PART VIII.

Report on Commercial Fertilizers, 1908.

By E. H. JENKINS, *Director,* and JOHN PHILLIPS STREET,
Chemist in charge of the Analytical Laboratory.

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

The station is also required to publish these analyses.

DUTIES OF MANUFACTURERS AND DEALERS.

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

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

Attention is called to the requirement of law that the name of the manufacturer and place of manufacture must be stated on the label. The place of manufacture is the place where the materials which compose the manufactured article are mixed and put together. The manufacturer is the person or firm which owns or controls the manufacturing plant or machinery.

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

3. Before any brand of fertilizer is sold in the state, the agent or seller must file with the director of this station two certified

copies of the statement named in 1, and a sealed glass jar containing not less than one pound of the fertilizer, with an affidavit that it is a fair average sample.

The agent or seller is free from the three obligations just stated only when the manufacturer or importer fulfils them instead.

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

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

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

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

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

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

The percentage of acid-soluble phosphoric acid may be stated or omitted.

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

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

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

OBSERVANCE OF THE FERTILIZER LAW.

During 1908 thirty-nine individuals or firms have entered for sale in this state two hundred and eighty-seven brands of fertilizers, viz:

Special manures for particular crops	130
Other nitrogenous superphosphates	96
Bone manures and "bone and potash"	25
Fish, tankage, castor pomace and chemicals	36
Total	287

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, 1909:

Firm.	*Brand of Fertilizer.*
American Agricultural Chemical Co., The, 2 Rector St., N. Y. City.	A. A. C. Co.'s Complete Manure with 10% Potash, Complete Tobacco Manure, Grass and Lawn Top Dressing, H. G. Tobacco Manure, Superphosphate, Tobacco Starter & Grower, Dry Ground Fish, Fine Ground Bone, Grass and Oats Fertilizer, Acid Phosphate, Castor Pomace, Muriate of Potash, Nitrate of Soda, Bradley's Complete Manure for Potatoes and Vegetables, Complete Manure for Top Dressing Grass and Grain, Corn Phosphate, Eclipse Phosphate, Farmers New Method Fertilizer, Niagara Phosphate, Potato Fertilizer, Manure, Church's Fish and Potash, Crocker's Ammoniated Corn Phosphate, Potato, Hop and Tobacco Fertilizer, Darling's Blood, Bone and Potash, Dissolved Bone and Potash, Farm Favorite, General Fertilizer, Potato Manure, East India A. A. Ammoniated Superphosphate, Potato Manure, Great Eastern General, H. G. Vegetable, Vine and Tobacco Fertilizer, Northern Corn Special,

Firm.	*Brand of Fertilizer.*
American Agricultural Chemical Co., The, 2 Rector St., N. Y. City—*Continued.*	Packers' Union Animal Corn Fertilizer, Gardeners Complete Manure, Potato Manure, Universal Fertilizer, Quinnipiac Climax Phosphate, Corn Manure, Market Garden Manure, Phosphate, Potato Manure, Phosphate, Read's Practical Potato Special, Standard Superphosphate, Vegetable and Vine Fertilizer, Wheeler's Corn Fertilizer, Havana Tobacco Grower, Potato Manure, Wm's & C's Americus Ammoniated Bone Superphosphate, Corn Phosphate, H. G. Special Fertilizer, Potato Manure, Potato Phosphate.
Armour Fertilizer Works, The, Baltimore, Md.	All Soluble, Ammoniated Bone with Potash, Bone, Blood and Potash, Complete Potato, Corn King, Fish and Potash, Fruit and Root Crop Special, Grain Grower, High Grade Potato, Market Garden, Bone Meal.
Baker, H. J., & Bro., 100 William St., N. Y. City.	Baker's Castor Pomace.
Berkshire Fertilizer Co., Bridgeport, Conn.	Berkshire Ammoniated Bone Phosphate, Complete Fertilizer, Grass Special, Long Island Special, Potato and Vegetable Phosphate, Tobacco Special, Fine Ground Bone.
Boardman, F. E., Route 1, Middletown, Conn.	Boardman's Complete Fertilizer.
Bohl, Valentine, Waterbury, Conn.	Self Recommending Fertilizer.
Bowker Fertilizer Co., 60 Trinity Place, N. Y. City.	Castor Pomace, Muriate of Potash, Nitrate of Soda,

Firm.	*Brand of Fertilizer.*
Bowker Fertilizer Co., 60 Trinity Place, N. Y. City—*Continued.*	Bowker's Acid Phosphate, Complete Alkaline Tobacco Grower, Corn Phosphate, Early Potato Manure, Fine Ground Fish, Fisherman's Brand Fish and Potash, Fresh Ground Bone, Gloucester Fish and Potash, Hill and Drill Phosphate, Lawn and Garden Dressing, Market Garden Fertilizer, Potato and Vegetable Fertilizer, Potato and Vegetable Phosphate, Pure Unleached Canada Hard Wood Ashes, Sure Crop Phosphate, Tobacco Ash Elements, Starter, XX Bone, Stockbridge Special Complete Manure for Corn and Grain, Stockbridge Special Complete Manure for Potatoes and Vegetables, Stockbridge Special Complete Manure for Top Dressing and for Forcing, Stockbridge Tobacco Manure.
Buffalo Fertilizer Co., Buffalo, N. Y.	Buffalo Tobacco Producer, Celery and Potato Special, Farmers' Choice, Fish Guano, H. G. Manure, Ideal Wheat and Corn, Top Dresser, Vegetable and Potato, Bone Meal.
Clark Seed Co., Everett B., The, Milford, Conn.	Clark's Special Mixture for General Use, Special 10% Brand.
Coe-Mortimer Co., The, 24 Stone St., N. Y. City.	Genuine Peruvian Guano, Chincha Grade, Gold Brand Excelsior Guano, H. G. Ammoniated Bone Superphosphate, Tobacco and Onion Manure, E. Frank Coe's Celebrated Special Potato Fertilizer, E. Frank Coe's New Englander Corn and Potato Fertilizer, E. Frank Coe's Peruvian Vegetable Grower,

Firm.	*Brand of Fertilizer.*
Coe-Mortimer Co., The, 24 Stone St., N. Y. City—*Continued.*	E. Frank Coe's Red Brand Excelsior Guano, E. Frank Coe's XXX Pure Ground Bone.
Conn. Fat Rendering & Fertilizing Corp'n, New Haven, Conn.	Tankage.
Conn. Valley Orchard Co., Berlin, Conn.	C. V. O. Co.'s H. G. Special.
Cooper's Glue Factory, Peter, 13 Burling Slip, N. Y. City.	Pure Bone Dust.
Dennis, George L., Stafford Springs, Conn.	Bone.
Eldredge, T. H., Norwich, Conn.	Eldredge's Special Fish and Potash Fertilizer, Superphosphate.
Essex Fertilizer Co., 39 North Market St., Boston, Mass.	Essex Complete, Potatoes, Roots and Vegetables, Corn, Grain and Grass, Grass and Top Dressing, Market Garden and Potato Manure, Special Tobacco Manure, Tobacco Starter and Grower, XXX Fish and Potash, Dry Ground Fish, Ground Bone.
Frisbie, L. T., Co., The, New Haven, Conn.	Frisbie's Fine Bone Meal.
Germofert Mfg. Co., 22 Broad St., Charleston, S. C.	Germofert Patented Fruit and Flower Fertilizer, General Fertilizer, Vegetable Fertilizer.
Goodsell, W. O., Bristol, Conn.	Special Grass Mixture.
James, Ernest L., Warrenville, Conn.	James' Bone Phosphate, Ground Bone.
Kelsey, E. R., Branford, Conn.	Bone, Fish and Potash.
Listers' Agricultural Chemical Works, Newark, N. J.	Listers Ammoniated Dissolved Bone Phosphate, Potato Manure, Special Corn, Potato, Tobacco, Standard Pure Bone Superphosphate of Lime, Success Fertilizer, Animal Bone and Potash, Celebrated Ground Bone Acidulated.

Firm.	*Brand of Fertilizer.*
Manchester, E., & Sons, Winsted, Conn.	Manchester's Formula.
Mapes F. & P. G. Co., The, 143 Liberty St., N. Y. City.	Average Soil Complete Manure, Cereal Brand, Complete Manure "A" Brand, Corn Manure, Economical Potato Manure, Fruit and Vine, Potato Manure, Seeding Down Manure, Tobacco Ash Constituents, Manure, Wrapper Brand, Starter, Improved, Top Dresser, Improved, Full Strength, Half Strength, Vegetable Manure, or Complete Manure for Light Soils, Dissolved Bone.
National Fertilizer Co., 60 Trinity Pl., N. Y. City.	Chittenden's Ammoniated Bone Phosphate, Complete Fertilizer, Conn. Valley Tobacco Grower, Conn. Valley Tobacco Starter, Fish and Potash, Formula "A", "B", H. G. Special Tobacco Fertilizer, Market Garden Fertilizer, Potato Phosphate, Special, Tobacco Special with Carbonate of Potash, XXX Fish and Potash, Soluble Bone and Potash, Dry Ground Fish, Nitrate of Soda.
New England Fertilizer Co., 40A North Market St., Boston, Mass.	N. E. Corn and Grain Fertilizer, H. G. Potato Fertilizer, Perfect Tobacco Grower, Potato Fertilizer, Superphosphate, Ground Bone.
Niantic Menhaden Oil & Guano Co., The, South Lyme, Conn.	Bone, Fish and Potash.
North Western Fertilizing Co., P. O. Drawer 814, Detroit, Mich.	North Western Bone, Fish and Potash, Empire Special Manure, Market Garden Phosphate, Superphosphate, 10% Manure, 10% Potato Fertilizer, Universal Fertilizer.

Firm.	*Brand of Fertilizer.*
Olds & Whipple, Hartford, Conn.	O. & W.'s Complete Tobacco Fertilizer, Corn and Potato Fertilizer, Fish and Potash, Grass Fertilizer, H. G. Potato Fertilizer, Special Phosphate, Dry Ground Fish, Grey Pomace, Vegetable Potash.
Parmenter & Polsey Fertilizer Co., 40 North Market St., Boston, Mass.	"A. A." Brand, Plymouth Rock Brand, Special Potato Fertilizer, P. & P. Potato Fertilizer, Ground Bone, Muriate of Potash.
Rogers & Hubbard Co., The, Middletown, Conn.	Hubbard's Complete Phosphate, Fertilizer for Oats and Top Dressing, Grass and Grain Fertilizer, Potato Phosphate, Soluble Corn and General Crops Manure, Soluble Potato Manure, Tobacco Manure, Pure Raw Knuckle Bone Flour, Strictly Pure Fine Bone.
Rogers Mfg. Co., The, Rockfall, Conn.	All Round Fertilizer, Corn and Onion, Fish and Potash, Grass and Grain, H. G. Soluble Tobacco, Oats and Top Dressing, Potato and Vegetable, Tobacco and Potato, Tobacco Grower, Starter, Fine Ground Bone, Knuckle Bone Flour.
Russia Cement Co., *see Essex Fertilizer Co.*	
Sanderson Fertilizer & Chemical Co., New Haven, Conn.	Atlantic Coast Bone, Fish and Potash, Sanderson's Corn Superphosphate, Formula A, B for Tobacco, Potato Manure, Special with 10% Potash, Top Dressing for Grass and Grains, Fine Ground Bone, Fish,

Firm.	*Brand of Fertilizer.*
Sanderson Fertilizer & Chemical Co., New Haven, Conn—*Continued.*	Blood, Bone and Meat, Acid Phosphate, Kainit, Muriate of Potash, Nitrate of Soda, Sulphate of Potash.
Shay, C. M., Fertilizer Co., The, Groton, Conn.	Shay's Corn Fertilizer, Grass and Lawn, Potato, Pure Ground Bone.
Shoemaker, M. L., & Co., Venango St. and Delaware Ave., Philadelphia, Pa.	"Swift-Sure" Guano for Truck, Corn and Onions, Superphosphate for General Use, Superphosphate for Potatoes, Bone Meal.
Swift's Lowell Fertilizer Co., 40 North Market St., Boston, Mass.	Swift's Lowell Animal Brand, Bone Fertilizer, Dissolved Bone and Potash, Empress Brand, Market Garden Manure, Perfect Tobacco Grower, Potato Manure, Phosphate, Special Grass Mixture, Ground Bone, Tobacco Manure, Acid Phosphate, Muriate of Potash, Nitrate of Soda.
Wheeler Bros., Stonington, Conn.	Wheeler's Special Potato.
Wilcox Fertilizer Co., The, Mystic, Conn.	Wilcox's Complete Bone Superphosphate, Fish and Potash, Grass Fertilizer, H. G. Fish and Potash, Tobacco Special, Potato Fertilizer, Onion and Vegetable Manure, Special Superphosphate, Dry Ground Fish, Pure Ground Bone, Acid Phosphate, Muriate of Potash, Nitrate of Soda.
Woodruff, S. D., & Sons, Orange, Conn.	Woodruff's Home Mixture.

SAMPLING AND COLLECTION OF FERTILIZERS.

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

Litchfield County	7
Hartford County	24
Tolland County	7
Windham County	10
New London County	10
Middlesex County	8
New Haven County	16
Fairfield County	7
	89

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

The sampling agent could not find on sale the American Agricultural Chemical Co.'s High Grade Tobacco Manure, Acid Phosphate, Complete with 10 per cent. Potash, Bowker's Canada Ashes, Buffalo Fertilizer Co.'s Tobacco Producer, Lister's Special Potato, Parmenter & Polsey's A.A Brand, Special Potato, and National Fertilizer Co.'s Formula B, Nitrate of Soda.

As no samples of any of these brands were deposited at the station by the manufacturers, it was impossible to make analyses of them.

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

When several samples of a single brand are drawn in different parts of the state, the analysis is usually made, not on any single sample, but on a mixture 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 to open at least three packages of each brand for sampling, and, if the number of packages is very large, to take a portion from every tenth one, by means of a sampling tube which withdraws a section or core diagonally through the entire length of the bag or barrel.

As a rule, the station will not analyze samples taken from stock of less than one ton, or which has lain over from last season, or which is improperly stored, as in bags lying on wet ground, or exposed to the weather, etc.

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

A sample taken carelessly or incorrectly is quite certain to work injustice both to the seller and buyer. Accuracy of sampling is just as necessary as accuracy of analysis. The sampling is, in reality, a very important part of the analysis.

ANALYSES OF FERTILIZERS.

During the year 632 samples of commercial fertilizers and manurial waste-products have been analyzed. A classified list of them is given below and the results of their examination appear 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.

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.

Every percentage given has been determined by two separate analyses, usually made by two chemists working independently, and all calculations are also made in duplicate.

* The analyses of fertilizers included in this chapter have been made by Mr. Street, chemist in charge, with the assistance of Messrs. Bailey, Morrison, Stevens and Brautlecht, station chemists, and of Mr. Lange. The results have been tabulated and discussed by the director.

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.

CLASSIFICATION OF THE FERTILIZERS ANALYZED.

	No of Samples.
1. *Containing nitrogen as the chief active ingredient.*	
Nitrate of soda	8
Dried blood	2
Cotton seed meal	162
Castor pomace	13
2. *Containing phosphoric acid as the chief active ingredient.*	
Dissolved phosphate rock	7
Precipitated bone	2
Floats	1
3. *Containing potash as the chief active ingredient.*	
Carbonate of potash	3
Vegetable potash	2
Black potash	1
High grade sulphate of potash	2
Double sulphate of potash and magnesia	2
Muriate of potash	12
Kainit	1
4. *Containing nitrogen and phosphoric acid.*	
Bone manures	31
Slaughter-house tankage	11
Dried fish	11
5. *Mixed fertilizers.*	
Nitrogenous superphosphates and guanos	134
Special manures	157
Home mixtures	14
6. *Miscellaneous fertilizers and manures.*	
Cotton hull ashes	9
Wood ashes	28
Lime and lime-kiln ashes	8
Others, miscellaneous	11
	632

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 15.50 per cent. of nitrogen, equivalent to 94.1 per cent. of pure sodium nitrate. The other usual constituents are moisture and small quantities of common salt and Glauber's salts.

Shipments differ somewhat in composition, as is shown by the eight samples which have been analyzed, as follows:—

20348. Sold by National Fertilizer Co., Bridgeport. Sampled from stock of Henry Davis, Thompsonville.

20331. Sampled from stock of S. D. Woodruff & Sons, Orange.

20368. Sold by American Agricultural Chemical Co., New York. Sampled from stock of Edmund Halladay, Suffield.

20486. Sold by Bowker Fertilizer Co., New York. Sampled from stock of Bowker's Branch, Hartford.

20425. Sold by and sampled from stock of Sanderson Fertilizer & Chemical Co., New Haven.

20424. Sold by and sampled from stock of Wilcox Fertilizer Co., Mystic.

20270. Sold by Swift's Lowell Fertilizer Co., Boston. Sampled from stock of Andrew Ure, Highwood.

20532. Sold by Sanderson Fertilizer & Chemical Co., New Haven. Sampled from stock of Connecticut School for Boys, Meriden.

ANALYSES OF NITRATE OF SODA.

	National Fert. Co.	Woodruff.	A. A. C. Co.	Bowker.	Sanderson.	Wilcox.	Swift's-Lowell.	Sanderson.
Station No.	20348	20331	20368	20486	20425	20424	20270	20532
Percentage amounts of								
Nitrogen found	15.84	15.08	15.20	15.32	15.28	15.32	15.08	15.36
Nitrogen guaranteed	15.8	-----	15.8	15.0	15.0	15.0	15.0	15.0
Cost per ton	$56.00	57.00	59.00	60.00	60.00	60.00	-----	-----
Nitrogen costs cents per pound	17.7	18.9	19.4	19.6	19.6	19.6	-----	-----

The percentage of nitrogen ranges from 15.84 to 15.08 and averages 15.31, 0.2 lower than last year.

The retail cost of nitrogen ranges from 17.7 to 19.6, the average being 19.1 cents per pound.

DRIED BLOOD.

This is blood collected in slaughter houses, cooked to thoroughly coagulate it, dried by pressure and artificial heat, and then ground. Prepared in this way it contains about 14 per cent. of nitrogen. Lower grades mixed with tankage and other material, and containing 10 to 12 per cent. of nitrogen, are also on the market.

Two samples of this material were examined. One of them, **20272**, bought of the Swift's Lowell Fertilizer Co., Boston, sampled from stock of W. I. Munson, Highwood, contained 9.84 per cent. of nitrogen and 4.72 per cent. of phosphoric acid. Ten per cent. of nitrogen was guaranteed.

The other sample, **20345**, bought of the National Fertilizer Co., Bridgeport, sampled and sent by Henry Davis, Thompsonville, contained 10.56 per cent. of nitrogen and 2.05 per cent. of phosphoric acid. 12.5 per cent. of nitrogen was guaranteed. The sample contained 1.4 per cent. less nitrogen than was guaranteed.

COTTON SEED MEAL.

(Analyses on pages 470 to 480.)

This material is of two kinds, which are known in trade respectively as undecorticated and decorticated. In the manufacture of decorticated meal, which is the only grade which Connecticut farmers can afford to buy for a fertilizer, 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 kernels from the hulls. The kernels are cooked and the oil is expressed. The cake from the presses is ground or shipped to Europe in slabs and is used as a cattle feed and fertilizer. Formerly the hulls were burned for fuel in the factories, and the resulting ashes, which contained from 20 to 30 per cent. of potash, were used in this state as a tobacco fertilizer.

The hulls have, however, come into extensive use as a cattle feed in the South, and now sell for this purpose at prices which usually forbid their use as fuel. A larger proportion of them is now left in the so-called "decorticated meal" than ever before, which accounts for the gradual lowering of the feeding and fertilizer content of this valuable product. It is a not uncommon practice also to grind the hulls fine and mix them with the ground cotton seed cake. Buyers who are only anxious to get a "smooth" meal are quite likely to have these fraudulent mixtures worked off on them.

The color and the "smoothness" of the meal give no knowledge of its content of nitrogen and hence of its fertilizing value. The dry meals, which are dark, because of over-cooking or of slight fermentation, are, in our experience, as likely to have a high content of nitrogen as the bright yellow meals.

In view of the fact that more than 5,000 tons of cotton seed meal, costing $155,000, are annually used as a fertilizer in Connecticut, by tobacco growers alone, the rules of the Interstate Cotton Seed Crushers Association are of importance:

STANDARD CLASSIFICATION.

"Sec. 1. Choice Cotton Seed Meal must be finely ground, perfectly sound and sweet in odor, yellow, free from excess of lint and hulls, and by analysis must contain at least 8 per cent. of ammonia. (6.59 per cent. of nitrogen.)"

To determine its composition, on which its price should be based, proper sampling is quite as important and difficult as accurate analysis.

It is necessary, in order to establish a claim for rebate, in case the meal does not meet the seller's guaranty, that the following rule for sampling, adopted by the trade, should always be followed:

"Rule 20. 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 fifty sacks from each 100 tons, if not shipped in car lots, shall be sufficient to represent a shipment. Separate samples of meal should be well wrapped in heavy paper, sealed and labeled, so as to identify them and the shipment they represent. Samples of meal, if of approximately the same grade and quality, need not be kept separate, but may be commingled, in which case they must be placed in a metal mailing or sample box and carefully marked, showing the number of samples taken, as well as car number and mark."

Under the laws of this state cotton seed meal is classed as a commercial feed and not as a fertilizer. The law regarding commercial feeds (General Statutes, §4592) requires that every lot

"shall have affixed thereto, in a conspicuous place on the outside thereof, a legible and plainly printed statement, certifying the number of net pounds of feeding stuff contained therein, the name, brand, or trade-mark under which the article is sold, the name and address of the manufacturer or importer, and a statement of the percentage it contains of crude fat and of crude protein, allowing one per cent. of nitrogen to equal six and one-fourth per cent. of protein," etc.

The sale of cotton seed meal or other commercial feed which does not comply with the above requirements is illegal and *renders the person who sells the meal in Connecticut* liable to a fine of $100 for the first offense and $200 for the second.

GUARANTIES.

Of the 160 analyses included in the table, 49, or more than one-fourth of the whole number, show less nitrogen than was guaranteed by more than one-tenth per cent. In eighteen cases the difference amounts to one-quarter of one per cent., representing a value of $1.00 per ton or more.

The meal is usually shipped direct from the mills to the Connecticut dealer, and the commission merchant who makes the sale does not see the meal, but sells it on the maker's guaranty. In selling it, however, he assumes, or should assume, responsibility for the correctness of the representations, in order that he may protect the Connecticut dealer, who is liable under our state law.

This responsibility has been assumed during the last year by Messrs. Humphreys, Godwin & Co., of Memphis, Tenn.

The tags on meal furnished by them this year give the following guaranty:

"This tag is attached to comply with the State Law—but the actual Nitrogen is guaranteed in the contract and if an analysis of the meal in this shipment does not equal within $^{10}/_{100}$ of nitrogen guaranteed—we agree to refund on basis $3.50 per unit nitrogen—such claim supported by proper samples to be made within 10 days after arrival of car."

(A "unit" is one per cent. or 20 pounds per ton. "Units" of nitrogen are calculated to units of ammonia by multiplying by 1.2, and conversely units of ammonia are reduced to units of nitrogen by dividing by 1.2.) We understand that the firm named has fulfilled this promise during the present year. Such a guaranty by a responsible party is a very different thing from a guaranty printed on the tag, for which no one will hold himself responsible and for which the law can only hold the Connecticut dealer responsible. It is hoped that other commission houses

will see the wisdom of following the plan adopted by the firm named.

The system of selling by the unit of plant food actually present in the lot delivered to each purchaser is altogether the fairest and so the most satisfactory. It throws a large amount of work on the station during the spring, but thus far the station has been able to execute all the analyses promptly.

The station is frequently asked what rebate should be given where meal fails to meet the guaranty. The station has no authority or desire to prescribe adjustments of price between buyer and seller, but has suggested the following example as perhaps indicating a fair method of adjustment:

A meal costing $31.00 per ton, guaranteed 6.5 per cent. of nitrogen, contains only 6.24.

As stated below the average valuation of phosphoric acid and potash in a ton of meal is $4.42; $31 — $4.42 = $26.58, which we may call the price of the nitrogen in it. The meal is guaranteed to have 6.50 per cent. of nitrogen, or 130 pounds per ton; $26.58 ÷ 130 = 20.4, the cost of a pound of nitrogen in the meal if as guaranteed. But instead of 130 pounds it contains in fact only 6.24 × 20 = 124.8 pounds, a deficiency of 5.2 pounds, which, at 20.4 cents per pound, equals $1.06, the rebate to be allowed to the buyer.

Composition and Valuation.

Besides nitrogen, cotton seed meal contains relatively small quantities of phosphoric acid and potash.

The average, computed from a large number of samples, is 3.15 and 1.9 per cent., respectively, and the computed valuation, $4.42 per ton.

To determine the cost of nitrogen, the above figure is subtracted from the ton price, and the remainder, after multiplying by 100 to reduce it to cents, is divided by the number of pounds of nitrogen in a ton of meal.

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

Analyses of Cotton Seed Meal.

Station No.	Dealer.	Purchased, Sampled, or Sent by	Per cent. of Nitrogen. Found.	Per cent. of Nitrogen. Guaranteed.	Cost per ton.	Nitrogen costs cents per pound.
20332	Humphreys, Godwin & Co., Olds & Whipple, Hartford	E. J. Welles, East Windsor Hill, and Phelps Bros., R. D. Warehouse Pt.	7.28	6.50	$29.00	16.9
20515	Hunter Bros. Milling Co., St. Louis, Mo.	Ernest N. Austin, Suffield	7.02	6.58	28.25	17.0
20525	H. G. & Co., Memphis, Tenn., Olds & Whipple, Hartford	The Conn. Tobacco Corporation, Granby	7.05	6.50	28.50	17.1
20432	H. G. & Co., Memphis, Tenn., Loomis Bros. Co., Granby	Wm. R. Messenger, Granby	7.50	7.00	30.25	17.2
20378	Arthur Sikes, Suffield	John Holzafpel and others, Suffield	7.23	6.50	29.50	17.3
20380	Arthur Sikes, Suffield	E. A. Russel and others, Suffield	7.21	6.50	29.50	17.4
20512	H. G. & Co., Memphis, Tenn., Loomis Bros. Co., Granby	Wm. R. Messenger, Granby	7.44	7.00	30.50	17.5
20308	Arthur Sikes, Suffield	E. C. Holdridge and others, Suffield	7.02	6.50	29.00	17.5
20522	H. G. & Co., Memphis, Tenn., Broad Brook L. & C. Co., Broad Brook	Broad Brook Lumber and Coal Co.	7.14	6.50	29.50	17.6
20293	H. G. & Co., Memphis, Tenn., Olds & Whipple, Hartford	Olds & Whipple	7.84	7.25	32.00	17.6
20285	Arthur Sikes, Suffield	Edwin R. Lay, Westfield, Mass.	7.00	6.50	29.00	17.6
20428	H. G. & Co., Memphis, Tenn., Spencer Bros., Suffield	Spencer Bros., Suffield	7.22	6.50	30.00	17.7
20510	Loomis Bros. Co., Granby	F. E. Miller, Granby	7.35	7.00	30.50	17.7
20286	A. Sikes, Suffield	C. P. Viets, E. Granby	6.96	6.50	29.00	17.7
20526	H. G. & Co., Memphis, Tenn., Olds & Whipple, Hartford	The Conn. Tobacco Corporation, Granby	6.72	6.50	28.50	17.9
20291	H. G. & Co., Memphis, Tenn., Olds & Whipple, Hartford	Olds & Whipple, Hartford	7.72	7.25	32.00	17.9
20379	Arthur Sikes, Suffield	W. C. Knox, Suffield, and others	7.02	6.50	29.50	17.9

Analyses of Cotton Seed Meal.—*Continued.*

Station No.	Dealer.	Purchased, Sampled, or Sent by	Per cent. of Nitrogen. Found.	Per cent. of Nitrogen. Guaranteed.	Cost per ton.	Nitrogen costs cents per pound.
20431	H. G. & Co., Memphis, Tenn., Spencer Bros., Suffield	Geo. S. Phelps, Suffield	6.84	6.50	$29.00	18.0
20567	H. G. & Co., Memphis, Tenn., Ackley, Hatch & Marsh, New Milford	Ackley, Hatch & Marsh	7.10	6.50	30.00	18.0
20255	H. G. & Co., Memphis, Tenn., Spencer Bros., Suffield	B. L. Root, Suffield	7.67	7.50	32.00	18.0
20513	H. G. & Co. Memphis, Tenn., Loomis Bros. Co., Granby	Wm. R. Messenger, Granby	7.25	7.00	30.50	18.0
20376	Arthur Sikes, Suffield	G. W. Phelps, Jr., and others, Suffield	6.82	6.50	29.00	18.0
20494	H. G. & Co., Memphis, Tenn., Broad Brook L. & C. Co., Broad Brook	Harry W. Mohn, Warehouse Point	6.92	6.50	29.50	18.1
20511	H. G. & Co., Memphis, Tenn., Loomis Bros. Co., Granby	Wm. R. Messenger, Granby	6.92	6.50	29.50	18.1
20521	H. G. & Co., Memphis, Tenn., Broad Brook L. & C. Co., Broad Brook	Broad Brook Lumber & Coal Co.	6.93	6.50	29.50	18.1
20429	H. G. & Co., Memphis, Tenn., Spencer Bros., Suffield	Spencer Bros.	7.07	6.50	30.00	18.1
20253	Olds & Whipple, Hartford	R. D. Allen, Hartford	7.90	7.50	33.00	18.1
20339	H. G. & Co., Memphis, Tenn., Spencer Bros., Suffield	Spencer Bros.	7.70	7.65	32.50	18.2
20430	H. G. & Co., Memphis, Tenn., Spencer Bros., Suffield	C. A. Prout, Suffield	7.71	7.82	32.50	18.2
20333	H. G. & Co., Memphis, Tenn., Olds & Whipple, Hartford	Olds & Whipple	7.04	6.50	30.00	18.2
20433	Arthur Sikes, Suffield	D. I. King, Suffield	6.77	6.50	29.00	18.2
20385	Arthur Sikes, Suffield	Hermann Weber, Windsor	6.90	6.50	29.50	18.2
20679	American Cotton Oil Co., New York	Mead Baumer, Suffield	6.72	6.50	29.00	18.3

ANALYSES OF COTTON SEED MEAL.—*Continued.*

Station No.	Dealer.	Purchased, Sampled, or Sent by	Per cent. of Nitrogen. Found.	Per cent. of Nitrogen. Guaranteed.	Cost per ton.	Nitrogen costs cents per pound.
20452	H. G. & Co., Memphis, Tenn., I. B. Barnard, Bloomfield	I. B. Barnard	6.87	7.00	$29.50	18.3
20451	H. G. & Co., Memphis, Tenn., Spencer Bros., Suffield	Spencer Bros.	7.11	6.50	30.50	18.3
20237	H. G. & Co., Memphis, Tenn., Spencer Bros., Suffield	Arthur E. Pascoe, Warehouse Point	7.66	7.50	32.50	18.3
20736	H. G. & Co., Memphis, Tenn., Olds & Whipple, Hartford	Olds & Whipple	7.82	7.40	33.00	18.3
20477	H. G. & Co., Memphis, Tenn., Granby Grain Co., Granby	Indian Head Plantations, Tariffville	6.62	6.50	28.75	18.4
20568	H. G. & Co., Memphis, Tenn., Broad Brook L. & C. Co., Broad Brook	Broad Brook Lumber and Coal Co.	6.82	6.50	29.50	18.4
20366	H. G. & Co., Memphis, Tenn., Olds & Whipple, Hartford	Olds & Whipple	6.96	6.50	30.00	18.4
20479	H. G. & Co., Memphis, Tenn., Spencer Bros., Suffield	S. J. Colter, Suffield	7.75	7.82	33.00	18.4
20278	H. G. & Co., Memphis, Tenn., Spencer Bros., Suffield	T. Conley, Suffield	8.04	8.00	34.00	18.4
20304	H. G. & Co., Memphis, Tenn., Spencer Bros., Suffield	T. Conley, Suffield	8.04	8.00	34.00	18.4
20324	H. G. & Co., Memphis, Tenn., Loomis Bros. Co., Granby	Arthur M. Griffin, Granby	6.96	....	30.00	18.4
20527	H. G. & Co., Memphis, Tenn., Olds & Whipple, Hartford	Conn. Tobacco Corporation, Granby	6.50	6.50	28.50	18.5
20386	H. G. & Co., Memphis, Tenn., Ackley, Hatch & Marsh, New Milford	Ackley, Hatch & Marsh	6.93	6.50	30.00	18.5
20322	H. G. & Co., Memphis, Tenn., Loomis Bros. Co., Granby	Alfred H. Griffin, Granby	6.92	7.00	30.00	18.5

ANALYSES OF COTTON SEED MEAL.—*Continued.*

Station No.	Dealer.	Purchased, Sampled, or Sent by	Per cent. of Nitrogen. Found.	Per cent. of Nitrogen. Guaranteed.	Cost per ton.	Nitrogen costs cents per pound.
20337	H. G. & Co., Memphis, Tenn., Spencer Bros., Suffield	F. B. Hatheway, Suffield	7.04	7.00	$30.50	18.5
20492	H. G. & Co., Memphis, Tenn., Olds & Whipple, Hartford	Olds & Whipple	7.72	7.82	33.00	18.5
20261	Arthur Sikes, Suffield	W. C. Sikes and others, Suffield	6.79	6.50	29.50	18.5
20523	H. G. & Co., Memphis, Tenn., Broad Brook L. & C. Co., Broad Brook	Broad Brook Lumber and Coal Co.	6.73	6.50	29.50	18.6
20256	H. G. & Co., Memphis, Tenn., Spencer Bros., Suffield	James H. Sullivan, Suffield	6.87	6.50	30.00	18.6
20267	H. G. & Co., Memphis, Tenn., Spencer Bros., Suffield	B. L. Root, Suffield	6.86	6.50	30.00	18.6
20384	H. G. & Co., Memphis, Tenn., Loomis Bros. Co., Granby	Wm. R. Messenger, Granby	6.95	7.00	30.25	18.6
20227	H. G. & Co., Memphis, Tenn., Olds & Whipple, Hartford	C. F. Segee, East Hartford	7.14	7.50	31.00	18.6
20735	H. G. & Co., Memphis, Tenn., Olds & Whipple, Hartford	Olds & Whipple	7.40	7.00	32.00	18.6
20338	H. G. & Co., Memphis, Tenn., Spencer Bros., Suffield	B. L. Root, Suffield	7.53	7.65	32.50	18.6
20478	H. G. & Co., Memphis, Tenn., Spencer Bros., Suffield	S. Vining, Southwick, Mass.	7.60	7.85	32.75	18.6
20287	H. G. & Co., Memphis, Tenn., Spencer Bros., Suffield	T. Conley, Suffield	7.96	8.00	34.00	18.6
20377	Arthur Sikes, Suffield	John Holzafpel and others, Suffield	6.75	6.50	29.50	18.6
20288	H. G. & Co., Memphis, Tenn., Spencer Bros., Suffield	Spencer Bros.	6.84	6.50	30.00	18.7
20455	H. G. & Co., Memphis, Tenn., Olds & Whipple, Hartford	Olds & Whipple	6.84	6.50	30.00	18.7

Analyses of Cotton Seed Meal.—*Continued.*

Station No.	Dealer.	Purchased, Sampled, or Sent by	Per cent. of Nitrogen. Found.	Per cent. of Nitrogen. Guaranteed.	Cost per ton.	Nitrogen costs cents per pound.
20252	H. G. & Co., Memphis, Tenn., Olds & Whipple, Hartford	H. H. Ellsworth and others, Windsor	7.26	7.00	$31.50	18.7
20789	H. G. & Co.. Memphis, Tenn., Olds & Whipple, Hartford	Olds & Whipple	7.36	7.50	32.00	18.7
20493	H. G. & Co., Memphis, Tenn., Olds & Whipple, Hartford	Olds & Whipple	7.65	7.82	33.00	18.7
20290	H. G. & Co., Memphis, Tenn., Spencer Bros., Suffield	Timothy Conley, Suffield	7.91	8.00	34.00	18.7
20303	H. G. & Co., Memphis, Tenn., Spencer Bros., Suffield	Timothy Conley, Suffield	7.92	8.00	34.00	18.7
20453	American Cotton Oil Co., Greenville, Miss., J. E. Phelps, Suffield	Oscar E. Pitcher, Suffield	6.33	6.50	28.25	18.8
20426	F. W. Brode & Co., Memphis, Tenn., A. R. Manning, Yantic	Station Agent	7.34	6.50	32.00	18.8
20310	H. G. & Co., Memphis, Tenn., Granby Grain Co., Granby	Indian Head Plantations, Tariffville	6.46	6.50	28.75	18.8
20281	H. G. & Co., Memphis, Tenn., Horace K. Brainard, Thompsonville	Geo. A. Douglass, Suffield, and others	6.66	6.50	29.50	18.8
20323	H. G. & Co., Memphis, Tenn., Loomis Bros. Co., Granby	D. A. Merriam, Granby	6.82	7.00	30.00	18.8
20528	H. G. & Co., Memphis, Tenn., Olds & Whipple, Hartford	M. W. Broderick, Windsor Locks	7 07	7.00	31.00	18.8
20474	H. G. & Co., Memphis, Tenn., Olds & Whipple, Hartford	Olds & Whipple	7.62	7.82	33.00	18.8
20746	H. G. & Co., Memphis, Tenn., E. N. Austin, Suffield	Station Agent	7.60	8.70	33.00	18.8
20325	Loomis Bros. Co., Granby	John B. Cannon, Granby	6.80	7.00	30.00	18.8

