half or partially grown individuals that carry the species through the winter.

The experiments in fall spraying herein described were made December 10 and later, and though satisfactory it seems reasonable that even better results might follow from a treatment made two weeks earlier in the season.

Experiments at Bridgeport.

At Bridgeport an orchard of about six hundred Japanese plum, one hundred and twenty-five peach, thirty-four pear and ten quince trees was sprayed with the lime and sulphur mixture December 10 and 11. The trees were quite close together and irregular in size. This orchard was sprayed in the spring of 1902 with crude oil and water. While this treatment was quite successful, some scales came through alive, and as the orchard is in a badly infested locality, conditions were favorable for the scale to continue to breed. Since the treatment in 1902, trees which became badly infested were sprayed with kerosene emulsion, whale oil soap, or other similar mixtures. At the time of the last treatment, the orchard was not badly infested, but scales could be found on nearly every tree.

The lime and sulphur mixture was prepared at a near-by woodyard, where a twenty horse-power upright boiler furnished steam to cook the mixture. A fifty gallon cask was used for boiling the mixture, steam being conveyed through a hose connected to the boiler.

The following formula (No. 1) was used:

14 lbs. fresh finishing lime.
14 lbs. flowers of sulphur.
40 galls. water.

The sulphur was made into a thick smooth paste with water as hot as could be conveniently borne by the hands, which were used to work the lumps out of the paste. The lime was put into a barrel, hot water added, and as soon as it commenced to slake the sulphur paste was poured in, and the whole stirred to prevent the lime from "burning." By the time the lime was slaked we had a smooth mixture which was assuming a darker color, showing that the sulphur was being dissolved. About one-third the required amount of water was then added, the steam turned on and the mixture boiled vigorously for thirty minutes. This was stirred frequently, and the hose moved to different places in the barrel so that the mixture was kept well agitated. The boiled mixture was dipped out and strained into the pump barrel.

The sulphur appeared to be all dissolved, and very little sediment was present, that which accumulated in the strainer being practically all washed through with cold water. After the boiled lime and sulphur mixture was transferred to the pump barrel, cold water was added until the barrel was filled within about four inches of the top. This made practically forty gallons.

The spraying outfit consisted of a barrel pump, mounted on the end of a forty-five gallon barrel. This was placed on a low wagon, and fitted with two lines of one-half inch hose from thirty to forty feet long. To each line of hose was attached an eight-foot bamboo extension with a double Vermorel nozzle.

The trees were coated as thoroughly as possible. On some of the trees that had been sprayed with the soap and oil solu-

tions the mixture did not seem to stick as well, and when the trees dried the coating was of a bluish grey color.

TABLE I.—LATE FALL SPRAYING AT BRIDGEPORT, DEC. 10 AND 11, 1903.

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 and winter.	Alive Jan. 2, 1904.	Alive June 22, 1904.	Effect of treatment on trees.
Pear	34	Moderately infested.	Formula No. 1— 14 lbs. lime.	00	93	18	7	No injury.
Peach	125	"	14 lbs. sulphur.	00	91	19	9	"
Jap. Plum	600	"	40 galls. water.	00	84	18	16	"
Wild Plum	3	"	"	00	85	15	....	"
Quince	10	"	"	00	....	....	....	....
Average	772				88	17.5	10.6	

No twigs were cut for the purpose of examining the scales at the time of treatment, but it was assumed that 100 per cent. were alive at that time, as the insects had been breeding up to a few days previous and there had been no cold weather to cause wholesale destruction of them. Twigs were cut January 2, 1904, and examined, and again on June 22. The figures are given in Table I. on page 227.

Results at Bridgeport.

It has already been stated that the trees were not made very white by the mixture (Formula No. 1). This is partly due to the fact that oil had previously been used on some of the trees, and partly due to the small quantity of lime in the mixture. Nevertheless, the adhesive qualities were good and the mixture could be seen on the trees in some places when the final examination was made on October 20.

On December 10–11, when the spraying was done, the scales were about all alive. On January 2, less than a month after the application, twigs were cut and examined, with the result that an average of 17.5 per cent. of living insects were found. This can fairly be attributed to the effect of the treatment, principally because no severe weather or ice storms had occurred to kill the scale-insects in unusual numbers.

The results of the second examination of twigs on June 22 are somewhat disappointing, as an average of 10.6 per cent. of living insects were found after one of the most severe winters known in recent years. In spite of the rather large percentage of living insects in this test, the writers believe that fall or early winter spraying can and soon will be practiced by the growers. We shall make further tests along this line. The following account of fall spraying at New Haven shows better results in figures than the Bridgeport experiments.

When the final examination was made of the sprayed trees at Bridgeport on October 20, they were found to be in a very satisfactory condition. The trees had made good growth, borne a crop of fruit and few living scale-insects could be found.

Experiments at New Haven.

On December 19 a number of small trees and shrubs in the western part of the city were sprayed with the lime and sodium sulphide mixture (Formula No. 5). The sulphide was broken into lumps not larger than butternuts and was added to the lime after the slaking process was well started with hot water.

After slaking the lime the whole was allowed to stand for a few minutes, utilizing the heat to help dissolve the lumps of sodium sulphide. Then cold water was added and the liquid sprayed upon the trees. This makes a mixture which is ash-grey in

TABLE II.—LATE FALL SPRAYING AT NEW HAVEN, DECEMBER 19, 1903.

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 and winter.*	Alive after treatment.	Effect of treatment on trees.
Peach	2	Badly infested.		00	98	2	No injury.
Japan Plum	1	"		00	....	....	"
Cherry	1	"	Formula No. 5—	00	....	....	"
Pear	2	Slightly infested.	20 lbs. lime.	00	....	....	"
Hawthorn	1	"	20 lbs. sodium sulphide.	00	96	4	"
Currant	3	Moderately infested.	40 galls. water.	00	94	6	"
Gooseberry	2	"		00	....	....	"
Apple	2	"		00	95	5	"
Average	14			00	96	4.2	

* Winter had killed none at time of treatment. Probably the mortality is due to both treatment and effect of winter.

color and does not disfigure the trees and shrubs to which it is applied like the boiled mixture; but it is very caustic in its action, and therefore needs to be handled with more care. Sore spots are formed wherever it strikes the skin and it corrodes the finger nails; therefore face and hands should be well protected if this mixture is to be used.

A few trees on the station grounds were also sprayed during December, using the same formula.

Table II. contains the data connected with these tests.

Results at New Haven.

Most of the trees sprayed with lime and sodium sulphide were on rented land and were destroyed by the tenant on vacating the premises in April. The twigs examined, therefore, were cut during April instead of June, as in most of the other experiments. Nevertheless the percentage of living insects was reasonably small, though probably the winter is partly responsible. Two larger trees (apple) on the station grounds received similar treatment, and though only 5 per cent. of living insects were found in June the trees were fairly well coated with scale-insects in October at the writing of this bulletin.

Spraying in Late Winter and Spring.

Westville Experiments.

About 150 pear trees were sprayed on March 21 and 24. This is the same orchard that was sprayed last year and described in bulletin 144, page 9. The condition of the trees generally was about the same as last year, except that those treated last season with Bordeaux mixture and plain whitewash were more scaly than was the case a year ago, and also more scaly than the other trees. Nearly all were seriously infested, but had not suffered from winter injury as much as most peach and plum trees in the same region.

March 21 was a bright, still day, becoming cloudy in the afternoon, with a light snow at night and a light drizzle of rain in the forenoon of the 22d.

The boiled mixture (see formula No. 2, page 224) was used on the first five rows, beginning on the northwest side. Hot water and light sulphur flour were added to the hard finishing

Table III.—Westville Experiments, March 21–24, 1904.

Experiment numbers.	Kind of trees.	Number of trees treated.	Condition of trees before treatment.	Materials applied.	Alive after treatment. Average percentage.	Effect of treatment on trees.
1–15	Pear.	50	Majority badly infested.	Formula No. 2— 14 lbs. lime. 14 lbs. sulphur. 40 galls. water.	7.7	No injury by spray. Some injury by scale and winter.
16–27	"	40	Majority badly infested.	Formula No. 9— 14 lbs. lime. 6 lbs. sulphur. 6 lbs. sodium sulphide. 40 galls. water.	6.1	No injury by spray. Some injury by scale and winter.
28–38	"	40	Majority badly infested.	Formula No. 10— 14 lbs. lime. 11 lbs. sulphur. 11 lbs. sodium sulphide. 40 galls. water.	4.4	No injury by spray. Some injury by scale and winter.
39–42	"	10	Majority badly infested.	Formula No. 14— 14 lbs. lime. 14 lbs. sulphur. 7 lbs. caustic soda. 40 galls. water.	4.3	No injury by spray. Some injury by scale and winter.
43–46	"	10	Majority badly infested.	Formula No. 12— 8 lbs. caustic soda. 40 galls. water.	10.7	No injury by spray. Some injury by scale and winter.
		150				

lime and the mixture well stirred until the lime was thoroughly slaked. It was then boiled for 45 minutes in a feed cooker corresponding to a kettle over a wood fire. This outfit is shown on plate V, b. The next eight rows were sprayed with lime, sulphur and sodium sulphide, four receiving formula No. 9, and four formula No. 10. One row was sprayed with lime, sulphur and caustic soda (Formula No. 14) and one row with the caustic soda solution (Formula No. 12).

Results at Westville.

These spraying tests show the boiled lime and sulphur mixture to be no more efficient in destroying the scale-insects than similar mixtures containing lime and sulphur and prepared without boiling. Apparently there was not much difference in the adhesive qualities of these mixtures. When twigs were cut in June for final examination, the whitish coating could be seen, especially on the under sides of the branches of all the trees, except, of course, those receiving the caustic soda solution containing no lime. Caustic soda solution as used here (1 lb. in 5 gallons water) was less effective in destroying scale than any of the lime and sulphur mixtures. (See Table III.)

None of the pear trees of the orchard showed any injury that could be ascribed to the spraying, though some branches were killed by scale and winter. When examined October 22, most of the trees had made good growth and there were few scales on the new wood, though the old wood was well covered with dead ones. The trees sprayed with the caustic soda solution were far more scaly than any of the others. There was but little difference in effectiveness between formulas No. 2, No. 9, No. 10 and No. 14, though No. 9 was probably the least efficient.

Wallingford Experiments.

The trees sprayed at Wallingford were seven years old, of good size, and but slightly infested with the San José scale-insect. The damage to the trees by the winter was slight. The applications were made April 8. Ninety trees were sprayed, using the following formula (No. 9):

14 lbs. fresh finishing lime.	6 lbs. sodium sulphide.
6 lbs. flowers of sulphur.	40 galls. water.

The materials were weighed out, the lime placed in a barrel and just enough cold water added to start it slaking. When the lime began to slake, the sulphur and sodium sulphide were added and the mixture kept well stirred. Just enough cold water was added to prevent the lime from becoming dry or "burning," thus keeping the mixture hot in order to dissolve the sodium sulphide, and as much of the sulphur as possible. After the lime had slaked, a small amount of water was added and the mixture allowed to stand for at least twenty minutes, with occasional stirring. It was then dipped out, strained and diluted. This preparation was of a dark muddy olive-green color, becoming greenish yellow when diluted. Upon straining this into the pump barrel no more sediment remained than with the boiled lime and sulphur mixture.

The spraying outfit consisted of a No. 6 "Hardie" pump mounted on the side of a fifty-gallon barrel. The trees were covered thoroughly. Upon drying, the coating was not as white as on the trees sprayed with the boiled mixture (Formula No. 3). This, of course, was due to the smaller amount of lime used in our mixture and the darker color which the sodium sulphide imparted to it.

About forty trees in the same block were sprayed with a mixture made after formula No. 10.

This was prepared in the same way as the above mixture. The additional amount of sulphur and sodium sulphide made very little difference in the appearance of the mixture, making it a trifle darker in color. The following table gives the chief data:

Results at Wallingford.

Though 130 trees were sprayed here by the writers, the owners of the orchard sprayed the remaining 9,000 trees with boiled lime and sulphur mixture, using for the most part formula No. 3. (See page 224.) Their work was done with thoroughness and twigs were cut from some of the trees for comparison with our tests. The mixture made after formula No. 9 did not appear to stick on the trees as well as the boiled mixture, and the figures show that it was less effective as a scale-destroyer; though where more sulphur and more sodium sulphide were used (No. 10) the results were much better; the average number of surviving scale-insects being smaller even than where the boiled mixture was used.

TABLE IV.—WALLINGFORD EXPERIMENTS, APRIL 8, 1904.

Experiment numbers.	Kind of trees.	Number of trees treated.	Condition of trees before treatment.	Materials applied.	Alive after treatment. Average percentage.	Effect of treatment on trees.
55–60	Peach.	90	Slightly infested.	Formula No. 9— 14 lbs. lime. 6 lbs. sulphur. 6 lbs. sodium sulphide. 40 galls. water.	9.5	No injury by spray. Slight injury by scale and winter.
61–65	"	40	"	Formula No. 10— 14 lbs. lime. 11 lbs. sulphur. 11 lbs. sodium sulphide. 40 galls. water.	2.4	No injury by spray. Slight injury by scale and winter.
—	Peach and Japan Plum.	9000*	A few badly infested; most of them slightly infested.	Formula No. 3— 20 lbs. lime. 14 lbs. sulphur. 40 galls. water.	3.9	No injury by spray. Slight injury by scale and winter.

* These trees were thoroughly sprayed by the owners, and do not form a part of our experiments except as a basis for comparison of results.

The orchard was examined on October 26, and the trees were found to be in a very satisfactory condition. It was difficult to find living insects on any of the sprayed trees in the orchard.

Experiments at Southington.

The small peach orchard sprayed last year and described on page 14 of bulletin 144 should be mentioned here. That half of the orchard receiving lime and sulphur mixtures remained quite free from scale, and though the trees suffered injury from the winter, were in much better condition than the trees in the other half of the orchard where whitewash was used and kerosene emulsion applied in August. The whitewashed trees went into the winter in a badly infested condition and were killed, or injured to such an extent that they were cut out in the spring. Twigs and branches were dead.

The remaining trees, 100 in number, were sprayed on April 4 and 5. Seventy received boiled lime and sulphur. (See formula No. 2, page 224.) The other trees were sprayed with lime, sulphur and sodium sulphide, 18 with formula No. 9, and 12 with formula No. 10.

A much larger peach orchard at Spring Lake farm, owned by Mr. L. V. Walkley, was found to be seriously infested by the scale-insect, and though winter injury was at first apparent it was considered a good place for experimentation, and about 950 large trees and 1,500 small ones were sprayed with various mixtures April 4–19. The boiled mixtures were cooked with steam from the boiler of a Kinney "Safe" portable engine. The data are presented in Tables V. and VI.

Results at Southington.

The percentage of living insects shown in Tables V. and VI. are all low and would indicate that the mixtures were efficient had not the winter killed such a large proportion of the scales. On the whole, the mixtures adhered well to the trees and could be seen on the trunks and larger branches when the twigs were cut in June. The boiled mixtures remained perhaps longer than those made without boiling, though the differences were not great. The effect of the winter on this orchard makes it difficult to draw any accurate conclusions regarding the efficiency of the various mixtures used. It seems safe to say, however, that the spread of the scale was greatly checked by

TABLE V.—SOUTHINGTON EXPERIMENTS, APRIL 4–19, 1904.

Experiment numbers.	Kind of trees.	Number of trees treated.	Conditions of trees before treatment.	Materials applied.	Alive after treatment. Average percentage.	Effect of treatment on trees.
51	Peach.	70*	Slightly infested.	Formula No. 2— 14 lbs. lime. 14 lbs. sulphur. 40 galls. water.	6.9	No injury by spray. Some winter injury.
52	"	12*	"	Formula No. 10— 14 lbs. lime. 11 lbs. sulphur. 11 lbs. sodium sulphide. 40 galls. water.	4.9	No injury by spray. Some winter injury.
53	"	18*	"	Formula No. 9— 14 lbs. lime. 6 lbs. sulphur. 6 lbs. sodium sulphide. 40 galls. water.		No injury by spray. Some winter injury.
72–104	"	322	Seriously infested.	Formula No. 2— 14 lbs. lime. 14 lbs. sulphur. 40 galls. water.	2.9	No injury by spray. Some winter injury.
105–134	"	1962†	"	Formula No. 3— 20 lbs. lime. 14 lbs. sulphur. 40 galls. water.	4.2	No injury by spray. Some winter injury.
135–169	"	128	"	Formula No. 7— 20 lbs. lime. 6 lbs. sulphur. 6 lbs. sodium sulphide. 40 galls. water.	2.1	No injury by spray. Some winter injury.

* Barnes orchard. These trees were sprayed last year.
† 1500 were small trees slightly infested.

TABLE VI.—SOUTHINGTON EXPERIMENTS, APRIL 4–9, 1904.

Experiment numbers.	Kind of trees.	Number of trees treated.	Condition of trees before treatment.	Materials applied.	Alive after treatment. Average percentage.	Effect of treatment on trees.
158–159	Peach.	12	Seriously infested.	Formula No. 11— 20 lbs. lime. 14 lbs. sulphur. 6 lbs. sodium sulphide. 40 galls. water.	3.6	No injury by spray. Some winter injury.
163–172	"	28	" "	Formula No. 8— 20 lbs. lime. 11 lbs. sulphur. 11 lbs. sodium sulphide. 40 galls. water.	2.4	No injury by spray. Some winter injury.

the treatment and that all the mixtures here used were fairly efficient. The final examination made on October 26 showed the trees to be almost free from scale, though the winter injury was more serious than was supposed early in the season.

Experiments at Milford.

On April 22–23, various mixtures prepared without boiling were applied to 217 fruit trees and 256 currant bushes at Milford. The spraying season was nearly at an end and the buds were opening on plum trees, currant and gooseberry bushes. The lime, sulphur and sodium sulphide mixture (formula No. 7), lime and potassium sulphide (formula No. 4), lime, sulphur and caustic soda (formula No. 15), and caustic soda solution (formula No. 13), lime and sodium sulphide (formula No. 6) were used in these tests.

Most of the trees and bushes were moderately infested with scales, and some were killed or injured by the winter, so that leaves did not start from the branches. In some cases growth started from the upper portion of the trunks.

Data connected with these experiments are given in the accompanying table.

Results at Milford.

Trees sprayed with mixtures No. 4 and No. 15 gave the lowest percentage of living insects in June. Those receiving No. 6 and No. 13 gave the highest. No. 6 probably washed off sooner than the other mixtures containing lime, though there was little difference in this respect between 4, 7 and 15. Though no boiled mixture was employed here for comparison, it certainly seems as if mixtures Nos. 4 and 15 gave about as good results as could be expected of a boiled mixture. The sprayed trees were examined October 25. Formulas Nos. 7, 4 and 15 gave very satisfactory results, the new growth of the trees being mostly clean. Nos. 6 and 13 were less efficient and more living scales were found on trees sprayed with these preparations.

CONNECTICUT ORCHARDS SPRAYED IN 1904.

It is safe to say that over 100,000 fruit trees in orchards and gardens were sprayed in Connecticut during 1904 with the lime and sulphur mixtures. Mr. J. H. Hale sprayed about

TABLE VII.—EXPERIMENTS AT MILFORD, APRIL 22–23, 1904.

Experiment numbers.	Kind of trees.	Number of trees treated.	Condition of trees before treatment.	Materials applied.	Alive after treatment. Average percentage.	Effect of treatment on trees.
175–181	Japan plum. European plum. Cherry. Pear. Currant.	20 135	Moderately infested.	Formula No. 7— 20 lbs. lime. 6 lbs. sulphur. 6 lbs. sodium sulphide. 40 galls. water.	6.2	No injury by spray. Some injury by scale and winter.
182–187	Peach. Plum. Currant.	11 36	"	Formula No. 4— 20 lbs. lime. 20 lbs. potassium sulphide. 40 galls. water.	2.3	No injury by spray. Some injury by scale and winter.
188–195	Pear. Plum. Currant.	6 20 70	"	Formula No. 15— 20 lbs. lime. 14 lbs. sulphur. 5 lbs. caustic soda. 40 galls. water.	1.8	No injury by spray. Some injury by scale and winter.
196–201	Peach. Pear } Apple }	11 14	"	Formula No. 13— 7 lbs. caustic soda. 40 galls. water.	8.9	No injury by spray. Some injury by scale and winter.
202–204	Plum. Currant.	8 150	"	Formula No. 6— 20 lbs. lime. 10 lbs. sodium sulphide. 40 galls. water.	10.7	No injury by spray. Some injury by scale and winter.

16,000 trees in his orchards at Glastonbury and Seymour; Mr. C. E. Lyman sprayed 12,000 trees at Middlefield, and it has already been mentioned that the Highland Fruit Co. of Wallingford sprayed their entire orchard of 9,000 trees. Other growers who have done more or less spraying with the lime and sulphur mixture are A. C. Sternberg, West Hartford; C. I. Allen, Terryville; T. H. & L. C. Root, Farmington; Barnes Brothers, Yalesville; A. E. Plant & Son, Branford; G. F. Platt & Son, N. D. Platt & Son, Milford; Hall & Barnes, Wallingford, and many others.

In Keney Park, Hartford, a great deal of spraying was done in the ornamental planting of trees and shrubbery, and the writers are informed that the lime and sulphur mixture is considered preferable to any of the oils or soaps previously used here for the purpose of killing the scale.

So far as can be learned, the results of this spraying work have been on the whole satisfactory. The boiled mixture has been used in most cases, and the work done in the spring. The care with which the mixtures are made and applied, the condition of the trees, and the climatic conditions all affect the final results.

Making the Boiled Mixture.

A portable steam boiler is probably the most convenient outfit for cooking the lime and sulphur mixture for the average orchard. The boiler can be set up in the orchard, preferably near a water supply, and the mixture cooked in open barrels. Common rubber hose is more convenient than iron pipe for conveying the steam to the barrels, as it can be removed more readily. The mixture can then be applied as fast as it is made. Each line of hose should be fitted with a valve. If there is no spring or stream of water near the orchard it is not impracticable to cart water to the boiler, as was done at Wallingford by the Highland Fruit Co., or to cart the boiled mixture a mile or more from the boiler to the orchard. Mr. Plant of Branford cooked the spraying mixture near his house, drawing water in a spout directly into the cooking vats from a spring on the hillside. From the boiler the mixture was carted in tight casks into the orchard about a mile distant, drawn off into the spray barrels and applied. The portable boiler can

be used in any moderate sized orchard, but is capable of cooking material for large orchards. The Kinney "Safe" engine with boiler is a common source of power on Connecticut farms, and this has probably been used more than any other forms of portable boilers for cooking the mixture, and has been very satisfactory; one of 5 h. p. capacity furnished steam to cook all of the mixture used in spraying 9,000 good sized peach trees in the orchard of the Highland Fruit Co. at Wallingford. An outfit of similar size and pattern was used in an orchard of 12,000 trees by Mr. C. E. Lyman of Middlefield. Some of the largest orchards, however, are provided with more permanent stationary cooking plants. That of Barnes Brothers of Yalesville has already been described and figured in the Report of this Station for 1902, page 120. A much more elaborate outfit has been devised by Mr. J. H. Hale of South Glastonbury. (See plate VI, a.) Mr. Hale's plant consists of a horizontal boiler of 20 h. p. connected by pipes with eight barrels in which the materials are boiled. Above each barrel the steam pipe has a valve, and at the bottom of the barrel the pipe is fitted with a 4-way connection containing short pipes drilled with small holes for the escape of the steam. By this arrangement no stirring is necessary. The bottom of each barrel is also connected by pipe to the water supply, and by means of valves the boiled mixture can be diluted, and drawn off through the same pipes into the spray barrel or into casks to be carted away. This appears to be a good type of a large cooking plant and has a capacity of about 50 barrels of mixture per day.

It is not essential, however, for the owner of a small orchard to go to the trouble and expense of fitting up an elaborate outfit of this sort. Neither is it necessary to employ the portable boiler, as the mixture can be cooked very satisfactorily with steam from the heating plant of the house; in a set kettle or portable feed cooker, such as are in use on many farms, or even in a kettle on the stove, where small quantities are required. A feed cooker used in our Westville experiments is shown on plate V, b.

Finishing lime should be used where possible, as this slakes completely, leaving little sediment to clog strainer and nozzles. It comes in hard white lumps, costs more than mortar lime and generates more heat in slaking. It is important that the lime should be properly slaked, for upon this depends in a large measure the amount of sediment. Water should be added to the lime only as needed to prevent burning. Lime needs air as well as water in order to slake well. Therefore too much water will hinder the slaking process or "drown" it, as the bricklayer says. Constant stirring is also required to prevent "burning" in spots. The weight of the lime should equal or slightly exceed that of the sulphur. A great excess injures the mixture, causing it to flake off from the trees. Sulphur should be used either in the form of the sublimed "flowers," or the finely ground "light sulphur flour." The particles are somewhat smaller in the sublimed product, but there is a greater tendency to become lumpy under pressure and this, of course, retards solution. The writers believe that the light flour is the better, all things considered.

The sulphur should be added to the lime before slaking, as the heat of the slaking lime can be utilized to help dissolve the sulphur, though this heat alone will probably dissolve only a small portion of it. It is well to stir the materials thoroughly during the slaking process to prevent "burning" of the lime. Water should be added as needed, and after the lime is slaked the barrel can be filled about one-third full of water and the steam or heat applied. The mixture should boil for a period of time varying from forty-five to sixty minutes. Of course, the heat can be applied during the slaking process, and in this case it should be turned on for at least an hour to make sure that the sulphur is well dissolved. In our Bridgeport experiments, the sulphur was made into a paste by working it over with the hands, warm water being used. This prepared the sulphur for more immediate action, and the materials were boiled only thirty minutes and very little or no sulphur remained undissolved. But in most cases it will be found more economical to add dry sulphur to the slaking lime and boil it for a longer time. There should not be more than a pint of sediment for each barrel of mixture if properly made, and the mixture should be strained when put into the spray barrel.

Salt may be added to this mixture and is still used in some orchards, though in most cases it is omitted. In previous tests conducted by us and by many other experimenters, salt was found to have no value either in making the mixture more adhesive or in rendering it more destructive to the scale-insects.

Making the Mixture Without Boiling.

The fact that the ordinary lime and sulphur mixture requires boiling has kept many from using it, in spite of the small cost of the mixture, even when boiled. In large orchards, where suitable outfits can be procured, the question of boiling is not such a serious one, but in hundreds of small orchards and gardens the trees would be sprayed if some easily made mixture could be used. There is a demand for a mixture that can be prepared without hot water, and this has prompted us to try several things with the view of possibly supplying this demand.

Last year we used potassium sulphide and found it a valuable addition to our list of scale insecticides. It has been used the present season with good results. It is too expensive for large spraying operations, but is very convenient for spraying a few small trees or shrubs near the buildings or in a city yard. Knowing that sodium compounds are usually cheaper than potassium compounds, and have similar properties, we sought the former, and through considerable correspondence we learned that two grades of sodium sulphide could be obtained at a low price. The crystallized form contained less than 30 per cent. of sodium sulphide and cost 1¾ cents per pound in 500 lb. barrels. The fused form has nearly 60 per cent. of sodium sulphide and costs 2¾ cents per pound in drums of over 700 lbs. Both kinds were tested in the laboratory and mixtures with lime were made from each and sprayed upon trees. The mixture from the crystallized sulphide did not stick as well as that from the fused, and as it contained such a small quantity of sodium sulphide, was not employed extensively. The fused sulphide, however, promised to be of value and was used quite extensively in these experiments. The worst feature about it is the form in which it comes—in a fused mass, hard as a rock. When freshly broken it is of a reddish color, resembling the mineral cinnabar. On exposure to the air it soon blackens and gives off a strong odor of sulphuretted hydrogen. The large lumps are hard to dissolve, but the finely pulverized material is very soluble in cold water. The entire mass was broken with hammers into small pieces—no larger than a hen's egg. In this form it would nearly all dissolve when added to the slaking lime, but in uniting with the lime to form calcium sulphides caustic soda was also formed, and the mixture was so very caustic that it went through the skin, making sore spots wherever it struck. In our laboratory tests the dissolved sodium sulphide was found to be an excellent solvent of sulphur, exceeding caustic soda when in cold solution, though the latter would dissolve more sulphur if heated. In discussing the properties of this sodium sulphide, Director Jenkins suggested to the writers that by using this as a solvent for sulphur in connection with lime, the causticity would probably be much reduced—which was found to be the case.

An effort then was made to prepare a mixture without boiling based on the same cost of materials as the boiled mixture. Formula No. 7 is the result, and No. 8 was simply a test of larger quantities of sulphur and sodium sulphide with the same amount of lime. When prepared after either formula, this mixture is no more caustic or unpleasant to handle than the boiled lime and sulphur mixture, and while we are not yet prepared to state that it is just as good, it certainly has given favorable results that warrant further trial. If this sodium sulphide could be obtained in pulverized form it would be much more convenient to use, and we have taken up the matter with the manufacturers in Germany to try and bring it about.

This 60 per cent. sodium sulphide can now be obtained in crushed form from the Roessler & Hasslacher Chemical Co., 100 William street, New York City, and doubtless from other dealers. It is packed in iron drums holding 110 pounds each and costs 3½ cents per pound F.O.B. at New York. The price may vary somewhat, but is sufficiently low to make the preparation an inexpensive one to use in orchards.

In making the mixtures without boiling, the unslaked finishing lime was used. This generates more heat in slaking than the mortar lime, and heat aids in dissolving the sulphides. The best solution resulted when the greatest amount of heat was produced by the slaking lime. The light sulphur flour is the grade of sulphur best adapted for the unboiled solutions. As has already been mentioned, this does not form as many dry lumps as the flowers of sulphur. Boiling will break up some of these lumps, but it is more necessary in the unboiled mixture to use the form that is least inclined to become lumpy.

Cold water was used in most cases. Warm, or hot water, of course, assists greatly in slaking the lime and dissolving the sulphides. But it requires nearly as much of an outfit to heat the water as to boil the lime and sulphur mixture, and the chief object of an unboiled mixture is to do away with such an outfit.

Lime and Potassium Sulphide Mixture.

Formula No. 4. { 20 lbs. lime.
20 lbs. potassium sulphide.
40 galls. water.

This can be prepared in two ways, either of which is satisfactory.

1. Place the weighed potassium sulphide in a half-barrel and add three or four pails of water. Stir occasionally. Place the lime in a barrel and slake carefully, the same as for a boiled mixture. When the potassium sulphide has all dissolved add it to the slaked lime, with water to make about one-third the required volume. Then strain the mixture into the pump barrel, dilute to make the right proportion and apply to the trees.

2. Weigh out the materials. Put the lime in a barrel and start it slaking. When it begins to slake vigorously add the dry sulphide. Then stir the mixture vigorously and add just enough water to keep the lime from burning. After the lime has slaked, add a small quantity of water and allow the mixture to stand for a short time, with frequent stirring. Then dilute and apply.

The above formula has been given in several Experiment Station bulletins with directions that the potassium sulphide be dissolved in warm water and the lime slaked with this solution. We do not recommend this method, because the sulphide when dissolved makes a soapy, caustic solution which, when added to the lime, immediately coats over the lumps, excluding the air and checking the slaking process. Besides, there is practically nothing gained by this method.

Lime, Sulphur and Sodium Sulphide Mixture.

No. 5.
- 20 lbs. lime.
- 20 lbs. sodium sulphide.
- 40 galls. water.

No. 6.
- 20 lbs. lime.
- 10 lbs. sodium sulphide.
- 40 galls. water.

No. 7.
- 20 lbs. lime.
- 6 lbs. sulphur.
- 6 lbs. sodium sulphide.
- 40 galls. water.

No. 8.
- 20 lbs. lime.
- 11 lbs. sulphur.
- 11 lbs. sodium sulphide.
- 40 galls. water.

No. 9.
- 14 lbs. lime.
- 6 lbs. sulphur.
- 6 lbs. sodium sulphide.
- 40 galls. water.

No. 10.
- 14 lbs. lime.
- 11 lbs. sulphur.
- 11 lbs. sodium sulphide.
- 40 galls. water.

These mixtures are made practically in the same way as the last preparation. It is important to use as little water as possible in slaking the lime and to let the lime get well started before the other ingredients are put in.

Weigh the materials, put the lime in a barrel, add water, and when it begins to slake vigorously add the dry sulphur and lumps of sodium sulphide. Keep the whole well stirred. When the lime is slaked, add a few pails of water, and let the solution stand for about twenty minutes. It can then be strained, diluted, and sprayed upon the trees. The sodium sulphide used in these mixtures is dissolved by the water, aided by the heat of the lime. The caustic properties of the sulphide and lime, together with the heat, dissolve the sulphur flour, thus forming sulphides of lime similar to those formed in a boiled lime and sulphur mixture.

This appears much like the regular boiled mixture, except that it is olive-green in color instead of yellow.

Lime, Sulphur and Caustic Soda.

Formula No. 14.
- 14 lbs. lime.
- 14 lbs. sulphur.
- 7 lbs. caustic soda.
- 40 galls. water.

In this mixture caustic soda is added to assist in dissolving the sulphur. Start the lime slaking and add the sulphur and caustic soda. The caustic soda causes violent boiling of the mixture, and water must be added at intervals to prevent the mixture from boiling over the top of the barrel. The mixture becomes reddish in color very soon after adding the caustic soda, and by the time the action ceases the color reaches deep reddish brown. Then dilute with water and apply. This mixture is convenient and effective. Common household lye can be used instead of caustic soda.

This is similar to the mixture originated at the New York (Geneva) Experiment Station and used extensively there in the orchards. (See Bulletins 228 and 247 N. Y. Expt. Station, Geneva, N. Y.)

The outfit required for making the self-boiled mixtures is shown on plate IX.

Caustic Soda and Water.

No. 12.
- 8 lbs. caustic soda.
- 40 galls. water.

No. 13.
- 7 lbs. caustic soda.
- 40 galls. water.

Dissolve the weighed amount of caustic soda in water and dilute ready for use. This solution is very disagreeable to use; every drop that strikes the skin makes it smart violently.

Outfit for Applying the Mixture.

Spraying with the lime and sulphur mixture is looked upon as one of the arduous and disagreeable jobs of the fruit grower. The spring spraying comes at a time when each day brings the grower nearer the regular spring work. Especially if a few days of bad weather occur, the spraying must be rushed as fast as possible. The above reasons alone are sufficient to show that the best and most practical outfit procurable should be used, to make the work go as smoothly and pleasantly as possible and to obviate the loss of time from the breaking down and the giving out of an inadequate spraying outfit.

As spraying is more and more practiced, the good and bad points of spray pumps and their accessories are being brought out.

Many inquiries have come to the station during the past year in regard to the best kinds of spray pumps, nozzles, etc. It seems, therefore, advisable to describe a practical outfit in this report.

Pump, Barrel and Carriage.

It has not yet been demonstrated that power sprayers are as practical or can take the place of the hand barrel pump for orchard work in Connecticut. The first thing to consider is the pump, which should be of large size, furnishing ample pressure to supply at least two lines of hose fitted with double Vermorel nozzles. This should be made so that when it is mounted on the end of a fifty gallon cask, the highest point should be the fulcrum or post on which the pump handle or lever works. This should be just high enough to give the handle a good working distance,—that is, when pushed down it will just clear the chine of the barrel. The air chamber should be under the handle post, the larger part of it being in the barrel out of sight. It is essential that the cylinder be of good size and the plunger must be packed in such a manner that it can be tightened quickly and easily. The valves should be made as simple as possible. It must be possible to take the whole pump apart and put it together with a monkey wrench. The lime and sulphur mixture requires a pump with an agitator that will keep the liquid well mixed. In purchasing a pump for applying these mixtures it is better to select one with iron cylinder because it is less expensive than a pump made entirely of brass and corrodes less rapidly. All pumps are made with brass working parts. Three types of pumps are shown on plate VII.

There are several pumps on the market which are of this type. One which has recently been brought to the attention of the Connecticut fruit grower is the "Hardie." This pump has several features worth pointing out. The plunger is made so the packing can be tightened by turning the plunger rod with a wrench without removing it from the cylinder. The plunger consists of two cone-shaped pieces, one screwing upon the other; the groove between them is wound full with cotton waste. This is pushed into the cylinder and a projection on the lower cone holds it stationary while the upper one is screwed down by turning the rod. This crowds the packing together until it fills the cylinder. The mixture enters the pump through a strainer at the side instead of the bottom, and the agitator works up and down in front of this place, keeping the strainer from becoming clogged.

Among the pumps used in Connecticut that have given fairly good satisfaction are the "Eclipse," manufactured by the Morrill & Morley Co., Benton Harbor, Mich.; the pumps manufactured by the Goulds Mfg. Co., Seneca Falls, N. Y., of which the "Pomona" is a type; and the "Century," manufactured by

the Deming Co., Salem, Ohio. These pumps all have some good features as well as weak ones. All pumps should be made so that they can be removed from the barrel more readily.

Plate IV, b, shows one of the most practical ways of mounting a pump. The pump is mounted on the side of the barrel instead of the end. One can readily see many advantages in this method. The barrel is less liable to tip over in rough places. It is much easier to fill than when mounted on the end. When a strainer like the one described is used a hole only large enough to take in the pipe is necessary in filling the barrel. This can be plugged tightly. A drag or sled is made of two pieces of 4 x 6 inch scantling for runners, and spiking a platform of plank to the upper edge of them. The front ends of the runners are rounded. The barrel is placed crosswise of this sled on wooden blocks cut to fit the curve of the barrel and fastened to both barrel and sled. There should be standing room behind the barrel for the man who pumps. A piece of scantling is placed close to each side of the barrel and fastened to the wooden blocks, thus forming a frame around the barrel, securely fastening it to the sled. Iron straps may also be used for holding the barrel in place. Plate IV, b, shows two pumps. One is mounted in the manner just described, the other is placed lengthwise of the runners. It took but a short time to prove which was the practical way of mounting. Where it was mounted lengthwise there was more chance for the barrel to tip over. The handle was at the side and liable to catch on the trees and branches in going through the orchard. The man pumping was continually in the way of the hose on one side. The hose leads from the back and front of the outfit instead of the sides, as in the other case, consequently the hose was continually bent at the point of attachment and soon gave out.

When the barrel was mounted crosswise of the drag, the man pumping stood back on the platform out of the way of the men handling the hose.

Pump manufacturers make outfits consisting of small-sized barrels holding from 15 to 25 gallons, mounted on wheels, for hand use in the garden. The ordinary barrel pump is used in these outfits, though sometimes of a smaller size than would be chosen for orchard work. These hand wheel outfits are most useful in the home garden of four or five acres. (See plate

VII, b.) For still smaller places, like the ordinary city yard, or for spraying a few large trees, a bucket pump costing from four to six dollars is perhaps the best form of outfit. Such a pump is shown on plate VIII, c, and can be used with any wooden pail or bucket. The small compressed air pumps on the market, and the knapsack pumps, will answer the purpose, but most of them are badly corroded by the lime and sulphur mixtures.

Clean water should be run through pump, hose and nozzles at the end of each day's work, and at the end of the spraying season the pump and nozzles should be well cleaned and oiled to prevent corrosion.

Hose.

For general spraying work, we prefer half-inch rubber hose in lengths of not less than 25 feet. Where two lines of hose are used it is frequently of advantage to have one of them 50 feet long for reaching the opposite side of trees or for working a long distance behind the pump. Most of the pumps are sent out with a piece of hose seven or eight feet in length, which is altogether too short for practical work. This hose, though of good quality, usually costs 16 or 18 cents per foot, making it too expensive for orchard use. We have been using a grade of hose which can be purchased from the rubber stores in the larger cities of Connecticut for eight or nine cents per foot. This hose has been very satisfactory, withstands the pressure, and for dragging about in the orchard seems to wear about as long as the more expensive hose. The points of breakage are always near the ends where sharp bending occurs.

The ready-made devices for fastening the hose to its connections are not satisfactory for spraying work. We much prefer number 16 soft iron wire, which can be obtained from any hardware store at five cents per coil. This is just the thing for wiring the hose to the connections. For this purpose a coil of wire and pair of cutting pliers should always be carried in the pocket of at least one of the men connected with each spraying outfit.

Extension Rods.

For reaching into the trees it is necessary to use some form of rod six to ten feet long, and the lightest and best is a hollow one which screws onto the end of the hose and permits the liquid to pass through it. Bamboo rods have been designed for this purpose, each consisting of a brass tube inside of a piece of bamboo. Screw connections are made between the brass rod and the hose at one end, while the other end takes the nozzle. The hose connection should also have a stop cock or "shut off" to avoid wasting the spray mixture. The bamboo extensions are light and convenient, but not durable, as the screw connections soon break off or the bamboo splits or becomes loosened on the brass rod. For this reason many orchardists have adopted an extension made of quarter-inch gas-pipe. Though heavier and harder to hold in the hand on account of the smaller diameter, the gas-pipe rods are more durable and considerably cheaper than the bamboo extensions.

Nozzles.

The double Vermorel nozzle has been used probably more than any other in orchard spraying and has given satisfaction. For large trees the MacGowen is preferred by some operators. During the past season the Goulds Mfg. Co. has put upon the market a new nozzle called the "Mistry." The "Mistry" is a large and somewhat complicated nozzle that gives a fine spray. Formerly the caps wore out very quickly and often needed replacing once or twice each season, but now these nozzles are made with a hardened steel disk containing a hole through which the liquid passes. The lime and sulphur mixture, when forced in a thin stream under great pressure against the cap, will soon wear and enlarge the opening on any of these nozzles. If the caps could be made of hard steel instead of brass, they would last much longer. Some growers praise the "Mistry" highly, while others prefer the double Vermorel. The Spramotor Co. has originated a nozzle fitted with hard steel disks, through which the openings are made. These disks can be replaced easily and while we have not yet given these nozzles a practical trial in the orchard, they appear to work nicely and throw an excellent spray. One man who makes a business of spraying trees informs me that the Spramotor is the best nozzle that he can find for his work. The nozzles of the "Bordeaux" and "Seneca" type give a fan-shaped spray, are heavy and not readily cleaned after being set, and the handles are hook-shaped and get caught in the branches. For these reasons they are not well adapted to orchard work. These nozzles are all shown on plate VIII, a.

Strainer and Funnel.

We have found a home-made strainer the most satisfactory, as the ready-made strainers are not of the proper size or shape for practical use. The strainer and funnel that we have adopted consists of a common wooden pail with the bottom reinforced and a piece of one and one-half inch iron gas-pipe screwed through it. About half-way up on the inside of the pail is tacked a circular piece of iron wire cloth, having at least 20 meshes per inch. A finer strainer is not needed and only hinders the work, as the men must wait for the liquid to go through. This kind of a strainer is always convenient, will hold a pailful at a time, and there is more straining surface than if the wire was placed at the bottom. It is shown on plate VIII, b. The materials for such a strainer cost not more than fifty cents, and the wire cloth can be obtained from the wire stores in New Haven and Hartford. One square foot of this cloth is usually enough for a strainer and costs about fifteen cents.

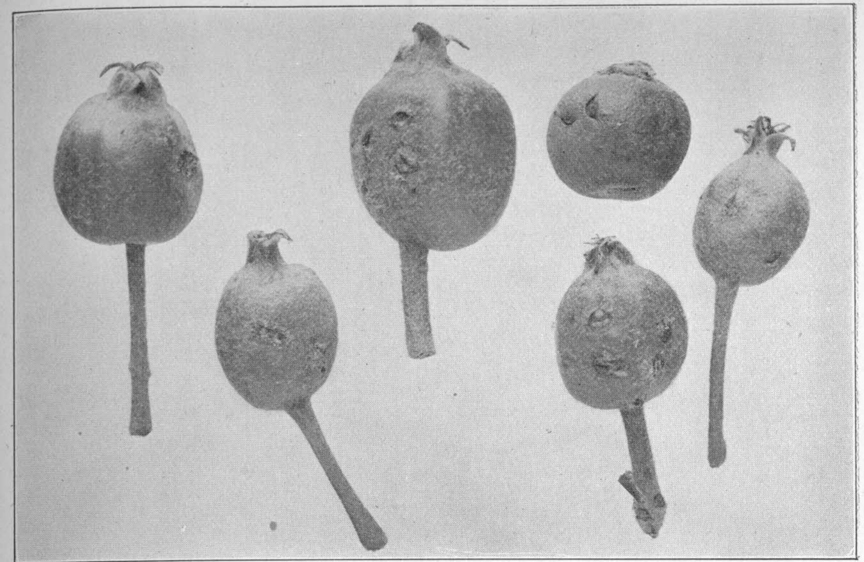
SUMMARY.

1. This station conducted spraying experiments in Bridgeport, New Haven, Westville, Wallingford, Southington and Milford during the past season, to kill the San José scale-insect. Over 4,000 trees were treated. Nearly 800 were sprayed in December and the remainder in March and April. Fifteen different formulas were used in the preparation of the materials; mixtures of lime and sulphur were used chiefly.

2. The winter injury to trees was very serious, many orchards being permanently damaged. This makes it impracticable to express in exact figures in all cases the results of these experiments. Fifty per cent. of the San José scale-insects were also destroyed by the winter in many localities.

3. Fall or early winter spraying gave good results, both where the boiled and unboiled lime and sulphur mixtures were used, and will doubtless soon be practiced by fruit-growers.

4. The boiled mixture of lime and sulphur, using as much or a little more lime than sulphur, is probably as effective and as inexpensive as any mixture for ordinary orchard work. Of the mixtures made without boiling, the potassium sulphide and lime is excellent for a few small trees or shrubs, but is rather expensive for spraying large trees; the lime, sulphur and sodium sulphide mixture is a promising one, worthy of further trial, and giving good results in these experiments. Lime and sodium sulphide make a mixture that is less efficient than those

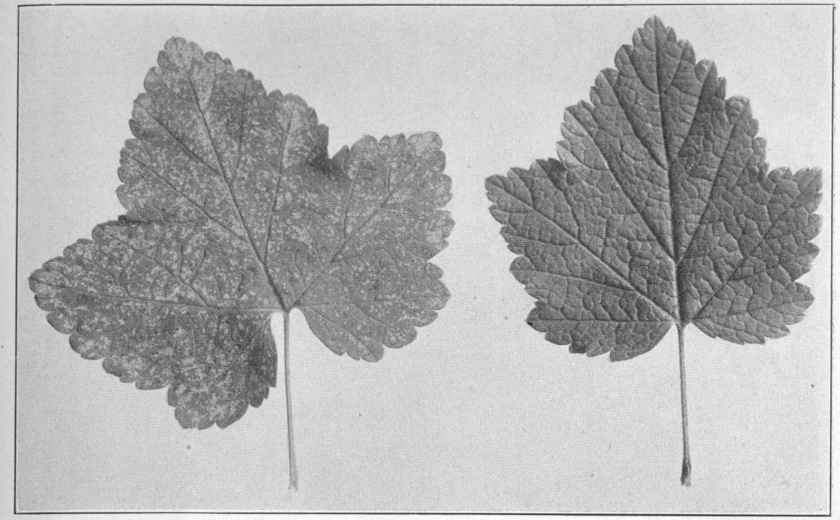


a. Young apples showing punctures made by the plum curculio.

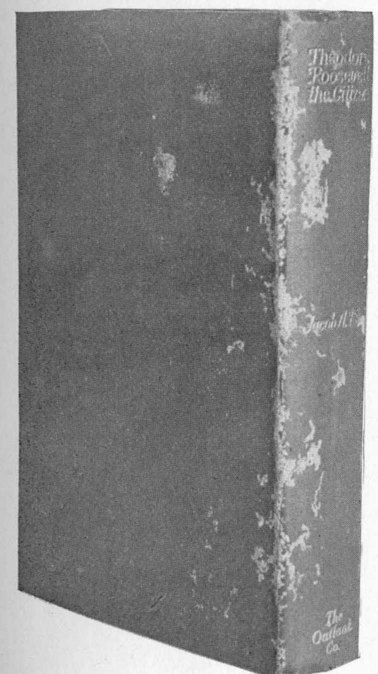
b. Galls on honey locust.

INSECT INJURIES TO APPLE AND HONEY LOCUST.

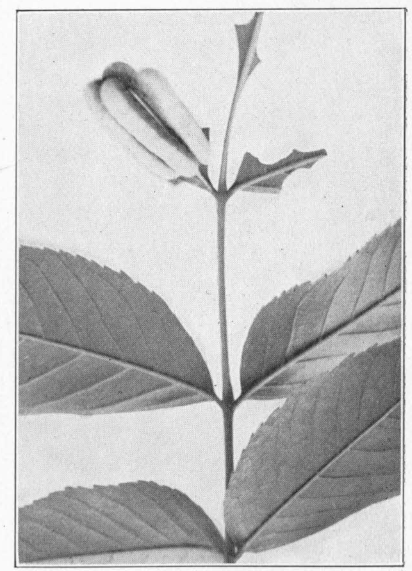
PLATE III.



a. Currant leaf injured by *Empoasca mali:* healthy leaf at right.



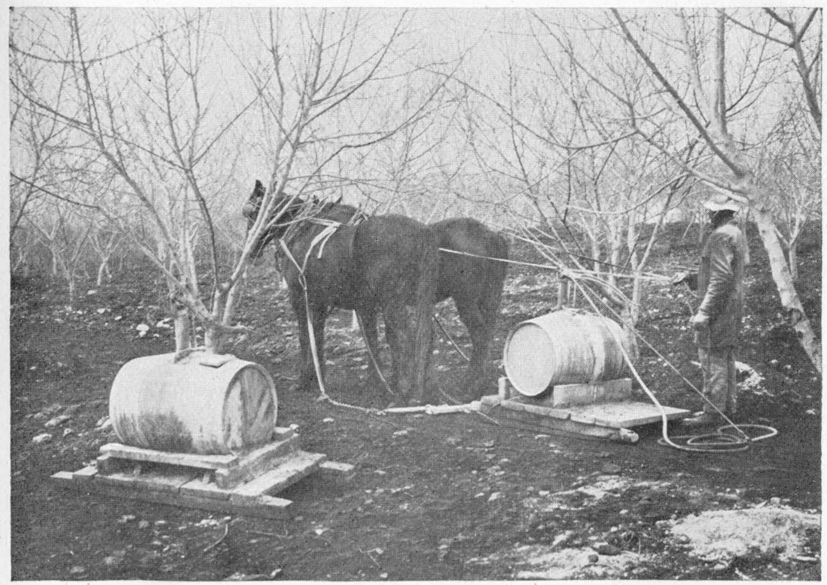
b. Injury to book by cockroaches.



c. Sawfly larvae on ash.

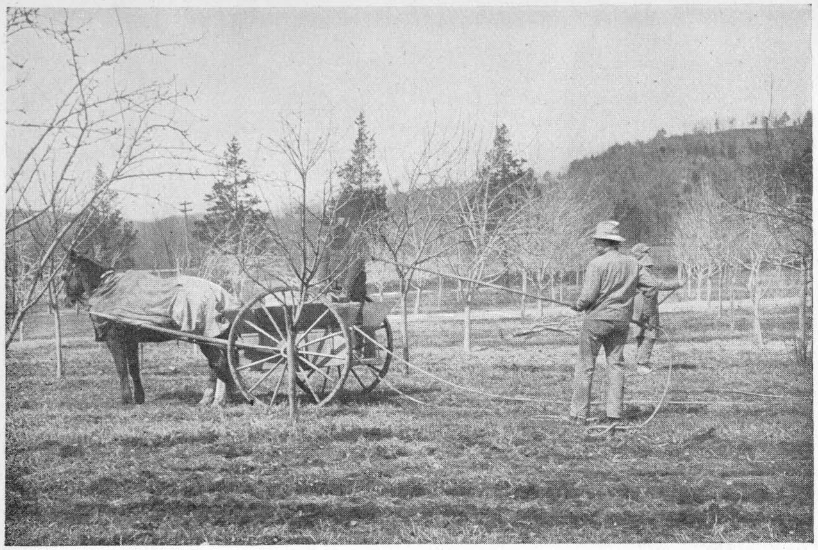
INSECT INJURIES TO CURRANT, ASH AND BOOKBINDINGS.

a. The noon hour in spraying time. Portable boiling plant and outfits for applying the lime and sulphur mixture.



b. Nearer view showing methods of mounting pump and barrel. The proper method is shown at the right. This is an excellent outfit for a rough orchard.

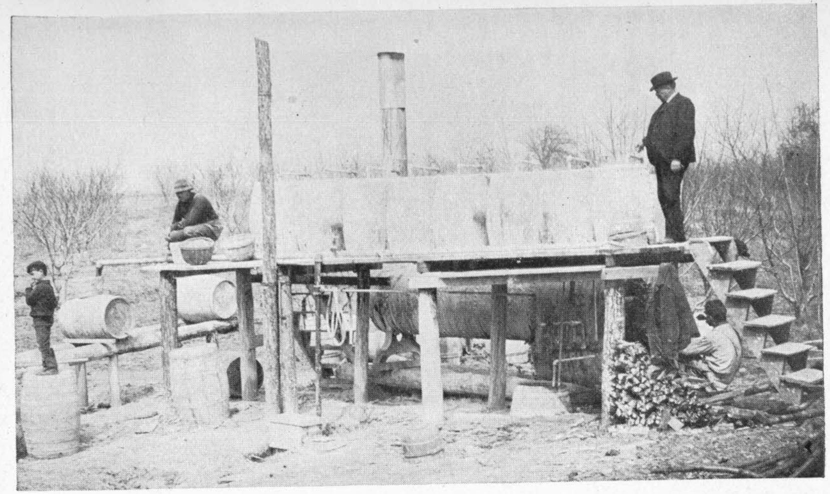
VIEWS IN ORCHARD OF HIGHLAND FRUIT CO., WALLINGFORD.



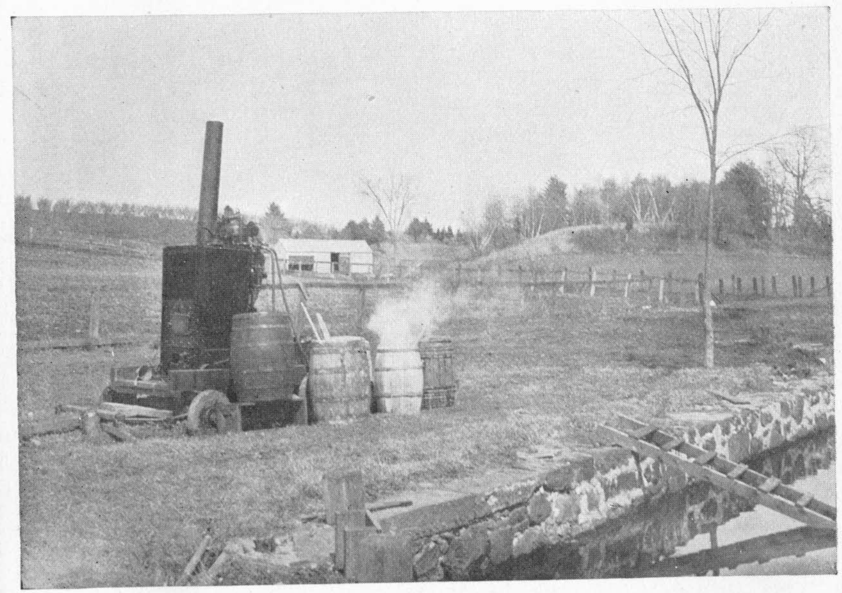
a. Applying the mixture to infested pear trees.

b. Boiling the lime and sulphur mixture in a kettle or feed cooker.

WESTVILLE SPRAYING EXPERIMENTS.

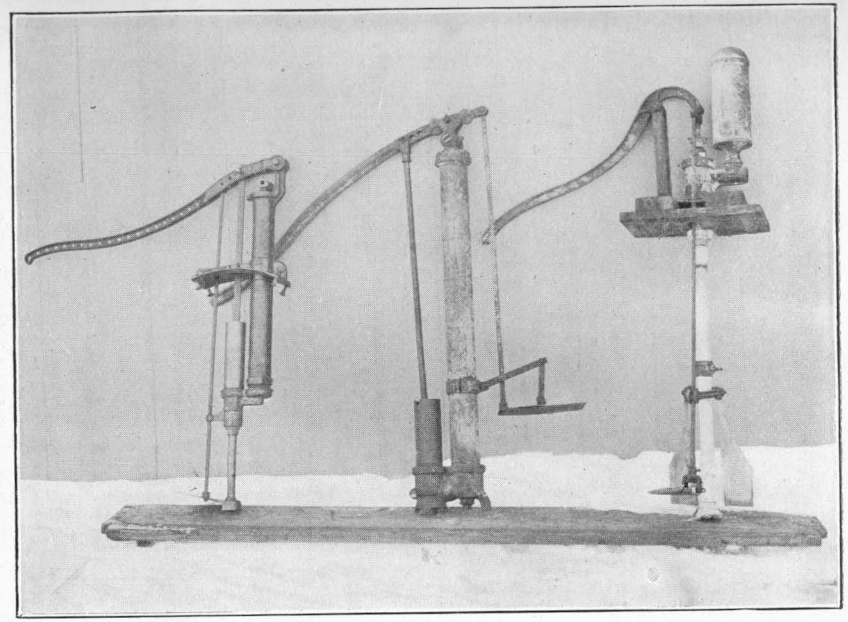


a. Improved stationary cooking plant of J. H. Hale, South Glastonbury. Capacity of this plant is about 50 barrels of mixture per day.

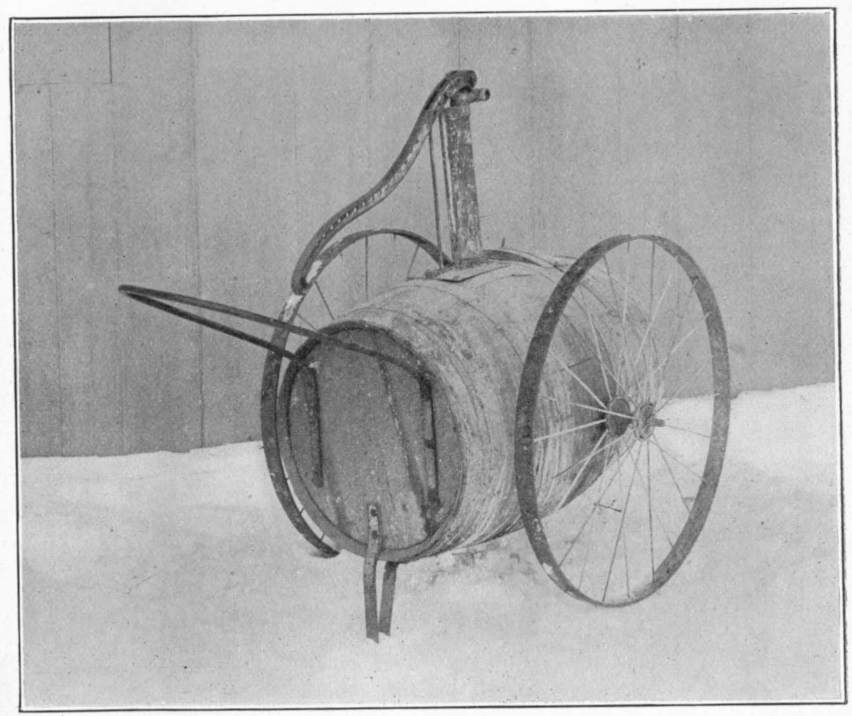


b. The common method in Connecticut orchards. A portable engine with boiler is placed near the orchard where water can be obtained. Steam is conveyed to the barrels through common rubber hose.

STATIONARY AND PORTABLE STEAM COOKING PLANTS.

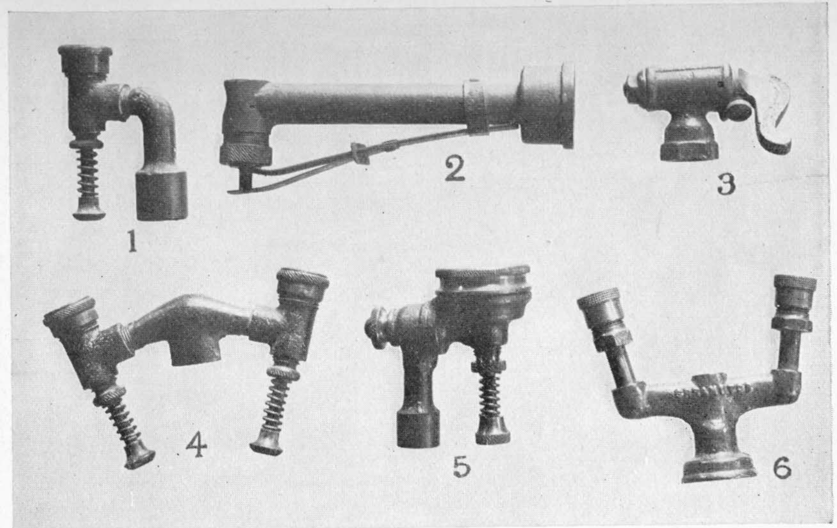


a. Three types of barrel pumps.



b. A convenient outfit for the garden.

SPRAYING PUMPS.

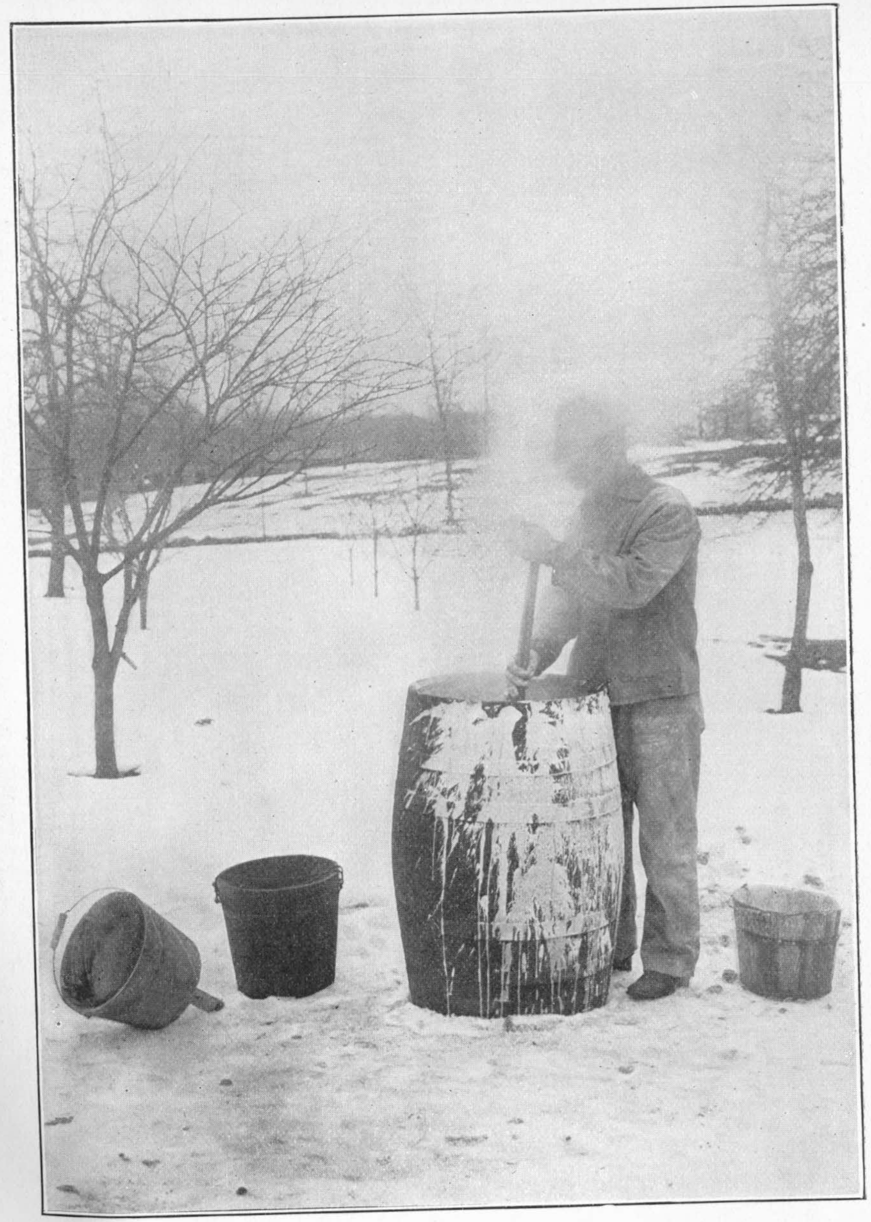


a. Some spray nozzles in common use. 1. Single Vermorel: 2. McGowen: 3. Bordeaux: 4. Double Vermorel: 5. Mistry: 6. Double Spramotor.

b. An excellent home-made strainer and funnel.

c. Spraying a tree with a bucket pump. This is an excellent outfit for the garden and the city yard.