Analyses of Cotton Seed Meal.—*Continued.*

Station No.	Dealer.	Purchased, Sampled, or Sent by	Per cent. of Nitrogen. Found.	Per cent. of Nitrogen. Guaranteed.	Cost per ton.	Nitrogen costs cents per pound.
20259	Arthur Sikes, Suffield	J. A. DuBon, Poquonock	6.80	6.50	$30.00	18.8
20260	Arthur Sikes, Suffield	Hugh Biggerstaff, Suffield, and others	6.95	6.50	30.50	18.8
20297	H. G. & Co., Memphis, Tenn., Olds & Whipple, Hartford	A. E. Holcomb and others, Windsor	6.50	6.50	29.00	18.9
20277	H. G. & Co., Memphis, Tenn., Spencer Bros., Suffield	Spencer Bros.	6.65	6.50	29.50	18.9
20295	H. G. & Co., Memphis, Tenn., H. K. Brainard, Thompsonville	Geo. N. Remington, Suffield	6.65	6.50	29.50	18.9
20565	H. G. & Co., Memphis, Tenn., H. K. Brainard, Thompsonville	Leslie C. Brainard, Thompsonville	6.63	6.50	29.50	18.9
20298	H. G. & Co., Memphis, Tenn., Olds & Whipple, Hartford	E. Handel, Hockanum	6.78	6.50	30.00	18.9
20335	H. G. & Co., Memphis, Tenn., Olds & Whipple, Hartford	F. G. Strickland, Poquonock, and others	6.90	6.50	30.50	18.9
20381	H. G. & Co., Memphis, Tenn., Spencer Bros., Suffield	Joseph Prekop, Southwick, Mass.	7.02	6.50	31.00	18.9
20393	H. G. & Co., Memphis, Tenn., Olds & Whipple, Hartford	Olds & Whipple	7.70	7.82	33.50	18.9
20394	H. G. & Co., Memphis, Tenn., Olds & Whipple, Hartford	Olds & Whipple	7.70	7.91	33.50	18.9
20529	H. G. & Co., Memphis, Tenn., Olds & Whipple, Hartford	Olds & Whipple	7.68	7.82	33.50	18.9
20514	Hunter Bros. Milling Co., St. Louis, Mo., E. N. Austin, Suffield	Ernest N. Austin	6.44	6.58	28.75	18.9
20284	Arthur Sikes, Suffield	C. F. Whittemore, West Suffield	6.38	6.50	28.50	18.9
20296	H. G. & Co., Memphis, Tenn., H. K. Brainard, Thompsonville	James Burgess, Thompsonville	6.60	6.50	29.50	19.0

ANALYSES OF COTTON SEED MEAL.—*Continued.*

Station No.	Dealer.	Purchased, Sampled, or Sent by	Per cent. of Nitrogen. Found.	Per cent. of Nitrogen. Guaranteed.	Cost per ton.	Nitrogen costs cents per pound.
19958	H. G. & Co., Memphis, Tenn., Spencer Bros., Suffield	B. L. Root, Suffield	6.72	6.50	$30.00	19.0
20395	H. G. & Co., Memphis, Tenn., Loomis Bros. Co., Granby	H. G. Viets, Granby	6.74	6.50	30.00	19.0
20531	H. G. & Co., Memphis, Tenn., Olds & Whipple, Hartford	Olds & Whipple	6.74	6.58	30.00	19.0
20475	H. G. & Co., Memphis, Tenn., Olds & Whipple, Hartford	Olds & Whipple	7.54	7.82	33.00	19.0
20607	H. G. & Co., Memphis, Tenn., Olds & Whipple, Hartford	Olds & Whipple	7.67	7.82	33.50	19.0
20014	Olds & Whipple, Hartford	Wm. H. Brewer, Silver Lane	7.50	7.62	33.00	19.0
20015	Olds & Whipple, Hartford	Wm. H. Brewer, Silver Lane	7.52	7.62	33.00	19.0
20516	Hunter Bros. Milling Co., St. Louis, Mo., E. N. Austin, Suffield	Ernest N. Austin	6.38	6.58	28.65	19.0
20637	H. G. & Co., Memphis, Tenn., Olds & Whipple, Hartford	Olds & Whipple	7.77	7.82	34.00	19.0
20745	J. Lindsay Wells Co., Memphis, Tenn., E. N. Austin, Suffield	Station Agent	6.34	6.50	28.50	19.0
20509	American Cotton Oil Co., West Point, Miss., James Price, Warehouse Point	Walter E. Price, Warehouse Point	6.58	6.50	29.50	19.1
20289	H. G. & Co., Memphis, Tenn., Spencer Bros., Suffield	Geo. A. Peckham, Suffield	6.68	6.50	30.00	19.1
20305	H. G. & Co., Memphis, Tenn., Spencer Bros., Suffield	Harry Noone, Suffield	6.94	7.00	31.00	19.1
20644	H. G. & Co., Memphis, Tenn., Spencer Bros., Suffield	Spencer Bros.	6.94	---	31.00	19.1
20575	H. G. & Co., Memphis, Tenn., Olds & Whipple, Hartford	Olds & Whipple	7.60	7.82	33.50	19.1

ANALYSES OF COTTON SEED MEAL.—*Continued.*

Station No.	Dealer.	Purchased, Sampled, or Sent by	Per cent. of Nitrogen. Found.	Per cent. of Nitrogen. Guaranteed.	Cost per ton.	Nitrogen costs cents per pound.
20645	H. G. & Co., Memphis, Tenn., Spencer Bros., Suffield	Spencer Bros.	6.91	6.50	$31.00	19.2
20558	H. G. & Co., Memphis, Tenn., Olds & Whipple, Hartford	Olds & Whipple	7.45	7.41	33.00	19.2
20559	H. G. & Co., Memphis, Tenn., Olds & Whipple, Hartford	Olds & Whipple	7.43	7.41	33.00	19.2
20576	H. G. & Co., Memphis, Tenn., Olds & Whipple, Hartford	Olds & Whipple	7.59	7.82	33.50	19.2
20635	Hunter Bros. Milling Co., St. Louis, Mo., Olds & Whipple, Hartford	Olds & Whipple	7.17	7.00	32.00	19.2
20608	Arthur Sikes, Suffield	Mrs. Rose Maloy, Suffield, and others	6.65	6.50	30.00	19.2
20326	J. Lindsay Wells Co., Memphis, Tenn., L. C. Daniels Grain Co., Bloomfield	Geo. E. Brown, Bloomfield	6.66	6.50	30.00	19.2
20570	J. Lindsay Wells Co., Memphis, Tenn., E. N. Austin, Suffield	M. Doughney, Windsor Locks	6.30	6.50	28.60	19.2
20473	H. G. & Co., Memphis, Tenn., Olds & Whipple, Hartford	Olds & Whipple	6.87	6.50	31.00	19.3
20633	H. G. & Co., Memphis, Tenn., Olds & Whipple, Hartford	Olds & Whipple	7.41	7.41	33.00	19.3
20788	H. G. & Co., Memphis, Tenn., Olds & Whipple, Hartford	Olds & Whipple	7.40	7.50	33.00	19.3
20427	H. G. & Co., Memphis, Tenn., Spencer Bros., Suffield	Spencer Bros.	7.66	8.00	34.00	19.3
20580	Olds & Whipple, Hartford	Lowell Brewer, Hockanum	6.61	6.50	30.00	19.3
20450	H. G. & Co., Memphis, Tenn., Spencer Bros., Suffield	Samuel Barr, Suffield	6.72	6.50	30.50	19.4
20606	H. G. & Co., Memphis, Tenn., Olds & Whipple, Hartford	Olds & Whipple	7.37	7.41	33.00	19.4

ANALYSES OF COTTON SEED MEAL.—*Continued.*

Station No.	Dealer.	Purchased, Sampled, or Sent by	Per cent. of Nitrogen. Found.	Per cent. of Nitrogen. Guaranteed.	Cost per ton.	Nitrogen costs cents per pound.
20634	Hunter Bros. Milling Co., St. Louis. Mo., Olds & Whipple, Hartford	Olds & Whipple	7.10	7.00	$32.00	19.4
20743	J. Lindsay Wells Co., Memphis, Tenn., E. N. Austin, Suffield	Station Agent	6.22	6.50	28.50	19.4
20476	J. Lindsay Wells Co., Memphis, Tenn., A. R. Manning, Yantic	Station Agent	6.84	6.50	31.00	19.4
20282	H. G. & Co., Memphis, Tenn., Olds & Whipple, Hartford	Olds & Whipple	7.20	7.50	32.50	19.5
20530	H. G. & Co., Memphis, Tenn., Olds & Whipple, Hartford	Olds & Whipple	7.45	7.82	33.50	19.5
20334	H. G. & Co., Memphis, Tenn., Olds & Whipple, Hartford	H. W. Alford, Windsor and others	7.86	8.00	35.00	19.5
20306	H. G. & Co., Memphis, Tenn., Olds & Whipple, Hartford	Olds & Whipple	6.53	6.50	30.00	19.6
20307	H. G. & Co., Memphis, Tenn., Olds & Whipple, Hartford	E. P. Brewer, Silver Lane	6.52	6.50	30.00	19.6
20254	H. G. & Co., Memphis, Tenn., Olds & Whipple, Hartford	R. M. Thompson, Hartford	7.80	8.00	35.00	19.6
20636	H. G. & Co., Memphis, Tenn., Olds & Whipple, Hartford	Olds & Whipple	7.30	7.41	33.00	19.6
20222	Olds & Whipple, Hartford	Robert A. McJunkin, Hartford	7.28	7.50	33.00	19.6
20265	Olds & Whipple, Hartford	E. P. Brewer, Silver Lane	7.80	8.00	35.00	19.6
20383	J. E. Soper & Co., Boston, Mass., Spencer Bros., Suffield	Arthur L. Jackson, Suffield	6.77	6.50	31.00	19.6
20609	H. G. & Co., Memphis, Tenn., Newell St. John, Simsbury	Station Agent	6.50	6.50	30.00	19.7
20744	Hunter Bros. Milling Co., St. Louis, Mo., E. N. Austin, Suffield	Station Agent	6.16	6.00	28.75	19.7

ANALYSES OF COTTON SEED MEAL.—*Continued.*

Station No.	Dealer.	Purchased, Sampled, or Sent by	Per cent. of Nitrogen. Found.	Per cent. of Nitrogen. Guaranteed.	Cost per ton.	Nitrogen costs cents per pound.
20299	Meech & Stoddard, Middletown	Joseph W. Alsop, Avon	6.47	6.56	$29.85	19.7
20574	C. H. Dexter & Sons, Windsor Locks	E. S. Seymour, Suffield	6.72	7.00	31.00	19.8
20676	H. G. & Co., Memphis, Tenn., Olds & Whipple, Hartford	Olds & Whipple	7.48	7.41	34.00	19.8
20229	Olds & Whipple, Hartford	E. J. Brewer, Silver Lane	7.22	7.50	33.00	19.8
20560	H. G. & Co., Memphis, Tenn., Olds & Whipple, Hartford	Olds & Whipple	7.42	7.82	34.00	19.9
19960	H. G. & Co., Memphis, Tenn., Spencer Bros., Suffield	Spencer Bros.	6.38	6.50	30.00	20.0
20266	American Cotton Oil Co., New York, Spencer Bros., Suffield	Christopher Michel, Suffield	6.60	6.50	31.00	20.1
20268	Olds & Whipple, Hartford	T. P. Kinney, Windsor	7.62	8.00	35.00	20.1
20678	H. G. & Co., Memphis, Tenn., Olds & Whipple, Hartford	Olds & Whipple	7.32	7.41	34.00	20.2
20632	C. H. Dexter & Sons, Windsor Locks	John L. Firtion, Suffield	6.54	7.00	31.00	20.3
20566	H. G. & Co., Memphis, Tenn., Spencer Bros., Suffield	A. C. Scott, Suffield	6.41	6.50	30.50	20.3
20677	H. G. & Co., Memphis, Tenn., Olds & Whipple, Hartford	Olds & Whipple	7.30	7.41	34.00	20.3
20569	H. G. & Co., Memphis, Tenn., Broad Brook L. & C. Co., Broad Brook	Broad Brook Lumber & Coal Co.	6.15	6.50	29.50	20.4
20336	American Cotton Oil Co., New York, Spencer Bros., Suffield	Spencer Bros.	6.49	6.50	31.00	20.5
20631	S. D. Viets Co., Springfield, Mass., Ackley, Hatch & Marsh, New Milford	Ackley, Hatch & Marsh	6.45	6.50	31.00	20.6
20647	American Cotton Oil Co., Greenville, Miss., G. W. Strant, S. Manchester	F. N. Buckland, Glastonbury	6.43	6.50	31.00	20.7

Analyses of Cotton Seed Meal.—*Concluded.*

Station No.	Dealer.	Purchased, Sampled, or Sent by	Per cent. of Nitrogen. Found.	Per cent. of Nitrogen. Guaranteed.	Cost per ton.	Nitrogen costs cents per pound.
20340	American Cotton Oil Co., New York, Spencer Bros., Suffield	Spencer Bros.	6.16	6.50	$30.00	20.8
20280	H. G. & Co., Memphis, Tenn., Ackley, Hatch & Marsh, New Milford	Ackley, Hatch & Marsh	6.64	6.50	32.00	20.8
19959	H. G. & Co., Memphis, Tenn., Spencer Bros., Suffield	B. L. Root, Suffield	6.10	6.50	30.00	20.9
20382	American Cotton Oil Co., New York, Spencer Bros., Suffield	Matthew Leahey, West Suffield	6.08	6.50	30.00	21.0
20675	American Cotton Oil Co., Greenville, Miss., S. D. Viets Co., Springfield, Mass.	Ackley, Hatch & Marsh, New Milford	6.34	6.50	31.00	21.0
19957	H. G. & Co., Memphis, Tenn., Ackley, Hatch & Marsh, New Milford	Ackley, Hatch & Marsh, New Milford	6.76	6.50	33.00	21.1
20605	H. G. & Co., Memphis, Tenn., Olds & Whipple, Hartford	Olds & Whipple	6.22	6.58	31.00	21.4
20773	F. W. Brode & Co., Memphis, Tenn., Meech & Stoddard, Middletown	Pierson & Kirkpatrick, Cromwell	6.16	6.50	33.00	23.2

The percentage of nitrogen in the samples analyzed has ranged from 8.04 to 6.08, the average of all being 7.04, or 0.2 higher than last year. The cost of nitrogen has ranged from 16.9 cents per pound to 23.2 cents, the average being 18.9 cents, half a cent lower than last year.

These figures mean that the grower who pays 23.2 cents per pound for nitrogen, instead of the average, 18.9 cents, adds from ⅓ to ½ a cent a pound to the cost of raising his tobacco crop.

CASTOR POMACE.

(Analyses on page 482.)

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

Thirteen samples have been analyzed this year, as follows:

Station No.	Sold by	Sampled and sent by
20577	Olds & Whipple, Hartford,	L. H. Brewer, Hockanum,
20573	“ “ “ “	E. S. Seymour, Suffield,
20454	“ “ “ “	G. A. Peckham, “
20709	“ “ “ “	H. E. Pitkin, So. Windsor,
20708	“ “ “ “	F. H. Ensign, Hockanum,
20680	“ “ “ “	Mead Baumer, Suffield,
20365	“ “ “ “	Station Agent,
20006	“ “ “ “	R. C. Hyde, Windsor,
20347	Nat'l Fertilizer Co., B'port,	E. Linn Pease, Thompsonville,
20389	H. J. Baker & Bro., N. Y.,	Stn. Agt. (Stock of Spencer Bros),
20833	“ “ “ “ “ “ “	“ “ “ “ W. Ford),
20367	Am. Agric. Chem. Co., N. Y.,	“ “ “ “ E. Halladay),
20707	Bowker Fertilizer “ “ “	“ “ “ “ Bowker's Branch).

The samples of Olds & Whipple's stock were all gray pomace; the others were dark pomace, containing considerably less nitrogen. The gray pomace contains less nitrogen than was found in it formerly. Most of the samples, however, contain the guaranteed amount.

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

The cost of nitrogen in castor pomace has ranged from 20.0 to 26 cents per pound, the average of the eight samples being 21.9 cents, three cents per pound more than in cotton seed meal.

Analyses of Castor Pomace.

	Olds & Whipple.								National.	H. J. Baker & Bro.		Am. Ag. Chem. Co.	Bowker.
Station No.	20577	20573	20454	20709	20708	20680	20365	20006	20347	20389	20833	20367	23707
Percentage amounts of													
Nitrogen found	5.37	5.35	5.62	5.30	5.30	5.19	5.10	5.06	4.75	4.60	4.68	4.36	4.22
Nitrogen guaranteed	5.25	5.25	5.25	5.0	5.0	5.5	5.0	5.0	3.43	----	4.00	4.12	4.12
Cost per ton	$24.00	24.00	25.00	24.00	24.00	24.00	24.00	24.00	24.50	24.00	24.50	25.00	24.50
Nitrogen costs cents per pound	20.0	20.0	20.0	20.2	20.2	20.7	21.0	21.2	23.1	23.3	23.5	25.7	26.0

II. RAW MATERIALS CHIEFLY VALUABLE FOR PHOSPHORIC ACID.

DISSOLVED ROCK PHOSPHATE OR ACID ROCK.

(Analyses on page 484.)

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

The following seven analyses show the quality of the dissolved phosphate sold this year in this state:—

20613. Sold by the Coe-Mortimer Co., New York City. Sampled and sent by W. A. Simpson, Wallingford.

20392. Stock of Wilcox Fertilizer Co., Mystic.

20329. Stock of S. D. Woodruff & Sons, Orange.

20705. Sold by Bowker Fertilizer Co., New York City. Sampled from stock of Bowker Branch, Hartford.

20274. Sold by Swift's Lowell Fertilizer Co. Sampled from stock of W. I. Munson, Highwood.

20460. Sold by Buffalo Fertilizer Co., Buffalo. Sampled and sent by Linus H. Hall, Wallingford.

20562. Sold by Sanderson Fertilizer & Chemical Co., New Haven. Sampled from stock of Conn. School for Boys.

The acid phosphate on the market at present is of several quite distinct grades, as appears in the analyses.

The cost of so-called "available" phosphoric acid in the few samples of acid phosphate examined ranged from 4.0 to 6.3 cents per pound. It has been bought by farmers in car lots this year for 3.5 cents per pound.

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

ANALYSES OF ACID PHOSPHATE.

	Coe-Mortimer.		Woodruff & Sons.	Bowker.	Swift's Lowell.	Buffalo.	Sanderson.
Station No.	**20613**	**20392**	**20329**	**20705**	**20274**	**20460**	**20562**
Percentage amounts of							
Water-soluble phosphoric acid	3.13	12.43	12.59	9.86	10.13	16.31	9.93
Citrate-soluble phosphoric acid	16.88	2.14	1.68	3.69	4.07	1.05	3.89
Citrate-insoluble phosphoric acid	5.50	2.09	0.52	1.88	2.34	0.14	0.64
Total phosphoric acid found	25.51	16.66	14.79	15.43	16.54	17.50	14.46
Total phosphoric acid guaranteed	....	....	....	14.00	15.00	....	....
Sum of water-soluble and citrate-soluble phosphoric acid found	20.01	14.57	14.27	13.55	14.20	17.36	13.82
"Available" phosphoric acid guar.	14.00	14.00	....	12.00	14.00	16.00	14.00
Cost per ton	$16.00	15.00	16.00	17.00	....	....	....
"Available" phosphoric acid costs cents per pound	**4.0**	**5.1**	**5.6**	**6.3**	....	....	....

and there is no means, at present known, for determining this difference in the laboratory.

The method of citrate extraction was devised for and is strictly applicable to the determination of that part of the phosphoric acid in a plain superphosphate ("acid phosphate," or dissolved rock phosphate) which had been at first dissolved by sulphuric acid but by further chemical reactions has become insoluble in water. It was formerly called "backgone" or "reverted" phosphoric acid. Such a case is perhaps represented by the sample—**20613**—cited above.

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

PRECIPITATED BONE.

This apparently consists of some form of phosphate which has been precipitated from its solution and is a fine powder, very readily soluble in ammonium citrate and probably very readily available to plants.

Two samples, **20579** and **19995**, both from stock of Olds & Whipple, Hartford, one sent by Lowell Brewer and the other by E. P. Brewer, of Silver Lane, had the following composition:

	20579	19995
Water-soluble phosphoric acid	2.17	3.36
Citrate-soluble phosphoric acid	30.17	29.91
Citrate-insoluble phosphoric acid	4.76	4.37
Total phosphoric acid	37.10	37.64
Cost per ton	$45.00	45.00
"Available" phosphoric acid costs cents per pound	**6.9**	**6.8**

FLOATS.

This material is a finely ground phosphate rock untreated with any chemicals.

On our thin soils, deficient in humus, the phosphoric acid of floats is extremely slow in becoming available to crops when applied by itself. It remains in the soil, like the other rock fragments of which the soil is made, waiting for some solvent to decompose it. It adds to the permanent soil capital but not to its floating capital or "available" funds. Quite different, apparently, is its behavior when it is applied to a soil full of decaying vegetable matter (green manures), or is mixed with rotting stable manure. Experiments made chiefly at the Ohio station indicate that, when mixed with stable manure, its phosphoric acid becomes available enough to yield large returns on land which is in itself relatively deficient in phosphoric acid and on which available phosphoric acid is the only application which really pays.

In these experiments 40 pounds of rock phosphate were mixed with each ton of stable manure and comparison was made with the same kind of manure unmixed with rock phosphate.

In 56 separate tests, covering 11 years, an average of $5.68 in increased crop was recovered for every dollar spent in rock phosphate, *which was bought for $8.00 per ton.*

Of course no such results are to be expected on soils like many of our own, where, however deficient phosphoric acid may be, nitrogen is much more deficient. But the stocking of land with phosphoric acid by use of the amount of floats indicated above, which can be strewn in the manure trenches of the stables, may be profitable in connection with the growing of legumes and other means of increasing the available nitrogen of the farm.

A single sample, **20741**, sold by the Buffalo Fertilizer Co., of Buffalo, N. Y., drawn by the station agent from stock of Thomas Holt, Southington, contained 25.0 per cent. of phosphoric acid, which was the guaranteed amount.

III. RAW MATERIALS OF HIGH GRADE CONTAINING POTASH.

CARBONATE OF POTASH.

Commercial carbonate of potash has been a popular form of potash fertilizer for tobacco. During the present year, however, only three samples have been sent for analysis.

20482. Sold by Olds & Whipple, Hartford. Sampled and sent by Spencer Bros., Suffield.

20681. Sold by Innis, Speiden & Co., New York City. Sampled and sent by Mead Baumer, Suffield.

20615. Sold by Innis, Speiden & Co. Sampled and sent by G. A. Douglass, Suffield.

ANALYSES.

Station No.	20482	20681	20615
Percentage amounts of			
Potash found	66.21	66.58	66.81
Potash guaranteed	65.40	67.00	66.00
Cost per ton	$95.00*	97.50	97.50
Potash costs cents per pound	**7.2***	**7.3**	**7.3**

VEGETABLE POTASH.

This material, sold by Olds & Whipple, Hartford, is understood to be the ashes of beet residues from the manufacture of beet sugar.

20561 was sampled by station agent from stock of Olds & Whipple. **20578** was sampled and sent by L. Brewer.

ANALYSES OF VEGETABLE POTASH.

Station No.	20561	20578
Percentage amounts of		
Potash† calculated as muriate	2.34	1.50
Potash† calculated as sulphate	4.73	2.52
Potash calculated as carbonate	18.37	21.28
Total potash	25.44	25.30
Chlorine	1.76	1.13
Sulphuric acid	4.02	2.14
Cost per ton	$44.00	44.00
Potash costs cents per pound	**8.6**	**8.7**

"BLACK POTASH."

A sample, **20689**, bearing this name, sent by Barnes and Hall, Wallingford, supplied by the Rogers Manufacturing Co., Rockfall, contained 19.9 per cent. of water-soluble potash.

At the price quoted, $36.75, actual potash cost 9.2 cents per pound.

HIGH GRADE SULPHATE OF POTASH.

(ANALYSES ON PAGES 488 AND 489.)

This chemical should contain about 90 per cent. of pure potassium sulphate (sulphate of potash), or about 49 per cent. of potassium oxide ("potash"), and should be nearly free from chlorides. One of the two samples analyzed, No. **20390**, was quite below the average quality of this material.

The cost of potash in high grade sulphate has been a little over five cents a pound.

* f. o. b. N. Y.
† See note regarding this calculation, page 557.

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

Station No.	Drawn from stock in possession of	Sampled or sent by	Potash soluble in water, found.	Potash guaranteed.	Cost per ton.	Potash costs cents per pound.
	High Grade Sulphate of Potash:					
20480	Spencer Bros., Suffield, from Coe-Mortimer Co., N. Y.	S. R. Spencer, Suffield	51.26	49.8	$50.00	4.9
20390	Wilcox Fertilizer Co., Mystic, Conn.	Station agent	46.64	48.0	50.00	5.4
	Double Sulphate of Potash and Magnesia:					
20362	Sanderson Fertilizer & Chemical Co., New Haven	Station agent	28.00	25.0	30.00	5.4
20488	Sanderson Fertilizer & Chemical Co., New Haven	Station agent	27.74	27.0	----	----
	Muriate of Potash:					
20487	J. G. Schwink, Meriden, from Coe-Mortimer Co., N. Y.	Station agent	57.64	50.0	44.00	3.8
20520	Walter E. Fiske, Warehouse Point, from New England Fertilizer Co., Boston, Mass.	James Price, Warehouse Point	52.86	50.0	42.00	4.0
20485	T. J. Pring & Bro., Wallingford, from Parmenter & Polsey Fert. Co., Boston, Mass.	Station agent	52.27	50.0	44.00	4.2
20363	Sanderson Fertilizer & Chemical Co., New Haven	Station agent	53.89	50.0	45.00	4.2
20388	J. M. Gager, Willimantic, from C. M. Shay Fertilizer Co., Groton	J. M. Gager	49.28	50.0	42.00	4.3
20391	Wilcox Fertilizer Co., Mystic	Station agent	48.93	50.0	43.00	4.4
20742	Bowker's Branch, Hartford, from Bowker Fertilizer Co.	Station agent	50.12	50.0	45.00	4.5
20330	S. D. Woodruff & Sons, Orange	Station agent	50.25		46.00	4.6
20370	C. Buckingham, Southport, and Edmund Halladay, Suffield, from American Agricultural Chemical Co., N. Y.	Station agent	50.34	50.0	----	----
20747	Connecticut School for Boys, Meriden, from Sanderson Fertilizer & Chemical Co., New Haven	Station agent	51.16	50.0	----	----
20271	Andrew Ure, Highwood, from Swift's Lowell Fertilizer Co., Boston, Mass.	Station agent	52.03	50.0	----	----
19976	J. H. Hale, So. Glastonbury, from Buffalo Fertilizer Co., Buffalo, N. Y.	J. H. Hale	54.53	----	----	----
	Kainit:					
20490	Connecticut School for Boys, Meriden, from Sanderson Fertilizer & Chemical Co., New Haven	Station agent	13.56	12.0	----	----

DOUBLE SULPHATE OF POTASH AND MAGNESIA.

(ANALYSES ON PAGES 488 AND 489.)

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.

The two samples analyzed were of the usual quality.

The cost of potash per pound, in double sulphate of potash of good quality, has been about five and one-half cents, as usual a trifle higher than in the high grade sulphate.

MURIATE OF POTASH.

(ANALYSES ON PAGES 488 AND 489.)

Commercial muriate of potash contains about 80 per cent. of muriate of potash (potassium chloride), equivalent to 50.5 per cent. of actual potash, 15 per cent. or more of common salt (sodium chloride) and 4 per cent. or more of water.

Of the twelve samples examined, two were quite below the usual guaranteed composition of 50 per cent. It should be said that potash salts can only be bought on the analyses of the German syndicate, made before the goods are shipped from Germany, and that these analyses are not regarded even in Germany as accurately showing the composition of the various shipments. Our own jobbers and retailers apparently cannot help themselves in the matter.

One sample, **20487**, contains an unusually large percentage of potash, 57.64, equivalent to 91 per cent. of muriate.

The price per pound of actual potash in the muriate has been about four and one-quarter cents.

KAINIT.

(ANALYSIS ON PAGES 488 AND 489.)

Kainit is less uniform in composition than the other potash salts. It contains from 11 to 15 per cent. of potash, more than that quantity of soda, and rather less magnesia. These "bases" are combined with chlorine and sulphuric acid. Unless "calcined," it contains more water than either the sulphate or the muriate of potash. It is usually sold on a guaranty of 12 to 15 per cent. of potash, or 23 to 25 per cent. "sulphate of potash." It is not properly called, or claimed to be, a sulphate of potash, since it contains more than enough chlorine to combine with all the potash present, and there are sound reasons for believing that its potash exists chiefly as muriate and, to a much less extent, as sulphate. Its action and effects are unquestionably those of a muriate rather than of a sulphate.

The single sample analyzed contained 12.0 per cent. of potash.

IV. RAW MATERIALS CONTAINING NITROGEN AND PHOSPHORIC ACID.

BONE MANURES.

(ANALYSES ON PAGES 494 AND 495.)

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 table of analyses of bone manures contains a column headed "Valuation per ton."

VALUATION OF FERTILIZERS IN GENERAL.

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

The trade value per pound of these ingredients is reckoned from the current market prices of the standard articles which furnish them to commerce. *The valuation of a fertilizer does not show either its fair price or agricultural value. Nor should it be inferred that the ingredients of a given mixture always have the market value represented by the valuation.*

The valuation, properly understood and used, does, however, furnish a rational basis for comparing the commercial values of fertilizer mixtures.

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 1908.*

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 1907, were as follows:

	Cents per pound.
Nitrogen in nitrates	18½
ammonia salts	17½
Organic nitrogen in dry and fine ground fish, meat and blood, and in mixed fertilizers	20½
in fine† bone and tankage	20½
in coarse† bone and tankage	15
Phosphoric acid, water-soluble	5
citrate-soluble‡	4½
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

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.

* Adopted at a conference of representatives of the Maine, Massachusetts, New Jersey, Rhode Island, Vermont and Connecticut stations held in March, 1908.

† In this report "fine," as applied to bone and tankage, signifies smaller than $\frac{1}{50}$ inch; and "coarse," larger than $\frac{1}{50}$ inch.

‡ 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.

Valuation of Bone and Tankage.

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

The nitrogen value of each grade is separately computed by multiplying the pounds of nitrogen per ton by the per cent. of each grade, multiplying the 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.

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

In the table on pages 494 and 495 are tabulated analyses of twenty-four samples.

GUARANTIES.

Of the samples having a guaranty, 6 failed in one particular to meet it, but in every case this deficiency was met by a corresponding excess of the other ingredient, so that a full money equivalent was given for the plant food guaranteed.

COST AND VALUATION.

Six of the samples had a valuation greater than the cost. The average cost per ton of the 24 brands examined was $30.32 and the valuation $28.40. The average cost is the same as last year and the average valuation one dollar higher.

2. *Sampled by Others than the Station Agent.*

In the table on pages 494 and 495 are included seven analyses of samples drawn by manufacturers and others. The station is responsible only for the analyses, but not for the correctness of the sampling of these seven.

SLAUGHTER-HOUSE TANKAGE.

(Analyses on page 497.)

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, page 497, are analyses of eleven samples of this material from the Connecticut market.

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	Chemical Analysis. Nitrogen. Guaranteed.	Chemical Analysis. Phosphoric Acid. Found.	Chemical Analysis. Phosphoric Acid. Guaranteed.	Mechanical Analysis. Finer than 1-50 inch.	Mechanical Analysis. Coarser than 1-50 inch.
	Sampled by Station Agent:											
20847	Self-Recommending Fertilizer	Valentine Bohl, Waterbury	Manufacturer	$28.00	$32.34	13.4*	4.51	3.8	22.13	23.0	59	41
20861	Fine Ground Bone	Rogers Manufacturing Co., Rockfall	Manufacturer	32.00	35.91	10.9*	3.56	3.3	27.71	26.0	91	09
20865	Swift-Sure Ground Bone	M. L. Shoemaker & Co., Philadelphia, Pa.	Olds & Whipple, Hartford	34.00	38.01	10.6*	5.45	4.1	24.18	20.0	66	34
20855	Bone Meal	L. T. Frisbie Co., New Haven	L. T. Frisbie Co., Hartford	27.00	29.21	7.5*	4.28	3.3	20.14	18.0	49	51
20858	Pure Ground Bone	Parmenter & Polsey Fertilizer Co., Boston	T. J. Pring & Bro., Wallingford	26.00	27.90	6.8*	2.42	2.5	26.56	23.0	59	41
20862	Bone Flour	Rogers Manufacturing Co., Rockfall	Meeker Coal Co., Norwalk	34.00	34.34	3.8*	3.64	3.8	26.61	24.0	80	20
			Manufacturer	32.00								
				33.00								
20866	Ground Bone	Swift's Lowell Fertilizer Co., Boston	E. A. Buck & Co., Willimantic	30.00	29.64	2.9	3.18	2.5	25.84	22.0	53	47
			J. P. Barstow, Norwich	30.50								
20867	Wilcox's Ground Bone	Wilcox Fertilizer Co., Mystic	Edward White, Rockville	29.00	28.18	2.9	2.41	2.5	26.56	22.0	63	37
20854	Essex Ground Bone	Essex Fertilizer Co., Boston	J. & H. Woodford, Avon	30.00	28.82	4.1	2.35	2.5	28.09	23.0	60	40
20852	Ground Bone	Peter Cooper's Glue Factory, N. Y.	S. G. Cook, Branford †	26.00	24.62	5.6	1.24	0.9	28.89	26.0	50	50
20863	Sanderson's Fine Ground Bone	Sanderson Fertilizer and Chemical Co., New Haven	Manufacturer	30.00	28.23	6.2	3.46	2.47	22.90	20.0	49	51
			F. Hallock & Co., Derby	30.00								
20859	Pure Raw Knuckle Bone Flour	The Rogers & Hubbard Co., Middletown	H. W. Andrews, Wallingford	36.00	33.48	7.5	3.82	3.5	25.53	24.5	72	28
20844	Fine Ground Bone	Amer. Agric'l. Chem. Co., N. Y. City	C. Buckingham, Southport	28.00	27.71	8.2	2.53	2.5	25.97	22.8	57	43
			G. W. Eaton, Bristol	32.00								
				30.00								
20849	Bowker's XX Bone	Bowker Fertilizer Co., N. Y.	Barnes Bros. Co., Yalesville	24.00	22.09	8.6	0.88	1.0	26.30	25.0	59	41
20857	Ground Bone	New England Fertilizer Co., Boston	T. B. Atwater, Plantsville	30.00	27.49	9.1	2.51	2.5	25.97	22.0	55	45
20845	Armour's Bone Meal	Armour Fertilizer Works, Baltimore	Farmers Supply Co., Bridgeport	33.00	28.67	9.8	2.55	2.5	25.53	24.0	72	28
			W. O. Goodsell, Bristol	30.00								
				31.50								
20853	Ground Bone	G. L. Dennis, Stafford Springs	Manufacturer	28.00	25.47	9.9	3.77	3.0	21.36	20.0	16	84
20864	Ground Bone	C M. Shay Fertilizer Co., Groton	Manufacturer	30.00	27.26	10.0	2.18	1.5	27.45	25.0	54	46
20848	Bowker's Fresh Ground Bone	Bowker Fertilizer Co., New York	Lightbourn & Pond, New Haven	30.50								
			Wm. Ewald, Cromwell	30.00	26.62	12.7	2.39	2.5	25.46	22.0	54	46
				30.25								
20850	Buffalo Bone Meal	Buffalo Fertilizer Co., Buffalo, N. Y.	Ansonia Flour & Grain Co., Ansonia	32.00	27.19	17.7	3.10	2.0	20.65	22.0	73	27
20846	Ground Bone	Berkshire Fertilizer Co., Bridgeport	Johnson Bros., Jewett City	32.00	26.49	20.8	2.69	2.5	23.87	20.0	53	47
20860	Hubbard's Strictly Fine Bone	The Rogers & Hubbard Co., Middletown	F. S. Platt Co., New Haven	35.00	27.18	21.4	3.67	2.9	20.80	22.0	45	55
			C. S. Gillette, Cheshire	31.00								
				33.00								
20851	XXX Bone	Coe-Mortimer Co., N. Y.	W. A. Burr, West Hartford	37.00	26.26	40.9	2.58	2.5	24.54	25.0	49	51
20856	Celebrated Ground Bone	Lister's Agric. Chemical Works, Newark, N. J.	J. A. Foster, R. D. Stafford Springs	30.00	18.52	61.9	2.68	2.7	12.72	12.0	52	48
	Sampled by purchasers and others.		*Sampled or sent by*									
20616	Swift's Bone	Swift's Lowell Fertilizer Co., Boston	G. A. Douglass, R. D. 2, Suffield	26.00	30.06	13.5*	2.92	2.5	25.08	23.0	76	24
20300	Pure Bone Dust	Peter Cooper's Glue Factory, N. Y. City	Joseph W. Alsop, Avon	24.60	25.58	3.8*	1.50	2.5	28.83	26.7	51	49
20557	Cooper's Ground Bone	Peter Cooper's Glue Factory, N. Y. City	A. E. Plant, Branford	26.00	24.45	6.3	1.72	0.9	28.02	26.7	33	67
20910	James' Ground Bone	E. L. James, Warrenville	Manufacturer	29.00	25.59	13.3	4.10	3.5	21.56	20.0	04	96
20013	Bone Meal	Buffalo Fertilizer Co., Buffalo, N. Y.	D. W. Patten, Clintonville	-----	29.07	----	3.03	2.5	24.18	25.0	67	33
19964	Fine Ground Bone	Salisbury Knife Handle Co., Salisbury	Grassland Farms, Chapinville	-----	34.35	----	4.02	----	26.32	----	67	33
19965	Bone Sawdust	Salisbury Knife Handle Co., Bone Sawing Department	Grassland Farms, Chapinville	-----	31.64	----	3.93	----	25.66	----	47	53

* Valuation exceeds cost. † Not a dealer.

1. *Sampled by Station Agent.*

20610. Made by Connecticut Fat Rendering & Fertilizer Corp., New Haven.

20371. Bought in New York by C. R. Treat, Orange.

20327 and **20328.** Bought in New York by S. D. Woodruff & Sons.

20273. Sold by Swift's Lowell Fertilizer Co., Boston. Sampled from stock bought by W. I. Munson, Highwood.

20489. Sold by Sanderson Fertilizer & Chemical Co., New Haven. Sampled from stock bought by Connecticut School for Boys.

20563. Sold by C. M. Shay Fertilizer Co., Groton. Sampled from stock bought by J. M. Gager, Willimantic.

2. *Sampled by Others than Station Agent.*

20688. Sold by the Rogers Manufacturing Co., Rockfall. Sampled and sent by A. R. Tucker, Middlefield.

20686. Sold by N. E. Fertilizer Co., Boston. Sampled and sent by A. R. Tucker, Middlefield.

20612. Sold by the Coe-Mortimer Co., New York. Sampled and sent by W. A. Simpson, Wallingford.

20387. Sold by the C. M. Shay Fertilizer Co., Groton. Sampled and sent by J. M. Gager, Willimantic.

GUARANTIES.

Most of the guaranties, both of nitrogen and phosphoric acid, in the samples of tankage, look like unfortunate guesses rather than intelligent statements of composition. Tankage is less uniform in composition than bone, but such wide discrepancies between promise and performance as here appear are inexcusable. In every case, however, a full value for the price paid has been given in the amount of nitrogen and phosphoric acid supplied.

VALUATION.

In six of the eight cases in which the cost was reported the valuation has exceeded it.

DRY GROUND FISH.

(ANALYSES ON PAGE 499.)

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 fac-

ANALYSES OF TANKAGE.

	Conn. Rend. & Fertz. Corp.	C. R. Treat.	Bought by S. D. Woodruff & Sons.		Swift's Lowell.	Sanderson F. & C. Co.	Shay Fertilizer Co.	*Sent by purchasers.* Rogers Mfg. Co.	N. E. Fertz. Co.	Coe-Mortimer Co.	Shay Fertilizer Co.
Station No.	20610	20371	20327	20328	20273	20489	20563	20688	20686	20612	20387
MECHANICAL ANALYSES:											
Finer than $\frac{1}{50}$ inch	30	58	57	59	40	43	26	52	49	44	21
Coarser " " "	70	42	43	41	60	57	74	48	51	56	79
	100	100	100	100	100	100	100	100	100	100	100
CHEMICAL ANALYSES:											
Percentage amounts of											
Nitrogen found	6.91	6.10	6.16	5.38	5.80	6.18	6.60	7.67	5.48	6.35	6.70
" guaranteed	**7.0**	**6.2**	----	----	**4.9**	**5.8**	**8.0**	----	**6.0**	**5.8**	**8.0**
Phosphoric acid found	14.25	11.55	12.82	14.01	13.88	12.26	9.51	12.56	16.25	12.29	9.15
" " guaranteed	----	**9.2**	----	----	**14.0**	**10.0**	**12.0**	----	**15.0**	----	**12.0**
Cost per ton	$25.00	27.80†	29.00	29.00	----	----	----	33.00	29.00	31.00	28.00
Valuation	$32.42	30.46	31.50	29.70	29.39	29.88	27.89	36.24	30.74	30.58	27.52
Percentage difference between cost and valuation	**22.9***	**8.7***	**7.9***	**2.3***	----	----	----	8.9*	5.6*	1.4	1.7

*Valuation exceeds cost. †Car lot.

tories, 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. Eleven samples have been examined, as follows:—

20346, 20838 and **20704** were sold by the National Fertilizer Co., Bridgeport. **20346** sampled and sent by Henry Davis, Thompsonville; **20838** from stock of J. M. Lasbury, Broad Brook and **20704** from stock of G. A. Williams, Silver Lane.

20840. Sold by Sanderson Fertilizer & Chemical Co., New Haven, and sampled from their stock and that of A. E. Phelps, Glastonbury.

20519. Sold by Wilcox Fertilizer Co., Mystic. Sampled by James Price, Warehouse Point, from stock of S. D. Veits Co., Springfield.

20364. Sold by Olds & Whipple, Hartford. Sampled from stock of F. S. Bidwell & Co., Windsor Locks.

20369. Sold by American Agricultural Chemical Co., New York. Sampled from stock of Spencer Bros. and E. Halladay, Suffield.

20841. Sold by Wilcox Fertilizer Co., Mystic. Sampled from their stock and that of A. S. Field, Brooklyn.

20835. Sold by Essex Fertilizer Co., Boston. Sampled from stock of John Parker, Poquonock, and J. & H. Woodford, Avon.

20653. Sold by American Agricultural Chemical Co., New York. Sampled from stock of Arthur Manning, Hillstown, by F. N. Buckland, Glastonbury.

20703. Sold by Bowker Fertilizer Co., New York. Sampled from stock of A. D. Bridges' Sons, Hazardville, and Bowker's Branch, Hartford.

Olds & Whipple's Fish, **20364,** contains much less nitrogen than the others and much more phosphoric acid even than the Essex Brand, which is made largely of fish bones and trimmings. The sample has every appearance of being a mixture of fish and steamed bone.

GUARANTIES.

All of the samples fairly meet their guaranties, Bowker's Fish, 20703, only being below in nitrogen, and 20369 ,sold by the Am. Agl. Chem. Co., being below guaranty in phosphoric acid.

PERCENTAGE COMPOSITION AND VALUATION OF DRY FISH.

	National Fertilizer Co.			Sanderson Fertz. and Chem. Co.	Wilcox Fertilizer Co.	Olds & Whipple.	Am. Ag. Chem. Co.	Wilcox Fertilizer Co.	Essex Fertilizer Co.	Am. Ag. Chem. Co.	Bowker Fertilizer Co.
Station No.	20346	20838	20704	20840	20519	20364	20369	20841	20835	20653	20703
Percentage amounts of											
Nitrogen, organic	9.50	8.68	9.08	8.3	8.89	6.58	8.52	8.69	7.77	8.34	8.02
Total nitrogen found	9.50	8.68	9.08	8.3	8.89	6.58	8.52	8.69	7.77	8.34	8.02
" " guaranteed	8.2	8.2	8.2	8.2	8.5	6.6	8.2	8.5	7.5	8.2	8.2
Phosphoric acid, water-sol.	0.50	0.56	0.55	0.88	0.32	0.58	0.74	0.77	0.59	0.69	0.88
" " citrate-sol.	4.62	5.36	5.53	6.65	4.66	11.56	3.82	5.25	9.86	4.69	3.68
" " citrate-insol.	2.28	1.88	2.01	1.27	2.00	5.91	1.87	0.96	3.24	1.45	1.82
Total phosphoric acid found	7.40	7.80	8.09	8.80	6.98	18.05	6.43	6.98	13.69	6.83	6.38
" " " guar.	6.0	6.0	6.0	6.0	6.0	12.0	7.0	6.0	11.0	7.0	6.0
Cost per ton	$39.00	38.00	40.00	39.00	40.00	39.00	40.00	42.00	43.50	42.50	41.00
Valuation per ton	$44.58	41.72	43.56	41.41	41.76	40.33	39.86	41.51	42.62	39.68	37.80
Percentage difference between cost and valuation	12.5*	8.9*	8.1*	5.8*	4.2*	3.3*	0.4	1.1	2.1	7.1	8.4

*Valuation exceeds cost.

VALUATIONS.

The valuations of six of these samples exceed the cost and those of the other five samples are not much below their cost. This means that the nitrogen and phosphoric acid of dry fish this year have been relatively cheap.

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, pages 510 to 529, are given analyses of one hundred and one samples belonging to this class, arranged according to the percentage difference between cost and valuation.

Analyses requiring Special Notice.

20588 and **20767**. The manufacturer of Manchester's formula requested that a second sample be examined as the first, **20588**, showed an unaccountable shortage of phosphoric acid. The second analysis showed the guaranteed amount. See pages 510 and 511.

20750 and **20351**. The manufacturers of Clark's Special Mixture for General Use stated that they believed analysis **20351** did not fairly represent the average quality of their goods, being somewhat lower in nitrogen and much lower in potash than was guaranteed. A second sample, **20750**, was therefore examined, which fully met the nitrogen guaranty. See pages 510 to 512.

20445. The manufacturers state that $50 to $52 is a fair cash retail price for their Coe's Peruvian Guano, Chincha grade. The latter figure has been used as a basis for comparing cost and valuation, instead of the average of the two widely different quotations. See pages 514 and 515.

20721. The manufacturers of Rogers Manufacturing Co.'s Fish and Potash stated that the potash found in this sample was far below what the brand should contain. It was not possible to get another sample for analysis. The two lots from which the sample was prepared contained 2.64 and 2.52 per cent. of potash respectively. See pages 518 and 519.

GUARANTIES.

Of the one hundred and one samples examined, thirty-three did not meet the maker's guaranty in every particular. Nine were below in nitrogen alone, eleven in total phosphoric acid and two in potash. Nine were below their guaranties in respect of two ingredients.

In most of these cases, however, a deficiency of one element of plant food was fully made up by excess of one or both of the others. There were only three brands which did not furnish, in the samples examined by us, an amount of plant food equivalent in money value to the amount guaranteed.

These are as follows:—

20820. Swift's Lowell Market Garden Manure. Nitrogen found, 3.67; guaranteed, 4.1. Phosphoric acid found, 8.78; guaranteed, 8.0. Potash found, 5.92; guaranteed, 6.0 per cent.

20351. Clark's Special Mixture for General Use. One sample was found quite below guaranty in nitrogen and phosphoric acid, but another fully met the guaranty. See note page 500.

20466. Buffalo High Grade Manure. Nitrogen found, 2.82; guaranteed, 3.3. Phosphoric acid found, 10.16; guaranteed, 8.0. Potash found, 8.57; guaranteed, 10.0 per cent.

COST AND VALUATION.

Cost.

The method used to ascertain the retail cash cost price of the superphosphates and of commercial fertilizers in general is as follows:

The sampling agent inquires and notes the price at the time each sample is drawn. The analysis is reported as soon as made 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. When the data thus gathered show a wide range of prices, further correspondence is required and the manufacturers are also consulted. In general an average or nearly average price forms the basis of comparison between cost and valuation. The price thus employed is printed in the following tables in full-face type.

Valuation.

The valuation of a mixed fertilizer, as practiced at this station, consists in calculating the retail trade-value or cash-cost at freight centers (in raw material of good quality) of an amount of nitrogen, phosphoric acid and potash equal to that contained in one ton of the fertilizer.

The schedule of trade-values is given on page 492. The organic nitrogen in mixed fertilizers is reckoned at the price of nitrogen in raw material of the best quality, 20½ cents per pound. Citrate-insoluble phosphoric acid is rated at 2 cents per pound. Potash is rated at 4¼ cents, if sufficient chlorine is present in the fertilizer to combine with it to make muriate. If there is more potash present than will combine with the chlorine, then this excess of potash is reckoned at 5 cents per pound, except in certain special cases, to be noted later, where carbonate of potash has been used in the mixture.

In most cases the valuation of the ingredients in superphosphates and specials falls considerably below the retail price of these goods. The difference between the two figures represents the manufacturers' necessary 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.

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

Percentage Difference given in the table shows the percentage excess of the cost price over the average retail cost, at freight centers, of the nitrogen, phosphoric acid and potash contained in the fertilizer and furnishes the best means we have for expressing the comparative commercial value of the different brands.

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

The average cost per ton of the one hundred and one nitrogenous superphosphates is $32.28, the average valuation $23.02, and the percentage difference 40.2.

The average composition and cost of nitrogenous superphosphates for the last five years have been as follows:

	Nitrogen.	Total Phosphoric Acid.	"Available" Phosphoric Acid.	Potash.	Cost per ton.	Percentage Difference.
1904	2.68	10.02	....	4.31	$31.01	50.1
1905	2.56	10.02	....	4.59	30.79	45.5
1906	2.50	9.99	....	4.66	31.00	47.6
1907	2.81	9.66	....	5.04	32.04	34.6
1908	2.67	9.63	8.22	4.68	32.28	40.2

The Selection and Purchase of Commercial Fertilizers.

Sometimes a fertilizer is reasonably used to supply in part a single thing, like available nitrogen, which experience suggests is especially lacking in the soil, or for which the crop to be grown makes special demands.

Again, some soils are known to have a supply of available potash, or of phosphoric acid, much greater than their supply of the other two elements. This may be because of the nature of the soil itself, or of the previous crop, or of the system of manuring. In either case the dressing of such a soil with this abundant element would give no larger crop and so would be a waste.

To supply these special needs of a soil, a fertilizer chemical, or a home mixture, is probably more convenient and economical than a commercial "complete" fertilizer.

More commonly, however, the use of a commercial fertilizer, as distinguished from green manures, crop residues or farm manures, is to give the crop an early start and a perfect stand; to support its first growth before the farm manures or crop residues which are plowed under have sufficiently decayed to make them available to the young crop.

It is the farmer's first business to consider for which of these objects he is to get his commercial fertilizer and then to decide *how much of the single elements of plant food* he wishes to put on per acre. The amount of mixed fertilizer he uses gives no idea of the amount of plant food unless its composition is known. "Half a ton of phosphate to the acre" is a common answer to the question, What fertilizer was used? "Phosphate" means in this connection any mixed fertilizer. This year it might mean, as reference to the tables shows, anywhere from 10 to 99 pounds of nitrogen, 75 to 97 pounds phosphoric acid and 12 to 44 pounds of potash.

For business farming the farmer must get into the habit of regarding the actual amounts of plant food which he applies in his fertilizer and its cost and get out of the habit of considering only the number of pounds of "phosphate" which he applies per acre and the cost per ton. The chief value of these tables of analyses is to put the farmer in position to compare fertilizers in two ways: first, by the amounts of nitrogen, phosphoric acid and potash in them, and second, by the cost of these things in the different brands.

The tables of analyses show what fertilizers contain the relative proportions of nitrogen, phosphoric acid and potash which he wants. Thus if he plans a dressing of 30 pounds of nitrogen, 20 of phosphoric acid and 45 of potash, he will look for goods which have 3.0, 2 and 4.5 per cent. of these ingredients respectively, or some multiple of these, or at least the proportion of one per cent. of nitrogen to six-tenths of one per cent. of phosphoric acid, to one and a half of potash. He will see at once that they are not there; that almost all goods contain a much larger amount of phosphoric acid than of either of the other ingredients. The reason for this we need not here discuss. He will have to accept an excess of phosphoric acid to get nitrogen and potash in the ratio he wants them, i.e., one of nitrogen to about one and one-half of potash.

Having found brands which meet his ideas as to composition or ratio of nitrogen to potash as nearly as may be, his next step is to determine which is the most economical to buy.

In the table he finds more than twenty of them, the percentage of nitrogen ranging from 5.4 to 1.0 and the cost from $39 to $26 per ton. A few of them are given here for illustration:

PERCENTAGE COMPOSITION.

	Ton Price.	Nitrogen.	Total Phos. Acid.	"Available" Phos. Acid.	Potash.	To supply 30 lbs. of potash are required of the fertilizer No. pounds	Costing.
1	$39.00	4.2	8.2	7.5	5.5	714	$13.92
2	36.00	4.0	8.9	8.1	7.0	750	13.50
3	33.00	2.7	9.6	8.5	4.0	1110	18.31
4	30.00	2.4	9.2	8.4	4.2	1250	18.75
5	30.00	1.6	11.6	10.1	2.3	1870	28.05
6	26.75	1.0	9.7	8.3	1.2	3000	45.00
7	26.00	2.6	7.1	6.2	3.5	1154	15.00

This shows that the farmer can get 30 pounds of nitrogen with the phosphoric acid and potash he wants for $13.50 in 750 pounds of "phosphate" from a commercial fertilizer sold in this state,

or he can pay $45.00 and haul and handle 3,000 pounds of "phosphate" to get the same amount of plant food.

The table shows at once that at least Nos. 4, 5 and 6 are to be let alone by the business farmer, and that No. 1, the highest priced in the lot, is more economical to buy than No. 6, which is near the lowest priced.

A closer comparison can be made by finding what amounts of nitrogen, phosphoric acid and potash can be bought for the same amount of money, $30.00 for instance. This is easily done by the "rule of three." For example: the cost of No. 1, $39.00, is to $30.00 as the quantity of nitrogen bought for $39.00 ($4.2 \times 20 =$ 84 pounds) is to the amount purchasable for $30.00, $\frac{84 \times 30}{39} = 64$. Sixty-four pounds of nitrogen, with a proportional amount of phosphoric acid and potash, can be bought for $30.00 in No. 1.

The whole statement, thus calculated, is as follows:

POUNDS OF NITROGEN, PHOSPHORIC ACID AND POTASH PURCHASABLE FOR THIRTY DOLLARS.

No.	Nitrogen.	Total Phosphoric Acid.	Available Phosphoric Acid.	Potash.	Weight of Fertilizer.
1	64	124	115	85	550
2	67	148	135	117	625
3	49	175	155	73	1010
4	48	184	168	84	1250
5	32	232	202	46	1870
6	23	218	186	27	3370
7	60	163	143	81	1331

This shows that Nos. 3, 4, 5 and 6 are out of the question, because much more nitrogen, which costs pound for pound five times as much as any other ingredient, can be got for the same money in Nos. 1, 2 and 7. Carting and handling No. 7, which is nearly equal to Nos. 1 and 2 in amount of plant food, costs twice as much. *The choice, as far as quantity of fertilizer elements and cost go, is between Nos. 1 and 2.*

The table also shows how price is no index of the farm value of these goods, how *in general* the higher-priced goods give better value for the same amount of money, but how, as in No. 7, the rule may not always hold.

The beginning of saving is to drop the idea of using so many "pounds of phosphate" and take up the idea of using so many pounds of nitrogen, phosphoric acid and potash in the cheapest and most concentrated form. Then the manufacturer will drop his practice of using swamp muck, phosphate dust and other fillers necessary to meet the call for "a $25.00 phosphate" and will search all the more diligently for high grade goods.

The above illustration is given at length to show in some detail the way in which the farmer may use the tables of analyses which are published every year and save waste in his fertilizer account.

The objection will be raised, Is it not possible that the makers of Nos. 1 and 2 in your table have used a cheap and insoluble form of nitrogen and "got a good analysis" and that after all Nos. 3, 4 and 5 have more quickly available nitrogen and will give better crops than Nos. 1 and 2? If so, of what use are the analyses to the farmer?

Regarding the first question, it is certainly possible that the nitrogen in these higher goods is inferior, and on the other hand, that the nitrogen of the lower-priced goods is in good forms. Certainly this is not usual. It is in low-priced goods, if anywhere, that we look for adulteration or inferior quality. While the station is working on the problem, it has not been able thus far to certainly detect all inert forms of nitrogen in mixed fertilizers. Their detection in unmixed chemicals is far easier and that is one argument for home-mixing. The purchaser takes the same risk in buying fertilizers as in buying coffee, grass seed, or woolen cloth. His first means of protection is in dealing with reputable firms, whose reputation for honesty is one of their best assets.

Regarding the second question, the usefulness of these tables has been explained in preceding paragraphs and rests on the assumption that the manufacturing firms doing business year after year in this state are not using inferior forms of nitrogen. If a farmer knows of dishonest practices, or failures to meet their promises, on the part of any firm, he will, of course, exclude their goods from consideration.

Such a study and comparison as we have outlined above will not in all cases insure the choice of the very best fertilizer in the Connecticut market, but it will go very far towards eliminating from his choice brands which the farmer cannot possibly use to advantage.

The above table has been made from selected analyses of samples having a certain proportion of nitrogen to potash. A similar statement follows in which all the samples on each manuscript page of the tables given on pages 510 to 529 have been averaged and the amounts of plant food purchasable for $30.00 in these averages have been calculated.

PURCHASABLE FOR THIRTY DOLLARS.

Analyses.	Nitrogen, pounds.	Total Phosphoric Acid, pounds.	Available Phosphoric Acid, pounds.	Potash, pounds.
In the first 14 analyses in the table	74	161	135	125
" next 16 " " "	55	179	153	115
" " 12 " " "	59	163	144	77
" " 12 " " "	49	179	146	91
" " 12 " " "	48	162	141	80
" " 8 " " "	36	202	174	77
" " 9 " " "	42	185	155	58
" " 12 " " "	31	223	167	55
" " 5 " " "	16	243	210	42

The great differences in the price paid for plant food in the various brands now in market are clearly shown in this table.

Thus the farmer can select factory-mixed fertilizers which for $30.00 will give him 74 pounds of nitrogen, 161 of phosphoric acid and 125 of potash. With less care in selection he is likely to get 45 to 50 pounds of nitrogen, 180 to 200 pounds of phosphoric acid and 80 to 100 pounds of potash for the same money.

He may also get, and particularly if he is looking for "cheap" fertilizers, only 16 pounds of nitrogen, 243 of phosphoric acid and 42 of potash for his outlay of $30.00.

In the last case he pays fully three times as much for his plant food as in the first case. Yet in no case is he defrauded by the manufacturer, if the goods are as guaranteed. He simply pays for his carelessness or lack of sense in doing business.

The seller is not to be blamed for charging a very high price for his goods if, without fraud, he can find people simple enough to pay it.

Low-priced fertilizers are not by any means uneconomical to buy *in all cases*. In the table there are certain brands which are sold quite below the average price of $32.00 and yet supply plant food at relatively low rates. On the other hand, the fertilizers which furnish the smallest quantities of plant food for the money all sell at low prices, from four to six dollars at least under the average price of superphosphates.

As the groups of fertilizers are arranged in the table above, each supplies less value in plant food for a given outlay than any group preceding it, and supplies more value in plant food than any which follows it. That is, they are arranged in the strict order of the economy of this purchase.

But this order of arrangement is the same as in the tables of analyses on pages 510 to 529, where the order is that of the "percentage difference," based on the station's system of valuation. The station valuations, when compared with the selling prices, as is done by the statements of percentage difference, do, therefore, in a fairly accurate manner, show the probable relative value of the fertilizers.

2. *Sampled by Purchasers and Others.*

On pages 526 to 529 are tabulated twenty-one analyses of samples of nitrogenous superphosphates which were sent to the station for analysis by interested persons. The station is not responsible for the sampling of these articles.

No. **20829** was sampled by W. E. Russell, Suffield, and described on the station form as Peruvian Guano. Judging from the guaranty this is the "Genuine Peruvian Guano, Chincha Grade." The analysis is quite different from No. **20445**, given on pages 514 and 515, made on a sample taken by the station agent. The discrepancy between the two analyses is apparently due to moisture in No. **20829** and a loss of nitrogen.

According to a letter from the dealer, O. E. Pitcher, "the guano when received was quite moist and seemed to gather moisture as it lay stored in a tobacco shed, on a tight board floor 1½ to 2½ feet above the ground and a tight roof over it."

Guano is particularly apt to lose ammonia—as carbonate—if exposed to a moist atmosphere.

The following partial analyses were made to determine whether certain lots of fertilizer agreed in composition with the general composition of the brands they represented.

20648. Connecticut Valley Orchard Co.'s Fertilizer Car 2; **20649,** same brand, from Car 3, sent by J. L. Watrous, Meriden.

21202. Shay's Potato Manure, sampled and sent by J. O. Spicer, Groton; **21711,** same brand, sampled and sent by the C. M. Shay Fertilizer Co.

20283. E. R. Kelsey's Bone, Fish and Potash, sampled and sent by the manufacturer.

19990. Special Mixture, made by Sanderson Fertilizer & Chemical Co., New Haven, sampled from stock of S. A. Flight, Highwood.

20611. Animal Brand Fertilizer, made by Swift's Lowell Fertilizer Co., Boston, sampled and sent by M. E. Cooke, Wallingford.

	20648	20649	21202	21711	20283	19990	20611
Nitrogen	2.68	2.35	3.93	4.06	2.20	3.41	2.43
Water-soluble phosphoric acid	....	....	....	....	....	....	6.82
Citrate-soluble " "	....	....	....	....	....	....	1.84
Citrate-insoluble " "	....	....	....	....	....	....	0.51
Total phosphoric acid	9.37	10.43	8.53	8.41	8.12	8.21	9.17
Potash	5.21	3.65	8.26	8.12	5.55	6.16	3.92

Nitrogenous Superphosphates.

Station No.	Name or Brand.	Manufacturer.	Dealer.	Dealer's cash price per ton.	Valuation per ton.
	Sampled by Station Agent:				
20588*	Manchester's Formula	E. Manchester & Sons, Winsted	Manufacturer	$30.00	$29.95
20507	Woodruff's Home Mixture	S. D. Woodruff & Sons, Orange	Manufacturer	30.00	29.24
20498	Boardman's Complete Fertilizer for Potatoes & General Crops	F. E. Boardman, R.D., Middletown	Manufacturer	33.00	31.18
20750*	Clark's Special Mixture for General Use	E. B. Clark Seed Co., Milford	Manufacturer	31.00	28.53
20350	Special 10% Brand	E. B. Clark Seed Co., Milford	Manufacturer	34.00	31.18
20627	Bone, Fish and Potash	E. R. Kelsey, Branford	S. G. Cook,† Branford	26.00	23.46
20767*	Manchester's Formula	E. Manchester & Sons, Winsted	J. B. McLean,† Simsbury	32.00	28.74
20756	Mapes' Top Dresser, Improved, full strength	Mapes F. & P. G. Co., N. Y.	Mapes' Branch, Hartford	53.00	47.35
			Thompson Bros., East Haddam	53.00	
20500	C. V. O. Co.'s Complete H. G. Fertilizer	(Made for) Conn. Valley Orchard Co., Berlin	C. V. O. Co., Berlin	27.00	23.06
20505	Swift-Sure Superphosphate for General Use	M. L. Shoemaker & Co., Phila., Pa.	Spencer Bros., Suffield	36.00	29.99
			F. H. Rolf, Guilford	35.00	
			Olds & Whipple, Hartford	35.00	
				35.25	
20730	Wilcox's H. G. Fish and Potash	Wilcox Fertilizer Co., Mystic	I. W. Dennison, Mystic	27.00	24.26
			W. A. Howard, Woodstock	30.00	
				28.50	
20628	North Western 10% Manure	North Western Fertilizing Co., Detroit, Mich.	R. H. Nesbit, Highwood	33.50	28.45
20411	Buffalo Top Dresser	Buffalo Fertilizer Co., Buffalo, N. Y.	J. P. Barstow, Norwich	41.00	32.80
			J. R. Reinhard & Sons, West Cheshire	38.00	
				39.50	
20356	O. & W.'s Special Phosphate	Olds & Whipple, Hartford	Manufacturer	35.00	28.78
20780	Quinnipiac Market Garden Manure	Am'n Agric'l Chem. Co., N. Y. City	C. Buckingham, Southport	35.50	29.09
20812	North Western Empire Special	North Western Fertilizing Co., Detroit, Mich.	C. Buckingham, Southport	35.00	28.61

* See note page 500. † Purchaser.

Analyses and Valuations.

Station No.	Percentage difference between cost and valuation.	Nitrogen.					Phosphoric Acid.							Potash.		
					Total Nitrogen.					Total.		So-called "Available."		Found.		
		As Nitrates.	As Ammonia.	Organic.	Found.	Guaranteed.	Water-soluble.	Citrate-soluble.	Citrate-insoluble.	Found.	Guaranteed.	Found.	Guaranteed.	As Muriate.	Total.	Guaranteed.
20588	0.2	0.50	0.18	3.60	4.28	3.6	1.73	3.68	2.38	7.79	9.0	5.41	----	7.91	7.91	7.5
20507	2.6	1.25	0.16	2.29	3.70	3.3	4.16	4.12	2.57	10.85	8.0	8.28	----	6.77	6.77	8.0
20498	5.8	0.30	0.58	2.32	3.20	2.9	6.72	2.19	0.51	9.42	----	8.91	6.0	11.34	11.34	10.0
20750	8.7	1.50	0.08	2.06	3.64	3.3	3.94	3.38	1.29	8.61	----	7.32	8.0	7.94	7.94	7.0
20350	9.0	1.30	0.10	2.44	3.84	3.3	3.52	3.52	1.47	8.51	----	7.04	6.0	10.28	10.28	10.0
20627	10.8	----	0.68	1.95	2.63	2.5	2.74	4.89	0.47	8.10	5.0	7.63	4.0	0.80	5.87	4.0
20767	11.3	0.38	0.17	3.01	3.56	3.6	2.44	4.25	2.67	9.36	9.0	6.69	----	8.30	8.30	7.5
20756	14.0	6.35	3.37	0.35	10.07	9.9	0.46	6.15	0.93	7.54	8.0	6.61	----	0.90	4.37	4.0
20500	17.1	0.13	0.95	1.47	2.55	2.5	7.09	1.77	0.35	9.21	11.0	8.86	9.0	5.18	5.18	4.0
20505	17.5	1.00	0.04	2.14	3.18	2.9	8.64	3.56	0.96	13.16	14.0	12.20	9.0	0.17	5.19	4.5
20730	17.5	----	0.24	3.09	3.33	3.3	3.43	2.82	1.29	7.54	6.0	6.25	5.0	5.01	5.01	4.0
20628	17.8	----	1.94	1.36	3.30	3.3	5.96	1.32	0.45	7.73	7.0	7.28	6.0	9.71	10.21	10.0
20411	20.4	3.30	0.95	1.23	5.48	5.7	4.93	2.59	1.27	8.79	7.0	7.52	6.0	4.27	5.09	5.0
20356	21.6	----	0.16	4.52	4.68	4.1	0.11	5.38	3.71	9.20	----	5.49	4.0	3.83	3.83	3.0
20780	22.0	0.28	1.92	1.47	3.67	3.3	6.14	2.57	0.77	9.48	9.0	8.71	8.0	7.69	7.69	7.0
20812	22.3	----	1.19	2.33	3.52	3.3	5.63	3.06	1.15	9.84	8.0	8.69	7.0	7.12	7.12	7.0

NITROGENOUS SUPERPHOSPHATES.

Station No.	Name or Brand.	Manufacturer.	Dealer.	Dealer's cash price per ton.	Valuation per ton.
	Sampled by Station Agent:				
20775	Darling's Blood, Bone and Potash	Am'n Agric'l Chem. Co., N. Y. City	E. H. Austin, Gaylordsville	$36.00	$29.34
20820	Swift's Lowell Market Garden Manure	Swift's Lowell Fertilizer Co., Boston	W. H. Burr, Westport	34.00	27.64
20597	Germofert Patent General Fertilizer	Germofert Mfg. Co., Charleston, S. C.	F. F. Meeker, Westport	31.00	25.13
20351*	Spl. Mixture for General Use	E. B. Clark Seed Co., Milford	Manufacturer	31.00	24.85
20442	Sanderson's Formula A	Sanderson Fertilizer & Chem. Co., New Haven	A. I. Martin, Wallingford Morse & Landon, Guilford	34.00 35.00 34.50	27.42
20796	E. F. Coe's Red Brand Excelsior Guano	Coe-Mortimer Co., N. Y. City	L. A. Gowdy, Somersville	37.00	29.15
20837	Mapes' Dissolved Bone	Mapes F. & P. G. Co., N. Y. City	Mapes' Branch, Hartford	35.00	27.36
20669	Armour's Blood, Bone and Potash	Armour Fertilizer Works, Baltimore, Md.	Farmers' Supply Co., Bridgeport W. O. Goodsell, Bristol	40.00 39.00 39.50	30.86
20587	Buffalo Fish Guano	Buffalo Fertilizer Co., Buffalo, N. Y.	Ansonia Flour and Grain Co., Ansonia R. B. Witter, Brooklyn Gault Bros., Westport	23.00 23.00 25.00 23.75	18.38
20713	Mapes' Vegetable Manure, or Complete for Light Soils	Mapes F. & P. G. Co., N. Y. City	Mapes' Branch, Hartford J. P. Barstow, Norwich	45.00 43.00 44.00	34.01
20714	Chittenden's Formula A	National Fertilizer Co., N. Y. City	H. A. Bugbee, Willimantic G. D. Mosher, Milford	34.00 35.00 34.50	26.59
20728	Wilcox's Fish and Potash	Wilcox Fertilizer Co., Mystic	Manufacturer E. Tillinghast, Danielson	26.00 ----	19.91
20466	Buffalo High Grade Manure	Buffalo Fertilizer Co., Buffalo, N. Y.	J. R. Reinhard & Sons, West Cheshire F. B. Newton, Plainville	34.50 36.00 35.25	26.82
20724	Sanderson's Special with 10% Potash	Sanderson Fertilizer & Chemical Co., New Haven	The G. W. Eaton Estate, Plainville Loomis Bros. Co., Granby	36.00 37.00 36.50	27.67

* See note page 500.

ANALYSES AND VALUATIONS—*Continued.*

Station No.	Percentage difference between cost and valuation.	Nitrogen.					Phosphoric Acid.							Potash.		
		As Nitrates.	As Ammonia.	Organic.	Total Nitrogen. Found.	Total Nitrogen. Guaranteed.	Water-soluble.	Citrate-soluble.	Citrate-insoluble.	Total. Found.	Total. Guaranteed.	So-called "Available." Found.	So-called "Available." Guaranteed.	Found. As Muriate.	Found. Total.	Guaranteed.
20775	22.7	0.06	1.96	1.96	3.98	**4.1**	6.72	1.36	0.84	8.92	**8.0**	8.08	**7.0**	6.99	6.99	**7.0**
20820	23.0	----	0.74	2.93	3.67	**4.1**	5.16	2.81	0.81	8.78	**8.0**	7.97	**7.0**	5.92	5.92	**6.0**
20597	23.4	0.42	0.60	1.36	2.38	**2.5**	----	8.22	5.80	14.02	**10.0**	8.22	**4.3**	0.52	6.26	**8.0**
20351	24.8	0.82	0.12	1.99	2.93	**3.3**	4.80	3.57	1.52	9.89	----	8.37	**8.0**	5.44	5.44	**7.0**
20442	25.8	0.51	0.09	2.75	3.35	**3.0**	3.57	4.47	2.16	10.20	**9.0**	8.04	**6.0**	6.45	6.45	**6.0**
20796	26.9	----	1.27	2.07	3.34	**3.2**	8.17	3.10	0.45	11.72	**11.0**	11.27	**9.0**	5.96	5.96	**6.0**
20837	27.9	----	0.57	2.55	3.12	**2.1**	3.30	12.45	0.97	16.72	----	15.75	**12.0**	----	----	----
20669	28.0	2.21	0.20	1.81	4.22	**4.1**	6.87	0.95	0.88	8.70	**10.0**	7.82	**8.0**	7.63	7.63	**7.0**
20587	29.2	----	0.12	1.20	1.32	**0.8**	5.31	3.76	2.26	11.33	**10.0**	9.07	**9.0**	4.06	4.06	**2.0**
20713	29.4	2.95	1.42	0.99	5.36	**4.9**	0.95	6.41	1.28	8.64	**8.0**	7.36	**6.0**	0.94	6.97	**6.0**
20714	29.7	----	1.27	2.09	3.36	**3.3**	5.81	1.27	0.65	7.73	**7.0**	7.08	**6.0**	1.29	6.55	**6.0**
20728	30.6	----	0.30	2.40	2.70	**2.5**	1.60	3.75	3.29	8.64	**6.0**	5.35	**5.0**	3.21	3.21	**3.0**
20466	31.4	1.19	0.68	0.95	2.82	**3.3**	4.99	3.58	1.59	10.16	**8.0**	8.57	**7.0**	8.57	8.57	**10.0**
20724	31.9	0.55	0.05	2.18	2.78	**2.5**	3.94	3.02	0.91	7.87	**8.0**	6.96	**5.0**	9.95	10.98	**10.0**

NITROGENOUS SUPERPHOSPHATES.