NOZZLES, STRAINER AND BUCKET PUMP.



MAKING THE SELF-BOILED LIME AND SULPHUR MIXTURE.

just mentioned, nearly as caustic in its action as caustic soda, and workmen need protection in handling it. At present sodium sulphide (fused) is put up in a convenient form for orchard use and is inexpensive.

5. Caustic soda as used in these tests did not give as good results as most of the other mixtures. Its caustic action makes it hard to handle and the hands and faces of the men should be protected.

6. Probably 100,000 fruit trees in Connecticut orchards and gardens were sprayed with the lime and sulphur mixtures during the spring of 1904. The results were generally satisfactory.

7. A satisfactory spraying outfit consists of hand pump in barrel mounted on drag or wagon and fitted with two lines of half-inch hose at least 25 feet long, extension rods and nozzles, as described in the foregoing pages.

REPORT ON MOSQUITO INVESTIGATIONS.

By W. E. Britton and Henry L. Viereck.

Recent discoveries have established the fact that certain species of mosquitoes transmit malaria, yellow fever, and filariasis (elephantiasis), and by so doing make these diseases epidemic. This knowledge has given great importance to the study of mosquitoes; their species, life histories and relations to public health.

In 1896 about 250 species were known in the world,—less than 30 in the United States. Now over 400 species have been described—over 60 of them occurring in this country.

Mosquitoes cannot any longer be regarded merely as producers of irritation or discomfort, but rather as a menace to the health of the community: and a pool where the malarial mosquito breeds is a public nuisance.

Health boards and officers are condemning and destroying the breeding places in thickly settled communities in the interest of the public health, while at the same time many owners of shore property and summer resorts have by the drainage or filling of stagnant pools greatly abated or removed the plague of mosquitoes and thus enhanced the value of their property.

The survey herein described was undertaken in order to learn what species of mosquitoes are found in the state, where are their chief breeding places and what means may be useful in diminishing or entirely abating the mosquito nuisance.

To cover the whole state will require several years' work with the limited means at our command. A beginning has, however, been made by examining the coast region and the largest centers of population where the nuisance is more seriously felt.

Before describing this survey it will be worth while to notice briefly the evidence regarding the connection of mosquitoes with the transmission of certain diseases.

Mosquitoes as Carriers of Disease.

Malaria.

*In the year 1880 Laveran, a French army surgeon, discovered in the blood of persons showing symptoms of ague, a peculiar protozoan parasite which he believed to be the cause of the disease, and named *Plasmodium malariae* — the *Plasmodium* of malaria. Within a few years this discovery was confirmed by careful observers all over the world. In 1882 King and others suggested the mosquito as a possible agent in the transmission of the parasite.†

The malarial parasite is found in the red corpuscles of the blood and may be readily demonstrated by spreading a drop of fresh blood from a malarial patient evenly upon a slide and staining with Jenner's, Goldhorn's or Leishman's stains.‡ After entering the human system the parasite develops in the red blood corpuscles and in from 9 to 14 days splits up or sporulates, bursts the blood cell and the segments are discharged into the serum. This is the period at which the malarial spasms (chills and fever) appear and at which quinine is the most efficacious. Some of these segments enter other blood cells heretofore healthy and undergo the same process of development, while others do not divide up in this manner, and though similar in size to the dividing forms, take stains differently and send out flagella or threads after the blood has been drawn from the human body. In 1895 Dr. Patrick Manson of London expressed an opinion that this flagellated form was probably connected with an alternate mode of reproduction which takes place outside of the human body, and considered some blood-sucking

* The greater part of this chapter was taken from a paper read by the State Entomologist before a conference of health officers, at Hartford, December 15, 1903. It will probably be printed in the Report of the State Board of Health.

† L. O. Howard, Mosquitoes, page 48.

‡ W. N. Berkeley, Laboratory Work with Mosquitoes, page 72.

insect (probably a mosquito) the most probable host. Dr. Ronald Ross, an English military surgeon and pupil of Dr. Manson's, afterwards went to India with a strong determination to find that insect. He dissected the bodies of "nearly a thousand mosquitoes," and finally his efforts were rewarded by the discovery of a single specimen (*Anopheles*) which had pigmented bodies in the stomach wall after having bitten a malarial patient. Since then it has been learned through many investigations by patient workers in different parts of the world, that a definite development of the flagellated form takes place within the body of the malarial mosquito. Small capsules are formed upon the wall of the stomach and these increase in size for six or eight days, finally bursting and discharging a great number of sickle-shaped bodies into the body cavity of the insect. These sickle-shaped bodies finally reach the poison gland and some escape into the blood of the person next bitten by this mosquito. The victim usually becomes ill in about fourteen days after being bitten.

Evidence of the transmission of malaria by mosquitoes is briefly as follows:

Doctors Sambon and Low of the London School of Tropical Medicine constructed in 1900 a five-room wooden house in one of the worst malarial sections of the Roman Campagna. The house was thoroughly screened to keep out mosquitoes, and the occupants went inside each evening before sundown and remained until daylight the next morning. Here they lived throughout the season when malaria was most abundant and a canal near the house was literally swarming with the larvae of *Anopheles;* yet while many of the people in the surrounding regions became ill, the occupants of this house remained perfectly healthy. *Anopheles* mosquitoes which had bitten a malarial patient in Rome were taken to London and there allowed to bite the son of Dr. Patrick Manson. Though he had not previously had the disease, he became ill in due time, and a microscopic examination of his blood showed that the parasites were present in large numbers.

In the summer of 1900 Grassi, an Italian observer, screened completely ten cottages at St. Nicolo, Varco and Albanella in the Plain of Capaccio, Italy. A hundred and four persons, only eleven of whom had previously escaped malaria, were asked to live in these cottages. Here they lived during the entire malarial season, from June 25th to October 15th, and only five developed symptoms of malaria, though no quinine was taken. The exceptions were light cases ascribed to relapses in persons who had malaria the season before. Of 415 other persons, not protected by screens, in the same neighborhood, every one contracted the disease.

Man, and mosquitoes belonging to the genus *Anopheles*, then, are essential hosts of the malarial parasite; no other hosts are known, and while it is possible that some other may be discovered, it is thought that fully 99 per cent. of the cases of malaria are transmitted to man by Anopheles.*

Thus it is seen that the mosquito must bite twice in order to transmit the disease from one person to another. It must also be noted that the mosquito is not simply a mechanical carrier, but absolutely essential to the completion of the life circle of the malarial parasite. Moreover, a period of at least twelve days must elapse between the bite with which the disease is imbibed and the bite which transmits it.

Exactly analogous is the development of an allied parasite (*Proteosoma*) which causes malaria in sparrows and crows, except that the parasite of the birds is harbored by certain mosquitoes belonging to the genus *Culex* instead of *Anopheles*. Much work on bird malaria has been done by Dr. Ross in India with the sparrows, and by MacCallum of Johns Hopkins University with the common crow. These researches have been an important aid in working out the similar development of the human malarial parasite.

Malaria in Connecticut.

From the records that can be obtained it seems almost certain that malaria has occurred in sections of Connecticut for nearly 250 years. But it was not generally distributed nor did it assume the nature of an epidemic until after 1860, when it broke out in the southwestern corner and gradually spread over the state; the disbanded soldiers returning to their homes from the Civil War brought it from the South; in 1882 it seemed doubtful if a single town had been exempt. An interesting paper by Dr. R. W. Griswold of Rocky Hill* reviews this epidemic in an interesting and suggestive manner, and points out how the disease followed the construction of the Valley railroad from Saybrook Junction northward to Hartford. The epidemic afterwards subsided in a large measure, probably through the almost universal administration of quinine, but malaria still exists and occasional cases appear in all parts of the state. It is unfortunate that we have no record of the cases, but the people are so accustomed to taking quinine for relief that they do so often without consulting physicians. Then too the term "malaria," like charity, covers a multitude of sins and is doubtless applied to many troubles of a different nature. Through the kindness of the Secretary of the State Board of Health I am able to present a record of the deaths from malarial diseases in Connecticut for the past decade.

* W. N. Berkeley, Proceedings, first Anti-Mosquito Convention, p. 38.

DEATHS FROM MALARIAL DISEASES IN CONNECTICUT, 1894–1903.

	1894	1895	1896	1897	1898	1899	1900	1901	1902	1903	Total.
Intermittent Fever	16	24	18	17	11	13	53	68	75	38	295
Remittent Fever	28	10	28	27	18	19	24	23	6	7	190
Malarial Cachexia	----	----	----	----	----	----	----	3	----	----	3
Pernicious or Congestive Fever	6	13	11	16	13	15	8	----	----	----	82
Other Malarial Disorders	65	69	113	67	82	80	37	---	----	----	503
Total (all Malarial Disorders)	105	116	172	127	124	127	104	94	81	45	1,073

It is reasonably certain that the figures of mortality from these diseases can be greatly reduced in the next decade,—as well as the prevalence of illness from malaria,—if we can abolish the chief breeding places of mosquitoes. Of course we can hardly hope to abolish all mosquito breeding places during the coming year or during the next five years. Education is an important factor in the solution of this problem as it is in the solution of the tuberculosis problem or in fact any similar problem. There is still much ignorance regarding the habits and life histories of mosquitoes, and missionary work must be done before the owners of land will take proper and sanitary care of it.

* Report of Connecticut State Board of Health for 1885.

Yellow Fever.

As early as 1881 Dr. Charles Finlay of Habana noticed a correspondence between the abundance of mosquitoes and of yellow fever. When the island of Cuba was occupied by American troops during the Spanish war and just after the method of transmission of malaria had been established, Surgeon-General Sternberg appointed an investigating commission of army surgeons, composed of Messrs. Reed, Lazear, Carroll and Agramonte, to investigate the yellow fever from the mosquito standpoint. In 1900 these investigations were conducted at Habana and eleven non-immune individuals were inoculated with the disease by the bites of a species of mosquito known to entomologists as *Stegomyia fasciata.* Two positive cases resulted and in one of these all other possible sources of infection had been excluded. Even at this time the cause of the disease was not definitely known, though thought to be a bacterial or plant germ, *Bacillus icteroides.* The researches of the commission, however, showed (1) that this *Bacillus* was not the cause of the disease, but only a secondary invader when present; and (2) that the mosquito served as intermediate host for the parasite of yellow fever.* During the investigation Drs. Lazear and Carroll both contracted the disease. Dr. Lazear died—a martyr to the cause of truth and science and public health—no less a hero than many who have laid down their lives upon the field of battle. Dr. Carroll recovered and the experimental work was later continued. A small house was built and effectually screened against the entrance of all mosquitoes. A circulation of air was also prevented and all sunlight excluded. A temperature of 76.20° F. with a moist air was maintained for sixty-three days—just the conditions favorable to the spread of bacterial diseases. Moreover, clothes, blankets and bedding which had been used by yellow fever patients, and not cleansed were put into the building and used by the inmates. Seven non-immunes were kept in this house, two or three sleeping in one room with the contaminated bed-clothing, for about twenty nights, then shifts were made and other subjects placed under the same conditions. All seven were released from quarantine in excellent health at the end of sixty-three days, not a single case of

* L. O. Howard, Mosquitoes, page 124.

yellow fever appearing. Formerly, contaminated clothing, bedding, etc., were regarded as a dangerous source of infection and were usually burned.

Another similar building was erected by these investigators and was divided into two large rooms, one admitting air and sunlight freely and containing the mosquitoes which had previously bitten yellow fever patients. In this room six out of seven persons bitten came down with yellow fever. From the other room mosquitoes were excluded and the occupants remained in perfect health. These tests still more strongly confirmed previous experiments implicating the mosquito in transmitting yellow fever, and acting on this knowledge General Wood issued orders requiring the use of mosquito bars at the barracks and for the destruction of mosquito larvae in the breeding pools by the use of petroleum. This work, in charge of Col. Gorgas, was carried out thoroughly, and continued until Habana is now a comparatively healthy city. Not a single endemic case of yellow fever has occurred there since September 28, 1901. Patients are often brought to the city from other places, but these are at once screened from mosquitoes, and the fever is not transmitted to others. Mosquito extermination has everywhere been practiced—fumigating buildings with tobacco or sulphur to kill the adults, and draining and filling the pools or applying oil to kill the larvae or wrigglers. Of 26,000 of these mosquito breeding places within the city limits in March, 1901, only 300 remained in January, 1902.* Moreover, the number of deaths from malaria in Habana was greatly reduced from 325 in 1900, to 151 in 1901, 77 in 1902, and 45 up to the first of November, 1903. These efforts at Habana constitute the best demonstration that we have of the efficiency of practical work in mosquito extermination to prevent the spread of human diseases.

But when this work was begun the cause of yellow fever had not been discovered. In 1902 another party was sent out by Surgeon-General Wyman to investigate yellow fever at Vera Cruz, Mexico. This party worked for six months, with the result that a protozoan parasite was found in the bodies of the yellow fever mosquito *Stegomyia fasciata.* This organism is

* W. C. Gorgas, A Few General Directions with Regard to Destroying Mosquitoes; Government Printing Office, Washington, D. C., 1904.

not far removed from the malarial parasite and was thought to be the cause of the disease and therefore named *Myxococcidium stegomyiae*.* Later researches, however, have disproved these conclusions, and Surgeon-General Wyman states in a letter that the causative germ of yellow fever still remains undiscovered.

In 1794 there was an outbreak of yellow fever here in Connecticut with something like 64 deaths occurring out of 160 cases in New Haven. There were also cases in Middletown. A ship had previously arrived from the West Indies and in all probability some mosquitoes were brought to Connecticut in such a way that they could not escape until the boat landed at New Haven.

A third disease which occurs in the East and West Indies, and which is called filariasis or elephantiasis has been found by Dr. Manson to be transmitted by mosquitoes. We have related these investigations and discoveries to show that the agency of mosquitoes in the transmission of disease has been abundantly proved.

What Mosquitoes Are.

Mosquitoes belong to the same group of insects as the flies (order *Diptera*). These insects have two wings in the adult stage, with mouthparts fitted for sucking. Mosquitoes have the mouthparts formed into a long and slender proboscis. We can readily distinguish mosquitoes from other flies by the scales on their wings. There is usually a fringe of scales around the margin and along each of the veins, as is shown in figure 12, and on plate XIV, b. Most other flies do not have these scales.

Life of a Mosquito.

Like most other kinds of insects, a mosquito has a life cycle made up of four distinct stages, namely: egg, larva or wriggler, pupa, adult or winged mosquito. The second and third stages are passed in the water and cannot exist elsewhere. During the warm summer weather only about one week is required for a mosquito to develop from the egg to the adult state. In cold weather a much longer period is necessary. The eggs of some species, like the rain-barrel mosquito, float

* Bulletin 13, Yellow Fever Institute, Treasury Department, Public Health and Hospital Service. Washington, D. C. 1903.

on the surface of the water where they are deposited in raft-like masses. (Fig. 11.) The eggs of some others, like the salt marsh mosquito, are laid at the edge of the water or in the soft mud; these are not collected in masses and do not float. Eggs of the malarial mosquito float singly upon the surface of the water. The eggs of all species hatch in a few hours and the young larvae or wrigglers feed in the water on minute particles of vegetable matter. Each larva goes to the surface every few

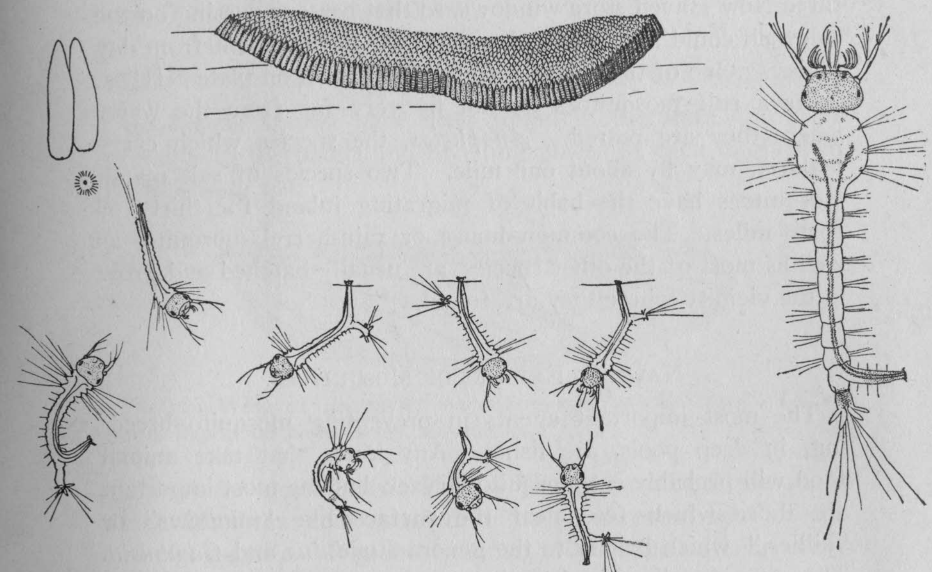


Fig. 11.—Eggs and young larvae of the house or rain barrel mosquito, *Culex pipiens* Linn. All enlarged. (After Howard, Bulletin 25, Bureau of Entomology, U. S. Department of Agriculture.)

minutes to inhale air through the tube or siphon near the tail. After a few days of feeding the larvae change to pupae, which have a peculiar hunchback appearance. Two or three days later the adult mosquito emerges, using the cast skin as a boat in which to stand until the wings are strong and ready for use. The male mosquito neither sings nor bites. The blood of man or some of the higher animals seems to be a necessary food for egg production. Mosquitoes may live for about five weeks in summer, but they usually die after laying eggs. Some kinds of mosquitoes hide away in cellars, caves and other protected places during the winter, emerging in spring to lay eggs for the first brood. Certain other kinds pass the winter in the larval state, freezing up in the ice and going on with their development after thawing out in the spring. Still others, including the salt marsh mosquito, hibernate in the egg state, in the soft mud of the marshes where they breed. These eggs do not hatch until warm weather comes and until there is an abundance of water in which they can pass their larval and pupal existence. We placed jars of wrigglers in one Hartford and three New Haven store windows, so that persons passing on the sidewalk could see them and watch their development from day to day. One of these jars with label is shown on plate XIII, a.

As a rule mosquitoes do not fly very far from the water where they are reared. *Anopheles,* the species which carry malaria, may fly about one mile. Two species of salt marsh mosquitoes have the habit of migrating inland for thirty or forty miles. The common house or rain-barrel mosquito, as well as most of the other species, are usually hatched and grow in the vicinity where they are found.

Natural Enemies of Mosquitoes.

The most important agents in preventing mosquito breeding, in deep pools, are fishes. Any kinds that take animal food will probably eat mosquito larvae; but the most important are those which feed near the surface like "minnows" or "killies," which belong to the genera *Fundulus* and *Gambusia.* These are usually found in the streams, tide ditches and many of the permanent pools, and can easily be introduced into any permanent body of water where they do not occur naturally.

In many shallow pools not inhabited by fishes we find the larvae of certain aquatic insects that devour large numbers of wrigglers. The adults of certain water beetles, known as "whirligig" beetles, eat many wrigglers each day if they can get them. The larvae of the larger aquatic beetles like *Dytiscus* and *Hydrophilus* eat wrigglers also. One of these (*Hydrophilus obtusatus* Say) in captivity devoured one hundred *C. sollicitans* larvae in about a week. Dragon flies (order *Odonata*) are useful in two ways; their larvae feed upon wrigglers in the water and the adults catch mosquitoes in the air and devour them. It will also be noted by reference to page 306 of this report that shrimps devour small numbers of mosquito larvae.

A small round worm (*Agamomermis culicis* Stiles) is parasitic in the intestinal tract of the salt marsh mosquito *C. sollicitans.* This parasite was so abundant in New Jersey in 1903 that 80 per cent. of the mosquitoes examined were infested. The abdomen of the female is filled by the parasite, leaving no room for the development of eggs. This parasite has not yet been observed in Connecticut.

List of Species of Mosquitoes Found in Connecticut.

So far 22 species have been found in the state. A brief reference to the habits and breeding places of each is given in the following list.

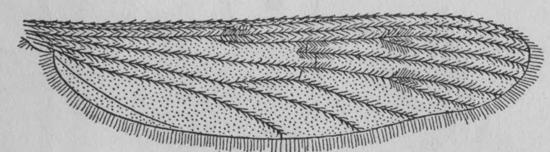


Fig. 12.—Wing of *Anopheles maculipennis* Meig. Enlarged. (After Smith, Report on New Jersey Mosquitoes.)

Anopheles maculipennis Meig.—The real malarial mosquito, which has been demonstrated to be an essential host of the malarial parasite. It probably occurs all over the state, breeding chiefly in fresh water. Compared with other species of mosquitoes it is not very abundant. A wing is shown in figure 12.

Anopheles punctipennis Say.—Seems to be more abundant than *A. maculipennis,* and breeds in similar places. It is a striking species with spotted wings, and more conspicuous than *A. maculipennis.* Probably found all over the state. This species is not known to carry malaria and experiments have been recorded showing that it failed to do so in forty-eight cases under apparently favorable conditions. Shown in figure 13.

While the species of *Anopheles* will breed in any water where *Culex* breeds, the breeding is usually rather scattered and is common along the grassy and ragged edges of streams where the larvae are protected from their natural enemies. The eggs are laid singly and float upon the water, each being cigar-shaped and provided with air cavities (see figure 14); the air cavities distinguish them from those *Culex* eggs which are also laid singly.

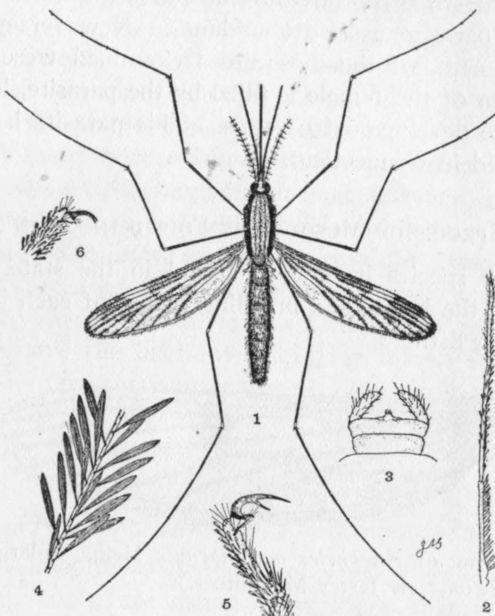


FIG. 13.—*Anopheles punctipennis* Say: 1. adult female: 2. palpus: 3. genitalia: 4. part of wing vein showing scales: 5. anterior and 6. middle claws of male. All enlarged. (After Smith, Report on New Jersey Mosquitoes.)

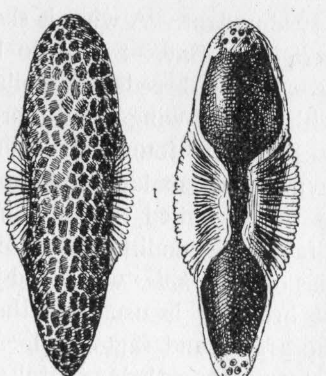


FIG. 14.—Eggs of the malarial mosquito, *Anopheles maculipennis.* Enlarged. (After Howard, Bulletin 25, Bureau of Entomology, U. S. Department of Agriculture.)

The young larvae appear from twenty-four to forty-eight hours after the eggs are laid, and there is much color variation in all sizes of the larvae. They are usually spotted with white when young and become more or less uniform and dark grey when near the pupa stage. It is not unusual, however, to find them light or dark green or even black, resembling bits of grass or debris. This seems to be a protective resemblance through which they are able to escape their natural enemies.

Throughout their larva existence they pass most of the time at the surface of the water, where they lie horizontally and quiet, thus increasing their resemblance to bits of debris. The larva is not provided with a long air tube as in *Culex,* and *Culex*

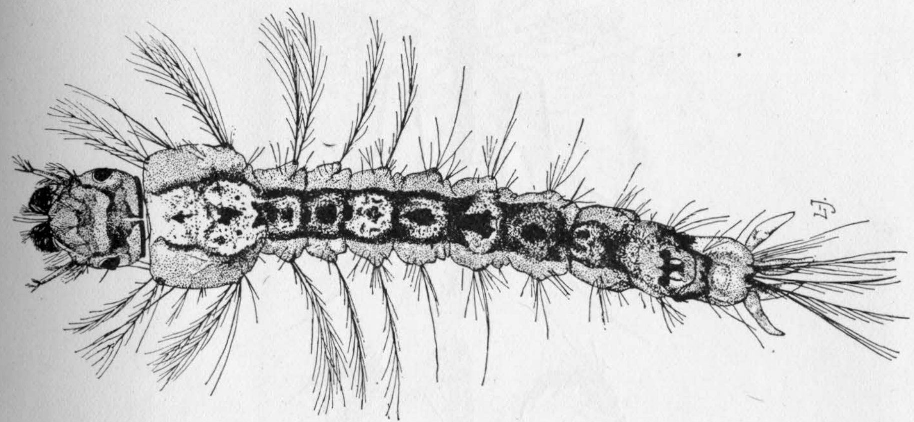


FIG. 15.—Larva of *Anopheles;* dorsal view. Greatly enlarged. (After Felt, Culicidae of New York State.)

larvae hold their heads downward when at the surface of the water for air. Both *Culex* and *Anopheles* larvae are shown in figure 21.

The malarial mosquito flies at night and seldom more than a mile from its breeding place, usually being found near it. The breeding season begins in May and continues into November, the species being much more abundant during the latter part of the summer. *Anopheles* lives through the winter in a dormant condition in cellars, caves, and other secluded places, sometimes appearing even in midwinter. The two species of *Anopheles* cannot easily be distinguished in the larval form, and of the adults reared from the larvae collected in the state, a majority were *A. punctipennis,* though the other species was also found.

Culex pipiens Linn. — This is the common rain-barrel or house mosquito that breeds as if by preference in the vicinity of houses, or wherever water stands that is free from mosquito enemies. It makes no difference how dirty the water is. The species deserves its name of house mosquito for it invades houses almost exclusively. Rain-water barrels and receptacles of all kinds are favorite breeding places of this species, but pools of foul or muddy water are often selected. In Hartford on

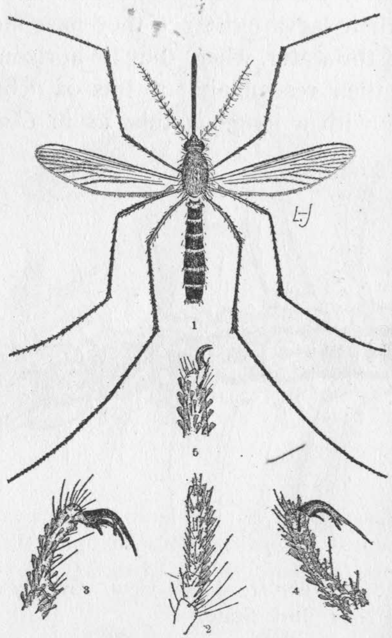


FIG. 16.—The house or rain-barrel mosquito, *Culex pipiens* Linn: 1. adult female; 2. palpus; 3. anterior, 4. middle, 5. posterior claws of male. All enlarged. (After Smith, Report on New Jersey Mosquitoes.)

October 24th we found the highly colored water of a pool close beside a large heap of composted stable manure, to be fairly alive with the larvae of this species. To show how rapidly it breeds, Dr. Lugger of Minnesota counted 17,259 eggs, larvae and pupae of this species in a rain-water barrel in July. These were all destroyed and the barrel again filled with water. Sixteen days later there were 19,110 eggs, larvae and pupae in the same barrel.

The eggs are laid in raft-shaped masses, containing from 200 to 400 eggs, placed side by side, the end of each touching the

water. They hatch in about ten days, the larvae dropping from the lower end directly into the water, where they immediately begin to wriggle about. The larva has a large head and thorax, and a long air tube near the posterior end of the body, which it extrudes from the surface of the water in breathing, during which time it can be seen with head downward. It descends to the bottom, where it feeds upon the spores of algae or other

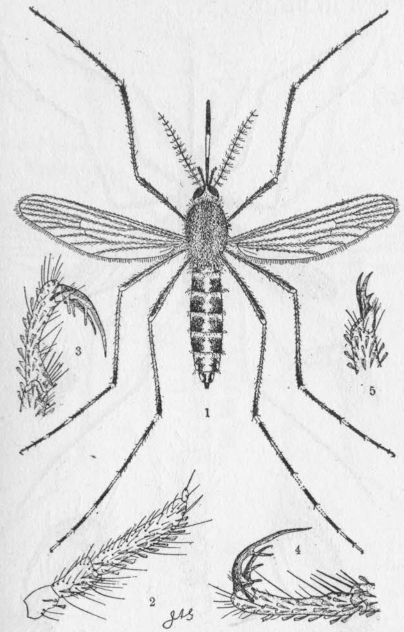


FIG. 17.—The salt marsh mosquito, *Culex sollicitans* Walk.: 1. adult female; 2. palpus: 3. anterior, 4. median and 5. posterior claws of male. All enlarged. (After Smith, Report on New Jersey Mosquitoes.)

vegetable matter. In about seven days in warm weather the larva becomes full-size and changes to a peculiar looking hunch-backed wriggler, the pupa, from which, after about two days, the adult emerges. This species is usually the most abundant and troublesome within doors. Some of the adults hide away in buildings and pass the winter, emerging in the spring to lay their eggs. The eggs and young larvae of this species are shown in figure 11 and the adult in figure 16.

Culex pipiens flies only a short distance from its breeding place, and is therefore easily controlled, but as it breeds everywhere, concerted action is necessary. Other inland species are only of local importance and are mentioned on page 278.

Culex sollicitans Walk.—Is the most common species of the salt marsh and remarkable for its migratory habits, sometimes going thirty miles. It breeds abundantly in certain pools in the marsh during the last half of summer. The species can be easily distinguished by the conspicuous white-banded legs and beak and is shown in figure 17.

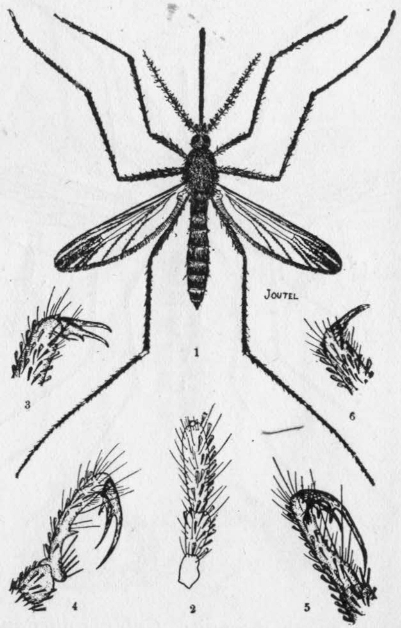


FIG. 18.—The brown salt marsh mosquito, *Culex cantator* Coq.: 1. adult female: 2. palpus; 3. anterior claw of same; 4. 5. 6. anterior, median and posterior claws of male. All enlarged. (After Smith, Report on New Jersey Mosquitoes.)

Culex cantator Coq.—Is called the brown salt marsh mosquito and is the common species on the Connecticut marshes in May and June. Like *C. sollicitans* it migrates inland long distances, and both species are very troublesome pests near the coast. Shown in figure 18.

Culex sylvestris Theo.—Breeds in fresh swamps and in many permanent and temporary pools near the swamps. In some localities it visits the house and becomes a nuisance.

Culex cantans Meig.—Does not fly far from its breeding place in or near woodlands and is too rare to be important.

Culex canadensis Theo.—Is a woodland species, most common early in spring. It is not troublesome except where dwellings are located near the breeding places.

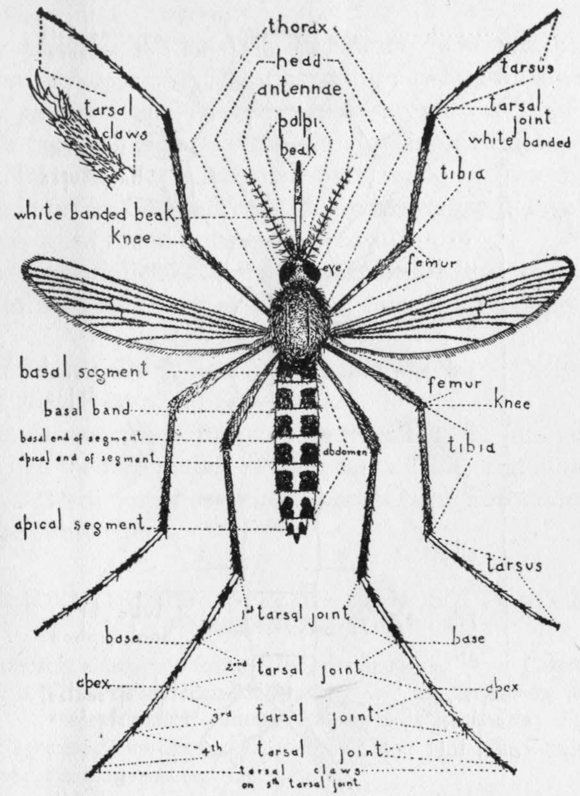


FIG. 19.—Adult mosquito and names of its parts, which are used in classification. (After Smith, Report on New Jersey Mosquitoes.)

Culex atropalpus Coq.—Breeds along streams in depressions of rock, etc. We found it only in ledges near the Sound where depressions had become filled with rain water. It is apparently only a local nuisance.

Culex trivittatus Coq. and *triseriatus* Say.—Are comparatively rare woodland species; any trouble they may give will be strictly local.

Culex perturbans Walk.—The complete life history of this species is unknown. It may be either a fresh or salt water mosquito, but has been found chiefly near salt water. We found the species only at Branford and Woodmont.

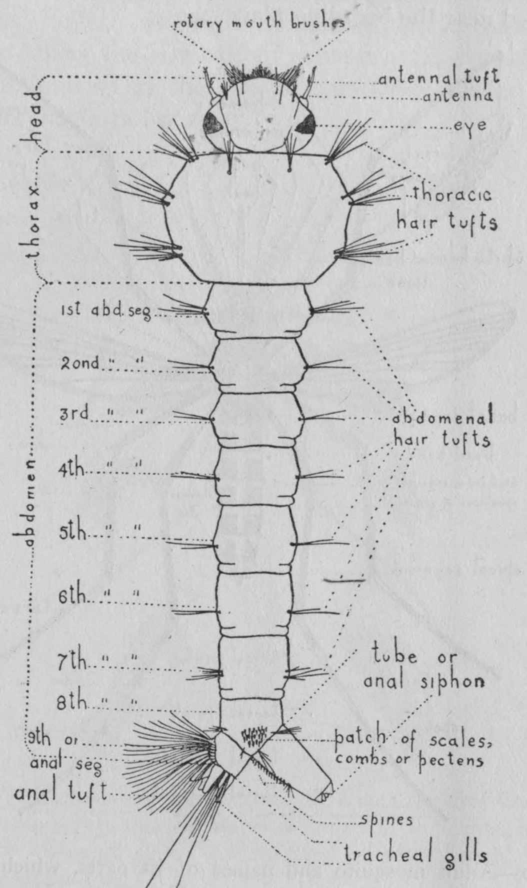


FIG. 20.—Mosquito larva, showing the parts used in classification. (After Smith, Report on New Jersey Mosquitoes.)

Culex taeniorhynchus Say.—The habits of this species are so much like those of *C. sollicitans* that it was at one time thought to be a form of that species. It does not, however, have the longitudinal abdominal stripe found on *sollicitans*. Our experience indicates that the species is comparatively rare.

Culex salinarius Coq.—This species has been found at New Haven and Branford. It resembles the rain-barrel mosquito and is to the salt marsh what that species is to the inland.

Culex pretans Grossbeck.—Has formerly been regarded as a comparatively rare woodland species. At Hartford we found it breeding by the million in wooded pools at south meadows, from which it spread into the adjoining portion of the city, becoming the most troublesome mosquito. (See figure 22 and plate XII.)

Culex territans Walk.—Is a pure water mosquito, comparatively rare and occurring in springs. It may become a nuisance.

Culex curriei Coq.—A fresh water species. A single specimen was taken at New Haven—the first record for the species east of Nebraska, but it has since been found in New York.

Culex aurifer Coq.—Breeds in fresh water. Only a few specimens were found during the season.

Culex brittoni Felt.—A single specimen found at Branford proved to be a new species and was described recently by Dr. Felt.

Aedes fuscus O. S.—A fresh water species. Three adults taken at New Haven and Southington.

Sayomyia americana Johan.—The members of this genus do not bite like the mosquitoes of the genera *Culex* and *Anopheles*. The larvae were found breeding in pools in an abandoned stone quarry at Stony Creek.

KEY TO IDENTIFY THE SPECIES OF MOSQUITOES FOUND IN CONNECTICUT.

A. Proboscis short, not formed for piercing: CORETHRINAE.
- a. First tarsal segment longer than the following segment; species small; antennae with hairs in whorls: *Sayomyia*.

(But one species, *S. americana* Johans., has been found in Connecticut.)

AA. Proboscis long, formed for piercing.
- a. Palpi long in both sexes; wings usually spotted: ANOPHELINAE.
  - b. Species with yellowish white marginal spot near the apical fourth of the wing: (*Anopheles*) *punctipennis*.
  - bb. Without yellowish white spot as above: *maculipennis*.
- aa. Palpi short in both sexes: AEDEOMYINAE (*Aedes*) *fuscus*
- aaa. Palpi short in female; wings unspotted: CULICINAE.
  - b. Size large (length about 11 mm.); legs thickly covered with nearly erect scales: (*Psorophora*) *ciliata*.
  - bb. Size smaller (4.5–7 mm.): *Culex*.

B. Joints of the tarsi and segments of abdomen banded at the base.
a. Beak with a more or less distinct white band.
b. Upper surface of abdomen with a longitudinal whitish stripe.
White band at middle of beak; sides of thorax whitish beneath a blackish edge: *sollicitans.*
bb. Abdomen without longitudinal stripe.
c. Hind tibia with a light band near the tip.
A large scaly brown mosquito: *perturbans.*
cc. Hind tibia without markings: *taeniorhynchus.*
aa. Beak without band.
b. Segments of abdomen white banded at base.
c. Claws toothed.*
d. Bands of tarsi broad. 6-6.5 mm.; light brown with the yellow bands of the abdomen only slightly notched: *cantans.*
dd. Bands of tarsi narrow. Small dark species with white bands of abdomen nearly divided in the middle: *sylvestris.*
cc. Posterior claws simple; tarsal bands narrow. Otherwise resembles *cantans:* *cantator.*
ccc. All claws simple; wing fringe uneven: *brittoni.*
BB. Joints of the tarsi banded at both ends; last joint white.
a. Bands of the tarsal joints broad; thorax unmarked. A good sized brown mosquito: *canadensis.*
aa. Bands of tarsal joints narrower; thorax with grayish scales and a dark central line. Slightly smaller and darker than the preceding species:† *atropalpus.*
b. Abdomen yellowish white with a pair of black scale patches on segments 2-5 inclusive: *curriei.*
BBB. Joints of the tarsi not banded.
a. Abdomen not banded.
b. Thorax with a central brown stripe between two whitish stripes: *trivittatus.*
c. Thorax brown on top; sides covered with golden scales: *aurifer.*
d. Thorax dark brown on top; sides covered with whitish scales: *triseriatus.*
aa. Abdomen with segments banded at base.
b. 4.5-6 mm. (about $^3/_{16}$-¼ in.). Bands of abdomen narrow: *pipiens.*

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* This character is sometimes necessary to distinguish *C. sylvestris* and *C. cantator.* It also serves to distinguish rubbed specimens of *C. cantans* and *C. cantator.*

† The petiole of the first sub-marginal cell in *C. canadensis* is about two-thirds the length of the cell; while in *C. atropalpus* the petiole is about one-half the length of the cell.

BBB. Joints of the tarsi not banded.
c. Similar to *pipiens;* slightly darker; legs longer and more slender: *salinarius.**
d. Thorax yellowish with a darker central stripe; a medium sized darkish species: *pretans.*
aaa. Abdomen with segments banded at apex.
b. A small dark species: *territans.*

KEY TO LARVAE.

A. Larva without air tube on last abdominal segment.
b. Larva transparent or nearly so; last segment with hooks; no spiracles apparent: *Sayomyia.*
(Only *S. americana* has been taken in Connecticut.)
bb. Larva not transparent.
c. Last abdominal segment with flat dorsal area containing two spiracles; anal segment cylindrical: *Anopheles.*
AA. Air tube long, conspicuous.
b. Larva large, about ½ inch long: (*Psorophora*) *ciliata.*
c. Larva small, from ¼-⅜ inch long: *Culex.*
d. Air tube 6 or more times as long as broad.
e. Head as wide as thorax: *territans.*
f. Head narrower than thorax: *salinarius.*
dd. Air tube 4-5 times as long as broad: *pipiens.*
ddd. Air tube 3-½ times as long as broad.
e. 28-40 spines on air tube; 25-30 comb scales: *aurifer.*
dddd. Air tube 2½ times as long as broad.
e. With 16-24 spines: 36-50 comb scales: *canadensis.*
f. Antennae short; 14-16 spines: 10-15 comb scales: *sylvestris.*
g. Antennae longer with slight swelling at base; 16-24 spines: 26-50 comb scales: *cantans.*
h. Antennae shorter than preceding without swelling at base. Spines and scales as above: *cantator.*
i. Antennae tuft only a single hair: comb scales about 46 in 5 rows. Several spines on air tube widely separated from the others: *atropalpus.*
j. spines on air tube in a continuous row, distal ones not widely separated.
k. 12 comb scales, arranged in an irregular double row: each divided digitately: *triseriatus.*
l. 14-22 comb scales, elliptical, each with a terminal spine: *trivittatus.*

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* Salt marsh species.

AA. Air tube long, conspicuous.

m. 16–20 spines on air tube; 25–30 comb scales; thorax broader than long with sides angulated: *pretans*.

ddddd. Air tube not more than twice as long as broad.

e. Spines dentate on both sides: 16–24 scales in comb: head maculate: *taeniorynchus*.

f. About 14 spines dentate on one side only: 28–40 comb scales: head generally immaculate: *sollicitans*.

The larvae of *Aedes fuscus* and *Culex curriei* have not been observed in Connecticut, while that of *C. brittoni* is unknown.

OTHER SPECIES PROBABLY OCCURRING IN CONNECTICUT.

The following species have been found in New York or New Jersey, and most of them will, doubtless, be taken in Connecticut, though not yet collected here.

Culex discolor Coq.—A species with banded tarsi and spotted wings, slightly resembling Anopheles.

Culex jamacensis Theo.—A large blackish species with a white band near the tip of the femur. Somewhat resembles *sollicitans*.

Culex squamiger Coq.—A very large mosquito with tarsal joints white banded at base; sides of thorax and abdominal bands white.

Culex signifer Coq.—A small dark form with fine bluish lines on top of thorax; wings somewhat mottled.

Culex serratus Theo.—A golden brown species with a broad central sharply defined white stripe on top of thorax.

Culex dupreei Coq.—A very small blackish species with a white central diffused stripe on top of thorax.

Culex restuans Theo.—Has a pair of white dots on top of thorax in front of ∩-shaped white mark. Narrow bands at ends of hind tarsal joints.

Culex melanurus Coq.—A dark brown species of moderate size; legs, thorax and abdomen unbanded.

How to Distinguish Malarial from Non-Malarial Mosquitoes.

Anopheles, the malarial-bearing mosquito, may be distinguished from *Culex,* the non-malarial mosquito, by the following characteristics:

Anopheles.

Larva small, with short breathing tube, and lying horizontally at the surface of the water.

Adult with spotted wings; beak and body almost in a straight line, nearly perpendicular to the surface on which the mosquito stands. Palpi nearly as long as beak in both sexes.

Culex.

Larva larger than *Anopheles* with large head hanging downward in the water, and longer breathing tube. (See figure 21.)

Adult usually with wings unspotted; beak forms an angle with the axis of the body; body nearly parallel to the surface on which the mosquito stands. Palpi short in female.

Breeding Places and How to Locate Them.

Mosquitoes can only be eradicated or greatly reduced in number by destroying their breeding places so that the eggs

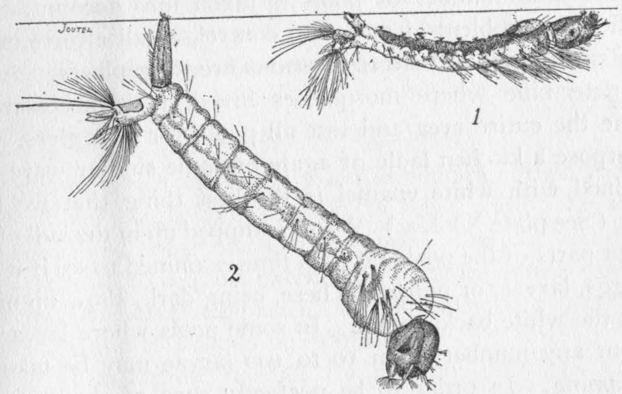


FIG. 21.—Larvae of *Culex* and *Anopheles,* showing the characteristic position of each at the surface of the water. 1. *Anopheles:* 2. *Culex cantator.*

cannot hatch, or by killing them while in the immature condition in the pools where they are breeding. It is of the first importance therefore to find where the different species breed.

Mosquitoes do not breed in grass and weeds, as many persons suppose, but only feed and rest there during the day, flying out when disturbed. They breed only in water, usually in stagnant pools, and receptacles such as rain-water barrels, kettles, tin cans and bottles which have been allowed to remain where they will fill with water. They do not breed in running streams, but often such streams have ragged edges forming little pools where the water stagnates, and in such places mosquitoes will breed. Many of the worst breeding places are caused by the building of roads across marshes, cutting off the natural drainage and leaving depressions where water collects and stagnates. Most species of mosquitoes breed only in fresh water, but a few kinds breed in the salt and brackish water of marshes along the coast. *Anopheles*, the malarial mosquito, will breed in almost any water sustaining *Culex*. Many pools are stocked with fishes or aquatic insects that devour the larvae and so prevent the breeding of mosquitoes. The use of oil on the surface of such pools may do more harm than good, because it may kill the natural enemies of mosquitoes. Ponds filled with green slime or duck-weed are usually not serious breeding places of mosquitoes. Serious breeding places are comparatively few when the total number of pools is taken into account. This simplifies the problem of mosquito control, as all efforts can be concentrated against these few serious breeding places.

To determine where mosquitoes breed, it is necessary to examine the entire area and test all pools for wrigglers. For this purpose a kitchen ladle of agate or some similar ware with bowl lined with white enamel is the best thing that we have found. (See plate XVI, a.) Water is dipped up in the ladle from different parts of the pool and each time examined to see if it contains eggs, larvae, or pupae. These, being dark, show up nicely against the white background. In some pools where larvae are abundant any number from 10 to 100 larvae may be taken at each dipping. In order to be perfectly sure of the status of pools several examinations should be made at different times during the season, including tests early and late and during mid-summer and in periods of scanty and abundant rainfall. The infested pools should be charted on a map of the region, and field notes of each examination should be made and kept for reference, as this is a necessary preliminary to any form of exterminative measures. It is also well to preserve larvae and pupae and also to rear adults if a study of the species is contemplated. In any case the person making the examination should be familiar with mosquito life and be able to distinguish the malarial from the non-malarial kinds.

A MOSQUITO SURVEY OF CONNECTICUT.

This survey was commenced in the spring of 1904 to determine what species inhabit the state and where are their chief breeding places. A systematic examination was made of the coast region from New York to Rhode Island, and a few inland

regions which were brought to our attention were also examined. The junior author, Mr. Viereck, worked in the field all summer, testing pools, mapping breeding places, collecting specimens and making such field notes as would be likely to prove useful in further study of the mosquitoes or in the practical work of controlling them. The breeding areas were marked on maps and a copy of the local map with descriptive notes and recommendations for treatment was sent to the health officer of each of the shore towns. Maps of the Hartford and New Haven regions are reproduced in this report.

Many larvae were collected and preserved for future study, and adults were also reared from each lot. The more important results of the investigation appear in the following pages.

Weather Conditions.

Since mosquitoes must have water in which to breed and some species prefer stagnant rain water to other water, the amount of rainfall is of the greatest importance. The salt marsh mosquitoes depend to a great extent and at times entirely on rain-water pools for breeding places; consequently their broods bear a direct relation to periods of rainfall.

April.—The largest rainfall for any one day was 1.68 in., on the 1st. Less than 1 in. fell on any other day; the total for the month was 6.64 in. The lowest temperature for the month was 24°, the highest 77°. Pools existed in depressions that became dry during May and remained so during the greater part of the summer.

May.—During the first part of May, when the mosquito survey was started, the spring pools contained larvae of *Culex pipiens*, the rain-barrel mosquito and *Culex canadensis*, a woodland species. The largest rainfall, 1.07 in., was on the 30th. Rainfall on other days was .80 in. or less. The total for the month was 2.94 in. The lowest temperature was 39°, the highest 85°.

June.—On the 9th .70 in. of rain fell; on other days .44 in. or less. The total was 2.46 in. The temperature ranged from 45° to 93°.

July.—On the 18th there was a heavy rainfall of .52 in.; on another day .50 in., on all other days, .23 in. or less. Total, 2.08 in. Temperature, 51° to 93°.

August.—On the 20th there was a heavy rainfall of 3.11 in.; on the 10th a fall of 1.74 in., on all other days .62 in., on the 2d, of less. Total, 6.27 in. Temperature, 50° to 84°.

This summary of weather conditions indicates what a poor chance the mosquitoes, fortunately, had to breed during the past season. The total rainfall before June afforded breeding facilities of a varied character in woodland and on the marsh; conditions which did not again occur during the season. In June the light rains afforded only sparse breeding. During July breeding occurred chiefly in pools caused by an extra high or perigee tide. In August, breeding was generally started by the heavy rain of the 2d, which, however, amounted to only .62 in. The brood started at this time did not mature in all places. On the 10th the heavy rain started another brood which matured and emerged about the 19th. On September 2d some mature larvae were found in a pool which was almost dry, and others dead and dry were observed in depressions from which all the water had evaporated. These observations were made on salt marsh mosquitoes. In the inland regions very few fresh water mosquitoes were found outside of the more permanent streams and pools after the temporary pools had become dry.

A. THE INLAND REGION.

In the inland region mosquitoes chiefly breed in small natural or artificial pools of rain-water, in swamps, along the ragged grassy edges of streams, and in receptacles such as rain-water barrels, kettles, tin cans, bottles, etc. Breeding is nowhere general over so large an area as on the salt marshes. Moreover, the chief kinds of mosquitoes are not the same species that are the most annoying near the coast.

Chief Inland Species of Mosquitoes.

Anopheles, the malarial mosquito, also called "dapple wings," must be considered the most important because of its agency in the transmission of malaria. In point of number, fortunately, it ranks far below the rain-barrel or house mosquito, *Culex pipiens,* which is the most abundant of all inland species. *C. pretans* Gross. was abundant at Hartford in May. All other fresh water species are only rarely abundant and breed near the place where they are found. *C. sollicitans* and *C. cantator* are salt marsh species, but on acount of their migatory habits may be found inland throughout the southern half of the state.

HARTFORD.

Hartford has the usual inland mosquito problem augmented by meadow land along the Connecticut River, where in large depressions water collects and mosquitoes breed abundantly.

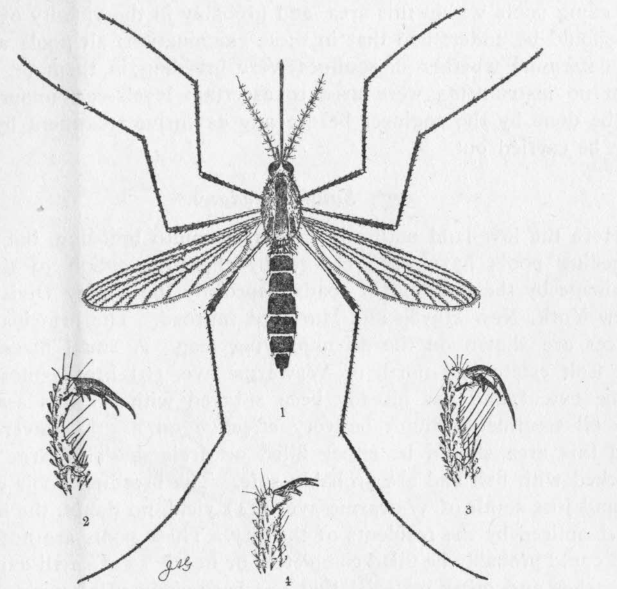


FIG. 22.—*Culex pretans* Gross: 1. adult female: 2. anterior, 3. middle, 4. posterior claws of male. All enlarged. (After Smith, Report on New Jersey Mosquitoes.)

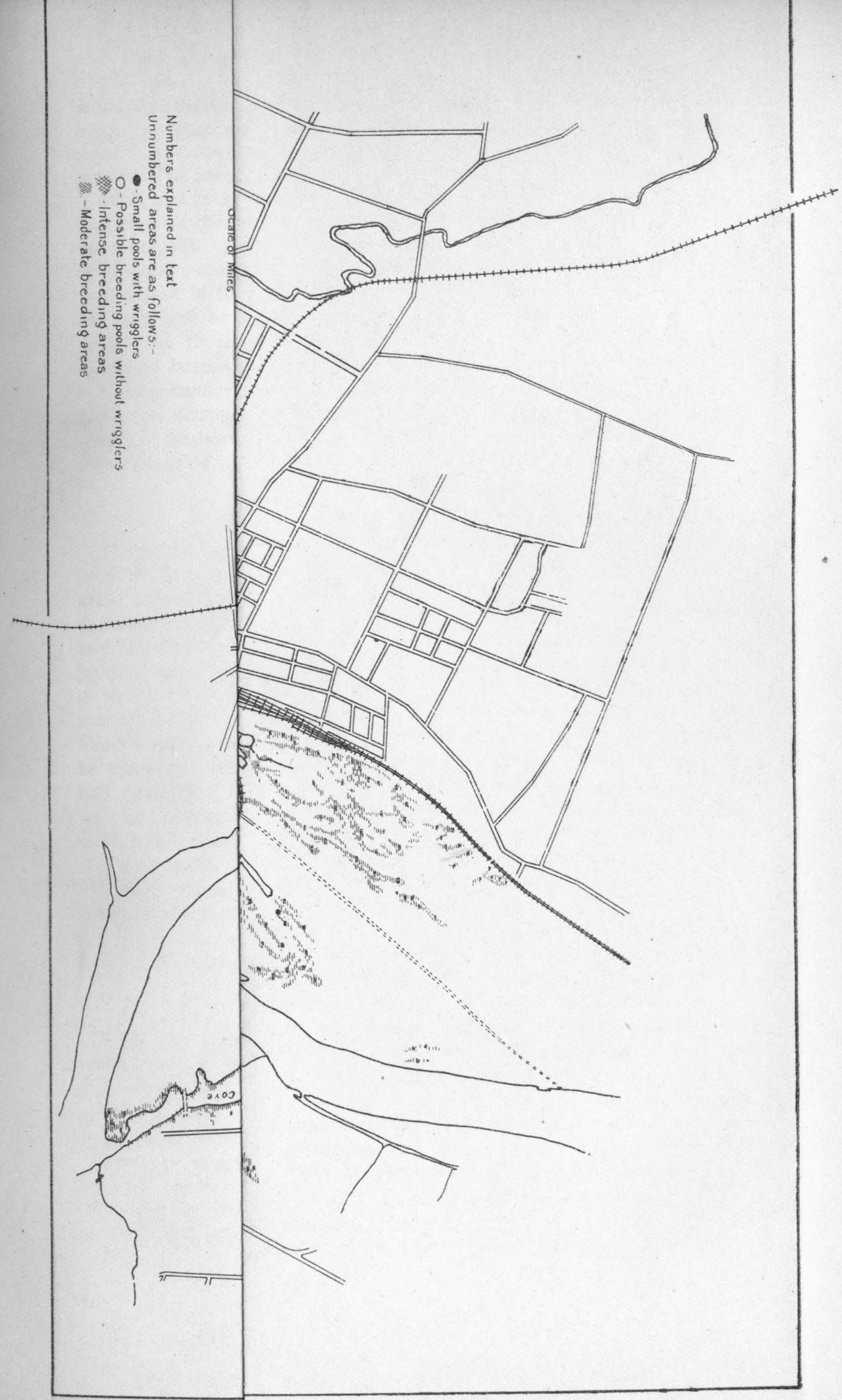
The ragged edges of the streams in and about this city are the chief source of malarial mosquitoes. Nearly every test made along the edges of the Hartford streams in late summer revealed larvae of the malarial mosquito. In May the most common mosquito in Hartford was *Culex pretans,* a species that breeds in woodland pools. It was present in great numbers in the spring and caused considerable annoyance in the southeastern portion of the city. When the Common Council voted an appropriation to be spent by the Board of Health in oiling the pools, we made an examination of the suspicious areas in the vicinity of Hartford in order to locate the real breeding places and submitted the following report to the Board of Health.

"We hereby submit a preliminary report on the location of the mosquito breeding places in the vicinity of Hartford. A close examination has been made of the lowland west of the Connecticut river, including the south meadow for a distance of two and one-half miles from the City Hall, and of the north meadow for a similar distance. The examinations were made on May 17, 18 and 20, and revealed the worst breeding pools within this area, and probably in the vicinity of Hartford. It should be understood that in these examinations all pools were tested to determine whether mosquitoes were breeding in them or not. Also that no instruments were used to ascertain levels—an important work to be done by the engineer before any extensive treatment by drainage can be carried out.

South Meadows.

Here the low land naturally favors mosquito breeding, but the worst breeding pools have been caused by the interception of the natural drainage by the building of roads, especially the Valley Division of the New York, New Haven and Hartford railroad. The principal breeding places are shown on the accompanying map. A small marsh area on the Colt estate just north of Wawarme ave. (6) breeds mosquitoes to some extent and has already been sprayed with oil this season. But the oil treatment cannot be very effective on a grass-covered marsh, and this area should be either filled or drained. The large pools are stocked with fish and are probably safe. The breeding pools contiguous to and just south of Wawarme ave. (14) yield, no doubt, the mosquitoes most noticed by the residents of the city. These pools are not extensive and could probably be filled completely or nearly so at small expense with the ashes and other material that has been dumped alongside the pools from the avenue. The marsh south of Wawarme ave. is soggy and has water standing almost everywhere, still the breeding is confined to the edge nearest the line of trees (21), as indicated on the map. Below this somewhat enclosed area the soggy marsh land extends to Meadow Road. It is imperfectly drained by the creek (7) shown on the map. The stream is choked, and actually breeds mosquitoes, though not a chronic breeder. This creek should be kept open through the entire meadow. This marsh area will need to be drained with ditches or else the water will need to be concentrated into a pond and stocked with fish. Drainage will no doubt prove to be the most feasible and satisfactory solution of the problem here. Along Meadow Road between Wethersfield ave. and the Valley Division of the New York, New Haven and Hartford railroad (8), drainage will secure the best results because the creek at this place has a good flow and lies lower than the adjacent area.

The pools along the railroad (9) can be treated in three ways, either of which should prove effective,—(1) by drainage through ditches deep enough to do the work at all times, emptying into the creek at Meadow



Road and the Connecticut River at Wawarme ave.—(2) by filling—perhaps the most expensive method in this place—(3) by removing the trees that shade the water and converting all the pools into fish stocked ponds. The breeding pool near Wawarme ave. is shown on plate XII.

At 15 and 16 (see map) are pools that would be drained if the ditches that connect them with the cove were made and kept deep enough to do the work. At 17 (see map) is a serious breeding area among trees and bushes extending over more than an acre of land. The remedy here will consist in the removal of the trees and bushes so that this part of the lake will be open like the other portion where mosquitoes do not breed. At 18 is another place that requires clearing. Clearing away trees and bushes is advocated here because the very abundant mosquito is a woodland species that develops in the shade of the wood: it will, therefore, disappear naturally when the conditions are changed. If the trees and bushes are removed, fish will doubtless prevent the breeding of other kinds of mosquitoes in this area.

North Meadow.

The north meadow is apparently higher than the south meadow, and does not present chronic breeding pools such as are found in the latter area. Along the river the ground is dry and has a good drainage, giving excellent opportunities for farming. Along the New York, New Haven and Hartford railroad the ground is low, soggy and full of depressions holding fresh water—a typical fresh-water marsh, the excess of which is drained off by Meadow Creek. Some of the outer edges of this marsh toward the river had a sparse mosquito population in the water-filled depressions, enough to show that this particular area will have to be examined again at some more opportune time (considering that it had rained the day before the examination and that the present brood was fast leaving the water); still on the whole, this area does not look as though it could ever produce as many mosquitoes as the south marsh.

A mile north of City Hall, between the New York, New Haven and Hartford railroad and the river, are some wooded coves that have a similar appearance to the typical breeding places in the south meadow, but to get the true character of these places an examination will have to be made when a brood is forming.

With the successful treatment of the areas enumerated, the really serious part of the mosquito problem for Hartford will have been solved. It is always best, where possible, to destroy the breeding places of mosquitoes in some such manner as we have indicated rather than to merely make them useless for the time being.

Kerosene sprayed upon the surface is at best only a temporary expedient, and needs repeating about every ten days—yet it may be employed effectively to make the breeding pools temporarily safe while the permanent work is being done."

The Park River and tributaries were examined in August. Tests were made at various points from Capitol avenue to the city line. *Anopheles* were found generally along the ragged edges (1, 2, 3, 4, 5), where they were protected from their enemies by the aquatic plants and grasses. To prevent this breeding it will be necessary to clean up the river edges. *Anopheles* were also found breeding along the edge of the stream at No. 11.

On September 12th the breeding areas in Keney Park were examined. These consisted of a series of pond holes and isolated pond holes extending from Hartford north into Windsor. The pond holes were of various types, one containing sphagnum, cat-tails, etc., another button bush, etc., a third mermaid weed, *Proserpinaca*. They were in some cases seven feet deep and most of them were dry. At this time standing water was found only in the pond with sphagnum, where in a pocket with water, a short tubed larva of *Culex* was found. Some of the depressions had been filled, as is related on page 304 of this report, and all will be taken care of in the near future.

South of Keney Park in the water of a large clay pit on the Sage estate, *Anopheles* were found in abundance.

EAST HARTFORD.

In August part of a day was spent in examining that portion of East Hartford adjoining the Connecticut River, from the bridge southward for about one mile. Just south of the bridge (10) in the bank of loose earth, depressions holding water were breeding *Anopheles* and *Culex*. The meadow was comparatively dry and appeared to be higher than the meadow opposite in Hartford. One depression was found that looked like a typical breeder of *Culex pretans,* but it was dry at the time. *Anopheles* breeding in this region will undoubtedly fly into Hartford.

MIDDLETOWN.

At the suggestion of Prof. W. O. Atwater of Wesleyan University, an examination was made of the mosquito breeding conditions in the immediate vicinity of Middletown on June 18th by Messrs. Britton and Viereck in company with Mayor Crittenden. It was reported that mosquitoes had been rather abund-

ant in the northwestern portion of the city, while in the southern and eastern portion they were not troublesome. A fountain at the intersection of Washington and High streets had been suspected, but on making a careful examination no wrigglers could be found in it.

The swamp south of the Air Line division of the New York, New Haven and Hartford railroad just west of the point where the railroad crosses Washington street, is not well drained and the malarial mosquito, *Anopheles,* was found breeding here quite extensively. This area was probably once properly drained, but the ditches have become clogged by deposit and vegetation. Two or three open ditches, properly placed, would do away with the nuisance and the expense would be slight. Sparse breeding of *Anopheles* and *Culex* also occurs in the grassy ditches north of the railroad just west of where it crosses Washington street. A duckweed pool close beside the tracks of the railroad connecting Middletown and Berlin and southeast of the shops where the Keating bicycles were formerly manufactured, is being filled by using it as a public dump. *Culex* was found breeding in this stagnant water. The best treatment for this pool is to let the good work go on and fill it as soon as possible. No other breeding areas worth mentioning were found about Middletown, but perhaps breeding areas occur in some of the adjoining towns or localities which must be examined at another time.

CHESHIRE.

The problem presented at this place is very interesting and warrants the insertion here of an extract from our report sent to the health officer of this town.

On July 8th, the region along both sides of the railroad for about one mile north and one mile south of the railroad station was examined for mosquito breeding places.

On the east side of the railroad, in the canal, *Anopheles* and *Culex* were found all along the ragged edges among the duckweed, from the factory north for about one mile or as far as the tests were made. Refuse injurious to the duckweed empties into the canal from the factory of the Ball and Socket Mfg. Co. Apparently this refuse is not injurious to the fish resembling carp that were seen in the water, both above and below the factory. No mosquito larvae of any kind were found south of the factory and the edge of the stream here is quite clean, and not ragged with vegetation as it is north of the railroad station.

On the west side of the railroad north of the station is a depression which may become filled with water during a heavy rain and may breed mosquitoes. South of the railroad station, along the swift brook, no indication of mosquito breeding was detected. This stream is probably safe at all times.

To rid Cheshire of malarial mosquitoes it will be necessary to keep clean the margins of the canal and remove the duck weed so that the fish will be able to reach every portion of the stream. If the cause of the breeding (i. e., ragged edges and duckweed) is not removed, the canal will have to be sprayed with kerosene oil once every two weeks if the mosquito pest is to be mitigated.

Remedial Treatment for Inland Areas.

The best treatment is to abolish permanently all breeding places wherever possible. This can often be done at small expense by opening old drains that have become choked or by cutting new ditches to carry off all standing water. Filling small areas is often cheaper than draining. Where neither is practicable on account of the low level or great distance to cut ditches, a portion of the area can be dredged and the remainder either filled with the dredgings or drained into the depression, thus forming a permanent pond which should be well stocked with fish. In other words, the standing water of swamps should either be drained off or else concentrated into fish-stocked ponds.

The banks of all ditches and pools should be kept clean and rather steep and no ragged edges allowed, for these hold water in which mosquitoes can breed out of the reach of fish. Such pools as cannot be treated by either of the methods just described can be sprayed every ten days with kerosene or light fuel oil. The application should be made while the larvae are in the water. Mosquitoes develop in broods, and if the oil is applied just after the adults have emerged it will probably disappear before the next brood of larvae develop. Oil can also be used to good advantage to render breeding pools temporarily safe until the drainage or other permanent work can be carried out, but the indiscriminate use of oil on pools is not to be recommended.

Very often the sudden appearance of mosquitoes about the house can be traced to water standing on the heads of barrels, in tin cans half-full of rain water, or in half empty bottles. The removal of these things from the premises will often greatly diminish the annoyance. All dwellings should be thoroughly screened wherever mosquitoes are abundant.

Rain-water barrels should always be screened to prevent mosquitoes from laying their eggs; this may be done by fastening a piece of cheese cloth to a hoop large enough to slip over the top of the barrel.

B. THE COAST REGION.

The towns forming the coast of Connecticut are confronted by a mosquito problem essentially different from that of the inland towns, for the salt marsh species breed along the coast and, though not the only kinds occurring there, far exceed all others in point of abundance.

The salt marsh area of the state, equalling 34.79 square miles or 22,264 acres,* is unevenly distributed along the coast, being most extensive between Southport and the Connecticut River. When we consider that fully 50 per cent. of this area has been thoroughly drained for salt hay farming, and that some of the marshes and portions of others are naturally well drained, it will be seen that the problem of making this marsh area proof against mosquito breeding is by no means a discouraging one. A brief description of the marsh territory with our observations covering one season will show what we have to contend with, in an effort to abolish the breeding places of the salt marsh mosquito.

In looking over the coast marshes which are mostly salt, many fresh-water pools and marshes were also examined. The streams of the salt marshes are usually fed by inland lakes, springs, and by surface drainage. These streams change the character of the salt marsh vegetation, which is replaced along their courses by fresh-water plants; also the mosquito fauna is

*D. M. Nesbit, Miscellaneous Special Report No. 7. The Tide Marshes of the United States, U. S. Department of Agriculture, 1884.

modified, salt marsh species being replaced by fresh water or inland species. The latter are usually sparse if present and breed much less rapidly than the salt marsh species. The smaller marshes are often entirely salt, but a large quantity of fresh water in the streams sometimes causes the formation of quite extensive areas of fresh marsh. At the mouth of the Connecticut River there is an excellent example of this influence of the fresh water upon the character of the vegetation. The salt marsh is here confined to the extreme mouth of the river, while immediately within the mouth and up the river the marshes are of the fresh brackish water type, and practically free from the breeding of salt marsh mosquitoes. A large portion of the great Quinnipiac marsh of over 3,600 acres, near New Haven, is in a similar condition.

Coast Mosquitoes.

The most abundant mosquitoes on the marshes are the salt marsh mosquito, *Culex sollicitans* and *C. cantator*. In New Jersey these species are known to migrate inland for a distance of over thirty miles, but it is not yet evident that they do this in Connecticut. We have found them five miles inland, but our observations are limited owing to pressure of other work. During frequent visits to Hartford throughout the summer and visits to Middletown and Derby we searched for, but did not find these species. Mr. Walden collected insects at Scotland during the last week in July, but found no salt marsh species. The inland migration is undoubtedly checked in Connecticut by the hills near the shore. Large numbers of salt marsh mosquitoes were found in the grass and bushes on Prospect Hill, New Haven, after the emergence of each brood, showing this hill to be a barrier to migration. The most favorable routes for inland migrations are evidently up the Housatonic, Quinnipiac and Connecticut rivers.

In May and June the broods on the salt marshes were comparatively light and *cantator* was present almost to the exclusion of *sollicitans*. As the season advanced however, *cantator* was gradually and almost completely replaced by *sollicitans*. During the season about seven distinct broods were generated, the broods following, almost without exception, the rains. Some light breeding was caused by tide water, and at least one rather

annoying and large brood was started and brought to maturity at Fairfield in depressions filled with tide water and free from fishes. It is not known whether or not these species come into Connecticut from Long Island. It is highly probable that they may do so at times. Certainly the western end of the Connecticut coast region must occasionally receive mosquitoes from New York.

Aside from the two species just mentioned we find *C. taeniorhynchus*, *C. perturbans* and *C. salinarius* on the salt marshes of the coast region. Also some of the fresh-water species, including *Anopheles maculipennis* and *A. punctipennis*, frequently breed in the fresh areas separated from the tide water, around the edges of the marsh. But all of these species fly only short distances and are less troublesome generally than the migratory forms. All, however, may be troublesome locally.

Drainage Conditions of the Salt Marshes.

The marshes vary greatly as to natural drainage and other conditions. Some marshes contain several broad streams affording more than adequate drainage; again we find only a single narrow stream through a large marsh area and the marsh insufficiently drained; or perhaps a stream has been choked with sand or debris and the drainage cut off completely.

Slough holes are shallow or deep depressions or ponds said to be formed by the pressure of large cakes of ice on the soft marsh, thus creating the initial depressions which hold water; during hot weather the water reaches a high temperature and the grass decays. The decayed material is washed away from time to time by the extra high tides and this process going on for years makes deep holes. The deeper ones, however, are constantly filled with water in wet seasons and as fishes are supplied by the extra high tides, these slough holes are free from mosquitoes. In a very dry season, however, even these deep depressions may become dry and the fishes perish. When again filled with rain-water or by an exceptionally high tide each becomes a serious breeding place which must be treated either by ditching or restocking with fishes. The fact that slough holes are formed in this way makes it necessary to inspect all marsh areas annually if we would prevent mosquito breeding absolutely.

to a great extent harmless or neutral; only when congested by the formation of slough holes or by human agency in building of roads, etc., does this become a serious breeding ground.

Sometimes cat-tail and "three square grass" invade the salt marsh sufficiently to assume importance.

From a survey of these grasses the real problem must be evident, namely, the drainage of all depressed areas in marshes occupied by these plants.

Artificial Breeding Places.

In addition to the fresh and salt marshes mentioned, hundreds of artificial breeding places were examined. Some of these were pools caused by filling, hoof prints in the ground filled with water, rain barrels, wells, tin cans and other receptacles too numerous to mention. At West Stratford, opposite the factory of Coulter & MacKenzie, a pond which was being filled with refuse from the city contained millions of wrigglers of *Culex pipiens*.

Our experience leads us to believe that the malarial mosquito *Anopheles* will breed almost anywhere if water stands long enough, and the larvae are protected from natural enemies.

Some of the most serious breeding places are formed by salt grass areas being cut off from their natural drainage by intercepting roads, dikes or other filling operations. In such cases the detached portion immediately becomes a potential breeding area which may become serious at any time if rain water accumulates and evaporates periodically. If the depressions in this area are deep enough to hold water permanently under ordinary conditions, fresh water species are likely to occur instead of the salt marsh species. Depressions of any kind caused artificially or naturally in the salt grass region are sure to become danger spots for the breeding of salt marsh mosquitoes if not deep enough to hold water permanently.

REPORTS OF COAST TOWNS.

During the summer one or more visits were made to every town on the coast of Connecticut and very careful examination was made of the marsh area with reference to the breeding places of mosquitoes. Somewhat detailed accounts of the observations are given in the following paragraphs, regarding certain towns. The conditions are nearly alike in the following towns, which may therefore be considered together: Greenwich, Stamford, Darien, Norwalk, Westport, East Haven, Clinton, Westbrook, Old Saybrook, Old Lyme, East Lyme, Waterford, Groton.

These places in the summer of 1904 had no very serious breeding places of the salt marsh mosquito, but had marsh areas which might, if neglected, breed mosquitoes. The marshes must be watched to find and fill or drain any depressions which form from time to time. Whenever improvements are made, as the building of roads, filling of land, etc., care must be taken that no undrained depressions are formed, as they will surely become breeding places. The farming of the marshes for salt hay has resulted in maintaining ditches which keep the marsh comparatively free from breeding holes.

A comparatively small outlay of time and money will make the marshes in the towns fairly free from breeding places. It is especially necessary to drain any stagnant places on the edge of the marshes between them and the high land.

To rid the marshes of mosquitoes, as distinguished from *breeding* places of mosquitoes, concerted action of all the towns is necessary because, as has been said, the salt marsh mosquito may travel far from his breeding place and a place which breeds none of them may yet be infested from a distant breeding place.

Nevertheless, the destruction of all breeding places in a town may be expected of itself to greatly abate the mosquito nuisance.

FAIRFIELD.

The marsh areas in Fairfield chiefly require simple ditches to connect the infested areas along the edge of the upland with tide water. North of the railroad the salt marsh is, after a short distance, replaced by the fresh-water marsh, where mosquitoes are never very abundant unless the marsh becomes congested by the interception of its natural drainage, and such a condition does not exist here.

The Bridgeport side of Ash Creek has some serious breeding places in the marsh adjoining, especially near the railroad. It will, of course, require the coöperation of the Bridgeport people to make the work in Fairfield an unqualified success, though the breeding places for the salt marsh mosquito in Bridgeport, nearest to Fairfield, are nearly two miles from Fairfield's center of population.

The observations for this report were made July 11th, 15th and 16th, after a period of light rains and just after a perigee tide, consequently actual breeding was found only in such depressions surrounded by grass that admitted tide water and excluded fishes.

BRIDGEPORT.

The Bridgeport problem is easily solved because the breeding area is found almost entirely in the marshes along Ash Creek and Black Rock Harbor.

In West Stratford the most serious annoyance is a pond opposite the Coulter & MacKenzie machine shop, where the rain-barrel mosquito breeds steadily all the season, by millions. This pond is being filled slowly, but until the filling has been accomplished, oil should be applied every two weeks. A gallon of oil will suffice if properly applied with a spray pump.

STRATFORD.

The problem of getting rid of the salt marsh mosquito breeding places in Stratford township is practically solved. The community is entitled to congratulation on the excellent work done to exterminate mosquitoes. August 16th and 17th, 1904, the Stratford territory was examined. Nothing very serious was found.

MILFORD.

This township has a large marsh area, the condition of which is responsible for the presence of the great numbers of mosquitoes that appear every year in this vicinity. This marsh can, at comparatively small expense, be drained by the use of a ditching machine and be made mosquito proof. Simple ditches only are necessary. With the prevailing winds from the southwest and no other serious breeding area nearer than Fairfield, it is easy to see that to put a stop to the breeding in this large Milford marsh will greatly reduce the pest of mosquitoes in the town of Milford.

ORANGE.

The Woodmont marsh is in a fairly good condition, owing to the salt grass farming that has helped the drainage. The Savin Rock marsh had some mosquitoes breeding in it when examined on August 20th, but as a whole it is solid and well drained. If the danger spots are removed by putting in a few simple ditches, the marsh will be in an excellent condition and no longer the source of a nuisance.

The Old Field Creek or Sandy Point marsh was examined September 10th and found to be in a fairly good condition, owing to the salt grass farming which has resulted in much ditching and rather thorough drainage. West of Peck avenue, however, the marsh is of the fresh water type and a source of the malarial mosquitoes. In the West River marsh the breeding area is limited to a comparatively small area, owing to the salt grass farming that has put this marsh in good condition.

NEW HAVEN.

The following is reproduced with slight emendations from the report sent to the health officer of New Haven in August:

"In New Haven the most serious breeding places of malarial and other mosquitoes are found in the public parks and on other land owned by the city. These breeding places have been described and remedial treatment suggested, in a special report made to the New Haven Board of Park Commissioners on June 25, 1904, a copy of which is included herewith. Your attention is also directed to the remaining mosquito breeding areas in the vicinity of New Haven outside of the park system. In order to make the report complete geographically, a portion of Orange township is included.

The breeding places can be located by means of the numbers on the accompanying map.

The West River Marsh.

Between Chapel street and Derby avenue the condition of the marsh is much the same as between Chapel street and Edgewood avenue. From Derby avenue to Washington avenue the marsh is in a fairly well-drained condition, the danger spots lying in the pools east of the Boulevard and at No. 23 and No. 24; at No. 23 sparse breeding was detected early in the season; at No. 24 is a potential* salt marsh area where one choked ditch was breeding the salt marsh mosquito and another had fishes in it. This area, however, appears to be too flat to

* A potential area is a depression that will hold water and will breed mosquitoes, though not containing wrigglers when examined.

become very serious; at No. 25, between the Boulevard and the railroad, serious breeding was found in progress in the latter part of May. Below the New York Division of the New York, New Haven and Hartford railroad the West river marsh has the characteristic tendency to become potential in spots along the edge of the highland. The area where mosquitoes were actually found breeding is represented by a black border on the map. The oval area in the marsh, between Front and Campbell avenue, was of the potential type, stocked with fishes by the tide when examined May 25th. In the bank of the stream at No. 26, is a barrel that holds water and breeds *Anopheles,* the malarial mosquito.

Mill River Marsh.

This marsh is very well drained at the base of East Rock; its danger spots are at 27, 28, 29, 30, 31 and 32 (observations made June 1st-3d).

27 A few shallow depressions near ditches breeding salt marsh mosquitoes, the largest pool at this place being stocked with fishes.

32 Breeding sparse owing to ditches that need but small extensions to drain this area thoroughly.

28 This marsh area has potential breeding area in it that produce no serious broods of mosquitoes; it will take but a small extension of the ditches nearby to drain these areas. Along Willow street the refuse that is emptied on the bank is choking the ditch at the base of the embankment—a breeding area may be formed here in this way.

31 A fairly well-drained marsh, but the ditches must be extended to remove the breeding pools along the edge of the highland.

30 A serious breeding area completely cut off from its natural drain, a tide stream, by a cinder road. Ditches and a sluice, or filling, is here necessary.

29 A shallow pool over cinders with no mosquitoes in it, may never be dangerous.

Quinnipiac Marsh.

Fortunately, ditching to increase the yield of salt hay has removed such breeding areas as may have existed, and no serious problem confronts us here. The places that need attention are as follows. Observations made June 3d-8th.

33 Boat at Middletown avenue and Quinnipiac Creek: partially filled with water, and breeding mosquitoes.

34 Small neutral depression.

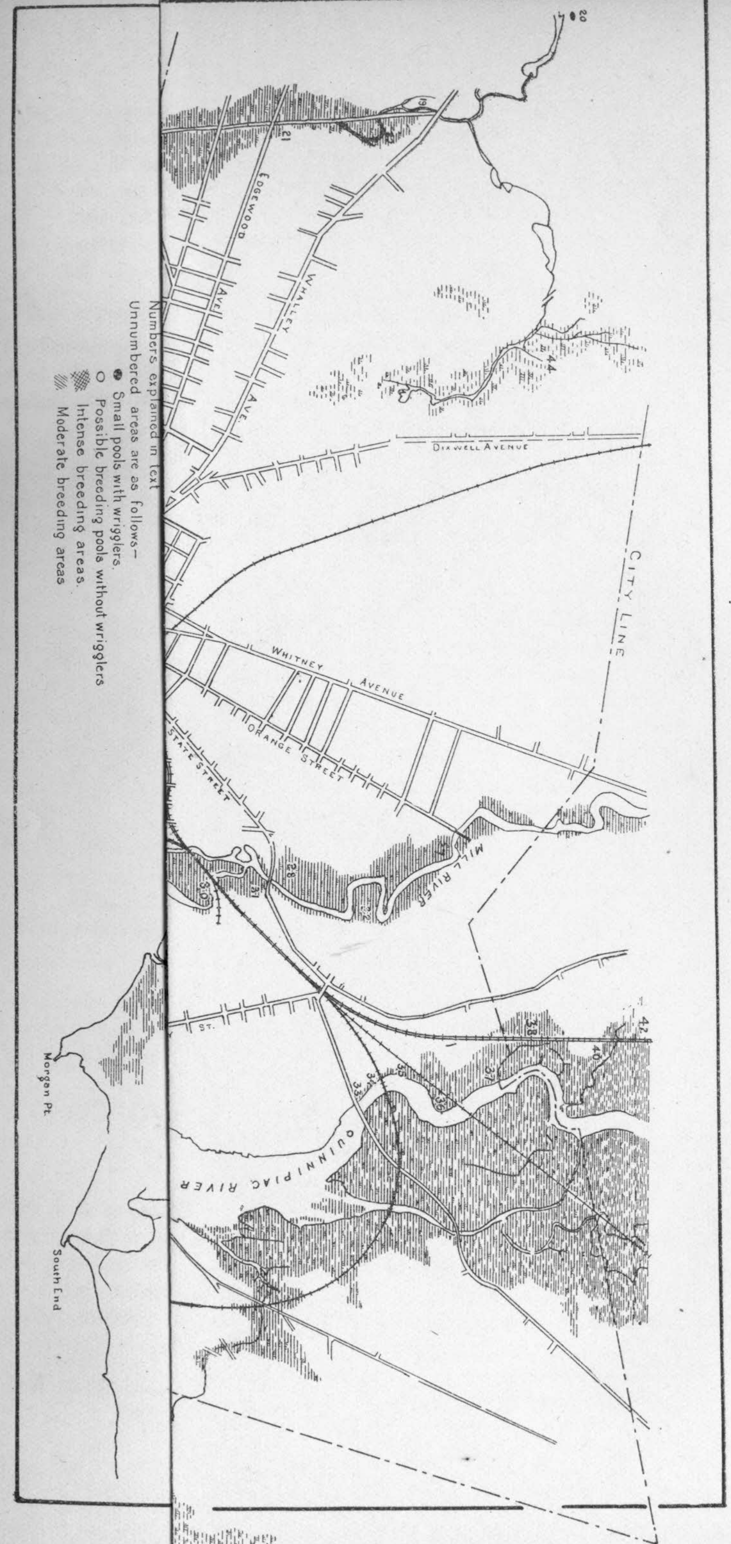
35 Cat-tail pond with *Culex* at the margin.

36 This marsh between the two railroads is potential: one depression had wrigglers in it, some pools with fishes, others neutral. Many dry potential areas had female mosquitoes over them, ready to lay eggs. All this could easily be drained.

37 This area is potential but no wrigglers were found, some pools had fishes in them.

38 Of the same type as 37.

39 Neutral, fishes in the ditches.



40 Brick yard with the ponds neutral and some stocked with fishes.
41 Cat-tail pond with a ragged edge, no wrigglers were found.
42 A cat-tail swamp with a central narrow stream and broad soggy margins extending from just north of Scheutzen Park tavern past the New Haven Gun Club to the railroad with a sluice under the railroad. Back of the Gun Club is a depression cut off from the main swamp. *Culex* larvae were found.

Marshes along the Quinnipiac River from Ferry Street to Morris Cove.

No breeding was detected except in Fort Hale Park (see Park Report) and at Morris Cove; still a season with frequent rains may develop breeding areas in the marsh between Fort Hale Park and Ferry street.

Morris Cove.

From Morris Cove comes New Haven's chief supply of mosquitoes when breeding is at its height, and here the condition is almost entirely of a salt marsh character. The most serious places are near the following numbers.

1-2 Woodland pools developing a woodland species that does not fly far.
3-3½ Typical salt marsh depressions where millions of salt marsh mosquitoes may breed.
4 Another typical salt marsh breeder.
5 and 10 Roadside pools of no serious character, present only in rainy weather.
11 Serious breeding area.
66 Breeding in typical potential areas.
67 Neutral salt marsh ponds.
60, 61, 62 Potential areas.
56 Covered with clear water (June 15th) though not entirely, soggy with sparse breeding.
57 Sparse breeding as in 56 (June 15th).

Other Breeding Places.

Receptacles around dwellings, business houses, etc., if exposed, will of course collect rain water and often become the source of great annoyance. Such places will have to be searched for by the sanitary inspector.

A MOSQUITO SURVEY OF THE NEW HAVEN PARK SYSTEM.*

Edgewood Park.

Very little breeding was found between Chapel street and Edgewood avenue, though it is hard to understand why, but just north of Edgewood avenue and east of the river were a few small pools filled with *Culex* larvae. (21) Apparently these pools were formed by the dredging of the river, the material being placed along the bank in such a way as to form a dam, preventing the surplus water from draining into the river.

* Sent to the New Haven Board of Park Commissioners in July.

These pools are probably not permanent ones, but exist in the early summer and in rainy periods long enough to breed mosquitoes. The judicious use of a few loads of filling material and the cutting of two or three short drains at slight expense would do away with these pools. The lagoon in the northwestern part of the meadow, (19) near Whalley avenue, was found to be a prolific breeder of *Anopheles* during August: sixteen larvae were taken at one dip with a ladle holding about a gill.

In the north portion of the meadow east of the river the conditions are also such that both malarial and non-malarial mosquitoes are breeding in the choked ditches, and water standing in the grass at the upper end of the artificial lily pond. (22) The land is rather low here, and a portion should be dredged out, and added to the meadow, thus increasing the pond and increasing the banks. The old ditches should be opened, and new ones cut wherever necessary. Further south a ditch crossing the meadow west of the river has also become choked, and larvae of the malarial mosquito (*Anopheles*) were quite abundant in it. This drain, as well as the lily pond where malarial mosquitoes breed, should receive immediate attention, and while we have not taken any levels in the meadow, we assume that the draining can be carried out without difficulty, as those parts of the meadow where the old drains are open are in good condition.

Beaver Park and Vicinity.

The area known as Hudson Park, which has recently been filled with ashes, is, of course, free from pools in which mosquitoes can breed. But the Beaver Swamp region (44) is the most serious breeding place of the *Anopheles* mosquito (the species which transmits malaria) in the vicinity of New Haven, and is a continuous breeder of both *Anopheles* and *Culex*. The streams contain running water and are free from mosquitoes except along the ragged edges where sheltered coves and depressions in the sphagnum and grass favor the accumulation of stagnant water. The whole swamp is water-soaked, with grass and sphagnum in the northern half and bushes in the southern half. Nearly all the ditches are choked and slimy and breed mosquitoes. The worst part of the region is between Munson and Fournier streets and is owned by the city, though perhaps not under the charge of your commission. Drainage would, doubtless, remove most of the stagnant water, and thus greatly improve the property and the public health.

East Rock Park.

A careful examination of the meadows at the base of East Rock shows them to be well drained. No serious breeding places were found on park property along Mill river.

West Rock Park.

The area along the river at the foot of West Rock was examined on June 18. Just below the Valley street bridge near the paper mills an arm of the river branching to the north extends nearly as far east as the foot of Emerson street. During high water in spring this area is doubtless connected at both ends with the river, but when examined the water was stagnant, and without connection with the river. *Anopheles* larvae were abundant throughout this pool, and a few *Culex* larvae were found. This is certainly a serious breeding place at present, and a menace to health as long as it breeds malarial mosquitoes. A channel at the lower end properly graded would probably drain off this pool. Until this can be done the area should be kept well oiled. The breeding place can be located readily by means of the accompanying map. (See No. 20.)

Fort Hale Park.

This park contains a marsh area, the natural drainage of which has been interfered with by the continuation of Fort Hale Road along the shore east of the fort. The condition will be better understood by referring to the accompanying map. (45) The black spots mark the serious breeding areas where larvae of the salt marsh mosquito were found in abundance on June 13. The stream crossing the road has a good flow but does not properly drain the marsh area. Ditches connecting this stream with the breeding areas will be the most satisfactory solution of the problem here. On the northern side of the park and just over the boundary near Fort Hale Road, is another serious breeding area where ditches will be needed to carry off the water.

Other Parks.

Fort Wooster, Bay View, Waterside and Quinnipiac parks are situated on high land having good drainage and contain no mosquito breeding areas."

Recapitulation for New Haven.

Beaver Pond marsh, West River marsh and the fresh water portion of Sandy Point marsh in West Haven are the chief sources of malarial mosquitoes in New Haven. Next in importance are the small pools where *Anopheles* were found breeding, and finally the irregular edges of streams, the latter being least productive. The large lakes furnishing the city water supply are practically mosquito proof, owing to the clean margins and the presence of natural enemies; but eternal vigilance is even here the price of immunity and care must be taken that the aquatic plants do not grow too dense and thus create shelters in which mosquitoes may breed.

BRANFORD.

This report is based on observations made in the latter part of June during a period when the rainfall had been very light for six weeks, consequently actual breeding was not discovered in many places that are surely potential.* Though the marshes were very dry it was possible to locate the most serious breeding places. The stream running around the northern and eastern portion of the village past the lock works and into Branford River was the chief source of mosquitoes in 1904. *Anopheles,* the malarial mosquito, was found everywhere. That portion of the stream between the lock works and the river was in very bad condition and malarial and rain-barrel mosquitoes were breeding abundantly. This region has since been drained and the condition much improved. In this vicinity the adults of *Culex perturbans* were also quite abundant from early in May until the middle of July, being troublesome on porches and verandas through the afternoon and early evening. Many specimens were captured in a corner of the brick foundation of a house back of some shrubbery. All attempts to breed this species were unsuccessful. The natural breeding place was not found, and we were not able to obtain eggs from females confined in gauze cages and fed on blood.

The salt marsh in the vicinity of Short Beach and Double Beach is comparatively limited and not in a serious condition as regards the breeding of mosquitoes.

In Pine Orchard the work of extermination has done much to control the salt marsh mosquito, but to complete the work it will be necessary to deepen the ditches already put in and to add more. The fresh marsh extending from the lake to north of the railroad is capable of breeding malarial mosquitoes, though none were actually found there.

The salt marshes of the vicinity of Stony Creek have such an excellent natural drainage that the task of exterminating the salt marsh species, that breed in this region, is comparatively easy and well within the grasp of the community. The fresh-water marsh extending through the woods from near the shore to north of the railroad, will have to be treated to prevent malarial mosquitoes from breeding in it.

GUILFORD.

The breeding areas, for the salt marsh mosquitoes that are such a nuisance, are quite extensive in the marshes of the West and East Rivers in Guilford. At least half of the edge of the marsh adjoining the upland is depressed and holds rain water

* See note at bottom of page 293.

long enough to generate an inconceivable number of mosquitoes every favorable season. Aside from the breeding along the edge of the marsh there is nothing of importance. The marshes have ample streams running through them.

Near Sachem's Head the problem is more serious than usual, because the marsh areas are rather imperfectly drained by the remarkably narrow streams that pass through them. The marsh that could undoubtedly be drained into Island Bay has a decidedly inadequate drainage, owing to the narrow sluice in the form of a two-foot pipe that is laid under the railroad for its stream to pass through. This is an engineering problem, but throughout the remainder of the marsh areas simple ditches will evidently suffice. (See plate XIV, a.)

MADISON.

Madison has a greater mosquito problem than most towns along the coast, owing to the numerous breeding areas along the edge of the salt marsh adjoining the upland, and the unusual congested condition of the marsh between Hammonasset Beach and Hammonasset River. This Hammonasset marsh is in an exceptionally serious condition, owing to the insufficient drainage caused by lack of streams and the choking of one stream by a storm. Here a broad central ditch will be necessary to take the drainage through simple lateral ditches from the infested area.

NEW LONDON.

This township has small salt marsh nuisances at Fort Trumbull and Alewife Cove. At Fort Trumbull the salt marsh is somewhat cut up, especially by roads, thus forming potential areas. The solitary pool found at the time the observations for this report were made (September 5, 1904) was stocked with fishes, evidence that it is visited by tide water. This area will doubtless be filled in eventually, but in the meantime ditches and sluices should be put in to drain it and make the place free from breeding pools. Along Alewife Cove the marsh is naturally in a well-drained condition and needs very little, if any attention, unless the improvements in progress at Ocean Beach should cut off portions of the marsh from their natural drainage and cause serious conditions.

STONINGTON.

Here the really serious problem is confined to the large marsh area in the eastern part of the town. With this exception the marshes are in a fairly safe condition, owing to ample natural drainage and the salt grass farming.

RECAPITULATION.

In the foregoing pages we have pointed out the chief breeding places of mosquitoes on the salt marshes of Connecticut. Wherever improvements are made on the marshes, great care must be taken that no undrained depressions remain, for such are almost sure to become breeding places. Those portions of the marshes where salt grass is cut periodically are generally quite free from breeding places, and require but slight attention to make them perfectly safe.

In order to keep the salt marshes in a permanently safe condition it will be necessary to go over them each year and correct any imperfections that may occur.

It is important that adjoining property owners and adjoining towns should coöperate in the treatment of the marshes, especially where division lines are marked by streams with mosquito breeding areas along both sides. In such cases perfect results cannot be obtained without coöperation.

TREATMENT OF SALT MARSHES.

Simple ditching should be practiced in localities where the breeding area is not extensive or where the marsh is too soft to hold up a team. One method is to cut the sod with hay-knives or sharpened spades and then pick it out with forks. Some use spades alone. The ditches need not be more than eight inches wide and should be placed from 100 to 150 feet apart, according to the condition of the area drained; in very soggy areas it may be necessary to bring the ditches closer than 100 feet. Ditches of this kind will last for at least three years and perhaps longer without any attention except to keep them clear of debris.

The following information was issued in July in the form of a circular illustrated with some of the photographs used in the plates of this report.

USEFUL FACTS ABOUT DESTROYING THE SALT MARSH MOSQUITO.

In draining ordinary salt marsh land, an Italian laborer can dig per day of ten hours at least 100 feet of ditch 18 inches wide and 18 inches deep.* His wages are from $1.25 to $1.50.

The ditching squad should contain from seven to ten men. The foreman should carry a ladle to dip water from the pools to see if wrigglers are present and in what numbers. By doing this he will soon become familiar with the sort of places where mosquitoes breed and those which are safe.

If a mosquito survey of the region has been made, the serious breeding places will have been indicated upon a map, and this will be found a useful guide; still a little experience enables one to recognize these places by their appearance.

The worst breeding places are usually the brown depressions near the edge of the highland. These bare places look as if scooped out and the brown color is due to the rotted condition of the sod. Water stands in these areas after each rain. Such places must be connected with tide water by the ditches and should receive first attention, even if dry, because after each rain they may breed mosquitoes. Drains can then be cut to the pools having the most wrigglers.

After these worst places have been treated, all standing water near the edge of the highland must be tested again and again and ditches cut to drain all pools wherever wrigglers are found.

Fish-stocked pools near the edge of the marsh, though usually safe, occasionally become dry. The fish are killed and when filled again with water a mosquito breeding place is formed. This makes it quite necessary to test from time to time all ponds near the edge of the marsh even though they are usually safe. Clear ponds reached by tides and ponds stocked with fish are as a rule safe for all time.

After the ditches have been cut in the marsh they should be tested, and all imperfections removed that would permit the breeding of mosquitoes in them. Ditches must be sufficient to drain completely, or open to the tide all breeding areas. The ditches will need cleaning out at least once each year to prevent them from becoming clogged by the growing vegetation or flood debris.

* Report of Experiments, Lawrence, L. I., Board of Health.

By constantly examining the marsh and by cutting ditches wherever necessary, exemption from mosquito breeding will soon follow, and the results will be of lasting value.

Most ditches need not be more than from 8 to 12 inches wide, but a good depth is necessary through nearly the entire length. A satisfactory way is to cut the sides with an ordinary hay knife and remove the sod with a potato hook, as is shown in the accompanying illustration. (Plate XV, b.) It will facilitate the work if the tall grass is cut with a scythe before the ditches are started. Much depends upon the thoroughness of the work, and no loop hole should remain where a solitary mosquito can breed.

Where the area to be ditched is so extensive as to require the expenditure of $500 or more, and where the marsh is sufficiently solid, a ditching machine should be employed.

DITCHING MACHINES.

In New Jersey where extensive work has been conducted on large marsh areas, a ditching machine has been found economical and satisfactory.

Prof. J. B. Smith reports that ditches can be dug for about one cent per running foot by the True Ditching Machine, which has been used extensively. In New Jersey narrow ditches from four to eight inches wide, which preclude the growth of vegetation, and from two to three feet deep, have been found much more satisfactory than wide and shallow ones, which soon become choked with plant growth or debris. The narrow ditches, even if they become closed at the top, keep open at the bottom and for several years are effective in draining the land.

The True Ditcher is made to be operated by hand power, and in larger sizes by steam or gasoline engines. Formerly the manufacturers have taken ditching contracts on large areas of salt marsh, and the machine was not for sale; but recently we have been informed that the manufacturers are going out of the business and wish to sell the patent rights for this machine. Shown on plate XVI, b.

The Buckeye Traction Ditcher is the name of another machine which the manufacturers claim will do satisfactory work on marsh land that is not too soft. We are not aware, however, that any tests have actually been made with this machine on salt marshes.

MOSQUITO CONTROL IN CONNECTICUT.

There seems to be a reluctance on the part of many to take up the work of mosquito control. This we believe is due largely to a lack of confidence in the results to be attained.

The application of oil to breeding areas has been practiced in some places, but oil to be effective must be applied to every brood, which means every two weeks in a favorable season. At the end of the season the locality is no better off for having been treated with oil than it was before. Of course, oil can, and should, always be used as a makeshift until the lasting work such as ditching or filling, which are the only rational means, has been accomplished.

A few years ago one of the worst mosquito breeding places in Connecticut was undoubtedly the extensive Stratford marsh lying east of Bridgeport. This marsh was elaborately ditched and diked by a land improvement company, the work being in charge of Mr. W. R. Hopson of Bridgeport. The number of mosquitoes was noticeably reduced by the improvement and Mr. Hopson was rewarded by the people of Stratford. This large marsh is now almost entirely free from breeding places, and produces a much better quality of salt hay than formerly.

At Indian Neck in Branford, Mr. W. A. Bryan has been working systematically since 1900 to reduce the number of mosquitoes. Mr. Bryan is proprietor of the Montowese House, a summer hotel, and he realizes that destroying the mosquitoes will improve his business. At first Mr. Bryan used oil on the breeding pools, but during the past two years draining has been practiced, thus permanently abolishing them. Mr. Bryan has been aided in this good work by some of his neighbors and by the Branford Board of Health.

The most serious breeding place of malarial mosquitoes in Branford has been practically destroyed during the past season by the drainage of the choked marsh area just east of the village. This was brought about chiefly through the efforts of Dr. C. W. Gaylord of the local health board.

The Improvement Association of Pine Orchard in the town of Branford has systematically drained considerable marsh area during two seasons, expending nearly $300 each season on the work. Oil has also been used, especially on the inland swampy areas.

In past years considerable excellent work has been done by Mr. Sturgis, in filling the inland pools of Fairfield.

Oil has been used to combat the salt marsh mosquito at many places, where through lack of persistent effort it has given only temporary benefit.

The natural growth and extension of cities and towns, and the general improvement of the land, have been responsible for the destruction of many mosquito breeding places throughout the inland areas.

At Hartford the Board of Health expended about $80 in 1903 in oiling certain pools in the South Meadows where mosquitoes were supposed to breed. This work must have been satisfactory for early in the summer of 1904 the common council appropriated a sum of money not to exceed $250 for the work, placing the appropriation at the disposal of the Board of Health. We believe this to be the first case in Connecticut where a municipality has appropriated money for the control of the mosquito pest.

In Keney Park, Hartford, considerable work has been done in draining, filling and oiling certain natural depressions called "pond holes" or "sink holes," where mosquitoes were breeding. This work has recently been in charge of Mr. W. F. Schults, and through the courtesy of Mr. G. A. Parker, Superintendent of the Park, we have been furnished with a detailed account of the operations.

Coöperation and Compulsion in Mosquito Control.

While much can be done by individuals in the work of mosquito control, the results are so far-reaching, especially in the coast region, that community of effort should be directed in its behalf. Generally speaking, it should be the duty of every property owner or tenant to prevent mosquito breeding upon the property of which he has charge. Possibly some legislation may be necessary in order to make action compulsory in the worst cases. Apparently the only relief that can now be had by statute provision comes through the local health officer. That he has power to act no one will dispute; but the cost of the work in some cases should properly be borne by the community, town or city, and not wholly by the owner. The health

officer, too, will feel more justified in acting in cases of malarial species, than if only a pest is complained of: but there should be some way of reaching and controlling mosquito breeding even if the malarial species is absent. There is no reason why any community should be continually annoyed each season, when often with the expenditure of a small amount of money it can be abated locally.

The salt marsh species, as already stated, are chiefly migratory forms. For this reason they assume a peculiar importance which is augmented by their intense breeding, wherever conditions are favorable on the salt marsh—millions developing in comparatively small pools. Their habit of migrating as far as thirty miles from their breeding places makes local action result in palliation rather than in absolute control, where the locality is so situated that mosquitoes can come from neighboring marshes and makes it obvious that coöperation all along the coast is necessary before this nuisance can be thoroughly abated.

Mosquitoes Affect Property Values.

The mosquito question concerns not only the health and comfort of every man in the community, but affects also his business interests. The mosquito nuisance is the only disadvantage of the beautiful shore region of Connecticut. The salt marsh species, which breed in certain stagnant water areas of the salt marsh, often make life almost unendurable near the shore. The persons owning shore cottages, summer hotels, boarding houses and places of amusement should be deeply interested from a business standpoint in the question of mosquito control. Property values are higher, and summer visitors more numerous, where mosquitoes are few. Not only is property increased in value on account of summer visitors, but the land bears better crops of salt marsh grass where properly drained. In many cases this increase more than pays for the cost of the draining work. It is well known that marsh land is fertile, and will produce good crops under the proper treatment, if we can get rid of some of the water. The best celery fields in the country were once fresh water swamps. Many of the mosquito breeding areas which are now serious can be done away with completely and permanently at slight expense. Every dollar judiciously expended in permanent work will mean millions less of mosquitoes not only for a season, but each year for years to come, as the simple ditches will remain open usually for a long time. Even a ten dollar ditch will often drain a breeding area capable of producing more than ten million mosquitoes in a wet season.

The mosquito survey described in the foregoing pages shows that a large proportion of the salt marsh mosquitoes breed on a small area of the salt marshes, and the maps which we have placed in the hands of the shore town health officers show just where these breeding areas are, while the reports explaining them tell what treatment seems advisable. Duplicate maps and reports can be seen at the Station, where information about the region will be freely given to those interested in taking up the work of mosquito control.

No one can overestimate the benefits to be derived from this work and no community need hesitate to start it, for the outlay of a comparatively small amount will at once do away with the worst part of the problem in most localities.

Experiments with Copper Sulphate.

Copper sulphate is now recommended and used for the destruction of algae in reservoirs and lakes. It has been advised for use against mosquitoes, chiefly because it destroys the organisms upon which the larvae feed. There is considerable misapprehension, however, on this point and we find many persons who believe that the larvae are killed directly by the copper sulphate. To have a direct action it must be employed in a much stronger solution than is commonly used in potable water supplies, namely 1 part in 100,000. A few tests were made with this chemical substance and its action upon mosquito larvae.

At 10 A. M. on May 13th 1 gram of copper sulphate was put into 3 ounces of water containing wrigglers of *C. cantator*. The larvae died off gradually so that no living ones remained at 9 A. M. on May 16th; most of the pupae matured, only a few died.

On July 30th 1 gram of copper sulphate was added to 60,000 grams of water containing all sizes of wrigglers but no pupae. On August 2d apparently no change had taken place in the barrel, except the appearance of one pupa. At 8 A. M. on August 4th two pupae had formed and about 30 per cent. of all sizes of the larvae were dead. On August 5th the experiment barrel presented no appreciable decrease in population. On August 6th there were no pupae, no egg boats and an apparent decrease in larvae of all sizes. When examined August 8th there was found one egg boat and two pupae; otherwise conditions unchanged.

From these experiments it is evident that copper sulphate used in the proportion of 1 part in 60,000 does not wholly check development or entirely prohibit breeding. Similar tests were made with larvae of *C. pipiens.*

Experiment with Shrimps.

Three shrimps were brought to the Experiment Station from the salt marsh in a jar with some larvae of salt marsh mosquitoes. They were apparently eating the larvae, and in order to determine their effectiveness along this line, the following tests were made.

On August 2d nine wrigglers were put into the jar with the three shrimps. Though at the time a pair of the shrimps were in coitu all started forth at once to seize the wrigglers. The single specimen caught a wriggler, as did one of the pair. The larvae was held head first between the mouth and the legs of the shrimp and the anterior half eaten in about five minutes; then the shrimp dropped the remainder and set to work cleaning itself, during which operation the shrimp remained curled up in one place without moving its appendages. At all other times these appendages seem to be constantly in motion. In ten minutes the shrimp had eaten the remaining portion of this larva.

On August 6th one larva remained in the jar with the shrimps. That shrimps aid in reducing mosquitoes is evident, but their structure and small capacity does not enable them to destroy very great numbers of the larvae.

Experiments with a Young Pike Fish (*Lucius americanus*).

On May 16th about fifty *Anopheles* larvae, only a few of which were fully grown, were put in a jar containing two ounces of water with a small fish, less than an inch in length. Two days later all *Anopheles* larvae had been devoured and the fish was apparently dead, doubtless from overfeeding; however, it recovered. On May 21st twelve *C. cantator* larvae were put into the jar with the fish. On the 23d only three larvae remained and the fish was active. All had been devoured on May 25th.

Acknowledgments.

We desire to here express our appreciation of the courtesies shown by various individuals who have given information that aided our work. On July 23d Mr. Viereck visited Lawrence, Long Island, and was shown the drained marshes there by Mr. E. M. Bentley, President of the Board of Health, who has had charge of the work. Mosquito breeding at Lawrence has been almost completely done away with, by the draining of the extensive marsh areas, and much valuable information was given us by Mr. Bentley regarding the width and effect of ditches, their durability, etc.

To Mr. W. A. Bryan of Indian Neck, Branford, who has had experience in ditching work, and Mr. F. H. Hart, who has been connected with the important work at Pine Orchard; to Mayor Crittenden of Middletown; to Mr. S. H. Wheeler of Fairfield; to the Hartford Board of Health and to Mr. G. A. Parker, Superintendent of Keney Park, Hartford, we are indebted for the many courtesies shown and the information given regarding the local conditions, and to all parties mentioned we here express our thanks.

We are especially indebted to Dr. L. O. Howard, Chief of the Bureau of Entomology for the identification of some of the species by Mr. Coquillet; to Dr. E. P. Felt, State Entomologist of New York, who has examined all of the specimens of mosquitoes in our collection, and the keys printed in this report.

SUMMARY.

The recent discoveries show that certain kinds of mosquitoes are responsible chiefly, if not wholly, for the transmission of certain human diseases such as malaria, yellow fever and filariasis (elephantiasis). At the present time over four hundred species of mosquitoes are known in the world, and over sixty occur in the United States. Twenty-two of these have been found in Connecticut.

A mosquito survey of the state was undertaken in 1904 to learn what species occur in Connecticut, where they breed most abundantly, and what means will be found most useful in abating the nuisance. Mosquitoes do not breed in grass, as many suppose, but only rest and hide there. Water is absolutely essential, and in it the larval and pupal stages are passed. The development of a brood requires only about a week in warm weather. The wrigglers are obliged to rise to the surface every few minutes to get air.

Anopheles, the malarial mosquito, lies horizontally at the surface of the water when breathing, while Culex larvae hang with heads downward. The regions about Hartford, Middletown and Cheshire were inspected, and the entire salt marsh region extending along the coast from New York State to Rhode Island was examined during the summer. The breeding places were marked upon maps, and a map of each town with a report of the breeding places and recommendations for abolishing them were placed in the hands of the local health officer. Duplicate copies of maps and reports were deposited in the office of the Secretary of the State Board of Health at New Haven.

In the inland region the malarial mosquito Anopheles, and the house or rain-barrel mosquito, Culex pipiens, are the important species. Connecticut has over thirty-four square miles of salt marsh, most of which is well drained and free from serious breeding places; such places occur, however, next to the upland, around the edges of many marshes, and the building of roads, etc., across the marshes has in many cases interfered with natural drainage so as to form breeding places. Slough holes are formed from year to year, and become mosquito breeding places. Serious breeding areas may often be detected by the character of the vegetation even when not filled with water.

Culex sollicitans and C. cantator are the most abundant mosquitoes near the coast. They breed on the salt marshes, and migrate inland for several miles. The malarial and other mosquitoes breed around the salt marsh in fresh or brackish water.

The natural enemies of mosquitoes are fishes which live upon animal food, and predaceous aquatic insects, like water beetles and dragon flies.

Remedial measures practiced against mosquitoes consist in abolishing, where possible, all pools or receptacles in which they can breed. Receptacles should be removed or screened, pools or other standing water in the ground should be drained or filled. Pools that cannot well be drained or filled should be stocked with fish. Many permanent

pools contain aquatic insects which feed upon mosquito larvae. Narrow and rather deep ditches cut in the salt marshes in the proper places will drain the soil and be open to the action of the tides, both of which will tend to do away with mosquito breeding. In large marshes a ditching machine can be used, but in small ones the ditches can be cut by hand. Coöperation should be practiced in the treatment of the salt marshes, as adjoining towns and villages are affected, and in some sections the marsh land is owned by many individuals.

All houses should be screened to keep out mosquitoes. Kerosene or light fuel oil may be spread upon the surface of the water to kill the wrigglers, but this is a temporary expedient, and should be repeated each ten days.

Considerable draining work has been done in the state, especially at Stratford, Indian Neck and Pine Orchard, Fairfield and Hartford. Mosquito control is no longer simply experimental. Plenty of demonstrations have been made to show its feasibility, and health boards, individuals and communities are taking up the work.

Drainage greatly improves salt marsh land for farming purposes. Property values increase around summer resorts, and summer visitors become more numerous where mosquitoes are controlled.

Details of the survey may be found in the foregoing pages.

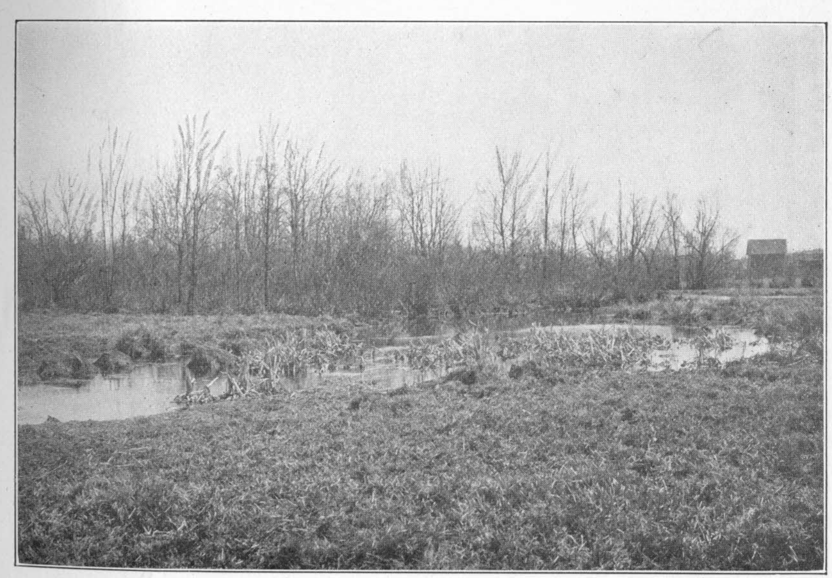
The Station will furnish information regarding the breeding places, life histories of mosquitoes, and best methods of treatment for particular localities, to individuals and communities planning to take up the work of mosquito control. So far as is possible it will, upon request, send a specialist to examine areas suspected of breeding mosquitoes.

a. This depression, formed by an uprooted tree, filled with rain water and was breeding *Culex Canadensis* in May.

b. This depression in the ledge contained water and was breeding *Culex cantans* by the million early in the season. Near Morris Cove.

FRESH WATER BREEDING POOLS.

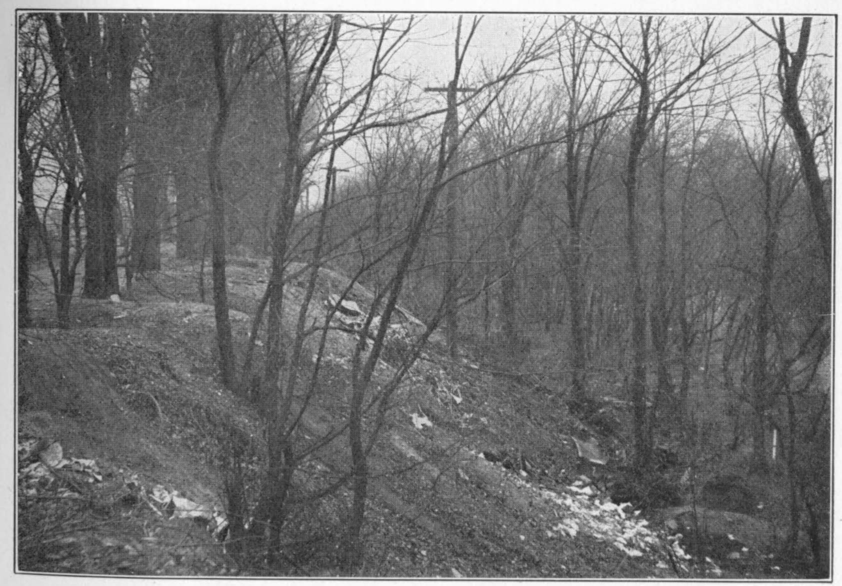
a. View near the Cedar Hill railroad station. The natural drainage has been cut off by the building of a road, and a serious mosquito breeding place has been formed.



b. View in Beaver Swamp, New Haven. Both *Culex* and *Anopheles* breed here abundantly.

FRESH WATER MOSQUITO BREEDING AREAS.

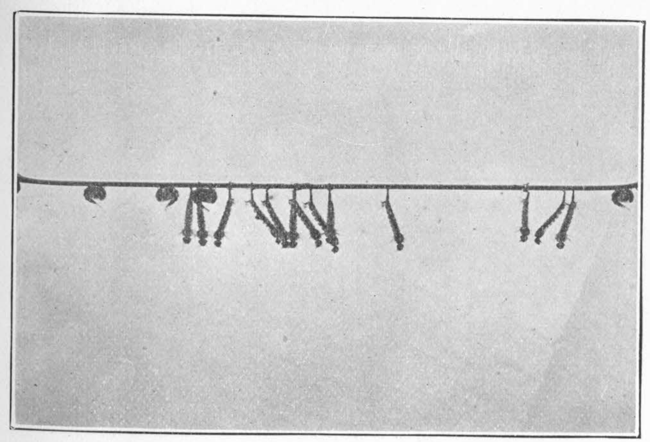
a. This pool contained an abundance of larvae of *Culex pretans* in May. Near Wawarme Ave., Hartford.



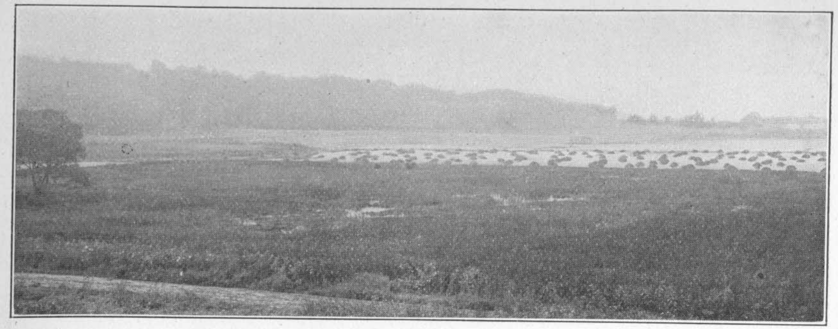
b. Ashes and other material dumped along Wawarme Ave., which might be used to fill the pool shown in a. The white stake is shown in both pictures.

MOSQUITO BREEDING POOLS AT HARTFORD.

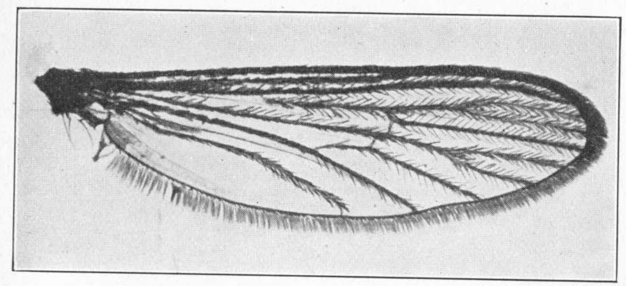
a. Jar for exhibiting mosquito wrigglers.



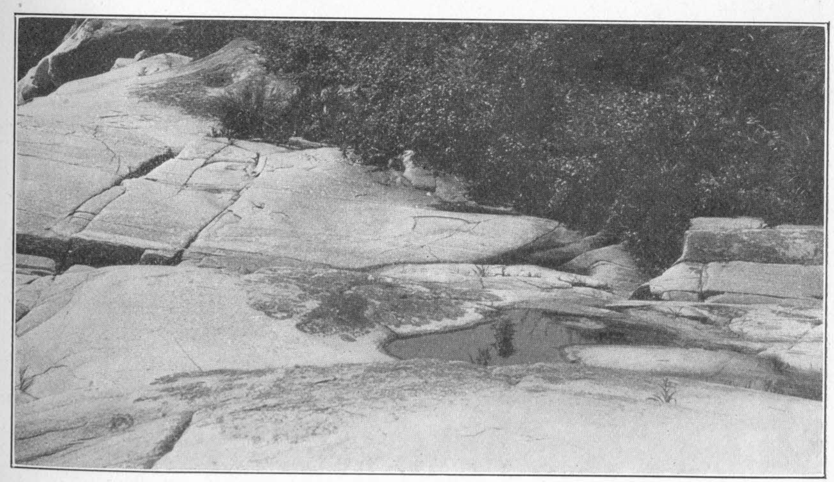
b. Mosquito wrigglers. Larvae and pupæ as they appear at the surface of the water to get air.



a. Salt marsh not well drained. Hay stacks are standing in water which can escape only through a choked drain leading at first directly inland. View looking seaward. Near Leete's Island, Guilford.



b. Wing of a mosquito, showing scales.



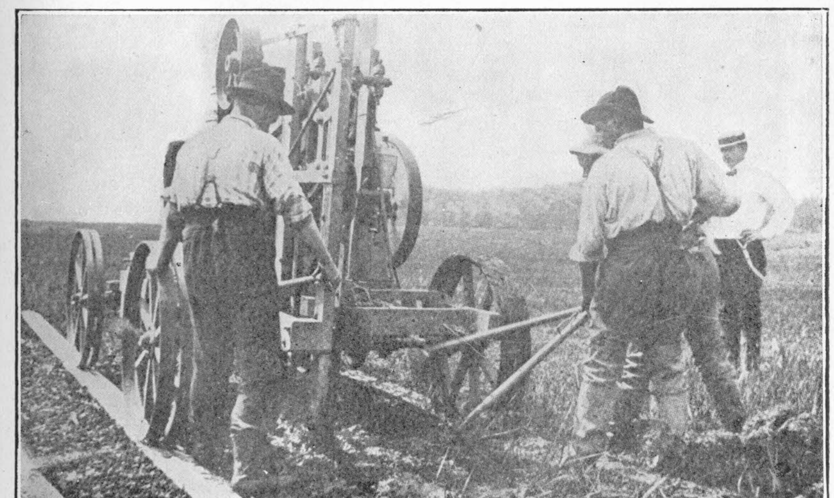
c. This small depression in the ledge was filled with rain water containing wrigglers of *Culex atropalpus* at Double Beach, Branford, in July.

a. Pool near edge of salt marsh where mosquitoes were breeding by the million. Near Morris Cove, New Haven.

b. Simple method of cutting ditches through a marsh. The sides are cut with hay knives and the turf pulled out with a potato hook.

THE SALT MARSH: MOSQUITO BREEDING POOL AND METHOD OF DITCHING.

a. A typical breeding place for the salt marsh mosquito is where water stands in the grass on the marsh. Wrigglers are out of the reach of their natural enemies. View back of Morris Cove.



b. The True Ditching Machine at work on a New Jersey marsh. (After Smith, Report on New Jersey mosquitoes.)

THE SALT MARSH: MOSQUITO BREEDING AREA AND DITCHING MACHINE.

1. Rush Salt Grass *Spartina juncea*. 2. Black Grass *Juncus gerardi*.
3. Spike Grass *Distichlis maritima*.

SALT MARSH PLANTS WHICH ARE GUIDES TO BREEDING PLACES.

CONNECTICUT

AGRICULTURAL EXPERIMENT STATION

REPORT OF THE BOTANIST

G. P. CLINTON, Sc. D.

I. Notes on Fungous Diseases, etc., for 1904.

II. Downy Mildew, or Blight, *Peronoplasmopora Cubensis* (B. & C.) Clint., of Musk Melons and Cucumbers.

III. Downy Mildew, or Blight, *Phytophthora infestans* (Mont.) DeBy., of Potato.

Issued May, 1905

REPORT OF THE BOTANIST.

NOTES ON FUNGOUS DISEASES, ETC., FOR 1904.

In the last Annual Report, 1903, pp. 279–370, the writer gave short notes on all of the fungous and bacterial diseases and physiological troubles which had been observed up to that time on the cultivated plants of Connecticut. In the present article are given notes on those that were prominent the past year and those that were much less conspicuous than during the two previous seasons, together with brief descriptions of the few troubles found in the state for the first time and additional information gained concerning old ones. The half-tone illustrations are natural size unless otherwise stated. On the whole, 1904 was not conspicuous for serious outbreaks of fungous troubles, especially when compared with the two previous years. This was largely due to the warmer, drier season.

ALFALFA, *Medicago sativa.*

Leaf Spot, *Pseudopeziza Medicaginis* (Lib.) Sacc. Plate XVIII, a. Recently further attention has been called to the cultivation of alfalfa in this state for dairy purposes. While undoubtedly a valuable plant in many regions, most efforts to raise it here have been unsuccessful thus far. In the Report for 1903, p. 297, attention was called to the leaf spot disease of this plant. During the past season this disease considerably damaged a small plot of alfalfa grown on the Experiment Station grounds. Plate XVIII, a, shows the general appearance of the purplish spots it produces on the leaves, which, as they become badly infected, turn yellowish and die prematurely.

APPLE, *Pirus Malus.*

Powdery Mildew, *Podosphaera leucotricha* (Ell. & Ev.) Salm. Plate XVIII, b. As noted in the Report for 1903, p. 300, this fungus does most damage to nursery stock, occurring commonly on the twigs. It is worse on some varieties than on others and was found especially abundant on Rome Beauty in one nursery the past season. The illustration shows the minute perithecia crowded together in dark patches on the dirty white mycelium that enveloped the twigs of that variety.

RUST, *Gymnosporangium macropus* Lk. Plate XVIII, c. Apple rust was not as prominent as usual the past year. Certain varieties are known to be very susceptible to attack. (See Report 1903, p. 301.) This was shown very plainly last spring in the Experiment Station disease garden in the case of Bechtel's Flowering Crab. A ripe "cedar ball" of the above rust was attached to the top of a young tree during moist weather in May. In June the spermagonial stage was very prominent on the upper side of many of the leaves to which had been carried the germinating sporidia from this cedar ball. The illustration shows the clusters of spermagonia on a leaf which developed about forty separate points of infection. On another leaf over one hundred distinct spermagonial clusters were counted, while on some of the leaves the whole surface was covered, so that there was no separation into distinct colonies. In July the aecidial stage became prominent on the under surface of these leaves.

SCAB, *Venturia inæqualis* (Cke.) Aderh. This fungus was not unusually prominent the past season. Attention was called in the last Report, p. 301, to a case where the parasitic stage, *Fusicladium dendriticum*, was found on the twigs of a single nursery tree. Last fall it was found again in another nursery on the twigs of the Fall Pippin and the leaves of this variety were unusually scabby. No sign of the asco-spore stage has yet been observed on the twigs.

Winter Injury. Mention was made in the Report for 1903 of the injury done by the two unusual winters of 1902–3 and 1903–4. During the past summer further observations have shown a number of young orchards that suffered severely from winter injury. Its effect on young orchard and nursery trees was usually shown by the killing or severe injury of the wood. If snow was on the ground this injury only extended down to the snow line. Externally the trees looked all right, as the bark and cambium were not injured, so that new wood was formed during the summer, but this annual ring of growth was often very slight. A cross section of the stem showed this as a white growth just beneath the bark and around the blackened injured wood of the preceding seasons. Some trees were killed outright or so severely injured that they died during the summer. When the injury did not extend entirely down to the stock, badly damaged trees were cut off and a new trunk started from a bud on the uninjured part of the scion. Such trees, if properly cultivated, made very satisfactory growth during the summer. Where the injury was not so severe, thorough pruning proved helpful.

In bearing orchards the injury usually showed itself in the bark and not in the wood. Usually the bark was injured only at the base of the trunk by a girdled, dead area extending from the ground up, often only on one side. Sometimes isolated dead areas could be found further up on the trunk or on the branches. The younger trees suffered more severely and often in the summer shed many of their leaves, and if the trunk was completely girdled finally died. When the bark becomes loosened on these dead areas it should be scraped off and the wood painted over to prevent rot. For orchard sites high, exposed hillsides are preferable, other things being equal, to sheltered lowlands, where, in our experience, winter injury most commonly occurs. Late cultivation and excessive fertilization, too, are apt to send the trees into winter with their wood in an unripened condition and thus more susceptible to injury. Some of the nurseries of the state suffered severely from winter injury to stock left outdoors. To prevent future trouble from this source one firm the past summer built a large storage house where all of the stock offered for sale in the spring can be wintered out of reach of the cold. See Peach.