Station No.	Name or Brand.	Manufacturer	Dealer.	Dealer's cash price per ton.	Valuation per ton.
	Sampled by Station Agent:				
20548	Chittenden's XXX Fish and Potash	National Fertilizer Co., N. Y. City	F. H. Rolf, Guilford	$25.00	$19.65
			J. & H. Woodford, Avon	28.00	
			H. A. Bugbee, Willimantic	25.00	
				26.00	
20777	Packers' Union Gardeners' Complete Manure	Am'n Agric'l Chem. Co., N. Y. City	F. M. Loomis, North Granby	37.50	28.39
20784	Market Garden Special	Armour Fertilizer Works, Baltimore, Md.	S. V. Osborn, Branford	36.00	27.17
20813	North Western Superphosphate	North Western Fertilizing Co., Detroit, Mich.	The G. W. Eaton Estate, Bristol	30.00	22.57
20798	Ammoniated Dissolved Bone Phosphate	Lister's Agricultural Chemical Works, Newark, N. J.	J. A. Foster, R. D., Stafford Springs	29.00	21.26
20445*	E. F. Coe's Peruvian Guano, Chincha Grade	Coe–Mortimer Co., N. Y. City	Lightbourn & Pond Co., New Haven	50.00	38.03
			Farmers' Supply Co., Bridgeport	56.00	
				52.00	
20501	Mapes' Average Soil Complete Manure	Mapes F. & P. G. Co., N. Y. City	Mapes' Branch, Hartford	37.00	28.12
			Southington Lumber Co., Southington	38.00	
				38.50	
20276	Swift's Animal Brand for All Crops	Swift's Lowell Fertilizer Co., Boston	Andrew Ure, Highwood	30.00	21.70
20691	Berkshire Long Island Special	Berkshire Fertilizer Co., Bridgeport	Manufacturer	37.00	26.76
			C. B. Meeker, Westport	37.00	
20412	Buffalo Farmers' Choice	Buffalo Fertilizer Co., Buffalo, N. Y.	Ansonia Flour and Grain Co., Ansonia	26.00	18.02
			J. P. Barstow, Norwich	26.50	
			J. R. Reinhard & Sons, West Cheshire	22.50	
				25.00	
20542	Bone, Fish and Potash	Niantic Menhaden Oil & Guano Co., South Lyme	G. W. Dennison, Saybrook	30.00	19.79
			S. A. Billings, Stonington	25.00	
				27.50	
20446	Berkshire Complete Fertilizer	Berkshire Fertilizer Co., Bridgeport	Avery Bros., Norwich Town	34.00	24.43
			J. A. Glasnapp, Cheshire	34.00	

* See note page 500.

ANALYSES AND VALUATIONS—*Continued.*

Station No.	Percentage difference between cost and valuation.	Nitrogen. As Nitrates.	Nitrogen. As Ammonia.	Nitrogen. Organic.	Total Nitrogen. Found.	Total Nitrogen. Guaranteed.	Phosphoric Acid. Water-soluble.	Phosphoric Acid. Citrate-soluble.	Phosphoric Acid. Citrate-insoluble.	Phosphoric Acid. Total. Found.	Phosphoric Acid. Total. Guaranteed.	So-called "Available." Found.	So-called "Available." Guaranteed.	Potash. Found. As Muriate.	Potash. Found. Total.	Potash. Guaranteed.
20548	32.3	----	0.58	2.00	2.58	**2.5**	4.61	1.62	0.92	7.15	**6.0**	6.23	**5.0**	3.50	3.50	**3.0**
20777	32.4	----	0.74	1.72	2.46	**2.5**	6.86	1.01	0.46	8.33	**7.0**	7.87	**6.0**	0.61	10.89	**10.0**
20784	32.5	----	1.48	1.62	3.10	**3.3**	7.14	1.66	0.32	9.12	**10.0**	8.80	**8.0**	7.75	7.75	**7.0**
20813	32.9	----	0.18	2.35	2.53	**2.5**	7.66	2.47	1.15	11.28	**11.0**	10.13	**9.0**	2.30	2.30	**2.0**
20798	36.4	----	0.16	2.22	2.38	**2.1**	5.99	4.02	1.30	11.31	**9.0**	10.01	**8.0**	1.73	1.73	**1.0**
20445	36.7	2.36	1.94	2.97	7.27	**7.0**	2.94	4.91	1.69	9.54	**8.5**	7.85	**6.5**	1.06	2.51	**2.0**
20501	36.8	2.44	0.90	0.82	4.16	**4.1**	1.98	5.52	0.65	8.15	**8.0**	7.50	**7.0**	0.68	5.47	**5.0**
20276	38.2	----	0.08	2.28	2.36	**2.5**	6.34	2.03	0.82	9.19	**10.0**	8.37	**8.0**	4.20	4.20	**4.0**
20691	38.3	0.15	0.40	2.63	3.18	**3.3**	4.55	2.37	0.67	7.59	**8.0**	6.92	**6.0**	8.32	8.32	**7.0**
20412	38.7	----	---	0.97	0.97	**0.8**	5.60	3.65	1.91	11.16	**9.0**	9.25	**8.0**	5.18	5.18	**5.0**
20542	39.0	0.38	0.76	1.70	2.84	**2.5**	1.60	3.68	1.45	6.73	**6.0**	5.28	**5.0**	3.84	3.84	**3.0**
20446	39.2	----	0.40	2.29	2.69	**2.5**	6.46	2.35	0.52	9.33	**10.0**	8.81	**8.0**	5.72	5.72	**6.0**

Nitrogenous Superphosphates.

Station No.	Name or Brand.	Manufacturer.	Dealer.	Dealer's cash price per ton.	Valuation per ton.
	Sampled by Station Agent:				
20553	Wheeler's Ammoniated Bone & Potash	(Made for) Wheeler Bros., Stonington	Wheeler Bros., Stonington	$30.00	$21.48
20720	Hubbard's Soluble Corn and General Crops Manure	The Rogers & Hubbard Co., Middletown	H. W. Andrews, Wallingford	37.00	25.35
			John Hofman, Cromwell	34.00	
				35.50	
20783	Williams & Clark's H. G. Special Fertilizer	Am'n Agric'l Chem. Co., N. Y. City	W. H. H. Chappell, R. D., Oakdale	38.00	27.07
20776	Great Eastern General Fertilizer	Am'n Agric'l Chem. Co., N. Y. City	T. E. Greene, Plainfield	----	19.22
				27.00	
20589	Plymouth Rock Brand	Parmenter & Polsey Fertilizer Co., Boston	T. J. Pring & Bro., Wallingford	32.00	22.71
			Arthur Williams, So. Woodstock	----	
20461	Darling's Dissolved Bone and Potash	Am'n Agric'l Chem. Co., N. Y. City	C. E. Evarts & Son, Wallingford	37.50	26.00
			I. J. Scoville, Plainville	36.50	
			C. B. Wier, Southington	36.00	
				36.75	
20792	Berkshire Complete Fertilizer	Berkshire Fertilizer Co., Bridgeport	Hotchkiss & Templeton, Waterbury	36.00	24.75
			Loomis Bros. Co., Granby	34.00	
				35.00	
20727	Wilcox's Complete Bone Superphosphate	Wilcox Fertilizer Co., Mystic	Manufacturer	29.00	21.70
			C. S. Fields, Brooklyn, Conn.	33.00	
				31.00	
20357	O. & W.'s Fish and Potash	Olds & Whipple, Hartford	Manufacturer	30.00	20.97
20800	Standard Bone Superphosphate of Lime	Lister's Agri'l Chem. Wks., Newark, N. J.	A. I. Martin, Wallingford	32.00	22.27
20440	Mapes' Top Dresser Improved, Half Strength	Mapes F. & P. G. Co., N. Y. City	Mapes' Branch, Hartford	34.00	23.97
			F. S. Bidwell & Co., Windsor Locks	35.00	
				34.50	
20441	Swift's Lowell Animal Brand	Swift's Lowell Fertilizer Co., Boston	Standard Feed Co., Bridgeport	31.00	22.49
			Spencer Bros., Suffield	34.00	
				32.50	
20540	E. F. Coe's H. G. Ammoniated Bone Superphosphate	Coe-Mortimer Co., N. Y. City	A. L. Burdick, Westbrook	30.00	22.83
			J. P. Barstow & Co., Norwich	32.00	
			W. A. Burr, West Hartford	37.00	
				33.00	

Analyses and Valuations—*Continued.*

Station No.	Percentage difference between cost and valuation.	Nitrogen.					Phosphoric Acid.							Potash.		
		As Nitrates.	As Ammonia.	Organic.	Total Nitrogen. Found.	Total Nitrogen. Guaranteed.	Water-soluble.	Citrate-soluble.	Citrate-insoluble.	Total. Found.	Total. Guaranteed.	So-called "Available." Found.	So-called "Available." Guaranteed.	Found. As Muriate.	Found. Total.	Guaranteed.
20553	39.7	1.35	0.03	1.78	3.16	2.5	5.31	1.59	1.11	8.01	8.0	6.90	6.0	2.22	2.22	2.0
20720	40.0	1.12	0.16	1.26	2.54	2.5	2.97	5.19	1.18	9.34	8.0	8.16	6.0	8.67	8.67	8.0
20783	40.3	1.62	0.21	1.45	3.28	3.3	6.01	2.36	1.39	9.76	9.0	8.37	8.0	6.70	6.70	7.0
20776	40.5	----	0.11	1.49	1.60	0.8	5.64	2.48	2.17	10.29	10.0	8.12	8.0	4.68	4.68	4.0
20589	40.9	----	0.06	2.38	2.44	2.5	6.26	3.16	0.78	10.20	9.0	9.42	8.0	3.92	3.92	4.0
20461	41.3	0.16	0.36	1.95	2.47	2.5	5.25	1.86	0.91	8.02	7.0	7.11	6.0	10.43	10.43	10.0
20792	41.4	----	0.34	2.07	2.41	2.5	6.82	2.28	0.49	9.59	10.0	9.10	8.0	4.45	6.67	6.0
20727	42.9	----	0.62	1.60	2.22	2.1	1.79	6.44	5.50	13.73	9.0	8.23	8.0	3.74	3.74	3.0
20357	43.1	----	---	2.96	2.96	2.5	trace	5.33	1.50	6.83	----	5.33	5.0	4.04	4.04	3.0
20800	43.7	----	0.93	1.75	2.68	2.5	6.12	3.64	1.06	10.82	11.0	9.76	9.0	2.36	2.36	2.0
20440	43.9	2.90	1.69	0.35	4.94	4.9	0.32	3.07	0.93	4.32	4.0	3.39	----	0.44	2.50	2.0
20441	44.5	----	0.10	2.30	2.40	2.4	5.05	3.98	1.50	10.53	10.0	9.03	8.0	4.09	4.09	4.0
20540	44.5	0.12	0.38	1.78	2.28	1.9	4.36	6.20	4.18	14.74	11.0	10.56	9.0	2.53	2.53	2.3

NITROGENOUS SUPERPHOSPHATES.

Station No.	Name or Brand.	Manufacturer.	Dealer.	Dealer's cash price per ton.	Valuation per ton.
	Sampled by Station Agent:				
20757	New England Superphosphate	New England Fertilizer Co., Boston	B. F. Eddy, East Woodstock	**$33.00**	$22.84
			A. T. Camp, Hawleyville	33.00	
20795	E. F. Coe's Gold Brand Excelsior Guano	Coe-Mortimer Co., N. Y. City	Farmers' Supply Co., Bridgeport	**40.00**	27.69
20547	Quinnipiac Phosphate	Am'n Agric'l Chem. Co., N. Y. City	G. M. Williams Co., New London	32.00	22.11
			Young Bros. Co., Danielson	33.00	
			C.C. Pierce, Thompson	32.00	
				32.25	
20802	Chittenden's Complete Fertilizer	National Fertilizer Co., N. Y. City	G. A. Williams, Silver Lane	**40.00**	27.38
20670	Armour's All Soluble	Armour Fertilizer Works, Baltimore, Md.	Lightbourn & Pond Co., New Haven	33.00	23.13
			Farmers' Supply Co., Bridgeport	35.00	
				34.00	
20814	North Western Universal Fertilizer	No. Western Fertiliz'g Co., Detroit, Mich.	Edmund Halladay, Suffield	----	22.31
				33.00	
20621	Darling's Farm Favorite	Am'n Agric'l Chem. Co., N. Y. City	C. E. Evarts & Son, Wallingford	31.00	20.25
			B. F. Eddy, East Woodstock	29.00	
				30.00	
20808	Chittenden's Market Garden Fertilizer	National Fertilizer Co., N. Y. City	J. B. Fuller, West Hartford	**36.00**	24.22
20716	North Western Mkt. Garden Phosphate	North Western Fertilizing Co., Detroit, Mich.	C. Buckingham, Southport	32.50	24.38
			C. M. Beach, New Milford	40.00	
				36.25	
20715	Chittenden's Fish and Potash	National Fertilizer Co., N. Y. City	J. A. Glasnapp, Cheshire	31.00	22.87
			G. A. Williams, Silver Lane	38.00	
				34.50	
20721*	Fish and Potash	Rogers Mfg. Co., Rockfall	Meeker Coal Co., Norwalk	32.00	20.80
			F. U. Wadhams, Torrington	31.00	
				31.50	
20469	North Western Bone, Fish and Potash	North Western Fertilizing Co., Detroit, Mich	The F. S. Platt Co., New Haven	33.00	19.12
			C. Buckingham, Southport	26.00	
			I. J. Scoville, Plainville	28.00	
				29.00	

* See note page 500.

ANALYSES AND VALUATIONS—*Continued.*

Station No.	Percentage difference between cost and valuation.	Nitrogen. As Nitrates.	Nitrogen. As Ammonia.	Nitrogen. Organic.	Total Nitrogen. Found.	Total Nitrogen. Guaranteed.	Phosphoric Acid. Water-soluble.	Phosphoric Acid. Citrate-soluble.	Phosphoric Acid. Citrate-insoluble.	Phosphoric Acid. Total. Found.	Phosphoric Acid. Total. Guaranteed.	So-called "Available." Found.	So-called "Available." Guaranteed.	Potash. Found. As Muriate.	Potash. Found. Total.	Potash. Guaranteed.
20757	44.5	0.25	0.10	2.34	2.69	**2.5**	5.25	3.26	1.05	9.56	**10.0**	8.51	**8.0**	3.96	3.96	**4.0**
20795	44.5	----	0.68	2.62	3.30	**2.4**	4.58	3.78	0.63	8.99	**10.0**	8.36	**8.0**	0.31	6.39	**6.0**
20547	45.9	0.76	0.10	1.63	2.49	**2.5**	7.68	2.17	1.75	11.60	**10.0**	9.85	**9.0**	2.28	2.28	**2.0**
20802	46.1	----	0.67	2.51	3.18	**3.3**	7.01	2.20	0.99	10.20	**9.0**	9.21	**8.0**	6.29	6.29	**6.0**
20670	47.0	0.91	0.18	1.61	2.70	**2.9**	7.25	1.26	0.61	9.12	**10.0**	8.51	**8.0**	4.60	4.60	**4.0**
20814	47.9	0.59	0.10	1.69	2.38	**2.5**	6.96	2.19	1.02	10.17	**9.0**	9.15	**8.0**	4.13	4.13	**4.0**
20621	48.1	0.53	0.08	1.54	2.15	**2.1**	5.22	3.32	1.81	10.35	**9.0**	8.54	**8.0**	3.26	3.26	**3.0**
20808	48.6	----	0.65	1.95	2.60	**2.5**	5.36	2.93	1.60	9.89	**9.0**	8.29	**8.0**	6.23	6.23	**6.0**
20716	48.7	----	1.00	1.62	2.62	**2.5**	6.56	2.09	1.10	9.75	**9.0**	8.65	**8.0**	6.30	6.30	**6.0**
20715	50.9	----	0.64	2.37	3.01	**3.0**	5.49	1.52	0.86	7.87	**7.0**	7.01	**6.0**	4.37	4.37	**4.0**
20721	51.4	0.49	0.96	1.77	3.22	**3.3**	3.15	2.40	2.06	7.61	**6.0**	5.55	**4.0**	2.63	2.63	**3.8**
20469	51.7	----	0.62	2.00	2.62	**2.5**	3.26	1.90	0.72	5.88	**5.0**	5.16	**4.0**	4.10	4.10	**4.0**

NITROGENOUS SUPERPHOSPHATES.

Station No.	Name or Brand.	Manufacturer.	Dealer.	Dealer's cash price per ton.	Valuation per ton.
	Sampled by Station Agent:				
20536	Bowker's Market Garden Fertilizer	Bowker Fertilizer Co., N. Y. City	Bowker's Branch, Hartford	$37.00	$24.83
			Wm. Ewald, Cromwell	37.00	
			W. T. McKenzie, Yalesville	39.00	
				37.75	
20617	Bradley's Farmers' New Method Fertilizer	Am'n Agric'l Chem. Co., N. Y. City	Avery Bros., Norwich Town	31.00	20.04
			Wilson & Burr, Middletown	30.00	
				30.50	
20592	Wilcox's Special Superphosphate	Wilcox Fertilizer Co., Mystic	Manufacturer	25.00	15.51
			Fernando Wheeler, Stonington	22.00	
			W. A. Howard, Woodstock	24.00	
				23.75	
20726	Swift's Lowell Dissolved Bone and Potash	Swift's Lowell Fertilizer Co., Boston	A. S. Bennett, Cheshire	27.50	19.07
			J. D. Beasley, Ellington	31.00	
				29.25	
20601	Hubbard's Complete Phosphate	The Rogers & Hubbard Co., Middletown	H. W. Andrews, Wallingford	27.00	18.53
			Edgar T. Clark, Milford	28.00	
			F. U. Wadhams, Torrington	31.00	
				28.75	
20406	Essex XXX Fish and Potash	Essex Fertilizer Co., Boston	John Parker, Poquonock	31.00	20.46
			Spencer Bros., Suffield	32.00	
			A. R. Manning, Yantic	32.00	
				31.75	
20399	Bradley's Superphosphate	Am'n Agric'l Chem. Co., N. Y. City	Spencer Bros., Suffield	34.00	21.22
			H. K. Brainard, Thompsonville	32.00	
			Avery Bros., Norwich Town	33.00	
20624	Packers' Union Universal Fertilizer	Am'n Agric'l Chem. Co., N. Y. City	G. W. Eaton, Bristol	27.00	17.78
			Geo. A. Forsyth, Waterford	28.50	
				27.75	
20499	Bowker's Fisherman's Brand Fish and Potash	Bowker Fertilizer Co., N. Y. City	Wilson & Burr, Middletown	28.00	18.41
			Bowker's Branch, Hartford	28.00	
			Wm. Ewald, Cromwell	30.00	
				28.75	

ANALYSES AND VALUATIONS—*Continued.*

Station No.	Percentage difference between cost and valuation.	Nitrogen. As Nitrates.	Nitrogen. As Ammonia.	Nitrogen. Organic.	Total Nitrogen. Found.	Total Nitrogen. Guaranteed.	Phosphoric Acid. Water-soluble.	Phosphoric Acid. Citrate-soluble.	Phosphoric Acid. Citrate-insoluble.	Phosphoric Acid. Total. Found.	Phosphoric Acid. Total. Guaranteed.	Phosphoric Acid. So-called "Available." Found.	Phosphoric Acid. So-called "Available." Guaranteed.	Potash. Found. As Muriate.	Potash. Found. Total.	Potash. Guaranteed.
20536	52.0	....	1.00	1.42	2.42	**2.5**	5.37	1.83	1.09	8.29	**7.0**	7.20	**6.0**	9.47	9.47	**10.0**
20617	52.2	0.65	0.08	1.39	2.12	**1.7**	5.69	2.74	1.83	10.26	**10.0**	8.43	**8.0**	3.25	3.25	**3.0**
20592	53.1	0.11	0.06	0.94	1.11	**1.0**	7.74	0.80	1.07	9.61	**9.0**	8.54	**8.0**	2.53	2.53	**1.5**
20726	53.4	....	0.10	1.78	1.88	**1.7**	6.37	2.99	1.10	10.46	**10.0**	9.36	**9.0**	2.26	2.26	**2.0**
20601	55.2	0.30	0.02	1.09	1.41	**1.0**	5.25	4.34	1.37	10.96	**9.0**	9.59	**8.0**	3.73	3.73	**3.5**
20406	55.2	....	....	2.06	2.06	**2.0**	5.71	3.41	1.34	10.46	**9.0**	9.12	**8.0**	3.17	3.17	**3.0**
20399	55.5	0.53	0.25	1.56	2.34	**2.5**	7.22	2.36	1.77	11.35	**10.0**	9.58	**9.0**	2.26	2.26	**2.0**
20624	56.1	....	0.04	1.16	1.20	**0.8**	6.84	1.76	1.57	10.17	**9.0**	8.60	**8.0**	4.50	4.50	**4.0**
20499	56.2	....	1.00	1.46	2.46	**2.5**	2.30	2.79	1.15	6.24	**5.0**	5.09	**4.0**	4.29	4.29	**4.0**

Nitrogenous Superphosphates.

Station No.	Name or Brand.	Manufacturer.	Dealer.	Dealer's cash price per ton.	Valuation per ton.
	Sampled by Station Agent:				
20402	Church's Fish and Potash	Am'n Agric'l Chem. Co., N. Y. City	A. H. Cashen, Meriden	$28.00	$17.52
			A. I. Martin, Wallingford	----	
			J. W. Potter & Son, Norwich	27.00	
				27.50	
20758	All Round Fertilizer	Rogers Mfg. Co., Rockfall	F. U. Wadhams, Torrington	31.00	18.76
			Manufacturer	28.00	
				29.50	
20449	East India A. A. Ammoniated Bone Superphosphate	Am'n Agric'l Chem. Co., N. Y. City	The F. S. Platt Co., New Haven	36.00	21.61
			Edmund Halladay, Suffield	32.00	
				34.00	
20462	Armour's Fish and Potash Mixture	Armour Fertilizer Works, Baltimore, Md.	August Grulich, Meriden	27.00	16.42
			S. V. Osborn, Branford	25.00	
			Hugh Reynolds, New Britain	**26.00**	
20497	Ammoniated Bone with Potash	Armour Fertilizer Works, Baltimore, Md.	T. H. Eldredge, Norwich	30.00	18.44
			Farmers' Supply Co., Bridgeport	31.00	
			Hugh Reynolds, New Britain	28.00	
				29.50	
20782	Williams & Clark's Americus Ammoniated Bone Superphosphate	Am'n Agric'l Chem. Co., N. Y. City	D. B. Wilson Co., Waterbury	**35.00**	21.81
20504	Atlantic Coast Bone, Fish and Potash	Sanderson Fertilizer & Chemical Co., New Haven	G. W. Dennison, Saybrook	30.00	16.76
			Morse & Landon, Guilford	25.00	
			The G. W. Eaton Estate, Plainville	26.00	
				27.00	
20755	Success Fertilizer	Lister's Agric'l Chem. Wks., Newark, N. J.	J. A. Foster, R. D., Stafford Springs	**30.00**	18.62
			D. C. Burnham, Moodus	30.00	
20417	Mapes' Complete Manure, A Brand	Mapes F. & P. G. Co., N. Y. City	Birdsey & Raven, Meriden	**38.00**	23.27
			F. S. Bidwell & Co., Windsor Locks	37.00	
			Southington Lumber Co., Southington	38.00	

Analyses and Valuations—*Continued.*

Station No.	Percentage difference between cost and valuation.	Nitrogen.					Phosphoric Acid.							Potash.		
					Total Nitrogen.					Total.		So-called "Available."		Found.		
		As Nitrates.	As Ammonia.	Organic.	Found.	Guaranteed.	Water-soluble.	Citrate-soluble.	Citrate-insoluble.	Found.	Guaranteed.	Found.	Guaranteed.	As Muriate.	Total.	Guaranteed.
20402	57.0	----	0.12	1.94	2.06	**2.1**	4.05	2.96	1.75	8.76	**7.0**	7.01	**6.0**	2.03	2.03	**2.0**
20758	57.2	0.32	0.68	1.04	2.04	**1.7**	5.99	2.85	1.66	10.50	**10.0**	8.84	**8.0**	2.04	2.04	**2.0**
20449	57.3	----	0.12	2.25	2.37	**2.5**	5.50	4.29	1.80	11.59	**10.0**	9.79	**9.0**	2.21	2.21	**2.0**
20462	58.3	0.04	0.06	1.82	1.92	**2.1**	4.41	1.50	1.06	6.97	**7.0**	5.91	**6.0**	2.85	2.85	**2.0**
20497	59.9	----	0.26	1.99	2.25	**2.5**	5.05	1.86	0.73	7.64	**7.0**	6.91	**6.0**	2.77	2.77	**2.0**
20782	60.5	----	0.70	1.70	2.40	**2.5**	5.25	4.73	1.92	11.90	**10.0**	9.98	**9.0**	2.48	2.48	**2.0**
20504	61.1	----	0.06	1.60	1.66	**1.7**	2.56	2.67	1.74	6.97	**6.0**	5.23	**4.0**	5.09	5.09	**4.0**
20755	61.1	----	0.17	1.39	1.56	**1.2**	6.70	3.36	1.56	11.62	**11.0**	10.06	**9.0**	2.33	2.33	**2.0**
20417	63.3	0.20	1.98	0.61	2.79	**2.5**	1.29	8.81	3.13	13.23	**12.0**	10.10	**10.0**	3.09	3.09	**2.5**

NITROGENOUS SUPERPHOSPHATES.

Station No.	Name or Brand.	Manufacturer.	Dealer.	Dealer's cash price per ton.	Valuation per ton.
	Sampled by Station Agent:				
20419	Swift's Lowell Bone Fertilizer	Swift's Lowell Fertilizer Co., Boston	Standard Feed Co., Bridgeport	$30.00	$18.34
			Edward White, Rockville	30.00	
			A. S. Bennett, Cheshire	29.50	
20693	Bowker's Hill & Drill Phosphate	Bowker Fertilizer Co., N. Y. City	J. P. Barstow & Co., Norwich	35.00	20.67
			A. D. Bridges' Sons, Hazardville	35.00	
20781	Read's Standard Superphosphate	Am'n Agric'l Chem. Co., N. Y. City	G. K. Goodwin, East Canaan	29.00	16.97
20404	Eldredge's Fish and Potash	(Made for) T. H. Eldredge, Norwich	T. H. Eldredge, Norwich	30.00	16.98
20585	Berkshire Ammoniated Bone Phosphate	Berkshire Fertilizer Co., Bridgeport	Hotchkiss & Templeton, Waterbury	29.00	15.86
			Johnson Bros., Jewett City	28.00	
			F. C. Benjamin & Co., Danbury	28.00	
				28.25	
20405	Eldredge's Special Superphosphate	(Made for) T. H. Eldredge, Norwich	T. H. Eldredge, Norwich	28.00	15.69
20593	Bradley's Niagara Phosphate	Am'n Agric'l Chem. Co., N. Y. City	F. M. Cole, Putnam	28.00	15.66
			Phineas Platt, Milford	28.00	
20594	Bradley's Eclipse Phosphate	Am'n Agric'l Chem. Co., N. Y. City	F. M. Cole, Putnam	29.00	16.46
			Phineas Platt, Milford	30.00	
				29.50	
20620	Darling's General Fertilizer	Am'n Agric'l Chem. Co., N. Y. City	C. E. Evarts & Son, Wallingford	28.50	16.05
			H. W. Hewin, New Hartford	30.00	
				29.25	
20604	Swift's Lowell Empress Brand	Swift's Lowell Fertilizer Co., Boston	A. S. Bennett, Cheshire	26.00	14.33
			A. C. Tillinghast, Plainfield	25.00	
			Tanner & Wilcox, East Winsted	28.00	
				26.25	
20779	Quinnipiac Climax Phosphate	Am'n Agric'l Chem. Co., N. Y. City	J. P. Lathrop, Plainfield	30.00	16.30
20836	Animal Bone and Potash	Lister's Agric'l Chem. Wks., Newark, N.J.	John McNamara, Norwich Town	25.00	12.47
			D. H. Carrier & Son, Glastonbury	21.00	
				23.00	

ANALYSES AND VALUATIONS—*Continued.*

Station No.	Percentage difference between cost and valuation.	Nitrogen. As Nitrates.	Nitrogen. As Ammonia.	Nitrogen. Organic.	Nitrogen. Total Nitrogen. Found.	Nitrogen. Total Nitrogen. Guaranteed.	Phosphoric Acid. Water-soluble.	Phosphoric Acid. Citrate-soluble.	Phosphoric Acid. Citrate-insoluble.	Phosphoric Acid. Total. Found.	Phosphoric Acid. Total. Guaranteed.	Phosphoric Acid. So-called "Available." Found.	Phosphoric Acid. So-called "Available." Guaranteed.	Potash. Found. As Muriate.	Potash. Found. Total.	Potash. Guaranteed.
20419	63.6	0.07	0.08	1.60	1.75	1.6	5.50	3.08	0.99	9.57	9.0	8.58	8.0	3.02	3.02	3.0
20693	69.3	----	1.30	1.21	2.51	2.5	7.66	1.33	1.42	10.41	10.0	8.99	9.0	2.03	2.03	2.0
20781	70.9	----	0.12	0.98	1.10	0.8	7.20	1.45	1.20	9.85	9.0	8.65	8.0	4.18	4.18	4.0
20404	76.7	----	0.30	1.47	1.77	1.7	2.70	3.12	1.47	7.29	6.0	5.82	5.0	4.47	4.47	4.0
20585	78.1	----	0.02	1.18	1.20	0.8	6.40	2.56	0.58	9.54	10.0	8.96	8.0	2.38	2.38	2.0
20405	78.5	----	0.08	0.98	1.06	1.0	7.39	1.35	1.02	9.76	10.0	8.74	8.0	2.79	2.79	2.0
20593	78.8	0.12	0.10	1.08	1.30	0.8	5.69	2.85	1.84	10.38	8.0	8.54	7.0	1.71	1.71	1.0
20594	79.2	----	0.08	1.29	1.37	1.0	6.83	1.78	1.47	10.08	9.0	8.61	8.0	2.20	2.20	2.0
20620	82.2	0.13	0.11	1.17	1.41	1.2	4.90	2.69	0.93	8.52	7.0	7.59	6.0	3.17	3.17	3.0
20604	83.2	----	0.07	1.26	1.33	0.8	4.49	2.49	0.68	7.66	8.0	6.98	7.0	2.25	2.25	1.0
20779	84.0	0.25	0.08	0.88	1.21	1.0	6.40	2.62	1.92	10.94	10.0	9.02	8.0	2.29	2.29	2.0
20836	84.4	----	---	---	----	---	6.19	4.67	0.81	11.67	11.0	10.86	10.0	2.07	2.07	2.0

Nitrogenous Superphosphates.

Station No.	Name or Brand.	Manufacturer.	Dealer.	Dealer's cash price per ton.	Valuation per ton.
	Sampled by Station Agent:				
20660	Chittenden's Ammoniated Bone Phosphate	National Fertilizer Co., N. Y. City	G. A. Williams, Silver Lane	$33.00	$17.02
			H. A. Bugbee, Willimantic	30.00	
				31.50	
20839	Chittenden's Soluble Bone and Potash	National Fertilizer Co., N. Y. City	H. A. Bugbee, Willimantic	25.00	14.18
			F. U. Wadhams, Torrington	28.00	
				26.50	
20508	Bowker's Sure Crop Phosphate	Bowker Fertilizer Co., N. Y. City	A. R. Manning, Yantic	30.00	15.64
			Wm. Ewald, Cromwell	----	
			W. T. McKenzie, Yalesville	29.00	
				29.50	
20539	Gloucester Fish and Potash	Bowker Fertilizer Co., N. Y. City	Lightbourn & Pond Co., New Haven	25.00	13.63
			A. L. Burdick, Westbrook	25.00	
			J. P. Barstow & Co., Norwich	30.00	
				26.75	
	Samplea by purchasers and others:		*Sent by*		
20318	Special Mixture No. 1	Wilcox Fertilizer Co., Mystic	R. C. Wilcox & Sons, Guilford	36.50	35.56
20319	Special Mixture No. 2	Wilcox Fertilizer Co., Mystic	R. C. Wilcox & Sons, Guilford	36.00	34.48
20556	Bone, Fish and Potash	E. R. Kelsey, Branford	A. E. Plant, Branford	26.00	24.17
20294	Special 10% Brand	E. B. Clark Seed Co., Milford	Berton N. Smith, R. D. 2, Milford	35.00	32.36
20826	Fenn's Formula No. 2	Sanderson Fertilizer & Chem. Co., New Haven	Dennis Fenn, Milford	36.00	31.69
20823	Special Mixture, No. 1	Sanderson Fertilizer & Chem. Co., New Haven	James I. Webb, Box 1425, New Haven	29.50	25.90
20825	Fenn's Formula No. 1	Sanderson Fertilizer & Chem. Co., New Haven	Dennis Fenn, Milford	35.00	30.10
20909	James' Bone Phosphate	E. L. James, Warrenville, Conn.	Manufacturer	30.00	25.14
20650	C. V. O. Co.'s Fertilizer	Conn. Valley Orchard Co., Berlin	J. L. Watrous, Meriden	28.00	23.24

Analyses and Valuations—*Continued.*

Station No.	Percentage difference between cost and valuation.	Nitrogen.					Phosphoric Acid.							Potash.		
		As Nitrates.	As Ammonia.	Organic.	Total Nitrogen.		Water-soluble.	Citrate-soluble.	Citrate-insoluble.	Total.		So-called "Available."		Found.		Guaranteed.
					Found.	Guaranteed.				Found.	Guaranteed.	Found.	Guaranteed.	As Muriate.	Total.	
20660	85.1	----	0.16	1.45	1.61	**1.7**	6.56	1.88	1.22	9.66	**9.0**	8.44	**8.0**	2.08	2.08	**2.0**
20839	86.9	----	----	----	----	----	8.99	2.91	2.03	13.93	**12.0**	11.90	**11.0**	2.07	2.07	**2.0**
20508	88.6	----	0.10	0.94	1.04	**0.8**	6.52	2.75	1.45	10.72	**10.0**	9.27	**9.0**	2.20	2.20	**2.0**
20539	96.3	----	0.08	0.90	0.98	**0.8**	5.63	2.70	1.38	9.71	**9.0**	8.33	**8.0**	1.24	1.24	**1.0**
20318	2.6	2.16	0.08	3.10	5.34	**5.5**	2.93	3.33	4.00	10.26	**9.0**	6.26	**5.0**	8.29	8.29	**6.9**
20319	4.4	2.34	0.08	2.26	4.68	**4.8**	4.20	3.06	3.10	10.36	**8.7**	7.26	**5.5**	9.50	9.50	**8.1**
20556	7.6	0.74	0.58	1.65	2.97	**2.5**	2.81	4.66	0.79	8.26	**5.0**	7.47	**4.0**	0.68	5.41	**4.0**
20294	8.2	1.18	0.14	2.68	4.00	**3.3**	2.72	3.39	1.69	7.80	----	6.11	**6.0**	11.84	11.84	**10.0**
20826	13.6	2.25	0.08	1.97	4.30	----	2.57	7.66	3.01	13.24	----	10.23	----	5.10	5.10	----
20823	13.9	0.05	0.10	3.25	3.40	----	2.24	3.14	0.59	5.97	----	5.38	----	7.90	7.90	----
20825	16.2	1.57	0.08	2.23	3.88	----	1.98	7.65	3.30	12.93	----	9.63	----	5.50	5.50	----
20909	19.3	----	0.06	2.31	2.37	**2.0**	3.17	8.55	2.63	14.35	**13.0**	11.72	**10.0**	4.16	4.16	**3.5**
20650	20.5	0.13	1.36	1.21	2.70	----	7.36	1.40	2.01	10.77	----	8.76	----	4.26	4 26	----

NITROGENOUS SUPERPHOSPHATES.

Station No.	Name or Brand.	Manufacturer.	Sent by	Dealer's cash price per ton.	Valuation per ton.
	Sampled by purchasers and others:				
20731	Special Mixture No. 1	Sanderson Fertilizer & Chem. Co., New Haven	James I. Webb, Box 1425, New Haven	$29.50	$24.29
20359	Darling's Blood, Bone and Potash	Am'n Agric'l Chem. Co., N. Y. City	Adolph Greenbacher, Meriden	38.50	31.48
20685	C. V. O. Co.'s Fertilizer	Conn. Valley Orchard Co., Berlin	John F. Sellars, Deep River	28.00	22.88
20360	Darling's Dissolved Bone and Potash	Am'n Agric'l Chem. Co., N. Y. City	Adolph Greenbacher, Meriden	34.50	26.91
20824	Special Mixture, No. 2	Sanderson Fertilizer & Chem. Co., New Haven	James I. Webb. Box 1425, New Haven	29.50	22.79
20827	Special Top Dressing	Sanderson Fertilizer & Chem. Co., New Haven	Dennis Fenn, Milford	38.00	29.19
20732	Special Mixture No. 2	Sanderson Fertilizer & Chem. Co., New Haven	J. I. Webb, Box 1425, New Haven	29.50	22.54
20828	Germofert Natural Plant Food	Germofert Mfg. Co., Charleston, S. C.	Dennis Fenn, Milford	*29.00	27.52
20748	Unknown	Unknown	Anton Nogoviski, Milford	----	27.66
20439	Sweepings from Factory	Wilcox Fertilizer Co., Mystic	T. G. Whipple, Gales Ferry	19.00	22.28
20760	"Guano"	C. C. Clark & Son,† Mt. Ephraim, N. J.	T. A. Mitten, Supt., Stonington	10.00	8.48
20829	"Peruvian Guano"	Coe-Mortimer Co., New York City	W. E. Russell, Suffield	34.56	45.00

* Car lot. † Dealer.

SPECIAL MANURES.

Here are included such mixed fertilizers, chiefly nitrogenous superphosphates containing potash, 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, tobacco specials, are separately considered on pages 556 to 559.

1. *Samples Drawn by Station Agent.*

In the table on pages 534 to 555 are 122 analyses of samples of this kind.

ANALYSES AND VALUATIONS—*Concluded.*

Station No.	Percentage difference between cost and valuation.	Nitrogen.					Phosphoric Acid.							Potash.		
		As Nitrates.	As Ammonia.	Organic.	Total Nitrogen. Found.	Total Nitrogen. Guaranteed.	Water-soluble.	Citrate-soluble.	Citrate-insoluble.	Total Found.	Total Guaranteed.	So-called "Available." Found.	So-called "Available." Guaranteed.	Found. As Muriate.	Found. Total.	Guaranteed.
20731	21.4	0.13	0.13	3.28	3.54	---	2.93	2.48	0.82	6.23	----	5.41	----	5.19	5.19	----
20359	22.3	----	2.16	2.24	4.40	4.1	6.64	1.46	0.79	8.89	8.0	8.10	7.0	7.61	7.61	7.0
20685	22.4	0.62	0.42	1.56	2.60	2.5	6.73	2.68	0.79	10.20	11.0	9.41	9.0	3.84	3.84	4.0
20360	28.2	----	0.18	2.38	2.56	2.5	5.36	1.34	0.86	7.56	7.0	6.70	6.0	11.31	11.31	10.0
20824	29.4	0.90	0.04	2.13	3.07	---	0.52	5.78	3.40	9.70	----	6.30	----	4.13	4.13	----
20827	30.2	2.92	0.04	0.07	3.03	---	3.76	4.58	0.64	8.98	----	8.34	----	11.55	11.55	----
20732	30.9	0.14	0.04	2.73	2.91	---	2.56	1.75	0.95	5.26	----	4.31	----	7.27	7.27	----
20828	----	0.32	0.36	2.28	2.96	---	0.27	7.85	4.65	12.77	----	8.12	----	0.70	6.63	----
20748	----	1.66	0.96	0.91	3.53	---	4.72	3.33	1.25	9.30	----	8.05	----	7.31	7.31	----
20439	----	0.56	0.34	1.59	2.49	---	3.40	5.00	3.20	11.60	----	8.40	----	3.14	3.79	----
20760	----	0.04	0.01	0.28	0.33	---	----	4.00	8.81	12.81	----	4.00	----	0.04	0.04	----
20829	----	2.19	1.56	2.58	6.33	7.0	1.29	6.44	2.09	9.82	8.5	7.73	6.5	1.46	2.71	2.0

Analyses Requiring Special Notice.

The manufacturers of Rogers' High Grade Fertilizer, Oats and Top Dressing, Nos. **20763, 20443** and **20590**, pages 534 and 535, stated that **20443** did not represent the average quality of this brand and that the materials used in its manufacture should give a percentage of potash fully up to guaranty. Two other samples were, therefore, drawn, **20763** and **20590**, the analyses of which appear in the tables. The analyses of the three samples indicate either imperfect mixing or a partial separation of the raw materials after mixing.

The manufacturer of Rogers' H. G. Tobacco Grower, **20764**, page 534, the analysis of which shows 2.90 per cent. of potash as muriate, stated that not a pound of muriate was intentionally put into this brand. Accepting this statement as correct, it is quite possible that muriates in some form and in moderate amount were unwittingly introduced with the other ingredients of which this mixture is made. Nitrates, for instance, contain small amounts, and dried fish also. Sometimes there will be a bag or two of muriate shipped by mistake in a car of sulphate. The method of calculating potash as muriate and sulphate is explained on page 557.

The manufacturers of Berkshire Tobacco Special stated that analysis **20674**, given below, did not represent this brand, being very deficient in both nitrogen and potash, and that they believed there was a mistake in the sample. The two samples, from a mixture of which **20674** has been prepared, were separately examined. While one of them, **20787**, see page 538, contained the guaranteed amounts of nitrogen and potash, the other, **20786**, contained only 3.64 and 3.50 per cent. respectively; a discrepancy so great as to suggest doubt whether the sample was drawn from bags of this brand, or from some other brand, by some unaccountable mistake.

Analyses of samples	20674	20786	20787
Total nitrogen	3.84	3.64	4.08
Total phosphoric acid	5.49	....	5.31
Total potash	4.64	3.50	5.77
Valuation	$24.88	....	$26.86

20415, Essex Complete Manure for Potatoes, Roots and Vegetables, pages 546 and 547, contained 9.50 per cent. of potash, being one-half per cent. less than guaranteed. The three samples from which **20415** was prepared contained 9.66, 9.31 and 9.91 per cent. of potash respectively.

Sample **20600**, of Lister's Potato Manure, was prepared by mixing samples drawn from stock of John McNamara, Norwich Town, and J. C. Wilcoxson, Stratford. The analysis given below shows both nitrogen and potash to be far below guaranty. The manufacturers protested that the analysis was very different from the average composition of this brand. Examination of the two samples, **20739** and **20740**, from which the composite was made, showed a difference of about 1.8 per cent. of potash and made it

appear likely that one of the samples did not represent the brand. Two other samples of this brand were, therefore, drawn and analysis No. **20793**, pages 538 and 539, was made on a mixture of them.

Analyses of samples	20600	20739	20740
Nitrogen	3.03	....	....
Phosphoric acid	9.47	....	....
Potash	6.09	6.90	5.16

Sample **20799**, of Lister's Special Tobacco Fertilizer, was prepared by mixing samples drawn from stock of Wm. Sullivan, of New Milford and G. O. Case, Burnside. The analysis given below shows a marked deficiency of both nitrogen and potash, and the chlorine also is high, while the potash is claimed to be added wholly as sulphate. The manufacturers protested that this sample did not fairly represent the quality of their brand. Examination of the two samples **20991** and **20912** showed a difference of 1.3 per cent. of nitrogen and 2.92 of chlorine. Obviously, the two samples did not represent the same brand.

Sample **20912**, pages 544 and 545, corresponds fairly with the guaranty.

Analyses of samples	20799	20991	20912
Nitrogen	1.68	1.04	2.36
Phosphoric acid	12.14	....	11.28
Potash	4.01	....	3.25
Chlorine	2.40	3.86	0.94

Sample No. **20467**, Essex Complete Manure for Corn, Grain and Grass, was made of a mixture of three samples of this brand, as appears on pages 548 and 549. The manufacturer states that this brand is mixed to contain fully 10 per cent. of potash and that 10.80 per cent. was reported by another New England station on this brand this year. Determinations of potash in each of the samples from which **20467** was prepared, showed 9.69, 9.84 and 9.48 per cent., their average being 9.67. It was not possible, after receiving the manufacturer's protest, to draw other samples of the same brand. See pages 548 and 549.

20761, Rogers Mfg. Co.'s H. G. Corn and Onion Manure, from stock of S. A. Flight, Highwood, and **21203**, Wheeler's Havana Tobacco Grower, sent by W. A. Fitzgerald, Windsor Locks, were examined sufficiently to determine whether they met their guaranties.

The results were as follows:

	20761 Found.	20761 Guaranteed.	21203 Found.	21203 Guaranteed.
Nitrogen	3.56	3.6	2.70	2.5
Phosphoric acid	9.62	8.0	8.64	7.0
Potash	6.80	7.0	9.82	10.0

The cases of apparent confusion of brands noticed above may be explained in several ways. It sometimes happens that the retail agent puts the contents of a torn fertilizer bag into another, which is not always branded with the correct name. Again, the manufacturer's brand, if printed on the bags, is quite often rendered illegible by chafing in handling and transportation; so that a pile of goods stated to be of a certain brand may contain one or more packages of a different brand, which could not be distinguished by the label and were assumed by the workmen to be alike.

GUARANTIES.

Of the one hundred and twenty-two samples drawn by our agent, forty-one, or one-third of the whole number, are below their guaranties by more than one-tenth per cent., in respect of one or more ingredients. Eleven are below in nitrogen alone, seven in phosphoric acid and thirteen in potash, while ten are below guaranty in respect of two ingredients.

In most cases the discrepancies are not large and a deficiency of one ingredient is balanced by an excess of some other ingredient.

Four of these special manures, however, are so deficient that they do not contain a full equivalent in money value, of the quantities of plant food which they are claimed by their manufacturers to contain. The deficiencies range from 75 cents to $1.75 per ton.

The defective brands, to which attention is called, are the following:

20541, pages 534 and 535. A Special Grass Mixture, made for W. O. Goodsell, Bristol. Nitrogen found, 7.00; guaranteed, 7.5.

20408, pages 546 and 547. Shay's Corn Manure. Nitrogen found, 2.16; guaranteed, 2.5. Potash found, 3.88; guaranteed, 4.5.

20672, pages 546 and 547. Armour's Corn King. Nitrogen found, 2.64; guaranteed, 3.0. Phosphoric acid found, 8.74; guaranteed 9.0. Potash found, 3.97; guaranteed, 4.0.

20698, pages 550 and 551. Essex Grass and Top Dressing. Nitrogen found, 3.44; guaranteed, 4.0. Phosphoric acid found, 7.83; guaranteed 8.0. Potash found, 9.19; guaranteed, 8.0.

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 pages 501 and 502.

The average cost per ton of the one hundred and twenty-two special manures, the cost and valuation of which are given in the tables, was $35.67 per ton, the average valuation $26.02, and the percentage difference 37.1.

In 1907 the corresponding figures were: Cost $34.48; valuation 25.42; percentage difference 35.8.

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.	Total phosphoric acid.	"Available" phosphoric acid.	Potash.	Cost per ton.	Percentage difference.
1904	2.92	8.56	....	5.92	$33.93	45.0
1905	2.93	10.38	....	6.13	33.99	41.8
1906	2.99	9.98	....	5.92	34.28	44.6
1907	3.09	9.63	....	5.92	34.48	35.8
1908	3.12	9.49	7.75	6.42	35.67	37.1

A comparison of these figures with those relating to nitrogenous superphosphates, on page 503, shows that as a rule special manures contain more nitrogen and potash than the other nitrogenous superphosphates with the same amount of phosphoric acid and sell at a somewhat higher price.

Even a superficial examination of the tables of analyses shows a very wide range of prices and of content of plant food in these one hundred and twenty-two brands.

There must, therefore, be a great difference between them in the relative economy of their purchase. This is brought out clearly by the following table, which shows how much plant food can be bought for the same money, $30.00, in several groups of these special manures.

PURCHASABLE FOR THIRTY DOLLARS.

	Nitrogen, pounds.	Phosphoric acid, pounds.	Potash, pounds.
In the first 12 samples in the table	71	181	139
" next 15 " " "	68	153	119
" " 10 " " "	59	141	131
" " 11 " " "	57	141	113
" " 10 " " "	47	161	132
" " 9 " " "	57	138	93
" " 11 " " "	46	167	103
" " 9 " " "	47	154	101
" " 9 " " "	43	168	85
" " 9 " " "	40	169	78
" " 11 " " "	32	191	77
" " 6 " " "	34	147	80

SPECIAL MANURES.

Station No.	Name or Brand.	Manufacturer.	Dealer.	Dealer's cash price per ton.	Valuation per ton.
	Sampled by Station Agent:				
20410	Shay's Potato Manure	C. M. Shay Fertilizer Co., Groton	J. P. Barstow, Norwich Manufacturer	$31.00 30.00 30.50	$29.28
20503	Hubbard's Soluble Tobacco Manure	The Rogers & Hubbard Co., Middletown	H. W. Andrews, Wallingford John Hofman, Cromwell J. M. Page & Co., Naugatuck	46.00 44.00 43.00 44.50	41.43
20541	Special Grass Mixture	Made for W. O. Goodsell, Bristol	W. O. Goodsell	45.00	40.66
20763†	H. G. Oats & Top Dressing	Rogers Mfg. Co., Rockfall	S. J. Stevens, Glastonbury Manufacturer	45.00 45.00	40.53
20762	H. G. Grass & Grain	Rogers Mfg. Co., Rockfall	Manufacturer G. H. Sloan, Windsorville	40.00 40.00	35.83
20722	H. G. Soluble Tobacco Manure	Rogers Mfg. Co., Rockfall	Seth Alden, Thompsonville N. H. Root, New Milford	44.00 44.00	39.40
20409	Shay's Grass & Lawn Fertilizer	C. M. Shay Fertilizer Co., Groton	Manufacturer	35.00	31.25
20443†	H. G. Oats & Top Dressing	Rogers Mfg. Co., Rockfall	Thomas Holt, Southington R. E. Davis, Guilford	42.50 45.00 43.75	38.99
20554	Wheeler's Corn Special	Made for Wheeler Bros., Stonington	Wheeler Bros., Stonington	32.00	28.46
20754	Germofert Patent Vegetable Fertilizer	Germofert Mfg. Co., Charleston, S. C.	H. C. Sturgess,* Fairfield	33.50	29.71
20543	H. G. Soluble Tobacco and Potato Manure	Rogers Mfg. Co., Rockfall	Arthur Sikes, Suffield Thomas Holt, Southington E. T. Hurlburt, Somers	39.00 39.00 40.00 39.25	34.29
20598	Patent Fruit & Flower Fertilizer	Germofert Mfg. Co., Charleston, S. C.	F. F. Meeker, Westport	32.00	27.62
20764†	H. G. Tobacco Grower	Rogers Mfg. Co., Rockfall	Manufacturer Arthur Sikes, Suffield	38.00 38.00	32.61
20590†	H. G. Oats & Top Dressing	Rogers Mfg. Co., Rockfall	E. T. Hurlburt, Somers	46.00	39.44
20444	Hubbard's Soluble Potato Manure	The Rogers & Hubbard Co., Middletown	C. S. Gillette, Cheshire F. H. Rolf, Guilford	42.00 42.00	35.95

* Purchaser. † See note page 529.

ANALYSES AND VALUATIONS.

Station No.	Percentage difference between cost and valuation.	Nitrogen. As Nitrates.	Nitrogen. As Ammonia.	Nitrogen. Organic.	Total Nitrogen. Found.	Total Nitrogen. Guaranteed.	Phosphoric Acid. Water-soluble.	Phosphoric Acid. Citrate-soluble.	Phosphoric Acid. Citrate-insoluble.	Phosphoric Acid. Total. Found.	Phosphoric Acid. Total. Guaranteed.	So-called "Available." Found.	So-called "Available." Guaranteed.	Potash. Found. As Muriate.	Potash. Found. Total.	Potash. Guaranteed.
20410	4.2	0.48	0 20	3.36	4.04	4.0	3.20	4.28	2.11	9.59	8.0	7.48	----	6.04	6.04	6.0
20503	7.4	2.62	0.20	2.00	4.82	5.0	0.77	7.73	2.99	11.49	10.0	8.50	7.0	0.60	14.00	10.0
20541	10.7	5.97	0.05	0.98	7.00	7.5	4.58	0.39	0.47	5.44	4.0	4.97	----	4.43	9.91	9.5
20763	11.0	4.18	0.04	1.88	6.10	6.3	0.75	7.91	5.87	14.53	9.0	8.66	7.0	8.22	8.22	7.5
20762	11.6	0.32	0.02	2.84	3.18	3.0	----	7.94	10.66	18.60	16.0	7.94	----	13.56	13.56	12.0
20722	11.7	1.22	0.51	3.17	4.90	5.0	0.90	6.47	2.71	10.08	8.0	7.37	6.0	1.02	12.45	11.0
20409	12.0	0.75	0.20	3.13	4.08	4.0	3.97	4.86	2.35	11.18	10.0	8.83	----	5.82	6.53	6.0
20443	12.2	2.74	1.06	2.36	6.16	6.3	0.45	9.03	2.99	12.47	9.0	9.48	7.0	6.68	6.68	7.5
20554	12.4	1.39	0.04	1.77	3.20	2.9	7.68	1.11	0.38	9.17	9.0	8.79	8.0	8.34	8.34	8.0
20754	12.8	0.50	0.63	3.10	4.23	4.1	0.18	3.72	7.64	11.54	10.0	3.90	4.3	1.00	6.50	6.0
20543	14.5	1.36	0.80	1.64	3.80	3.5	0.14	10.41	2.97	13.52	9.0	10.55	7.0	0.74	9.15	8.8
20598	15.9	0.50	0.70	2.22	3.42	3.3	0.14	6.14	6.37	12.65	10.0	6.28	4.3	0.60	6.09	6.0
20764	16.5	0.98	0.11	3.89	4.98	5.0	0.14	4.08	3.07	7.29	5.0	4.22	4.0	2.90	8.03	6.0
20590	16.6	3.72	0.30	2.38	6.40	6.3	0.45	8.41	3.52	12.38	9.0	8.86	7.0	6.40	6.40	7.5
20444	16.8	2.74	0.30	2.11	5.15	5.0	0.64	8.71	3.26	12.61	10.0	9.35	7.0	0.80	6.45	5.0

SPECIAL MANURES.

Station No.	Name or Brand.	Manufacturer.	Dealer	Dealer's cash price per ton.	Valuation per ton.
	Sampled by Station Agent:				
20555	Wheeler's Potato Special	Made for Wheeler Bros., Stonington	Wheeler Bros., Stonington	$36.00	$30.19
20718	Hubbard's Oats & Top Dressing	The Rogers & Hubbard Co., Middletown	H. W. Andrews, Wallingford	57.00	48.65
			John Hofman, Cromwell	----	
				58.00	
20355	High Grade Potato Manure	Olds & Whipple, Hartford	Manufacturer	37.00	30.63
20801	Mapes' Seeding Down Manure	Mapes F. & P. G. Co., N. Y.	Mapes' Branch, Hartford	42.00	34.68
20807	Chittenden's H. G. Tobacco Special	National Fertilizer Co., N. Y.	J. N. Lasbury, Broad Brook	46.00	37.81
20806	Chittenden's Conn. Valley Tobacco Starter	National Fertilizer Co., N. Y.	J. N. Lasbury, Broad Brook	48.00	39.02
20657	E. Frank Coe's Special Potato Fertilizer	Coe-Mortimer Co. N. Y.	A. L. Burdick, Westbrook	30.00	24.37
			J. F. Wilcox, Bristol	----	
20471	O. & W.'s Corn and Potato	Olds & Whipple, Hartford	Manufacturer	34.00	27.57
20725	Swift-Sure Guano for Corn and Onions	M. L. Shoemaker & Co., Phila., Pa.	F. H. Rolf, Guilford	30.00	24.21
20544	Wilcox's Potato, Onion and Vegetable Manure	Wilcox Fertilizer Co., Mystic	I. W. Dennison, Mystic	35.00	28.78
			N. H. Dayton, New London	36.00	
			A. S. Fields,* Brooklyn	36 00	
				35.75	
20729	Wilcox's Grass Fertilizer	Wilcox Fertilizer Co., Mystic	Manufacturer	36.00	29.30
			C. C. Fairbank, Saybrook	37.00	
				36.50	
20603	Swift-Sure Superphosphate for Potatoes	M. L. Shoemaker & Co., Phila., Pa.	Loomis Bros. Co., Granby	36.00	28.68
20668	Wheeler's Havana Tobacco Grower	American Agricultural Chemical Co., N. Y.	F. M. Loomis, No. Granby	----	
			L. L. Loomis, Granby	35.00	27.79
20602	H. G. Complete Corn & Onion Manure	Rogers Mfg. Co., Rockfall	Thomas Holt, Southington	35.00	29.07
			E. T. Hurlburt, Somers	37.00	
			M. B. Clark, Milford	38.00	
				36.75	
20766	Wilcox's H. G. Tobacco Special	Wilcox Fertilizer Co., Mystic	Manufacturer	36.50	28.12
			M. E. Thompson, Ellington	35.00	
			E. N. Austin, Suffield	36.00	
				35.75	
20797	Peruvian Vegetable Grower	Coe-Mortimer Co., N. Y.	J. F. Wilcox, Bristol	----	31.42
				40.00	

* Purchaser.

ANALYSES AND VALUATIONS—*Continued.*

Station No.	Percentage difference between cost and valuation.	Nitrogen. As Nitrates.	Nitrogen. As Ammonia.	Nitrogen. Organic.	Total Nitrogen. Found.	Total Nitrogen. Guaranteed.	Phosphoric Acid. Water-soluble.	Phosphoric Acid. Citrate-soluble.	Phosphoric Acid. Citrate-insoluble.	Phosphoric Acid. Total. Found.	Phosphoric Acid. Total. Guaranteed.	So called "Available." Found.	So called "Available." Guaranteed.	Potash. Found. As Muriate.	Potash. Found. Total.	Potash. Guaranteed.
20555	19.2	----	0.98	2.10	3.08	**2.9**	6.14	1.38	0.27	7.79	**10.0**	7.52	**8.0**	10.31	12.21	**10.0**
20718	19.2	7.65	0.05	1.30	9.00	**8.5**	0.06	6.39	1.96	8.41	**8.0**	6.45	**3.9**	9.69	9.69	**8.0**
20355	20.8	---	0.45	3.27	3.72	**3.3**	0.34	5.68	2.14	8.16	----	6.02	**5.0**	10.97	10.97	**10.0**
20801	21.1	2.15	0.06	0.69	2.90	**2.5**	none	13.23	3.77	17.00	**18.0**	13.23	----	12.07	12.07	**10.0**
20807	21.7	----	2.12	3.34	5.46	**5.7**	5.23	1.31	0.38	6.92	**7.0**	6.54	**5.0**	1.20	10.32	**10.0**
20806	23.0	----	6.06	2.70	8.76	**8.3**	0.18	3.79	0.69	4.66	**3.0**	3.97	----	0.09	2.88	**2.5**
20657	23.1	0.15	0.55	1.60	2.30	**1.7**	6.84	3.39	2.58	12.81	**10.0**	10.23	**8.0**	5.18	5.18	**4.0**
20471	23.3	----	0.20	3.68	3.88	**3.3**	0.13	6.51	2.17	8.81	----	6.64	**6.0**	5.79	5.79	**6.0**
20725	23.9	0.70	0.04	1.32	2.06	**1.7**	7.09	3.66	1.66	12.41	----	10.75	**8.0**	5.92	5.92	**5.0**
20544	24.2	1.00	0.35	1.96	3.31	**3.3**	6.59	2.30	1.04	9.93	**8.0**	8.89	**7.0**	4.81	7.45	**6.0**
20729	24.6	1.35	0.58	2.19	4.12	**4.1**	2.83	4.04	3.07	9.94	**7.0**	6.87	**6.0**	2.29	5.93	**5.0**
20603	25.5	1.02	---	1.40	2.42	**2.9**	8.58	3.41	0.97	12.96	----	11.99	----	8.39	8.39	**7.0**
20668	26.0	----	1.00	1.76	2.76	**2.5**	6.22	0.90	0.77	7.89	**7.0**	7.12	**6.0**	0.90	9.86	**10.0**
20602	26.4	1.06	0.80	1.96	3.82	**3.6**	3.70	3.83	2.37	9.90	**8.0**	7.53	**6.0**	7.30	7.30	**7.0**
20766	27.1	0.84	0.11	2.62	3.57	**3.3**	----	4.03	4.93	8.96	**7.0**	4.03	**5.0**	0.33	8.33	**7.0**
20797	27.3	----	1.24	2.28	3.52	**3.0**	4.55	3.25	0.72	8.52	**10.0**	7.80	**7.0**	1.74	10.22	**9.0**

SPECIAL MANURES.

Station No.	Name or Brand.	Manufacturer.	Dealer.	Dealer's cash price per ton.	Valuation per ton.
	Sampled by Station Agent:				
20794	Stockbridge Tobacco Manure	Bowker Fertilizer Co., N. Y.	Wm. Ewald, Cromwell	**$47.00**	$36.81
20696	Stockbridge Top Dressing	Bowker Fertilizer Co., N. Y.	Lightbourn & Pond Co., New Haven	40.00	30.72
			Bowker's Branch, Hartford	38.50	
				39.25	
20723	Sanderson's Formula B. for Tobacco	Sanderson Fertilizer & Chemical Co., New Haven	Manufacturer	35.00	27.00
			Loomis Bros. Co., Granby	35.00	
			A. E. Phelps,* Glastonbury	34.00	
			J. O. Griswold,* Glastonbury	34.00	
				34.50	
20465	Buffalo Vegetable and Potato	Buffalo Fertilizer Co., Buffalo, N. Y.	J. P. Barstow, Norwich	33.00	25.24
			F. B. Newton, Plainville	32.00	
				32.50	
20759	Complete Potato and Vegetable Fertilizer	Rogers Mfg. Co., Rockfall	M. B. Clark, Milford	34.00	25.60
			Manufacturer	32.00	
				33.00	
20549	Swift's Tobacco Manure	Swift's Lowell Fertilizer Co., Boston, Mass.	W. F. Comstock,* East Hartford	**44.00**	34.12
20659	E. F. Coe's Tobacco and Onion Fertilizer	Coe-Mortimer Co., N. Y.	W. A. Burr, West Hartford	39.00	29.46
			L. A. Gowdy, Somerville	37.00	
				38.00	
20787†	Berkshire Tobacco Special	Berkshire Fertilizer Co., Bridgeport	A. G. Barnes,* New Milford	**35.00**	26.86
20793†	Lister's Potato Manure	Listers Agricultural Chemical Works, Newark, N. J.	G. O. Case, R. D. Burnside	38.00	28.74
			D. H. Carrier & Son, Glastonbury		
				38.00	
20413	Buffalo Ideal Wheat and Corn	Buffalo Fertilizer Co., Buffalo, N. Y.	Ansonia Flour & Grain Co., Ansonia	28.00	22.26
			L. A. Fenton, Norwich Town	30.00	
			John R. Reinhard & Sons, West Cheshire	30.50	
				29.50	
20502	Hubbard's Potato Phosphate	The Rogers & Hubbard Co., Middletown	H. W. Andrews, Wallingford	33.00	24.03
			C. S. Gillette, Cheshire	31.00	
			J. M. Page Co., Naugatuck	40.00	
				32.00	

* Purchaser. † See note page 530.

ANALYSES AND VALUATIONS—*Continued.*

Station No.	Percentage difference between cost and valuation.	Nitrogen. As Nitrates.	Nitrogen. As Ammonia.	Nitrogen. Organic.	Total Nitrogen. Found.	Total Nitrogen. Guaranteed.	Phosphoric Acid. Water-soluble.	Phosphoric Acid. Citrate-soluble.	Phosphoric Acid. Citrate-insoluble.	Phosphoric Acid. Total. Found.	Phosphoric Acid. Total. Guaranteed.	So-called "Available." Found.	So-called "Available." Guaranteed.	Potash. Found. As Muriate.	Potash. Found. Total.	Potash. Guaranteed.
20794	27.7	----	2.30	3.55	5.85	**5.8**	3.49	1.90	0.70	6.09	**6.0**	5.39	**4.0**	1.12	8.89	**10.0**
20696	27.8	0.68	1.47	2.95	5.10	**4.9**	2.47	2.77	1.13	6.37	**6.0**	5.24	**4.0**	6.52	6.52	**6.0**
20723	27.8	0.99	0.08	2.44	3.51	**3.3**	3.49	3.31	2.14	8.94	**10.0**	6.80	**6.0**	0.81	5.85	**6.0**
20465	28.4	0.22	0.82	1.14	2.18	**2.5**	4.35	3.76	1.51	9.62	**9.0**	8.11	**8.0**	10.07	10.07	**7.0**
20759	28.9	0.88	0.06	1.58	2.52	**2.3**	4.08	6.11	3.72	13.91	**10.0**	10.19	**8.0**	5.39	5.39	**5.0**
20549	29.0	0.81	0.07	3.37	4.25	**4.0**	2.09	4.77	1.84	8.70	**7.0**	6.86	**6.0**	0.85	10.06	**10.0**
20659	29.0	0.25	1.03	2.30	3.58	**3.0**	4.72	2.81	0.50	8.03	**7.0**	7.53	**6.0**	5.90	8.92	**8.0**
20787	30.3	----	0.66	3.42	4.08	**4.1**	2.74	2.19	0.38	5.31	**4.0**	4.93	**3.0**	0.70	5.77	**5.0**
20793	32.2	----	1.74	1.70	3.44	**3.3**	6.51	2.91	0.84	10.26	**9.0**	9.42	**8.0**	7.30	7.30	**7.0**
20413	32.5	0.20	0.60	1.09	1.89	**1.6**	5.37	3.93	1.59	10.89	**10.0**	9.30	**9.0**	6.35	6.35	**5.0**
20502	33.2	0.79	0.06	1.31	2.16	**2.0**	5.25	5.44	1.36	12.05	**10.0**	10.69	**9.0**	5.69	5.69	**5.0**

SPECIAL MANURES.

Station No.	Name or Brand.	Manufacturer.	Dealer.	Dealer's cash price per ton.	Valuation per ton.
	Sampled by Station Agent:				
20699	Essex Special Tobacco Manure	Essex Fertilizer Co., Boston, Mass.	John Parker, Poquonock	$45.00	$33.31
			J. & H. Woodford, Avon	44.00	
				44.50	
20358	Grass Fertilizer	Olds & Whipple, Hartford	Manufacturer	**34.00**	25.43
20771	N. E. Perfect Tobacco Grower	New England Fertilizer Co., Boston, Mass.	Gideon Brown, South Manchester	**34.00**	25.40
20403	Stockbridge Potato and Vegetable	Bowker Fertilizer Co., N. Y.	Lightbourn & Pond Co., New Haven	40.00	29.34
			Bowker's Branch, Hartford	38.50	
			A. R. Manning, Yantic	40.00	
				39.50	
20774	Bradley's Complete for Top Dressing Grass and Grain	American Agricultural Chemical Co., N. Y.	A. D. Bridges' Sons, Hazardville	**39.00**	28.98
20752	Tobacco Starter and Grower	American Agricultural Chemical Co., N. Y.	C. M. Beach, New Milford	38.00	26.92
			S. B. Warner, Windsor	34.50	
				36.25	
20468	Chittenden's Potato Phosphate	Nation'l Fertilizer Co., N. Y.	H. A. Bugbee, Willimantic	30.00	22.86
			J. & H. Woodford, Avon	32.00	
				31.00	
20821	Swift's Special Grass Mixture	Swift's Lowell Fertilizer Co., Boston, Mass.	Edward White, Rockville	**40.00**	29.49
20695	Stockbridge Corn and Grain	Bowker Fertilizer Co., N. Y.	A. R. Manning, Yantic	40.00	28.89
			Bowker's Branch, Hartford	38.50	
				39.25	
20414	Buffalo Celery and Potato Special	Buffalo Fertilizer Co., Buffalo, N. Y.	Ansonia Flour and Grain Co., Ansonia	32.00	22.93
			John R. Reinhard & Sons, West Cheshire	30.50	
				31.25	
20769	East India Potato Manure	American Agricultural Chemical Co., N. Y.	L. V. Walkley, Plantsville	----	28.48
				39.00	
20719	Hubbard's Grass and Grain Fertilizer	The Rogers & Hubbard Co., Middletown	C. S. Gillette, Cheshire	42.00	30.92
			C. H. Wheeler, East Canaan	43.00	
				42.50	

ANALYSES AND VALUATIONS—*Continued.*

Station No.	Percentage difference between cost and valuation.	Nitrogen. As Nitrates.	Nitrogen. As Ammonia.	Nitrogen. Organic.	Total Nitrogen. Found.	Total Nitrogen. Guaranteed.	Phosphoric Acid. Water-soluble.	Phosphoric Acid. Citrate-soluble.	Phosphoric Acid. Citrate-insoluble.	Phosphoric Acid. Total. Found.	Phosphoric Acid. Total. Guaranteed.	Phosphoric Acid. So-called "Available." Found.	Phosphoric Acid. So-called "Available." Guaranteed.	Potash. Found. As Muriate.	Potash. Found. Total.	Potash. Guaranteed.
20699	33.6	0.60	0.12	3.36	4.08	**4.0**	3.19	3.14	0.91	7.24	**7.0**	6.33	**6.0**	1.32	10.71	**10.0**
20358	33.7	----	---	3.33	3.33	**3.3**	0.10	5.81	3.01	8.92	----	5.91	**6.0**	6.18	6.18	**6.0**
20771	33.9	0.77	0.08	2.77	3.62	**4.1**	2.10	2.89	1.14	6.13	**5.0**	4.89	**4.0**	1.50	5.97	**6.0**
20403	34.6	0.64	0.90	1.94	3.48	**3.3**	4.03	2.56	1.19	7.78	**7.0**	6.59	**6.0**	10.65	10.65	**10.0**
20774	34.6	4.82	0.02	0.25	5.09	**4.9**	1.52	4.97	1.28	7.77	**6.0**	6.49	**5.0**	2.70	3.95	**2.5**
20752	34.7	----	1.72	1.80	3.52	**3.3**	7.74	1.46	0.78	9.98	**9.0**	9.20	**8.0**	0.54	4.24	**4.0**
20468	35.6	----	0.42	1.72	2.14	**2.1**	6.65	2.36	1.11	10.12	**9.0**	9.01	**8.0**	6.03	6.03	**6.0**
20821	35.6	0.04	0.77	3.25	4.06	**4.1**	5.23	3.17	0.82	9.22	**8.0**	8.40	**7.0**	5.77	5.77	**6.0**
20695	35.9	1.06	0.26	2.13	3.45	**3.3**	5.10	3.67	1.46	10.23	**11.0**	8.77	**10.0**	7.47	7.47	**7.0**
20414	36.3	----	0.38	1.37	1.75	**1.7**	3.97	3.93	1.64	9.54	**9.0**	7.90	**8.0**	9.19	9.19	**10.0**
20769	36.9	----	1.93	1.38	3.31	**3.3**	5.44	1.54	0.58	7.56	**7.0**	6.98	**6.0**	8.88	10.33	**10.0**
20719	37.4	0.30	0.17	2.14	2.61	**2.2**	0.42	8.04	8.21	16.67	**16.0**	8.46	**6.6**	11.16	11.16	**12.0**

Special Manures.

Station No.	Name or Brand.	Manufacturer.	Dealer.	Dealer's cash price per ton.	Valuation per ton.
	Sampled by Station Agent:				
20625	Packers' Union Potato Manure	American Agricultural Chemical Co., N. Y.	Geo. A. Forsyth, Waterford	**$32.00**	$23.16
			F. L. Mackey, Ellington	32.00	
20534	Armour's H. G. Potato	Armour Fertilizer Works, Baltimore, Md.	Farmers' Supply Co., Bridgeport	36.00	24.42
			Young Bros. Co., Danielson	31.00	
			W. O. Goodsell, Bristol	34.00	
				33.75	
20591	Swift's Lowell Perfect Tobacco Grower	Swift's Lowell Fertilizer Co., Boston, Mass.	Edward White, Rockville	40.00	28.19
			J. D. Beasley, Ellington	38.00	
			W. F. Comstock,* East Hartford	40.00	
				39.25	
20623	East India Potato Manure	American Agricultural Chemical Co., N. Y.	I. J. Scoville, Plainville	37.50	27.29
			S. J. Stevens, Glastonbury	38.50	
				38.00	
20421	Swift's Lowell Potato Phosphate	Swift's Lowell Fertilizer Co., Boston, Mass.	Standard Feed Co., Bridgeport	32.00	24.38
			Spencer Bros., Suffield	35.00	
			Edward White, Rockville	35.00	
				34.00	
20664	Quinnipiac Potato Manure	American Agricultural Chemical Co., N. Y.	C. Buckingham, Southport	30.00	22.22
			C. C. Pierce, Thompson	32.00	
				31.00	
20463	Armour's Fruit and Root Crop Special	Armour Fertilizer Works, Baltimore, Md.	August Grulich, Meriden	27.00	19.65
			Farmers' Supply Co., Bridgeport	30.00	
			Hugh Reynolds, New Britain	26.00	
				27.50	
20352	Mapes' Potato Manure	Mapes F. & P. G. Co., N. Y.	A. N. Clark, Milford	**42.00**	30.02
			Birdsey & Raven, Meriden	42.00	
			Mapes' Branch, Hartford	40.00	
			Spencer Bros., Suffield	41.00	

* Purchaser.