ASPARAGUS, *Asparagus officinalis*.

RUST, *Puccinia Asparagi* DC. Plate XIX, a-c. This fungus has been mentioned before as doing damage in this state, having been reported first in 1896. So far, however, the aecidial stage (see Report 1903, p. 305) has not been reported. This was observed the past season in a certain bed in Westville. The bright orange spores of this stage are produced in minute, toothed cups, embedded usually in elliptical clusters on the stems. (See Plate XIX, b.) Compared with the red and black rust stages of this fungus, this stage is infrequent and harmless (except as it serves as the source of infection for these other stages) and appears only in the spring and early summer. In most of the plants examined it was confined to the lower twelve inches of the stem. In this particular field the asparagus had been gathered by snapping off the tender tips, thereby often leaving stubs several inches long. It was on these old stubs that most of the aecidia were found. This method of removal hence served as a means of increasing the rust in the field, for if the asparagus had been cut off close to the ground the rust would have developed only on a few of the old plants. The reason why the aecidial stage usually appears on the base of the plants is apparently because infection takes place from the black rust stage carried over winter in fragments of the old stems in the ground and the bases of the stems are the most favorably situated portion of the plant for infection.

As the aecidial stage was just appearing in this field and as there were few old plants, the field having been severely cropped, it was decided to see if the subsequent injurious stages of the rust could be kept out of the field by thorough removal of stubs and stems showing the aecidial stage, since the bed was somewhat isolated. The aecidial stage was first observed June 14, but many of the aecidial cups were unopened and the weather was not favorable for the spread of the rust from the mature ones. June 15 to 17 the writer went carefully over the field, about a quarter of an acre, and removed all of the parts showing rust. The field was gone over twice at this time, as it was discovered that on the first search not all of the rust was found. In all 858 rusted stubs (chiefly) and stems were removed. There was no sign whatever of either the red or black rust stage at this time. On June 27 the field was again examined and 38 stems and stubs were removed. Of these, however, 11 showed the red rust (uredo) stage, though not abundantly. (See Plate XIX, c.) These were chiefly on the lower parts of the plants and were just beginning to split open to shed their spores. They were also mostly confined to plants showing the aecidial stage. The field was examined a third time on July 11 and 192 stems were removed. As many of these were large plants, further removal was impossible without injury to the bed. Then, too, the uredo stage had become quite common at this date and a few teleuto sori (black rust) were also present. Lest than half the stems removed showed the aecidial stage. It is quite probable that not all of the plants showing the uredo stage were cut at this time, as in large plants the scattered outbreaks were easily overlooked. August 4 the field was examined again and the uredo stage was found rather common through it. About September 23 the field was mowed and the tops raked together,—not very carefully,—and burned. The field was not examined until after this was done, so the relative amount of rust present at this time was not determined. It is easily seen from what has been stated that this removal of the aecidial stage did not prevent the uredo stage at least from becoming fairly abundant in the field. What effect this removal, coupled with the burning of the canes in the fall, will have, remains to be seen another year. That the very careful removal and burning of all of the tops and litter in the fall for several years helps to decrease the rust, if the patch is isolated, has been shown, apparently, in a small bed at the Experiment Station. In 1896 Dr. Sturgis first observed the rust in this bed. Beginning about 1897, and for at least four years, the tops and litter from this bed were removed and burned. The rust has gradually become less, until last season none whatever was found in it.

RUST PARASITE, *Darluca Filum* (Biv.) Cast. Plate XIX, d. This fungus is parasitic on the rust fungus, and so is beneficial in checking the latter. It was very abundant in the field described above. Unquestionably it prevented many of the aecidial cups from maturing their spores. The fruiting receptacles of this fungus appear in the illustration as minute black dots covering the area infested by the rust. The same fungus also is common here on the uredo and teleuto stages of the asparagus rust. In one field observed the past year that had been killed, apparently, by the rust, this parasite was much more conspicuous than the rust itself. Probably in this case the fungus was parasitic on the hidden mycelium of the rust and largely prevented its spore formation, so that the parasite, rather than the rust, appeared to be doing the harm. It is barely possible, however, that to some degree the parasite was really intruding on the host without the aid of the rust and so was responsible for part of the injury. This same parasite occurs on a number of other rust species in this state; for example, carnation rust and blue-grass rust.

BEANS (LIMA), *Phaseolus lunatus.*

BACTERIAL SPOT. Plate XX, a. The cotyledons of the lima bean at the time the seedlings appear above ground often show purplish discolored areas that develop into sunken spots, as is shown in the illustration. Microscopical examination of these in their young state generally reveals bacteria present before the fungi which later often fruit at these places; while without positive evidence, these cankered areas seem to be one of the sources of infection of the bacterial disease which later in the season often appears on the leaves as reddish bordered spots (Report 1903, p. 307) and does considerable injury.

CABBAGE, *Brassica oleracea.*

DOWNY MILDEW, *Peronospora parasitica* (Pers.) Tul. This fungus has been reported before on other cruciferous plants, but was observed for the first time last spring on young cabbage plants grown in a hot-bed. The trouble did not continue after the plants were set in the field, and, no doubt, was induced by too moist and crowded condition of the plants in the bed.

CHERRY, *Prunus avium.*

BROWN ROT, *Sclerotinia fructigena* (Pers.) Schröt. Plate XX, b. A specimen of Governor Wood cherry in the Experiment Station grounds seems to be especially subject to this rot year after year. In 1904 the disease showed very early on the perfectly green fruit. An examination indicated that the curculio or other puncturing insects had considerable to do with spreading it, as often the infected fruit showed signs of a sting and the trouble was almost as bad while the fruit was green as it was later when the fruit was ripe and more easily infected. Some of the blossoms were also infected, but no diseased twigs were found, though careful search was not made for them. The tree had been sprayed during the winter with lime and sulphur, which still covered it rather thoroughly, but this apparently had no influence in keeping down the rot, as one might suppose it would if it started first from spores produced on the twigs. A careful search has been made for three years for the Sclerotinia stage on the old cherry pits lying on the ground, but this has never been found. Very few mummies remain hanging on the tree at the beginning of spring, though their pedicles more often remain attached. The illustration shows that the disease often kills these pedicles, sometimes producing spores on their upper end. It was thought that possibly the fungus was perpetuated by its mycelium passing down the diseased pedicles into the fruiting spurs and then up into the flowers in which it was found in the spring. Examination of the fruiting spurs in the winter showed that often those having the old pedicles attached were dead, while cross sections of others revealed reddish discoloration of the tissues. Rough microscopic sections of these showed that often many of the parenchyma cells of the bark and pith were dead or severely injured, but there was no evident indication of mycelium, and when diseased or dead spurs were placed in a moist chamber or diseased tissue from them was inserted in Petrie dishes of agar agar no development whatsoever of the Monilia fungus took place. On the other hand, when the mummied fruit and diseased pedicles were placed in the moist chamber the production of the Monilia spores was abundant. These observations, then, indicate that the fungus does not travel down the diseased pedicles and from these infest the fruit spurs, but that the infection each spring comes, as ordinarily supposed, either from the mummied fruit (and pedicles) or infected branches, in which the Monilia spores are again produced in early spring during moist weather, and from these carry the disease first to the blossoms and from them to the young fruit, their infection of the latter being largely aided by puncturing insects. The influence of a puncture on the fruit was shown with green cherries, kept in a moist chamber in the laboratory, in which the spores of the fungus were inserted through a needle puncture. These cherries started to rot immediately at the punctured places, while others with spores placed on them without puncture and checks with no spores placed on them, though rotting later, usually started at some other point than where the spores were placed, probably from some injured place in the skin where spores had previously lodged.

CORN, *Zea Mays.*

LEAF BLIGHT, *Helminthosporium turcicum* Pass. This fungus, which was so injurious in 1903, did practically no damage the past season, thus showing that it is to be feared only in very moist seasons when the corn naturally does poorly.

CUCUMBER, *Cucumis sativus.*

DOWNY MILDEW, *Plasmopara Cubensis* (B. & C.) Humph. Not injurious this season. See Musk Melon.

DEWBERRY, *Rubus Canadensis.*

ORANGE RUST PARASITE, *Tuberculina persicina* (Ditm.) Sacc. Plate XXI, a. This fungus, especially in the west, is a common parasite of various rusts. Here, on the orange rust, it does not form the dusty purplish spores of the Hyphomycetous stage so conspicuously as it does later the subspherical sterile purplish sclerotia (See illustration.) There is little doubt that if these were properly developed they would reveal the existence of an asco-spore stage as yet unknown. It is questionable whether the fungus is of any practical use here in keeping the orange rust in check.

EGG PLANT, *Solanum Melongena.*

WILT, *Fusarium* sp. Plate XXI, b. The cause of this trouble has not been determined definitely, though it is probably a Fusarium fungus. It was present again the past year in some of the fields of this plant. Infected plants showed a dwarfed, yellowish appearance, and produced little and inferior fruit. Late in the season an examination of the badly diseased plants showed that the stem and roots under ground were badly rotted, as shown in the illustration. As was expected, spraying produced no favorable results with this trouble. There is no question that the disease begins in the very young plants, probably always in the seed bed, though it may not show plainly at this time, and starts from infected soil or diseased seed. Care, therefore, when possible, should be used to select the very best seed from undiseased plants and to use fresh soil in the seed beds.

FIG, *Ficus Carica.*

SMUTTY MOLD, *Sterigmatocystis Ficuum* (Reich.) P. Henn. Plate XXI, c. This smutty mold has been unusually common the past season in the market figs. The spores of the fungus partially fill the interior of the figs with a black smutty mass so much like the true smuts that the fungus was originally

described as one of these. It belongs, however, under the Hyphomycetes, or imperfect fungi. The same or a similar fungus also occurs in dates, but has not yet been reported in this state, though probably not uncommon in the markets.

GRAPE, *Vitis* sps.

POWDERY MILDEW, *Uncinula necator* (Schw.) Burr. Plate XXII, a-c. The powdery mildew of grapes was unusually abundant last fall, becoming especially prominent on the fruiting stems and the berries. It did not seem to cause unusual injury, however, except where it occurred on the thin-skinned varieties, especially the white varieties, in which the berries were more or less wilted, besides being somewhat disfigured by the presence of the fungus. The illustrations show the minute black perithecia, or spore receptacles, very abundantly scattered or clustered in the superficial whitish mycelium that covers various parts of the host. Suggestions for treatment were given in the Report for 1903, p. 324.

MULBERRY, *Morus* sp.

BACTERIAL DISEASE, *Bacillus Cubonianus* Macch. (*Bacterium Mori* Boy. & Lamb.) Plate XXIII, a-b. This disease was found in the state for the first time in one of the nurseries, where it was causing more or less injury to the young trees. Upon the leaves the disease shows as small reddish brown spots, when moist often semi-pellucid, that penetrate through the tissues to both surfaces. These are often more prominent and numerous than is shown in the illustration. The chief injury in this nursery, however, was to the twigs. Many of the branches and even whole young trees had a stunted, yellowish appearance. Usually the cause could be traced somewhere on the stem to an evident canker, like those shown in the illustration, which more or less completely girdled the stem. As these diseased areas in the bark become older, the growth of the tissues often tends to cut them off from further development, so that they show merely as a rough or corky superficial spot in the bark. When the disease penetrates to the cambium, however, the disease usually spreads internally between the bark and wood, doing considerable injury to each; see cut end of the largest branch in the illustration. This diseased condition, then, may not show exteriorly except through the yellowish, sickly growth. Sometimes the trouble becomes so bad that the young stem can be easily snapped off at the diseased place. This disease was first described from Italy and France and has been observed by the writer in Illinois on both cultivated and wild species of the mulberry. Probably the best treatment is to thoroughly prune out the disease in winter time, as is done for pear blight.

MUSK MELON, *Cucumis Melo.*

Bacterial Rot. Plate XXIII, c. A bacterial rot of the fruit was not uncommon in some of the musk melon patches the past summer. It seems to have been caused by the same organism that produces the wilt of the vines, or at least this may have been its starting point. The fruit developes a soft internal rot, without external evidence in the youngest stages, but eventually it spreads to the exterior, especially on the side next the ground. Some melons were found in which the bacteria were limited to the bundles in the peduncle and to those in the interior of the fruit, the surrounding tissues being healthy as yet, thus suggesting its relationship to the bacterial wilt, which was also found in these fields. Vines that were thoroughly sprayed several times during the season developed the rot in the fruit as badly as those not sprayed.

Downy Mildew (Blight), *Plasmopara Cubensis* (B. & C.) Humph. This trouble, which has been so common and injurious during several seasons past, was very uncommon the past year, so far as the writer observed doing no damage whatever. In 1903 its diminishing injury and later appearance was reported by the writer and the prediction made that it was on the wane. In 1904 for the first time in several years a fair crop of musk melons was obtained. This was largely due to the drier, warmer summer, which, besides keeping this fungus in check, was responsible for a vigorous growth of vines so necessary for the production of fruit in this crop. (See special article on this blight in the present Report.)

ONION, *Allium Cepa.*

Stem Rot, *Botrytis* sp. Plate XXIV, a-b. The stem rot trouble of the Southport White Globe onions (see Report, 1903, p. 334), which was so bad the two previous years, did no damage in 1904. As was suggested in the last Report, this trouble is largely induced by unusually wet seasons, especially during July and August. These months, in 1904, being considerably drier than those of the two previous years, were thus unfavorable for the development of the fungus. No signs of it whatever was found on plants in the field and no especial complaint of the rotting of the stored onions was made by the growers. Where planted, this variety did fairly well last season, except for the injury of the onion maggot, which was unusually common on all onions. Many growers, however, were so disheartened by the losses of the previous seasons that the acreage devoted to this variety was very much smaller than usual. So far, the writer has been unable to find any Sclerotinia stage connected with this fungus. The selerotia which often develop in the rotting tubers and carry the fungus over the winter apparently develop only the Botrytis stage, which causes the injury in the field and store house. Plate XXIV, b, shows an old onion, gathered outdoors in the spring, with several of these black sclerotial bodies.

Not being able to predict the character of the season as to its moisture, experiments to determine the value of spraying in preventing stem rot in White Globe onions were undertaken the past year on the farm of W. H. Burr at Green's Farms. As it turned out, there was no stem rot, so no information regarding the value of this treatment for the rot was gained, yet some points of value regarding spraying onions were obtained. Four or five treatments were planned, but on account of sickness only three were made, on June 24th, July 5th, and August 3d. Different plots of the onions were sprayed once, twice, three times and not at all. Onions are planted so closely together in the fields that no apparatus drawn by a horse can be used. In this experiment knapsack sprayers were used. These, however, are so cumbersome that they meet with little favor where any considerable spraying is to be done. The small barrel pump, mounted on wheels somewhat higher than usual, to bring the bottom of the barrel nearly clear of the tops of the onions, no doubt would be the best apparatus where any considerable spraying is to be done. One man can then pump and pull the barrel and another spray several rows of onions as they go along. The first treatment need not be made before the first week in July, since the plants are rather small before this time, and there is little danger of fungus troubles until then. It is very difficult to make Bordeaux mixture adhere to onions because there is very little surface, but chiefly because of the very smooth, glaucous character of this surface. This makes it almost necessary to use resin Bordeaux to secure fair results. Soap added to the ordinary Bordeaux proved of little value. Even with resin Bordeaux the glaucous character of the tops prevents the spray from adhering any length of time if there is rainy weather. This being the case, at least four or five sprayings will be necessary to secure moderate protection against any serious fungous trouble. With all these difficulties and objections it is not likely that spraying onions against fungous trouble, unless very serious, will come into very general use. The onions sprayed in this experiment were stored separately, but very little difference was noticed in their keeping qualities, and no true stem rot developed.

PEACH, *Prunus Persica.*

Brown Rot, *Sclerotinia fructigena* (Pers.) Schröt. Plate XXIV, c-d. Because of the light crop for two years the brown rot of peach was not especially prominent. Search last spring brought to light, for the first time in this state, the presence of the Sclerotinia, or asco-spore stage (see illustrations) on the old mummies partly buried in the ground. While these were not very common, they were found on both peach and plum mummies, and are no doubt more common when more of the rotten fruit is left on the ground. They serve as another means of infecting the young blossoms in the spring and thereby spreading the trouble to the fruit.

Frosty Spots. In August there were sent to the Experiment Station from Cannon Station diseased leaves of peach which showed in their first stage a purplish discoloration of the under surface and later a silver grey color as if mildewed. Sections of the diseased leaves, however, showed no fungus present, but did show that the epidermal cells and later the spongy parenchyma cells beneath had turned purplish, finally lost their contents and collapsed. The injury, apparently, was a physiological trouble caused by some unusual disturbance of natural conditions. Possibly it was due to insufficient water supply brought about through winter injury to the roots. Lack of water as a cause was suggested by the trouble showing first in the vicinity of the bundles, through which the water is brought, and by its occurrence on the under surface of the leaf where the stomates are, which regulate the transpiration of the water. A very similar trouble was noted in the Report for 1903, p. 360, on strawberry leaves.

Winter Injury. Many peach orchards were severely hurt by the winter of 1903-4. In most cases the wood was injured, usually down to the snow line, as shown by the darker color, without damage to the bark and cambium. Many trees had been similarly injured the year before, and so formed very little new wood the past season. Occasionally the trunks of older trees were split toward their base with prominent longitudinal cracks. In one orchard the injury was confined chiefly to the roots of certain trees. In the spring these trees put out a scanty, yellowish, sickly foliage. Examination showed the trunks generally healthy, but the roots injured or dead. The innermost vertical roots were always least injured, as they were more protected than the outer more horizontal roots. Apparently only those trees had suffered where the snow had blown off the most exposed places in the orchard, which was on a hill side. Many growers in the spring severely trimmed their trees and dug out those very badly injured. Undoubtedly the peach can stand severe winter injury to its wood and still make a slight growth of new wood the next year. Just what the ultimate value of these trees will be, however, is a point not yet settled. So far as observed by the writer, trees that were injured did better when severely pruned than when not pruned. See apple, also Report, 1903, p. 341.

PEAR, *Pirus communis.*

Scab, *Venturia pirina* (Lib.) Aderh. Plate XXV, a-c. This disease was not especially bad the past season, but is mentioned because the scab stage was found on the twigs of certain trees; see illustration. The occurrence of the fungus on the twigs is more common with pear than with apple scab. In the cases examined, the bark was more or less corroded or pustular at the infected places. Usually the outbreaks, especially in a fruiting condition, were found only on the one and two-year-old twigs. On the older twigs apparently the diseased bark gradually sloughed off and was replaced by a healthy growth. There was some indication that the mycelinum passed from last year's to this year's twigs, since on the latter the outbreaks often appeared first and most abundantly at their basal end. Undoubtedly, however, new infections often and possibly always take place by reinfection of the young twigs from spores produced on the older. In the winter time the scab areas may show plenty of the spore-bearing mycelium, but no spores, which begin to form early in the spring. Certain varieties are known to scab much worse than others, and in these cases it is probably largely because the fungus readily becomes established on the twigs. This being the case, spraying the dormant wood in the spring should have some effect in retarding and lessening the trouble. Observations made on certain trees sprayed last winter with lime and sulphur showed them freer the following summer from scab than usual, probably for this reason.

PLUM, *Prunus* sps.

Brown Rot, *Sclerotinia fructigena* (Pers.) Schröt. The Sclerotinia stage was found for the first time in this state on the mummied fruit half buried in the ground. See peach.

POTATO, *Solanum tuberosum*.

Bacterial Disease, (?) *Bacillus Solanacearum* Sm. Plate XXVII, a-b. The bacterial disease of potato stems mentioned in the Report of 1903, p. 351, was found again this season. This trouble appears early in June. Usually a plant here and there in the field is injured, but the disease does not seem to spread as the season advances. Diseased plants can usually be identified by their yellowish foliage and often dwarfed growth. Very badly diseased plants can be pulled easily from the soil, the underground stem being rotted (Plate XXVII, a) and few roots or tubers are developed. Sometimes these stems look as if attacked by borers, the pith within being rotted and hollowed out for some distance. Above the rotted part cross sections of the green, apparently healthy, stem usually show the bundles darkened and diseased when the rest of the tissues are healthy; see Plate XXVII, b. In these bundles there is found an abundance of bacteria. The Rhizoctonia fungus sometimes girdles places on the underground stem (see Plate XXVI, b) and may easily be confused with this trouble. The disease is apparently the southern tomato blight, described on tomatoes and potatoes in last year's report. Whether this trouble subsequently developes as the common soft rot of the tubers is a question not settled in the writer's mind. If so, it then becomes a serious disease in this state.

Downy Mildew (*Blight*), *Phytophthora infestans* (Mont.) DeBy. This trouble was very late in appearing and did no damage to the foliage of early varieties and but little to the late. The tubers, especially of the late varieties, however, rotted very badly. (See special article in this Report on the potato blight.)

Rhizoctonia (Rosette), *Corticium vagum* var. *Solani* Burt. Plate XXVI, a-c. Last spring the small black sclerotia of the sterile Rhizoctonia stage of this fungus were very common on tubers used for seed; Plate XXVI, a. Again this spring, 1905, the seed tubers were abundantly covered with these sclerotia. Such tubers if used for seed will yield a crop similarly infected, just as do scabby tubers, as was shown last season in a small experiment with infected and free tubers. So far as appearance goes, these sclerotia do very little harm since they are rather obscure and often resemble dirt. They become evident when one attempts to wash the tuber, as they do not wash off and the water brings out more strongly the contrast between their black color and that of the skin. An examination of the fields early in June showed the fungus present, the Corticium, or fruiting stage (Plate XXVI, c) being found then for the first time in this state. The mycelium, developed from the sclerotia, certainly grows out on the young stems and roots. Sometimes it produces diseased or girdled areas, as shown in Plate XXVI, b. When the mycelium reaches the stem just at the surface of the ground, it developes for a short distance a more abundant but still rather inconspicuous greyish mealy growth. This is the fruiting or Corticium stage and no injury is done to the stem here, as the fungus does not penetrate the tissues, but loosely covers the stem with a coating that gradually wears off as the spores are matured, and eventually disappears. Several fields were examined which showed from 15 to 20 per cent. of the plants having the Corticium stage on some of their stalks.

Apparently the plants did not suffer so severely from the fungus as some writers claim they do elsewhere. However, the relative injury caused here by this fungus is a subject that needs further attention, since with the parts attacked occurring under ground the injury and cause can easily escape notice. See Report, 1903, p. 350, for further description and treatment.

In the writer's opinion there is no doubt that the Corticium stage is the same fungus described by Prillieux and Delacroix of France [Soc. Myc. 7:220] in 1891, as *Hypochnus Solani.* They did not recognize its relation to the Rhizoctonia stage, *Rhizoctonia Solani* Kühn, which has been known in Europe for some time.

SCAB, *Oospora scabies* Thaxt. Considerable complaint was made of the damage caused by this fungus, which was unusually prevalent in 1904. See Report, 1903, p. 350, for treatment.

PRIVET, *Ligustrum Japonicum.*

Winter Injury. Plate XXVII, c. The California privet hedges were generally injured by the severe winter of 1903-4. In most cases the stems were killed down to about a foot from the ground. This injury apparently extended down to the snow line, which completely protected the parts below, since young hedges less than a foot high were not injured at all. There was some question among owners of these hedges as to what treatment should be given them. The best treatment, apparently, is to wait until the new growth begins to start in the spring and then trim back evenly to the uninjured portion. Plate XXVII, c, shows an injured hedge on the Experiment Station ground after the new growth had made a fair start and illustrates the trimming necessary in this case to remove the injured stems. As the roots of the hedges were rarely injured, the plants, when properly trimmed, made so vigorous a growth that often by midsummer all indication of injury had been obliterated.

RADISH, *Raphanus sativus.*

ROOT ROT, *Rhizoctonia* sp. Plate XXVIII, a, shows specimens, received from Elmwood, of greenhouse radishes that were severely injured by a dampening off and root rot trouble. This was caused by the sterile mycelium of a Rhizoctonia fungus which undoubtedly becomes established in the soil, and when

this is kept damp injures the underground parts of various plants. It is quite probable, for instance, that the stem rot of rhubarb, mentioned later, and possibly even the Rhizoctonia of the potato, is caused by this same fungus. In the Experiment Station greenhouse certain specimens of the cigar plant have been injured recently by a similar agent. In previous years other greenhouse plants have been attacked. Last spring young radishes in the New Haven market not infrequently had conspicuous, but shallow, injured spots on them which apparently had also been caused by the Rhizoctonia fungus. See Report 1903, p. 345.

RASPBERRY, *Rubus* sps.

WILT, *Leptosphaeria Coniothyrium* (Fckl.) Sacc. For three years a small patch of berries at North Haven has been injured by a wilt of the fruiting stems, which wither and die just as the berries begin to mature. The trouble has increased in severity, killing out most of the Palmers on which it started and finally appearing on the Kansas variety, several rows removed. The trouble apparently is caused by the above fungus girdling the stems or producing dead areas on them. Last May the parasitic pycnidial stage and the saprophytic asco-spore stage were both found on the stems. The former was especially abundant on the tips of the pruned stems. Probably this trouble is not uncommon in the state, though not often reported. See Report 1903, p. 355.

Winter Injury. Complaint was made by one grower that part of his raspberries had leaved out in the spring, but afterward had sickened and died. Examination of specimens received showed no sign of a fungus. The injured plants were on an exposed hill, where the winter's winds swept the ground bare of snow. Apparently the roots were severely injured or killed during the winter, while the stems were not, so they were able to leaf out but not to develop any further. The injury in some respects resembles the wilt disease.

RHUBARB, *Rheum Rhaponticum.*

STEM ROT, *Rhizoctonia* sp. Plate XXVIII, b, shows the base of leaf petioles with dark sunken cankers apparently caused by the sterile mycelium of the Rhizoctonia fungus which was present at these places. These specimens were sent from Southington, and a similar trouble was found on plants in New Haven. In the latter case the petioles sometimes rotted at the base and the leaves turned yellowish, wilted and finally died.

SWEET WILLIAM, *Dianthus barbatus.*

RUST, *Puccinia Arenariae* (Schum.) Schröt. Plate XXVIII, c. This rust was found for the first time in the state this year in some seedling plants grown in a yard in Westville. Only certain kinds of the seedlings were infected and the trouble apparently did not spread to the others in the same bed. This fungus, like the hollyhock rust, possesses only the teleuto spores which may germinate *in situ* as soon as formed and thus spread the disease.

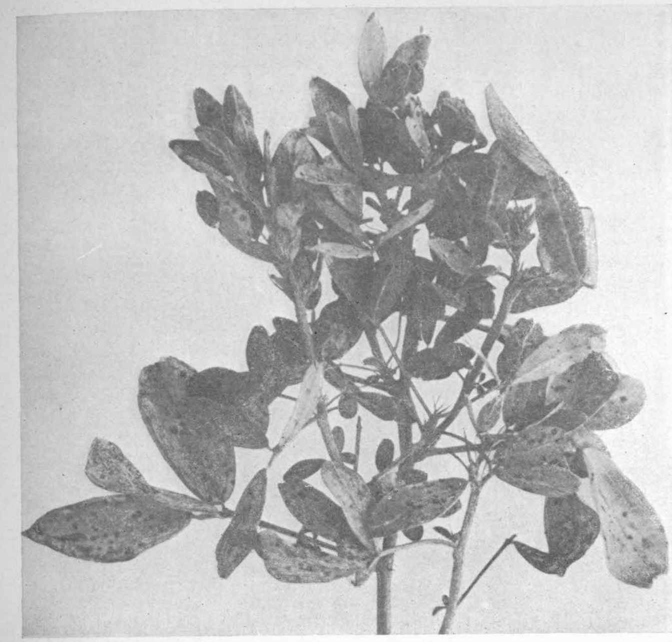
TOBACCO, *Nicotiana Tabacum.*

CANKER (BLACK SPOT*). This and the following are two warehouse troubles of tobacco not mentioned in our last Report. They appear in the leaves after these have been packed in cases for fermentation. Canker is apparently a fungus trouble in which dark colored patches are produced that often extend down through the leaves of several overlapping hands. The injured tissues are dark colored, become brittle and easily fall to pieces. Microscopic examination reveals the presence of abundant but isolated purplish black spores, apparently those of *Sterigmatocystis niger.* It is not known just what conditions favor the development of this trouble, whose presence is not known until the cases are opened for examination. Probably too much moisture favors its development, especially if care has not been used in selecting and packing the tobacco.

MUST is a fungus or bacterial trouble also developed in the packed tobacco and is named from its musty odor. Examination of specimens sent the writer from East Hartford showed the presence of a slight whitish growth, especially along the midribs. Numerous bacteria and also some molds were found in these growths. Cultures from a specimen placed in a damp chamber produced a reddish brown mold. Sometimes the dealers renovate musty tobacco by washing the leaves with rum.

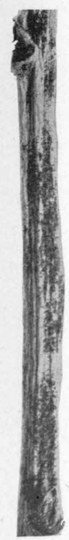
* *Loew, O.* Physiological Studies of Connecticut Leaf Tobacco. U. S. Dept. Agr. Rept. 65: 48.

Alfalfa.



a. Leaf Spot, p. 311.

Apple.

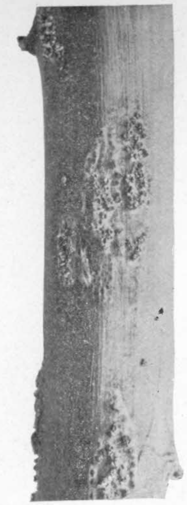


b. Powdery Mildew, p. 311.

c. Rust, p. 312.

FUNGI OF ALFALFA AND APPLE.

a. I Rust.



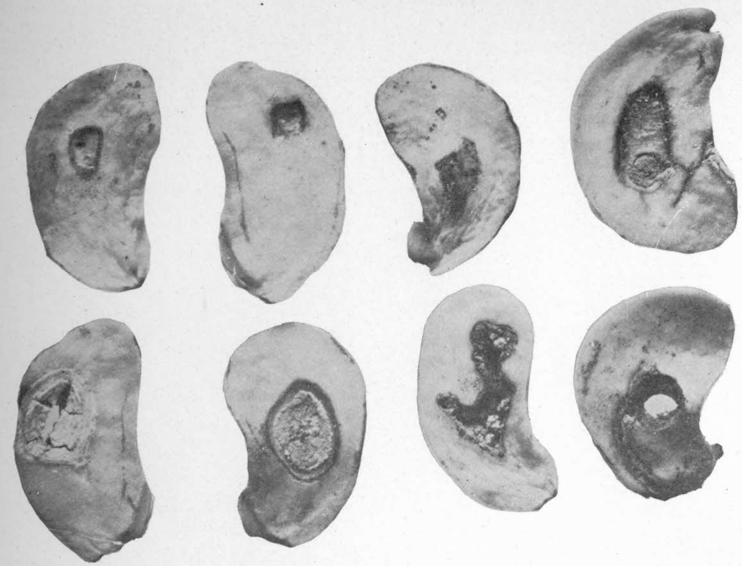
b. I Rust. × 2.

c. II Rust. × 2.

d. Rust Parasite. × 2.

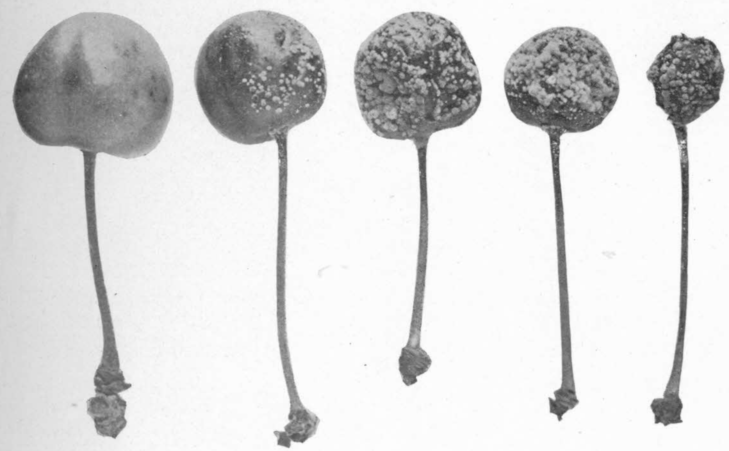
FUNGI OF ASPARAGUS, pp. 313–15.

Lima Bean.



a. Bacterial Spot of cotyledons, p. 316.

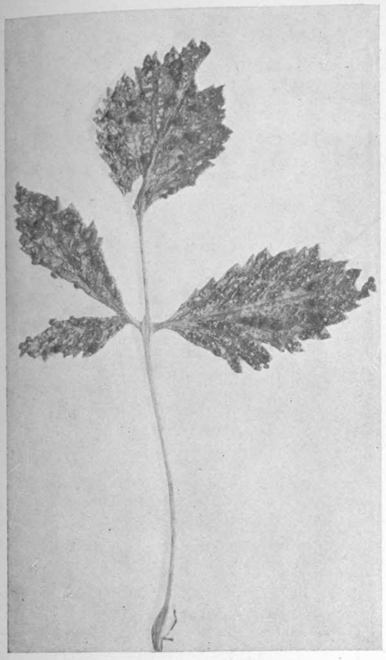
Cherry.



b. Brown Rot of fruit, p. 316.

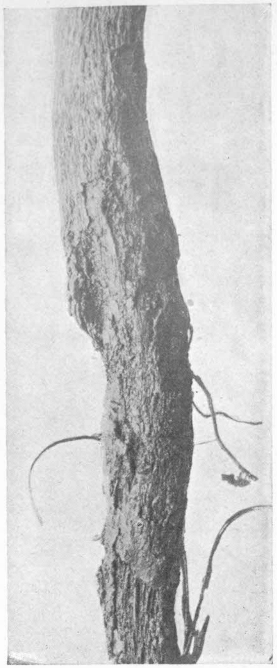
DISEASES OF LIMA BEAN AND CHERRY.

Dewberry.



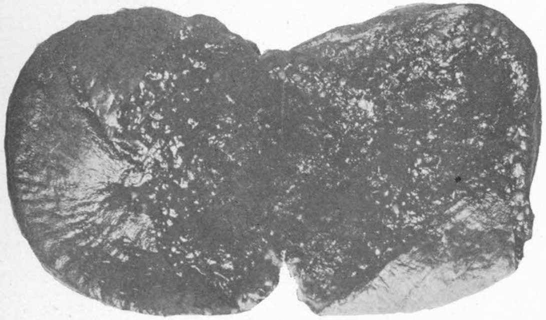
a. Orange Rust Parasite, p. 318.

Egg Plant.



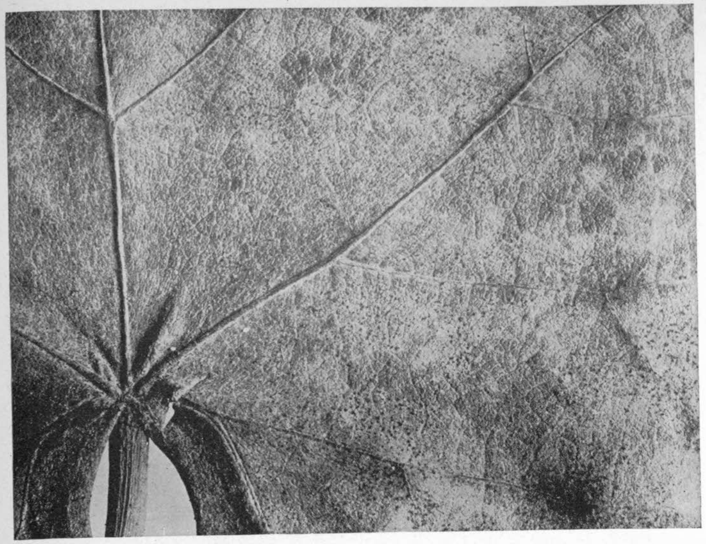
b. Wilt, p. 318.

Fig.

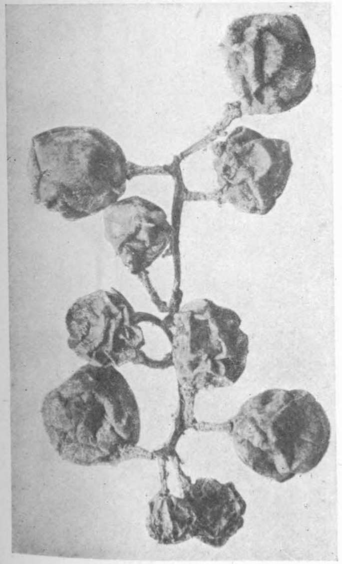


c. Smutty Mold, p. 318.

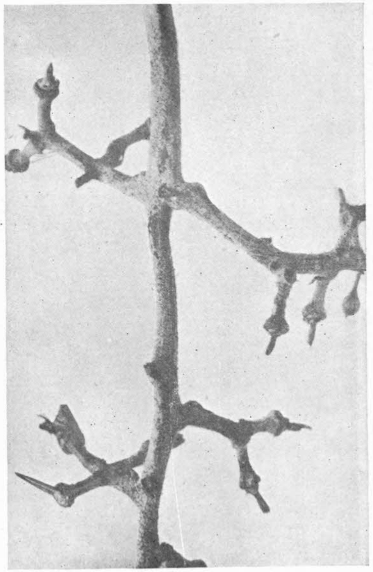
FUNGI OF DEWBERRY, EGG PLANT, FIG.



a. Showing white mycelium and minute black perithecia on leaf. × 2.



b. On the fruit.



c. On the fruiting stem.

POWDERY MILDEW OF GRAPE, p. 319.

Mulberry, p. 319.

a. Bacterial disease on leaf.

b. Bacterial disease on stems.

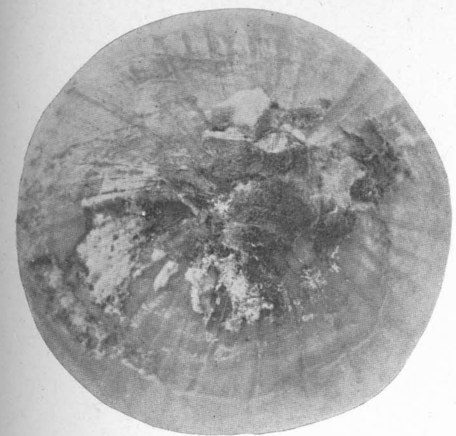
Musk Melon.

c. Bacterial Rot of fruit, p. 320.

BACTERIAL DISEASES OF MULBERRY AND MUSK MELON.

PLATE XXIV.

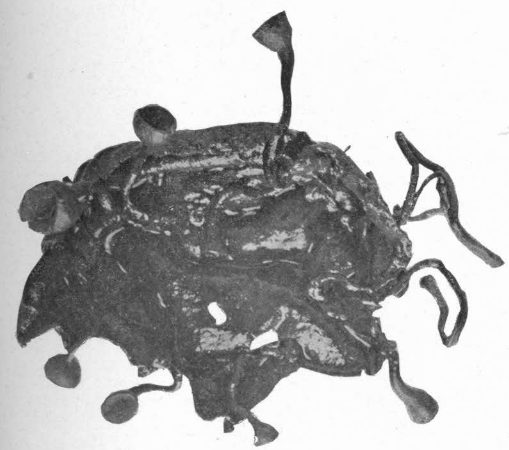
Stem Rot of Onion, p. 321.



a. End view of rotting bulb.

b. Sclerotia on decayed bulb.

Peach, p. 322.

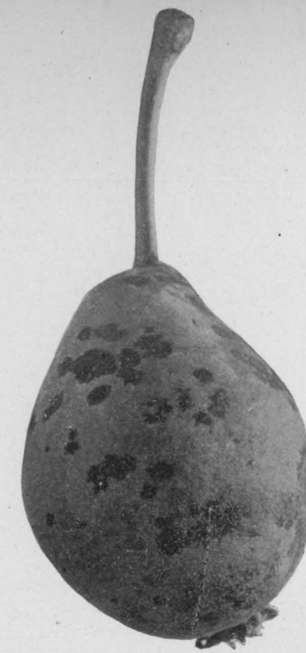


× 2.

c.-d. Sclerotinia stage of Brown Rot appearing on mummied fruit.

FUNGI OF ONION, PEACH.

a. On the leaf.

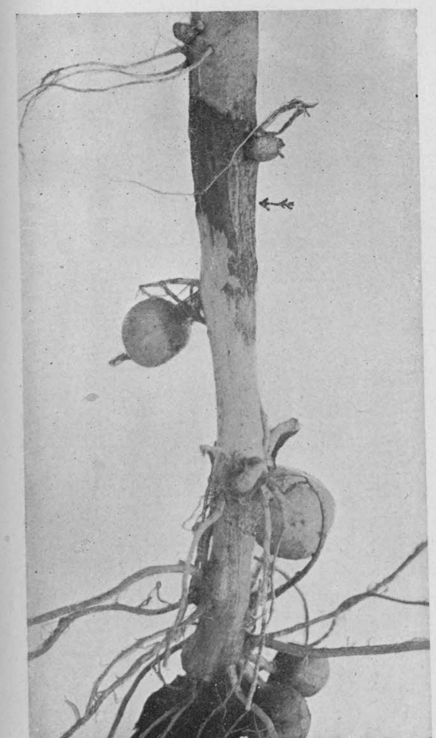


b. On the fruit.

c. On the twigs producing cankered places in bark.

PEAR SCAB, p. 323.

a. Rhizoctonia sclerotia on tuber.

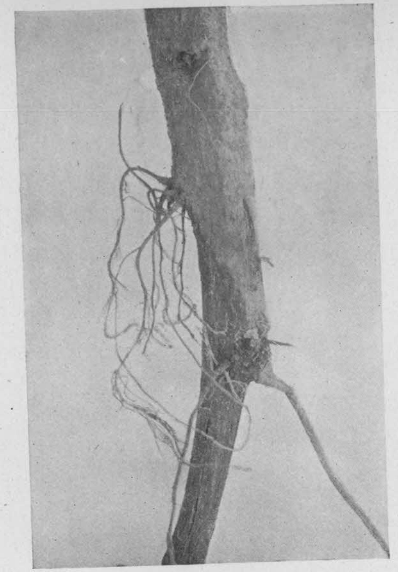


b. Cankered area on underground stem.

c. Corticium stage on stem just above ground.

RHIZOCTONIA FUNGUS OF POTATO, p. 325.

Bacterial disease of Potato, p. 324.



a. Diseased root.

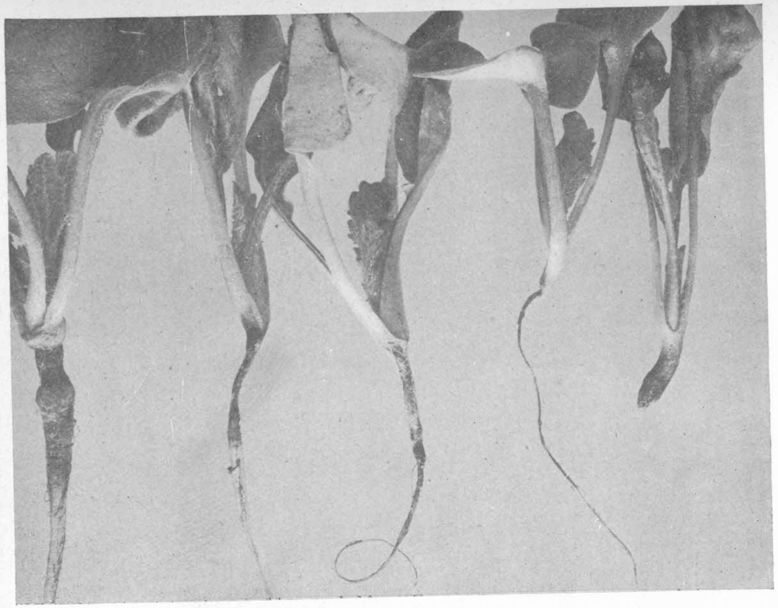
b. Cross section stem.

Privet.

c. Winter injury of California privet hedge, p. 326.

TROUBLES OF POTATO, PRIVET.

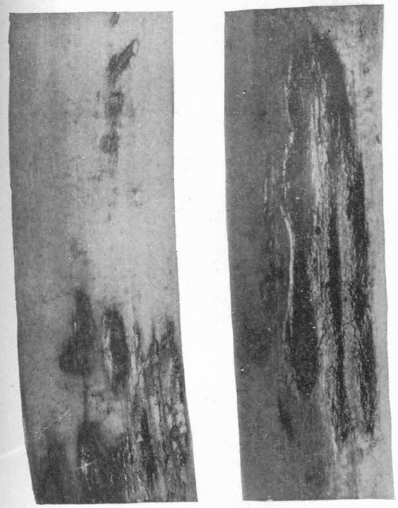
Radish.



a. Rhizoctonia injury to roots, p. 326.

Sweet William.

Rhubarb.



b. Rhizoctonia injury, p. 327.

c. Rust, p. 328.

FUNGI OF RADISH, RHUBARB, SWEET WILLIAM.

DOWNY MILDEW, OR BLIGHT, *Peronoplasmopara Cubensis* (B. & C.) Clint., OF MUSK MELONS AND CUCUMBERS.

HISTORICAL AND SYSTEMATIC CONSIDERATION.

Early Record. The downy mildew, or blight, of cucumbers, musk melons, and other cucurbits was first described in 1868 by Berkeley of England from specimens collected by Wright on a cucurbitaceous plant in Cuba. He named it *Peronospora Cubensis* B. & C. The description given was very meagre and the species was not regarded of special economic importance. Nothing more was heard of it until 1889, when Halsted (13) noted in the Botanical Gazette that a serious Peronospora trouble had been found on greenhouse cucumbers in New Jersey. He did not specifically identify the fungus. The same year Farlow (10), having seen Halsted's specimens, reported the fungus as *Peronospora Cubensis* B. C. and also stated that he had received specimens on cucumbers and another cucurbitaceous plant, collected the previous year in Japan, sent to him by Miyabe, who had recently examined the Berkeley and Curtis type specimens at Kew and found them to be the same. Late in this year Halsted (14) reported that the fungus had been injurious on cucurbits grown outdoors in New Jersey, giving as hosts squash, pumpkin and cucumbers; and Galloway (11) reported it as a serious pest of cucumbers in Florida and Texas. Humphrey (28) reported the fungus injurious to cucumbers and squashes in Massachusetts in 1890; and Thaxter (61) found it the same year on cucumbers at South Manchester in this state.

Recent Record. Since first found by Halsted this fungus has been reported nearly every year by some one in the United States though not discovered elsewhere until recently. The fungus, however, has not been so common here in some years as in others, and seems to have periods of vigorous development for a year or two, then gradually disappearing from conspicuous view. Apparently in 1896 and 1897, it was more serious than usual, especially on cucumbers, as it attracted especial investigation in these years from Stewart (53) of the New York and Selby (44) of the Ohio Experiment Station. Again, beginning about 1901, and reaching its climax in 1902, it was specially destructive in New England on musk melons and cucumbers. In 1903 the fungus was not especially prominent in this state, while in 1904 it was scarcely to be found.

In 1899 Massee (36) stated that the fungus had recently been introduced in England, on *Cucurbita pepo* and *Cucumis sativus,* from Japan. This seems to have been its first appearance, or at least discovery, in any European country, though recently it has attracted considerable attention in Russia and the Mediterranean region. Rostowzew (40) gives an account of its injury (in 1902) to cucumbers in the province of Twer, Russia, and the next year, as reported by Linhart (35) from Hungary and by Hecke (24) from Austria, certain cucumber and melon fields of Austro-Hungary were seriously injured. Saccardo (42) and others also reported it injurious in 1903 to cucurbits in Italy.

Hennings (26) stated in 1902 that the fungus was collected in Brazil in 1900. Zimmermann (65) also in 1902 described the fungus as a new variety from Java, and a year later listed it from Dutch East Africa.

Hosts and Distribution. All of the hosts upon which this downy mildew has been found belong to the cucurbit family, and nearly all of the reports of its occurrence have been on the cultivated species. Selby has reported it in Ohio on *Sicyos angulata* and *Echinocystis lobata,* two wild species common in the United States, but he notes that it escaped to these from a cultivated field near by. Others have looked for the fungus on these hosts, but have not found it, so it seems probable that they are not original hosts in the United States. Apparently the fungus is not a native of this country, but introduced, probably, from the West Indies, first in the southeastern states. Cuba may have been its original home, or it may have had independent origin in several places. The following distribution is taken chiefly from the literature of the fungus, together with the hosts and name of the person reporting:

Cucurbitaceae: Cuba, type (Berkeley), Japan (Farlow); *Citrullus vulgaris,* water melon, Conn. (Halsted), N. J. (Halsted), Ohio (Selby), Hungary (Linhart); *Cucumis Anguria,* gherkin gourd, Fla. (Swingle), Tex. (Swingle); *Cucumis Melo,* musk melon, Conn. (Sturgis), Ill. (Clinton), Mass. (Stone), N. H. (Lamson), N. J. (Halsted), N. Y. (Stewart), Ohio (Selby), R. I. (Stene), Hungary (Linhart), Italy (Saccardo); *Cucumis sativus,* cucumber, Conn. (Thaxter), DC. (Galloway), Fla. (Galloway), Ill. (Burrill), Ky. (Garman), Mass. (Humphrey), Md. (Swingle), Mich. (Orton), N. H. (Lamson), N. Y. (Stewart), Ohio (Selby), Penn. (Orton), R. I. (Stene), S. Car. (Orton), Tex. (Galloway), West Virg. (Orton), Austria (Hecke), Brazil (Hennings), Dutch East Africa (Zimmermann), England (Massee), Hungary (Linhart), Japan (Farlow), Russia (Rostowzew); *Cucumis sativus* var. *Anglicus,* English cucumber, Conn. (Clinton); *Cucurbita* sps., squash, Mass. (Humphrey), N. J. (Halsted), Ohio (Selby); *Cucurbita moschata,* winter crook-neck squash, N. Y. (Stewart); *Cucurbita pepo,* pumpkin, etc., N. J. (Halsted), Ohio (Selby), England (Massee), Java (Zimmermann); *Echinocystis lobata,* wild cucumber, Ohio (Selby); *Sicyos angulatus,* star cucumber, Ohio (Selby). Besides these hosts Selby of the Ohio Experiment Station in 1899 planted in a disease garden a large number of cucurbits to determine if the fungus would develop on them. It spread from the usual hosts upon the following not reported above: *Cucumis odoratissimus, Cucumis erinaceus, Cucurbita Melopepo, Cucurbita verrucosa(?), Lagenaria vulgaris, Coccinia Indica, Bryonopsis laciniosa erythrocarpa, Mukia scabrella, Momordica balsamia, Momordica Charantia, Melothria scabra, Trichosanthes colubrina.*

Systematic Position. Berkeley's original description of this fungus is so vague that it is only upon the authority of Miyabe, who has examined the specimens, that we are sure of its identity with the specimens since collected. Berkeley placed it under the genus Peronospora, calling it *Peronospora Cubensis* B. & C. Both Halsted and Tanaka (see Farlow 10) observed the germination of the spores, which was by zoospores. Humphrey also reported germination by zoospores, and as this type of germination is not characteristic of Peronospora, whose spores germinate through germ tubes, but of the genus Plasmopara, he renamed the fungus *Plasmopara Cubensis* (B. & C.) Humph., but at the same time called attention to the fact that it possessed characters common to both genera. A number of botanists have since made a more or less thorough study of the fungus and have placed it under one or the other of these genera, sometimes indicating doubt as to its real position.

Waite, for instance, in the Journal of Mycology in 1892, called attention to its resemblance to his new species, *Peronospora celtidis* and said: "The conidiophores of *P. celtidis* while of the type of Peronospora may be regarded as a step toward Plasmopara. . . . Mr. W. F. Swingle has pointed out to me that *Peronospora cubensis* B. & C. resembles *P. celtidis* quite closely and is its nearest ally and that these two species form a group by themselves, differing considerably from either Peronospora or Plasmopara. Both have long very dark conidia, pointed at each end and germinate by zoospores, with conidiophores of the so-called dichotomous type and strongly hygroscopic. For the present the form on Celtis is thought to be best placed in the genus Peronospora." Swingle, in an article on American Peronosporaceae in the same number of the Journal, places these two species under Peronospora in a doubtful section. A step further than this was taken by Berlese (4) in 1901, when he created a new subgenus, *Peronoplasmopara* Berl., of the genus Plasmopara, especially for these two species.

Zimmerman (65), in 1902, described a new variety of the fungus from Java, collected on leaves of *Cucurbita pepo,* calling it *Peronospora cubensis* var. *atra.* This author labored under the impression that the spores of *P. Cubensis* were hyaline, as has been stated by some authors, while those of his specimens were a dark grey, and so he made the variety on this difference. He also stated that their germination in water was by germ tubes. Unless the germination is always through germ tubes there seems to be no reason for considering the Java specimens distinct from those reported elsewhere.

Recently Rostowzew (40), a Russian botanist, has studied the fungus more in detail than any of the preceding investigators and has decided, like many of them, that it does not agree exactly either with Peronospora or Plasmopara, but has intermediate characters. So he has created a new genus, *Pseudoperonospora,* for it. While this author contrasts and compares the type of this genus with Peronospora and Plasmopara, he makes the mistake of not giving a brief scientific

description of his new genus, so that one is left somewhat in doubt as to just what its chief characters are. He does state, however, as have others, that its type species agrees with Peronospora in the character of the branching of the conidiophores and with Plasmopara in the conidia having an apical papilla and generally germinating by zoospores. Rostowzew also described the Russian form as a new variety, calling it *Pseudoperonospora Cubensis* var. *Tweriensis* Rostow. He had American specimens with which to compare his and found the following supposed differences: 1st, The Russian variety formed a more luxuriant, felt-like, growth on the leaves; 2d, the conidiophores were usually 2 or 3 or even 3 to 7 at a stomate while the American specimens had 1 or 2; and 3d, the conidia averaged slightly larger.

These points, if fairly constant, would without doubt entitle the Russian specimens to distinct varietal rank. Upon looking over American material, however, the writer finds that there is considerable variation, and it seems quite probable that Rostowzew's specimens from here did not show this. For instance, on the water melon there is usually no evident growth of the fungus; on the musk melon it often becomes evident especially at the juncture of diseased and healthy tissue; while on the cucumber, upon which host the Russian variety occurred, one often finds a very evident tinted growth on the under side of the leaves, especially when the weather conditions have been favorable for its development. Again, while the conidiophores are usually 1 or 2 at a stoma in American specimens, the writer has frequently found 3 or 4 in some specimens, and Stewart (53) of New York says, "the number of sporophores which proceed from a single stoma is small, usually one or two; but it is not uncommon to find as many as five and even larger numbers are occasionally seen." Finally, the writer has measured spores from the musk melon that averaged as large, or larger, than the average and the large measurements given by Rostowzew for his variety. It seems from these comparisons that the Russian form is not distinct, especially since the other European specimens have not been so considered.

Along with others the writer has had difficulty in placing this species generically, but after a careful consideration of the subject is in favor of a distinct genus for it. The only objection to this is that possibly a critical study of all of the species of Peronospora and Plasmopara, especially as to their germination, might show that these genera grade into each other through so many forms that an intermediate genus would only magnify the difficulties of generic distinctions. Berlese's sub-genus, Peronoplasmopara, because of priority of publication and also because it was given definite descriptive characters, seems to merit precedence over Rostowzew's rather indefinite Pseudoperonospora. Elevating *Peronoplasmopara* to generic rank, the distinctive characters of these three genera, in the writer's opinion, are as follows:

Peronospora Cda. Conidiophores chiefly of the dichotomous or modified dichotomous type of branching; with branches spreading mainly at acute angles, the ultimate spore-bearing tips being separate and sub-acute. Conidia hyaline or tinted, small to large, epapillate and germinating by germ threads. Haustoria usually conspicuous, branched and filiform, more rarely abbreviated and simple.

Peronoplasmopara Berl. Conidiophores of the dichotomous or modified dichotomous type of branching; with branches spreading mainly at acute angles, the ultimate spore-bearing tips being separate and sub-obtuse. Conidia chiefly large, tinted (violet chiefly), with a conspicuous papilla of dehiscence and germination typically by zoospores. Haustoria small and usually simple. Types: *Peronoplasmopara Cubensis* (B. & C.) Clint., *Peronoplasmopara Celtidis* (Waite) Clint.

Plasmopara Schröt. Conidiophores chiefly of the monopodial type of branching, with the successive shorter side branches (and their sub-branches) given off chiefly at right angles to the main branch, and with the ultimate, spore-bearing tips truncate and often somewhat clustered at the swollen ends. Conidia chiefly small, hyaline, papillate, and germinating by zoospores. Haustoria small, chiefly ovoid.

Specific Description. Since this species has been described rather meagerly and imperfectly, we give the following description, based on an examination of abundant material, and include references to synonymy and exsiccati:

Peronoplasmopara Cubensis (B. & C.) Clint. *n. comb.*

Peronospora Cubensis B. & C., Journ. Linn. Soc. Bot. 10: 363. 1868.
Plasmopara Cubensis Humph., Ann. Rept. Mass. Agr. Exp. Stat. 8: 212. 1891.
Plasmopara [*Peronoplasmopara*] *Cubensis* Berl., Riv. Pat. Veg. 9: 123. 1901.
Peronospora cubensis var. *atra* Zimm., Centr. Bak. Par. Infekt. 8: 148. 1902.
Pseudoperonospora Cubensis Rostow., Flora 92: 422. 1903.
Pseudoperonospora Cubensis var. *Tweriensis* Rostow., Flora 92: 422. 1903.

Exsiccati: *Peronospora Cubensis* B. & C., on *Cucumis sativus*, Seym. & Earle Econ. Fungi 41, Ell. & Ev. N. A. F. 2426 a, on *Cucurbita* sp. (squash), Ell. & Ev. N. A. F. 2426 b; *Plasmopara Cubensis* (B. & C.) Humph., on *Cucumis sativus*, Syd. Phyc. et Prot. 119, Barth. Fungi Col. 1840, on *Cucumis Melo*, D. Sacc. Myc. Ital. 1276. ?[K. Pósch Fungi Par. Exs. Plant. Cult. Hungariae.]

At first forming yellowish, rather indefinite discoloration of the leaves, but often finally producing definite reddish brown (sometimes purplish beneath) dead areas of varying size scattered over the leaves. Outbreaks of fungus chiefly hypophyllous, often invisible or evident only at margin of the spots, but sometimes forming a conspicuous purplish growth. Conidiophores chiefly 1 or 2, occasionally 3 or 4, rarely more, from a stoma, 180 to 400μ in length by 5–9μ in width, often with a slightly swollen base, 2–5 (chiefly 2–4) dichotomously (sometimes imperfectly) branched from upper third of length, with ultimate spore-bearing tips tapering, slightly curved, blunt, and 5–20μ long by about 2μ wide. Conidia olive brown to grayish purple, chiefly ovoid to ellipsoidal, with evident papilla of dehiscence and sometimes with remains of pedicel of attachment, 21–39μ by 14–23μ, though chiefly 23–30μ by 16–20μ. ?[Oospores spherical, yellowish, warty papillate, 30–43μ, maturing only after leaves decay in the ground, according to Rostowzew.]

Hosts and Distr.: on various Cucurbitaceæ, especially on cultivated species, reported from United States, Cuba (type), Brazil, England, Russia, Austro-Hungary, Italy, Japan, Java, Dutch East Africa.

Life History.

Mycelium. The mycelium consists of hyaline, somewhat irregular, branched threads, about 5.5–5.7 μ in diameter, that push their way between the cells of the leaf. These mycelial threads are found more abundantly on the lower side in the spongy parenchyma than in the palisade, or closely packed, cells of the upper leaf tissues. The cellulose walls are moderately thin and septa are rarely found. Protoplasmic contents at first fill the threads, but later they may become empty, especially in the old dead tissues. The threads reach the surface of the leaves usually on the under side, pushing their way through the stomates or more rarely boring directly through the epidermis. Here they give rise to the conidiophores, apparently developing one to several at the same time, or subsequently, according to weather conditions. When the tissues have become severely injured or killed, the production of conidiophores gradually ceases and new ones are then formed, chiefly at the margins of the enlarging injured areas.

The mycelium penetrates the cells of the interior of the leaf only by short ovate haustoria. These were first described and figured by Humphrey (28). It is rather difficult to make them out, since they are often obscured by the cell contents. Rostowzew found that they lacked the cellulose wall of the mycelium and that often they developed finger-like processes from their swollen tips. The object of the haustoria, of course, is to take food from the plant cells for the growth of the fungus.

Conidiophores. The conidiophores are the spore-bearing branches of the fungus, and from one to rarely five or six develop from a single stoma. When produced abundantly they make an evident growth on the exterior of the leaf. They are simple for about the lower two-thirds of their length and dichotomously branched at the upper third. This branching is not always exactly dichotomous, for sometimes one branch is larger and tends to continue as the main stem. The branches separate usually at acute angles and may be similarly sub-divided several times, usually two to four times. The main stem of the conidiophere is 5.5 to 9.5μ wide, with the base often slightly swollen just above the stomate, and then it is sometimes even 11μ wide here. The stem and branches very gradually narrow upward so that the ultimate, conidia-bearing tips are about 2μ or less in width. These tips or final branches vary from 5.5 to 14μ (rarely longer) in length and are usually slightly curved and taper somewhat to a bluntish apex. A single spore is borne on the end of each branch, which readily drops off when mature, especially if the conidiophore is placed in water. According to Rostowzew, the ultimate branches end in temporary sterigmatal tips that lack cellulose and dissolve in water, thus freeing the spores. The walls of the conidiophores certainly contain cellulose, as shown by color reaction with chloroiodide of zinc, and sometimes the extreme tips fail to color and often after the spores fall off are blunt. These points may indicate the fugacious sterigmata of Rostowzew, but if so these organs are not very completely differentiated. The conidiophores vary greatly in length, probably depending on weather conditions at time of their formation or possibly on the number produced from the same stoma. The extreme lengths observed were 140μ and 410μ with the average lengths about half way between these. The branching of the short conidiophore often begins lower down than the upper third, while that of the longer form may begin above this point. When young the conidiophore is filled with a uniform protoplasmic content, but as the spores are formed this gradually disappears from the base upward and is all gone when spore production ceases. With this disappearance of the protoplasm a septum or so is rarely formed in the conidiophore.

Summer Spores, or conidiospores, or temporary sporangia, as they are variously called, are formed, as stated above, on the tips of the ultimate branches of the conidiophores. When small these are hyaline, but they very soon assume a greyish or olive purplish color. When looked at with a hand lens they may even appear purple black. Some authors have incorrectly described them as hyaline, and of course as seen under the high powers of the microscope they are much lighter in color than when seen with a hand lens, but even then they always appear strongly tinted. They vary in shape usually from ellipsoidal to ovate, but occasionally are even subspherical. Specimens examined by the writer from the musk melon averaged longer and proportionately narrower than those from the cucumber. The measurements varied from 21–39μ in length and 14–23μ in width, while the average sizes were about 23–30μ

by 16–20μ. The spores have a uniform, rather thin wall, except at their apex, where there is an evident hyaline papilla of dehiscence, while at the base there is more or less evidence of the point of attachment. Except at these two points the cell wall gives the cellulose reaction when tested with chloroiodide of zinc.

Germination of Spores. The germination of the spores through zoospores has been mentioned by a number of writers, but no one has figured or carefully described this method. When placed in a drop of water in a Van Tiegham cell the spores sometimes started to germinate inside of two to four hours if they were in good condition. Many of the attempts to germinate the spores failed altogether, probably because in ordinary dry weather the spores very soon lose their power of germination. Generally they were successful where fresh spores, developing in a moist atmosphere, were used. In all cases the germination was by means of zoospores. Occasionally a faint division of the protoplasmic contents into areas (see Plate XXXI, 5) could be seen before the zoospores were discharged, but it was difficult to distinguish anything like separate zoospores even when apparently completely differentiated. The zoospores suddenly begin to escape from the spores through a pore formed by the dissolution of the papilla of dehiscence. Usually they were completely differentiated and escaped one at a time, swimming off immediately after their release; more rarely they escaped into a bunch just outside of the spore, from which they very soon isolated themselves and swam away. The pore by which they escape is too small to admit their unhindered passage, though they quickly push their way through, their plastic body admitting the necessary contraction for this. Plate XXXI, 6 shows the dumbbell shape assumed by a zoospore when half way through the opening. Rarely one of the zoospores fails entirely to escape and may finally germinate inside the spore, Plate XXXI, 7.

The zoospores very soon after escape lose the plasticity of the body wall and assume their permanent shape. This is somewhat turtle-like; that is, oval in dorsal view (that usually seen), but with side view more elongated, showing the dorsal aspect convex and the ventral often slightly concave. Two elongated cilia are attached to the ventral surface. These are

too fine to be detected without staining, but one is carried forward and the other extends to the rear. The protoplasmic contents of the zoospores are rather uniform, but often with granules of a more highly refractive index and with a prominent vacuole toward the forward end. The zoospores swim forward with a swift, gliding motion, often at the same time revolving more slowly around their elongated axis. At first they are very active, rarely remaining at rest long enough for one to measure them accurately, but their length is about 12 to 18μ. After an hour or two, or perhaps sometimes even considerably longer, they become more sluggish in their movements and gradually come permanently to rest. The cilia disappear and the zoospore assumes a spherical shape, about 10–13μ in diameter (Plate XXXI, 14). Some zoospores, instead of rounding up entirely, assume an amoeboidal appearance, but with scarcely any perceptible movement, and eventually go to pieces without further development (Plate XXXI, 15). Usually most of the rounded, resting zoospores soon begin to develop germ tubes, into which pass their contents. This germ tube is the infection thread by which the fungus gains entrance to its host. In water it becomes a simple (rarely branched) regular or irregular thread, eventually several times the length of the resting zoospore from which it issues (Plate XXXI, 16). After attaining some length it gradually becomes empty of contents at its base.

None of the spores observed by the writer germinated directly through germ tubes, but always through zoospores. Their germination, however, was tried only in water. Possibly had some nutrient solution been used, the germination would have been by germ tubes, as the potato blight spores, which ordinarily in water germinate through zoospores, in nutrient solutions will produce germ threads instead. Zimmermann (65), however, describes and figures the germination of his var. *atra* with germ threads, and Rostowzew (40) with his variety *Tweriensis* states that the germination is either by germ threads or zoospores. The germ threads proceed from the spores, usually from some other point than the papilla of dehiscence. Both these authors note the papilla of dehiscence, and as this is characteristic of germination by zoospores this may be considered the typical method.

Infection of Host. In moist summer weather the melon and cucumber leaves are often covered with small drops of water. During a cloudy day these may remain on them all day. This moisture offers a means for the germination of the spores produced on these leaves or carried there, and thus an infection of the tissues. The germ tubes of the resting zoospores, or of the spores when these germinate by germ threads, bore directly through the epidermis or push their way between the guard cells of the stomate into the interior of the leaf. (See Plate XXXI, 17–20.) Infection can take place through either the upper or lower surfaces of the leaves. Spores produced on the cucumber can infect leaves of the musk melon, as shown by an experiment by the writer, and no doubt the reverse is true. Once inside the leaf the infection thread develops the mycelium and from this soon arise the conidiophores to the exterior.

The extent of infection depends largely on weather conditions. If moist for some time after the fungus gains entrance to its host, this is favorable for the development of numerous conidiophores and spores and for the germination of the latter. During ordinary dry weather the conidiophores are not produced very abundantly and the spores soon lose their power to germinate. The effect of moisture on the production of conidiophores and spores was well illustrated in the infection experiments carried on in the laboratory. Usually two or three days after placing the spores in water on the leaves small discolored spots could be seen at these places, showing successful infection. If the plants were then left exposed to the ordinary dry air of the room, very few or no conidiophores were developed, though the diseased spot often slowly developed in the leaf. But if the leaves were sprayed with water and the moist plants covered with a bell jar to preserve a moist atmosphere, there resulted an evident increase of conidiophores, often by the next day. The following are short descriptions of two of these indoor infection experiments.

Experiment 1769–70. September 20 placed spores from cucumber in drop of water on upper side (1769) of each cotyledon of five seedling cucumbers and on lower side (1770) of four seedlings; seedlings in crocks under bell jars. September 22, two cotyledons of 1770 plainly, and one faintly showing small sunken and discolored spots; bell jars removed. September 23, eight of the ten cotyledons of 1769 and five of the eight of 1770 showing discolored spots; replaced bell jar over those of 1770 after spraying the seedlings with water. September 29, conidiophores and conidia on one cotyledon of 1770 but none on 1769. This experiment was in the laboratory room, which was not adapted for the plants.

Experiment 1771–72. September 26, used cucumber seedlings having two cotyledons and one leaf each; on the upper surface (1771) of one of the cotyledons and the leaf of each of seven seedlings placed spores from cucumbers in drop of water and on the upper surface (1772) of both cotyledons and the leaf of seven other seedlings placed small fragment of cucumber leaf containing spores; sprayed plants with water and left in greenhouse, as day was cloudy and moisture from leaves did not evaporate. September 29, only one or two leaves of 1772 showed slight discoloration. October 1, six cotyledons and two leaves of 1771 showed slight yellowish discoloration where spores were placed; 1772 showed several cotyledons with discolorations. October 15, 1771 showed six of the seven cotyledons and five of the seven leaves infected, infected areas dead, but no luxuriant growth of conidiophores, as atmosphere of greenhouse was dry; 1772 showed every cotyledon and five of the seven leaves infected; the cotyledons were almost dead at this time and the dead areas on the leaves were more prominent than in 1771. Conidia and conidiophores, however, were not abundant, so sprayed 1772 with water and placed under bell jar over night and the next morning there was an abundance of new conidiophores developed at the margin of the dead areas.

Winter Spores. The spores that have been described so far are thin-walled, temporary bodies that cannot survive over winter and are never produced saprophytically. The hosts, too, are annuals, and for this reason the mycelium cannot be perpetuated from year to year in perennial parts, as is the mycelium of the potato mildew (blight) in the tubers. Both these mildews, however, belong to the family Peronosporaceae and it is characteristic of this family to produce, besides the summer spores, large, thick-walled resting spores, or winter spores, that are formed within the infected tissues and often liberated only on their decay. Through the germination of those spores the next season their hosts are infected anew. These winter, or oospores, have been looked for on the melon, cucumber, etc., by a number of botanists, but have never been reported, except by Rostowzew (40). He claims to have found half-matured oospores in cucumber leaves infected with this mildew, and he gives a figure and description of them. He states that apparently they do not mature until the leaves have rotted in the ground, and so are largely saprophytic in their development. There is some question if what this writer saw really had any connection with this fungus, as often other fungi develop quite early in the dead spots of the leaves killed by the mildew. It is not impossible that the oospores develop only as a saprophyte rather than as a parasite, as is usual with this stage. There is need, however, of more evidence to show the nature and identity of the immature spores Rostowzew describes before they can be accepted or rejected as being connected with this mildew. The writer has made a special effort to discover oospores of the fungus on its recognized hosts in this state. All parts of the hosts, under all conditions of infection and decay and at different times of the year, have been examined, but nothing was found that suggested that the fungus develops such a stage either as a parasite or a saprophyte. So far there has been obtained no evidence that the fungus, in the United States, carries itself over the winter in this way. That such a stage may develop under certain conditions* or in certain regions or on certain hosts is entirely possible. Rostowzew seems to have had some further evidence of this stage, or some other stage, developing in old leaves in the ground, since he obtained earth from the infected region in Russia and using this on beds planted with cucumbers, finally developed the disease, while a check bed having none of this infected soil on it did not.

Before seeing the experiments of Rostowzew, the writer thought that possibly the fungus might be carried in the soil containing the remains of diseased plants, and conducted a couple of experiments to determine this. In the first experiments, in the fall of 1902, dead leaves from infected vines were mixed with new earth in crocks and planted with cucumbers; also old soil in which diseased plants had grown was placed in crocks and planted with cucumbers. These were kept in the greenhouse and the plants did not grow very luxuriantly, but though they lived two months no signs of the mildew appeared. In the second case musk melons were planted in a greenhouse bed in the winter, and after they were up, soil gathered the middle of February from ground that had badly diseased melons in it the fall before was placed around the plants, which were also sprayed with water drained through this soil. Other plants had the disintegrated remains of infected leaves placed on the soil and were sprayed with water drained through the leaves. No mildew showed on these plants two weeks after this treatment, but further observation was prevented by sickness. These experiments, while not necessarily contradicting Rostowzew's results, unfortunately do not confirm them.

* It is barely possible that the oospores are produced only on the union of distinct or sexual mycelial strains that do not commonly occur together.

If, then, the fungus in Connecticut is not carried over the winter by summer spores or mycelium, and if, as it appears, the oospores also are not developed here, how does it manage to be perpetuated? Two possible ways have been suggested, both of which may be of service. First, it is quite possible that the fungus in some places is carried over winter by cucumbers, etc., raised in greenhouses and later in hot-beds, finally spreading to the outdoor plants in the summer. A good many early reports of this fungus were of its occurrence upon greenhouse cucumbers, so that its occurrence there is not uncommon. The writer has found it on the English and market cucumbers in greenhouses late in the fall, and one year found the first observed infection of the summer on melons started originally in a greenhouse where cucumbers were usually grown in the winter. Second, the fungus may carry over winter in the south on hosts that grow outdoors the year around. Hume (27) states that this is true in Florida. The fungus in this case would have to advance northward with the season, and its appearance, no doubt, would be greatly influenced by the character of the weather each year. This would account for the variableness with which it appears and disappears. Selby, of Ohio, who has been especially interested in the study of this trouble, strongly supports this theory.

Effect of Season. As stated before, the downy mildew develops most vigorously when there is a very moist and cold season, especially during July and August. The cold is perhaps not so favorable for the development of the fungus, but when the seasons are unusually moist they are apt to be cool as a consequence. Periods of foggy or damp, cloudy weather, with perhaps not much rain, offer better opportunities for the development of the disease than violent rain storms followed by clear weather. Aside from any injury from the fungus, a cold, wet season, in itself, is just the opposite of what musk melons need in this state for their best development. For instance, the failure of musk melons in 1903 was as much due to the unfavorable season for growth as it was to injury by fungi. The cold, damp weather retarded the growth of the vines so that they were very late in coming into bearing, and this, coupled with fungous attacks, made the crop a failure. The development of the cucumber is not influenced so much as the musk melon by weather conditions.

Injury to Hosts. The mildew is one of the most injurious pests of the cucurbits. Ordinarily the cucumber and musk melon have suffered most, though the squash and watermelon have been reported as seriously injured. Halsted (17) reported that Sturgis found watermelons in this state severely injured, but Sturgis made no statement of such injury in the Reports of the Station. The writer has found the fungus only a few times on this host, and then doing no serious injury. These specimens showed a few dead areas on the leaves, but no external evidence of the fungus, whose presence was established only by microscopic examination. On the cucumber the fungus developed much more aggressively. There was a greenish yellow spotting of the leaves on their upper surface, while beneath usually could be seen a growth of the conidiophores, whose purple black spores became quite conspicuous under a hand lens. Later the leaves often became more conspicuously spotted or withered away, new growth ceased to take place and the plants finally died. With the musk melon the trouble seemed to be most severe, as the yellowish spots soon changed into dead reddish brown areas, with the resultant death of the intervening tissues and withering of the leaves. With weather favorable for the spread of the disease, the vines very quickly succumbed. The growth of the fungus on the under side of the leaves of the musk melon was not usually so evident as on the cucumber and became most pronounced at the border of the

dead areas. Even when the vines were not killed outright they rarely matured their fruit, or if some of the melons ripened they always lacked the requisite flavor. (See Plates XXIX, XXX.)

Financial Loss. It is difficult to estimate the financial loss caused by any disease. In this state the injury, due chiefly to this fungus, and partially to other fungi and unfavorable weather for growth, was so great during the years 1901, 1902, 1903 that the area devoted to musk melons was gradually cut down until it reached almost a zero limit in 1904, which year proving a fairly favorable season, no doubt the acreage will gradually go back to the maximum. In 1901, and especially in 1902, the fungus practically destroyed the melon fields in a few days.

The loss from injury to cucumbers in this state, while possibly equalling that of the melons, was not so evident. These plants often lag along under the disease and give a partial crop, especially the early plantings, and the flavor of the fruit is not an important question. Late cucumbers grown for pickles, however, suffer worse than the early, since the disease is often at its height when these are just starting, and the vines are usually killed before any fruit is obtained. Raising pickling cucumbers for the factories is not an important industry in this state, and so the loss here has been very much less than on Long Island and in Ohio.

Confusion with other Diseases. There are a number of other diseases of the cucurbits that have been in part responsible for the injury of these hosts. It is not always possible for one not well acquainted with these to distinguish them from the downy mildew. With this the most distinguishing macroscopic character is the growth of the fungus on the under surface of the spots, especially at the margins, the purplish black spores on the conidiophores becoming quite evident when a hand lens is used. The distinguishing characters of the other troubles as determined by the naked eye or a hand lens are as follows:

Scab, *Cladosporium cucumerinum,* occurs on the leaves, stems and fruit, producing sunken areas on the latter two, and the dead spots become covered with a more or less evident olive, moldy fungous growth.

Leaf Spot, *Alternaria Brassicae* var. *nigrescens,* usually forms roundish, dead, reddish brown spots on the leaves; these spots often show faint concentric rings of development, but no evident fungous growth. This sometimes becomes a serious trouble, considerably resembling the downy mildew in its ultimate effect and appearance.

Anthracnose, *Colletotrichum Lagenarium,* is a common and widespread trouble present more or less each season. It is most conspicuous on the ripening fruit, but this is often attacked while quite green, showing sunken, rotten areas that are usually covered with pinkish, often sticky, exudations of spores. The minute spore exudations on the leaves are easily washed off by rain, and the reddish brown spots are very similar to those of the leaf spot, but angular and often more extended.

Bacterial Wilt, *Bacillus tracheiphilus* Sm., often wilts down the whole vine without any spotting of the leaves, which merely dry up on their petioles. Sometimes, however, there appear distinct, often semi-pellucid, areas in the leaves. In the former case the bacteria merely clog the water ducts and cut off the supply of water from the leaves, which then wither and die, while in the latter case the bacteria also cause disease of the leaf tissues. A soft bacterial rot of the fruit, apparently, is sometimes connected with this trouble.

Prevention.

Cucumber. So destructive has the downy mildew proved to cucumbers grown in the eastern United States that a number of experiment stations have made experiments to determine if it could be controlled. Practically all of the experimental work has been done by spraying with Bordeaux mixture, the chief points of interest being to determine if the disease could be controlled, when and how often it was necessary to spray, and if spraying could be done on a paying basis.

Halsted (20) of New Jersey was the first to report spraying experiments against this trouble, conducted in 1895. He wrote in part as follows: "Spraying with Bordeaux gave very favorable results in the cucumber belts so treated. Two fungi peculiar to the cucumber, namely, the mildew (*Plasmopara Cubensis* B. & C.) and anthracnose (*Colletotrichum Lagenarium* Pass.), were sufficiently abundant to do serious injury. . . . By August 20 the combined attack of fungi and insects resulted in the destruction of most of the vines in all of the belts except in the two sprayed with Bordeaux. . . . As a result the Bordeaux vines were green and vigorous for over a month after those in the adjoining belts were dead. The yield of fruits was considerably increased and the percentage of fruit-rot greatly diminished."

The next year Stewart (53) of New York carried on experiments on Long Island to prevent this trouble on late or pickling cucumbers, which were being severely injured in that region. He says in his report of these experiments: "The downy mildew first appeared on the unsprayed plants August 7, and by August 21 it had injured the foliage to such an extent that scarcely any cucumbers were produced after this date. The thirty-two rows of plants which had been sprayed were in perfect health and vigor on August 21, and after this date produced two hundred and sixty dollars worth of cucumbers, which represents approximately the benefit resulting from spraying." In 1897 and in 1898 Stewart and Sirrine carried on other successful spraying experiments, both with early and late cucumbers. These experiments were conducted on a large scale and gave satisfactory financial results.

Selby (44) of Ohio, in 1897, also conducted successful spraying experiments on late or pickling cucumbers. He makes the following statement: "For Wayne County, Ohio, this fungus disease has caused in 1897 a loss of about 66⅔ per cent. of the crop. Computed at an average of about 210 bushels per acre, and one-third large pickles, this loss at factory prices reaches almost $45,000 for the single season in Wayne County. . . . These two diseases (mildew and anthracnose) may be very largely, if not entirely, suppressed by spraying about seven times with Bordeaux mixture, making the first application as the plants begin to vine and keeping the leaves covered with the fungicide thereafter, until about September 10. The cost for these sprayings need not exceed $10 per acre, and may be reduced to $7.50."

Since these earlier and most extensive experiments several other investigators have reported more or less successful experiments. With those conducted by the writer, chiefly against the mildew on the musk melon, one row of cucumbers was also sprayed, and the results obtained in this case were sufficient to show that ordinarily the mildew, anthracnose, leaf spot and scab could be controlled on this host by spraying a sufficient number of times with Bordeaux, and that when these troubles were bad such treatment was a paying venture. The bacterial wilt, however, seemed to be as bad on the sprayed as on the unsprayed vines.

The consensus of opinion, then, seems to be favorable for spraying cucumbers, especially late cucumbers raised for pickling, when suffering from mildew, anthracnose, etc. Of course, in the years when these fungous troubles are not injurious spraying would not pay for itself. Bordeaux mixture (four pounds copper sulphate, four pounds lime and forty to forty-five gallons water) is the best fungicide for this purpose. The spraying should begin about July 5 to 15, according to the season, but the first application should always precede rather than follow the first appearance of the disease. From five to seven sprayings are necessary to keep the foliage well covered with the fungicide until the first part of September. Where an acre or less of cucumbers are grown the small barrel pump mounted on two wheels and dragged by hand is a very convenient outfit. The vines can be trained about every fifty feet so that a path of sufficient width for the cart can be kept open. From this the vines on each side can be sprayed by using a twenty-foot hose, one man pumping and pulling the cart and another spraying the vines. Where more than an acre of cucumbers are grown it is advisable to leave roadways (perhaps planted with some early maturing crop), and from these the vines can be sprayed from a barrel pump carried in a light wagon. Before each spraying the ripe cucumbers should be picked, otherwise no attention need be paid about the spray getting on the fruit.

Musk melons: experiments elsewhere. The spraying experiments against this trouble on the musk melon are not nearly so favorable as those on the cucumber. In fact, when the mildew is severe it is doubtful if any good results, and even taken year in and year out very little will be gained if the failures are counted in. This does not mean that good does not result sometimes from spraying, as regards moderate attacks and especially with anthracnose, leaf spot or scab, which are more easily controlled, but in general the results do not warrant the extra cost and trouble of spraying.

Selby (46) of Ohio was one of the first to report spraying experiments, made in 1898, against the mildew on musk melons. His experiments were not so extensive with the musk melon as with the cucumber, and while favorable results were reported in one case, he states: "On the whole, we cannot conclude that the use of Bordeaux mixture for the fungus parasites of the musk melon has proven a decided success."

Lamson (33) reports that spraying experiments in 1901 made on garden musk melons after the mildew appeared gave little, if any, good results, while in 1902 (34) treatments started earlier and repeated five times kept the musk melons alive two or three weeks later than those not sprayed.

Stone and Smith, in the 15th Ann. Rept. of Mass., write as follows: "The subject of spraying as a preventive for this trouble has received considerable attention from this division for several years. During the past season [1902] experiments were made in coöperation with a local grower along the lines which previous experience had suggested. The details of this work will be reserved for a bulletin; but it may be said here that, even where plants were thoroughly sprayed with Bordeaux mixture, commencing early in July when the first leaves developed, no effect could be seen upon the development of the mildew, sprayed and unsprayed plots and fields were alike a complete failure."

Bennett (1) of Storrs Station, this state, reports spraying experiments in 1903, as follows: "Three plots of musk melons were planted, two of which were sprayed, the third being left unsprayed. Owing to the cold season none of the melons matured fruits. The result of the spraying was practically the same with the melons as with the cucumbers. Traces of blight could be seen on the sprayed foliage, but they were not sufficiently abundant to do any harm. The unsprayed plants succumbed to the disease even before the cucumbers did."

Musk melons: experiments in Connecticut. During the three seasons 1902, 1903, 1904, the writer conducted a number of experiments to determine how efficient and practical spraying was in preventing the downy mildew and other fungous troubles of the musk melon. Each year presented weather conditions somewhat different, varying from exceedingly favorable to unfavorable for the development of the mildew. From the results of these experiments, coupled with the experience of others, we have come to the conclusion that spraying musk melons with Bordeaux as a yearly practice will give no better average financial results than where no spraying is practiced. There are probably seasons when spraying would pay, if these could be foretold, but again there are seasons when it will be money thrown away. The results of these experiments are as follows:

In 1902 the mildew, which evidently had been very injurious to musk melons the year before, was first found in New Haven in a private garden about the middle of July. From then on to the first of August it appeared on practically all of the cucumbers and musk melons raised in this vicinity. With the musk melons the injury was sudden and severe, so that all of the vines were dead before any fruit ripened thoroughly. This was a cold, wet year, especially in July, which was unusually cold and foggy.

1. July 19 the writer examined three small patches of musk melons in the garden of Mr. Sperry, New Haven, and found the first outbreak of the mildew observed this year. The plants of the oldest patch had been started in the greenhouses, to mature them earlier, and these showed the disease rather badly, while the two younger patches were not yet visibly infected. Upon the advice of the writer, the gardener sprayed these younger vines a few days later. August 2 visited the garden again and found this spraying had not prevented the appearance of the disease on these melons, which were now in about the condition of the older melons when first seen. Numerous rains, however, had washed off all the spray. The vines soon died, with no melons matured.

2. M. W. Frisbie & Son, of Southington, on July 28, sprayed part of their commercial field at the writer's suggestion. At this time no mildew was seen in the field, though some bacterial wilt was present. When examined again, August 8, a few leaves showed the presence of the mildew. It was intended by the writer that other sprayings should be given, but wet weather prevented at the proper time, and then the owners were afraid the spray might injure the appearance of the fruit. No good resulted from this single treatment and the crop was a failure.

3. August 4 the writer sprayed a row of melons in each of two fields on the farm of Mr. Nesbit in Hamden. At this time the mildew was just beginning to appear scattered through the fields, though a week previous the anthracnose and bacterial wilt had been noticed in spots. August 9 examined the field and found the mildew spreading rapidly, with little difference between sprayed and unsprayed plants. August 13 one of these fields was pulled up, as both sprayed and unsprayed plants were beyond recovery. Sprayed the second field again on this date, but expected little or no good to result, as plants were severely injured. This field also was soon pulled up, as no melons were expected from either sprayed or unsprayed plants.

4. August 5, a little mildew was first seen on a few melons grown on the Experiment Station grounds, and on August 7 a part of these were very thoroughly sprayed with Bordeaux mixture. A few vines were sprayed above and then turned over and sprayed on their under surface. On August 20 the vines were sprayed thoroughly again. The mildew carried off the unsprayed vines finally. Those thoroughly sprayed on both surfaces did not develop the mildew much further, but they failed to make sufficient new growth to mature their fruit. Plate XXX, b, shows the condition of sprayed and unsprayed vines on August 30.

5. August 23, sprayed the greater part of a small patch of musk melons in the garden of Mr. Hartley at Centreville. The blight had rather severely injured these, but the spraying was made to see if its advance could be checked and the melons recover by new growth. September 2, examined the patch again, but as no beneficial results of the spraying could be seen no further treatments were given. No melons matured.

It will be noticed that most of these experiments were started after the appearance of the mildew on the vines. This was because the writer did not take up his work at the Station until July and so did not know what to expect from this trouble. It was thought desirable, however, to make these tardy treatments to see if the disease could be checked and a partial crop obtained. The experiments show that this certainly cannot be done when the disease is at all serious and the season unfavorable for the growth of the vines. However, it is quite certain that very few or no melons would have been obtained even had the spraying been started early and applied thoroughly through the season, as the following reports from Connecticut growers for this year show:

6. Mr. J. C. Eddy of Simsbury sprayed melons five times, twice in the greenhouse before transplanting. These vines were somewhat better than those not sprayed, but still "blighted" and produced no marketable fruit.

7. Mr. J. S. Eddy of Unionville thoroughly sprayed his melons, but they did not amount to anything. When examined by the writer on August 26 no mildew was found, but there was a small amount of leaf spot. The cold, damp season, apparently, was chiefly responsible for their feeble growth, which the owner described as "hide bound." The crop was a failure.

8. Mr. C. B. Meeker of Westport sprayed his melons six or seven times, beginning as soon as the vines started to run. He got no results from his spraying.

9. Mr. E. M. Ives of Meriden sprayed a few melons in his garden. He sprayed both sides of the leaves, turning the vines over to reach the under surface. He reports a few melons for his trouble.

In 1903 the growing season was also wet and somewhat cool, but not so bad as the previous one. The mildew was very much later in its appearance, being first found in the vicinity of New Haven September 14. On the whole it did no more damage to musk melons than did anthracnose, leaf spot, scab or wilt, all of which were found during the season, sometimes several occurring together in the same field. Taken altogether, these various fungus pests perhaps did not do as much injury to the melons as the cold, wet growing season did in preventing favorable growth of the vines. Little or no fruit was gathered from any of the fields and gardens.

10. A spraying experiment this year was made at the Experiment Station grounds on musk melons especially planted for this purpose and carefully watched during the whole season. A row each of Early Gem, Jenny Lind and Hackensack (also one of cucumbers) was planted and divided into five equal plats. These, except the fifth, or check plat, were all sprayed five times, as follows: July 14, July 28, August 8, August 26, September 10. The season was late, so that the first spraying was made on the plants when quite small and with no sign of any fungous disease on them. Bordeaux mixture was used on all four plats for the first three treatments, after which plat 1 received two treatments with resin Bordeaux, plat 2 two treatments with soda Bordeaux, plat 3 two treatments with potassium sulphide, and plat 4 two treatments with fresno (ammo. sol. cop. carb.). These other fungicides, except resin Bordeaux, were used in the last two sprayings to avoid any sediment on the fruit when ripe, as some growers seem to be afraid to spray after the melons begin to ripen.

The conclusions drawn from this experiment are as follows: (a) The sprayed plats, especially the Bordeaux plat 1, gave the best results in freedom of the foliage from fungi and in size and vigor of plants and number of young melons started. The unsprayed plat 5 was the poorest in these respects and developed considerable anthracnose and scab, and possibly a little mildew at the very end of the season. (b) The spraying did no good in preventing the bacterial wilt, as a few plants were killed in all of the plats and the fruit suffered some from a soft rot, possibly caused by the same organism. Some of the earlier sprayings did some slight injury to the leaves, shown by their turning yellow at the margins and slowly dying. (d) Resin Bordeaux adheres better than Bordeaux, but is more expensive and difficult to make, and so will not generally be used. If any spraying is to be done, everything considered, Bordeaux mixture is the most desirable fungicide, even for the late sprayings, as little spray reaches the melons if the ripe ones are picked before spraying, and no injury or harm can come from any little sediment that may remain when the fruit is picked subsequently. (e) The spraying in this experiment did not pay for itself, since practically no marketable melons were obtained. The failure of melons on the sprayed vines was chiefly due to the cold, wet season, which prevented vigorous growth of foliage.

In 1904 the season was warm and fairly dry during July and August, so that it was favorable for the growth of the vines, and also unfavorable for the development of fungous troubles. No mildew was found by the writer anywhere, except a little on some garden cucumbers on September 10. So this fungus did no damage whatever this season; neither were the other fungous diseases troublesome, so far as observed, except the wilt, which did less damage than usual. For the first time in several years, due chiefly to the warmer, drier growing season, a fair crop of musk melons was generally obtained throughout the state, though this was shortened somewhat by a killing frost on September 21.

11. A spraying experiment this year was conducted on the farm of Andrew Ure of Highwood to determine whether spraying with Bordeaux mixture was a desirable and profitable treatment to advocate to market gardeners for their melons. A patch of about a quarter of an acre was planted by Mr. Ure for this purpose and two-thirds of this was thoroughly sprayed four times. These treatments were made July 6, July 21, August 4 and August 18, and as the season was not very wet the vines were fairly well coated with the spray during the entire season.

The results may be summarized as follows: (a) No mildew appeared on either sprayed or unsprayed plants. A little leaf spot was finally observed on some of the unsprayed plants, but there was not enough to do any damage. The bacterial wilt injured and killed a few vines and there was considerable injury from a soft bacterial rot of the fruit about the time of its maturity, probably also caused by the wilt organism. (See Plate XXIII, c.) As shown last season and in this experiment, spraying was of little or no benefit in preventing the wilt. (b) The first spraying was really made on all of the vines, except two rows, but as it looked as if the treatment had caused some yellowing of the foliage, over one-third of the patch was left unsprayed thereafter. No evident or permanent injury resulted from spraying, however. At the end of the season the sprayed vines looked fully as vigorous, if not a little more so, than those which were not sprayed. The spraying, then, was of little or no benefit to the foliage and vines. (c) A fair crop of melons was gathered from both sprayed and unsprayed vines. No effort was made to determine the exact number from each, as it was evident that if any difference existed (and it would have been small) it would scarcely be due to the spraying.

CONCLUSIONS FROM EXPERIMENTS. Summing up the results of these three seasons' experiments, we conclude: First—When the downy mildew is very severe, as in 1902, spraying musk melons is useless. Second—When the seasons are cold and damp but fungi not unusually destructive, spraying may show some benefit to the foliage, but the unfavorable influence of the weather will not be overcome by this treatment. Third—Warm, fairly dry seasons (moisture well distributed) are necessary for the best development of musk melons in Connecticut and such seasons are not likely to bring serious attacks of fungi, so that spraying in these seasons is of little or no advantage. Fourth—Everything considered, spraying musk melons scarcely merits recommendation in this state. These statements do not apply to the cucumber, which host without doubt is often benefited by thorough spraying.

LITERATURE.

The following references include all the more important articles and even notes which the writer has found in literature relating to this mildew. As a natural consequence of the fungus being found, until recently, chiefly in this country, and because of its severe injury to cultivated plants, the literature is largely from our Experiment Station workers.

1. **Bennett, E. R.** Bordeaux Spraying for Melon Blight. Storrs Agr. Exp. Stat. Bull. 30: 17. 1904.
   Reports favorable results from spraying seven times with Bordeaux mixture, especially with the yield and foliage of the cucumbers, while with musk melons the foliage was improved.
2. **Berkeley and Curtis.** *Peronospora Cubensis* B. & C. Journ. Linn. Soc. Bot. **10**: 363. 1868.
   Describe this new species collected on cucurbitaceous host by Wright in Cuba.
3. **Berlese, A. N. and De Toni, J. B.** *Peronospora cubensis* Berk. et Curt. Sacc. Syll. Fung. **7**: 261. 1888.
   Give Berkeley's description of this fungus.
4. **Berlese, A. N.** *Plasmopara cubensis* (B. et C.). Riv. Pat. Veg. **9**: 123–6. 1901. [Illustr.]
   Gives botanical description, hosts, distribution and general discussion of this fungus, for which he creates a new sub-genus, Peronoplasmopara.
5. **Cazzani, E.** Sulla comparsa della *Peronospora cubensis* Berk. et Curt. in Italia. Centr. Bakt. Par. Infekt. **12**: 744. 1904. [Reprint from Atti Inst. Bot. Pavia **9**: 14. 1903–4.]
   Reports this on melon leaves from Pavia and Rimini, Italy, in 1903.
6. **Clinton, G. P.** Report on Fungous Diseases of 1903. Conn. Pom. Soc., Ann. Vol. **6**: 23. 1904.
   States that downy mildew appeared later and did less damage in Conn. in 1903 than it did the previous year.
7. **Clinton, G. P.** Downy Mildew (Blight) *Plasmopara Cubensis* (B. & C.) Humph. Conn. Agr. Exp. Stat. Rept. **1903**: 318–19, 330–31, 370. 1904. [Illustr.]
   Gives a short account of the fungus, with its hosts and the injury done in Conn.
8. **Cooke, M. C.** Cucumber and Melon Rot Mould. Journ. Roy. Hort. Soc. **27**: 823. 1903.

Gives short note on this fungus with suggestions for its prevention.

9. **Eckardt, C. H.** Ueber die wichtigsten in neuerer Zeit aufgetretenen Krankheiten der Gurken. Prakt. Blät Pflanzenb. Pflanzensch. **2**: [Review by Pósch, Centr. Bakt. Par. Infek. **13**: 787. 1904.]
Notes injury in Austria from this trouble, and suggests spraying.

10. **Farlow, W. G.** Notes on Fungi I. Bot. Gaz. **14**: 189–90. 1889.
Gives a general account of *Peronospora Cubensis* received from Japan, and identifies specimens from Halsted of New Jersey, the latter being the first collection in the United States.

11. **Galloway, B. T.** New Localities for *Peronospora Cubensis* B. & C. Journ. Myc. **5**: 216. 1889.
Reports this from Fla. and Texas, on cucumbers, which suffer severely from the fungus.

12. **Garman, H.** Cucumber Mildew. Ky. Agr. Exp. Stat. Bull. **91**: 50–1. 1901.
Notes this fungus especially destructive to cucumbers in Kentucky in 1897 and 1898; finds conidia larger than described by Berkeley.

13. **Halsted, B. D.** Peronospora upon cucumbers. Bot. Gaz. **14**: 152–3. 1889.
Notes appearance of an unidentified Peronospora (see Farlow) on greenhouse cucumbers in May, 1889, at New Brunswick, N. J. This is the first collection of the mildew in the United States.

14. **Halsted, B. D.** Some Notes upon Economic Peronosporeae for 1899 in New Jersey. Journ. Myc. **5**: 201–2. 1889.
Reports this later very abundant and injurious outdoors upon squash, pumpkin and cucumbers.

15. **Halsted, B. D.** Notes upon Peronosporae for 1890. Bot. Gaz. **15**: 322. 1890.
Notes the absence of cucumber mildew this year in N. J.

16. **Halsted, B. D.** Notes upon Peronosporeae for 1891. Bot. Gaz. **16**: 339. 1891.
Notes prevalence of *Peronospora Cubensis* B. & C. in 1891; lists from N. J., Dist. Col., and Conn. (on watermelon).

17. **Halsted, B. D.** *Peronospora Cubensis* B. & C. (Cucumber Mildew). N. J. Agr. Exp. Stat. Rept. **12**: 248. 1892.
Notes prevalence of this fungus in 1891 in N. J. and elsewhere; states Sturgis found it in Conn. on watermelon.

18. **Halsted, B. D.** Fungous Diseases of the Muskmelon. N. J. Agr. Exp. Stat. Rept. **14**: 352–3. 1894. [Illustr.]
Briefly describes damage done by downy mildew.

19. **Halsted, B. D.** The Downy Mildew (*Plasmopara Cubensis* B. & C.). N. J. Agr. Exp. Stat. Rept. **15**: 348, 350, 359. 1895.
Lists on cucumbers, musk melons and squash from N. J.

20. **Halsted, B. D.** Bordeaux with Cucumbers. N. J. Agr. Exp. Stat. Rept. **16**: 327. 1896.
Notes favorable results from spraying against downy mildew, etc., since the sprayed plants lived one month longer than those not sprayed.

21. **Halsted, B. D.** Experiments with Cucumbers. N. J. Agr. Exp. Stat. Rept. **17**: 340–44. 1897.
Sprayed plants with Bordeaux, soda Bordeaux, potash Bordeaux, but results of little importance in determining value in preventing downy mildew, as this was not present.

22. **Halsted, B. D.** Experiments with Cucumbers. N. J. Agr. Exp. Stat. Rept. **18**: 319–22. 1898.
Reports Bordeaux and potash Bordeaux as useful in preventing the downy mildew.

23. **Halsted, B. D.** The Blight of Cucumbers. N. J. Agr. Exp. Stat. Rept. **22**: 437, 440. 1902.
Notes that this was common in N. J. in 1901, and destroyed most of the musk melons; a plot of cucumbers was kept in full leaf and vigor by spraying with soda Bordeaux.

24. **Hecke, L.** Ueber das Auftreten von *Plasmopara cubensis* in Österreich. Ann. Myc. **2**: 355–8. 1904.
Reports the mildew from Vienna, Austria, on cucumbers; gives historical and botanical account of fungus.

25. **Hecke, L.** Ueber das Auftreten von *Plasmopara cubensis* in Österreich. Zeit. Landw. Ver. Oester. **1904.** [Review, Bot. Centr. **95**: 640–41. 1904.]
Notes presence in Austria on cucumbers; gives distribution, history, etc.

26. **Hennings, P.** Fungi S. Paulenses I. Hedw. **41**: 104. 1902.
Lists *Peronospora cubensis* B. et C. on *Cucumis sativus* from Sao Paulo, S. Amer., collected in 1900.

27. **Hume, H. H.** Downy Mildew of the Cucumber. Ann. Rept. Fla. Agr. Exp. Stat. **12–13**: 30. 1900.
Reports this serious in Fla. on cucumber; states that it lives there throughout the year; gives short botanical and historical account of fungus, and reports successful spraying experiments by a grower.

28. **Humphrey, J. E.** The Cucumber Mildew.—*Plasmopara Cubensis* (B. & C.) Humph. Ann. Rept. Mass. Agr. Exp. Stat. **1890**: 210–2. 1891. [Illustr.]
Notes injury in Mass. to cucumbers and squash by *Peronospora Cubensis* B. & C., which he here places under the genus *Plasmopara;* notes structure and germination of fungus.

29. **Humphrey, J. E.** The Downy Mildew.—*Plasmopara Cubensis* (B. & C.) Humph. Dept. Veg. Path. Mass. St. Exp. Stat. 1902: 18–19.
Notes its injury to cucumbers grown in greenhouse.

30. **Jaczewski, A. de.** Note sur le *Peronospora cubensis* B. et C. Rev. Myc. **22**: 45–7. 1900. [Illustr.]

Reports *Plasmopara australis* on *Schizopepo bryoniaefolius* collected in Manchuria in 1876 [not *P. Cubensis* as reported by Hecke]; calls attention to differences between these two mildews, and gives scientific description of *P. Cubensis,* but makes mistake in calling conidia hyaline.

31. **Jaczewski, A. de.** *Plasmopara Cubensis.* Bull. Torr. Bot. Club **29**: 649. 1902.
Notes presence of this fungus in Russia.

32. **Kornauth, K.** Ueber in Jahre 1903 beobachtete Pflanzenkrankheiten. Zeitschr Landw. Vers. Oester. **1904**: 159. [Review, Centr. Bakt. Par. Infek. **13**: 461.]
Notes presence of *Peronospora Cubensis* on cucurbitaceous plant in Vienna greenhouse.

33. **Lamson, H. H.** Downy Mildew of the Cucumber and Musk Melon. N. Hamp. Agr. Exp. Stat. Bull. 87: 129. 1901.
Notes this fungus injurious to cucumbers and musk melons in N. Hamp.; spraying experiments, begun after appearance of the disease, did no good.

34. **Lamson, H. H.** Fungous Diseases and Spraying. N. Hamp. Agr. Exp. Stat. Bull. 101: 63, 64. 1903.
Reports favorable results from spraying cucumbers and musk melons with Bordeaux beginning about the middle of July; applied five times at intervals of about 10 days.

35. **Linhart.** Die Peronospora-recte Pseudoperonospora Krankheit der Melon und Gurken in Ungarn. Zeits. Pflanzenk. 14: 143–45. 1904.
Reports severe outbreak of downy mildew on cucumbers, musk and watermelons in Hungary in 1903.

36. **Massee, G.** Cucumber and Melon Mildew. A Text Book of Plant Diseases: 80. 1899.
Notes its recent introduction into England, on *Cucurbita pepo* and *Cucumis sativa,* from Japan.

37. **Orton, W. A.** Plant Diseases in the United States in 1901. Yearbook U. S. Dept. Agr. **1901**: 670. 1902.
Notes downy mildew did damage to musk melons in Long Island, N. Y., Mass., Conn., N. J.

38. **Orton, W. A.** Plant Diseases in the United States in 1902. Yearbook U. S. Dept. Agr. **1902**: 717. 1903.
Reports downy mildew injurious to cucumbers and musk melons in southern New England.

39. **Orton, W. A.** Plant Diseases in 1903. Year Book U. S. Dept. Agr. **1903**: 553. 1904.
Reports downy mildew causing large loss of cucumbers in Florida and S. Car.; also destructive in West Virg., Penn., N. Y. and Mich.; occurred in Ohio, Mass., Conn., R. I.

40. **Rostowzew, S. J.** Beiträge zur Kenntnis der Peronosporeen. Flora **92**: 405–30. 1903. [Illustr.]
Describes a new var., *Tweriensis,* of the downy mildew, from the province Twer, Russia; places this and the species under a new genus, Pseudoperonospora; gives detailed botanical account

of the mildew; describes immature oospores; gives experiments with infected soil, etc.

41. **Saccardo, D.** *Plasmopara Cubensis* (B. & C.) Humphrey. Myc. Ital. 1276.
Issues specimens from Italy and states conidia are 22–25 by 15–17μ hyaline, finally olive brown, and not violet, as reported by Humphrey.

42. **Saccardo, P. A.** Notae mycologicae. Ann. Myc. **2**: 14. 1904.
Notes mildew was found on *Cucumis Melo* at Selva (Treviso), Italy, in 1903.

43. **Selby, A. D.** Downy Mildew of Cucumbers. Ohio Agr. Exp. Stat. Bull. 73: 234. 1897.
Notes prevalence in Ohio on cucumbers in greenhouses and also outdoors.

44. **Selby, A. D.** Cucumber Diseases. Ohio Agr. Exp. Stat. Bull. 89: 99–116. 1897.
Notes very injurious effect of downy mildew on late or pickling cucumbers in Ohio, especially in 1897; gives botanical account of fungus; records successful spraying experiments with Bordeaux.

45. **Selby, A. D.** Studies of the Diseases of Cucurbits and Tomatoes. Ohio Agr. Exp. Stat. Bull. 111: 140–41. 1899.
Refers to work done by Ohio Station in study and prevention of downy mildew of cucumbers, etc.

46. **Selby, A. D.** Further Studies of Cucumber, Melon and Tomato Diseases, with Experiments. Ohio Agr. Exp. Stat. Bull. 105: 219–21, 223–29, 230–1. 1899.
Gives notes on downy mildew; also list of hosts upon which it spread in the disease garden; gives successful spraying experiments with Bordeaux on cucumbers, and chiefly unsuccessful ones on musk melon.

47. **Selby, A. D.** Additional Host Plants of *Plasmopara cubensis.* Bot. Gaz. **27**: 67–8. 1899.
Grew a large number of cucurbits in a disease garden on most of which the mildew spread from the ordinary hosts. (See hosts elsewhere in this article.)

48. **Selby, A. D.** Certain troublesome Diseases of Tomatoes and Cucurbits. Reprint Journ. Columbus Hort. Soc. **11**: 1.
Notes downy mildew becoming common in Ohio, especially in greenhouses.

49. **Selby, A. D.** A Condensed Handbook of the Diseases of the Cultivated Plants in Ohio. Ohio Agr. Exp. Stat. Bull. 121: 29, 33, 38, 51, 54, 58. 1900.
Gives short notes on downy mildew under the following hosts: cucumber, gourd, musk melon, pumpkin, squash and watermelon.

50. **Selby, A. D.** Calendar for Treatment of Plant Diseases and Insect Pests. Ohio Agr. Exp. Stat. Bull. 147: 50, 51. 1904.
Recommends for downy mildew of cucumber and musk melon at least four sprayings with Bordeaux, at intervals of eight to ten days, beginning about the time the vines start to run.

51. **Sirrine, F. A. and Stewart, F. C.** Spraying Cucumbers in the Season of 1898. N. Y. Agr. Exp. Stat. Bull. 156: 376–96. 1898.
Give very favorable results of several spraying experiments with Bordeaux made on a large scale with pickling cucumbers; recommend first treatment July 15 to August 1, repeating every eight to ten days until frost; give cost of spraying, yields and profits in their experiments.

52. **Stene, A. E.** When to Spray. R. I. Agr. Exp. Stat. Bull. 100: 127. 1904.
Notes downy mildew difficult to control, recommends Bordeaux beginning middle of July and repeating every ten to twelve days during season of vines.

53. **Stewart, F. C.** The Downy Mildew of the Cucumber; what it is and how to prevent it. N. Y. Agr. Exp. Stat. Bull. 119: 155–82. 1897. [Illustr.]
Gives general and botanical account of this fungus, which was serious in New York in 1896; reports very successful spraying experiments with Bordeaux on late cucumbers; recommends spraying the young plants and repeating every eight to ten days till frost.

54. **Stewart, F. C.** Further Experiments on Spraying Cucumbers. N. Y. Agr. Exp. Stat. Bull. 138: 636–44. 1897.
Gives favorable results from spraying early cucumbers with Bordeaux (1 to 8 formula) to prevent downy mildew in 1897; notes impractical results of trying to prevent mildew by shading with corn; reports new host, *Cucumis moschata*.

55. **Stone, G. E. and Smith, R. E.** Cucumber Mildew (*Plasmopara Cubensis* B. & C.). Mass. Agr. Exp. Stat. Rept. 13: 72–3. 1901.
Note appearance on greenhouse cucumbers in Mass.

56. **Stone, G. E. and Smith, R. E.** Melon Failures. Mass. Agr. Exp. Stat. Rept. 14: 62–6. 1902.
Report downy mildew with Alternaria and Colletotrichum, the cause of unusual failure of musk melons; also bad on cucumbers; spraying not entirely effective with musk melon, but advocated.

57. **Stone, G. E. and Smith, R. E.** Report of the Botanists. Mass. Agr. Exp. Stat. Rept. 15: 28, 29–32, 37–8. 1903.
Give general notes on prevalence of downy mildew on cucumber and musk melon in Mass.; note growth of plants under tents; think mildew can be kept off from plants grown in greenhouse by proper watering; report little gain from spraying musk melons.

58. **Stone, G. E.** Cucumbers under Glass. Mass. Agr. Exp. Stat. Bull. 87: 36–7. 1903. [Illustr.]
Gives general account of the downy mildew and preventive measures.

59. **Sturgis. W. C.** Downy Mildew on Melons. Conn. Agr. Exp. Stat. Rept. 1899: 277–78. 1900.
Gives account of damage done at Meriden, Conn., on musk melons and advocates starting plants under glass to get an earlier start and escape in part this trouble.

60. **Swingle, W. T.** Some Peronosporaceae in the Herbarium of the Division of Vegetable Pathology. Journ. Myc. 7: 125. 1892.
Lists *Peronospora cubensis* B. & C., under doubtful section of this genus, on *Cucumis anguria* from Texas and Florida, and on *Cucumis sativus* from Texas and Maryland.

61. **Thaxter, R.** Peronospora on Cucumbers. Conn. Agr. Exp. Stat. Rept. 1890: 97. 1891.
Notes appearance of this fungus, for first time in Connecticut, at South Manchester.

62. **Tubeuf and Smith.** *Peronospora* (*Plasmopara*) *cubensis*. Diseases of Plants: 134. 1897.
Merely list as an injurious species.

63. **Waite, M. B.** Description of two New Species of Peronospora. Journ. Myc. 7: 106. 1892.
Notes the resemblance of his *Peronospora Celtidis, n. sp.*, on *Celtis occidentalis* to *Peronospora Cubensis* B. & C.

64. **Weed, C.** The Cucumber Mildew. Fungi and Fungicides: 160. 1894.
Gives short account of the fungus.

65. **Zimmermann, A.** Ueber einige an tropischen Kulturpflanzen beobachtete Pilze II. Centr. Bakt. Par. Infek. 8: 148. 1902. [Illustr.]
Describes *Peronospora cubensis* var. *atra, n. var.*, from Buitenzorg, Java, or *Cucurbita pepo*.

66. **Zimmermann, A.** Untersuchungen über tropische Pflanzenkrankheiten. Ber. über Land- und Forstwirtschaft in Deutsch- Ostafrika 2: 11–36. [Review, Centr. Bak. Par. Infekt. 12: 316. 1904.]
Lists *Peronospora cubensis* var. *atra* on cucumber leaves from Dutch East Afrika.

Explanation of Plate XXXI.

Detailed drawings of *Peronoplasmopara Cubensis*. Magnified about 600 diameters, except 1, which is only magnified about 350 diameters.

1. A single conidiophore emerging from a stomate of a leaf.

2. Base of a conidiophore and lobes of the mycelium from which other conidiophores develop in favorable weather.

3. Top of a conidiophore, showing an immature (a) and a mature (b) spore still attached.

4–9. Spores (temporary) that were produced on the conidiophores. 4. Contents emptied out through pore of dehiscence. 5. Spore about to germinate, showing areas in the protoplasm. 6. Showing last of about a dozen zoospores escaping from the spore. 7. A zoospore that failed to escape from the spore.

8. Cross section of an empty spore. 9. Empty spore, showing the pore through which the zoospores escaped.

10–12. Motile stage of the zoospores; 10, showing the separation of zoospores into individuals.

13. An unusually large zoospore making an unsuccessful attempt to divide.

14. Zoospores after coming to rest and before their germination.

15. Zoospores (in an amoeboid condition) that never germinated and finally died.

16. Different stages of the germination, in water, of the resting zoospores.

17–20. Infection of the host through germinating zoospores resting on the epidermis. 17. A zoospore settled down over a stomate. 18. The same zoospore two hours later, with its germ tube apparently entering the leaf between the guard cells of the stomate. 19–20. A resting zoospore (a) on leaf near a stomate; (b) its final position after starting to germinate two hours later; 20, its condition twenty-four hours later, apparently trying to bore into leaf through the epidermis.

a. Under surface of leaf showing early stage of blight.

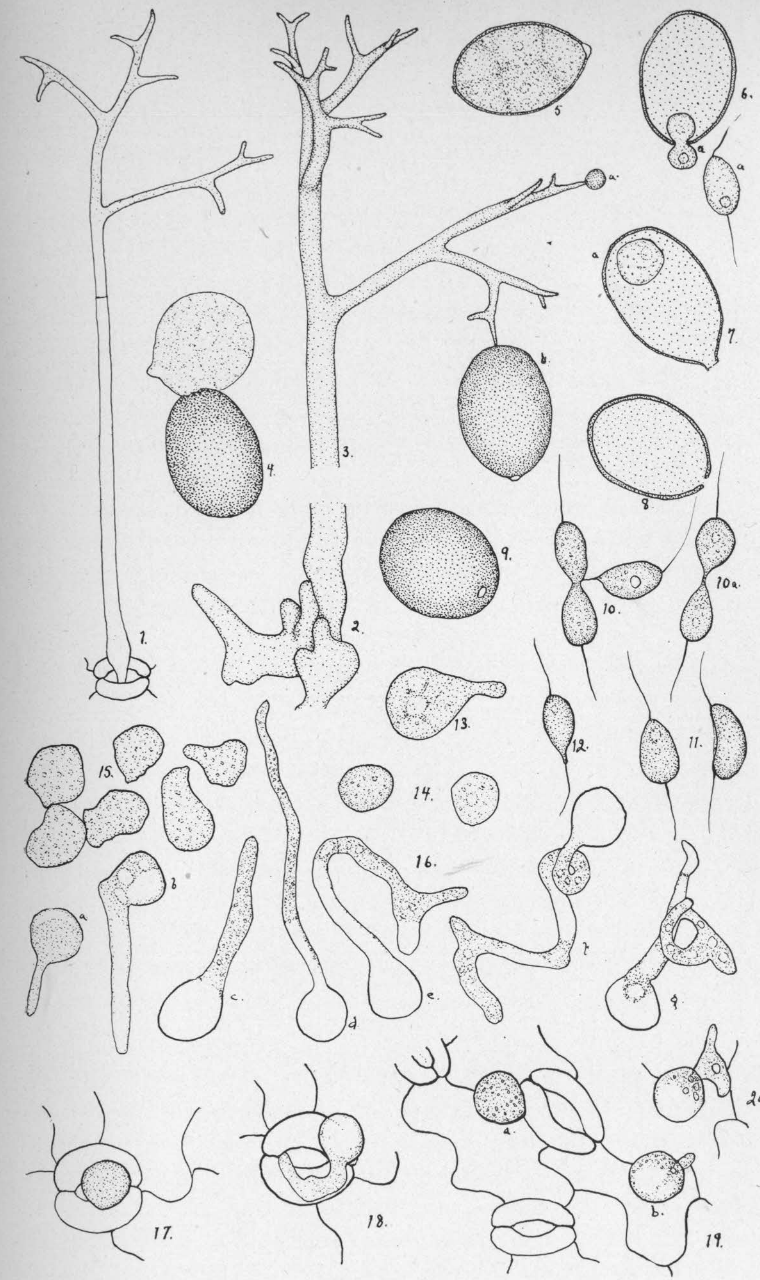
b. Under surface of leaf showing later stage of blight.

BLIGHT, OR DOWNY MILDEW, OF MUSK MELON, *Peronoplasmopara Cubensis*, p. 344.

a. Blighted vine in the field, p. 344.

b. Vines in foreground sprayed ; those in rear not sprayed, p. 351.

BLIGHT OR DOWNY MILDEW OF MUSK MELON.



DETAILED DRAWINGS OF *Peronoplasmopara Cubensis.*

DOWNY MILDEW, OR BLIGHT, *Phytophthora infestans* (Mont.) DeBy., OF POTATOES.

Aim of Investigations. In 1902 the writer began a series of spraying experiments with potatoes having two objects in view, namely, first, to determine just how injurious the blight fungus, *Phytophthora infestans*, is in this state year after year, and second, to determine the most effective and practical method of spraying to prevent it. No especial originality is claimed for these experiments, since the object was to apply chiefly what the general results of others had determined and see how these were adapted to the conditions that exist here. We report in this paper the results and suggestions that have been gained so far.

No idea was had at the start of a special study of the fungus that is responsible for blight, as it has had the attention of many European botanists. There are a number of points in its life history, however, that the writer has been forced to believe are not known, or at least have not been positively settled. A complete knowledge of the fungus must have considerable bearing in determining the very best ways for controlling the disease. Consequently, during the past year, efforts have been made to gain all possible information concerning the fungus itself. This second phase of the subject is not dealt with especially in this paper, as it is still under consideration, but as a general knowledge of the blight fungus is necessary to an intelligent understanding of the methods employed in combating it, we give briefly what we understand from our own observations and those of others to be the main facts in its life history.

Life History of Fungus.

Infected Tubers. To the ordinary observer blight begins in his field when it shows with the sudden or gradual death of the vines in the middle of July or later. Its first development, though hidden, really began when infected tubers in that or some other field were planted in the spring. In other words, the blight fungus is carried over the winter in the tubers from a previous diseased crop. Furthermore, *so far as we now know, the fungus is perpetuated only by the infected tubers,* and not through diseased tubers that have rotted outdoors, or by the old rotted vines, or through infection of the land, or on some other host of the fungus. However, *there is a possibility that one or more of these other means may also serve to perpetuate the fungus*, but as yet proof is lacking. A good deal of study has been made on this phase of the subject, but it needs still more.

The appearance of the disease as ordinarily shown at time of storage on potatoes is a reddish brown rot that develops only slowly, if at all, when the tubers become dried out and are kept in a cool, dry place. This discoloration shows at the surface, often extending inward from the skin to the bundles or further, and the surface may also become slightly sunken or pitted. (See Plate XXXIII, b.-c.) In the fields, and while still damp in storage, the rotting is often very rapid. This is largely due to the presence of bacteria or the Fusarium fungus that develop independently or as a consequence of the blight and are apparently more active agents of decay. Very often tubers are found having an end rot, usually the stem end, that affects the whole tuber as it progresses forward. Not infrequently the freshly diseased, or innermost, tissues have the same reddish brown color found in blighted tubers, and probably the fungus is sometimes present, but usually this end rot seems to be caused by the Fusarium fungus which breaks out in white fruiting pustules on the surface. This also becomes a slow dry rot in storage after the tubers have dried out. The bacterial trouble is usually shown in the field by a slimy, sticky, ill-smelling rot that, if first started by the blight fungus, soon outstrips it as the agent of decay and no doubt often starts independently of this fungus. In storage it gradually dries out and works slower and is often found in connection with the Fusarium or other fungi.

The blight fungus persists in the infected tubers by means of its mycelium, or its vegetative stage. This consists of microscopic threads that have pushed their way slowly between the cells of the tuber, occasionally sending short, thick-walled branches inside the cells to obtain nourishment for growth. This stage has directly to do with rotting the tubers and blighting the vines, but not with spreading the disease. During the storage of the tubers it apparently exists in a dormant, or at least not very active, condition.

When infected tubers are planted in the spring the mycelium may push out on the undiseased cut surface of the tuber from the diseased tissue and there form the temporary spore, or reproductive stage, the same that it develops in July or August on the leaves. This spore development is likely to continue only for a short time, as the blight fungus is easily crowded out by other fungi and it does not form this stage at all on rotten tissues. Some of the spores produced here may be carried accidentally by insects or washed by the rains to the young buds of the sprouting tuber and on germination infect these with the disease. Or probably the mycelium as often grows directly from the diseased tissue into the healthy tissue of the developing buds and secures infection in this way. It is quite probable that comparatively few plants in the field become infected through the diseased tubers; at least we can say positively from experiments that diseased tubers do not necessarily produce infected plants. In an experiment by the writer where badly rotted blight tubers were planted in a greenhouse, the tubers either failed entirely to produce plants or else developed plants in which the disease never appeared, though the fungus grew out on the cut surface in its spore stage. So far the writer has not observed in the fields stems developed from infected buds, but the few seen in the greenhouse remained dwarfed and of a reddish brown color at the surface, as if the fungus was superficial in the tissues. These infected stems do not produce spores except under proper conditions of moisture. This fact, together with their scarcity, possibly explains why the disease is so slow in getting started in a field, rarely ever appearing before the middle of July, and often much later. Once the spores begin to be produced above ground, however, with proper weather conditions they spread the disease through the field and, no doubt, to other fields. Just how far and how often the fungus is carried by these spores from one field to another are points that need further investigation. Also the whole subject of the very early development of the disease requires more observations and experiments.

Blighted Vines. This temporary spore stage may be described very briefly as follows: The fungus once started in a leaf, through infection from a germinating spore, develops its mycelium between leaf cells, killing the tissues as it goes, and also sends out to the exterior through the stomates, or openings in the epidermis, erect branched fertile threads that form the temporary spores. The spores mature very quickly and can germinate immediately if they fall in a drop of water. Many of the spores perish, however, as they cannot live long in dry air. The germination usually consists in the formation and liberation of several motile animal-like bodies called zoospores that swim around in the water for a short time and then come to rest. They then send out a germ thread that grows into the leaf tissues and develops the mycelium from which arise the spore-bearing threads as before. This process of spore formation, germination, infection and development of mycelium can be kept up indefinitely, or at least as long as weather conditions are favorable and there are green potato leaves left. The wind, rain and insects serve in spreading the spores. Moist, cloudy weather of several days' duration is best adapted for the growth and spread of the fungus, since the fruiting threads are then formed most abundantly; then conditions are also favorable for the germination of the spores and infection of the leaves and the diseased area in the leaf develops rapidly. In dry weather the blackened, diseased tissues of the leaf dry up, but the fungus makes very little further advance, while very few new fertile threads are developed on the exterior. The blackened, diseased spots usually start at the margin of the leaves and develop inward, and on the under side the spore threads, especially in moist weather, can be seen as a faint whitish growth just in advance of the discoloration. (See Plate XXXII, a.) The character of the weather during July and August determines largely how much injury the fungus will do to the vines. If after the disease has spread somewhat through the fields there comes a period of blight weather, the vines may all be gone in a week; or if the weather is less favorable for its development the disease may lag along slowly. Some seasons it does not appear until the very end.

Rotten Tubers. It has been stated by some writers that the blight fungus, through its mycelium, passed down the stems into the tubers. We have seen no evidence that this is so, and doubt if it ever (perhaps rarely) occurs. With the Fusarium and the bacterial rots of the tubers this may be true, since the disease in these cases often starts in the stem end of the tubers.

Infection of the blighted tubers takes place through the spores that fall on the ground from the infected leaves above. If these are washed down to the tubers, infection takes place on their germination by the germ threads boring directly into the tissues and there developing the mycelium. So far as observed by the writer, the fungus is not apt to send out fruiting threads on the surface of these tubers while in the ground and spread the disease this way. Such fruiting threads, however, have been seen in potatoes freshly dug and kept in a moist atmosphere, and probably are formed somewhat in the ground. The amount of moisture in the soil while these spores fall on the ground and the nearness of the tubers to the surface are two factors in determining the extent of the infection. Severity of blight in the foliage does not necessarily mean a corresponding severity of rot in the tubers. At least in July, 1902, there was a sudden and severe blighting of the vines, many fields being entirely dead a week after the appearance of the trouble, and yet there was comparatively little complaint of rot that year. On the other hand, in 1904 the blight made its appearance very late in the fields, doing comparatively little injury to the foliage; but this year the tubers rotted badly from the blight. The rot in the tubers does not usually start until the vines are dead. As mentioned before, all the rots of the tubers are not due to the blight fungus. In 1903, for instance, the tubers rotted rather badly, but this was caused chiefly by the bacterial rot and the Fusarium fungus.

Winter Spores. The spores of the blight fungus are temporary and cannot carry the fungus over the winter, but, as previously stated, this is accomplished by the mycelium in the infected tubers. Many of the fungi in the group to which the blight fungus belongs, however, develop thick-walled oospores (winter or resting spores), and these serve as a means of perpetuating such fungi. These spores have been looked for in connection with the potato fungus, but their existence has never positively been proven, though some investigators have thought that they found them. The writer has made a special search for them, and while some suspicious things have been seen, no positive evidence of their existence has been gained, though artificial cultures of the fungus have been grown on various media in test tubes and search has been made in the potato leaves and tubers in all stages of infection and decay. From these investigations we are inclined to the belief that if such spores are formed in this locality they develop only in the rotted tissues, tubers most likely in the very last stages of their complete decay; that is, in the late spring in the tubers left in the fields, and later in the summer, after rotting to pieces, in the infected seed tubers. Blighted tubers in this condition not infrequently contain spores of this nature that look suspicious, but as yet no positive proof of their connection has been obtained, and as a number of unrelated saprophytic fungi develop in the rotted tubers they could easily belong to some of these. It has occurred to the writer, also, that possibly these oospores are formed only on the union of two strains of mycelia (which may rarely occur together), as has recently been shown for a somewhat related group of fungi. In any case, whether this fungus possesses such spores or not, further study along this phase of the subject is needed.

Spraying Experiments.

Previous Experiments. Both the former botanists of this Station made a few spraying experiments that may be briefly mentioned here. Professor Thaxter, in 1889, when blight was unusually severe, made one of the very first spraying experiments against this trouble that has been reported. He sprayed three times with Bordeaux mixture, on July 18, July 25 and August 3, and got a decided difference in the foliage between those sprayed and those unsprayed. On August 3 the sprayed vines retained 50 to 60 per cent. of their foliage, while the unsprayed were entirely dead, and on August 10 the sprayed vines still retained 25 per cent. of their foliage. Unfortunately (Thaxter thought possibly due to error in harvesting) the treatment gave no increase in yield. In 1890 Thaxter reported a successful treatment by Mr. N. S. Platt, made after the blight appeared in the field; in this case the yield was reported considerably increased. Dr. Sturgis also conducted spraying experiments in 1892 and in 1893, but both these years there was little, if any, blight in the sprayed fields, so that his experiments were chiefly of value in showing what effect spraying has in years when blight is not troublesome. He reported considerable benefit resulting from the treatment the first year, but not the second, which was a very dry year.