Analyses and Valuations—*Continued.*

Station No.	Percentage difference between cost and valuation.	Nitrogen. As Nitrates.	Nitrogen. As Ammonia.	Nitrogen. Organic.	Total Nitrogen. Found.	Total Nitrogen. Guaranteed.	Phosphoric Acid. Water-soluble.	Phosphoric Acid. Citrate-soluble.	Phosphoric Acid. Citrate-insoluble.	Phosphoric Acid. Total. Found.	Phosphoric Acid. Total. Guaranteed.	So-called "Available." Found.	So-called "Available." Guaranteed.	Potash. Found. As Muriate.	Potash. Found. Total.	Potash. Guaranteed.
20625	38.1	0.42	0.10	1.73	2.25	2.1	6.35	2.41	1.36	10.12	10.0	8.76	8.0	6.01	6.01	6.0
20534	38.2	0.51	0.13	1.17	1.81	1.7	7.16	1.73	0.67	9.56	10.0	8.89	8.0	6.25	9.22	10.0
20591	39.2	0.44	0.08	3.46	3.98	4.0	0.96	4.73	2.01	7.70	5.0	5.69	4.0	1.40	6.28	6.0
20623	39.2	0.06	1.69	1.50	3.25	3.3	5.39	1.50	0.49	7.38	7.0	6.89	6.0	9.12	9.43	10.0
20421	39.5	....	....	2.33	2.33	2.5	4.48	4.86	1.89	11.23	9.0	9.34	8.0	6.14	6.14	6.0
20664	39.5	0.56	0.55	1.40	2.51	2.5	5.82	2.30	1.22	9.34	7.0	8.12	6.0	4.82	4.82	5.0
20463	39.9	0.34	0.20	1.18	1.72	1.7	6.97	1.30	0.81	9.08	10.0	8.27	8.0	5.16	5.16	5.0
20352	39.9	2.29	0.96	0.59	3.84	3.7	1.86	6.58	1.24	9.68	8.0	8.44	8.0	0.54	7.57	6.0

Special Manures.

Station No.	Name or Brand.	Manufacturer.	Dealer.	Dealer's cash price per ton.	Valuation per ton.
	Sampled by Station Agent:				
20353	Mapes' Economical Potato Manure	Mapes F. & P. G. Co., N. Y.	A. N. Clark, Milford	$39.00	$27.87
			Mapes' Branch, Hartford	37.00	
			F. S. Bidwell & Co., Windsor Locks	38.00	
20674*	Berkshire Tobacco Special	Berkshire Fertilizer Co., Bridgeport	Manufacturer	**35.00**	24.88
			A. G. Barnes,† New Milford	35.00	
20622	Darling's Potato Manure	American Agricultural Chemical Co., N. Y.	B. F. Eddy, East Woodstock	**32.00**	22.73
			H. W Hewin, R. D., New Hartford	32.00	
20673	Berkshire Grass Special	Berkshire Fertilizer Co., Bridgeport	Avery Bros., Norwich Town	35.00	26.62
			Hotchkiss & Templeton, Waterbury	40.00	
				37.50	
20546	Grass and Lawn Top Dressing	American Agricultural Chemical Co., N. Y.	F. S. Platt Co., New Haven	40.00	26.83
			F. M. Cole, Putnam	37.00	
			Geo. L. Dennis, Stafford Springs	37.00	
				38.00	
20618	Bradley's Complete Manure for Potatoes and Vegetables	American Agricultural Chemical Co., N. Y.	Avery Bros., Norwich Town	38.00	27.55
			Geo. L. Dennis, Stafford Springs	40.00	
				39.00	
20912*	Lister's Special Tobacco Fertilizer	Lister's Agricultural Chemical Works, Newark, N. J.	Wm. Sullivan, New Milford	36.00	22.53
			G. O. Case, R. F. D., Burnside	**32.00**	
20472	Sanderson's Potato Manure	Sanderson Fertilizer & Chemical Co., New Haven	Manufacturer.	**30.00**	21.04
			A. I. Martin, Wallingford	30.00	
			G. W. Eaton Estate, Plainville	30.00	
20595	Great Eastern Vegetable, Vine and Tobacco	American Agricultural Chemical Co., N. Y.	T. E. Greene, Plainfield	32.00	22.75
			L. L. Loomis, Granby	33.00	
				32.50	
20765	Tobacco Starter	Rogers Mfg. Co., Rockfall	E. T. Hurlburt, Somers	34.00	24.65
			Manufacturer	36.00	
			G. H. Sloan, Windsorville	36.00	
				35.25	

* See note page 531.

† Purchaser.

Analyses and Valuations—*Continued.*

Station No.	Percentage difference between cost and valuation.	Nitrogen. As Nitrates.	Nitrogen. As Ammonia.	Nitrogen. Organic.	Total Nitrogen. Found.	Total Nitrogen. Guaranteed.	Phosphoric Acid. Water-soluble.	Phosphoric Acid. Citrate-soluble.	Phosphoric Acid. Citrate-insoluble.	Phosphoric Acid. Total. Found.	Phosphoric Acid. Total. Guaranteed.	So-called "Available." Found.	So-called "Available." Guaranteed.	Potash. Found. As Muriate.	Potash. Found. Total.	Potash. Guaranteed.
20353	39.9	2.40	0.42	0.68	3.50	3.3	0.90	4.87	1.24	7.01	6.0	5.77	4.0	0.88	9.08	8.0
20674	40.7	....	0.64	3.20	3.84	4.1	3.30	1.68	0.51	5.49	4.0	4.98	3.0	0.90	4.64	5.0
20622	40.8	0.46	0.48	1.63	2.57	2.5	5.53	2.11	1.14	8.78	7.0	7.64	6.0	5.62	5.62	5.0
20673	40.9	1.89	0.08	3.05	5.02	5.0	2.23	2.21	0.69	5.13	5.0	4.44	4.0	2.75	2.75	2.0
20546	41.6	3.82	0.10	0.80	4.72	3.9	2.66	3 07	1.34	7.07	6.0	5.73	5.0	3.66	3.66	2.0
20618	41.6	1.30	0.10	1.88	3.28	3.3	6.31	1.99	1.36	9.66	9.0	8.30	8.0	7.11	7.11	7.0
20912	42.0	....	0.20	2.16	2.36	2.1	4.86	4.97	1.45	11.28	10.0	9.83	8.0	1.25	3.25	3.0
20472	42.6	0.26	0.06	1.76	2.08	1.7	3.52	2.87	1.70	8.09	8.0	6.39	5.0	3.59	6.41	6.0
20595	42.9	0.38	0.48	1.32	2.18	2.1	6.09	2.41	1.41	9.91	9.0	8.50	8.0	6.39	6.39	6.0
20765	43.0	0.90	0.17	2.70	3.77	3.8	0.31	4.50	3.89	8.70	5.0	4.81	4.0	0.74	3.84	3.0

Special Manures.

Station No.	Name or Brand.	Manufacturer.	Dealer.	Dealer's cash price per ton.	Valuation per ton.
	Sampled by Station Agent:				
20768	Essex Complete for Potatoes, Roots and Vegetables	Essex Fertilizer Co., Boston, Mass.	W. O. Goodsell, Bristol	$39.00	$27.22
20448	Quinnipiac Potato Phosphate	American Agricultural Chemical Co., N. Y.	C. Buckingham, Southport	29.00	20.57
			G. M. Williams Co., New London	30.00	
				29.50	
20810	Chittenden's Potato Special	Nation'l Fertilizer Co., N. Y.	H. A. Bugbee, Willimantic	35.00	24.37
20816	Sanderson's Corn Superphosphate	Sanderson Fertilizer & Chemical Co., New Haven	Manufacturer	28.00	19.27
20408	Shay's Corn Manure	C. M. Shay Fertilizer Co., Groton	J. P. Barstow, Norwich	31.00	19.49
			Manufacturer	26.00	
				28.50	
20672	Corn King	Armour Fertilizer Works, Baltimore, Md.	T. H. Eldredge, Norwich	32.00	21.89
			S. V. Osborn, Branford	32.00	
20596	Great Eastern Northern Corn Special	American Agricultural Chemical Co., N. Y.	T. E. Greene, Plainfield	32.00	21.53
			O. I. Backus, Danbury	31.00	
				31.50	
20778	Packers' Union Animal Corn Fertilizer	American Agricultural Chemical Co., N. Y.	Geo. A. Forsyth, Waterford	32.00	21.84
20811	N. E. High Grade Potato Fertilizer	New Engl'nd Fertilizer Co., Boston, Mass.	T. B. Atwater, Plantsville	36.00	24.58
20415*	Essex Complete Manure for Potatoes, Roots and Vegetables	Essex Fertilizer Co., Boston, Mass.	W. J. Cox, East Hartford	41.00	27.63
			John Parker, Poquonock	41.00	
			Knowles-Lombard Co., Guilford	40.00	
				40.50	
20538	Bowker's Early Potato Manure	Bowker Fertilizer Co., N. Y.	Wm. Ewald, Cromwell	37.00	26.44
			W. T. McKenzie, Yalesville	39.00	
			A. L. Burdick, Westbrook	40.00	
				38.75	
20819	Sanderson's Top Dressing for Grass and Grain	Sanderson Fertilizer & Chemical Co., New Haven	J. O. Griswold,† Glastonbury	----	25.76
				38.00	
20665	Read's Vegetable and Vine Fertilizer	American Agricultural Chemical Co., N. Y.	A. H. Cashen, Meriden	34.00	22.29
			G. K. Goodwin, East Canaan	32.00	
				33.00	

* See note page 530.

† Purchaser.

Analyses and Valuations—*Continued.*

Station No.	Percentage difference between cost and valuation.	Nitrogen. As Nitrates.	Nitrogen. As Ammonia.	Nitrogen. Organic.	Total Nitrogen. Found.	Total Nitrogen. Guaranteed.	Phosphoric Acid. Water-soluble.	Phosphoric Acid. Citrate-soluble.	Phosphoric Acid. Citrate-insoluble.	Phosphoric Acid. Total. Found.	Phosphoric Acid. Total. Guaranteed.	So-called "Available." Found.	So-called "Available." Guaranteed.	Potash. Found. As Muriate.	Potash. Found. Total.	Potash. Guaranteed.
20768	43.3	----	0.83	2.28	3.11	**3.3**	4.07	2.48	0.69	7.24	**7.0**	6.55	**6.0**	9.86	9.86	**10.0**
20448	43.4	0.30	0.16	1.64	2.10	**2.1**	6.32	2.90	1.59	10.81	**9.0**	9.22	**8.0**	3.07	3.07	**3.0**
20810	43.6	----	1.15	1.05	2.20	**2.5**	4.07	2.49	1.00	7.56	**6.0**	6.56	**5.0**	10.96	10.96	**10.0**
20816	45.3	0.15	0.04	1.79	1.98	**1.7**	4.03	4.01	2.19	10.23	**9.0**	8.04	**7.0**	3.19	3.19	**2.0**
20408	46.2	----	---	2.16	2.16	**2.5**	3.90	3.33	1.07	8.30	**8.0**	7.23	----	3.88	3.88	**4.5**
20672	46.2	0.17	0.83	1.64	2.64	**3.0**	6.77	1.41	0.56	8.74	**9.0**	8.18	**8.0**	3.97	3.97	**4.0**
20596	46.3	0.56	0.28	1.66	2.50	**2.5**	7.10	2.22	1.55	10.87	**11.0**	9.32	**9.0**	2.29	2.29	**2.0**
20778	46.5	0.55	0.21	1.70	2.46	**2.5**	7.65	1.91	1.70	11.26	**11.0**	9.56	**9.0**	2.40	2.40	**2.0**
20811	46.5	----	0.04	2.56	2.60	**2.5**	6.43	2.15	0.43	9.01	**9.0**	8.58	**8.0**	6.35	6.35	**6.0**
20415	46.6	0.14	1.20	1.98	3.32	**3.3**	4.16	2.54	0.64	7.34	**7.0**	6.70	**6.0**	9.50	9.50	**10.0**
20538	46.6	0.40	1.37	1.55	3.32	**3.3**	6.01	2.02	1.16	9.19	**8.0**	8.03	**7.0**	6.48	6.48	**7.0**
20819	47.5	1.40	0.04	1.72	3.16	**4.0**	2.21	4.83	1.93	8.97	----	7.04	**7.0**	7.13	7.13	**7.0**
20665	48.0	----	0.62	1.44	2.06	**2.1**	6.42	2.44	1.14	10.00	**9.0**	8.86	**8.0**	6.05	6.05	**6.0**

Special Manures.

Station No.	Name or Brand.	Manufacturer.	Dealer.	Dealer's cash price per ton.	Valuation per ton.
	Sampled by Station Agent:				
20467*	Essex Complete Manure for Corn, Grain and Grass	Essex Fertilizer Co., Boston, Mass.	W. J. Cox, East Hartford	$41.00	$27.50
			John Parker, Poquonock	40.00	
			H. C. Thompson, Plainville	41.50	
				40.75	
20400	Bradley's Potato Manure	American Agricultural Chemical Co., N. Y.	John Parker, Poquonock	34.00	22.67
			Spencer Bros., Suffield	34.00	
			J. W. Potter & Son, Norwich	33.00	
				33.75	
20533	Williams & Clark's Potato Phosphate	American Agricultural Chemical Co., N. Y.	D. B. Wilson Co., Waterbury	35.00	22.59
			Geo. Beaumont, Wallingford	34.00	
			W. H. H. Chappell, Chesterfield	32.00	
				33.75	
20697	Essex Tobacco Starter and Grower	Essex Fertilizer Co., Boston, Mass.	W. J. Cox, East Hartford	39.00	26.27
			John Parker, Poquonock	40.00	
				39.50	
20586	Bowker's Tobacco Starter	Bowker Fertilizer Co., N. Y.	Bowker's Branch, Hartford	**34.00**	22.57
			Warner & Hardin, Glastonbury	----	
			F. R. Green, New Milford	34.00	
20619	Crocker's Potato, Hop and Tobacco	American Agricultural Chemical Co., N. Y.	F. M. Loomis, North Granby	**31.00**	20.53
			L. L. Loomis, Granby	31.00	
20506	Wilcox's Potato Fertilizer	Wilcox Fertilizer Co., Mystic	N. H. Dayton, New London	30.00	19.99
			Manufacturer	28.50	
			W. R. McDonald, Cromwell	32.00	
				30.25	
20584	Williams & Clark's Potato Manure	American Agricultural Chemical Co., N. Y.	R. B. Witter, Brooklyn	30.00	20.43
			Carlos Bradley, Ellington	32.00	
			Collinsville Grain Co., Collinsville	**31.00**	
20582	Crocker's Ammoniated Corn Phosphate	American Agricultural Chemical Co., N. Y.	F. M. Loomis, North Granby	----	19.41
			C. H. Wheeler, East Canaan	30.00	
			L. L. Loomis, Granby	29.00	
				29.50	

* See note page 531.

Analyses and Valuations—*Continued.*

Station No.	Percentage difference between cost and valuation.	Nitrogen. As Nitrates.	Nitrogen. As Ammonia.	Nitrogen. Organic.	Total Nitrogen. Found.	Total Nitrogen. Guaranteed.	Phosphoric Acid. Water-soluble.	Phosphoric Acid. Citrate-soluble.	Phosphoric Acid. Citrate-insoluble.	Total. Found.	Total. Guaranteed.	So-called "Available." Found.	So-called "Available." Guaranteed.	Potash. Found. As Muriate.	Potash. Found. Total.	Potash. Guaranteed.
20467	48.1	0.09	1.32	1.84	3.25	3.3	4.48	2.37	0.56	7.41	7.0	6.85	6.0	9.62	9.62	10.0
20400	48.9	0.30	0.34	1.98	2.62	2.5	5.50	1.96	1.65	9.11	7.0	7.46	6.0	5.09	5.09	5.0
20533	49.4	0.47	0.70	1.51	2.68	2.5	5.76	1.97	1.06	8.79	7.0	7.73	6.0	5.01	5.01	5.0
20697	50.4	0.81	0.12	2.95	3.88	4.0	1.46	3.40	0.77	5.63	5.0	4.86	4.0	1.12	6.09	6.0
20586	50.6	----	0.99	1.46	2.45	2.5	7.23	2.30	1.34	10.87	10.0	9.53	8.0	1.00	3.42	3.0
20619	51.0	----	0.72	1.42	2.14	2.1	7.16	1.92	1.09	10.17	9.0	9.08	8.0	3.36	3.36	3.0
20506	51.3	----	0.63	1.54	2.17	2.1	1.84	4.47	2.16	8.47	7.0	6.31	----	3.69	5.30	4.5
20584	51.7	0.28	0.53	1.44	2.25	2.1	6.60	1.93	1.15	9.68	9.0	8.53	8.0	3.33	3.33	3.0
20582	52.0	----	0.42	1.80	2.22	2.1	6.72	1.80	1.20	9.72	9.0	8.52	8.0	2.05	2.05	1.5

Special Manures.

Station No.	Name or Brand.	Manufacturer.	Dealer.	Dealer's cash price per ton.	Valuation per ton.
	Sampled by Station Agent:				
20658	E. Frank Coe's New Englander Corn and Potato Fertilizer	Coe-Mortimer Co., N. Y.	W. E. Warner & Bro., Westville	$29.00	$18.94
			W. A. Burr, West Hartford	37.00	
20401	Bradley's Potato Fertilizer	American Agricultural Chemical Co., N. Y.	John Parker, Poquonock	32.00	20.72
			H. K. Brainard, Thompsonville	32.00	
			J. W. Potter & Son, Norwich	31.00	
				31.75	
20717	North Western 10% Potato Fertilizer	North Western Fertilizer Co., Detroit, Mich.	F. S. Platt Co., New Haven	38.00	24.46
			D. B. Wilson Co., Waterbury	38.00	
20698	Essex Grass and Top Dressing	Essex Fertilizer Co., Boston, Mass.	W. J. Cox, East Hartford	45.00	28.53
			John Parker, Poquonock	44.00	
				44.50	
20581	Bradley's Corn Phosphate	American Agricultural Chemical Co., N. Y.	J. G. Potter & Son, Norwich	29.00	19.04
			G. L. Dennis, Stafford Springs	31.00	
			D. L. Clarke, Milford	29.00	
				29.75	
20583	Williams & Clark's Corn Phosphate	American Agricultural Chemical Co., N. Y.	Geo. Beaumont, Wallingford	32.00	19.18
			W. H. H. Chappell, Chesterfield	30.00	
			Collinsville Grain Co., Collinsville	29.00	
				30.25	
20464	Bowker's Potato and Vegetable Fertilizer	Bowker Fertilizer Co., N. Y.	Bowker's Branch, Hartford	34.00	22.13
			A. R. Manning, Yantic	36.00	
				35.00	
20535	Berkshire Potato and Vegetable Phosph'te	Berkshire Fertilizer Co., Bridgeport	Avery Brothers, Norwich Town	31.00	19.40
			Hotchkiss & Templeton, Waterbury	32.00	
			Johnson Bros., Jewett City	30.00	
20667	Wheeler's Potato Manure	American Agricultural Chemical Co., N. Y.	W. A. Collins, Columbia	31.00	19.70
			M. K. Gray, Thomaston	32.00	
				31.50	

Analyses and Valuations—*Continued.*

Station No.	Percentage difference between cost and valuation.	Nitrogen.					Phosphoric Acid.							Potash.		
		As Nitrates.	As Ammonia.	Organic.	Total Nitrogen. Found.	Total Nitrogen. Guaranteed.	Water-soluble.	Citrate-soluble.	Citrate-insoluble.	Total. Found.	Total. Guaranteed.	So-called "Available." Found.	So-called "Available." Guaranteed.	Found. As Muriate.	Found. Total.	Guaranteed.
20658	53.1	0.13	0.36	1.07	1.56	0.8	5.80	4.05	1.16	11.01	9.0	9.85	7.5	2.56	3.29	3.0
20401	53.2	0.47	0.16	1.54	2.17	2.1	6.97	1.89	1.69	10.55	9.0	8.86	8.0	3.25	3.25	3.0
20717	55.4	----	0.48	1.22	1.70	1.7	6.84	1.85	0.88	9.57	9.0	8.69	8.0	10.50	10.50	10.0
20698	56.0	0.30	0.68	2.46	3.44	4.0	4.99	2.03	0.81	7.83	8.0	7.02	7.0	9.19	9.19	8.0
20581	56.3	0.30	0.16	1.54	2.00	2.1	7.04	2.00	1.65	10.69	10.0	9.04	8.0	1.83	1.83	1.5
20583	57.7	0.34	0.36	1.48	2.18	2.1	6.08	2.77	1.46	10.31	9.0	8.85	8.0	1.69	1.69	1.5
20464	58.2	0.39	0.61	1.45	2.45	2.5	6.33	2.27	1.57	10.17	9.0	8.60	8.0	4.24	4.24	4.0
20535	59.8	----	0.12	1.94	2.06	1.7	4.39	2.85	1.10	8.34	8.0	7.24	6.0	4.28	4.28	4.0
20667	59.9	0.35	0.43	1.31	2.09	2.1	5.83	2.48	1.57	9.88	9.0	8.31	8.0	3.33	3.33	3.0

Special Manures.

Station No.	Name or Brand.	Manufacturer.	Dealer.	Dealer's cash price per ton.	Valuation per ton.
	Sampled by Station Agent:				
20416	Essex Market Garden and Potato Manure	Essex Fertilizer Co., Boston, Mass.	W. J. Cox, East Hartford	$35.00	$22.00
			John Parker, Poquonock	36.00	
			W. O. Goodsell, Bristol	35.00	
				35.25	
20599	Lister's Corn and Potato Fertilizer	Lister's Agricultural Chemical Works, Newark, N. J.	J. A. Foster, Stafford	28.00	19.67
			Wm. Sullivan, New Milford	36.00	
				32.00	
20815	P. & P. Potato Fertilizer	Parmenter & Polsey, Boston, Mass.	Arthur Williams, South Woodstock	------	19.09
				31.00	
20407	Mapes' Corn Manure	Mapes F. & P. G. Co., N. Y.	Mapes' Branch, Hartford	36.00	23.14
			F. S. Bidwell & Co., Windsor Locks	37.00	
			J. P. Barstow, Norwich	37.00	
				38.00	
20663	Quinnipiac Corn Manure	American Agricultural Chemical Co., N. Y.	J. P. Lathrop, Plainfield	30.00	18.44
			Young Bros. Co., Danielson	31.00	
				30.50	
20447	Armour's Grain Grower	Armour Fertilizer Works, Baltimore, Md.	Lightbourn & Pond Co., New Haven	29.00	17.83
			T. H. Eldredge, Norwich	30.00	
				29.50	
20701	Mapes' Fruit and Vine Manure	Mapes F. & P. G. Co., N. Y.	Birdsey & Raven, Meriden	**43.00**	25.81
			Southington Lumber Co., Southington	42.00	
20671	Complete Potato	Armour Fertilizer Works, Baltimore, Md.	S. V. Osborn, Branford	**32.00**	19.12
20420	Swift's Lowell Potato Manure	Swift's Lowell Fertilizer Co., Boston, Mass.	Standard Feed Co. Bridgeport	29.00	17.72
			Edward White, Rockville	30.00	
			A. S. Bennett, Cheshire	30.00	
				29.75	
20666	Wheeler's Corn Fertilizer	American Agricultural Chemical Co., N. Y.	W. A. Collins, Columbia	**30.00**	17.86
			M. K. Gray, Thomaston	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. Water-soluble.	Phosphoric Acid. Citrate-soluble.	Phosphoric Acid. Citrate-insoluble.	Phosphoric Acid. Total. Found.	Phosphoric Acid. Total. Guaranteed.	So-called "Available." Found.	So-called "Available." Guaranteed.	Potash. Found. As Muriate.	Potash. Found. Total.	Potash. Guaranteed.
20416	60.2	0.10	0.12	1.91	2.13	**2.0**	5.44	3.49	1.14	10.07	**9.0**	8.93	**8.0**	5.11	5.11	**5.0**
20599	62.7	----	0.14	1.74	1.88	**1.7**	5.76	3.30	1.01	10.07	**9.0**	9.06	**8.0**	3.44	3.44	**3.0**
20815	62.9	----	0.10	1.63	1.73	**1.6**	4.53	2.26	0.63	7.42	**7.0**	6.79	**6.0**	6.18	6.18	**6.0**
20407	64.2	0.18	1.79	0.51	2.48	**2.5**	1.07	6.72	3.58	11.37	**10.0**	7.79	**8.0**	6.54	6.54	**6.0**
20663	65.4	0.52	0.10	1.38	2.00	**2.1**	6.22	2.39	1.73	10.34	**10.0**	8.61	**8.0**	1.71	1.71	**1.5**
20447	65.5	0.09	0.15	1.35	1.59	**1.7**	7.43	1.42	1.06	9.91	**10.0**	8.85	**8.0**	2.71	2.71	**2.0**
20701	66.6	1.64	0.10	0.48	2.22	**1.7**	0.74	5.78	1.10	7.62	**7.0**	6.52	**5.0**	1.00	11.19	**10.0**
20671	67.3	0.11	0.30	1.24	1.65	**1.7**	5.91	1.45	0.84	8.20	**8.0**	7.36	**7.0**	5.92	5.92	**6.0**
20420	67.9	----	---	1.72	1.72	**1.7**	4.46	3.03	0.43	7.92	**8.0**	7.49	**7.0**	3.89	3.89	**4.0**
20666	68.0	0.30	0.17	1.27	1.74	**1.7**	6.68	1.89	1.66	10.23	**9.0**	8.57	**8.0**	2.24	2.24	**2.0**

Special Manures.

Station No.	Name or Brand.	Manufacturer.	Dealer.	Dealer's cash price per ton.	Valuation per ton.
	Sampled by Station Agent:				
20834	Grass and Oats	American Agricultural Chemical Co., N. Y.	F. M. Loomis, North Granby	----	$13.67
			L. L. Loomis, Granby	$23.00	
20770	Special Corn Fertilizer	Lister's Agricultural Chemical Works, Newark, N. J.	G. O. Case, R. F. D., Burnside	32.00	18.93
20694	Bowker's Potato and Vegetable Phosphate	Bowker Fertilizer Co., N. Y.	Bowker's Branch, Hartford	30.00	18.81
			J. P. Barstow & Co., Norwich	35.00	
				32.50	
20785	Bowker's Lawn and Garden Dressing	Bowker Fertilizer Co., N. Y.	Lightbourn & Pond Co., New Haven	45.00	25.19
20418	New England Potato Fertilizer	New England Fertilizer Co., Boston, Mass.	Rockville Milling Co., Rockville	31.00	17.62
			A. R. Manning, Yantic	30.00	
			T. B. Atwater, Plantsville	35.00	
				32.00	
20537	Bowker's Corn Phosphate	Bowker Fertilizer Co., N. Y.	A. R. Manning, Yantic	32.00	17.55
			W. T. McKenzie, Yalesville	34.00	
			A. L. Burdick, Westbrook	30.00	
20700	Mapes' Cereal Brand	Mapes F. & P. G. Co., N. Y.	A. N. Clark, Milford	32.00	17.53
			Mapes' Branch, Hartford	30.00	
20661	New England Corn and Grain Fertilizer	New England Fertilizer Co., Boston, Mass.	Rockville Milling Co., Rockville	28.00	15.01
			A. R. Manning, Yantic	28.00	
20626	Read's Practical Potato Special	American Agricultural Chemical Co., N. Y.	A. I Martin, Wallingford	30.00	16.02
			C. W. Fulton, West Hartford	30.00	
	Sampled by purchasers and others:		*Sent by*		
20651	Formula B for Tobacco	Sanderson Fertilizer & Chemical Co., New Haven	F. N. Buckland, R. F. D., Glastonbury	32.30	24.31
20652	Tobacco Starter and Grower	American Agricultural Chemical Co., N. Y.	F. N. Buckland, R. F. D., Glastonbury	36.00	26.97
20361	Darling's Potato Fertilizer	American Agricultural Chemical Co., N. Y.	Adolph Greenbacher, Meriden	33.00	21.75

Analyses and Valuations—*Concluded.*

Station No.	Percentage difference between cost and valuation.	Nitrogen. As Nitrates.	Nitrogen. As Ammonia.	Nitrogen. Organic.	Total Nitrogen. Found.	Total Nitrogen. Guaranteed.	Phosphoric Acid. Water-soluble.	Phosphoric Acid. Citrate-soluble.	Phosphoric Acid. Citrate-insoluble.	Phosphoric Acid. Total. Found.	Phosphoric Acid. Total. Guaranteed.	Phosphoric Acid. So-called "Available." Found.	Phosphoric Acid. So-called "Available." Guaranteed	Potash. Found. As Muriate.	Potash. Found. Total.	Potash. Guaranteed.
20834	68.3	----	---	---	----	--	8.67	2.73	1.84	13.24	**12.0**	11.40	**11.0**	2.12	2.12	**2.0**
20770	69.0	0.30	0.10	1.34	1.74	**1.7**	5.67	3.22	1.50	10.39	**9.0**	8.89	**8.0**	3.30	3.30	**3.0**
20694	72.8	----	0.14	1.68	1.82	**1.7**	6.40	2.83	1.65	10.88	**10.0**	9.23	**9.0**	2.14	2.14	**2.0**
20785	78.6	----	0.84	2.62	3.46	**3.0**	1.93	4.30	2.06	8.29	**8.0**	6.23	**4.0**	5.75	5.75	**5.0**
20418	81.6	----	0.09	1.51	1.60	**1.6**	4.93	2.71	0.47	8.11	**8.0**	7.64	**7.0**	4.18	4.18	**4.0**
20537	82.3	0.18	0.12	1.40	1.70	**1.7**	5.22	3.04	1.97	10.23	**9.0**	8.26	**8.0**	2.32	2.32	**2.0**
20700	82.5	0.04	1.37	0.66	2.07	**1.7**	0.52	6.37	1.59	8.48	**8.0**	6.89	**6.0**	3.51	3.51	**3.0**
20661	86.5	0.07	0.08	1.31	1.46	**1.2**	4.81	2.36	0.79	7.96	**8.0**	7.17	**7.0**	2.18	2.18	**2.0**
20626	87.3	----	0.11	0.85	0.96	**0.8**	2.78	1.95	0.80	5.53	**5.0**	4.73	**4.0**	8.58	8.58	**8.0**
20651	32.9	0.90	0.07	2.53	3.50	**3.3**	1.93	3.79	2.56	8.28	**10.0**	5.72	**6.0**	1.10	4.16	**6.0**
20652	33.5	----	1.68	1.81	3.49	**3.3**	7.54	1.51	0.74	9.79	**9.0**	9.05	**8.0**	0.40	4.53	**4.0**
20361	51.7	----	1.10	1.48	2.58	**2.5**	4.99	2.17	0.99	8.15	**7.0**	7.16	**6.0**	5.28	5.28	**5.0**

The table shows that among fertilizers made by reputable manufacturers and containing practically all that is guaranteed for them, there are some which supply more than twice as much nitrogen and a little less than twice as much potash and about the same amount of phosphoric acid as others for the same money.

Another point worthy of notice is that this table, compared with the table of analyses in which the several brands are arranged in order of their percentage difference, shows that as the percentage difference between cost and valuation increases, the probable economy of purchase decreases.

2. *Sampled by Purchasers and Others.*

In the table on pages 554 and 555 are three analyses of special manures, made on samples drawn by others than station agents.

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

In the table on page 558 are given eighteen analyses of samples representing nine brands of this class of special manures.

All of these mixtures are claimed to contain potash, largely in form of carbonate, and "available" phosphoric acid. The trade name "available phosphoric acid" has already been discussed on page 483 of this report. It should be added that in strongly alkaline mixtures, like these special tobacco manures, from which the alkali cannot be fully removed by washing with water and which contain no considerable amount of water-soluble phosphates, the conditions prescribed for the use of the ammonium citrate cannot be maintained, and the term "available" phosphoric acid has no definite significance and is of no use in fixing the value of the fertilizer. It is a perfectly meaningless term as applied to such goods as these.

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

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

Our experiments, as well as the experience of growers of tobacco in Connecticut, have also proved that some form of carbonate is one of the best sources from which to supply potash to the tobacco crop.

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

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

Guaranties.

One-half the number of tobacco specials contained less water-soluble potash than the guaranty and one was deficient in nitrogen.

The cause of some of these discrepancies is, no doubt, that manufacturers in some cases have based their guaranty on the total quantity of potash contained in the potash salts, in the ashes and in the various nitrogenous matters from which the mixtures are made; whereas, the station determines only the potash which is soluble in boiling water. Cotton hull ashes may contain from one to three per cent. of potash insoluble in water but soluble in strong acids. This acid-soluble potash is quite certainly less available to plants than the water-soluble part. It should not be regarded in a valuation.

Tobacco Fertilizers containing Carbonates.

Station No.	Name or Brand.	Manufacturer.	Dealer or Purchaser.
20545	Complete Tobacco Manure	Am'n Agric'l Chem'l Co., N. Y. City	S. J. Stevens, Glastonbury A. D. Bridges' Sons, Hazardville
20753	" " "	Am'n Agric'l Chem'l Co., N. Y. City	Carlos Bradley, Ellington S. B. Warner, Windsor C. M. Beach, New Milford
20817	Bowker's Alkaline Tobacco Grower	Bowker Fertilizer Co., N. Y. City	E. H. Austin, Gaylordsville George Smith, Suffield
20692	" " " "	" " " " "	George Thompson, Suffield Bowker's Branch, Hartford
20517	Bowker's Ash	" " " " "	Wm. Ewald, Cromwell E. N. Austin, Suffield
20524	" "	" " " " "	Chas. A. Prout, Suffield
20656	" "	" " " " "	A. D. Bridges' Sons, Hazardville
20818	" "	" " " " "	Newell St. John, Simsbury Bowker's Branch, Hartford Seth Veits, West Suffield A. W. Blanchard, East Hartford Bowker's Branch, Hartford
20491*	Tobacco Ash Constituents	Mapes F. & P.G. Co., N.Y. City	Harry W. Mohn, Warehouse Pt.
20702	" " "	" " " " " "	Spencer Bros., Suffield
20712	Tobacco Starter Improved	" " " " " "	Mapes Branch, Hartford Spencer Bros., Suffield
20711	Tobacco Manure, Wrapper Brand	" " " " " "	F. S. Bidwell Co., Windsor Locks Mapes Branch, Hartford A. D. Bridges' Sons, Hazardville
20344	Chittenden's Tobacco Special with Carbonate	National Fertilizer Co., N. Y. City	E. Linn Pease, Thompsonville
20809	Chittenden's Tobacco Special with Carbonate	National Fertilizer Co., N. Y. City	J. M. Lasbury, Broad Brook
20805	Chittenden's Conn. Valley Tobacco Grower	National Fertilizer Co., N. Y. City	" " " " "
20734	Complete Tobacco Fertilizer	Olds & Whipple, Hartford	R. M. Thompson, R. D., South Manchester
20733	" " "	" " " "	R. C. Hyde, Vernon
20470	" " "	" " " "	Manufacturer

*Stock of 1907.

Moreover, a part of the potash contained in vegetable matters, like cotton seed meal, is not dissolved by boiling water, although it is generally assumed—though not proved by experiment as far as we know—that this water-insoluble potash becomes quickly available to crops.

The methods of the Association of Official Agricultural Chemists, which are followed by this station and by all American stations which do fertilizer control work, recognize only the potash which becomes soluble on boiling with water for a half hour.

Manufacturers should make their guaranties cover only water-soluble forms. It is this which the buyer wants, and any other

Analyses and Valuations.