Recent Experiments. The following experiments have been made personally by the writer in order that he might learn of the disadvantages as well as the advantages of spraying. They have been conducted on all scales from a small garden plot to a five-acre field. The various types of spraying apparatus have been tried to determine their merits and demerits. The number of sprayings in each case has been reduced to the minimum, because it was felt that a maximum number of treatments did not meet with favor among growers generally. Most of the treatments, however, were made very thorough, for upon this thoroughness and the proper time of application largely depends the success of spraying. Bordeaux mixture (four pounds lime, four pounds copper sulphate, and forty to fifty gallons water) was used in all cases, with the addition, when needed, of Paris green for the potato beetle. The check plants were also usually sprayed once or twice with Paris green. In making the Bordeaux, the lime was slaked in a small amount of water and then strained into a barrel about half filled with water. The copper sulphate (kept in stock solution of one pound to one gallon of water) was poured into another barrel, about half filled with water. The half-barrel of copper sulphate solution was then poured into the half-barrel of the lime water, stirring the mixture as this was done.

No direction was assumed of the sprayed fields as to their culture, fertilization, etc., and these conditions varied considerably in the different experiments. In testing the yields it was desired to determine how much more or less the sprayed plats gave over those unsprayed in number and weight of tubers and the amount of rot in each. These tests were always made from the same measured lengths of the sprayed and unsprayed rows, practically side by side, and from at least two places in the field. This was to eliminate, as far as possible, any other influence beside the spraying that might affect the yields.

Spraying Experiments in 1902.

General Notes. This year the blight appeared suddenly in July and a number of the fields were ruined by it before the end of the month. (See Plate XXXII, b.) The weather during

July and August was of the kind especially fitted to develop blight, being cold, rainy and foggy, often several days occurring together with little or no sunshine. By the middle of August there were few green potato fields in the state. For example, on August 26, while riding on the train from Unionville to New Haven, there were counted about sixty potato fields, and in all of these the vines were entirely dead, excepting three or four, where the vines were still partially green. Except for the blight, the fields of late potatoes should have lived until killed by the frost, which this year, according to the weather bureau at New Haven, did not occur until October 10 and October 22. Little rot developed in the tubers, the injury being thus largely confined to this very premature death of the vines.

Exp. 1, in Ogden field with late potatoes. This field, of about half an acre, was elevated, stony and the soil naturally rather poor, but it was well dressed with artificial fertilizers and the culture was fair. The potato vines did not cover the ground so densely as they often do in richer, moist soil, so it was easier to protect this field against blight than one of rank growth. The first spraying, July 30, was made just after a small amount of blight appeared in the field. This application was somewhat tardy, about ten days, but it made less difference in this field than it would have made in one of luxuriant vegetation. The second and third treatments were made on August 5 and August 23, and on the latter date there was evident difference between the sprayed and unsprayed parts in the injury from blight. On September 2 the unsprayed plants were nearly all dead, while the sprayed plants were mostly alive, being the only green field in the vicinity. At the time of digging, September 25, forty-two of the two hundred and twenty sprayed plants reported in Table I were still partially green. Plate XXXVI, a-b, shows the condition of sprayed and unsprayed plants on September 16. The spraying was done with an ordinary barrel pump carried on a light spring wagon. One man drove and pumped and one man sprayed about six rows, using a twenty-five-foot hose with a single nozzle. The wagon reach was about six inches too narrow for straddling two rows perfectly, so the vines were run over somewhat. This caused little permanent injury, much less than is ordinarily supposed, but by planting the rows at the right distance or by using a cart

having the right gauge this trouble can be largely avoided. The results of the spraying are given in detail in Table I. This shows that the sprayed plat gave an increase of 108 per cent. in weight of tubers over the unsprayed plat and the increased yield was evident not only in the number of marketable tubers, but also in their larger size. Neither sprayed or unsprayed potatoes rotted at all. This experiment gave the best results of any tried during the three years.

TABLE I.—LATE POTATOES, OGDEN FIELD, 1902.

Treatment.	Dug.	Number plants.	Large to medium tubers.		Medium to small tubers.		Total marketable.		Very small tubers.		Rotten tubers, Number.
			Number.	Weight, lbs.	Number.	Weight, lbs.	Number.	Weight, lbs.	Number.	Weight, lbs.	
Sprayed July 30, August 5, August 23.	Sept 25, equal length in each plat.	220*	512	237	871	157	1383	384	296	14⅓	2
Unsprayed.		197*	264	106¾	479	78¾	743	185½	248	12	5

* Planted rather unevenly by planter, but possibly part of plants in unsprayed rows destroyed by blight.

Exp. 2, in Nesbit field after blight started. These potatoes were on rather rich lowland and the vines were very luxuriant, entirely covering the ground. When first sprayed, the mildew was well scattered through the field (not consipcuous, except in a few scattered patches, where the plants were plainly injured), and all the conditions were favorable to rapid advance of the blight with the proper weather. The experiment was undertaken to determine if in a field of this character spraying would be of any value when tardily applied. The first treatment was made August 4 on a small part of the potatoes on either side of a roadway, spraying in as far as could be reached with the twenty-five-foot hose. Favorable blight weather followed the spraying, and when examined again on August 13 those sprayed on one side of the roadway were little or no better than those unsprayed, as both were badly blighted. The potatoes on the other side of the roadway were apparently of a later planting and were still green, though severely injured by the blight, and these were given a second treatment. These two sprayings, however, failed to check the progress of the blight, and when finally examined on September 15 the only difference seen between the sprayed and unsprayed parts was an occasional partially green plant in the sprayed plat. The rest of the field was entirely dead. As no influence on the yield was expected from these results, this was not determined. We conclude from this experiment that it is useless to begin spraying in a field with luxuriant foliage after the blight has become well established and the season is favorable for its development.

Spraying Experiments in 1903.

General Notes. This season was also wet, though not so cold or damp as the preceding. The blight appeared considerably later; the very first found by the writer was on August 8. From this time on it spread through the fields, gradually killing the leaves until August 24 to 31, when in a period of weather favorable to blight all of the fields where it had a foothold were quickly ruined. The possible yield was not cut down so much as the year before by premature death of the vines, but the rot in the tubers was much more serious. These did not begin to rot, with the late varieties at least, until the plants were killed by the blight; yet from an examination of the tubers the writer could not find the blight fungus as the agent of the rot. Most of the tubers examined began to decay at the stem end and the rot seemed to be caused by bacteria and the Fusarium fungus. The largest tubers suffered the most. By killing the green vines the blight fungus probably (indirectly) was responsible for starting these troubles.

Most of the spraying this year was made or started with geared spraying carts in order to test the efficiency of this kind of an apparatus. (See Plate XXXV.) Spraying by hand requires more time and men than these machines, where the horse, at the same time he is pulling the apparatus through the field, is pumping (by means of gearing attached to the wheels) the Bordeaux from stationary nozzles that project over the potato rows. Only one man is needed, and he drives, seated on the cart. Two machines were used that seemed to be as well fitted for the work as any. Our experience with these machines, and our observation and information concerning others, leads us to conclude

that such machines are not to be recommended for applying Bordeaux mixture against potato blight. There is need, however, of some cheap machine that will do the spraying more rapidly and cheaply, and yet about as thoroughly as can be done by hand. One of the machines tried had single nozzles for covering four rows, while the other had double nozzles. Neither machine could place sufficient spray, well distributed, on the vines, even by going over the potatoes two and three times, at the same spraying. Usually the Bordeaux showed as a streak of blue on the tops of the full-grown vines. The use of stationary nozzles, even with two to a row and a level and evenly planted field for spraying, occasionally caused parts of a row to be missed. The slower the geared machine is driven the less the power, and yet it is desirable to go slow in order to place more spray on the vines. Even at their best, these machines used only about a barrel of the spray to an acre and a half, whereas two or three barrels per acre is needed to thoroughly protect the mature vines.

The apparatus shown in Plate XXXIV, b, is a type often used. In this case the stationary nozzles are attached to the end of an ordinary cart carrying a barrel pump, and the pumping is done by hand. This, too, has some of the objections of the geared machines. By very slow driving, however, more spray can be placed on the vines, but because of the stationary nozzles it will not be done very thoroughly or evenly. In this particular apparatus better work would have been done if the pump had been stronger. It was not powerful enough to readily supply the eight nozzles used.

By far the most satisfactory type of spraying outfit for thoroughness of work is that shown in Plate XXXIV, a. This is merely a two-wheeled cart, of sufficient reach to straddle two rows of the potatoes, which carries an ordinary barrel pump and a man to pump and drive. Two men follow the cart, each using a twenty-five-foot hose with a single nozzle, and they each spray three rows without moving from the row, in which they travel backward. The man drives the length of the hose and the men spray their rows up to the cart, which then moves on again. In this way the ground can be gone over fairly quickly and the spraying can be done as thoroughly as desired. Two nozzles to a hose seem to be little better than one and waste more of the material. Where only two men are available for the work, only one need be used for spraying. Each hose should be fitted with a cock at the nozzle and a holder for inserting a short pole for directing the spray. The chief objections against this method of spraying are that it requires an extra man or two, and its slowness; but, taken altogether, it is the best way known to the writer for spraying any considerable area thoroughly.

Exp. 3, in Farnham field with late potatoes. This level field, of about six acres, has a rich but slightly sandy soil. The cultivation and fertilization were good. The first blight was found in the field August 8, or after the first two sprayings had been made. These treatments were made with the geared power sprayer, but this worked so unsatisfactorily that six rows (plat A, see Table II) next the four unsprayed rows were sprayed on August 8 and August 24 by hand, as shown in Plate XXXIV, a. On August 24 the blight had made such progress in the main part of the field sprayed by the geared machine that part of this was sprayed more thoroughly by hand, but this was too late to materially check the advance of the blight. On this date the thoroughly sprayed six rows, plat A, were in fair condition, while the unsprayed rows were two-thirds gone with the blight. On September 3 the unsprayed rows were entirely dead; the imperfectly sprayed main field, plat B, was about as badly gone; while the more thoroughly sprayed plat A was still green, having only about half the foliage destroyed. (See Plate XXXVII.) The yield, as tested on September 4, gave the more perfectly sprayed plat A 59 per cent. greater yield by weight than the unsprayed rows next to it, while the imperfectly sprayed plat B, which was tested quite removed from the check unsprayed rows, gave 42 per cent. greater yield. At this date little rot had developed in the field. As the vines in plat A were still partially green at this time, a second test of this and the check rows was made on September 25, after all the vines were dead. This test was made in rows side by side with the first. It showed that while plat A had made some increase in weight and number of marketable tubers during this interval, this was completely offset by the rot that had developed. The unsprayed rows, however, being entirely dead, had made no increase and had suffered more severely through rot. So on the second digging the sprayed plat A showed 91 per cent. increase in weight over the unsprayed. This experiment indicates that the rot starts soon after the death of the vines, usually in a week or so, as was shown in the digging of the main field.

TABLE II.—LATE POTATOES, FARNHAM FIELD, 1903.

Treatment.	Dug (200 feet).	Number plants.	Large to medium tubers.		Medium to small tubers.		Total marketable.		Very small tubers.		Rotten tubers.	
			Number.	Weight, lbs.	Number.	Weight, lbs.	Number.	Weight, lbs.	Number.	Weight, lbs.	Number.	Weight, lbs.
(A) Sprayed: July 10, Aug. 1, Aug. 8, Aug. 24.	Sept. 4	129	151	72	563	115	714	187	125	7	0	
	Sept. 25	119	53	27½	651	150½	704	178	172	8¾	50	14
Unsprayed, or Check.	Sept. 4	126	29	13	618	104½	647	117½	123	6½	5	
	Sept. 25	127	11	6	369	82	380	93	143	9	104	25
(B) Imperfectly sprayed: July 10, Aug. 1, Aug. 24.	Sept. 4	130	140	67	444	100	574	167	62	4	4	

Exp. 4, in Farnham field with late variety planted very late. This was in the same field reported in experiment 3, but the potatoes were not planted until about the middle of June. The experiment was to determine if such late planting on land used earlier in the season for other crops was feasible if the potatoes were sprayed to ward off the blight, which might otherwise carry them off before the tubers were of marketable size. Unfortunately only two treatments were made. Doubtless three would have given better results, especially if the first had been made a little earlier. At the time of the first spraying, August 8, a little blight was found on these plants, but it was not nearly so abundant as in the unsprayed part of the earlier planted potatoes. On August 24, at the time of the second spraying, the fungus was common in the check rows of the unsprayed late-planted potatoes, but still was not nearly so abundant as in the unsprayed early planted potatoes. This confirms DeBary's statement that blight generally seems to develop most prominently in a field when the vines are in their prime of development. On September 3 the unsprayed rows were very nearly gone with the blight, while the sprayed rows still retained half of their foliage. The sprayed plat was dug September 25, when the yield was found to be a little greater and the rot a little less than in the unsprayed plat of the early planted portions of the field. It was not possible to compare it with its proper check, since this had been dug by accident a few days before, but the man in charge said that these unsprayed rows had yielded very poorly. It would seem from this experiment, then, that where it is very desirable to use a field for another crop until the middle of June, a moderate yield of potatoes can be secured from it afterward if these are thoroughly sprayed three times to ward off the blight.

Exp. 5, in Ogden field with early and late potatoes. This field contained about one acre and a half of rather level and medium rich land. The day before planting the potatoes the green rye on the field was plowed under. Dry weather followed, so that the potatoes were a long time coming up, and a very uneven stand was made, as many of the plants never came up or were rotted off below the ground by a bacterial rot. Without much question, the humus of the decaying rye had much to do with this stem rot and the severe rot of the tubers that developed later. The field was very poorly cultivated and became very weedy. All of these conditions were against the potatoes. The vines were sprayed three times (July 5, August 11, September 1), twice with the geared spraying machines and once with the stationary nozzle outfit shown on Plate XXXIV, b. It was impossible with either of these appliances to properly cover the foliage, even by going over the field two and three times each spraying. Consequently the spraying was done very imperfectly. August 11, at the time of the second spraying, blight was first noticed in the field, being most abundant on the unsprayed early potatoes. September 1 the blight was quite prevalent in the field and with but slight difference in favor of the sprayed parts. When dug on September 21 all of the vines had been dead for some time. The rot, which developed very badly, was largely a soft bacterial rot. A field nearby suffered very little from rot. The sprayed plat of the late variety, which constituted most of the field, gave 20 per cent. less yield by weight than did its unsprayed plat. This was the only experiment during the three years in which a smaller yield was got from a sprayed than from an unsprayed

plat, but even here the yield was originally greater in the sprayed plat, but lost through more severe rotting of the tubers. The early variety, however, gave an increase of 100 per cent. for the sprayed over the unsprayed vines. Because of the imperfect spraying and the development of severe rot, probably due to plowing under the green rye, the experiment was not very satisfactory. See Table III. for details.

TABLE III.—LATE AND EARLY POTATOES, OGDEN FIELD, 1903.

Treatment.	Dug. (100 feet.)	Number plants.	Large to medium tubers. Number.	Large to medium tubers. Weight, lbs.	Medium to small tubers. Number.	Medium to small tubers. Weight, lbs.	Total marketable. Number.	Total marketable. Weight, lbs.	Very small tubers. Number.	Very small tubers. Weight, lbs.	Rotten tubers. Number.	Rotten tubers. Lbs.
A. *Late variety.*												
Imperfectly sprayed: July 15, Aug. 11, Sept. 1.	Sept. 21	64	6	3	92	17	98	20	96	4	165	22
Unsprayed:	Sept. 21	64	2	1	131	23	133	24	188	9	81	11½
B. *Early variety.*												
Imperfectly sprayed: July 15, Aug. 11, Sept. 1.	Sept. 21	60	2	1½	223	35	225	36½	126	6	74	10
Unsprayed:	Sept. 21	55	0	0	92	18	92	18	73	4	39	6

Spraying Experiments in 1904.

General Notes. This year was drier and warmer than either of the two preceding years and did not develop special blight weather during July or August. The very first blight seen was on August 3, but September found most of the late potato fields still green, and it was during the moist weather of this month that most of the injury to the foliage was done. Coming so late in the season, however, this injury would have been insignificant, and a large crop would have been harvested, but for the fact that this late blighting served to supply the spores that during the moist weather of September and October started a very serious and widespread rot of the tubers. Unlike the preceding year, this rot could be directly traced in its beginning to the blight fungus. The rot started at any place on the tubers, attacking small as well as large ones when severe, and showed the characteristic sunken areas with reddish brown discoloration of the superficial tissues beneath. There is little doubt, however, that after the blight fungus started the trouble, bacteria were often responsible for extending it, even outstripping the blight fungus in their progress and injury.

Exp. 6, in Farnham field with early potatoes and early spraying. This was a level, rather low field of rich but slightly sandy soil, and was well fertilized and thoroughly cultivated during the season. The aim of the experiment was to determine if spraying would prove profitable in a field of early potatoes that were to be dug and sold, at least in part, as soon as they were of marketable size. As the earliest potatoes are often dug for the market about the time that the blight appears, it was not expected that benefit would result so much from preventing blight as it would from better protection against potato bugs and flea beetles, and from the stimulation that Bordeaux mixture seems to give potatoes even when free from fungus attack. Blight was so late in appearing that it was not found in this field even on the unsprayed vines. The gain from spraying, therefore, resulted entirely from better protection of the foliage from insect attack and from the stimulative action of the Bordeaux mixture. The spraying was made with the barrel pump mounted in a cart and was done very thoroughly. The first treatment was given June 17, and the second, on July 7, was made on only part of the field next the unsprayed rows. The difference in appearance of foliage between the sprayed and unsprayed plats on July 7 was marked. In the plats sprayed with Bordeaux mixture one pound of Paris green per barrel was used, and as the foliage was thoroughly covered and the sediment adhered through the season, this protected the vines completely from the potato beetles. The check rows also had been sprayed twice with Paris green only (by the owner), with a geared spraying machine. The spraying by this method was imperfectly done and there was nothing to keep the poison from washing off by rains, so these vines suffered severely from attack by the bugs, and as no lime was used with the Paris green this also burned the foliage considerably. The

first digging was made on July 20, as soon as the tubers were ready for market. Despite the injury from the bugs and Paris green burn, the unsprayed plat at this digging yielded about as well as either the plat sprayed once, which gave only 3 per cent. greater yield by weight, or the plat sprayed twice, which gave 5 per cent. greater yield. As the sprayed plants at this time were still in their prime and the unsprayed plants nearly dead, a second test was made August 5, after all the plants were about gone. The test showed an increase of 8 per cent. in those sprayed once and of 17 per cent. of those sprayed twice over the unsprayed plat. There was no loss from rot. This experiment indicates that, where early potatoes are dug as soon as marketable, spraying with Bordeaux mixture does not pay, but when these potatoes are left until the vines are entirely dead the spraying will be of greater value, especially if early blight has been injurious or the late blight appears before the end of their season. There is no doubt that Paris green used in Bordeaux is more effective in repelling attack of the potato beetle and even the flea beetle than when used alone, and there is then absolutely no danger of burning the foliage. It is the extra cost of applying the Bordeaux mixture, especially if labor is an important factor, that largely offsets its benefits in spraying early potatoes, unless these are severely injured by preventable fungus attack. For details of experiment, see Table IV.

TABLE IV. EARLY POTATOES, IN FARNHAM FIELD, 1904.

Treatment.	Dug. (200 ft.)	Number plants.	Large to medium tubers.		Medium to small tubers.		Total marketable.		Very small tubers.		Rotten tubers.
			Number.	Weight, lbs.	Number.	Weight, lbs.	Number.	Weight, lbs.	Number.	Weight, lbs.	
Sprayed once, June 17.	July 20	146	4	3	1007	197½	1011	200½	319	12½	0
	Aug. 5	....	22	13	1022	206	1044	219	356	15	2
Sprayed twice, June 17, July 7.	July 20	148	4	2½	1114	210	1118	212½	294	13	0
	Aug. 5	....	34	20	1034	224½	1068	244½	408	16	2
Unsprayed.	July 20	148	17	11½	915	184	932	195½	387	15	0
	Aug. 5	....	20	12	998	196	1018	208	334	15	0

Exp. 7, in Farnham field with late potatoes. This was an acre field of about the same character as the preceding, except the cultivation given the potatoes was very poor. As a result the field became very weedy, which somewhat hindered spraying, and *the tubers were formed so close to the ground that they were easily reached by the spores of the blight fungus and so suffered severely from rot.* All the potatoes except three check rows were sprayed four times, using the barrel pump mounted on a cart, namely, on July 7, July 20, August 5 and August 20. As the potatoes were planted very late, the first spraying was made when they were only eight to ten inches high. The vines were severely attacked by potato bugs, especially the check rows, though these were sprayed twice by a geared machine with Paris green only. On August 5, or at the time of the third spraying, no blight was found in the field. The writer was not present at the fourth spraying, but when examined again on September 8 the unsprayed vines were all dead, though the stems were still green, having apparently been injured chiefly by the potato bugs. The sprayed vines were still green, but now showed many blighted leaves scattered through the field. The fungicide at this time was almost all off the foliage and the wet September weather that followed rapidly developed the blight, so that at the end of the next ten days the vines were mostly dead. The effect of this delayed appearance of the blight was to develop a serious rot of the tubers, especially in the sprayed plat, for the vines in the unsprayed plat had largely died before the appearance of the blight. If the potatoes had been properly cultivated, and especially if the tubers had been buried deeper under the soil by some system of ridge culture, it does not seem likely that the rot would have developed nearly so badly. The potatoes were not dug for the test until October 4, when it was found the rot had become very serious, especially in the center of the field, which was slightly lower and probably more moist. The rot apparently had developed recently, as the lower end of the field when dug a week or ten days before revealed little rot. The test showed that while the sprayed plat developed much more rot (half the tubers were rotted) than the unsprayed plat, it still gave a yield of sound tubers 73 per cent. greater in weight. For details, see Table V.

TABLE V. LATE POTATOES PLANTED LATE, IN FARNHAM FIELD, 1904.

Treatment.	Dug. (200 ft.)	Number plants.	Large to medium tubers.		Medium to small tubers.		Total marketable.		Very small tubers.		Rotten tubers.	
			Number.	Weight, lbs.	Number.	Weight, lbs.	Number.	Weight, lbs.	Number.	Weight, lbs.	Number.	Weight, lbs.
Sprayed, July 7, July 20, Aug. 5, Aug. 20.	Oct. 4	Not Recorded	5	4	367	68½	372	72½	190	7½	370	82
Unsprayed.	Oct. 4		3	2	265	40	268	42	441	14	44	4

Exp. 8, in Clinton garden with early and late potatoes. This garden is in an isolated spot, well shut off by trees and hills from any other garden or field, and has been in use only two years. Whether this accounts for it or not, it is a fact that during these two years blight has been slower in appearing here and less injurious than in almost any place observed by the writer. The location is rather low, and moist at one end, and the soil is derived largely from red rock, but with plenty of humus. These potatoes were sprayed with one of the compressed air knapsack sprayers, which work fairly well when comparatively small patches are to be sprayed. The blight did little damage to the early potatoes and developed in the late abundantly only

TABLE VI. LATE AND EARLY POTATOES, IN CLINTON GARDEN, 1904.

Treatment.	Dug. (50 ft.)	Number plants.	Large to medium tubers.		Medium to small tubers.		Total marketable.		Very small tubers.		Rotten tubers.	
			Number.	Weight, lbs.	Number.	Weight, lbs.	Number.	Weight, lbs.	Number.	Weight, lbs.	Number.	Weight, lbs.
A. *Early Potatoes.*												
Sprayed June 23, July 2	Oct. 6	33	4	2½	184	38½	192	41	30	1¼	3	¾
Unsprayed	Oct. 6	33	0	0	150	29	150	29	53	2¼	17	3¾
B. *Late Potatoes.*												
Sprayed July 2, July 27	Oct. 6	32	11	8	161	47	172	55	27	1¼	7	2½
Unsprayed	Oct. 6	36	11	8	163	42	174	50	27	1½	6	¾

at the very end of the season. These latter should have had one or two more sprayings. There was very little rot, *probably because the tubers were well covered by earth through ridge culture;* the patch was a decided contrast, in this respect, with the Farnham field, Exp. 7, which was dug a few days before. The early potatoes gave an increase of 41 per cent., but the late only 10 per cent. over their unsprayed rows.

Summary and Conclusions.

The blight fungus, *Phytophthora infestans,* while by far the worst fungous pest of the potato in Connecticut, is often held responsible for any serious injury to the vines or rot of the tubers. The Rhizoctonia fungus, the early leaf blight, the Fusarium fungus, the bacterial stem rot, the wet bacterial rot of tubers and the well known scab are all parasitic agents at work in our potato fields and cause more or less injury. Considerable burning of the leaves is also done by the careless use of Paris green. In dry seasons, due to uncontrolled loss of moisture, tip burn of the leaves may develop.

During the three seasons 1902, 1903, 1904, which were years more moist than the average, the potatoes in this state suffered rather severely from blight, the crops being cut down at least 25 per cent. In 1902 the sudden and early blighting of the vines prevented a large yield, but there was little rot; in 1903 the yield was affected somewhat by the blighting of the vines, but was decreased chiefly by bacterial and Fusarium rots of the tubers that were apparently started by the premature death of the vines; while in 1904 blight was so late in developing that it did little injury to the vines, but did develop a serious rot of the tubers that carried off a large percentage of the crop.

Early potatoes suffer very much less from blight, especially in limiting the life of the vines, than the late varieties. This is because the blight often appears only toward the end of their season and sometimes not until they are entirely gone. It might be advocated, then, that early potatoes should largely supplant the late varieties. The yield from the late varieties, however, aside from serious injury from blight, is considerably greater, and because of this, and probably for other reasons, the late varieties generally seem to be much more in favor with

growers. Early potatoes, too, are not exempt from serious troubles.

There is no doubt that the character of the season is the dominant factor in determining how little or how much damage will be caused by blight. Rainy weather in July and August starts the fungus in the fields, and if there then comes a continuous period of rainy, cloudy or foggy weather the foliage will soon be destroyed. Wet weather in August or September following the blighting of the vines determines largely the amount of rot that develops in the tubers.

Besides the weather conditions, the moisture capacity of each field or portion of a field no doubt determines largely in a wet season the amount of rot that develops. This moisture in the soil is determined largely by elevation, drainage, mechanical character of the soil and its humus content. Other conditions being equal, well-drained, light, sandy soils apparently develop the least rot. As manure adds to the humus of the soil and is a carrier of certain troubles, as scab, etc., artificial fertilizers, rather than manure, should be used on the land the year it is planted with potatoes.

As the blight fungus, so far as known, carries over the winter only in the seed potatoes, the first step in lessening the disease should be with the selection of seed as free as possible from this and any other fungus disease, as scab, Rhizoctonia, etc. The selection of even perfect seed will not secure freedom from blight, as this trouble is often carried from one field to another after its general appearance; but it possibly may defer the time of its attack and lessen the injury.

Thorough cultivation tends to conserve the moisture of the soil in a dry season (when there is little danger of rot) and in a wet season it helps to keep the ground from becoming wet and soggy. Ridging the rows as late as possible in July holds up the vines from the ground and thus aids in a quicker evaporation of moisture from the foliage and ground, and in so doing aids in retarding the spread of the blight. It also covers the tubers deeper in the soil and so protects them better from the blight spores that fall from the leaves. Where spraying is practiced it also makes this operation easier. The objection to ridging is that in a dry season it may cause the plants to suffer for lack of moisture.

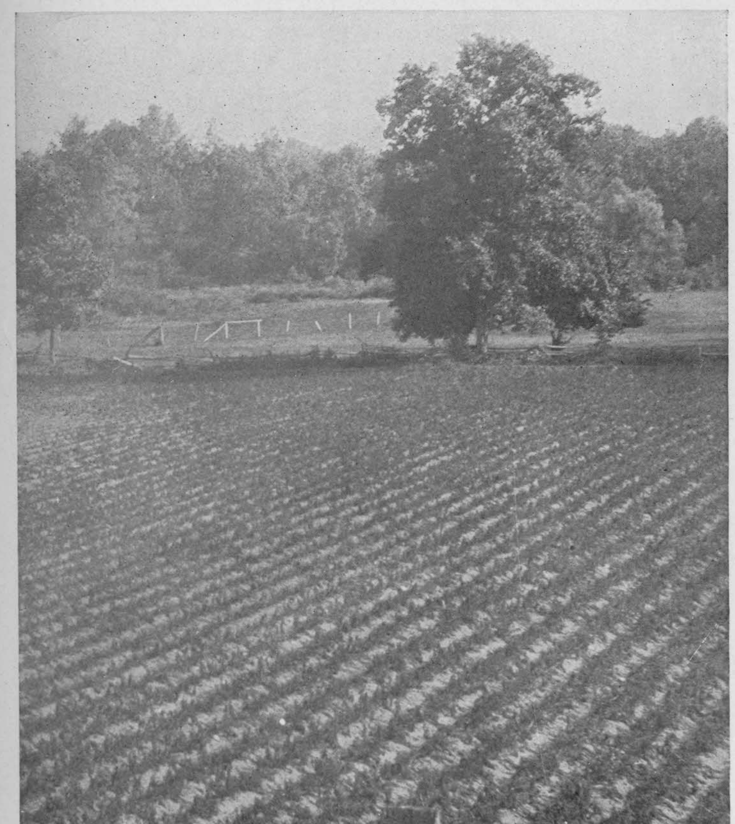
The results of spraying with Bordeaux mixture vary with different seasons, but depend largely on the thoroughness of the treatments and their application at the proper time. It is much easier to secure an increased yield of potatoes from spraying than it is to prevent rot in these afterward. This increased yield varies from almost nothing to sometimes over 100 per cent., and the rot of the tubers is usually less in the sprayed than in the unsprayed fields. An average gain of 15 to 20 per cent. should be had in order to pay for the extra cost and trouble of spraying; any gain above that is profit.

When late potatoes are to be sprayed for blight, the writer advocates three or four thorough applications, the first to be made July 5 to 15, according to the weather, and the final one the last of August or first of September. Paris green, if needed, can be used in the Bordeaux, half a pound to the barrel. Two to three barrels of the mixture should be used per acre at each spraying. Aim to have the vines thoroughly protected with the fungicide when the blight weather appears.

Geared spraying machines are rather unsatisfactory for spraying Bordeaux mixture, since they cover the vines very imperfectly with the spray. If used, the vines should be gone over two or three times each spraying. The barrel pump mounted on a cart that can straddle two rows of potatoes, and one man to drive and pump and one or two men to follow on foot, each with a twenty-five-foot hose, treating three or four rows, is the most thorough way of spraying a field. (See Plate XXXIV, a.)

When there is danger from rot the potatoes should be dug only in bright weather, after the dew is off the vines, and they should be spread out to dry off and be gathered up before evening. When the vines are blighting it is difficult to dig the potatoes without the spores coming in contact with the tubers, so some advocate leaving the potatoes in the ground at least ten days or two weeks after the death of the vines. Potatoes should be dried as thoroughly as possible before storage and should finally be stored in a dry, cool place. A little dry air-slaked lime dusted over them no doubt aids somewhat in their drying out.

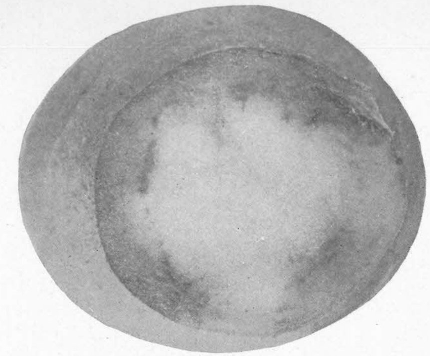
a. Green leaves showing early stage of blight, p. 366.



b. Blighted field which less than week before photographed was perfectly green, p. 369.

BLIGHT OF POTATO, *Phytophthora infestans*.

a. Late stage of blighted leaves, p. 366.



b. Section through blighted tuber, p. 364.

c. Blighted tuber, pitted and discolored reddish brown.

BLIGHT OF POTATO, *Phytophthora infestans*.

a. Best method for spraying potatoes, because the work can be done thoroughly, p. 373.

b. Less satisfactory, because of stationary nozzles; pump, also, was not powerful enough to use the eight nozzles, p. 373.

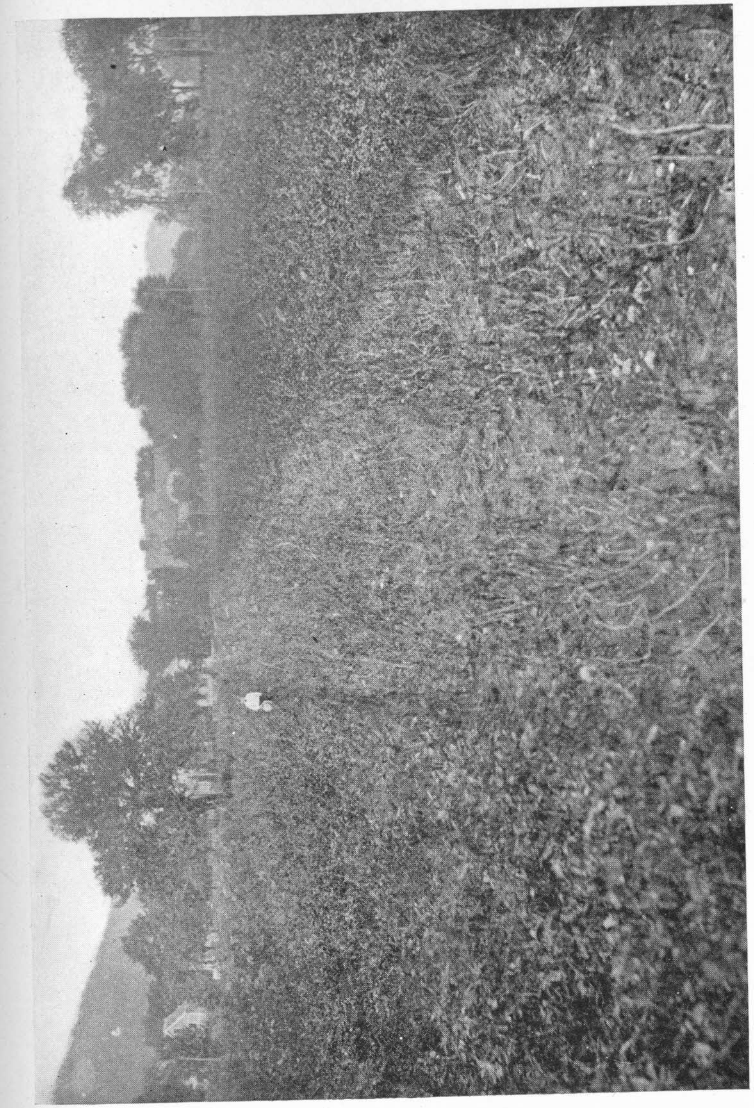
SPRAYING FOR POTATO BLIGHT.

Power sprayer, the least satisfactory, because of stationary nozzles and insufficiency of spray, p. 372.

a. Sprayed plant in Ogden's field ; photographed Sept. 16, 1902, p. 370.

b. Check or unsprayed plant in Ogden's field ; photographed same date, p. 370.

SPRAYING FOR POTATO BLIGHT, *Phytophthora infestans.*



Potato Blight. Farnham's field sprayed on either side of four central unsprayed rows; photographed Sept. 1, 1903, p. 374.

COMMERCIAL FEEDING STUFFS.*

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 the requirements of this law the following report on feeding stuffs has been prepared.

SAMPLING OF COMMERCIAL FEEDING STUFFS.

During the fall of 1904, Mr. V. L. Churchill, the sampling agent of this station, visited fifty-six towns and villages of this state and took three hundred and thirty-seven samples of

* This paper was published in January, 1905, as Bulletin 147.

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 thirty-three analyses of feeds which were sent to the station for analysis by individuals. Seven other samples of feeds have been sent for microscopic examination by other stations.

To make it easier to understand these analyses and their discussion, the following explanations are prepared:—

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 contains 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 in this bulletin, 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 the *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 wastes. 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 415, the analysis of cotton seed meal, No. 13047, compared with the average of seventeen analyses given on the same page, shows that its quality is far 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 423 the analyses of Chicago gluten meal show that the feed contains on the average about 4 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. This use is fully illustrated by the discussion of adulterated wheat food on page 396 of this report.

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 under Dr. Winton's direction, and with the coöperation of Messrs. Bailey and Andrew and Miss Barber; the results have been prepared for publication and discussed by the director.

Cotton Seed Meal.

Analyses on pages 414 and 415.

After ginning and linting to remove the fiber, the hulled and ground cotton seed is pressed to obtain cotton seed oil. Cotton seed meal is made by grinding the hard cakes from which the oil has been expressed. All of the samples examined this year have the guaranty required by law, and only the following samples fail to meet their guaranties by more than 0.7 per cent. of protein.

	Protein. Guaranteed.	Found.
American Cotton Oil Co., England Mill	43.0	42.2
" " " Argenta "	43.0	41.9
Chapin & Co., Green Diamond brand	43.0	41.4
Hunter Bros. Milling Co.	43.0	37.5

Sample 13047, from Hunter Bros. Milling Co., St. Louis, contains an excessive amount of hulls and is neither choice nor prime meal.

By the rules of the Cotton Seed Crushers Association, "choice" meal must contain at least 8 per cent. of ammonia, equivalent to 41.19 per cent. of protein, and "prime" meal must contain at least 8 per cent. of ammonia, or if from the South Atlantic States 7½ per cent. of ammonia, equivalent to 38.62 per cent. of protein.

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 six years:

	1899	1900	1901	1902	1903	1904
No. of Samples	10	4	6	8	25	17
Percentage of protein	46.4	43.9	44.4	43.0	43.2	43.4
" " fat	10.4	8.6	9.8	10.3	9.2	9.6
Average price	$24.00	27.00	28.80	29.70	29.04	28.88

The average price in 1904 has been a little lower than in the years 1902 and 1903, and the average percentage of protein a little higher.

Cotton Seed Meal, sampled and sent by Purchasers.

11539. Sold to R. H. Ensign, Simsbury, by the American Cereal Co., contained 38.12 per cent. protein and 8.58 per cent. fat; 43 per cent. protein was guaranteed. 11315, light meal, and 11314, dark meal, sold to T. A. Stanley, New Britain, by Chapin & Co., Boston, contained respectively 43.50 and 38.80 per cent. of protein.

Linseed Meal.

Analyses on pages 414 and 415.

"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, however, from 5 to 10 per cent. of oil, "fat," in the meal. By the "new process" the oil is so far extracted with naphtha as to leave, usually, less than 2½ per cent. in the meal. New process meal is more uniform in composition and contains more protein than old process meal.

The following brands fail to meet the manufacturer's guaranty by more than 0.7 per cent. of protein:

	Protein. Guaranteed.	Found
American Linseed Co.'s Flax Meal	38.5	35.1
" " New Process Linseed Meal	38.0	36.0
Hunter Bros., Old Process Linseed Meal	34.0	31.8
Midland Linseed Co., Old Process Linseed Meal	32.0	30.6

All the samples of each kind analyzed this year have been of fair quality and unadulterated. 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.			
	1901	1902	1903	1904	1901	1902	1903	1904
No. of Samples	3	4	2	3	4	6	9	11
Percentage of protein	39.0	39.8	36.4	36.2	34.4	32.8	33.1	33.8
" fat	1.8	2.1	3.2	3.1	7.7	7.8	7.5	7.1
Average price	$30.00	31.00	32.50	28.33	30.50	32.00	30.77	31.45

A guaranty of 38 per cent. protein is quite too high for the quality of new process meal which has come into the state in the last two years.

New process meal at $27 to $28 per ton deserves more attention from feeders.

The retail prices quoted on both feeds are based on very small sales. Car lots are quoted at this writing at about $2 per ton higher than cotton seed meal.

Heavy demand for export drove up this price of old process meal at about the time the samples were drawn.

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. The products made from winter wheat also differ in composition from those from spring wheat.

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.

Red Dog Flour is the poorest grade of flour; off color, containing bran dust and often sold as a cattle food.

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 416 and 417.

None of the lots sampled has the guaranty of composition which is required by law.

Three of the samples contain less than 14 per cent. of protein, and in so far are of inferior feeding value, but examination does not reveal any evidence of adulteration.

Bran from Spring Wheat.

Analyses on pages 416 and 417.

None of the lots of spring wheat bran examined bears the guaranty required by the state law.

The New Prague flaky bran, 13228, the Star and Crescent bran, 12977, and the Washburn-Crosby bran, 13136, contain less than 14 per cent. of protein and are, in so far, inferior in feeding value, but there is no evidence that they are other than

pure wheat bran. With these exceptions the samples are all of fair quality.

Middlings from Winter Wheat.

Analyses on pages 416 and 417.

None of the lots examined has the guaranty which is required by the state law. All the samples are of fair quality.

Middlings from Spring Wheat.

Analyses on pages 416–419.

None of the lots examined has the guaranty which is required by the state law. All of the samples are, however, pure and of good quality, as far as is indicated by chemical composition.

Mixed Feed from Winter Wheat.

Analyses on pages 418–421.

Of the forty-two lots examined, only two have the guaranty which is required by law; numbers 13121 and 13159, made by the American Cereal Co. The guaranty in each case was 17.75 per cent. of protein, and each sample contained 15.62 per cent.

All of the samples are apparently pure and of fair quality.

Mixed Feed from Spring Wheat.

Analyses on pages 420 and 421.

Of the fourteen lots examined, the only one bearing a guaranty, as required by the state law, is 13287, Brooks Elevator Co.'s Royal Mixed Feed, in which are guaranteed 16.61 per cent. of protein and 5.48 per cent. of fat. The sample analyzed fully meets this guaranty.

All the samples are apparently pure and of fair quality.

Average Composition of the Various Pure Wheat Products.

The average composition of the various pure wheat feeds sold in Connecticut in the last six years, with their prices, as given by retailers, appears in the following table:

AVERAGE COMPOSITION AND PRICE OF WHEAT FEEDS IN CONNECTICUT, 1899 TO 1904.

	Bran.		Middlings.		Mixed Feed.	
	Winter.	Spring.	Winter.	Spring.	Winter.	Spring.
1899						
Protein	15.9	15.6	15.8	15.6	16.8	16.8
Fat	4.3	4.7	4.4	4.7	4.5	5.1
Ton price	$19.80	19.14	19.00	19.25	19.44	19.25
1900						
Protein	16.1	16.5	17.7	19.1	18.1	17 6
Fat	4.6	5.0	4.7	5.5	4.7	5.3
Ton price	$21.09	20.00	21.00	21.50	21.00	20.80
1901						
Protein	16.3	17.3	18.0	19.7	17.5	18.5
Fat	4.5	4.7	5.0	5.5	4.7	5.1
Ton price	$21.80	21.06	22.75	22.10	22.20	22.20
1902						
Protein	17.1	16.7	18.1	19.2	17.7	17.7
Fat	4.6	4.9	4.4	5.4	4.6	5.1
Ton price	$23.37	20.90	23.85	23.44	22.00	22.35
1903						
Protein	15.5	15.9	16.4	17.9	16.7	16.9
Fat	4.5	4.9	4.5	5.0	4.5	5.0
Ton price	$23.00	22.50	25.55	25.50	23.55	23.53
1904						
Protein	15.0	15.5	16.5	17.1	16.0	16.3
Fat	4.4	4.7	4.6	5.0	4.5	4.7
Ton price	$26.13	24.57	28.14	26.60	25.83	26.07

This table indicates that:

1. The spring wheat products, as a rule, have somewhat higher percentages, both of protein and fat, than the winter wheat products.
2. This difference is rather more pronounced and constant in the case of middlings than in that of either bran or mixed feed.
3. The percentages of protein in bran are rather lower than in either middlings or mixed feed.
4. On the average the winter wheat products sell at a slightly higher price than the spring wheat products in spite of the higher protein and fat content of the latter.
5. The percentages of protein in all the wheat feeds have been considerably lower in 1904 than in either of the three years immediately preceding. The prices have, however, ruled higher.

The spring wheat products just analyzed represent for the most part the crop of 1903, while winter wheat products are, probably, of the 1904 crop. This last crop is stated to have been of poor quality.

Guaranties.

Attention is again called to the fact that the state law requires that wheat feeds should have affixed to the packages a guaranty or statement of the percentages of protein and fat in the feed. This law is almost universally disregarded by manufacturers and by the jobbers and retailers in Connecticut.

It has been urged that wheat feeds are staple articles, uniform in composition and not adulterated and therefore that no guaranty is needed. But our analyses show that these feeds vary decidedly in composition from year to year and that there is considerable fraud in the sale of mixed feed. If the buyer can get no guaranty that his wheat feeds are of standard quality and if they are commonly adulterated, he must drop them for the gluten feeds and dried brewers and distillers grains, which are more constant in composition and with which a guaranty is given.

Wheat Feeds sampled by Purchasers.

13358. Bran from Fairlea Farm, Orange.

11302. Columbia Mixed Feed from Fairlea Farm, Orange.

11570. Monogram Mixed Feed. Said to be a blend of spring wheat middlings, bran and flour. Taylor & Hubbell, Newtown.

11571. Carter Winter Mixed Feed, Taylor & Hubbell, Newtown.

12993. Wheat Feed sent by C. H. Clark, Durham.

ANALYSES.

	13358	11302	11570	11571	12993
Water	9.79	7.43	9.66	9.35	----
Ash	6.06	4.16	----	----	----
Protein	14.62	16.13	17.50	18.19	15.50
Fiber	9.53	6.73	----	----	----
Nitrogen-free Extract (starch, sugar, etc.)	55.08	60.38	----	----	----
Ether Extract (fat)	4.92	5.17	5.16	4.62	----
	100.00	100.00			

Wheat Feed containing Stinking Smut.

Sample 12993 was sent with the note that the cows would not eat it. The protein determination showed that it had the average amount, but Dr. Winton found, on microscopic examination, a large number of smut spores, identified by Dr. Clinton as those of the stinking smut of wheat. This, no doubt, explains the refusal of the cows to eat it. The smut is not distinctly poisonous to cattle, but they often refuse feed containing it.

Spurious "Mixed Feeds," made by the Indiana Milling Co. of Terre Haute, Indiana.

Two samples of so-called "Indiana Mixed Feed, Winter Wheat," were drawn by our agent; one, 13247, from stock of L. C. Daniels Grain Co., Hartford, bought of J. H. Cressey & Co. of Boston; the other, 13004, from Abner Hendee, New Haven. No guaranty or statement of composition was given with them or attached to the bags. They have the following composition:

	Analyses of Spurious Mixed Feed.		Average Composition of Genuine Mixed Feed from Winter Wheat.
	13247	13004	
Water	9.31	10.81	10.73
Ash	4.67	4.43	5.58
Protein	12.12	11.62	16.03
Fiber	14.96	14.69	7.76
Nitrogen-free Extract (starch, sugar, etc.)	55.46	55.33	55.41
Ether Extract (fat)	3.48	3.12	4.49
	100.00	100.00	100.00
Price charged per ton	$27.00	$25.00	$25.83

The above are made up of mixed feed,—a term everywhere used in the trade to denote a mixture of wheat products only—and ground corn cobs, a material of greatly inferior feeding value.

The analyses show that they contain, on the average, 4¼ per cent. less of protein and nearly twice as much fiber as genuine winter wheat feed, and are sold at retail at a higher average price than winter mixed feed.

Maize Meal.

Analyses on pages 422 and 423.

Only two samples of maize meal were found on sale in the places visited by our agent. They are called, respectively, A Meal and B Meal, made by the Buffalo Cereal Co., and sold without guaranty.

The B Meal contains 2 per cent. more protein and 4 per cent. more of fat than the A Meal.

No. 11305, yellow corn meal, sampled and sent by C. Daniel Way, Gilead, contains 9.31 per cent of protein.

No more important subject connected with dairy farming can engage the efforts of farmers and of this station than the improvement of our corn crop, both in yield and in quality. Before the silo came in as a necessary part of the dairy equipment and before the feeding value of corn fodder and stover was generally recognized,—corn being raised chiefly for the ears,—we had in this state many varieties of flint corn, which were perfectly hardy, had been bred with more or less skill for very many years, and yielded shelled corn much richer in protein than we can buy to-day. Corn meal with some bran was the staple feed for cows. With the coming of the silo we have sought after varieties which would give the largest possible yield of "roughage," stalks and leaves, and these appeared to be the southern and western dents. Our smaller flints have been neglected. The cold summer of 1903 was disastrous to the corn crop and it is believed that many farmers finally lost their crop of seed of these proved but somewhat neglected flint varieties, in that year. Are we not in danger of parting with a birthright in letting these flint varieties slip away from us?

While we are seeking to establish some leguminous crop to supply the present lack of protein on the farm, we need also to breed some of these flint varieties, naturally rich in protein, to a still larger production of protein and also of stover.

The classic work of Hopkins and others at the Illinois Station has shown that this is quite possible and has shown how to accomplish it.

Starting with some one of our well-established flint varieties of early maturity, in which it would not be difficult probably now to select ears bearing kernels with 12 to 13 per cent. of protein, we may hope to secure an increase of several per cent. in the average protein content of our crops of shelled corn.

Such a gain would be of immense advantage to stock feeders and particularly to those who still abide by corn meal as the principal grain feed, along with wheat feed, and look with suspicion on all concentrated "forcing" feeds.

This station has taken up this, together with the other question of increasing the yield of stover, in continuation of the work on the corn crop which it has done in past years.

Corn Flour.

Analyses on pages 422 and 423.

A single sample of this article, sold without guaranty, contains only 5.75 per cent. of protein, and 77.65 per cent. of extract, which is chiefly starch.

Gluten Meals.

Analyses on pages 422 and 423.

Two brands only were found.

Chicago Gluten Meal, made by the Glucose Sugar Refining Co., is guaranteed to contain 38.0 per cent. of protein and 3.0 per cent. of fat. The average percentages of protein and fat found are 33.83 and 3.74 respectively.

The amount of protein in the meal is 4 per cent. less than is guaranteed to be there.

Cream Gluten Meal, made by the Illinois Sugar Refining Co., is guaranteed to contain 35.5 per cent. of protein, and 3.0 per cent. of fat. The average percentages of these ingredients found are 34.87 and 3.69 respectively, so that the meal fairly meets the claims made for it as regards composition.

Gluten Feed.

Analyses on pages 422–425.

Six different brands of this feed have been examined.

Buffalo Gluten Feed, made by the Glucose Sugar Refining Co. of Chicago, contains 22.97 per cent. of protein and 2.89 per cent. of fat, as the average of seventeen analyses, in which the protein ranges from 19.50 to 25.56, and the fat from 2.29

to 4.21 per cent. The percentages guaranteed are 27 to 28 of protein and 3 of fat. No single analysis shows as much protein as the minimum guaranty, and only five of the eighteen contain the guaranteed amount of fat.

The same discrepancy between guaranty and composition appeared last year and was then explained as probably due to the greater amount of white corn used last year in the glucose manufacture, which caused an unexpected fall in the protein content. This might serve as an excuse last year, but it is not easy to see any excuse for the continued putting on the market of a feed which does not in any case meet the representations and claims of the manufacturer. Otherwise the Buffalo feed is pure and of good quality, as far as can be judged from chemical analysis.

Buffalo Gluten Feed. Sampled and sent by purchasers.

11540, car lot bought of Glucose Sugar Refining Co., sent by F. W. Holmes, Chapinville.

11572, bought of C. W. Keeler, Danbury.

11573, from Taylor & Hubbell, Newtown.

13359 and 13419, samples of same car lot bought of Abner Hendee, New Haven, by W. H. Lee, Fairlea Farm, Orange.

ANALYSES.

	11540	11572	11573	13359	13419
Water	----	10.57	8.86	9.05	----
Ash	----	----	----	1.02	----
Protein	20.19	22.25	23.75	22.12	22.25
Fiber	----	----	----	7.95	----
Nitrogen-free Extract (starch, sugar, etc.)	----	----	----	57.48	----
Ether Extract (fat)	2.03	1.82	2.17	2.38	----
				100.00	

J. H. Gluten, sold by the Buffalo Mill and Elevator Co., is sold without the guaranty which is required by law, and is of lower grade than any other brand of gluten feed found this year in the Connecticut market.

Globe Gluten Feed, made by the N. Y. Glucose Co., contains an average of 26.75 per cent. protein and 3.33 per cent. fat, as determined by analyses of fifteen samples. Some of the samples bear a guaranty of 27 per cent. protein and 3 of fat, others of 26 and 2.5. All the samples fully meet this lower guaranty, and all but three substantially meet the higher guaranty.

Pekin Gluten Feed, made by the Illinois Sugar Refining Co., does not meet the guaranty of protein by 1¾ per cent.

Queen Gluten Feed, made by the National Starch Co., has a guaranty of 25 per cent. of protein and 2.9 per cent. of fat. The single analysis does not meet this guaranty in either particular.

Warner's Gluten Feed, made at Waukegan, Ill., is sold without the guaranty which is required by law.

The average composition of the brands of gluten feed, as determined by our analyses, is given in the following statement, together with the manufacturers' guaranties:

No. of Analyses.	Name.	Price.	Protein. Found.	Protein. Guaranty.	Fat. Found.	Fat. Guaranty.
17	Buffalo	$25.68	22.97	27	2.89	3.0
1	J. H. Gluten	22.00	17.06	--	3.13	--
15	Globe Gluten	25.80	26.75	27	3.33	3.0
1	Pekin	27.00	26.25	28	3.46	3.0
1	Queen	27.00	22.12	25	2.25	2.9
1	Warner's	28.00	23.37	--	2.50	--

A sample of gluten meal, 11150, sent by R. G. Davis, New Haven, stated to be made by the J. E. Hubinger Co., Keokuk, Ill., and to contain 24.60 per cent. of protein and 1.70 of fat, contains 19.12 per cent. of protein.

Germ Meal.

A single sample, No. 11680, sampled and sent by F. B. Newton, Plainville, bought of W. T. Reynolds, Poughkeepsie, contains 20.56 per cent. of protein and 14.66 per cent. of fat.

Hominy Meal, Hominy Chop.

Analyses on pages 424–427.

This by-product, in part from hominy mills, but chiefly from breweries, is quite popular with dairymen.

American Hominy Co.'s Hominy Feed has a guaranty of 10 per cent. protein and 7 per cent. fat. The average percentages, of two analyses, are 10.3 and 8.4 respectively.

Buffalo Cereal Co.'s Hominy Feed has a guaranty of 10.5 protein and 8.5 fat. The average precentages found in six analyses are 10.02 and 7.39 respectively.

Chapin & Co.'s Niagara Hominy Chop, one analysis, fully meets its guaranty.

Chapin & Co.'s Green Diamond Hominy Chop, two analyses, is not far below the guaranty in composition.

Chas. M. Cox Co.'s Wirthmore Hominy Feed contains, as an average of seven analyses, 10.39 per cent. of protein and 8.01 per cent. of fat. The guaranty on some lots is 10 and 7, on others 10½ and 7½. In all cases the protein guaranty is substantially met. In two cases the percentage of fat is somewhat low.

Hunter Brothers Milling Co.'s Hominy Feed is guaranteed 11.0 per cent. of protein and 7.7 of fat. The average of the two samples examined is 10.68 protein and 8.58 fat.

Miner-Hilliard Milling Co.'s Steam Cooked Star Chop has a guaranty of 9 per cent. protein and 6 per cent. fat, and one lot has a guaranty of 10 per cent. protein and 7.5 of fat. The average of five analyses is 10.3 per cent. of protein and 6.58 per cent. of fat.

W. W. Payne & Sons Hominy Chop has a guaranty of 11 per cent. protein and 8 per cent. fat. The average composition, calculated from four analyses, is 10.84 per cent. protein and 7.7 per cent. fat.

The average of all the thirty-seven analyses made on samples drawn in the late fall of 1904 is 10.3 per cent. of protein and 7.6 per cent. of fat.

Hominy Meal sent by Purchasers.

Two samples, Nos. 11303 and 11304, the one marked S and the other W, sampled and sent by C. D. Way, Gilead, contains 10.81 and 10.25 per cent. of protein respectively.

Rye Feed.

Analyses on pages 428 and 429.

This material is sold without the guaranty required by the feed law. All the samples appear to be pure and of fair quality, with the single exception of 13087, which has more nearly the composition and appearance of rye flour than of rye feed.

Malt Sprouts.

Analyses on pages 428 and 429.

Four analyses are given in the table. None of the lots of this feed has the statement of guaranty which is required by law.

No. 13021 has a low percentage of protein, due probably to admixture of malt and oats.

Dried Distillery Grains.

Analyses on pages 428 and 429.

This is the residue left from cereals from which most of the starch has been extracted by treatment with malt and washing. What is left after this treatment is dried and sold as a cattle food. While the cereal grains contain not more than 10 to 12 per cent. of protein, the dried distillery grains contain three times that amount.

The question is frequently asked regarding this material, and the gluten meals and feeds,—How can a part of a grain contain more protein than the whole of it? It cannot, of course, contain more *pounds* of protein, but it often contains a higher *percentage* of protein. An illustration may make this clear. Suppose we have a grain containing 74 per cent. of starch, 10 of protein, 10 of water and 6 of other matters, and by a chemical process we remove from it one-half of the starch and leave the residue as dry as before.

The operation will run as follows:

	In the grain originally. Weight. Pounds.	In the grain originally. Per cent.	Taken out. Weight. Pounds.	Left in the residue. Weight. Pounds.	Left in the residue. Per cent.
Starch	74	74	37	37	62.2
Protein	10	10	--	10	17.3
Water	10	10	4.14	5.86	10.0
Other Matter	6	6	--	6	10.5
	100	100	41.14	58.86	100.0

By comparing the sum of the weights in the third and fourth columns it appears that nothing has been lost from or added to the hundred pounds of grain.

After removing the starch, the by-product or residue only weighs in this case a little over 58 pounds. It contains, however, all of the protein which was in 100 pounds of grain originally. It is clear that if the protein from 100 pounds of grain is gathered into a product which weighs only 58 pounds, then this product, *pound for pound,* will contain more protein than the original grain. This is equivalent to saying that it has a higher percentage, as appears above. The grain contains 10 per cent., but the by-product contains 17.3 per cent.

Ajax Flakes, sold by Chapin & Co., is the only brand of distillery grains which has been found this year in the state. It consists mainly of a corn product with some barley.

The average percentages of protein and fat found in the four samples examined are 32.09 protein and 14.13 fat. The former is about 1 per cent. below the guaranty, the latter is about 2 per cent. higher than the guaranty.

Dried Brewers Grains.

A single sample of this feed, No. 11538, sent by W. O. Burr, Fairfield, had the following composition:

Water	8.69
Ash	3.54
Protein	26.94
Fiber	12.75
Nitrogen-free Extract (starch, sugar, etc.)	39.63
Ether Extract (fat)	8.45
	100.00

Ground Oats.

Analyses on pages 428 and 429.

One sample of ground oats, 13058, has the usual composition, and is of average quality.

The sample of "Oat Feed" is a mixture of oats and oat hulls of very inferior value and sells for $18.00 per ton.

Miscellaneous Mixed Feeds.

Provender.

Analyses on pages 428–431.

The term provender was formerly, and in country places is still, used to designate a ground mixture of equal weights of corn and oats. Next to corn meal it is probably the chief product of our smaller grist mills.

Forty samples of this feed have been collected and analyzed. In only three cases, given below, are the goods sold with a guaranty.

No.	Manufacturer.	Dealer.	Protein. Guaranty.	Protein. Found.	Fat. Guaranty.	Fat. Found
12978	E. M. Bailey, Montpelier, Vt.	E. H. Caulkins, New London	9.0	9.6	4.0	4.0
12987	C. W. Campbell, Westerly, R. I.	S. H. Cheseboro, Stonington	11.0	9.4	4.0	4.2
13264	Smith, Northam & Co., Hartford	Manufacturer	9.0	9.6	4.0	4.0

The samples are pure and of average quality. No. 13066, containing much more protein than the others, 11.37 per cent., consists largely of oats.

Various Corn and Oat Feeds.

Analyses on pages 430–433.

These are sold under a variety of trade names and consist of factory by-products, among them considerable oat hulls. The protein in them ranges from 7.25 to 9.62.

All of them bear guaranties of composition, which appear in the tables of analyses.

The Buffalo Cereal Co.'s Corn and Oat Chop, and the Boss Oat Feed, fully meet the manufacturers' guaranty.

The composition of De-Fi Corn and Oat Feed and Haskell's Stock Feed is in substantial agreement with their guaranties, while Victor Corn and Oat Feed, Dickinson's Stock Food, Monarch Chop Feed and Lenox Stock Feed have considerably less protein than is called for by their guaranties.

Corn and Wheat Feeds.

Analyses on pages 432 and 433.

Colonial Wheat Middlings, made by the Miner-Hilliard Milling Co., Wilkesbarre, Penn., is a mixture of corn and wheat products containing no undue proportion of cob and in composition substantially meets its guaranty.

"Jersey" Mixed Feed claims to be a mixture of "winter wheat bran, winter wheat shipstuff and corn and cob meal." "A perfect ration." It is made by the Indiana Milling Co. of Terre Haute, Ind., which makes the wheat feed noticed on page 396, and in composition the two are not very unlike.

This brand is, however, sold with a statement of composition and a guaranty which it substantially meets. The relatively high percentage of fiber indicates the admixture of cob.

"Dairy Mixed Feed" is sold in packages bearing tags with precisely the same statements given with "Jersey" mixed feed, excepting that the name of the manufacturer is not given, but instead, "made for Jennings & Fulton, Boston."

The two feeds are quite similar in composition.

Corn, Oats and Barley.

Analyses on pages 432 and 433.

Schumacher's Stock Feed is a mixture of the above named materials, made by the American Cereal Co., containing an average of 10.77 per cent. of protein and 3.73 per cent. of fat. This percentage of protein is far below the guaranteed amount, viz., 13 per cent.

Proprietary Horse Feeds.

Analyses on pages 434 and 435.

Sucrene Horse Feed, made by the American Milling Co., Chicago, Ill., who claim, "Sucrene is the French word for sugar, and is our trade mark. We take molasses, and by a newly invented process, for which we have a patent, turn it into Sucrene (sugar) in the feed in a granular meal form," etc. This feed also contains salt, barley, corn, oats, a large amount of weed seed (screenings?), seed stalks and other straw elements of some cereal.

In chemical composition it meets the manufacturer's guaranty as regards protein.

Sucrene Horse Feed sampled by Purchasers.

12051 and 12052, sent by R. G. Davis, New Haven.

ANALYSES.

	12051	12052
Protein	14.62	14.87
Fat	4.04	4.27

Both samples meet the manufacturer's guaranty.

Buffalo Cereal Co.'s Horse Feed contains mill products of corn, oats products, wheat and linseed, and substantially meets the guaranty of composition.

H. O. Horse Feed contains mill products of corn, wheat, oats and peanuts, and substantially meets the manufacturer's guaranty.

New England Stock Feed, made by the Hoco Mills, Buffalo, from mill products of corn, oats, wheat and peanuts, fully meets the guaranty of composition.

Peck's Horse Feed, sent by W. J. Peck, Seymour, stated to sell at $22.00 per ton, contains 9.00 per cent. of protein and consists chiefly of corn and oats.

Proprietary Dairy and Stock Feeds.

Analyses on pages 434–437.

Quaker Dairy Feed, made by the American Cereal Co., consists chiefly of mill products of corn, oats, wheat and cotton seed meal. The average percentage of protein found in five analyses (12.66) is much below the guaranty of 14 per cent.

Sucrene Dairy Feed, made by the American Mill Co., Chicago, Ill., is a mixture of corn product, wheat product, oats, barley, malt sprouts, cotton seed meal, much weed seed and cereal stalks and meets the manufacturer's guaranty.

A single sample, sent by W. E. Waller, Bridgeport, stated to have been bought of Wheeler & Co., Bridgeport, with a statement on the bags of protein 18.50 per cent., fat 4.50 per cent., contains 14.06 per cent. of protein and 3.96 per cent. of fat.

Blatchford's Calf Metal contains less protein than the guaranteed amount.

Blomo Feed, made by the Blomo Manufacturing Co., New York, contains dried blood, saccharine matter and oat hulls, and rather less protein and fat than are guaranteed.

Creamery Feed, made by the Buffalo Cereal Co., Buffalo, N. Y., contains mill products of corn, oats, wheat and cotton seed meal. One of the two samples analyzed contains somewhat less protein than is guaranteed.

H. O. Dairy Feed, made by the H. O. Company, Buffalo, contains mill products of oats, cracked corn, wheat, peanuts and cotton seed meal. It substantially meets the manufacturer's guaranty.

United Breeders Dairy Food. A sample, No. 13360, sent by W. S. Fushey, Wallingford, is stated to be made by the United Breeders Co. of America, and to cost $9.00 per 100 pounds.

It contains 17.56 per cent. of protein, and the following foods, condiments and medicines: Charcoal, epsom salts, sulphur, fenugreek, linseed meal, wheat, corn, herbs.

It is one of the mixtures of food, medicine and condiment, which are being at present extensively advertised and which were fully discussed in Bulletin 132 of this station.

Proprietary Poultry Feeds.

Analyses on pages 436 and 437.

American Poultry Feed, made by the American Cereal Co., Chicago, is a mixture of wheat products, coarse corn meal and cotton seed meal, and substantially meets the guaranty.

Poultry Feed, made by Buffalo Cereal Co., Buffalo, is a mixture of wheat bran, coarse corn meal and rolled oats.

Laying Food, made by the Cypher Incubator Co., Buffalo, is a mixture of corn and wheat products, with some animal matter. The percentage of protein is considerably higher than the guaranty and that of fat somewhat lower.

H. O. Poultry Feed, made by the H. O. Co. of Buffalo, N. Y., contains rolled oats, cracked corn, wheat bran and peanuts, and fully meets the manufacturer's guaranty.

Animal Meal.

Analyses on pages 436 and 437.

Six brands of animal meal for poultry feed have been analyzed and the results, which appear in the following tables, do not call for special notice here.

Miscellaneous Poultry Feeds.

11549. A poultry feed containing bran, corn, oats, rolled oats and ground quartz from L. C. Daniels Grain Co., Hartford.

12135. Little Chick Feed contains oats (hulls removed) cracked wheat, cracked corn and millet of some kind.

13331. Scratching Food contains wheat, cracked corn, sorghum and hulled oats.

13332. Soft mash contains wheat bran, corn meal and an oat product.

The last three named feeds were sent by W. M. Brown, Bloomfield, and were sold by the L. C. Daniels Grain Co., Hartford.

12137. Grease Scraps or Cracklings, sent by F. J. Hamilton, Thompsonville, cost $30.00 per ton in the cake, $2.25 per hundred weight, ground and screened.

13413. Meat Meal sent by W. E. Copley, Hazardville.

ANALYSES.

	11549	12135	13331	13332	12137	13413
Water	9.00	12.09	----	----	21.81	6.49
Ash	8.92	----	----	----	----	----
Protein	14.50	11.00	11.63	14.63	46.75	51.25
Fat	4.54	3.10	----	----	13.42	13.81

Apple Pomace.

A sample of this material, sent by L. J. Platts, Deep River, has the following composition:

Water	70.07
Ash	2.28
Protein	1.66
Fiber	7.71
Nitrogen-free Extract (sugar, pectins, etc.)	16.39
Ether Extract (fat and wax)	1.89
	100.00

This material, of which there is a good deal to be had in any apple year, is well worth housing and feeding to cattle. Attention was called to it in the report of this Station for 1888. Mr. J. H. Dickerman of Mt. Carmel has fed it to both horses and cattle with good results. Its value as silage has been studied at the Vermont Station, which says regarding it in Bulletin 96:

"The experience of four years with apple pomace silage at this station, using over twenty cows, is a unit in affirming the nearly equivalent — if not, indeed, quite equivalent — feeding values of apple pomace and corn silage. No undesirable results whatsoever have followed its use. Cows continuously and heartily fed have not shrunk, but on the contrary have held up their milk flows remarkably well. Neither does the milk nor the butter seem injured in any respect. Inasmuch, however, as reports of severe shrinkage occurring coincident with the use of apple pomace are current, care is advised in feeding it at the outset.

Apple pomace needs no special care in ensiling. If levelled from time to time as put into the silo and left to itself uncovered and unweighted it does well. Fifteen pounds a day per cow has been fed at this station with entire satisfaction."

Dried Molasses Beet Pulp.

No. 11322. Made by the Alma Sugar Co., Alma, Mich., was sampled from stock of R. L. Bremner, Westville, and sent by W. B. French, Westville. It is understood to be the by-product made by drying the sugar beet "chips" from which the sugar has been extracted by repeated soaking in water. The analysis is as follows:

Water	6.09
Ash	5.64
Protein	9.75
Fiber	15.77
Nitrogen-free Extract (sugar, gums, etc.)	61.94
Ether Extract (fat)	0.51
	100.00

Another sample, sent by Taylor & Morse, Shelton, contained 8.94 per cent. of protein. The value of this *dried* beet pulp as a dairy feed has not to our knowledge been thoroughly tested.

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.

(Jordan's Compilation, Office of Experiment Stations, Bulletin 77.)

	Protein.	Fiber.	Nitrogen-free Extract.	Fat.
Cotton Seed Meal	88	56	62	93
Linseed Meal, new process	85	80	86	97
Linseed Meal, old process	89	57	78	89
Corn Meal	68	--	95	92
Gluten Meal	88	--	90	94
Gluten Feed	86	78	89	84
Wheat Bran	78	29	69	68
Wheat Middlings	80	33	81	86
Wheat Mixed Feed	80	25	78	78
Oats*	78	20	76	83
Rye Meal	84	-	92	64
Malt Sprouts	80	33	68	100
Dried Brewers' Grains	79	52	58	91
H. O. Dairy Feed	78	41	70	86
H. O. Horse Feed	74	35	79	84
Quaker Oat Feed	81	43	67	89
Quaker Dairy Feed†	78	41	70	86
Victor Corn and Oat Feed‡	71	48	83	87

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. It is the object of this paper to

*Mentzel and Lengerke. † Assumed same as H. O. Dairy Feed.
‡ Assumed for all other corn and oat feeds.

show what feeds there are in our market which meet this demand for digestible protein.

Table II is a summary of Table IV, and shows, first, the average composition of the feeds whose analyses are given in that table, *arranged according to the per cent. of protein in them;* second, the amount of digestible matter in each, so far as we have been able to calculate it; and third, the average retail prices of feeds in October and November last. The table divides the commercial feeds on the market into five classes, according to the quantities of protein in them.

1. Those having over 30 per cent. of protein—cotton seed, the linseed and gluten meals, distillery grains and buckwheat middlings. The average cost of them is about $28.68 per ton.

2. Those having between 20 and 30 per cent. of protein—most of the gluten feeds and malt sprouts. Their average cost is about $27.40 per ton.

3. Feeds having between 15 and 20 per cent. of protein—the wheat feeds, rye feeds and some proprietary feeds. The average cost of this group is about $26.40.

4. Feeds having between 10 and 15 per cent. of protein—hominy feed, ground oats and many proprietary feeds. The average cost is $26.45.

5. Feeds having less than 10 per cent. of protein. Here belong corn meal, provender and all the low grade "stock feeds" and "corn and oat" feeds. The average cost of this group is $25.61.

This table brings out strikingly the fact that the prices of feeds stand in no just relation to their feeding value. Thus, a mixture of low grade corn or corn meal with oat refuse, etc., and containing less than 9 per cent. of protein, costs—and is actually bought by Connecticut farmers for—only $3.00 less per ton than a feed having more than 30 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 consisting largely of 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.	N.-free extract (starch, etc.).	Ether extract (fat).	Protein.	Fiber.	N.-free extract (starch, etc.).	Ether extract (fat).	Cost per ton.
Containing over 30 p. c. protein.											
Cotton Seed Meal	8.8	6.8	43.4	6.7	24.7	9.6	38.2	3.7	15.4	8.9	$28.88
Linseed Meal, new process	10.2	5.8	36.2	9.4	35.4	3.0	30.7	7.6	30.4	3.0	28.33
Cream Gluten Meal	8.8	1.5	34.9	1.9	49.2	3.7	30.7	--	44.3	3.5	32.00
Chicago Gluten Meal	9.6	1.2	33.8	2.6	49.1	3.7	29.8	--	44.2	3.5	29.33
Linseed Meal, old process	10.7	5.2	33.8	8.4	34.8	7.1	30.1	4.8	27.1	6.4	31.45
Distillery Grains, Ajax Flakes	6.9	2.2	32.1	12.5	32.2	14.1	25.4	6.5	18.7	12.9	27.75
Buckwheat Middlings	13.7	5.5	30.8	7.6	34.0	8.4	----	--	----	----	23.00
Containing 20–30 p. c. protein.											
Globe Gluten Feed	9.3	2.1	26.8	7.6	50.9	3.3	23.0	6.0	45.3	2.8	25.80
Pekin Gluten Feed	9.2	1.0	26.3	7.6	52.4	3.5	22.6	5.9	46.8	2.9	27.00
Malt Sprouts	10.7	5.7	24.6	12.1	45.4	1.5	19.7	4.0	30.8	1.5	20.25
Warner's Gluten	10.0	1.1	23.4	7.0	56.0	2.5	20.1	5.5	49.9	2.1	28.00
Buffalo Gluten Feed	10.0	1.4	23.0	7.2	55.5	2.9	19.8	5.6	49.4	2.4	25.68
Blatchford's Calf Meal	10.5	4.2	22.7	4.5	53.4	4.7	----	--	----	----	38.00
Queen Gluten Feed	8.8	0.9	22.1	7.2	58.7	2.3	19.0	5.6	52.3	1.9	27.00
Containing 15–20 p. c. protein.											
Buffalo Creamery Feed	9.7	3.7	19.2	11.4	50.5	5.5	----	--	----	----	27.50
Sucrene Dairy Feed	10.4	6.2	18.6	11.9	49.2	3.7	----	--	----	----	27.00
H. O. Dairy Feed	9.3	3.6	17.4	12.6	51.0	6.1	13.6	5.2	35.7	5.3	28.50
J. H. Gluten Feed	9.6	0.6	17.1	10.5	59.1	3.1	14.7	8.2	52.6	2.6	22.00
Spring Wheat Middlings	11.0	4.2	17.1	6.4	56.3	5.0	13.6	2.1	45.6	4.3	26.60
Winter " "	10.9	4.4	16.5	5.8	57.8	4.6	13.2	1.9	46.8	4.0	28.14
Mixed Wheat Feed, Spring	11.1	4.9	16.3	8.0	55.0	4.7	13.0	2.0	42.9	3.6	26.07
" " " Winter	10.7	5.6	16.0	7.8	55.4	4.5	12.8	1.9	43.2	3.5	25.83
Spring Wheat Bran	10.7	6.3	15.5	10.6	52.2	4.7	12.1	3.1	36.1	3.2	24.57
Winter " "	10.8	6.0	15.0	9.7	54.1	4.4	11.7	2.8	37.3	3.0	26.13
Rye Feed	11.5	3.4	14.9	4.0	63.3	2.9	12.6	--	58.1	1.9	28.00
Containing 10–15 p. c. protein.											
Blomo Feed	16.8	9.9	14.0	11.1	47.6	0.6	----	--	----	----	24.00
Sucrene Horse Feed	11.2	6.3	13.9	10.5	55.2	2.9	----	--	----	----	27.50
Colonial Middlings	10.6	3.7	13.7	6.1	59.8	6.1	----	--	----	----	28.00
Jersey Mixed Feed	8.9	4.5	12.9	13.6	56.6	3.5	----	--	----	----	24.00
Quaker Dairy Feed	8.9	5.3	12.7	17.6	51.8	3.7	9.9	7.2	36.3	3.2	24.40
Buffalo Horse Feed	10.1	3.2	11.7	10.0	60.2	4.8	----	--	----	----	29.00
H. O. Horse Feed	10.7	2.9	11.6	9.2	60.8	4.8	8.6	3.2	48.0	4.1	29.67
"Dairy" Mixed Feed	9.0	4.6	11.5	15.2	56.5	3.2	----	--	----	----	25.00
New England Stock Feed	9.8	2.9	11.1	8.0	63.6	4.6	----	--	----	----	26.00
Ground Oats	11.1	2.9	10.9	9.0	62.5	3.6	8.5	1.8	47.5	3.0	39.00
Schumacher's Stock Feed	10.5	3.7	10.8	10.0	61.3	3.7	----	--	----	----	27.50
Hominy Feed	9.7	2.5	10.3	4.7	65.2	7.6	7.0	--	62.0	7.0	25.84
Containing less than 10 per cent. protein.											
Haskell's Stock Feed	9.0	2.8	9.6	8.9	63.7	6.0	6.8	4.3	52.8	5.2	27.00
Provender	11.7	2.0	9.6	4.7	67.9	4.1	6.8	2.3	56.4	3.6	27.73
Corn Meal	12.8	1.6	9.6	2.6	68.8	4.6	6.5	--	65.3	4.2	26.00
Boss Corn and Oat Feed	10.6	3.6	8.9	11.3	60.2	5.4	6.3	5.4	50.0	4.7	24.00
De-Fi Oat Feed	8.2	3.8	8.8	14.7	61.2	3.3	6.2	7.1	50.8	2.9	25.00
Dickinson's Stock Food	9.0	4.1	8.6	12.4	61.4	4.5	6.1	6.0	51.0	3.9	24.00
Victor Corn and Oat Feed	9.6	3.7	8.3	12.3	62.2	3.9	5.9	5.9	51.6	3.4	25.40
Corn and Oat Chop	9.9	3.7	8.2	12.5	61.6	4.1	5.8	6.0	51.2	3.6	26.00
Lenox Stock Feed	9.2	3.4	7.5	14.2	62.0	3.7	5.3	6.8	51.4	3.2	26.00
Monarch Chop Feed	9.4	2.9	7.3	12.9	64.3	3.2	5.2	6.2	53.5	2.8	25.00

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 1904.

Station No.	Brand.	Retail Dealer.	Analyses. Water.	Ash.	Protein.	Fiber.	Nitrogen-free Extract. (Starch, gum, etc.)	Ether Extract. (Fat.)	Price per ton.
	Cotton Seed Meal.								
13096	England Mill. American Cotton Oil Co., N. Y.	*Wallingford:* E. E. Hall	10.31	7.42	42.19	8.08	23.70	8.30	$28.00
13150	Texarkana Mill. " " "	*Middlefield:* A. E. Miller	9.09	6.12	44.00	6.94	25.11	8.74	28.00
13197	Ft. Smith, Ark. Mill. " " "	*New Milford:* F. R. Green	7.85	6.17	46.25	5.59	24.88	9.26	29.00
13232	Brinkley, Ark. Mill. " " "	*Unionville:* S. Richards	8.55	6.58	43.00	6.57	26.10	9.20	30.00
13268	Memphis, Tenn. Mill. " " "	*Suffield:* Spencer Bros.	8.46	7.03	42.94	6.64	25.72	9.21	29.00
13280	Argenta Mill. " " "	*Manchester:* Barrows & Kuhney	8.22	7.02	41.87	7.14	25.46	10.29	30.00
12988	Old Gold Brand. T. H. Bunch, Little Rock, Ark.	*East Hampton:* R. H. Hall	7.38	6.89	43.94	5.75	24.84	11.20	29.00
13213	Green Diamond Brand. Chapin & Co., St. Louis	*Torrington:* F. U. Wadhams	9.24	5.86	41.37	7.29	27.27	8.97	28.00
13047	------- The Hunter Bros. Milling Co., St. Louis	*Avon:* W. G. Woodford & Co.	10.06	6.27	37.50	10.38	28.47	7.32	29.00
13254	------- " " " "	*Hartford:* Daniels Mill Co.	8.55	6.72	42.25	8.44	26.10	7.94	29.00
13207	Dixie Brand. Humphreys, Godwin & Co., Memphis, Tenn.	*Middletown:* The Coles Co.	8.85	7.49	42.75	7.59	23.93	9.39	29.00
13031	Horse Shoe Brand. Hugh Pettit & Co., Memphis, Tenn.	*Norwalk:* Holmes, Keeler, Selleck Co.	10.16	6.96	45.25	4.67	23.76	9.20	29.00
13286	Star Brand. Sledge & Wells Co., Memphis, Tenn.	*Willimantic:* W. D. Grant	8.53	6.82	44.94	4.83	23.40	11.48	28.00
13061	------- J. E. Soper & Co., Boston	*Bristol:* W. O. Goodsell	9.60	6.71	43.56	6.30	22.53	11.30	30.00
13108	------- " " "	*Meriden:* Meriden Grain and Feed Co.	9.18	6.81	42.81	5.96	25.26	9.98	30.00
13124	------- " " "	*New Britain:* C. W. Lines Co.	9.25	7.05	44.12	6.53	23.97	9.08	28.00
13167	------- Abner Hendee, New Haven*	*Watertown:* John H. Taylor Co.	8.47	5.99	42.31	7.24	26.80	9.19	29.00
13202	------- Jobber unknown	*Middletown:* Meech & Stoddard	8.20	7.02	44.50	8.05	22.53	9.70	28.00
		Average of the 17 analyses†	**8.82**	**6.75**	**43.41**	**6.68**	**24.79**	**9.55**	**28.88**
		Average digestible	----	----	**38.20**	**3.74**	**15.37**	**8.88**	
	Linseed Meal, New Process.								
13206	------- American Linseed Co., New York*	*Middletown:* Meech & Stoddard	10.13	5.98	35.12	9.77	36.07	2.93	28.00
13283	------- " " Chicago	*Willimantic:* W. D. Grant	10.32	5.84	36.00	9.69	34.87	3.28	27.00
13384	------- " " "	*Yantic:* A. R. Manning	10.10	5.64	37.37	8.85	35.04	3.00	30.00
		Average of these 3 analyses	**10.18**	**5.82**	**36.16**	**9.44**	**35.33**	**3.07**	**28.33**
		Average digestible			**30.74**	**7.55**	**30.38**	**2.98**	
	Linseed Meal, Old Process.								
13107	------- American Linseed Co., New York	*Meriden:* Meriden Grain and Feed Co.	12.14	4.48	36.06	7.74	33.22	6.36	32.00
13125	------- " " "	*New Britain:* C. W. Lines Co.	12.30	4.56	35.37	7.99	32.98	6.80	30.00
13174	------- " " "	*Waterbury:* The Platt Mill Co.	10.43	4.70	34.87	8.41	34.86	6.73	32.00
13214	------- " " Buffalo	*Torrington:* F. U. Wadhams	10.65	4.60	36.50	7.09	34.12	7.04	32.00
13250	------- " " "	*Hartford:* L. C. Daniels Grain Co.	9.85	4.70	36.31	8.30	33.20	7.64	32.00
13190	------- A. L. Clement & Co., New York	*Danbury:* F. C. Benjamin & Co.	10.32	6.02	32.62	8.65	35.79	6.60	30.00
13388	------- Hunter Bros., St. Louis	*Norwich:* A. A. Beckwith	10.36	5.00	31.75	9.03	36.01	7.85	32.00
13052	------- Metzger Seed & Oil Co., Toledo, O.	*Bristol:* G. W. Eaton	11.21	5.87	32.25	8.75	35.67	6.25	31.00
13255	------- " " " "	*Hartford:* Daniels Mill Co.	9.58	6.45	32.00	9.54	35.13	7.30	32.00
13119	------- Midland Linseed Co., Minneapolis	*New Britain:* Hugh Reynolds	11.16	4.90	30.62	8.36	36.96	8.00	32.00
13010	-------	*New Haven:* Abner Hendee	10.15	5.36	33.62	8.27	34.72	7.88	31.00
		Average of these 11 analyses	**10.74**	**5.15**	**33.82**	**8.37**	**34.79**	**7.13**	**31.45**
		Average digestible	----	----	**30.10**	**4.77**	**27.14**	**6.35**	

* Statement of Dealer. † Excluding No. 13047.

TABLE IV.—*Continued.* ANALYSES OF COMMERCIAL FEEDS SAMPLED IN 1904.

Station No.	Brand.	Retail Dealer.	Analyses. Water.	Ash.	Protein.	Fiber.	Nitrogen-free Extract. (Starch, gum, etc.)	Ether Extract. (Fat.)	Price per ton.
	WHEAT PRODUCTS.								
	Bran from Winter Wheat.								
13037	Ballard's. Ballard & Ballard, Louisville, Ky.	*Stamford:* Scofield & Miller	12.60	5.76	13.87	8.00	55.71	4.06	$29.00
13263	-------- Dow & King, Pittsfield, Ill.	*Hartford:* Smith, Northam & Co	10.01	6.21	13.25	13.29	53.06	4.18	25.00
13131	Choice. Hecker-Jones-Jewell Mill. Co., N. Y.	*Plantsville:* T. B. Atwater	12.74	6.08	15.37	10.32	51.03	4.46	26.00
13383	Empire. Hunter Bros. Mill Co., St. Louis*	*Yantic:* A. R. Manning	9.12	5.70	15.62	8.12	56.74	4.70	24.00
13239	Stott's. David Stott, Detroit	*Pine Meadow:* D. B. Smith	10.20	6.27	16.06	8.72	53.93	4.82	28.00
13172	Voigt's Choice. Voigt Mill. Co., Grand Rapids, Mich.	*Waterbury:* The Platt Mill Co.	10.56	5.82	15.00	8.85	55.63	4.14	25.00
13090	--------	*Hamden:* I. W. Beers	11.28	5.99	13.62	10.88	53.75	4.48	25.00
13244	-------- J. S. Wolf, Pittsfield, Mass.*	*New Hartford:* New Hartford Elevator Co.	10.00	5.98	17.06	9.46	53.02	4.48	27.00
		Average of these 8 analyses	**10.81**	**5.98**	**14.98**	**9.70**	**54.12**	**4.41**	**26.13**
		Average digestible	----	----	**11.69**	**2.81**	**37.34**	**3.00**	
	Bran from Spring Wheat.								
13003	Wirthmore Fancy. Chas. M. Cox Co., Boston	*New Haven:* R. G. Davis	11.18	6.26	17.37	9.93	50.89	4.37	24.00
13085	" " " "	*Branford:* S. V. Osborn	11.02	6.15	17.37	11.15	49.36	4.95	26.00
13223	Clover Leaf. Gardner Mills, Hastings, Minn.	*Winsted:* Balch & Platt	10.24	6.34	15.37	10.12	53.18	4.75	26.00
13079	Duluth Imperial. Duluth Imperial Mill. Co., Duluth, Minn.	*Guilford:* Morse & Landon	10.80	5.70	16.75	10.37	51.63	4.75	24.00
13027	-------- Gooding, Coxe Co., Royalton, Minn.	*Bridgeport:* W. M. Terry & Co.	10.39	6.83	14.37	11.07	52.64	4.70	24.00
12985	-------- W. J. Jennison Co., Minneapolis	*Stonington:* S. H. Chesebro	8.77	6.35	16.06	10.01	53.97	4.84	26.00
13036	-------- Madelia Roller Mills, Madelia, Minn.	*South Norwalk:* Manuel T. Hatch	12.90	6.91	16.12	9.82	50.07	4.18	23.00
13228	New Prague Flaky. New Prague Roller Mills Co., New Prague, Minn.	*Canaan:* Ives & Pierce	9.02	6.72	13.31	12.15	54.04	4.76	23.50
13005	-------- The Northwestern Consolidated Mill Co.	*New Haven:* Abner Hendee	11.90	6.70	14.87	10.77	51.16	4.60	25.00
13194	Ben Hur. Royal Mill. Co.	*Danbury:* C. W. Keeler	10.58	5.92	16.00	10.53	52.08	4.89	25.00
13151	Bixota. Simmons Mill. Co., Red Wing, Minn.	*Middlefield:* A. E. Miller	10.28	6.70	15.06	10.22	53.35	4.39	22.50
13170	-------- Sleepy Eye Mill. Co., Sleepy Eye, Minn.	*Watertown:* John H. Taylor Co.	10.60	5.24	14.31	10.09	54.91	4.85	26.00
12977	-------- Star & Crescent Mill. Co., Chicago.	*Norwich:* Norwich Grain Co.	8.84	6.80	13.87	12.08	53.24	5.17	
13075	Superior. Lake Superior Mills, Superior, Wis.	*Guilford:* G. F. Walter	11.31	5.68	17.19	10.74	50.49	4.59	24.00
13136	-------- Washburn-Crosby Co., Minneapolis	*Southington:* Southington Lumber and Feed Co.	12.42	5.84	13.87	10.44	52.86	4.57	25.00
		Average of these 15 analyses	**10.68**	**6.28**	**15.47**	**10.63**	**52.25**	**4.69**	**24.57**
		Average digestible	----	----	**12.07**	**3.08**	**36.05**	**3.19**	
	Middlings, Winter Wheat.								
13210	Ballard's Shipstuff. Ballard & Ballard Co., Louisville, Ky.	*Torrington:* E. H. Talcott	10.58	4.79	16.75	6.24	56.99	4.65	28.00
13273	-------- Aug. J. Butte, Clinton, Mo.	*Suffield:* Arthur Sykes	11.99	2.51	15.94	2.37	63.33	3.86	28.00
13265	-------- Dow & King, Pittsfield, Ill.	*Windsor:* C. F. Lewis	10.86	3.86	14.87	4.17	61.92	4.32	28.00
13006	-------- Hecker-Jones-Jewell Mill. Co., N. Y.	*New Haven:* Abner Hendee	11.16	4.94	17.81	8.20	52.66	5.23	26.00
13054	M. " " " "	*Bristol:* G. W. Eaton	10.55	5.00	17.00	8.28	54.28	4.89	30.00
12974	Fancy. Hunter Bros., St. Louis*	*Norwich:* Norwich Grain Co.	10.28	4.64	16.19	5.13	59.29	4.47	28.00
13173	-------- Strong, Lefferts Co., New York	*Waterbury:* The Platt Mill Co.	10.75	4.73	17.06	6.29	56.31	4.86	29.00
		Average of these 7 analyses	**10.88**	**4.35**	**16.52**	**5.81**	**57.83**	**4.61**	**28.14**
		Average digestible	----	----	**13.22**	**1.92**	**46.84**	**3.96**	
	Middlings, Spring Wheat.								
13245	-------- American Cereal Co.*	*East Hartford:* W. J. Cox	11.44	2.78	15.25	3.38	62.83	4.32	28.00
13284	-------- Ashton Flouring Mills, Ashton, S. Dak.	*Willimantic:* W. D. Grant	9.96	5.85	18.75	7.45	52.63	5.36	25.00

* Statement of Dealer.

TABLE IV.—*Continued.* ANALYSES OF COMMERCIAL FEEDS SAMPLED IN 1904.

Station No.	Brand.	Retail Dealer.	Analyses. Water.	Ash.	Protein.	Fiber.	Nitrogen-free Extract. (Starch, gum, etc.)	Ether Extract. (Fat.)	Price per ton.
	WHEAT PRODUCTS—*Continued.* *Middlings, Spring Wheat.*								
13400	Standard. L. Christian & Co., Minneapolis	*Putnam:* Bosworth Bros.	10.53	4.48	15.87	6.64	57.33	5.15	$28.00
13143	Flour Middlings. Northwest. Cons. Mill. Co.	*Plainville:* G. W. Eaton	10.84	3.89	18.25	5.25	56.25	5.52	28.00
12983	Niagara Standard. Cataract City Mill. Co., Niagara Falls	*New London:* P. Schwartz	10.07	4.98	17.31	8.01	54.15	5.48	23.00
13088	Niagara White. Cataract City Mill. Co., Niagara Falls	*Hamden:* I. W. Beers	11.89	4.44	17.56	6.85	54.23	5.03	26.00
13218	.... J. D. Davis Co., Rochester, N. Y.	*Winsted:* F. Woodruff & Son	10.84	3.82	19.31	4.99	55.54	5.50	28.00
13148	.... Freeman Milling Co., Superior	*Plainville;* F. B. Newton	11.65	4.16	15.81	6.32	57.20	4.86	28.00
13222	Snowball. The Gardner Mills, Hastings, Minn.	*Winsted:* Balch & Platt	10.65	4.52	17.75	6.87	55.74	4.47	28.00
13112	<8> Imperial Mill Co., Duluth, Minn.	*Meriden:* A. H. Cashen	11.19	4.36	18.19	7.24	53.76	5.26	27.00
13389	.... Moseley & Motley Mill. Co., Rochester, N. Y.	*Norwich:* A. A. Beckwith	11.57	3.46	16.62	4.76	58.71	4.88	25.00
13227	New Prague Standard. New Prague Roller Mill. Co., New Prague, Minn.	*Canaan:* Ives & Pierce	10.13	4.55	15.94	7.99	56.07	5.32	25.00
13201	A. Pillsbury, Minneapolis	*New Milford:* Ackley, Hatch & Marsh	11.40	3.60	17.37	4.30	58.31	5.02	28.00
13248	B. " "	*Hartford:* L. C. Daniels Grain Co.	10.28	4.83	16.19	10.02	53.95	4.73	27.00
13193	Ben Hur Standard. Royal Mill. Co., Minneapolis	*Danbury:* C. W. Keeler	10.98	4.26	17.81	7.50	54.49	4.96	26.00
13028	White Sheffield. Sheffield King Mill. Co., Minn.	*Bridgeport:* Wm. M. Terry & Co.	12.06	3.79	16.31	5.24	58.40	4.20	28.00
13171	.... Sleepy Eye Mill. Co., Sleepy Eye, Minn.	*Watertown:* John H. Taylor Co.	11.49	3.90	16.69	5.69	56.52	5.71	27.00
12984	...... Star & Crescent Mill. Co., Chicago	*New London:* P. Schwartz	9.86	4.64	16.37	7.56	55.73	5.84	24.00
13184	Standard. Washburn-Crosby Co., Washburn, Ill.	*Thomaston:* L. E. Blackmer	11.28	4.72	15.94	8.31	54.86	4.89	26.00
13063	Snow's Cream. E. S. Woodworth & Co., Minneapolis	*Bristol:* W. O. Goodsell	12.70	2.72	17.75	2.55	60.35	3.93	27.00
		Average of these 20 analyses	**11.04**	**4.19**	**17.05**	**6.35**	**56.35**	**5.02**	**26.60**
		Average digestible	----	----	**13.64**	**2.10**	**45.64**	**4.32**	
	Mixed Feed from Winter Wheat.								
13261	Acme. Acme Mill. Co., Indianapolis	*Hartford:* Smith, Northam & Co.	9.30	5.58	15.62	7.62	57.13	4.75	26.00
13121	Buckeye. American Cereal Co.	*New Britain:* The C. W. Lines Co.	12.08	5.63	15.62	7.17	54.88	4.62	25.00
13159	" " "	*Ansonia:* Ansonia Flour and Grain Co.	10.94	5.84	15.87	9.14	53.46	4.75	25.00
13185	Angola. Simpson, Hendee & Co., New York	*Thomaston:* L. E. Blackmer	11.12	5.17	15.87	10.84	52.20	4.80	26.00
13285	Diamond. Annan, Burg & Co., St. Louis	*Willimantic:* W. D. Grant	9.74	4.86	15.25	7.34	58.20	4.61	26.00
13128	Carter's A. B. S. Chase Grain Co., New York*	*Plantsville:* T. B. Atwater	12.53	5.79	15.87	9.91	51.39	4.51	26,00
13180	Carter's A. B. S. J. E. Soper & Co., Boston*	*Waterbury:* I. A. Spencer	10.28	6.16	17.25	8.74	53.19	4.38	25.00
13025	Edison. Chapin & Co.	*Clintonville:* S. A. Smith & Son	11.34	5.40	16.00	6.64	56.21	4.41	26.00
13226	Edison. " "	*Canaan:* Ives & Pierce	9.71	5.32	16.25	7.07	56.51	5.14	26.00
13209	Erie. " "	*Torrington:* E. H. Talcott	10.50	6.03	16.25	7.69	55.32	4.21	26.00
13291	...... " "	*Stafford Springs:* G. L. Dennis	9.98	5.22	15.75	7.03	57.81	4.21	26.00
13220	Hoosier Mill. G. T. Evans, Indianapolis	*Winsted:* F. Woodruff & Son	9.41	5.51	15.50	7.69	57.39	4.50	26.00
13067	Garland. Garland Mill. Co., Greensburg, Ind.	*North Haven:* Co-op. Feed Co.	10.90	5.43	16.50	7.89	54.79	4.49	25.00
13279	" " " " "	*Manchester:* Barrows & Kuhney	9.58	5.60	15.62	7.31	57.40	4.49	26.00
13068	...... Waggoner Gates Mill. Co., Independence.	*North Haven:* Co-op. Feed Co.	11.30	5.83	16.75	8.37	52.77	4.98	25.00
13118	.... Hannibal Milling Co.	*New Britain:* Hugh Reynolds	12.42	5.17	14.56	7.51	56.30	4.04	26.00
13024	Manhattan. Hecker-Jones-Jewell Co., New York	*Clintonville:* S. A. Smith & Son	10.41	5.75	15.75	8.86	55.08	4.15	26.00
13034	Queen. " " " "	*South Norwalk:* Manuel T. Hatch	11.83	5.85	15.87	8.88	53.03	4.54	24.00
13050	Manhattan. " " " "	*Bristol:* G. W. Eaton	10.66	5.60	16.62	8.35	54.22	4.55	27.00
13387	Ship Stuff. J. Andrew Cain, Hope Mills, Versailles, Ky.	*Norwich:* A. A. Beckwith	9.43	5.24	15.31	6.89	58.51	4.62	27.00

* Statement of Dealer.

TABLE IV.—*Continued.* ANALYSES OF COMMERCIAL FEEDS. SAMPLED IN 1904.

Station No.	Brand.	Retail Dealer.	Analyses.						Price per ton.
			Water.	Ash.	Protein.	Fiber.	Nitrogen-free Extract. (Starch, gum, etc.)	Ether Extract. (Fat.)	
	WHEAT PRODUCTS—*Continued.*								
	Mixed Feed from Winter Wheat.								
13394	Ship Stuff. J. Andrew Cain, Hope Mills, Versailles, Ky.	*Danielson:* Waldo Bros.	10.16	5.18	15.37	6.23	58.62	4.44	$26.00
13094	.... Hunter Bros., St. Louis	*Wallingford:* E. E. Hall	11.31	5.84	15.75	8.49	54.61	4.00	26.00
13163	.... C. M. Cox Co., Boston*	*Westville:* W. E. Warner & Bro.	11.48	5.89	15.44	8.41	54.61	4.17	26.00
13141	Sunshine. Hunter Bros. Mill Co., St. Louis	*Plainville:* G. W. Eaton	12.06	5.64	16.19	6.99	54.19	4.93	26.00
13382	" " " "	*Yantic:* A. R. Manning	9.98	5.07	15.50	6.19	58.77	4.49	25.00
13142	.... Kehlor Bros.	*Plainville:* G. W. Eaton	11.36	5.68	15.75	8.01	54.85	4.35	26.00
13106	Snowflake. Lawrenceburg Mill. Co., Lawrenceburg, Ind.	*Meriden:* Meriden Grain and Feed Co.	11.24	6.02	15.69	7.41	54.90	4.74	27.00
13109	Eatmore. Louisville Mill. Co., Louisville, Ky.	*Meriden:* Meriden Grain and Feed Co.	12 22	6.17	17.00	8.10	52.33	4.18	27.00
13253	Model. John F. Meyer & Sons, Springfield, Mo.	*Hartford:* Daniels Mill Co.	9.82	5.65	16.19	8.03	55.59	4.72	26.00
13200	Results. National Mill. Co., Toledo, Ohio	*New Milford:* Ackley, Hatch & Marsh	11.33	5.50	15.94	7.58	55.10	4.55	28.00
13135	Rex. Rex Mill. Co., Kansas City	*Southington:* Southington Lumber and Feed Co.	11.81	5.50	16.06	8.44	53.90	4.29	26.00
13062	.... J. E. Soper & Co., Boston*	*Bristol:* W. O. Goodsell	11.15	5.16	17.56	7.24	54.87	4.02	26.00
13267	Try-Me. Sparks Mill. Co., Alton, Ill.	*Suffield:* Spencer Bros.	10.00	6.04	17.19	7.28	55.18	4.31	26.00
13274	Honest. David Stott, Detroit	*Suffield:* Arthur Sikes	9.90	5.61	16.50	7.61	55.49	4.89	26.00
13208	.... Valier & Spies Mill. Co., Marine, Ill.	*Torrington:* R. W. Jennings	10.59	5.54	16.37	6.21	57.04	4.25	25.00
13399	Farmers' Favorite. Valley City Mill. Co., Grand Rapids, Ill.	*Danielson:* Quinnebaug Mills	10.00	5.62	16.50	7.70	55.66	4.52	26.00
13278	.... Zenith Mills, Kansas City	*Thompsonville:* H. K. Brainard	9.98	6.28	16.50	8.74	53.58	4.92	23.00
13295	.... Abner Hendee, New Haven*	*Colchester:* E. F. Strong	10.11	5.41	16.50	6.55	57.17	4.26	26.00
13242	.... Henry Russell, Albany	*New Hartford:* New Hartford Elevator Co.	10.24	4.59	15.37	6.60	58.87	4.33	28.00
13001	.... " "	*New Haven:* R. G. Davis	11.50	6.10	15.87	8.65	53.36	4.52	25.00
13275	W. S. M. Chas. M. Cox Co., Boston*	*Suffield:* Arthur Sikes	10.05	5.45	16.25	7.59	56.04	4.62	26.00
13016	W. S. M.	*New Haven:* J. T. Benham Est.	10.69	5.41	15.87	7.01	56.84	4.18	24.00
		Average of these 42 analyses	**10.73**	**5.58**	**16.03**	**7.76**	**55.41**	**4.49**	**25.83**
		Average digestible	----	----	**12.82**	**1.94**	**43.22**	**3.50**	
	Mixed Feed from Spring Wheat.								
13013	Columbia. Chas. M. Cox Co., Boston	*New Haven:* J. T. Benham Est.	11.16	4.32	16.00	6.91	56.32	5.29	24.00
13074	" " " "	*Guilford:* G. F. Walter	11.63	4.29	16.12	7.47	55.79	4.70	26.00
13402	Commander. Gregory, Cook & Co., Commander Mills, Duluth, Minn.	*Putnam:* F. M. Cole & Co.	9.88	4.88	15.00	8.77	56.04	5.43	24.00
13287	Royal. Brooks Elevator Co., Minneapolis	*Willimantic:* E. A. Buck & Co.	9.97	4.92	15.12	9.06	56.63	4.30	27.00
13289	Minnesota Fancy Duchess. Rodney J. Hardy & Sons	*Stafford Springs:* G. L. Dennis	10.28	4.34	16.75	7.44	55.79	5.40	26.00
13044	Boston. Imperial Mill, Duluth, Minn.	*Avon:* W. G. Woodford & Co.	12.70	5.06	17.06	8.54	52.71	3.93	26.00
13073	" " "	*Guilford:* G. F. Walter	10.91	5.07	17.37	8.75	53.48	4.42	26.00
13199	Pillsbury's Fancy. Pillsbury, Minneapolis	*New Milford:* F. R. Green	10.26	5.05	16.87	7.19	56.00	4.63	28.00
13192	Ben Hur. Royal Mill. Co., Minneapolis	*Danbury:* C. W. Keeler	10.60	4.81	16.87	8.16	54.81	4.75	26.00
13049	.... Thornton & Chase, Buffalo	*Bristol:* G. W. Eaton	11.20	5.13	17.19	7.95	53.84	4.69	27.00
13056	Washburn-Crosby's Superior. Washburn-Crosby Co., Washburn Mills, Minneapolis	*Bristol:* G. W. Eaton	11.30	5.14	17.25	8.67	53.28	4.36	28.00
13122	Superior. Washburn-Crosby Co., Washburn's Mills, Minneapolis	*New Britain:* C. W. Lines Co.	11.01	4.92	16.31	8.75	54.12	4.89	25.00
13140	.... Abner Hendee, New Haven*	*Plainville:* F. B. Newton	12.25	5.09	15.00	7.37	55.94	4.35	26.00
13144	W. S. M. American Cereal Co.	*Plainville:* G. W. Eaton	12.64	5.17	15.00	7.80	55.15	4.24	26.00
		Average of these 14 analyses	**11.13**	**4.87**	**16.28**	**8.06**	**54.99**	**4.67**	**26.07**
		Average digestible	----	----	**13.02**	**2.02**	**42.89**	**3.64**	

* Statement of Dealer.

TABLE IV.—*Continued.* ANALYSES OF COMMERCIAL FEEDS. SAMPLED IN 1904.

Station No.	Brand.	Retail Dealer.	Analyses. Water.	Ash.	Protein.	Fiber.	Nitrogen-free Extract. (Starch, gum, etc.)	Ether Extract. (Fat.)	Price per ton.
	MAIZE PRODUCTS.								
	Corn Meal.								
13116	Meal, A. Buffalo Cereal Co., Buffalo	*Berlin:* J. C. Lincoln	14.29	1.26	8.56	1.20	72.06	2.63	$26.00
13117	" B. " "	*Berlin:* J. C. Lincoln	11.37	1.98	10.62	3.97	65.47	6.59	26.00
	Corn Flour.								
13241	Henry Russell, Albany*	*New Hartford:* New Hartford Elevator Co.	13.08	0.61	5.75	0.45	77.65	2.46	29.00
	Gluten Meal.								
13196	Chicago Gluten Meal. Glucose Sugar Refining Co., Chicago	*New Milford:* F. R. Green	10.67	0.79	33.75	2.86	48.18	3.75	30.00
13217	" " " " " "	*Winsted:* F. Woodruff & Sons	8.60	1.64	32.50	2.95	51.00	3.31	28.00
13240	" " " " " "	*New Hartford:* New Hartford Elevator Co.	9.42	1.13	35.25	2.09	47.96	4.15	30.00
		Guaranty			38.0			3.0	
		Average of these 3 analyses	**9.56**	**1.19**	**33.83**	**2.63**	**49.05**	**3.74**	**29.33**
		Average digestible			**29.77**		**44.15**	**3.52**	
13256	Cream Gluten Meal. Ill. Sug. Refining Co., Chicago	*Hartford:* Daniels Mill Co.	10.15	1.32	35.12	1.54	49.21	2.66	32.00
13259	" " " " "	*Hartford:* Smith, Northam & Co.	7.46	1.62	34.62	2.34	49.24	4.72	32.00
		Guaranty			35.5			3.0	
		Average of these 2 analyses	**8.80**	**1.47**	**34.87**	**1.94**	**49.23**	**3.69**	**32.00**
		Average digestible			**30.69**		**44.31**	**3.47**	
	Gluten Feed.								
13002	Buffalo Gluten Feed. Glucose Sugar Refining Co., Chicago	*New Haven:* R. G. Davis	10.64	2.09	24.94	6.70	51.54	4.09	25.00
13014	" " " " " " *	*New Haven:* J. T. Benham Est.	10.52	1.34	23.62	7.32	54.32	2.88	24.50
13035	" " " " " "	*South Norwalk:* M. T. Hatch	10.29	1.03	21.12	7.70	57.18	2.68	27.00
13040	" " " " " "	*Stamford:* Scofield & Miller	10.27	0.70	21.94	7.01	57.69	2.39	25.00
13072	" " " " " " *	*North Haven:* Co-operative Feed Co.	8.97	2.09	25.62	7.27	53.19	2.86	25.00
13080	" " " " " "	*Guilford:* Morse & Landon	9.95	0.72	19.50	7.84	59.51	2.48	26.00
13093	" " " " " " *	*Hamden:* I. W. Beers	9.83	2.69	25.56	7.64	51.58	2.70	25.00
13095	" " " " " "	*Wallingford:* E. E. Hall	10.31	1.80	23.94	6.73	54.01	3.21	25.00
13101	" " " " " "	*Yalesville:* W. T. McKenzie	10.74	2.04	25.00	6.90	51.74	3.58	26.00
13123	" " " " " "	*New Britain:* C. W. Lines Co.	10.24	0.86	22.75	7.71	55.94	2.50	26.00
13137	" " " " " "	*Plainville:* F. B. Newton	9.59	0.80	21.87	6.84	58.32	2.58	27.00
13145	" " " " " " *	*Plainville:* G. W. Eaton	10.55	1.28	23.56	6.40	55.63	2.58	26.00
13152	" " " " " "	*Derby:* Peterson, Hendee Co.	11.07	0.90	21.75	7.09	56.90	2.29	27.00
13165	" " " " " "	*Westville:* W. E. Warner & Bro.	10.30	2.13	24.62	7.60	52.01	3.34	25.00
13168	" " " " " "	*Watertown:* J. H. Taylor Co.	9.92	0.90	21.25	8.08	57.46	2.39	26.00
13229	" " " " " "	*Canaan:* Ives & Pierce	7.95	0.81	21.75	7.48	59.72	2.29	25.00
13271	" " " " " " *	*Suffield:* Spencer Bros.	8.87	1.85	21.75	6.20	57.12	4.21	26.00
		Guaranty			**27.0–28.0**			**3.0**	
		Average of these 17 analyses	**10.00**	**1.41**	**22.97**	**7.21**	**55.52**	**2.89**	**25.68**
		Average digestible			**19.75**	**5.62**	**49.41**	**2.43**	
13149	J. H. Gluten. Buffalo Mill & Eleva'r Co., Buffalo*	*Middlefield:* A. E. Miller	9.59	0.64	17.06	10.46	59.12	3.13	22.00
		Digestible			**14.67**	**8.16**	**52.62**	**2.63**	
13236	Chapin & Co., Boston*	*Collinsville:* The Collinsville Grain Co.	8.52	2.09	23.19	6.89	54.68	4.63	26.00

* Statement of Dealer.

TABLE IV.—*Continued.* ANALYSES OF COMMERCIAL FEEDS. SAMPLED IN 1904.

Station No.	Brand.	Retail Dealer.	Water.	Ash.	Protein.	Fiber.	Nitrogen-free Extract. (Starch, gum, etc.)	Ether Extract. (Fat.)	Price per ton.
	MAIZE PRODUCTS—*Continued.* *Gluten Feed.*								
12997	Globe Gluten Feed. N. Y. Glucose Co., Edgewater, N. J.	*New Haven:* R. G. Davis	9.60	2.50	26.44	8.03	49.95	3.48	$25.00
13022	" " " " " "	*Clintonville:* S. A. Smith & Son	6.34	2.55	27.19	7.86	52.92	3.14	25.00
13071	" " " " " "	* *North Haven:* Co-operative Feed Co.	9.21	1.87	26.59	7.64	50.00	3.79	25.00
13086	" " " " " "	*Branford:* S. V. Osborn	9.91	2.21	26.87	7.64	49.42	3.95	26.00
13104	" " " " " "	* *Meriden:* August Grulich	10.37	2.25	25.50	7.85	50.46	3.57	26.00
13105	" " " " " "	*Meriden:* Meriden Feed Co.	9.28	2.47	27.69	6.84	51.24	2.48	27.00
13113	" " " " " "	*Berlin:* J. C. Lincoln	9.55	1.91	25.75	7.98	51.65	3.16	26.00
13120	" " " " " "	*New Britain:* Hugh Reynolds	10.93	1.25	25.75	7.43	51.99	2.65	26.00
13156	" " " " " "	*Ansonia:* Ansonia Flour & Grain Co.	10.76	2.10	29.00	6.63	48.92	2.59	25.00
13158	" " " " " "	*Ansonia:* Ansonia Flour & Grain Co.	9.34	2.04	26.37	7.69	50.65	3.91	25.00
13162	" " " " " "	* *Westville:* W. E. Warner & Bro.	9.69	2.09	26.25	7.69	50.74	3.54	25.00
13182	" " " " " "	*Thomaston:* L. E. Blackmer	8.43	2.35	27.44	7.39	50.89	3.50	27.00
13203	" " " " " "	* *Middletown:* Meech & Stoddard	9.04	2.07	26.44	7.61	51.47	3.37	26.00
13234	" " " " " "	*Unionville:* S. Richards	8.57	2.25	27.62	8.11	50.23	3.22	27.00
13288	" " " " " "	*Willimantic:* H. A. Bugbee	8.24	1.78	26.37	8.08	51.99	3.54	26.00
		Guaranty			**27.0**			**3.0**	
		Average of these 15 analyses	**9.28**	**2.11**	**26.75**	**7.63**	**50.90**	**3.33**	**25.80**
		Average digestible			**23.01**	**5.95**	**45.30**	**2.80**	
13053	Pekin Gluten. Ill. Sugar Refining Co., Chicago	*Bristol:* G. W. Eaton	9.15	1.04	26.25	7.56	52.54	3.46	27.00
		Guaranty			**28.0**			**3.0**	
		Digestible			**22.58**	**5.90**	**46.76**	**2.91**	
13260	Queen Gluten Feed. Nat'l Starch Co., Chicago	*Hartford:* Smith, Northam & Co.	8.77	0.91	22.12	7.20	58.75	2.25	27.00
		Guaranty			**25.0**			**2.9**	
		Digestible			**19.02**	**5.62**	**52.29**	**1.89**	
13224	Warner's Gluten Feed. Waukegan, Ill.	*Winsted:* Balch & Platt	10.00	1.09	23.37	7.03	56.01	2.50	28.00
		Digestible			**20.10**	**5.48**	**49.85**	**2.10**	
	Hominy Feed.								
13103	Hominy Feed. American Hom. Co., Indianapolis	*Meriden:* August Grulich	8.53	2.85	9.69	8.21	62.94	7.78	26.00
13129	" " " " "	*Plantsville:* T. B. Atwater	9.12	2.81	10.87	3.99	64.25	8.96	26.00
		Guaranty			**10.0**			**7.0**	
		Average of these 2 analyses	**8.83**	**2.83**	**10.28**	**6.10**	**63.59**	**8.37**	**26.00**
		Average digestible			**6.99**		**60.41**	**7.70**	
12980	Hominy Feed. Buffalo Cereal Co., Buffalo	*New London:* P. Schwartz	9.89	2.37	10.00	3.71	66.53	7.50	26.00
13032	" " " " "	*South Norwalk:* M. T. Hatch	12.29	2.11	9.44	3.71	65.74	6.71	27.00
13060	" " " " "	*Bristol:* W. O. Goodsell	10.93	2.32	10.62	4.09	64.31	7.73	26.00
13111	" " " " "	*Meriden:* Meriden Grain & Feed Co.	10.81	2.34	10.25	4.06	64.60	7.94	27.00
13181	" " " " "	*Thomaston:* L. E. Blackmer	10.29	2.28	10.00	4.01	65.86	7.56	26.00
13393	" " " " "	*Plainfield:* Waldo Tillinghast	10.06	2.09	9.81	3.25	67.91	6.88	27.00
		Guaranty			**10.5**			**8.5**	
		Average of these 6 analyses	**10.71**	**2.25**	**10.02**	**3.81**	**65.82**	**7.39**	**26.50**
		Average digestible			**6.81**		**62.53**	**6.80**	

*Statement of Dealer.

TABLE IV.—ANALYSES OF COMMERCIAL FEEDS. SAMPLED IN 1904.

Station No.	Brand.	Retail Dealer.	Analyses. Water.	Ash.	Protein.	Fiber.	Nitrogen-free Extract. (Starch, gum, etc.)	Ether Extract. (Fat.)	Price per ton.
	MAIZE PRODUCTS—*Continued.* *Hominy Feed.*								
12986	-------- C. W. Campbell & Co., Westerly, R. I.*	*Stonington:* S. H. Chesebro	8.41	2.45	9.62	6.22	66.19	7.11	$26.00
12989	-------- The Coles Co., Middletown*	*East Hampton:* R. H. Hall	6.01	2.75	10.62	4.01	67.82	8.79	26.00
12979	Hominy Chop, Niagara. Chapin & Co., Boston*	*New London:* E. H. Caulkins	8.81	3.13	10.56	4.44	64.68	8.38	25.00
13198	" Green Diamond. " " "	*New Milford:* F. R. Green	8.60	2.43	9.25	7.63	65.04	7.05	26.00
13269	" " " " " "	*Suffield:* Spencer Bros.	9.30	2.73	9.50	6.38	65.09	7.00	26.00
13018	Hominy Feed, Wirthmore. C. M. Cox Co., Boston	*New Haven:* J. T. Benham Est.	10.59	2.13	9.87	3.49	67.48	6.44	25.00
13099	" " " " "	*Wallingford:* E. E. Hall	9.23	2.43	9.25	7.36	65.36	6.37	25.00
13102	" " " " " *	*Yalesville:* W. T. McKenzie	9.06	3.12	10.37	4.71	63.97	8.77	25.00
13138	" " " " " *	*Plainville:* F. B. Newton	10.68	2.83	10.94	5.29	61.58	8.68	27.00
13147	" " " " " *	*Plainville:* G. W. Eaton	11.28	2.71	10.94	4.94	62.16	7.97	27.00
13164	" " " " " *	*Westville:* W. E. Warner & Bro.	10.69	2.62	10.75	4.19	63.47	8.28	25.00
13189	" " " " "	*Danbury:* F. C. Benjamin & Co.	8.85	2.75	10.62	5.13	63.08	9.57	26.00
		Guaranty	----	----	10.0	----	----	7.0	--
		Average of these 7 analyses	**10.05**	**2.66**	**10.39**	**5.02**	**63.87**	**8.01**	**25.86**
		Average digestible	----	----	**7.07**	----	**60.68**	**7.37**	
13081	Hominy, Standard. Chas. M. Cox Co., Boston*	*Guilford:* Morse & Landon	9.97	2.44	10.75	4.92	64.46	7.46	25.00
13045	-------- L. C. Daniels Mill Co., Hartford*	*Avon:* W. G. Woodford & Co.	10.88	2.05	10.12	3.56	67.06	6.33	25.00
13221	Hominy Feed. Hunter Bros. Mill Co., St. Louis	*Winsted:* F. Woodruff & Son	7.32	3.18	10.87	5.04	64.67	8.92	26.00
13281	-------- " " " "	*Rockville:* Edward White	9.58	2.55	10.50	3.59	65.53	8.25	26.00
		Guaranty	----	----	11.0	----	----	7.7	----
		Average of these 2 analyses	**8.45**	**2.87**	**10.68**	**4.32**	**65.10**	**8.58**	**26.00**
		Average digestible	----	----	**7.26**	----	**61.85**	**7.89**	----
13017	Hominy Chop, Steam-cooked Star. Miner Hillard Mill. Co., Wilkesbarre, Pa.	*New Haven:* J. T. Benham Estate	11.73	1.80	9.19	3.81	69.90	3.57	24.00
13059	Hominy Meal. Miner Hillard Mill. Co. Wilkes-barre, Pa.*	*Bristol:* G. W. Eaton	9.42	2.28	10.56	1.74	69.45	6.55	28.00
13155	Hominy Feed, Steam-cooked. Miner Hillard Mill. Co., Wilkesbarre	*Ansonia:* Ansonia Flour and Grain Co.	11.77	1.92	9.75	2.80	68.01	5.75	25.00
13175	-------- Miner Hillard Mill. Co., Wilkesbarre*	*Waterbury:* The Platt Mill Co.	9.47	2.89	10.94	4.45	63.15	9.10	24.00
13252	-------- " " " "*	*Hartford:* Daniels Mill Co.	8.82	2.56	11.06	2.01	67.64	7.91	28.00
		Guaranty	----	----	9.0	----	----	6.0	----
		Average of these 5 analyses	**10.24**	**2.29**	**10.30**	**2.96**	**67.63**	**6.58**	**25.80**
		Average digestible	----	----	**7.00**	----	**64.25**	**6.05**	----
13023	Hominy Chop. Wm. M. Payne & Son, New York	*Clintonville:* S. A. Smith & Son	9.74	2.47	11.00	3.92	65.08	7.79	26.00
13041	" " " " " " *	*Stamford:* Scofield & Miller	10.48	2.47	10.69	4.27	64.21	7.88	26.00
13091	-------- " " " " " *	*Hamden:* I. W. Beers	9.84	2.45	10.81	4.24	65.16	7.50	26.00
13205	-------- " " " " " *	*Middletown:* Meech & Stoddard	9.56	2.39	10.87	3.94	65.60	7.64	25.00
		Guaranty	----	----	----	----	----	----	----
		Average of these 4 analyses	**9.91**	**2.45**	**10.84**	**4.09**	**65.01**	**7.70**	**25.75**
		Average digestible	----	----	**7.37**	----	**61.76**	**7.08**	----
13294	Hominy. Geo. B. Robinson, New York*	*Colchester:* E. F. Strong	9.47	3.03	10.69	4.62	62.93	9.26	25.00
13396	" Chop, Blue Ribbon. J. E. Soper & Co., Boston	*Danielson:* Young Bros. Co.	9.70	2.50	10.69	4.30	64.91	7.90	25.00
13391	Hominy Feed. The Toledo Elev. Co., Toledo, O.	*Jewett City:* J. E. Leonard & Son	9.33	2.64	9.19	7.86	64.22	6.76	26.00
13251	" Wilson & Eaton, Amenia, New York*	*Hartford:* L. C. Daniels Grain Co.	7.70	2.55	9.37	8.17	64.94	7.27	26.00
		Average of 37 analyses of Hominy feed	**9.68**	**2.53**	**10.27**	**4.65**	**65.27**	**7.60**	**25.84**
		Average digestible	----	----	**6.98**	----	**62.01**	**6.99**	----

* Statement of Dealer.

TABLE IV.—ANALYSES OF COMMERCIAL FEEDS. SAMPLED IN 1904.

Station No.	Brand.	Retail Dealer.	Analyses. Water.	Ash.	Protein.	Fiber.	Nitrogen-free Extract. (Starch, gum, etc.)	Ether Extract. (Fat.)	Price per ton.
	RYE PRODUCTS.								
13015	Rye Feed. Miner Hillard Mill Co., Wilkesbarre*	*New Haven:* J. T. Benham Est.	11.23	3.57	16.12	3.85	61.93	3.30	$27.00
13030	Rye Bran. Buffalo Cereal Co., New York*	*Bridgeport:* Wm. M. Terry & Co.	11.43	3.94	15.87	3.93	61.68	3.15	28.00
13070	" Abner Hendee, New Haven*	*North Haven:* Co-operative Feed Co.	12.02	3.55	16.12	5.50	59.47	3.34	28.00
13082	" Morse & Landon, Guilford	*Guilford:* Morse & Landon	7.74	3.22	14.12	3.66	68.41	2.82	25.00
13092	" I. W. Beers, Hamden	*Hamden:* I. W. Beers	12.56	3.78	16.19	5.28	59.08	3.11	30.00
13100	Rye Feed. E. E. Hall, Wallingford	*Wallingford:* E. E. Hall	12.09	3.79	15.62	4.18	61.50	2.82	28.00
13087	" S. V. Osborn, Branford	*Branford:* S. V. Osborn	13.68	1.92	10.56	1.75	70.37	1.72	30.00
		Average of these 7 analyses	**11.54**	**3.40**	**14.94**	**4.02**	**63.20**	**2.90**	**28.00**
		Average digestible	----	----	**12.55**	----	**58.14**	**1.86**	----
	BARLEY PRODUCTS.								
13000	Malt Sprouts. D. W. Ranlet, Boston	*New Haven:* R. G. Davis	10.18	5.79	24.31	11.25	47.03	1.44	21.00
13021	" John Ryan, Port Chester, New York	*Clintonville:* S. A. Smith & Son	12.20	5.55	20.62	12.15	47.24	2.24	20.00
13186	" Chase Grain Co., New Canaan, Conn.*	*Danbury:* F. C. Benjamin & Co.	11.25	5.68	26.12	12.28	43.44	1.23	20.00
13276	" Chas. M. Cox Co., Boston.*	*Suffield:* Arthur Sikes	9.30	5.74	27.37	12.69	43.73	1.17	20.00
		Average of these 4 analyses	**10.73**	**5.69**	**24.61**	**12.09**	**45.36**	**1.52**	**20.25**
		Average digestible	----	----	**19.69**	**3.99**	**30.84**	**1.52**	----
	Dried Distillery Grains.								
13048	Ajax Flakes	*Bristol:* G. W. Eaton	8.00	2.06	31.75	11.62	32.31	14.26	28.00
13216	" ----	*Torrington:* F. W. Wadhams	7.25	1.93	32.37	13.10	32.51	12.84	28.00
13262	" Chapin & Co., Boston	*Hartford:* Smith, Northam & Co.	5.93	2.13	32.12	12.89	32.08	14.85	28.00
13270	" " " "	*Suffield:* Spencer Bros.	6.24	2.63	32.12	12.43	32.00	14.58	27.00
		Guaranty	----	----	**33.00**	----	----	**12.0**	----
		Average of these 4 analyses	**6.85**	**2.18**	**32.09**	**12.53**	**32.22**	**14.13**	**27.75**
		Average digestible	----	----	**25.35**	**6.52**	**18.69**	**12.86**	----
	OAT PRODUCTS.								
13058	Ground Oats. G. W. Eaton, Bristol	*Bristol:* G. W. Eaton	11.08	2.85	10.87	8.97	62.59	3.64	39.00
12999	Oat Feed. Ogilvie Mills, Canada*	*New Haven:* R. G. Davis	7.67	5.32	7.12	22.87	53.43	3.59	18.00
	BUCKWHEAT PRODUCTS.								
13397	Buckwheat Middlings. Quinnebaug Mills, Danielson, Conn.	*Danielson:* Quinnebaug Mills	13.65	5.54	30.75	7.64	34.05	8.37	23.00
	MISCELLANEOUS MIXED FEEDS.								
13161	*Provender.* Ansonia Flour & Grain Co., Ansonia	*Ansonia:* Ansonia Flour & Grain Co.	11.69	2.17	10.25	4.68	66.92	4.29	28.00
13130	" F. B. Atwater, Plantsville	*Plantsville:* F. B. Atwater	12.31	1.86	9.87	4.11	67.60	4.25	27.00
12978	" E. W. Bailey, Montpelier, Vt.*	*New London:* E. H. Caulkins	11.05	2.15	9.62	5.21	67.96	4.01	30.00
13225	" Balch & Platt, Winsted	*Winsted:* Balch & Platt	11.70	1.68	9.57	3.47	69.46	4.12	28.00
13390	" A. A. Beckwith, Norwich	*Norwich:* A. A. Beckwith	11.97	1.85	9.94	4.08	68.52	3.64	27.00
13089	" I. W. Beers, Hamden	*Hamden:* I. W. Beers	12.73	1.92	9.62	6.51	65.17	4.05	26.00
13401	" Bosworth Bros., Putnam	*Putnam:* Bosworth Bros.	11.53	1.88	9.25	4.38	68.64	4.32	26.00
13277	" H. K. Brainard, Thompsonville	*Thompsonville:* H. K. Brainard	11.30	1.98	9.50	4.90	68.07	4.25	28.00
12987	" C. W. Campbell & Co., Westerly, R. I.	*Stonington:* S. H. Chesebro	10.55	1.83	9.44	4.05	69.89	4.24	28.00
13237	" Collinsville Grain Co., Collinsville	*Collinsville:* The Collinsville Grain Co.	11.90	2.12	9.62	4.73	67.14	4.49	27.00
13246	" W. J. Cox, East Hartford	*East Hartford:* W. J. Cox	11.45	1.66	9.50	3.32	70.13	3.94	28.00
12976	" Cutler Co., North Wilbraham, Mass.*	*Norwich:* Norwich Grain Co.	11.19	2.24	9.62	4.54	68.03	4.38	27.00

* Statement of Dealer.