Cost per ton.	Valuation per ton.	Nitrogen.					Phosphoric Acid.							Potash.					Chlorine.	Sulphuric acid.
		As Nitrates.	As Ammonia.	Organic.	Total. Found.	Total. Guaranteed.	Water-soluble.	Citrate-soluble.	Citrate-insoluble.	Total. Found.	Total. Guaranteed.	So-called "Available." Found.	So-called "Available." Guaranteed.	Calculated as chloride.	Calculated as sulphate.	Calculated as carbonate.	Water-soluble.	Guaranteed.		
$35.00 38.00	$29.70	----	0.20	4.42	4.62	**4.5**	0.13	4.21	3.40	7.74	**4.0**	4.34	**3.0**	0.90	2.49	1.47	4.86	**5.5**	0.68	2.12
36.50 35.00 36.00	29.68	----	0.12	4.42	4.54	**4.5**	0.27	3.84	3.44	7.55	**4.0**	4.11	**3.0**	0.74	2.62	1.74	5.10	**5.5**	0.56	2.23
---- 35.00	32.80	----	0.07	3.76	3.83	**4.0**	0.38	7.26	3.61	11.25	**5.0**	7.64	**4.0**	1.00	2.35	3.49	6.84	**5.0**	0.75	2.00
35.00 35.00	31.09	----	0.05	4.19	4.24	**4.0**	0.40	5.60	5.13	11.13	**5.0**	6.00	**4.0**	1.10	1.60	2.31	5.01	**5.0**	0.83	1.36
38.00 32.00	23.82	----	----	0.09	0.09	----	1.70	9.99	5.22	16.91	----	11.69	----	0.77	10.01	----	10.78	----	0.58	12.65
32.00	23.60	----	----	0.20	0.20	----	0.83	8.60	4.67	14.10	**7.0**	9.43	**6.0**	1.32	11.22	----	12.54	**15.0**	0.99	14.70
35.00	24.20	----	0.12	0.03	0.15	----	0.84	7.13	4.16	12.13	**7.0**	7.97	**6.0**	1.65	13.34	----	14.99	**15.0**	1.24	----
33.00 33.00 33.00 34.00 34.00	23.01	----	----	0.15	0.15	----	0.42	7.80	2.74	10.96	**7.0**	8.22	**6.0**	1.62	12.47	----	14.09	**15.0**	1.22	----
----	----	----	----	----	0.68	----	----	----	----	6.67	----	----	----	----	----	----	15.62	----	----	----
35.00	28.32	----	0.04	0.76	0.80	**0.5**	----	2.63	3.80	6.43	**5.7**	2.63	----	1.70	4.12	9.75	15.57	**15.0**	1.28	3.50
34.00 38.00	28.28	3.72	0.08	0.96	4.76	**4.1**	0.04	7.96	0.90	8.90	**8.0**	8.00	**6.0**	0.48	2.33	----	2.81	**1.0**	0.36	8.03
38.00 49.00 50.00	47.00	3.20	0.03	3.55	6.78	**6.2**	----	3.12	2.30	5.42	**4.5**	3.12	----	1.20	2.12	8.51	11.83	**10.5**	0.90	1.80
37.00	29.69	0.16	0.22	4.47	4.85	**4.5**	0.14	4.36	2.51	7.01	**5.0**	4.50	**3.0**	0.49	1.92	1.64	4.05	**5.5**	0.37	1.63
36.00	30.13	----	0.12	4.54	4.66	**4.5**	0.26	4.67	1.82	6.75	**4.0**	4.93	**3.0**	0.82	2.73	1.55	5.10	**5.5**	0.62	2.32
48.00	35.61	----	0.10	4.84	4.94	**4.9**	0.20	4.89	0.67	5.76	**5.0**	5.09	**4.0**	0.20	0.65	6.08	6.93	**8.0**	0.15	0.55
36.00	32.49	1.08	0.02	4.02	5.12	**4.5**	0.51	2.93	0.12	3.56	----	3.44	**3.0**	0.40	1.26	4.46	6.12	**5.5**	0.30	1.07
36.00	32.33	0.98	0.10	4.07	5.15	**4.5**	0.58	3.13	0.15	3.86	----	3.71	**3.0**	0.70	1.22	3.99	5.91	**5.5**	0.53	1.04
36.00	31.76	0.76	0.10	4.30	5.16	**4.5**	0.64	3.83	1.09	5.56	----	4.47	**3.0**	0.62	1.32	2.87	4.81	**5.5**	0.47	1.12

method of extraction includes the acid-soluble potash of ashes and of other forms inferior to ashes, which is certainly of very subordinate agricultural value.

HOME MIXTURES.

In the following table are analyses of fourteen samples of mixtures, which were prepared, with the three exceptions marked by asterisks, on the farm, from the materials which are in each case specified. The cost covers only the chemicals delivered and does not include the cost of mixing, which may be safely estimated at about $2.00 per ton. Making this allowance and excluding Nos. **20550** and **25551**, which were probably bought

HOME MIXTURES. FORMULAS,

Station No.	Made by or for	Formulas. Pounds per Ton of — Nitrate of Soda.	Dried Blood.	Cotton Seed Meal.	Dry Fish.	Bone.	Tankage.	Acid Phosphate.	High Grade Sulphate of Potash.	Double Sulphate of Potash.
20314	A. H. Birkett, Milford	200	500	---	---	---	500	400	400	---
20315	A. H. Birkett, Milford	300	360	---	---	---	400	600	340	---
20354	Charles R. Treat, Orange	165	---	---	---	---	890	545	---	---
20438	H. E. Clark, Middlebury	400	200	---	---	700	---	---	300	---
20550	Conn. School for Boys, Meriden (Grass)	500	---	---	---	---	500	400	---	---
20551	Conn. School for Boys, Meriden (Potatoes and Vegetables)	100	---	---	---	---	750	750	---	200
20552	H. H. McKnight, Ellington, (Top Dressing)	857	---	---	102	408	----	327	---	---
20654	F. N. Buckland, Glastonbury, (Tobacco)	---	---	303	970	---	---	---	---	---
20655	R. C. Merrill, West Haven	133	---	---	---	147	1093	200	224	---
20687	A. R. Tucker, Middlefield	---	---	---	---	200	1400	---	---	---
20749	H. H. McKnight, Ellington, (Corn)	250	---	---	500	300	----	500	---	---
20751	W. I. Gelston, East Haddam, (Potatoes)	833	---	---	---	---	--	833	334	---
20791	C. M. Abbe, New Haven	---	---	---	---	---	1300	300	---	---
20822	D. W. Meeker, West Cheshire	101	---	---	---	---	608	608	---	---

at car rates, the average composition, cost and valuation of these other mixtures is given below, and, for comparison, the same particulars regarding the nitrogenous superphosphates and special manures, previously noticed in this report.

	Home Mixtures.	Nitrogenous Superphosphates. Average.	Nitrogenous Superphosphates. First 14 in the table.	Special Manures. Average.	Special Manures. First 12 in the table.
Nitrogen	4.94	2.67	4.10	3.12	4.58
Phosphoric acid	8.88	9.63	8.98	9.49	11.69
Potash	9.54	4.68	6.95	6.42	8.95
Cost per ton	$35.65	32.28	33.40	35.67	38.70
Valuation per ton	$34.64	23.03	34.07	26.04	34.81

Regarding the economy of home mixing, nothing need be added to the discussion found on page 107 of this report.

COTTON HULL ASHES AND COTTON BOLL ASHES.

This material is the ashes of the hulls, which are separated from the "meats" of the cotton seed preliminary to the expres-

ANALYSES AND VALUATIONS.

Mixture. Muriate of Potash.	Kainit.	Plaster.	A. A. C. Co.'s Tobacco Starter and Grower.	Analyses. Nitrogen as Nitrate.	Nitrogen as Ammonia.	Nitrogen, Organic.	Total Nitrogen.	Water-Soluble Phosphoric Acid.	Citrate-Soluble Phosphoric Acid.	Citrate-Insoluble Phosphoric Acid.	Total Phosphoric Acid.	Potash.	Cost and Valuation. Cost per ton.	Valuation per ton.
---	---	---	---	1.64	0.10	3.33	5.07	2.26	3.03	2.60	7.89	10.44	$37.25*	$36.36
---	---	---	---	2.39	0.09	2.24	4.72	3.40	2.94	1.71	8.05	10.55	35.94*	35.43
400	---	---	---	1.56	0.10	2.48	4.14	3.79	3.80	1.74	9.33	9.31	29.00	32.11
---	---	400	---	3.14	0.05	1.99	5.18	---	3.32	5.16	8.48	7.69	32.50*	32.53
250	350	---	---	3.66	0.04	1.80	5.50	1.93	2.88	0.93	5.74	9.27	31.01	33.83
200	---	---	---	0.85	0.07	2.36	3.28	3.84	4.06	1.87	9.77	8.04	25.10	28.37
306	---	---	---	6.37	0.03	1.32	7.72	0.95	4.18	2.62	7.75	7.73	41.00	41.42
---	---	---	727	---	0.67	5.01	5.68	2.80	2.97	0.60	6.37	2.30	34.37	30.85
203	---	---	---	0.85	0.15	4.14	5.14	0.82	6.20	3.29	10.31	9.90	32.00	37.13
400	---	---	---	---	0.23	3.69	3.92	0.36	6.65	7.79	14.80	9.18	31.80	33.21
450	---	---	---	1.94	0.08	2.39	4.41	1.16	4.77	3.42	9.35	11.35	33.63	33.72
---	---	---	---	6.31	0.14	0.32	6.77	3.94	1.03	0.38	5.35	10.13	38.09	39.99
400	---	---	---	---	0.10	4.42	4.52	0.97	6.12	3.94	11.03	8.89	28.00	34.09
683	---	---	---	0.59	0.06	1.31	1.96	1.66	4.82	1.39	7.87	17.00	34.40	28.77

* Includes cost of mixing.

sion of cotton seed oil. For a time these ashes were abundant in our market and were the most generally satisfactory potash fertilizer for tobacco ever offered in Connecticut.

The more extensive use of hulls in cattle feeding at the south, however, has greatly diminished the supply and raised the price.

20917. Sold by Humphreys, Godwin & Co., Memphis, Tenn. Sampled from stock of Spencer Bros., Suffield, by S. R. Spencer.

20309. Sold by Arthur Sikes, Suffield. Sampled and sent by J. C. Eddy, Simsbury.

20312, 20311, 20571, 20373, 20572 and **20372.** Sold by Olds & Whipple, Hartford; **20312,** sampled and sent by Geo. A. Peckham, Suffield; **20311,** by Edward Perkins, Suffield; **20571,** by Alfred H. Griffin, Granby; **20373,** by Oscar J. Hazard, Suffield; **20572,** by E. S. Seymour, Suffield; **20372,** by H. W. Prout, Suffield.

20646. Mexican Cotton Hull Ashes, sold by Humphreys, Godwin & Co. Sampled and sent by S. R. Spencer, Suffield.

ANALYSES OF COTTON HULL ASHES.

Station No.	20917	20309	20312	20311	20571	20373	20572	20372	20646
Percentage amounts of									
Water-soluble potash found	18.04	26.91	24.64	24.24	22.07	23.64	23.46	22.51	25.18
Water-soluble potash guar.		27.00	22.20	22.20	23.00	22.00	22.00	22.00	25.00
Cost per ton	$35.08*	51.00	50.00	50.00	50.10	50.00	50.00	50.00	56.66†
Water-soluble potash costs cents per lb.	**8.2**	**8.3**	**8.9**	**9.0**	**9.1**	**9.2**	**9.2**	**9.7**	**10.0**

With one exception, all the samples here reported have met their guaranty.

The average of twenty analyses of cotton hull ashes, made in recent years, shows 0.82 per cent. of water-soluble, 6.72 per cent. of citrate-soluble and 0.78 per cent. of citrate-insoluble phosphoric acid.

The "valuation" of these quantities of phosphoric acid, at the present rates, amounts to $6.42 per ton. In each case we have, therefore, deducted this amount from the cost and divided the remainder by the number of pounds per ton of water-soluble potash found, to calculate the cost of this potash per pound.

In the nine samples examined, the cost per pound of potash has ranged from 8.2 to 10 cents; the average being about 9.1 cents, a fraction of a cent lower than last year.

WOOD ASHES.

(TABLE OF ANALYSES pp. 564 and 565.)

In the table are given analyses of 24 samples of Canada ashes, two of domestic cord wood ashes and one of the ashes of witch hazel twigs, used as fuel after extraction for the manufacture of witch hazel extract.

The wide range of composition and the average of all the analyses of Canada ashes made this year is shown in the following table:

RANGE OF COMPOSITION OF "CANADA ASHES," 1908.

	Highest.	Lowest.	Average.
Total potash	8.15	3.12	4.62
Water-soluble potash	7.46	2.56	3.77
Lime	33.04	20.40	26.47
Magnesia	5.38	1.54	2.46
Phosphoric acid	2.88	1.16	1.48
Sand	27.81	5.08	13.54
Coal	12.90	0.37	2.94

* $2.00 per unit of water-soluble potash.
† $2.25 per unit of water-soluble potash.

The fresh ashes left from burning clean cord wood have no uniform composition. Old trees yield less ashes than young ones, other things being equal, with rather less potash. The wood of young trees 20-30 years old as a rule contains less ashes and less potash during the spring and early summer, when growth is rapid, than at other seasons. The impression which prevails that, as a rule, hard wood ashes contain more potash than those from soft woods, seems to be justified.

According to German observations, deciduous trees contain a larger percentage of ashes, and also of potash, than conifers of the same age. Only the white pine appears to have a larger percentage of potash than other conifers, and the birch, among deciduous trees, has less potash than the others. With lime the reverse is true, a high potash content going with a low content of lime.

The Georgia Station, Bull. 2, found in the pure ash (calculated free from carbonic acid, sand and coal) of various woods, bark excluded, the following percentages of potash:

Ash	46.0	Post oak	21.9
White oak	42.1	Yellow pine	19.7
Hickory	28.6	Chestnut	18.1
Dogwood	28.0	Black pine	14.3
Red oak	24.7	Old field pine	3.9
Sycamore	23.2		

The three pines have lower percentages of potash than the woods of deciduous trees, excepting the chestnut, which has less than any other deciduous tree.

In the report of this station for 1883 are given complete analyses of ashes, made by burning considerable quantities of clean cord wood of different sorts in a stove, or on a hearth specially cleaned for the purpose. The following percentages of potash were found in the pure ash: birch, 15.59; oak, 14.66; hickory, 12.19, and chestnut, 7.07. Here again chestnut appears to have much less potash than the other deciduous woods.

WOOD ASHES.

PERCENTAGE COMPOSITION.

Station No.	Dealer or Purchaser.	Sampled or sent by	Total potash.	Water-soluble potash.	Phosphoric acid.	Lime.	Magnesia.	Sand.	Charcoal.	Cost per ton.
	Bowker Fertilizer Co., N. Y. City:									
20484	E. A. Jones, New Canaan	Purchaser	4.57	3.69	1.33	26.42	2.36	11.97	2.27	$10.50
	John Joynt, Lucknow, Canada:									
20236	F. S. Bidwell & Co., Windsor Locks	Dealer	5.80	4.91	1.41	22.34	2.04	11.69	1.57	13.25
20302	F. S. Bidwell & Co., Windsor Locks	Dealer	6.33	5.46	1.60	22.20	2.34	14.38	0.37	13.25
20342	G. E. Norton, Bristol	Purchaser	----	4.70	1.22	23.60	1.84	9.99	1.98	10.00
20456	Olds & Whipple, Hartford	Dealer	4.96	4.04	1.37	31.40	3.28	6.14	1.16	12.00
20518	Olds & Whipple, Hartford	C. H. Eno, Simsbury	8.15	7.46	2.88	20.40	4.19	27.81	3.85	12.00
		Average of five Analyses.	*6.31*	*5.31*	*1.69*	*23.99*	*2.74*	*14.00*	*1.78*	*12.10*
	F. R. Lalor, Dunnville, Canada:									
21204	D. N. Clark, Woodbridge	Purchaser	3.69	----	1.64	30.68	----	16.04	1.73	10.00
20423	H. K. Brainard, Thompsonville	Station Agent	3.23	2.92	1.19	30.84	2.30	11.06	4.46	12.00
20457	J. G. Schwink, Jr., Meriden	Purchaser	3.42	----	1.20	24.22	1.71	8.80	1.57	----
21361	Dwight L. Johnson, Bethany	Purchaser	----	3.10	1.38	28.40	2.37	7.41	1.63	10.00
		Average of four Analyses.	*3.45*	*3.01*	*1.35*	*28.54*	*2.12*	*10.83*	*2.35*	*10.66*
	G. L. Munroe & Sons, Oswego, N. Y.:									
20301	J. W. Alsop, Avon	Purchaser	----	2.72	1.19	22.32	1.54	10.32	12.90	10.25
20321	P. H. Woodford, Avon	Purchaser	----	2.56	0.92	21.18	1.67	25.25	3.37	----
20397	J. W. Alsop, Avon	Purchaser	3.12	2.64	1.29	23.30	1.56	20.41	2.75	10.25
20398	J. W. Alsop, Avon	Purchaser	3.30	2.90	1.16	23.20	1.84	20.95	2.19	10.25
		Average of four Analyses.	*3.21*	*2.70*	*1.14*	*22.50*	*1.65*	*19.23*	*5.30*	*10.25*
	Charles Stevens, Napanee:									
19954	John B. Cannon, Granby	Purchaser	----	3.51	1.69	33.04	2.22	12.20	1.96	12.00
19962	E. N. Austin, Suffield	Purchaser	4.30	3.77	1.82	32.89	2.16	5.95	1.46	12.00
		Average of two Analyses.	*4.30*	*3.64*	*1.75*	*32.96*	*2.19*	*9.07*	*1.71*	*12.00*
	George Stevens, Peterborough, Ont.:									
20343	H. F. Gilnack, So. Manchester	Purchaser	----	3.25	1.59	31.26	1.90	15.56	2.67	9.00
20483	E. O. Marsh, New Milford	Purchaser	----	3.84	1.38	28.68	1.70	8.02	2.03	9.84
		Average of two Analyses.		*3.54*	*1.48*	*29.97*	*1.80*	*11.79*	*2.35*	9.42
	Name of wholesale dealer unknown:									
19979		A. N. Pierson, Cromwell	----	3.63	1.28	23.36	2.81	21.77	2.51	----
19992		A. N. Pierson, Cromwell	----	3.78	1.36	24.72	2.41	14.47	1.70	----
20262	Sold by David Clark Bldg. Co., New Haven	C. M. Abbe, New Haven	----	2.61	1.20	24.24	5.38	22.15	2.02	----
20434	Sold by Jas. E. Perkins, Suffield	Bissell-Graves Co., Suffield	----	3.87	1.92	26.52	2.86	5.08	8.60	10.06
21360	Sold by Jas. E. Perkins, Suffield	Bissell-Graves Co., Suffield	----	4.62	2.46	32.86	3.82	8.33	4.19	11.00
20684	Conn. Valley Orchard Co., Berlin	Geo. W. Spicer, Deep River	----	3.09	1.28	27.30	2.22	10.07	1.56	----
20737	Home made Ashes	R. C. Wilcox & Sons, Guilford	----	6.43	3.58	28.98	3.67	15.04	4.78	----
20790	Hard Wood Ashes from Sperry & Barnes, Smoke House	C. M. Abbe, New Haven	----	5.62	1.34	43.84	3.72	3.42	0.69	10.00
20738	Witch Hazel Ashes, factory of Dickinson & Co., Essex	R. C. Wilcox & Sons, Guilford	----	5.23	3.75	32.90	3.33	6.65	1.94	*

*17 cents per bushel.

Further observations are necessary in order to determine the matter.

Even in these lots of cord wood, considerable sand adhered to the sticks, so that in one case the sand and soil in the ash amounted to some 15 per cent. An amount of dirt which is scarcely appreciable on the wood, amounts to a good deal in the ashes, because it is there concentrated in a small weight of other matters. Thus a cord of hickory weighs on the average 3,500 pounds, but the ashes from it weigh only about 70 pounds, and if the wood carried on it three-tenths of one per cent. of sand, the ashes would have 15 per cent.

The above analyses were made on ashes prepared with care to avoid all admixture of foreign matters, yet even these show from 3 to 15 per cent. of sand.

We may next consider what is the average composition of the ashes of domestic fires, where no special pains are taken to have the wood clean, but where we may suppose no sand or earth was intentionally or otherwise added to the ashes. The following table gives the data which are readily available:

COMPOSITION OF ASHES FROM HOUSEHOLD FIRES.

	Average 3 Analyses Conn. hard-wood.	Average 2 Analyses Georgia wood.	Average 5 Analyses Maine hard-wood.	Average 6 Analyses Conn. wood.	Average 13 Analyses Storer.*
Potash total	5.66	8.19	9.19	4.74	8.50
Potash water-soluble	....	....	7.67	....	....
Soda	0.95	4.03	....	....	....
Lime	31.70	43.69	36.48	....	....
Magnesia	6.33	0.03	....	....	....
Oxide of iron	3.91	1.12	....	....	....
Sulphuric acid	1.78	1.24	....	....	....
Phosphoric acid	2.19	1.38	3.32	2.27	2.04
Chlorine	0.62	0.40	....	....	....
Carbonic acid	17.53	32.12	....	....	25.53
Sand	22.29	5.01	....	....	6.97
Charcoal	2.25	3.02	....	....	....
Moisture	4.79	....	2.14	....	....
	100.00	100.23			

In single samples the sum of the percentages of sand and coal has ranged from 6.90 to 29.96. The presence, therefore, of large quantities of sand is not proof of adulteration. The amount of

* Bull., Bussey Inst., Part III, 1874, p. 193.

moisture is low in the samples above given, showing that the ashes have not been exposed to the weather.

It is clear, from the above considerations, that a large amount of sand is no evidence of the adulteration of ashes, and that the quantity of potash, even in hard wood ashes, is quite variable.

Where less than four per cent. of potash is found, it may well be doubted whether the ashes are from hardwoods and whether they are unleached. If the sample contains much more than fourteen per cent. of moisture, this is an indication of exposure to the weather, which may, or may not, have leached out part of the potash.

A sample, **20396**, sent as Canada ashes drawn from a car lot, contained 14.23 per cent. of water-soluble potash. There was obviously a mistake on the part of the sender, the above sample probably being from a lot of tobacco stem ashes.

LIME, CARBONATE OF LIME AND LIME-KILN ASHES.

20481. Hydrated Lime, bought of the New Jersey Lime Co., Hamburg, N. J., by Spencer Bros., Suffield. Cost per ton, $9.50.

19955. Air Slacked Lime, sold by Sanderson Fertz. and Chem. Co., New Haven. Sent by J. H. Elwood, Greens Farms. Cost per ton, $10.00.

20923. Fine Lime, being floor sweepings from the lime room connected with a lime-kiln. Stored under cover.

21205. Same as the above, except taken from a pile exposed to the weather. A coat of hardened lime forms over the exterior and protects that within. This sample is understood to have been taken from the interior. Cost, $1.60 per ton.

20682 and **20614.** Samples of "Caledonia Marl." This is a fine dry material, formed largely from shells, consisting of carbonate of lime in a fine, non-crystalline condition. This carbonate of lime, like that of wood ashes, answers all the purposes for which stone lime or burned lime is used, but is less destructive of the vegetable matter of the soil. No. **20682** was sent by the Berkshire Fertilizer Co., of Bridgeport, No. **20614** by G. A. Douglass, Suffield. Cost, $7.50 per ton.

20706 and **20830.** Lime-Kiln Ashes. Made by New England Lime Co., New Milford. **20706**, sampled from stock of J. G. Schwink, Meriden. **20830**, sampled and sent by C. M. Jarvis, Berlin.

ANALYSES OF LIME, CARBONATE OF LIME AND LIME-KILN ASHES.

	Hydrated Lime.	Air-slaked Lime.	Lime Sweepings.		Caledonia Marl.		Lime-kiln Ashes.	
	20481	**19955**	**20923**	**21205**	**20682**	**20614**	**20706**	**20830**
Water-soluble potash	.....	.....	.....	.....	.....	.....	2.78	1.42
Lime	71.16	43.72	41.57	33.34	48.35	46.60	42.04	34.95
Magnesia	.....	.....	.....	.....	.....	.....	.....	9.03
Phosphoric acid	.....	.....	.....	.....	.....	.....	1.33	0.81
Sulphuric acid	0.32	.....	.....	.....	.....	.....	.....	.....
Sand	.....	.....	.....	.....	.....	0.59	.....	3.36
Cost per ton	$9.50	10.00	.....	1.60	.....	7.50	10.00	5.80*
Lime costs cents per 100 pounds	66	114	.....	24	.....	80	119† 85‡	83*† 61‡

ASHES OF WASTE MATERIAL.

20275. Ashes from pea vines, from Andrew Ure, Highwood, contained 1.50 per cent. of water-soluble potash and 0.68 per cent. of phosphoric acid.

20341. Ashes from tobacco, sent by the Bissell-Graves Co., Suffield, from stock of Innis Speiden & Co., New York City. Price, $37.50 per ton. The sample contained 12.44 per cent. of water-soluble potash as against 37.50, guaranteed.

"Ashes of Refuse Stuff," **20683.** Sampled and sent by L. R. Shelley, Guilford, who inquired whether it would pay for barreling and freight from New York for use as a fertilizer. As it contained only 0.24 per cent. of potash and 0.99 per cent. of phosphoric acid, it was obviously not worth handling.

BEET REFUSE.

A sample, **20257,** bearing this label, received from H. K. Brainard, Thompsonville, contained:

Nitrogen as ammonia	3.86
Nitrogen, organic	1.49
Potash as muriate	1.69
Potash as sulphate	5.13
Phosphoric acid	trace

* Car lot. † With no allowance for potash and phosphoric acid.
‡ Allowing 4¼ and 2 cents per pound for potash and phosphoric acid respectively.

WASH FROM BARNYARD.

A sample, **20349,** of liquid drainings from a barnyard sent by H. J. Brockett, Clintonville, weighed 7.95 lbs. to the gallon and contained no phosphoric acid; .0039 pounds of nitrogen and .0092 pounds of potash per gallon. A thousand gallons, or twenty-two barrels of this liquor, carries only four pounds of nitrogen and nine of potash. Of course the composition of the drainage water from such a place will vary considerably, depending on the frequency and amount of rainfall, the way the manure lies or is piled in the yard, etc.

WASTE FROM EXPLOSIVES FACTORY.

20436. Sampled and sent by David Taylor, Winsted. Claimed to contain "fertilizing elements" and offered for $5.00 per ton. It was a refuse salt.

SWAMP MUCK OR PEAT.

19994. Sampled and sent by H. P. Smith, North Haven.
20690. Sampled and sent by C. D. Tows, Norfolk, from a large deposit.
20772. From the surface of a reclaimed salt marsh.
21362. Sampled and sent by C. W. Scranton, Madison.

	19994	20690	20772	21362
As received.				
Water	25.76	72.30	41.11	74.47
*Organic matter	5.50	11.72	28.25	24.69
Ash	68.74	15.98	30.64	0.84
	100.00	100.00	100.00	100.00
* Containing nitrogen	0.21	0.32	0.91	0.37
Water free.				
†Organic matter	7.42	42.27	47.99	96.71
Ash	92.58	57.73	52.01	3.29
	100.00	100.00	100.00	100.00
† Containing nitrogen	0.28	1.15	1.54	1.45

These analyses represent fairly the wide range of composition and value in "muck" or "peat," which is a general name applied both to thin deposits, which consist of recent vegetation that has decayed without much access of air, and to very old and very extensive deposits of vegetable origin. Some, like **19994,** while black in appearance, consist largely of fine sand and are of no agricultural value; others, like **21362**, are almost wholly black vegetable matter, which has high fuel value and when dried makes the most effective absorbent and deodorizer in stables, and, if it can be got out cheaply enough, might make a valuable compost with manure and an amendment on light sandy land. The station is examining samples of different types of peat or muck, in connection with the natural history survey of the state, on which full report will be made later.

"HUMUS FERTILIZER No. 3."

This is one of several brands made by the Wallace Fertilizer Co. of New York City. "Multum in Parvo Odorless Humus Fertilizers."

19989. Sent by W. C. Osborne, Newington. Its analysis is as follows:

Water	23.05
Organic matter	55.59
Mineral matter	21.36
	100.00

It contains:

		Manufacturer's Statement of Composition.
Nitrogen	2.21	2.50
Phosphoric acid	0.51	0.25
Water-soluble potash	0.56	0.40
Lime	4.90	2.50
Chlorine	0.32	....

The material, tempered with some sand or soil, would apparently make a good potting soil for florists. It cannot be regarded as a "commercial fertilizer," in the ordinary sense of the word. A dried peat, with some added lime, would have about the same composition.

NEW HAVEN, December 1, 1908.

To His Excellency, Rollin S. Woodruff, Governor of Connecticut:

As required by law, this station respectfully submits to you the Thirteenth Report on Food Products for the year ending July 31, 1908, by John Phillips Street.

Respectfully yours,

E. H. JENKINS, *Director.*

PART IX.

THIRTEENTH REPORT ON FOOD PRODUCTS FOR 1908.

(Examined during the year ending July 31, 1908.)

By John Phillips Street.

This station is required by law to make examinations of food products and to report to the dairy commissioner all cases of adulteration which are discovered. Under this law the sampling agent of the station has visited a considerable number of places and has bought a large number of samples which have been examined and all cases of adulteration reported to the dairy commissioner. An account of this work is given in the following pages.

The dairy commissioner and his deputy have sent a large number of samples of molasses, vinegar and butter, the sale of which is regulated by special statutes, as well as samples of other foods and drugs, which he is authorized to take under the food law. These are but briefly noticed here, being discussed in the commissioner's report, where account is also given of the results of prosecution under the law.

Lastly, a considerable number of samples of food products have been examined for individuals, which will likewise receive brief mention.

The General Assembly, at the January session of 1907, passed an act (Chap. 225) regarding foods and drugs which took effect January 1, 1908, and which, in addition to the work required under acts previously passed, requires the station to undertake also the examination of drugs. Although no appropriation was made for this added work, the station has been able to make a considerable number of such examinations, which will appear in the following pages.

CORN STARCH.

Twenty-six samples were examined microscopically and found free from any foreign starch. The net weight of the samples ranged from 15.0 to 17.5 oz. in what were evidently intended to be 16 oz. packages. None of the variations was sufficiently large to indicate intentional short weight.

The range of price, from 6 to 10 cents per package, is rather wide for such a cheap material.

The brands examined and not found adulterated were the following:

Oneida, Barber & Perkins, Philadelphia, Pa.; Brighton Starch Co., N. Y.; Butternut, F. C. Bushnell Co., New Haven; Premium; Best, Corn Products Co., Chicago; A. & P., Great Atlantic & Pacific Tea Co., N. Y.; Grand Union Tea Co., N. Y.; Gold Medal, Extra Process; Prize Medal, Miner, Read & Garrette, New Haven; Duryea's and Niagara, National Starch Co., N. Y.; Murdock's, Oswego Maize Products Co., N. Y.; Old Glory, John A. Pilgard, Hartford; "The Popular Market"; "Our Own," Retail Grocers' Ass'n, Waterbury; Cream, The Staley M'f'g Co., Baltimore, Md.; Snowflake, Stoddard, Gilbert & Co., New Haven; Capitol City, Tucker, Goodwin & Co., Hartford; Sovereign, Union Pacific Tea Co., N. Y.; Jewel, Union Supply Co., New Haven; Standard, Warner Sugar R'f'g Co., Waukegan, Ill.; Wellington Extra Process and Royal brands, Wellington Starch Co., Lititz, Pa.; Star, D. M. Welch & Co., New Haven; The White-Simmons Co., Waterbury.

ARROWROOT AND POTATO STARCH.

Two samples of arrowroot starch and 1 of potato starch were found, by microscopical examination, to be true to name.

The brands were, Pure Bermuda Arrowroot, Taylor Bros., London, Eng., (2 samples), and Health Brand "Akta" Potato Flour, Scandinavian Importing Co., Boston.

GROUND GINGER.

Of the 78 samples examined, 35 were sold in original sealed packages, and 43 were sold in bulk in quarter-pound lots. Of the sealed samples, 4 were adulterated or below standard, as were 3 samples of the bulk goods. One sample contained turmeric, 1

coffee hulls, 4 contained excessive sand, and 1, by its low total and water-soluble ash and its low water extract, indicated that it was an exhausted ginger.

The standards, which were adopted by this station in 1904, require that ginger shall contain "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." All the samples included under the caption "not found adulterated" (Table I) conformed to these standards. The samples classed as adulterated (Table II), which exceeded these limits for total ash and ash insoluble in hydrochloric acid, contained from 8.06 to 9.95 per cent. of total ash, and from 3.08 to 5.00 per cent. of acid-insoluble ash (sand). The largest amount of lime found in the samples examined was 0.90 per cent.

The following summary of the results of the analyses of the 71 samples not found to be adulterated, gives useful data as to the variations in composition of ground ginger as found on the market at the present time:

	Maximum.	Minimum.	Average.
Total Ash	7.97	3.89	6.01
Ash, soluble in water	4.03	2.07	2.93
Ash, insoluble in water (sand-free)	2.56	0.81	1.78
Sand	2.99	0.28	1.30
Alcohol extract	8.90	4.68	5.96
Water extract	17.54	8.98	13.03

In 1898 Winton analyzed at this station (Report for 1898, p. 202) 18 samples of whole ginger of undoubted authenticity. The average amount of ash in the authentic ginger was 0.74 per cent. less and of sand was 0.86 per cent. less than the averages found in the analyses made this year. Fifty of this year's samples contain sand in large excess over Winton's average for the pure spice, 0.44 per cent., and the allowance of 3 per cent. permitted by the standards seems too large.

Weight of Packages and Selling Price.

The intentional selling of short-weight goods accomplishes the same fraud as the use of an adulterant for a makeweight. The law does not require a statement of weight on the label, but demands that if such a statement be given it shall be correct. Many of the sealed packages bore no statement of weight, but the size of the package and the price were quite certain evidence

TABLE I.—GROUND GINGER. NOT FOUND ADULTERATED.

Station No.	Brand.	Dealer.	Weight of package. Claimed.	Weight of package. Found.	Price of package.	Ash. Total.	Ash. Water-soluble.	Ash. Water-insoluble. (Sand-free.)	Ash. Insoluble in Hydrochloric acid. (Sand.)	Lime.	Alcohol Extract.	Cold Water Extract.
			oz.	oz.	cts.							
18690	John P. Augur, New Haven Crescent Mills	*New Haven:* H. J. Finnegan	----	1.4	5	5.24	2.57	1.91	0.76	----	6.54	12.28
18489	Austin Nichols & Co., N. Y., Blue Ribbon Brand, Pure African Ginger. (In pasteboard carton.)	*Bridgeport:* H. Isenberg & Co.	4	3.9	10	7.97	3.42	1.64	2.91	----	5.50	12.75
18611	Austin Nichols & Co., N. Y., Blue Ribbon Pure African Ginger. (In tin box.)	*Meriden:* H. E. Bushnell	4	4.1	10	7.79	3.72	1.20	2.87	0.22	5.16	12.85
18705	Bennett, Simpson & Co., London. Borneo Ginger	*New Haven:* D. M. Welch & Son	4	4.1	10	5.14	3.07	1.77	0.30	----	6.06	13.95
18571	Bennett, Sloan & Co., N. Y., Monogram Brand. (In tin box.)	*Stamford:* I. L. Smallhorn	----	3.9	10	4.80	2.55	1.97	0.28	----	6.32	13.77
18687	Bennett, Sloan & Co., N. Y., Monogram. (In pasteboard carton.)	*New Haven:* Philip Mayrand	4	4.0	10	4.76	2.46	1.93	0.37	----	6.11	13.86
18550	Centennial Tea Co., Bridgeport	*Bridgeport:* Centennial Tea Co.	4	4.3	10	4.79	3.01	1.36	0.42	----	5.11	15.13
19468	The A. Colburn Co., Phila., Pa. Colburn's A Spices	*New London:* W. A. Holt	----	3.8	10	4.99	2.71	1.81	0.47	----	6.19	14.16
18574	Columbia Tea Co., Stamford	*Stamford:* Columbia Tea Co.	----	4.4	13	7.84	2.85	2.30	2.69	0.90	5.73	12.26
18686	W. C. Dean & Son, N. Y., Ardent Brand	*New Haven:* D. M. Welch & Son	----	3.9	7	4.90	2.30	2.05	0.55	0.60	5.66	14.68
18553	E. R. Durkee & Co., N. Y., Gauntlet Brand	*Bridgeport:* D. E. McNamara	2	2.0	5	5.32	2.93	1.82	0.57	----	6.02	13.50
19567	Edwin J. Gillies & Co., N. Y.	*Danbury:* M. J. Shanley	----	2.3	5	7.29	2.90	2.29	2.10	0.62	5.23	10.90
18562	C. L. Glover, Norwalk. (Distributor)	*Norwalk:* C. L. Glover	----	4.0	10	5.48	2.25	1.96	1.27	0.45	5.30	11.28
18547	Grand Union Tea Co., Brooklyn, N. Y.	*Bridgeport:* Grand Union Tea Co.	----	2.8	10	5.05	2.23	2.27	0.55	0.05	6.69	15.05
18684	Edw. E. Hall & Son, New Haven. Ginger, Jamaica	*New Haven:* Edward E. Hall	----	4.3	13	4.27	2.75	1.08	0.44	----	6.05	16.78
18573	Robt. Hill, N. Y. Crown Brand	*Stamford:* Empire State Tea Co.	----	4.0	10	6.21	2.64	1.98	1.59	----	5.61	11.83
19477	Howard & Co., N. Y., Empress African Ginger	*New London:* F. H. Davis & Co.	----	3.7	10	5.90	3.00	2.28	0.62	----	7.37	14.63
18685	Francis H. Leggett & Co., N. Y. Nabob Ginger	*New Haven:* S. S. Adams	4	4.1	12	6.09	2.47	2.56	1.06	0.67	6.40	12.57
19485	Francis H. Leggett & Co., N. Y. Premier Ginger	*Putnam:* E. T. Tucker	4	4.1	10	6.44	2.80	2.26	1.38	0.86	5.96	11.91
19555	Chas. G. Lincoln & Co., Hartford. Capitol Mills	*Waterbury:* Spencer, Pierpont Co.	----	4.2	10	5.73	2.70	1.75	1.28	----	5.86	11.16
19486	W. H. Mansfield & Co., Putnam. Mansfield's Monogram Brand	*Putnam:* W. H. Mansfield & Co.	----	4.1	12	7.48	3.31	1.34	2.83	----	4.72	10.92
19517	Middlesex Tea Co., Middletown. Four Leaf Clover Brand	*Middletown:* Middlesex Tea Co.	----	3.4	10	5.19	3.01	1.76	0.42	----	6.63	14.09
19438	Miner, Read & Garrette, New Haven. Pure African Ginger	*New Haven:* Wray & Co.	4.0	4.0	8	6.56	3.00	1.32	2.24	----	5.03	12.36
19526	Put up for The T. R. Sadd Co., Willimantic	*Willimantic:* The T. R. Sadd Co.	4.0	4.0	10	4.38	2.73	1.25	0.40	----	5.03	14.31
18612	D. & L. Slade Co., Boston. Extra Strong Ginger	*Meriden:* L. C. Brown	4.0	3.9	10	6.00	2.91	1.58	1.51	----	6.11	13.35
19554	Sprague, Warner & Co., Chicago. Richelieu Brand	*Waterbury:* Model Market Co.	----	4.1	12	4.34	3.16	0.81	0.37	----	4.86	15.71
18552	Stickney & Poor, Boston	*Bridgeport:* E. L. Sullivan	4.0	4.0	10	6.77	2.89	1.86	2.02	----	5.43	12.24

TABLE I.—GROUND GINGER.