TABLE IV.—*Continued.* ANALYSES OF COMMERCIAL FEEDS. SAMPLED IN 1904.

Station No.	Brand.	Retail Dealer.	Analyses. Water.	Ash.	Protein.	Fiber.	Nitrogen-free Extract. (Starch, gum, etc.)	Ether Extract. (Fat.)	Price per ton.
	MISCELLANEOUS MIXED FEEDS—*Continued.*								
13258	*Provender.* Daniels Mill Co., Hartford	*Hartford:* Daniels Mill Co.	11.59	1.88	9.12	5.60	67.97	3.84	$28.00
13249	" L. C. Daniels Grain Co., Hartford	*Hartford:* L. C. Daniels Grain Co.	10.43	2.21	10.00	6.11	67.05	4.20	28.00
13292	" Geo. L. Dennis, Stafford Springs	*Stafford Springs:* G. L. Dennis	12.61	1.58	9.12	3.28	69.45	3.96	27.00
13178	" D. L. Dickinson, Waterbury	*Waterbury:* D. L. Dickinson & Son	11.30	1.80	9.62	4.01	69.10	4.17	26.00
13057	" G. W. Eaton, Bristol	*Bristol:* G. W. Eaton	12.51	2.01	9.62	4.37	67.94	3.55	30.00
13146	" G. W. Eaton, Plainville	*Plainville:* G. W. Eaton	12.32	1.95	9.44	4.45	66.98	4.86	28.00
13066	" W. O. Goodsell, Bristol	*Bristol:* W. O. Goodsell	11.25	2.50	11.37	7.56	62.73	4.59	28.90
13097	" E. E. Hall, Wallingford	*Wallingford:* E. E. Hall	13.11	1.67	9.00	4.30	68.98	2.94	28.00
13153	" Peterson, Hendee Co., Derby	*Derby:* Peterson, Hendee Co.	12.93	1.69	9.19	3.69	68.47	4.03	28.00
13230	" Ives & Pierce, Canaan	*Canaan:* Ives & Pierce	10.59	2.27	9.94	6.41	66.17	4.62	27.00
13266	" C. F. Lewis, Windsor	*Windsor:* C. F. Lewis	12.24	1.57	9.00	2.21	70.90	4.08	28.00
13127	" C. W. Lines Co., New Britain	*New Britain:* C. W. Lines Co.	12.76	2.34	9.00	6.48	65.75	3.67	28.00
13385	" A. R. Manning, Yantic	*Yantic:* A. R. Manning	11.08	2.00	9.37	5.16	68.19	4.20	27.00
13204	" Meech & Stoddard, Middletown	*Middletown:* Meech & Stoddard	11.55	1.75	9.06	5.44	68.15	4.05	29.00
13078	" Morse & Landon, Guilford	*Guilford:* Morse & Landon	12.39	1.95	9.56	5.35	66.65	4.10	28.00
13243	" New Hartford Elev. Co., New Hartford	*New Hartford:* New Hartford Elevator Co.	10.86	2.11	9.31	4.71	68.89	4.12	28.00
13139	" F. B. Newton, Plainville	*Plainville:* F. B. Newton	11.99	2.03	9.37	4.69	67.61	4.31	28.00
13083	" S. V. Osborn, Branford	*Branford:* S. V. Osborn	12.84	2.13	9.87	5.42	64.85	4.89	28.00
13398	" Quinnebaug Mills, Danielson	*Danielson:* Quinnebaug Mills	11.53	1.74	9.50	3.64	69.76	3.83	27.00
13233	" S. Richards, Unionville	*Unionville:* S. Richards	9.87	2.47	9.81	6.53	66.57	4.75	27.00
13238	" D. B. Smith, Pine Meadow	*Pine Meadow:* D. B. Smith	11.65	1.80	9.75	3.31	69.58	3.91	28.00
13264	" Smith, Northam & Co., Hartford	*Hartford:* Smith, Northam & Co.	11.28	1.73	9.56	4.31	69.11	4.01	28.00
13133	" Southington Lumber & Feed Co., Southington	*Southington:* Southington Lumber & Feed Co.	12.40	1.75	9.31	3.96	68.56	4.02	27.00
13211	" E. H. Talcott, Torrington	*Torrington:* E. H. Talcott	11.73	1.86	9.62	3.95	69.14	3.70	28.00
13169	" John H. Taylor Co., Watertown	*Watertown:* John H. Taylor Co.	12.21	2.05	9.50	4.64	67.64	3.96	29.00
13215	" F. U. Wadhams, Torrington	*Torrington:* F. U. Wadhams	10.86	2.22	9.69	5.59	67.51	4.13	28.00
13046	" W. G. Woodford & Co., Avon	*Avon:* W. G. Woodford & Co.	12.70	1.70	9.37	3.99	68.17	4.07	27.00
13219	" F. Woodruff & Sons	*Winsted:* F. Woodruff & Sons.	11.38	1.86	9.37	4.52	68.67	4.20	28.00
		Average of these 40 analyses	**11.73**	**1.95**	**9.56**	**4.69**	**67.95**	**4.12**	**27.73**
		Average digestible	----	----	**6.79**	**2.25**	**56.40**	**3.58**	
12981	*Victor Corn and Oat Feed.* American Cereal Co.	*New London:* P. Schwartz	8.87	4.16	8.12	11.75	63.10	4.00	25.00
13033	" " " " "	*South Norwalk:* M. T. Hatch	9.61	3.52	8.19	11.40	63.12	4.16	27.00
13069	" " " " "	*North Haven:* Co-operative Feed Co.	9.71	4.10	8.31	12.32	61.42	4.14	25.00
13098	" " " " "	*Wallingford:* E. E. Hall	10.38	2.96	8.37	13.17	61.90	3.22	25.00
13132	" " " " "	*Southington:* Southington Lumber and Feed Co.	9.59	3.74	8.31	12.69	61.54	4.13	25.00
		Guaranty	----	----	**9.0**	----	-	**4.0**	
		Average of these 5 analyses	**9.63**	**3.70**	**8.26**	**12.27**	**62.21**	**3.93**	**25.40**
		Average digestible	----	----	**5.86**	**5.89**	**51.63**	**3.42**	
12996	*Corn and Oat Chop.* Buffalo Cereal Co., Buffalo	*New Haven:* R. G. Davis	10.53	3.70	8.19	12.89	61.17	3.52	24.00
13183	" " " " "	*Thomaston:* L. E. Blackmer	9.25	3.61	8.25	12.01	62.24	4.64	28.00
		Guaranty	----	----	**8.0**	----	----	**4.0**	
		Average of these 2 analyses	**9.89**	**3.66**	**8.22**	**12.45**	**61.70**	**4.08**	**26.00**
		Average digestible	----	----	**5.84**	**5.98**	**51.21**	**3.55**	

TABLE IV.—*Continued.* ANALYSES OF COMMERCIAL FEEDS.

SAMPLED IN 1904.

Station No.	Brand.	Retail Dealer.	Analyses. Water.	Ash.	Protein.	Fiber.	Nitrogen-free Extract. (Starch, gum, etc.)	Ether Extract. (Fat.)	Price per ton.
	MISCELLANEOUS MIXED FEEDS—*Continued.* *Miscellaneous Corn and Oat Feeds.*								
13195	*De-Fi Corn and Oat Feed.* Ellsworth & Co., Buffalo	*Danbury:* C. W. Keeler	8.21	3.84	8.75	14.71	61.19	3.30	$25.00
		Guaranty	----	----	8.3	----	----	3.0	
		Digestible	----	----	6.21	7.06	50.79	2.87	
13177	*Dickinson's Stock Food*	*Waterbury:* D. L. Dickinson & Son	8.99	4.06	8.62	12.44	61.44	4.45	24.00
		Guaranty	----	----	10.0	----	----	4.1	
		Digestible	----	----	6.12	5.97	50.99	3.87	
13007	*Boss Corn and Oat Feed.* The Great Western Cereal Co., Chicago	*New Haven:* Abner Hendee	10.55	3.64	8.87	11.30	60.21	5.43	24.00
		Guaranty	----	----	9.0	----	----	4.0	
		Digestible	----	----	6.30	5.42	49.97	4.72	
13235	*Haskell's Stock Feed.* W. H. Haskell & Co., Toledo, Ohio	*Unionville:* S. Richards	9.03	2.84	9.62	8.94	63.57	6.00	27.00
		Guaranty	----	----	10.0	----	----	6.3	
		Digestible	----	----	6.83	4.29	52.76	5.22	
13293 (13193)	*Monarch Chop Feed.* Husted Mill & Elevator Co., Buffalo	*Colchester:* E. F. Strong	9.36	2.90	7.25	12.90	64.40	3.19	25.00
		Guaranty	----	----	8.1	----	----	4.2	
		Digestible	----	----	5.15	6.19	53.45	2.78	
13191	*Lenox Stock Feed.* The Strong, Lefferts Co., Produce Exchange, N. Y.	*Danbury:* F. C. Benjamin & Co.	9.22	3.44	7.50	14.18	61.94	3.72	26.00
		Guaranty	----	----	9.9	----	----	3.3	
		Digestible	----	----	5.33	6.81	51.41	3.24	
	CORN AND WHEAT FEEDS.								
13012	*Colonial Middlings.* Miner Hillard Milling Co., Wilkesbarre	*New Haven:* J. T. Benham Est.	10.78	3.58	13.12	5.73	60.44	6.35	28.00
13126	*Colonial Middlings.* Miner Hillard Milling Co., Wilkesbarre	*New Britain:* C. W. Lines Co.	10.41	3.88	14.37	6.36	59.11	5.87	28.00
		Guaranty	----	----	13.5	----	----	6.75	
		Average of these 2 analyses	10.59	3.73	13.74	6.05	59.78	6.11	28.00
13290	"*Dairy*" *Mixed Feea.* Jennings & Fulton, Boston	*Stafford Springs:* G. L. Dennis	9.00	4.58	11.50	15.23	56.47	3.22	25.00
		Guaranty	----	----	12.05	----	----	3.20	
13395	"*Jersey*" *Mixed Feed.* Indiana Milling Co., Terre Haute	*Danielson:* Young Bros. Co.	8.93	4.54	12.87	13.64	56.54	3.48	24.00
			----	----	12.05	----	----	3.25	
13231	*Wheat and Oats.* S. Richards, Unionville	*Unionville:* S. Richards	9.57	3.62	12.87	7.43	61.91	4.60	26.00
	CORN, OATS AND BARLEY.								
13019	*Schumacher's Stock Feed.* American Cereal Co.	*New Haven:* J. T. Benham Est.	10.41	3.16	10.69	9.43	63.12	3.19	26.00
13039	" " " "	*Stamford:* Scofield & Miller	12.15	3.30	10.25	9.04	62.64	2.62	28.00
13051	" " " "	*Bristol:* G. W. Eaton	9.66	3.94	10.94	10.66	60.25	4.55	29.00
13115	" " " "	*Berlin:* J. C. Lincoln	9.76	4.24	11.19	11.14	59.12	4.55	27.00
		Guaranty	----	----	13.0	----	----	5.0	
		Average of these 4 analyses	10.49	3.66	10.77	10.07	61.28	3.73	27.50

Table IV.—Analyses of Commercial Feeds Sampled in 1904.

Station No.	Brand.	Retail Dealer.	Analyses. Water.	Ash.	Protein.	Fiber.	Nitrogen-free Extract. (Starch, gum, etc.)	Ether Extract. (Fat.)	Price per ton.
	Proprietary Horse Feeds.								
12998	*Sucrene Horse Feed.* American Mill. Co., Chicago	*New Haven:* R. G. Davis	11.14	6.84	14.25	11.01	53.31	3.45	$28.00
13157	" " " "	*Ansonia:* Ansonia Flour & Grain Co.	11.19	5.80	13.62	9.98	56.98	2.43	27.00
		Guaranty	----	----	13.5	----	----	3.5	
		Average of these 2 analyses	**11.17**	**6.32**	**13.94**	**10.49**	**55.14**	**2.94**	**27.50**
13026	*Horse Feed.* Buffalo Cereal Co., Buffalo	*Bridgeport:* Wm. M. Terry & Co.	9.99	3.16	11.94	9.54	60.48	4.89	30.00
13114	" " " "	*Berlin:* J. C. Lincoln	10.17	3.28	11.50	10.41	59.94	4.70	28.00
		Guaranty	----	----	12.0	----	----	4.5	
		Average of these 2 analyses	**10.08**	**3.22**	**11.72**	**9.98**	**60.21**	**4.79**	**29.00**
13008	*H-O Horse Feed.* H-O Co., Buffalo	*New Haven:* Abner Hendee	10.08	2.84	11.44	8.89	61.66	5.09	29.00
13042	" " " "	*Stamford:* Scofield & Miller	11.41	2.89	11.62	9.21	60.14	4.73	30.00
13076	" " " "	*Guilford:* G. F. Walter	10.53	2.98	11.69	9.57	60.56	4.67	30.00
		Guaranty	----	----	12.0	----	----	4.5	
		Average of these 3 analyses	**10.67**	**2.90**	**11.59**	**9.22**	**60.79**	**4.83**	**29.67**
		Average digestible	----	----	**8.58**	**3.23**	**48.02**	**4.06**	
13179	*N-E-S-F. New England Stock Feed.* Hoco Mills, Buffalo	*Waterbury:* I. A. Spencer	9.25	3.03	11.19	8.56	63.49	4.48	26.00
13187	" " " "	*Danbury:* F. C. Benjamin & Co.	10.33	2.84	11.06	7.51	63.61	4.65	26.00
		Guaranty	----	----	10.0	----	----	4.0	
		Average of these 2 analyses	**9.79**	**2.93**	**11.13**	**8.03**	**63.55**	**4.57**	**26.00**
	Proprietary Dairy and Stock Feeds.								
12982	*Quaker Dairy Feed.* American Cereal Co.	*New London:* P. Schwartz	7.75	5.50	12.75	17.71	52.33	3.96	24.00
13043	" " " "	*Stamford:* W. L. Crabb	10.25	5.61	11.81	16.53	52.39	3.41	25.00
13084	" " " "	*Branford:* S. V. Osborn	8.61	5.11	11.94	18.52	52.20	3.62	25.00
13110	" " " "	*Meriden:* A. H. Cashen	9.48	4.61	12.81	17.20	52.51	3.39	25.00
13166	" " " "	*Watertown:* John H. Taylor Co.	8.26	5.73	14.00	18.07	49.86	4.08	23.00
		Guaranty	----	----	14.0	----	----	3.5	
		Average of these 5 analyses	**8.87**	**5.31**	**12.66**	**17.61**	**51.86**	**3.69**	**24.40**
		Average digestible	----	----	**9.87**	**7.22**	**36.30**	**3.17**	
13065	*Sucrene Dairy Feed.* American Mill. Co., Chicago	*Bristol:* W. O. Goodsell	10.65	6.43	18.94	11.77	48.54	3.67	28.00
13154	" " " "	*Ansonia:* Ansonia Flour & Grain Co.	10.14	5.91	18.19	11.94	50.19	3.63	26.00
		Guaranty	----	----	16.5	----	----	3.5	
		Average of these 2 analyses	**10.39**	**6.17**	**18.59**	**11.85**	**49.37**	**3.65**	**27.00**
13176	*Blatchford's Calf Meal.* J. W. Barwell, Waukegan, Ill.	*Waterbury:* The Platt Mill Co.	10.47	4.18	22.69	4.52	53.46	4.68	38.00
		Guaranty	---	----	25.00	----	----	5.0	
13009	*Blomo Feed.* Blomo Mfg. Co., New York	*New Haven:* Abner Hendee	17.00	10.00	13.87	10.44	48.14	0.55	24.00
13077	" " " "	*Guilford:* G. F. Walter	16.64	9.83	14.06	11.71	47.02	0.74	24.00
		Guaranty	----	----	15.0	----	----	1.2	
		Average of these 2 analyses	**16.82**	**9.92**	**13.97**	**11.07**	**47.58**	**0.64**	**24.00**

TABLE IV.—ANALYSES OF COMMERCIAL FEEDS. SAMPLED IN 1904.

Station No.	Brand.	Retail Dealer.	Analyses. Water.	Ash.	Protein.	Fiber.	Nitrogen-free Extract. (Starch, gum, etc.)	Ether Extract. (Fat.)	Price per ton.
	PROPRIETARY DAIRY AND STOCK FEEDS—*Continued.*								
13064	*Creamery Feed.* Buffalo Cereal Co., Buffalo	*Bristol:* W. O. Goodsell	9.38	4.13	19.62	11.83	49.12	5.92	$27.00
13160	" " " " "	*Ansonia:* Ansonia Flour & Grain Co.	10.04	3.32	18.81	10.93	51.78	5.12	28.00
		Guaranty	----	----	**20.0**	----	----	**5.0**	----
		Average of these 2 analyses	**9.71**	**3.72**	**19.22**	**11.38**	**50.45**	**5.52**	**27.50**
13038	*H-O Dairy Feed.* H-O Company, Buffalo	*Stamford:* Scofield & Miller	9.88	3.44	17.37	12.62	50.57	6.12	29.00
13188	" " " " "	*Danbury:* F. C. Benjamin & Co.	8.67	3.66	17.44	12.54	51.54	6.15	28.00
		Guaranty	----	----	**18.0**	----	----	**4.5**	----
		Average of these 2 analyses	**9.27**	**3.55**	**17.41**	**12.58**	**51.06**	**6.13**	**28.50**
		Average digestible	----	----	**13.67**	**5.16**	**35.74**	**5.27**	----
	PROPRIETARY POULTRY FEEDS.								
13020	*American Poultry Food.* Am. Cereal Co., Chicago	*New Haven:* J. T. Benham Est.	11.60	3.19	13.75	4.59	60.94	5.93	34.00
13134	" " " " " "	*Southington:* Southington Lumber and Feed Co.	11.16	3.10	13.87	4.86	62.48	4.53	33.00
		Guaranty	----	----	**14.0**	----	----	**4.5**	----
		Average of these 2 analyses	**11.38**	**3.14**	**13.81**	**4.73**	**61.71**	**5.23**	**33.50**
13029	*Poultry Feed.* Buffalo Cereal Co., Buffalo	*Bridgeport:* Wm. M. Terry & Co.	11.29	3.04	17.62	5.12	59.32	3.61	32.00
		Guaranty	----	----	**17.0**	----	----	**5.5**	----
13212	*Laying Food.* Cyphers Incubator Co., Buffalo	*Torrington:* F. U. Wadhams	12.24	2.65	16.37	2.69	62.35	3.70	38.00
		Guaranty	----	----	**15.0**	----	----	**5.0**	----
13011	*H-O Poultry Food.* H-O Company, Buffalo	*New Haven:* Abner Hendee	10.95	2.90	17.50	5.62	57.10	5.93	37.00
13055	" " " " "	*Bristol:* G. W. Eaton	10.67	2.96	18.12	5.56	56.76	5.93	38.00
		Guaranty	----	----	**17.0**	----	----	**5.5**	----
		Average of these 2 analyses	**10.81**	**2.93**	**17.81**	**5.59**	**56.93**	**5.93**	**37.50**
	ANIMAL MEAL AND BONE FOR POULTRY.								
12975	*Bowker's Animal Meal.* Bowker Co., New York	*Norwich:* Norwich Grain Co.	5.80	41.83	39.69	----	----	10.95	40.00
		Guaranty	----	----	**38.0**	----	----	**5.0**	----
13272	*Breck's Ground Beef Scrap.* J. Breck & Son, Boston	*Suffield:* Spencer Bros.	9.49	24.66	45.62	----	----	20.18	45.00
		Guaranty	----	----	**50.0**	----	----	**15.0**	----
13392	*Darling's Beef Scrap.* L. B. Darling Fertilizer Co.	*Jewett City:* J. E. Leonard & Son	6.84	24.90	49.00	----	----	16.50	50.00
		Guaranty	----	----	**50.0**	----	----	**16.0**	----
13257	*Frisbie's Beef Scraps.* L. T. Frisbie Co., Hartford	*Hartford:* Daniels Mill Co.	7.67	34.76	40.69	----	----	13.58	50.00
		Guaranty	----	----	**40.0**	----	----	**15.0**	----
13386	*Beef Scrap.* New England Fertilizer Co., Boston	*Yantic:* A. R. Manning	7.22	24.61	49.50	----	----	15.09	50.00
		Guaranty	----	----	**40.0**	----	----	**15.0**	----
13282	*Swift's Bone and Meat Meal.* Lowell Fert. Co., Boston	*Rockville:* Edward White	6.62	30.59	46.69	----	----	11.93	45.00
		Guaranty	----	----	**40.0**	----	----	**8.0**	----

TEST OF THE VITALITY OF VEGETABLE SEEDS.

BY E. H. JENKINS.

During the year 1904, four hundred and fifteen samples of field and garden seeds have been tested as to their sprouting capacity for seed growers or purchasers. The tests have been made by Mr. V. L. Churchill.

The methods followed are those adopted by the Association of American Agricultural Colleges and Experiment Stations.

Large quantities of onion and sweet corn seed are raised for sale in this state and more tests of these varieties are annually made than of all other kinds taken together.

Table I presents the average, maximum and minimum vitality of all the seeds tested at the station by the above named methods. The age of the seeds given in the table is that reported by the seedsmen or growers who sent the samples. The samples were in all cases drawn by the persons sending them. Since the samples were sent by the seedmen for their own information, and it was understood that the results of the tests were not to be published as representing the character of their goods, there was no motive for any misrepresentation as to the age of the seed. The samples for the most part undoubtedly represented cleaned seed as prepared for market.

The "percentage" of beet seed and mangel wurzel sprouting, as given in the table, is considerably over 100. To test the vitality of beet seed, one hundred "seeds" are put in the germinating apparatus and all the sprouts are counted. As each beet "seed" is a fruit which may contain from two to six separate seeds, it is evident that the possible number of sprouts may be 600. To count the actual number of seeds in the one hundred fruits examined, which would make a true percentage statement of sprouting power possible, would be extremely laborious; but the form of statement here followed is sufficiently intelligible and is justified by usage.

TABLE I.—GERMINATION TESTS OF SEEDS OF GARDEN AND FIELD CROPS.

	Age of Seed in years, when tested.	Number of samples.	Average percentage by number of Seed sprouting.	Maximum.	Minimum.
Beans	0–1	7	86.5	100.0	56.7
	1–2	15	91.1	100.0	72.0
	2–3	8	87.0	100.0	59.0
	3–4	15	92.3	99.0	83.0
Beets	0–1	36	128.0	211.0	55.5
	1–2	28	132.0	230.0	44.5
	2–3	7	140.8	192.0	73.5
	3–4	1	66.0	----	----
	5–6	2	50.0	69.5	30.5
Brussels Sprouts	1–2	1	77.8	----	----
	3–4	2	18.4	36.0	0.8
Cabbage	0–1	37	84.3	95.8	44.0
	1–2	33	73.5	96.5	28.3
	2–3	8	71.3	88.0	43.0
	3–4	7	61.7	91.5	27.0
	4–5	5	47.8	85.8	0.00
	6–7	1	63.8	----	--
Carrots	0–1	42	63.0	90.8	35.0
	1–2	45	52.5	91.3	13.5
	2–3	13	57.4	74.0	31.0
Cauliflower	0–1	4	72.9	88.8	47.8
	1–2	9	56.6	93.5	27.5
	2–3	3	59.6	75.5	48.8
	3–4	1	77.3	----	----
Celery	0–1	36	52.6	83.5	8.3
	1–2	42	26.7	63.8	1.0
	2–3	18	37.5	79.3	4.8
	3–4	5	47.2	63.5	6.3
Corn, Sweet	0–1	71	79.6	100.0	18.0
	1–2	13	75.9	98.0	37.5
	2–3	4	86.5	92.0	78.0
Corn Salad	1–2	1	63.0	---	----
Cress	0–1	3	61.5	91.3	35.5
	1–2	3	51.2	69.8	40.0
Cucumbers	0–1	14	86.4	99.0	57.0
	1–2	30	73.6	99.0	18.0
	2–3	2	81.2	83.0	79.5
	3–4	4	50.4	90.5	6.4
	4–5	2	81.7	84.5	79.0
	5–6	1	80.5	----	----
	10–11	1	23.5	----	----
	11–12	1	5.5	----	----

TABLE I.—*Continued.* GERMINATION TESTS OF SEEDS OF GARDEN AND FIELD CROPS.

	Age of Seed in years, when tested.	Number of samples.	Average percentage by number of Seed sprouting.	Maximum.	Minimum.
Dandelion	0–1	2	68.3	70.3	66.3
	1–2	3	30.2	54.5	13.3
	2–3	1	0.0	----	----
Egg Plant	0–1	5	52.1	67.4	40.0
	1–2	1	58.5	----	----
Endive	0–1	2	50.1	53.8	46.5
	1–2	5	40.6	54.0	34.0
Kale	0–1	3	90.2	96.0	80.5
	2–3	1	6.0	----	----
	3–4	1	45.8	----	----
Kohl Rabi	1–2	4	67.8	72.3	58.8
Leek	0–1	8	73.8	86.0	59.8
	1–2	8	72.2	94.0	53.3
	2–3	1	35.5	----	----
Lettuce	0–1	79	65.0	100.0	4.3
	1–2	60	79.3	100.0	8.8
	2–3	21	78.4	98.8	23.8
	3–4	2	58.6	87.8	6.4
	4–5	1	82.0	----	----
	5–6	1	10.3	----	----
Mangel Wurzel	0–1	2	190.0	203.0	177.0
	1–2	8	89.4	176.0	20.0
	2–3	4	103.5	181.0	21.0
Musk Melon	0–1	10	77.5	100.0	28.0
	1–2	22	71.1	99.0	18.0
	2–3	6	33.2	92.5	2.5
	3–4	11	36.7	81.0	10.0
Onion, Connecticut grown	0–1	475	74.9	97.5	36.8
	1–2	118	62.7	92.8	0.8
	2–3	24	21.9	68.3	0.5
	3–4	1	59.5	----	----
California grown	0–1	128	90.9	98.0	55.8
	1–2	43	78.0	98.0	41.5
	2–3	9	63.6	91.5	22.3
	3–4	1	10.0	----	----
Parsley	0–1	5	71.4	79.3	58.8
	1–2	12	30.4	72.0	7.8
	2–3	1	16.5	----	----
Parsnip	0–1	10	48.0	63.5	34.3
	1–2	4	15.6	42.8	2.5
	2–3	1	30.3	----	----

TABLE I.—*Continued.* GERMINATION TESTS OF SEEDS OF GARDEN AND FIELD CROPS.

	Age of Seed in years, when tested.	Number of samples.	Average percentage by number of Seed sprouting.	Maximum.	Minimum.
Peas	0–1	23	68.1	96.0	32.0
	1–2	1	71.5	84.0	47.0
	2–3	1	78.0	----	----
	3–4	2	98.5	99.0	98.0
Pepper	0–1	9	76.5	89.5	61.0
	1–2	13	53.4	80.3	7.5
Pumpkin	0–1	6	74.0	95.0	40.0
	1–2	9	59.1	92.0	1.1
	2–3	1	97.3	----	----
	3–4	1	21.0	----	----
Radish	0–1	29	88.3	99.8	72.0
	1–2	33	69.1	98.8	4.8
	2–3	26	47.2	90.5	1.8
	3–4	17	31.7	86.0	0.0
	4–5	1	89.0	----	----
Salsify	0–1	3	67.0	80.5	41.0
Spinach	0–1	35	81.3	94.3	59.5
	1–2	21	72.5	88.3	28.3
	2–3	3	63.4	91.5	40.0
Squash	0–1	13	87.8	100.0	68.8
	1–2	9	91.6	98.0	75.0
	3–4	13	38.8	89.0	0.5
Sunflower	1–2	1	97.5	----	----
Tomato	0–1	31	85.1	96.5	64.3
	1–2	28	81.3	96.8	46.0
	2–3	5	76.8	97.5	51.0
	3–4	5	68.0	96.2	40.5
	4–5	1	14.5	----	----
	5–6	1	78.8	----	----
Turnip	0–1	9	95.4	98.8	88.8
	1–2	9	87.4	98.0	40.3
	2–3	3	91.0	93.3	89.5
	3–4	4	59.7	94.5	28.0
Watermelon	0–1	7	82.7	100.0	56.3
	1–2	25	49.8	89.6	0.0
	2–3	12	33.4	85.0	0.1
	3–4	2	21.5	42.0	1.0
	4–5	2	7.5	15.0	0.0
	5–6	1	69.5	----	----

Vitality of Sweet Corn Seed, Crop of 1904.

The thirty-two tests made here indicate that the sprouting power of seed sweet corn of 1904 crop has been very satisfactory. The figures are as follows:

	No. of Samples tested.	Average percentage, by number of Seed sprouting.	Maximum.	Minimum.
Country Gentleman	5	93.4	98.0	90.0
Early Crosby	7	94.3	99.0	91.0
Early Evergreen	3	91.0	96.0	88.0
Hickox	1	96.0	----	----
Metropolitan	1	99.0	----	----
Old Colony	2	92.5	95.0	90.0
Stowell's Evergreen	15	87.0	100.0	73.0

Vitality of Onion Seed as affected by the Age of the Seed.

Since November 1, 1896, the station has examined seven hundred and ninety-eight samples of onion seed of the crop of 1896, and of very succeeding crop. The results appear in Table II, together with those of tests of onion seeds which were more than one year old when examined. In the samples examined, the percentage by number of seed which sprouted was as follows:

TABLE II.—VITALITY OF ONION SEED.

	CONNECTICUT GROWN.		CALIFORNIA GROWN.	
	No. of Samples.	Per cent. sprouted.	No. of Samples.	Per cent. sprouted.
Seed stated to be less than 1 year old	474	74.9	128	90.9
Seed stated to be between 1 and 2 years old	118	62.7	43	78.0
Seed stated to be between 2 and 3 years old	24	21.9	9	63.6
Seed stated to be between 3 and 4 years old	1	59.5	1	10.0

While the number of samples of California-grown seed examined is not large enough to make a close comparison, it is quite evident that a larger percentage of the California seed germinates than of the Connecticut seed.

Table II also shows that onion seed more than one year old, as a rule, has much less sprouting capacity than new seed. Occasionally, however, are found samples of onion seed more than a year old which sprout as well as most samples of new seed. Whether the plants produced from old seed are as vigorous and productive as those from fresh seed is quite another question, on which laboratory germination tests can give no light.

Comparison of the Vitality of Crops of Connecticut-grown Onion Seed in the years 1894–1904.

The average sprouting capacity of Connecticut-grown onion seed, as determined for a number of years at this station, has been as follows:

TABLE III.—VITALITY OF CROPS OF ONION SEED.

	No. of Samples tested.	Average Percentage sprouted.
In 1880	14	87.0
1894	25	82.9
1895	13	85.5
1896	44	72.4
1897	39	77.9
1898	68	69.3
1899	62	89.0
1900	77	88.5
1901	60	71.0
1902	60	80.6
1903	59	62.0
1904	42	80.4

Average for 11 consecutive years, 78.1 per cent.

The sprouting capacity of the onion seed raised in 1903 is much lower than that of this crop in any other year of which we have knowledge, and growers explain this by the exceptionally wet and cold summer season of that year.

The Sprouting Capacity of Different Varieties.

The average sprouting capacity of five varieties, of which a considerable number of samples has been tested, is as follows (only those samples are here included which were alleged to be less than one year old at the time of testing and were grown in Connecticut):

TABLE IV.—SPROUTING CAPACITY OF DIFFERENT VARIETIES OF ONION SEED.

Variety.	No. of Samples tested.	Average Percentage of sprouting Seed.
Yellow Globe	219	75.3
Red Globe	182	80.0
White Globe	119	76.7
White Portugal	31	69.7
Wethersfield Red	13	79.1

OBSERVATIONS ON THE FERTILIZATION OF PEACH ORCHARDS.

By E. H. Jenkins.

An experiment on this subject was begun in 1896, in the orchard of Mr. A. E. Plant of Branford. Its progress has been noted in each of the Reports of this station from the year 1899 to the present.

We here add the data obtained in the year 1904, with such explanation as is necessary to make them intelligible, reserving discussion of the results for the present.

There are six plots included in the test, each of about one-third of an acre and containing 48 trees. These plots have been fertilized as follows, each year, since 1896:

A 65 pounds of muriate of potash, 160 pounds of acid phosphate.
B " " " " " and 170 pounds of cotton seed meal.
C 65 pounds of muriate of potash, 160 pounds of acid phosphate.
D 130 " " " " "
E 260 " " " " "
F 260 " high grade sulphate of potash, 160 pounds of acid phosphate.

Three and one-half bushels, 167 pounds, of slaked oyster shell lime have been annually applied to the northern half of each plot.

Until 1901, crimson clover had been sown each year, in August, on plots C, D, E and F, and had been plowed under in May.

It will be seen that Plot A has abundance of potash and phosphoric acid, but gets no nitrogenous fertilizer. Plot B has each year about 500 pounds of cotton seed meal per acre, containing 35 pounds of nitrogen, while all the other plots receive their nitrogenous fertilizer in form of crimson clover as a green manure.

Plots C, D, E should show the effects of heavy dressing with muriate of potash and F should show the comparative effects of a heavy dressing of high grade sulphate.

The southwest corner of the field, on Plot A, is the dampest part of the lot, in spite of an underground drain, and we believe Plot A is the least favorably placed of all the plots.

Each year a certain number of the trees have died and have been replaced by new ones in the spring. No case of yellows was found in the orchard until 1900.

Each spring a census of the trees which died during the last year has been made, which is as follows:

Number of Dead Trees Found in the Spring.

	1896.	1897.	1898.	1899.	1900.	1901.	1902.	1903.	Total.
Plot A	2	12	2	1	10	4	5	6	42
B	3	6	1	1	2	3	5	0	21
C	2	3	1	1	7	3	3	5	25
D	0	1	2	0	8	3	4	2	20
E	0	1	0	0	0	0	5	1	7
F	0	0	0	0	0	2	3	0	5
	7	23	6	3	27	15	25	14	120

Plot A has suffered most, losing five-sixths of the trees on it in eight years. This we believe, is partly due to the excess of water in the soil. Plot B has lost 21 trees, not quite one-half of the original number; C has lost more than one-half; D has lost more than three-eighths of the number originally planted, E and F seven and five trees respectively.

Of the 25 trees removed in the fall and winter of 1901-1902, 7 were on the limed end of the plots and 18 on the unlimed. Of 14 removed in 1902-1903, half were on the limed and half on the unlimed.

In 1898 there was a fine set of fruit buds, but most of the very young fruit fell later in consequence of cold storms at, and just after, setting time.

In 1899 there was an excellent set of fruit in the large orchard of which the trees above referred to form a part, while in most orchards of the state every flower bud was killed during the winter.

The crops were as follows:

Peach Crop of 1899. Number of Baskets.

Plot.	A	B	C	D	E	F
No. of baskets	65	117	81	110	155½	140½
No. of trees in bearing exclusive of Early Rivers	20	31	23	27	36	30
Average number of baskets per tree in bearing	3.2	3.8	3.5	4.1	4.3	4.7

The yield of peaches in 1900 was also a very good one. The drought during the summer was severe, but by constant cultivation from late June until harvest the crop was carried through successfully.

The crops were as follows:

PEACH CROP OF 1900. NUMBER OF BASKETS.

Plot.	A	B	C	D	E	F
No. of baskets	140¼	212½	151½	190¾	279	243¾
No. of trees in bearing	25	35	29	33	44	40
Average number of baskets per tree in bearing	5.6	6.3	5.2	5.8	6.3	6.1

Immediately after harvest, one tree on B and two each on C, D and F were pulled out and burned because affected with peach yellows. In the large orchard adjoining, the loss from yellows this year was not quite 3 per cent.

The yield of peaches in 1901 was much smaller than in 1900. The season was a wet one with much warm, foggy and rainy weather during harvest, so that the loss from rot was very large.

The crops were as follows:

PEACH CROP OF 1901. NUMBER OF BASKETS.

Plot.	A	B	C	D	E	F
No. of baskets	66½	99	73¾	112¾	168	172½
No. of trees in bearing	20	30	26	31	40	37
Average number of baskets per tree in bearing	3.3	3.3	2.8	3.6	4.2	4.6

Immediately after harvest, 15 trees were pulled out of the experiment orchard and burned, because they showed signs of yellows. Two were Early Rivers, the others were Champions. Two came from Plot B, three from C, three from D, five from E and two from F.

It is noteworthy that no trees affected with yellows were found on the half plots which had been limed each year. In the adjoining orchard 320 trees, or about 11 per cent. of the whole number, were pulled because of yellows.

PEACH CROP OF 1902. NUMBER OF BASKETS.

Plot.	A	B	C	D	E	F
No. of baskets	48½	117½	64	69½	125	80½
No. of trees in bearing	31	33	31	31	33	35
Average number of baskets per tree in bearing	1.6	3.6	2.1	2.2	3.8	2.3

The first picking was made on August 22d, the last on September 8.

In the fall of 1902 only one tree was destroyed because of yellows and that stood on the limed part of Plot C.

In the spring of 1903 fourteen dead trees were removed from the plots, as shown in the table above, none of them affected with yellows.

New trees were planted in their places. There was a fair set of peaches, but a heavy northeast storm, August 27th to 30th, blew off much fruit, uprooted or broke down some trees and what fruit was left rotted badly, so that of 140 baskets gathered at one picking, only 50 could be sold.

It was clear that the trees on Plot B, which received each year a dressing of cotton seed meal, made a better growth than any others and that the fruit from that plot was larger.

In addition to the fertilizers named above, nitrate of soda was put on plots E and F at the rate of 250 pounds per acre in the spring of 1903.

The effect of this was seen during the summer of 1903 in greater growth of wood and darker foliage.

The crop of 1903, which, as just stated, was seriously damaged by storm and damp weather at harvest time, was as follows:

PEACH CROP OF 1903. NUMBER OF BASKETS.

Plot.	A	B	C	D	E	F
No. of baskets	74	63	43	41	55	41
No. of trees in bearing	33	32	30	30	34	36
Average number of baskets per tree in bearing	2.2	2.0	1.4	1.4	1 6	1.1

The whole orchard was sprayed with the lime, sulphur and salt wash in the spring of 1904, because the trees showed slight infection with San José Scale. The fertilizers were sowed as usual, on all the plots, May 4th. The favorable effect of nitrate sown the year before on plots E and F was so very evident, in the more vigorous growth and better looking wood, that, in addition to the other fertilizers, 700 pounds of nitrate of soda were applied evenly over the whole piece.

PEACH CROP OF 1904. NUMBER OF BASKETS.

Plot.	A	B	C	D	E	F
No. of baskets	9	5	10	24	69	66
No. of trees in bearing	17	17	24	20	30	27
Average number of baskets per tree in bearing	0.5	0.3	0.4	1.2	2.3	2.4

The effect of the application of nitrate of soda in 1903 to plots E and F seems very evident.

CATTLE POISONED BY FRESH PAINT.

By E. H. Jenkins.

In June last Mr. Edgar Brewer of Hockanum lost two valuable cows which died suddenly with symptoms of poisoning. Portions of the stomach contents, liver and blood were sent to the station. Examination by the writer showed the presence of lead, in amount equivalent to more than 3.4 grams of lead sulphate in the material received. Neither arsenic or copper was present. Inquiry showed that a barn standing in the pasture had just been painted for an advertisement and paint was spilled on the ground and grass around it. The cows had either licked the fresh paint from the boards,—which they will greedily do when the chance offers,—or had taken it with the grass.

The owner recovered damages from the party responsible for the painting.

EXAMINATION OF BABCOCK TEST APPARATUS.

Pursuant to the requirements of section 4887 of the General Statutes, the station has tested within the year, and marked as "accurate," or bad," 151 pieces of glass apparatus for the creameries and dairymen of the state; making the total number tested since the passage of the law, 3,774.

There were tested in 1904:

	Tested.	Found inaccurate.
Pipettes for milk	8	0
Milk-test bottles	107	0
Cream-test bottles	36	1
	151	1

Percentage found inaccurate in 1901	2.3
" " " 1902	1.0
" " " 1903	0.0
" " " 1904	0.7

EXPERIMENTS IN BREEDING TOBACCO.

By E. H. Jenkins.

In the season of 1903 there were grown on the Experiment field at Pequonock twelve different types or strains of tobacco. Seven of them were variants of the Sumatra type, two were Cuban, and there was one each of Connecticut broad leaf, Connecticut Havana and White Burley. The objects were to satisfy ourselves whether cross-fertilization was needed to make tobacco blossoms partially or fully productive, and whether by self-fertilization or by a cross-fertilization which was artificially produced, seeds could be obtained which would yield plants like the selected parent from which they came.

Had we remembered Darwin's observations described in his Self- and Cross-Fertilization in the Vegetable Kingdom, the first question would have been answered, for he showed that seeds of the type of tobacco on which he worked and which were produced by cross-fertilization, yielded no larger plants in three consecutive generations than seeds from self-fertilized flowers. Indeed, in the first generation, the offspring of self-fertilized flowers surpassed those of the cross-fertilized in height. Moreover, the seed production was, on the whole, larger when the flowers were self-fertilized.

From the experiments of 1903 we had secured small quantities of seed, produced, in each case, by individual plants selected as being the very best in the plots where they grew and exclusively self-fertilized.

These several lots of seed were sown in separate plots in a new bed where no tobacco had been grown for years and where it was certain that no tobacco plants would grow except from the planted seed,—a thing one is never sure of in beds previously used.

The seeds, set to sprout on March 29th, were sowed in the bed April 5th and the plants set in the field May 18th.

The field was under shade cloth, and was dressed with 2,400 pounds of cotton seed meal, 400 pounds of bone meal, 500 pounds of vegetable potash and 350 pounds of land plaster.

The season was favorable, and the crops were harvested August 29th, 30th and 31st, the leaves being primed and strung in the field.

There were four strains of the Sumatra type, one Cuban, and one each of Connecticut broad leaf, Connecticut Havana and White Burley.

There was also the Holcomb variety of Connecticut Havana, which should be specially noted because the seed was raised by Mr. J. A. DuBon in 1885, was labeled at harvest time, and has been in his possession ever since. At the time named it was regarded as one of the specially good strains, maturing rather more quickly than most other strains.

The seed was very slow to start, but we got enough eventually for our purpose. The strains of Sumatra grown this year are as follows, somewhat in order of their merit:

Sumatra No. 1. This is the best of all, much the tallest and leafiest, and almost free from suckers through the season. The leaves are quite uniform in size and shape from top to bottom. The number of leaves, counting only from the spike sucker down, range from twenty-seven to nineteen, and average a little over twenty-two.

Sumatra No. 5. This has good shaped leaves, which do not set as near the ground as the other varieties, so they waste less. All the leaves are spotted this year, but last year there were no spots. The number of leaves ranges from twenty-one to sixteen and averages nineteen.

Sumatra No. 3. These are fairly good plants, but the leaves are too few, ranging from nineteen to fifteen, with an average of seventeen leaves per plant.

Sumatra No. 2. This is a "drop-leaf" type, averaging only sixteen leaves to the plant, and not of very desirable shape. The selections of other types do not need special notice.

The Connecticut broad leaf under shade yielded at the rate of 1,810 pounds of leaf in the bundle, and the White Burley at the rate of 1,838 pounds.

The latter can be fermented in the same way as our domestic leaf, and has given us some finished tobacco, looking very much like broad leaf, having exceptionally light even colors, but deficient in burn and flavor. There would seem to be no inducement to grow it in Connecticut, though it might have some value for hybridizing.

As in the previous year, very carefully selected plants were capped in the field in 1904 in order that seed might be saved from them for future work.

The general result of the year's experiment is this: In a remarkable degree the characters of the particularly selected mother plant were repeated in each one of the offspring. The result was that, for the first time since the experiments with Sumatra were begun in 1900, we had plots in which the plants were alike; uniform in size and in the number and shape of the leaves. In previous years there have been at least four quite distinct types of leaf in each field, and all sorts of freak plants, which made the crops very expensive to sort and helped to make them impossible to sell. Indeed, the plants were more uniform in size than we commonly see in fields of Havana or broad leaf, as was to be expected. Similar work to this has been done at Granby in this state, by Mr. A. D. Shamel of the Bureau of Plant Industry of the U. S. Department of Agriculture, and of course on a very much larger scale, many points having been worked out by the Department which the station could not undertake, and this work has been described in addresses made by Dr. Webber and by Mr. Shamel before the Tobacco Growers Association.

The results are of very great importance to the growers of this state.

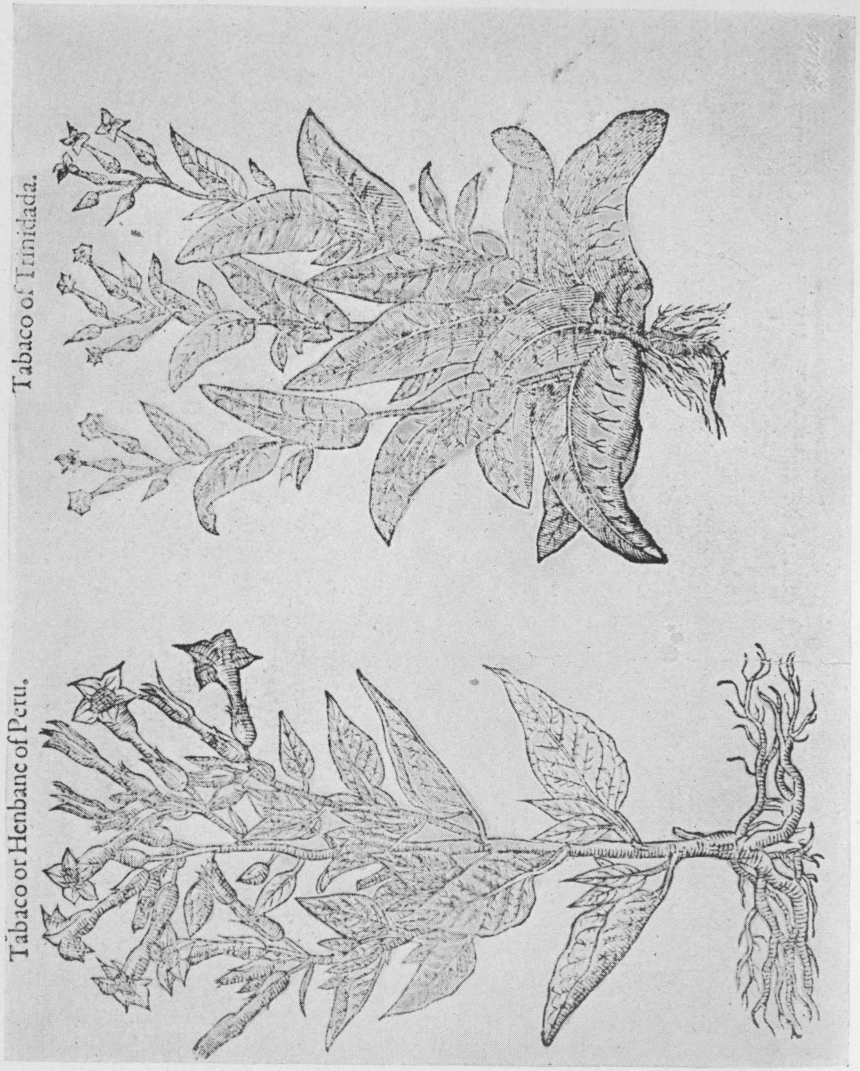
While the tobacco flower is provided with nectaries to tempt into it sugar-eating insects, and while it is constantly visited by humming birds, sphynx moths, bees and other insects, which no doubt carry the pollen from flower to flower and from plant to plant, it is yet abundantly self-fertile. By that is meant that the pollen, or male element in a tobacco flower, will, without help from without, fertilize the pistil, or female element in the same flower, and produce seed abundantly. If, then, we can keep out all insect visitors, we shall have offspring which are solely the product of the parent plant and do not represent any mixture of the qualities of this parent with those of other and unknown plants. This last named mixture we certainly have when insects visit the flowers. Any one would expect that in the former case the daughter plants would more closely resemble the mother than in the latter case. But Mr. Shamel's experiments and our own indicate that the likeness is much more extensive and more nearly complete than we had imagined. Particulars regarding this will be given in a report to be made later.

But the practical bearing of the experiments is in this. Often a grower sees in his field one or more plants of particularly good quality as to size of leaf, shape of leaf or number of leaves on the stalk. Less often he finds a single plant strikingly different from all the rest, and showing, in one way or another, a feature that looks specially desirable. The virtues of these plants he would like to secure for his whole crop or at least for an experimental plot.

If he saves the seed of them in the usual way, he knows that the flowers of his choice plants have been visited by numbers of insects, who have also visited many other plants, and have brought pollen from fifty or perhaps a vastly larger number of flowers. Therefore the resulting seed is likely to yield plants which have a jumble of the qualities of a considerable number of unlike plants, and are not at all likely to closely resemble the mother plant.

On the other hand, if he cuts off the side branches and small leaves of the flower head, together with any flowers which may already have opened, and over the head draws a manila bag (the twelve-pound size is convenient) and ties it around the stem so that no insects can get in, he insures strict self-fertilization, protection from all crosses, and will generally, if not invariably, get seed which will give plants closely resembling their mother plant. The bag should be moved up the stalk from time to time to suit the rapidly growing flower head, and when the flowers have fallen it is well to open the mouth of the bag and shake them out and then close it again. The leaves may be primed at harvest, cured and fermented, and from them a final judgment may be made of the merits of the plant. There is not in Connecticut, nor anywhere else, a tobacco field in which all the plants are alike. Any grower can pick out plants which, in his view, are better than the majority. He can save seed from them protected from any cross-fertilization. He can thus get a strain of tobacco more uniform and more profitable than what he now has.

Darwin's experiments and those of Mr. Shamel show that the yield of seed from self-fertilized plants is abundant and productive for three generations. For how much longer it will be true only experiment can determine. It is quite possible that sooner or later the generation produced by



Pictures of the Tobacco Plant. From Gerarde's Herbal, 1597.

exclusive self-fertilization may begin to deteriorate in respect of yield or vigor of growth, and a cross will then be necessary with some related strain or type to "bring in new blood." Darwin notes, "But when the flowers of one variety" (of tobacco) "were crossed with pollen from a slightly different variety, which had grown under somewhat different conditions—that is, by a fresh stock,—the seedlings derived from this cross exceeded in height and weight those from the self-fertilized flowers in an extraordinary degree."

During the year 1905 the Bureau of Plant Industry, through Mr. Shamel, and this station will work in coöperation on the improvement of tobacco by breeding.

In connection with these studies of tobacco, the following article is valuable, as it gives one of the very earliest descriptions and pictures of the tobacco plant, written soon after its introduction into the Old World from the West Indies. The pictures, facing this page, are readily recognized and the two types here pictured might serve as likenesses of our Connecticut Havana and Broadleaf as grown to-day,—the "Tabaco of Peru" suggesting the former, while the "Tabaco of Trinidada" suggests the Broadleaf.

The description is from

THE HERBAL OR GENERAL HISTORY OF PLANTES
Gathered by John Gerarde
of London
Master in Chirurgerie
Imprinted at London by
John Norton
1597

OF TABACO OR HENBANE OF PERU.

**The kindes.*

There be two sorts or kindes of Tabaco, one greater, the other lesser; the greater was brought into Europe out of the provinces of America, which we call the west Indies: the other from Trinidada an Ilande neere unto the continent of the same Indies; some have added a thirde sort, and others making the yellowe Henbane for a kinde thereof, although not properly.

1 *Hoscyamus Peruvianus.* Tabaco or Henbane of Peru.

2 *Sana Sancta Indorum.* Tabaco of Trinidada.

**The description.*

1 Tabaco or Henbane of Peru, hath very great stalkes of the bignesse of a childes arme, growing in fertill and well dunged ground, of seaven or eight foote highe, deviding it selfe into sundrie braunches of great length, whereon are placed in most comely order verie faire long leaves, broade, smooth, and sharpe pointed, soft, and of a light greene colour, so fastned about the stalks, that they seeme to embrace and compasse it about. The flowers grow at the top of the stalks in shape like a bel flower, somwhat long and cornered, hollow within, of a light carnation colour, tending to whitnesse toward the brims. The seede is conteined in long sharpe pointed cods or seede vessels, like unto the seede of yellow Henbane, but somewhat smaller and browner of colour. The roote is great, thicke, and of a wooddie substaunce, with some threddie strings annexed thereto.

2 Trinidada Tabaco hath a thicke, tough and fibrous roote, from which immediately rise up long broade leaves, and smooth, of a greenish colour, lesser then those of Peru, among which riseth up a stalke dividing it selfe at the grounde into divers braunches, whereon are set confusedly the like leaves, but lesser: at the top of the stalks, stande up long necked hollow flowers of a pale purple, tending to a blush colour; after which succeede the cods or seede vessels, including many small seeds like unto the seede of Marierom. The whole plant perisheth at the first approch of winter.

**The place.*

It was first brought into Europe out of the provinces of America, which is called the west Indies, in which is the province or countrey of Peru: but being now planted in the gardens of Europe, it prospereth very well, and commeth from seede in one yeere to beare both flowers and seede. The which I take to be better for the constitution of our bodies, then that which is brought from India; and that growing in the Indies better for the people of the same countrey; notwithstanding it is not so thought nor received of our Tabackians; for according to the English proverbe; Far fetcht and deere bought is best for Ladies.

**The time.*

Tabaco must be sowen in the most fruitefull grounde that may be founde, carelesly cast abroade in the sowing, without raking it into the grounde or any such paine or industrie taken, as is requisite in the sowing of other seedes as my selfe have found by proofe, who have experimented every way to cause it quickly to growe: for I have committed some to the earth in the ende of March, some in Aprill, and some in the beginning of Maie, bicause I durst not hazard all my seede at one time lest some unkindly blast should happen after the sowing, which might be a great enimie thereunto.

**The names.*

The people of America call it *Petun:* others *Sacra Herba, sancta Herba,* and *sana sancta Indorum, L'Obely* and *Penae,* and some *Hyoscyamus Peruvianus,* or Henbane of Peru: *Nicolaus Monardis* nameth it Tabaco: that it is *Hyoscyami species,* or a kinde of Henbane, not onely the forme being like to yellowe Henbane, but the qualitie also doth declare: for it bringeth drowsinesse, troubleth the sences, and maketh a man as it were drunke by taking of the fume onely; as *Andreas Thevetus* testifieth, (and common experience sheweth:) of some it is called *Nicotiana:* the which I refer to the yellowe Henbane for distinction sake.

**The temperature.*

It is hot and drie, and that in the second degree, as *Monardis* thinketh: and is withall of power to discusse or resolve, and to clense away filthie humours, having also a certaine small astriction and a stupifieing or benumming qualitie, and purgeth by the stoole: and *Monardis* writeth that it hath a certaine power to resist poison. And to proove it to bee of a hot temperature the biting quality of the leaves doth shewe, which is easily perceaved by taste: also the greene leaves laid upon ulcers in sinewie parts may serve for a proofe of heate in this plant; bicause they do draw out filth and corrupted matter, which a cold simple would never do. The leaves likewise being chewed draw foorth flegme and water, as doth also the fume taken when the leaves are dried: which things declare that this is not a little hot: for what things soever being chewed or helde in the mouth bring foorth flegme and water, the same be all counted hot, as the roote of Pellitorie of Spaine, of Saxifrage, and other things of like power. Moreover the benumming qualitie heereof is not hard to be perceived, for upon the taking of the fume at the mouth there followeth an infirmitie like unto drunkennesse, and many times sleepe: as after the taking of *Opium*, which also sheweth in the taste a byting qualitie, and therefore is not without heate; which when it is chewed and inwardly taken, it doth foorthwith shewe, causing a certaine heate in the chest, and yet withall troubling the wits: as *Petrus Bellonius* in his thirde booke of singularities doth declare; where also he sheweth that the Turkes do oftentimes use *Opium*, and take one dram and a halfe thereof at one time; without anie other hurt following, saving that they are thereupon taken with a certaine lighte drunkennesse as it were. So also this Tabaco being in taste biting, and in temperature hot, hath notwithstanding a benumming qualitie. Heereupon it seemeth to follow, that not onely this Henbane of Peru, but also the juice of poppie otherwise called *Opium*, consisteth of divers parts, some biting and hot, and others extreme colde, that is to saie, stupifieing or benumming: if so be that this benumming qualitie proceede of extreme colde (as *Galen* and all the olde phisitions holde opinion:) but if the benumming facultie doth not depende of an extreme colde qualitie, and that in the fourth degree, but proceedeth of the essence of the substance; then may Tabaco be both colde and also benumming; of temperature hot and benumming, not by reason of his temperature, but through the propertie of his substaunce, otherwise then a purging medicine, which hath his force not from the temperature, but from the essence of the whole substance.

INVESTIGATIONS ON THE VEGETABLE PROTEIDS.

By T. B. Osborne.

The work done since the last report of it was made may be summarized as follows:

I. The alcohol soluble protein substance of wheat flour has been subjected to a very careful investigation in order to meet some questions recently raised by German investigators respecting the supposed existence of other alcohol soluble proteins than gliadin. The results of former work done in this laboratory have been fully confirmed by our present study. This investigation was also extended to determine the proportion of glutaminic acid yielded by gliadin when decomposed by boiling acids, and nearly 40 per cent. of this product was obtained. This is the largest proportion of any single decomposition product yet isolated in a pure state from any protein substance, and shows that this most important food protein has a unique constitution in comparison with the other proteins thus far examined in this particular connection with problems of nutrition, thus raising many questions of importance. The results of this investigation have been published in detail in the *American Journal of Physiology,* Vol. xiii, p. 35. (This work was done in connection with the first Carnegie grant.)

II. As a preliminary to the preparation of protein substances in quantity, the method of separation suggested by Hofmeister, based on fraction precipitation by $(NH_4)_2SO_4$ has been applied to extracts of considerable quantities of several seeds. Unexpected results were obtained, for, contrary to the current views of physiological chemists, the proportion of $(NH_4)_2 SO_4$ required for precipitation of the individual proteins was not found to be constant, although the method proved exceedingly satisfactory as a means of separating different proteins from one another. Incidentally this investigation was so planned as to subject several of the proteins that had been the subject of earlier investigation in this laboratory, to this newer method of separation and purification, the result of which was to confirm the correctness of the former work. This work is now in course of publishing in the *American Journal of Physiology.*

III. The investigation of the solubility of globulin in salt solution, a preliminary account of which was given in the report for 1902, has been brought to a conclusion, and the paper on this subject is now in type to be published in the *American Journal of Physiology*. In this work the relative solvent power of different salts has been studied for the first time, and many facts have been learned concerning this relation of proteins to salts which plays a most important part in physiological processes.

IV. A very careful study of the protein constituents of the castor oil bean has been made with special reference to the isolation of the substance known as ricin. This substance has been known for some time as a very toxic principle contained in these seeds, and until recently was regarded as a protein body closely related to the supposed toxalbumins of snake venom and some other vegetable products. Quite recently the protein nature of this toxine has been put in doubt by the researches of Jacoby. The importance of a knowledge of this substance lies in the recently discovered relations which ricin evidently bears to the toxines of bacterial disease, in consequence of which crude products obtained from the castor bean and containing minute quantities of ricin have been used by many foreign investigators in their studies relating to immunity. As a study of the literature made it evident that even approximately pure preparations of this product had never been made, we undertook a careful study of the proteids of the castor bean with the expectation that in one of these we would find this toxic substance. This expectation has been realized, for when the several proteins of this seed were perfectly separated from one another, we found that only one of these possessed toxic power and that this one was more toxic than any substance of which we can find an account. The toxicity of the preparation which we have made in very considerable quantity is so great that 0.001 milligram or $\frac{16}{1000000}$ of a grain is sufficient, when injected under the skin, to kill a rabbit weighing five pounds—or as usually expressed by physiologists, its toxicity was 0.0005 milligram per kilogram. This product of ours has powerful "agglutinating" properties when minute quantities are added to diluted blood, and also produces a "precipitin" in the blood serum when small but

increasing doses are fed to rabbits, the animal at the same time acquiring an immunity against the toxic action of the ricin so that a great many times the initially fatal dose can be fed without harm. The ricin, which we have thus prepared, is completely soluble in distilled water, consists wholly of protein matter with traces of the usual mineral salts. It gives all the characteristic protein reactions, has a composition in close agreement with that of the average of this substance, has a similar specific rotation, to the left, and contains nitrogen in the different forms of binding in close agreement with the average of the ordinary proteins. One preparation contained about 75 per cent. of coagulable albumin and 25 per cent. of proteose. The albumin we regard as the toxic substance, for we were unable to obtain toxic effects in solutions free from it, and never failed with solutions containing it. Moreover, the toxicity of our solutions was closely proportional to their albumin contents.

The protein nature of ricin can no longer be a subject of doubt. That such extremely minute quantities should cause such profound physiological changes as occur, and that a considerable interval of time is required for fatal effects with minimal doses, strongly suggests that it is fermentative or enzymatic, its presence inducing abnormal physiological processes which result in profound changes of the tissues and soon cause death.

If this view is correct, we have, in the results of this investigation, evidence of the protein nature of enzymes, a fact long believed by many but as yet never proved. Now that we have a method for producing approximately pure preparations of this most interesting substance, its use in studying many of the problems of immunity and related subjects ought to lead to important results. The physiological experiments in connection with this work were made by Prof. L. B. Mendel of Yale. The results of this investigation have been communicated in two papers read before the American Physiological Society, and the detailed results will soon be published in the *American Journal of Physiology*.

TESTS OF GUERNSEY COWS FOR ADVANCED REGISTRY.

On request of the Guernsey Cattle Club the Station has, since June, 1903, made monthly tests of the weight of milk and butter-fat given by thoroughbred Guernsey cows in Connecticut which are entered for advanced registry.

Tests of twenty-four cows for a period of one year have been finished, four cows were withdrawn before a year elapsed, retests on four cows are now being made, and six cows are being tested for the first time.

From the herd of A. A. Pope of Farmington the following cows were admitted to advanced registry, the year's record of milk and butter-fat being as given below:

		Age in years and months.	Pounds of milk.	Pounds of butter-fat.	Average per cent. of butter-fat.	Advanced registry number.
Markeeta	8514	8– 0	7993.2	365.2	4.65	140
Corona Parnell	12656	3– 7	8205.3	392.5	5.01	141
Floret Williams	12602	3–10	6955.3	341.5	5.05	153
Hotine	12956	3– 3	6932.8	415.5	6.02	142
Monda	14996	2– 0	5822.3	312.8	5.47	148

The following official year's records are also noted:

		Age in years and months.	Pounds of milk.	Pounds of butter-fat.
Jessamine of Simsbury	11662	6– 0	8560.24	344.3
Pomp's Duchess	7398	9– 0	5430.80	265.2

From the herd of H. B. Tuttle, Naugatuck, the following cows have been admitted to advanced registry:

		Age in years and months.	Pounds of milk.	Pounds of butter-fat.	Average per cent. of butter-fat.	Advanced registry number.
Fidora	14645	2– 9	6939.4	366.36	5.30	211
Luna Lenfestey	14646	2–11	5265.0	316.28	6.05	212
Modita	14644	2–10	5339.2	337.70	6.36	194
Lady Pauline	14643	2– 9	6827.1	387.26	5.90	239
Lady Malena	14639	2– 7	7250.7	395.92	5.60	241
Lorna Lenfestey	14666	2– 8	7167.1	347.19	5.01	240
Lotty Morse	14641	2– 7	5482.6	331.59	6.09	228
Lucy Lenfestey	8573	8– 5	6947.2	417.66	6.20	238
Conovia	14648	2– 9	6331.4	347.13	5.78	246
Leslie Lenfestey	14640	2– 8	5337.2	331.68	6.44	245

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