Station No.	Brand.	Dealer.
18572	Thomas & Turner, N. Y. Star Mills	*Stamford:* H. L. Wood
18551	The Union Pacific Tea Co., N. Y. Sovereign Spices	*Bridgeport:* Union Pacific Tea Co.
18594	R. C. Williams & Co., N. Y. Borneo Ginger	*Greenwich:* Timmons & Latham
18635	The Williams & Carleton Co., Hartford	*New Britain:* J. E. Murphy
18486	Sold in bulk	*Bridgeport:* Pike Bros. Co.
18487	" "	" P. D. Lyons
18488	" "	" C. McCarthy
18554	" "	" Logan Bros.
18555	" "	" W. L. Woolfram
18556	" "	" M. Rome
18557	" "	" Wheeler & Co.
18558	" "	" Village Store Co.
19568	" "	*Danbury:* Village Store Co.
19533	" "	*Derby:* Logan Bros.
18592	" "	*Greenwich:* G. A. Finch
18593	" "	" S. A. Moshier
18666	" "	*Hartford:* Cannon & Flanagan
18667	" "	" Hynes & Hannon
18669	" "	" Buckley & Reardon
18670	" "	" Union Supply Co.
18608	" "	*Meriden:* McBride's Cash Grocery
18609	" "	" M. Keegan
19518	" "	*Middletown:* New England Tea Co.
19519	" "	" Middletown Cash Grocery
18625	" "	*New Britain:* Sovereign's Trading Co.
18626	" "	*New Britain:* F. Dobson
18688	" "	*New Haven:* A. H. Waterbury
18689	" "	" E. Schoenberger & Son
19452	" "	" S. S. Adams
19453	" "	" F. J. Markle
19460	" "	" W. R. Bailey
19461	" "	" H. M. Tower
19504	" "	" C. Baun
19469	" "	*New London:* Stacy & Kiely
18563	" "	*Norwalk:* Union Grocery Co.
18564	" "	" Grand Central Grocery
19501	" "	*Norwich:* Disco Bros.
18496	" "	*So. Norwalk:* United Grocery Co.
18497	" "	" C. Becker & Son
18498	" "	" F. D. Lawton & Co.
18584	" "	*Stamford:* R. T. Woodbury
18585	" "	" New York Cash Grocery
19539	" "	*Waterbury:* Waterbury Market Co.
19557	" "	" Wm. Beck
	Maximum	
	Minimum	
	Average	

NOT FOUND ADULTERATED.—*Concluded.*

Station No.	Weight of package. Claimed.	Weight of package. Found.	Price of package.	Ash. Total.	Ash. Water-soluble.	Ash. Water-insoluble. (Sand-free.)	Ash. Insoluble in Hydrochloric acid. (Sand.)	Lime.	Alcohol Extract.	Cold Water Extract.
	oz.	oz.	cts.							
18572	----	4.3	15	4.92	2.17	2.38	0.37	0.37	6.69	15.63
18551	----	2.5	10	6.52	2.90	2.14	1.48	0.30	5.62	13.00
18594	----	4.1	10	6.18	3.55	2.03	0.60	0.45	8.90	17.54
18635	----	4.2	10	5.50	2.30	1.93	1.27	0.24	5.41	11.65
18486	4.0	4.0	7	5.81	3.02	2.32	0.47	0.25	6.87	14.04
18487	4.0	4.0	10	7.53	3.31	1.76	2.46	----	5.92	13.28
18488	4.0	3.8	7	6.75	3.01	1.54	2.20	----	4.68	12.91
18554	4.0	4.1	5	7.20	4.03	1.10	2.07	----	5.24	13.01
18555	4.0	4.2	10	7.76	3.48	1.29	2.99	----	5.19	12.41
18556	4.0	2.8	5	4.88	2.48	2.03	0.37	0.46	7.63	15.08
18557	4.0	4.6	7	4.86	2.91	1.48	0.47	----	5.98	13.76
18558	4.0	4.0	4	6.94	3.16	1.93	1.85	----	6.15	13.52
19568	4.0	4.0	4	7.05	3.14	1.93	1.98	----	6.10	12.00
19533	4.0	4.7	7	7.30	3.50	1.28	2.52	----	5.22	11.20
18592	4.0	3.8	10	7.23	3.76	1.41	2.06	----	7.13	14.66
18593	4.0	4.7	10	5.87	2.75	2.24	0.88	0.73	6.82	12.12
18666	4.0	3.3	5	5.87	3.07	2.21	0.59	0.59	8.36	13.41
18667	4.0	4.4	8	5.71	2.51	1.89	1.31	---	5.89	12.13
18669	4.0	4.1	8	6.77	2.74	2.21	1.82	0.28	6.28	12.34
18670	4.0	3.8	10	4.10	2.34	1.35	0.41	----	5.94	8.98
18608	4.0	3.8	10	6.82	3.11	1.74	1.97	----	6.28	13.26
18609	4.0	3.8	10	5.05	2.53	2.04	0.48	0.42	4.81	15.60
19518	4.0	4.6	10	7.20	3.10	2.07	2.03	----	5.56	11.09
19519	4.0	3.9	13	5.34	2.29	1.88	1.17	----	5.75	10.45
18625	4.0	4.0	10	5.09	2.40	1.55	1.14	----	5.34	12.46
18626	4.0	2.9	10	4.94	2.27	1.48	1.19	----	4.70	11.43
18688	4.0	4.0	5	6.99	3.13	1.94	1.92	----	5.09	12.85
18689	4.0	4.0	10	5.88	2.70	1.34	1.84	----	5.79	13.03
19452	4.0	4.3	9	3.89	2.07	1.40	0.42	----	5.65	12.34
19453	4.0	4.5	8	6.76	3.13	1.77	1.86	----	6.34	13.33
19460	4.0	4.1	10	5.10	2.79	1.88	0.43	----	7.04	13.63
19461	4.0	3.8	10	6.32	2.88	2.03	1.41	0.40	5.72	12.68
19504	4.0	3.7	8	6.81	3.34	1.92	1.55	----	6.38	13.00
19469	4.0	4.1	8	6.24	3.09	2.46	0.69	0.42	6.50	12.10
18563	4.0	4.0	10	6.95	3.46	1.91	1.58	----	6.20	13.48
18564	4.0	4.2	9	5.45	2.30	1.89	1.26	----	5.75	11.56
19501	4.0	3.8	10	6.71	3.34	1.85	1.52	----	5.64	12.52
18496	4.0	4.0	10	5.60	3.05	1.93	0.62	----	6.95	13.63
18497	4.0	4.3	10	6.66	2.65	2.18	1.83	0.30	6.18	12.81
18498	4.0	4.7	10	5.73	3.01	2.27	0.45	0.69	5.48	15.31
18584	4.0	4.1	6	7.98	3.87	1.28	2.83	----	5.30	11.98
18585	4.0	4.0	10	6.85	2.71	2.13	2.01	0.60	5.71	12.61
19539	4.0	4.1	8	5.19	2.61	1.39	1.19	----	6.06	10.82
19557	4.0	4.1	10	6.17	3.06	1.99	1.12	----	6.24	12.16
-----	----	----	----	7.97	4.03	2.56	2.99	----	8.90	17.54
-----	----	----	----	3.89	2.07	0.81	0.28	----	4.68	8.98
-----	----	----	----	*6.01*	*2.93*	*1.78*	*1.30*	----	*5.96*	*13.03*

TABLE II.—GROUND GINGER.

Station No.	Brand.	Dealer.
19520	The Wm. Boardman & Sons Co., Hartford. Boardman's Pure	*Middletown:* O. Thompson & Co.
19470	The Mohican Co. Mohican Brand, Strictly Pure	*New London:* The Mohican Co.
18549	Sultana Spice Mills, N. Y. Sultana Ginger	*Bridgeport:* Atl. & Pac. Tea Co.
19556	David Trubee & Co., Bridgeport. Seaside Mills, Strictly Pure	*Waterbury:* Cruess Bros.
19534	Sold in bulk	*Derby:* D. M. Welch & Son
18668	" "	*Hartford:* P. S. Kennedy
18586	" "	*Stamford:* W. W. Waterbury

ADULTERATED OR BELOW STANDARD.

Station No.	Weight of package. Claimed.	Weight of package. Found.	Price of package.	Ash. Total.	Ash. Water-soluble.	Ash. Water-insoluble. (Sand-free.)	Ash. Insoluble in Hydrochloric acid. (Sand.)	Lime.	Alcohol Extract.	Cold Water Extract.
	oz.	oz.	cts.							
19520	----	4.2	10	8.52	3.71	1.53	3.28	----	5.10	11.46
19470	----	3.5	10	9.46	3.61	1.61	4.24	----	5.56	12.69
18549	----	4.4	10	5.77	3.10	1.37	1.30	*	5.55	15.75
19556	----	3.2	10	9.95	3.24	1.71	5.00	----	4.54	11.32
19534	4	4.1	8	3.53	1.51	1.49	0.53	0.49	4.83	8.57
18668	4	4.3	8	6.65	2.54	1.78	2.33	†	4.80	12.51
18586	4	4.0	6	8.06	3.72	1.26	3.08	----	4.82	11.65

* Contains turmeric. † Contains coffee hulls.

of the weight intended, especially as ginger is retailed generally in four or two ounce packages. The bulk samples in each case were sold in response to a request for four ounces of ginger. Three sealed samples, although in containers somewhat different in shape and size from the usual, were sold for 10 cents each, the average prices this year for sealed four ounce packages. The ginger in them weighed 2.5, 2.8 and 3.4 ounces, and the purchaser, instead of paying 10 cents for a quarter-pound of ginger, paid 16.0, 14.3 and 11.8 cents respectively. Of the bulk goods only three samples were much below weight; they weighed 2.8, 2.9, and 3.3 ounces, selling for 5, 10 and 15 cents respectively.

The range of prices, from 4 to 15 cents for four ounces, was very wide, for a product of the nature of ginger.

A summary of the data obtained concerning the sealed and bulk samples follows:

Average.	Sealed Packages.	Sold in Bulk.
Weight (oz.)	3.9	4.0
Cost per quarter (cents)	10.0	8.5
Ash, total	5.80	6.18
Ash, water-soluble	2.90	2.95
Ash, water-insoluble (sand-free)	1.74	1.81
Sand	1.16	1.42
Alcohol extract	5.91	6.00
Water extract	13.41	12.72

JAMS, JELLIES AND PRESERVES.

(TABLES OF ANALYSES PAGES 586 TO 594.)

Fifty-seven jams, preserves, marmalades and apple butters, 25 jellies, 1 jelly powder and 1 raspberry syrup were bought and examined. Ten jams and preserves and 8 jellies were sold as pure, while 47 jams and preserves and 17 jellies were labeled more or less clearly as "compounds." The single samples of raspberry syrup and jelly powder were labeled as "compounds."

The samples sold as pure products were examined for total solids, polarization before and after inversion, starch, artificial color, benzoic acid and salicylic acid. The samples labeled "compounds" were examined to determine if the labeling complied with the law, and in all cases where the use of either artificial coloring, or preservatives, or both, was not specified, tests were made for these adulterants.

Of the 10 jams and preserves sold as pure, 4 were not found adulterated, while 6 were adulterated, 3 with glucose, 2 with glucose and artificial color, and 1 with artificial color and tin. The last-named sample, No. 18521, in a tin can, did not bear the name of the manufacturer on the label. The cover had been attacked by the acids present, and the contents contained 0.1512 grams of tin in solution.

Of the 8 samples of jelly sold as pure, none was found to be adulterated.

One sample of jam, No. 18503, labeled as a compound, gave no indication on the label of the artificial color which was present.

An examination of jams and jellies was made by this station in 1898 and again in 1901; the results of the examinations of those years are compared with that of this year in the table below. While the percentages of samples not found adulterated was about the same in the three years, the percentage of adulterated samples in 1908 was very much less than in either 1898 or 1901. This was due to the labeling required by law of "compounds," which would otherwise be classed as adulterated.

Summary of Analyses Made in 1898, 1901 and 1908, of Jams, Preserves, Jellies, etc.

	Not found adulterated.	Adulterated.	Labeled "Compound."	Total.
Examined in 1898.				
Jams, etc.	3	44	2	49
Jellies	20	43	7	70
Total	23	87	9	119
Percentage	19	73	8	100
Examined in 1901.				
Jams, etc.	2	16	10	28
Jellies	10	18	10	38
Total	12	34	20	66
Percentage	19	51	30	100
Examined in 1908.				
Jams etc.	4	6	47	57
Jellies	8	..	17	25
Total	12	6	64	82
Percentage	15	7	78	100

The Labeling of Compound Jams and Jellies.

Forty-seven jams and preserves were labeled "compounds." Of these, 38 contained glucose, 26 apple stock, 18 artificial color, 29 benzoic acid, 2 saccharin, 1 phosphoric acid, and 1 tartaric acid. Of the 17 jellies labeled "compound," 9 contained glucose, 13 apple stock, 11 benzoic acid, 7 artificial color, and 2 tartaric acid. These extraneous matters occurred, either singly or in various combinations, with more or less of the fruit indicated.

The purpose of the law, in requiring compounds and imitations to be labeled in conformity with their actual composition, is to protect the manufacturer of pure products and to give the purchaser full opportunity to know just what he is buying. A careful consideration of these 64 "compound" jams and jellies shows, that while with very few exceptions the letter of the law has been obeyed in their labeling, its spirit has been in many cases almost completely ignored. It is true that in every case these samples bear somewhere on the jar or tumbler the information that they are not pure products; it would require, however, much mental dexterity in some cases to ascertain these facts, and the casual observer would not obtain the needed information at all. In some cases the compound nature of the preparation was partially indicated on each of three different labels, placed on different parts of the containers; in a large number of samples the following was printed in small letters on a narrow label, around the top of the container: "Prepared from fresh fruit, granulated sugar and enough corn syrup to prevent crystalization." Not only is such a label very indefinite, but it is so placed as readily to escape observation, and may easily be made undecipherable by dust or the escaping contents of the jar; or may be destroyed altogether. In other cases, particularly in jellies, "preserved with benzoic acid" was handstamped on the paper cover, and frequently so indistinctly as to require a lens to decipher it. To state on the principal label that a product is a pure product, and then, on a subordinate label in an inconspicuous place, to state the presence of certain impurities, certainly is not obeying the spirit of the law. In fully one-third of these compounds the hasty purchaser would be led to expect he was obtaining a pure product.

All of these samples were collected and examined before January 1, 1908, the time when the new Connecticut Food and Drug Law went into effect. Under this law nearly all of the "compounds" would be incorrectly labeled. The requirements of the new law are much more definite and exacting regarding the labeling of "compounds."

JELLY POWDER.

19476. Royal Powdered Jelly, Orange. Made by Royal Pure Food Co., N. Y. Sold by F. H. Davis & Co., New London. Price

TABLE III.—JAMS, PRESERVES AND JELLIES. NOT FOUND ADULTERATED.

Station No.	Brand.	Dealer.	Station No.	Price per jar, cents.	Total solids.	Polarization. Direct.	Polarization. After inversion.	Polarization. Temperature C.
	Cherry Preserve.							
18675	Beech-Nut Packing Co., Canajoharie, N. Y.	*Hartford:* S. Vogel	18675	20	73.85	15.4	−19.1	23
	Grape Fruit Marmalade.							
18535	Beech-Nut Packing Co., Canajoharie, N. Y.	*Bridgeport:* D. E. McNamara	18535	10	69.22	16.4	−18.3	23
	Peach Jam.							
19514	Austin, Nichols & Co., N. Y. Sunbeam Brand	*Willimantic:* H. C. Hall	19514	25	67.74	45.8	−17.6	23
	Preserved Pineapple.							
18682	Libby, McNeill & Libby, Chicago	*Hartford:* Tolhurst & Son	18682	40	65.20	21.0	−16.3	23
	Crabapple Jelly.							
18596	R. C. Williams & Co., N. Y.	*Greenwich:* Timmons & Latham	18596	25	64.80	12.6	−20.2	25
	Currant Jelly.							
18590	Beech-Nut Packing Co., Canajoharie, N. Y. Red Currant	*Stamford:* New York Provision Co.	18590	20	64.42	−2.0	−18.9	25
18525	Clark, Chapin & Bushnell, N. Y. Pleasant Valley	*Bridgeport:* Wheeler & Co.	18525	15	68.50	−6.0	−19.1	25
18665	E. T. Cowdrey Co., Boston. Red Currant	*Hartford:* Boston Branch Grocery	18665	10	71.00	32.0	−19.8	25
18630	Libby, McNeill & Libby, Chicago. Black Currant	*New Britain:* Eugene Glaser	18630	15	64.00	−12.8	−14.7	25
18534	E. Pritchard, N. Y. Eddy's Home Made Red Currant	*Bridgeport:* Atlantic & Pacific Tea Co.	18534	15	63.72	−4.0	−14.7	25
	Plum Jelly.							
19553	Sprague, Warner & Co., Chicago. Richelieu Brand	*Waterbury:* Model Market Co.	19553	10	71.86	−2.0	−17.6	25
	Quince Jelly.							
18595	Beech-Nut Packing Co., Canajoharie, N. Y.	*Greenwich:* G. A. Finch	18595	15	64.30	37.6	−19.4	25

10 cents per box. The following statement is printed on the label in small type: "We absolutely guarantee that Royal Powdered Jelly is a carefully prepared combination of Powdered Gelatine, Refined Sugar, Acid of Lemons, artificial harmless colors and flavors, and nothing else." Chemical examination indicated that the statement of ingredients was correct.

RASPBERRY SYRUP.

19521. Finaste Hallonsaft, Raspberry Syrup Blend. Made by Scandinavian Imp. Co., Boston. Sold by O. Thompson & Co., Middletown. Price 25 cents per bottle. "Three to four tablespoonfuls to a glass of water makes a refreshing summer beverage. The contents of this bottle is a mixture of raspberry

TABLE IV.—ADULTERATED JAMS AND PRESERVES.

Station No.	Brand.	Dealer.	Price per jar, cents.	Total solids.	Polarization. Direct.	Polarization. After inversion.	Polarization. Temperature C.	Adulteration.
	Apricot Jam.							
18680	P. J. Ritter Conserve Co., Philadelphia. Seal Brand	*Hartford:* Brown, Thomson & Co.	15	65.16	95.2	82.2	22	Glucose.
	Red Raspberry Jam.							
18565	Geo. K. McMechen & Son Co., Wheeling, Va. Old Virginia	*Norwalk:* Union Grocery Co.	15	73.89	48.8	28.8	22	Glucose and Artificial Color.
	Canned Black Raspberries.							
18521	Packed at Newark, Wayne Co., N. Y. West Shore Brand	*Bridgeport:* Logan Bros.	10	20.25	1.2	−3.3	23	*Tin and Artificial Color.
	Strawberry Jam.							
18538	The John T. Doyle Co., New Haven. Country Club	" Peter Hron	15	68.86	127.2	126.8	22	Glucose.
19472	LeRoy Packing Co., Boston. LeRoy Extra Quality	*New London:* City Market	25	75.10	67.4	38.8	22	Glucose.
19525	P. J. Ritter Conserve Co., Philadelphia. Seal Brand	*Willimantic:* Frank Larrabee	20	74.23	88.8	81.8	22	Glucose and Artificial Color.

* Packed in tin can, which was badly corroded. Sample contained .027 per cent. of tin, or .1512 gm. for total contents of can

juice, sugar syrup, synthetic essence of raspberry, citric acid, and a trifle of coloring." The material is obviously sold as a compound of an almost completely artificial nature. The use of the term "blend" for such a product is not permissible under the new food law, as it is not a mixture of like substances. More than "a trifle of coloring" of an artificial nature was found to be present.

TABLE SALT.

Common salt is nearly pure sodium chlorid. It is not found in nature in a perfectly pure condition, but always associated with impurities, whose complete removal is exceedingly difficult. The common impurities found in salt prepared for table or dairy use are calcium sulphate, calcium and magnesium chlorids, sodium and magnesium sulphates, moisture and occasionally mechanical impurities. Sodium chlorid itself undergoes no change when exposed to the air, but magnesium or calcium chlorids, which are common impurities, rapidly absorb moisture.

The U. S. standard for table salt, and the one adopted by this station, requires that it must contain in the water-free material not more than 1.4 per cent. of calcium sulphate, not more that 0.5 per cent. of calcium and magnesium chlorids, nor more than 0.1 per cent. of matters insoluble in water.

The adulteration of salt is not common, but there are comparatively wide variations in the amount of moisture and the mineral impurities present. Certain manufacturers, to prevent caking and to permit of ready use in salt-shakers even in a damp atmosphere, add flour, starch, or other materials, to the salt. While such additions are made for the purposes named and not as makeweights, yet unless the labels clearly indicate their mixed composition, such mixtures cannot be sold as salt.

Twenty-one samples of salt were analyzed, representing eighteen brands. Three of these were sold as prepared or compound salt.

TABLE V.—JAMS, PRESERVES AND JELLIES LABELED "COMPOUNDS."

Station No.	Brand.	Dealer.	Price per jar, cents.	Sugar other than cane sugar.	Color.	Preservative.
	Apple Butter.					
18681	P. J. Ritter Conserve Co., Philadelphia	*Hartford:* Brown, Thomson & Co.	10	-------	Natural.	*Benzoic acid.
	Apricot Jam.					
18531	Curtice Bros. Co., Rochester, N. Y.	*Bridgeport:* Bridgeport Public Market	15	-------	Natural.	*Benzoic acid.
18678	Francis H. Leggett & Co., Nabob Fruit Jam Compound	*Hartford:* D. F. Burns	18	*Glucose.	Natural.	*Benzoic acid.
18622	Logan, Johnson & Co., Boston. Ideal Apricot Compound	*Meriden:* F. C Buhles	10	*Glucose.	*Artificial.	*Benzoic acid.
	Cherry Jam.					
18597	Francis H. Leggett & Co., N. Y. Nabob Fruit Jam	*Greenwich:* S. A. Moshier	20	*Glucose.	Natural.	*Benzoic acid.
	Damson Preserves.					
18620	Mansfield, Witham & Co., Lowell, Mass. Riverside Fruit Preserves	*Meriden:* Julius Augur	10	*Glucose.	Natural.	None.
	Orange Marmalade.					
18589	Logan, Johnson & Co., Boston. Pure Fruit Preserves	*Stamford:* New York Cash Grocery	15	*Glucose.	Natural.	None.

* Indicated on label.

TABLE V.—JAMS, PRESERVES AND JELLIES LABELED "COMPOUNDS."—*Continued.*

Station No.	Brand.	Dealer.	Price per jar, cents.	Sugar other than cane sugar.	Color.	Preservative.
	Peach Jam.					
19451	Curtice Bros. Co., Rochester, N. Y.	*New Haven:* Wray & Co.	15	--------	Natural.	*Benzoic acid.
18491	Francis H. Leggett & Co., N. Y. Nabob Fruit Jam	*Bridgeport:* C. McCarthy	15	*Glucose.	Natural.	*Benzoic acid.
18647	John S. Sills & Sons, N. Y. Red Lion Fresh Fruit Jams	*New Britain:* Wray & Co.	15	*Glucose.	Natural.	None.
	Pineapple Jam or Preserves.					
18676	The American Preserve Co., Philadelphia. Schimmel's Fresh Fruit Preserves	*Hartford:* Wise, Smith & Co.	20	--------	Natural.	*Benzoic acid.
18566	A. F. Beckmann & Co., N. Y. Crown Aster Brand Jam	*Norwalk:* New York Grocery	15	*Glucose.	Natural.	None.
18644	Miner, Read & Garrette, New Haven, Nutmeg Brand Jam	*New Britain:* J. E. Murphy	15	*Glucose.	Natural.	None.
	Quince Jam or Preserves.					
19505	Austin, Nichols & Co., N. Y. Thistle Brand Compound Jam	*New Haven:* O. Nestel	15	*Glucose.	*Artificial.	*Benzoic acid.
18526	East Brooklyn Pres. Co., East Brooklyn, Md. Reliance Fruit Preserves	*Bridgeport:* East End Grocery	10	*Glucose.	*Artificial.	*Benzoic acid.
18495	Logan, Johnson & Co., Boston. Quince and Apple Preserves	" Bridgeport Public Market	10	*Glucose.	Natural.	None.
18532	Logan, Johnson & Co., Boston. High Grade Preserves. Compound	*Bridgeport:* Bridgeport Public Market	10	*Glucose.	*Natural.	*Benzoic acid.

* Indicated on label.

TABLE V.—JAMS, PRESERVES AND JELLIES LABELED "COMPOUNDS."—*Continued.*

Station No.	Brand.	Dealer.	Price per jar, cents.	Sugar other than cane sugar.	Color.	Preservative.
	Quince Jam or Preserves. (cont.)					
19507	National Preserving Co., Baltimore. Compound Quince Preserves	*New Haven :* Delicatessen, 701 Grand Ave.	10	*Glucose.	Natural.	*Benzoic acid.
	Raspberry Jam or Preserves.					
18536	The American Preserve Co., Philadelphia. Schimmel's Fresh Fruit Jam	*Bridgeport :* Village Store Co.	15	--------	Natural.	*Benzoic acid.
18588	Austin, Nichols & Co., N. Y. Republic Jams. Raspberry-Apple	*Stamford :* R. T. Woodbury	15	--------	Natural.	None.
19531	Austin, Nichols & Co., N. Y. Republic Jams. Raspberry-Apple and Sugar	*Derby :* D. M. Welch & Son	18	--------	Natural.	None.
18673	Austin, Nichols & Co., N. Y. Republic Jams. Red Raspberry-Apple and Sugar	*Hartford :* Union Grocery	17	--------	Natural.	None.
18677	East Brooklyn Pres. Co., East Brooklyn, Md. Reliance Fruit Preserves	" Cady & Lombard	10	*Glucose.	*Artificial.	*Benzoic acid.
18576	The Great Atlantic & Pacific Tea Co., N. Y. Grandmother's A. and P. Jam	*Stamford:* Atlantic & Pacific Tea Co.	15	*Glucose.	Natural.	*Benzoic acid.
18577	Robert Hill, N. Y. Pure Fruit Jams	" Empire State Tea Co.	15	*Glucose.	Natural.	None.
18674	Logan, Johnson & Co., Boston. High Grade Preserves. Compound	*Hartford :* Hartford Market Co.	10	*Glucose.	*Artificial.	*Benzoic acid.
18527	Logan, Johnson & Co., Boston. Ideal Raspberry and Apple	*Bridgeport :* I. Rome	10	*Glucose.	Natural.	None.

* Indicated on label.

TABLE V.—JAMS, PRESERVES AND JELLIES LABELED "COMPOUNDS."—*Continued.*

Station No.	Brand.	Dealer.	Price per jar, cents.	Sugar other than cane sugar.	Color.	Preservative.
	Raspberry Jam or Preserves. (cont.)					
18492	Logan, Johnson & Co., Boston. Fruit Preserves	*Bridgeport :* P. D. Lyon	15	*Glucose.	Natural.	None.
18619	Mansfield, Witham & Co., Lowell, Mass. Riverside Jam. Compounded	*Meriden :* L. C. Brown	10	*Glucose.	*Artificial.	*Benzoic acid.
18621	Miner, Read & Garrette, New Haven. Nutmeg Brand Jam	" Booth's Market	15	*Glucose.	Natural.	None.
19558	P. J. Ritter Conserve Co., Philadelphia. Pure Food Red Raspberry Pomona	*Waterbury :* Spencer, Pierpont Co.	10	*Glucose.	Natural.	*Benzoic acid.
18490	W. Va. Pres. Co., Wheeling, W. Va. Fort Henry Brand. Compound	*Bridgeport :* H. Isenberg & Co.	10	*Glucose.	*Artificial.	{ *Saccharin. *Benzoic acid.
	Strawberry Jam or Preserves.					
19474	The American Pickling Co., Providence, R. I. American Brand, Glucose Preserves	*New London :* The Mohican Co.	10	*Glucose.	*Artificial.	{ *Phos'ric acid. *Benzoic acid.
18539	Austin, Nichols & Co., N. Y. Lion Compound Fruit Jam	*Bridgeport :* Logan Bros.	10	*Glucose.	*Artificial.	None.
18501	A. F. Beckmann & Co., N. Y. Crown Aster Brand Jam	*So. Norwalk :* New York Grocery	15	*Glucose.	Natural.	None.
18502	Blue Bell Preserve Co., New Haven. Blue Bell Jam	" United Grocery Co.	10	*Glucose.	*Artificial.	{ *Saccharin. *Benzoic acid.
19566	Curtis & Moore, Boston. Strawberry Preserve	*Danbury :* Ehle's Grocery	10	--------	*Artificial.	*Benzoic acid.

* Indicated on label.

TABLE V.—JAMS, PRESERVES AND JELLIES LABELED "COMPOUNDS."—*Continued.*

Station No.	Brand.	Dealer.	Price per jar, cents.	Sugar other than cane sugar.	Color.	Preservative.
	Strawberry Jam or Preserves. (cont.)					
18694	The John T. Doyle Co., New Haven. Blue Bell Preserve, Strawberry Flavor	*New Haven*: Philip Mayrand	10	*Glucose.	*Artificial.	*Benzoic acid.
19479	Empress Jam	*New London*: M. Wilson Dart	15	*Glucose.	Natural.	*Benzoic acid.
18587	Howard & Co., N. Y. Empress Fruit Jam	*Stamford*: W. W. Waterbury	10	*Glucose.	*Artificial.	*Benzoic acid.
18529	Gibbs Preserving Co., Baltimore. White Label Brand Jam	*Bridgeport*: A. Mertin & Son	10	*Glucose.	*Artificial.	*Tartaric acid. *Benzoic acid.
18537	The Great Atlantic & Pacific Tea Co. N. Y. Grandmother's A. & P. Jam	" Atlantic & Pacific Tea Co.	15	*Glucose.	Natural.	*Benzoic acid.
18530	Logan, Johnson & Co., Boston. Ideal Strawberry and Apple	" R. W. Parrot	10	*Glucose.	*Artificial.	None.
18533	Logan, Johnson & Co., Boston. Ideal Strawberry Compound	" Centennial Tea Co.	10	*Glucose.	*Artificial.	*Benzoic acid.
18568	Wallace & Thomson, N. Y. Watson Compound Fruit Preserves	*Norwalk*: Grand Central Grocery	10	*Glucose.	*Artificial.	None.
18528	The Williams Bros. Co., Detroit. Highland Brand Jam	*Bridgeport*: Logan Bros.	10	*Glucose.	Natural.	None.
18503	Wyoming Preserving Co. Wyoming Brand Strawberry Compound	*So. Norwalk*: C. Becker & Son	10	*Glucose.	†Artificial.	*Benzoic acid.
	Apple Jelly.					
18693	P. J. Ritter Conserve Co., Philadelphia. Pomona	*New Haven*: C. Reinwald & Son	10	*Glucose.	Natural.	*Benzoic acid.

* Indicated on label. † Not indicated on label.

TABLE V.—JAMS, PRESERVES AND JELLIES LABELED "COMPOUNDS."—*Continued.*

Station No.	Brand.	Dealer.	Price per jar, cents.	Sugar other than cane sugar.	Color.	Preservative.
	Apple Jelly. (cont.)					
19540	W. Va. Pres. Co., Wheeling, W. Va. Fort Henry Compound	*Waterbury*: The White-Simmons Co.	10	*Glucose.	*Artificial.	*Benzoic acid.
	Crabapple Jelly.					
19454	Clark, Chapin & Bushnell, N. Y. Pleasant Valley Brand	*New Haven*: W. D. Minor	14	--------	Natural.	*Benzoic acid.
18493	McMechen Pres. Co., Wheeling, W. Va. Old Virginia Compound	*Bridgeport*: H. Isenberg & Co.	10	--------	*Artificial.	*Benzoic acid.
	Currant Jelly.					
18505	Austin, Nichols & Co., N. Y. Republic. Currant, Apple, Sugar	*So. Norwalk*: F. D. Lawton	20	--------	Natural.	None.
19532	A. F. Beckmann & Co., N. Y. Gold Rock	*Derby*: New York Grocery Co.	10	--------	Natural.	*Tartaric acid.
18494	Francis H. Leggett & Co., N. Y. Nabob Apple and Currant Flavor	*Bridgeport*: Pike Bros. Co.	15	--------	Natural.	*Benzoic acid.
18645	Renwick Preserving Co., N. Y. Renwick Brand Compound	*New Britain*: J. J. Quilty	10	*Glucose.	*Artificial.	*Benzoic acid.
19478	Riverside Preserving Co., Lowell, Mass. Merrimac Brand. Currant Flavor	*New London*: F. H Davis & Co.	10	*Glucose.	*Artificial.	None.
18540	The Williams Bros. Co., Detroit. Wilco Brand. Apple and Currant	*Bridgeport*: East End Grocery	10	--------	Natural.	*Tartaric acid.
18623	Currant Flavor	*Meriden*: M. Keegan	10	†Glucose.	†Artificial.	None.

* Indicated on label. † Label crumpled and indistinct; artificial color found.

TABLE V.—JAMS, PRESERVES AND JELLIES LABELED "COMPOUNDS."—*Concluded.*

Station No.	Brand.	Dealer.	Price per jar, cents.	Sugar other than cane sugar.	Color.	Preservative.
	Grape Jelly.					
18692	Cruikshanks Bros. Co., Pittsburg. Grape-Apple Jelly	*New Haven*: E. Schoenberger & Son	10	-------	Natural.	*Benzoic acid.
	Quince Jelly.					
19488	Francis H. Leggett & Co., N. Y. Nabob	*Putnam*: E. T. Tucker	20	-------	Natural.	*Benzoic acid.
18504	W. Va. Pres. Co., Wheeling, W. Va. Fort Henry Compound	*So. Norwalk*: Edwin Wilcox	12	*Glucose.	*Artificial.	*Benzoic acid. *Phosphates.
	Raspberry Jelly.					
18567	McMechen Pres. Co., Wheeling, W. Va. Old Virginia Apple and Red Raspberry	*Norwalk*: Grand Central Grocery	10	-------	Natural.	None.
19459	P. J. Ritter Conserve Co., Philadelphia. Pomona Apple Jelly, Raspberry Flavor	*New Haven*: G. W. Eul	10	*Glucose.	Natural.	*Benzoic acid.
	Strawberry Jelly.					
18646	Renwick Preserving Co., N. Y. Renwick Brand. Compound	*New Britain*: Wray & Co.	10	*Glucose.	*Artificial.	*Benzoic acid.

* Indicated on label.

The samples were tested for water, insoluble matter, lime, magnesia, chlorin and sulphuric acid. In calculating the probable combinations of bases and acids, the sulphuric acid was calculated as calcium sulphate, any excess of lime as calcium chlorid, the magnesium as magnesium chlorid, and sodium chlorid by difference. The results of the analyses appear in Table VI.

The samples sold as pure salt showed the following range in composition:

Water	0.00 to 0.60	Ave.	0.33
Insoluble matter	0.00 to 0.08	"	0.03
Calcium sulphate	0.30 to 1.23	"	0.87
Calcium chlorid	0.00 to 0.35	"	0.13
Magnesium chlorid	0.08 to 0.21	"	0.09
Sodium chlorid	98.04 to 99.54	"	98.54

The samples show on the average a fair state of purity. The moisture content is generally insignificant, exceeding 0.50 per cent. in only four samples. Every sample satisfied the requirements of the standard as regards insoluble matter, calcium sulphate and calcium and magnesium chlorids. The actual content of sodium chlorid varies from 98.04 to 99.54, with an average of 98.54 per cent. Diamond Crystal Salt shows the highest degree of purity, with an average of 99.52; the other brands contain from 1.05 to 1.96 per cent. of impurities.

The three brands of compound salt indicated that they were not pure salt on the labels. In two cases the added matter was intended to facilitate the use of the salt in the shaker, but in Cerebos Salt nutriment was alleged to have been added.

Cerebos Nutritive Salt. Made by Cerebos Limited, Newcastle-on-Tyne and London. "Contains, among other ingredients, mixed phosphates, constituting the food strength of bran (usually thrown away), forming the substance of bone, brain and nerve."

This preparation consists of sodium chlorid, with an addition of calcium phosphate, sodium sulphate, and a little magnesium carbonate. These added ingredients are claimed to be derived from bran. The insoluble matter, 2.92 per cent., consists wholly of tricalcic phosphate. Assuming that these phosphates are derived from vegetable matter, as stated by the manufacturer, they must be considered as present in an inorganic form, as the analysis

TABLE VI.—TABLE SALT.

Station No.	Brand.	Dealer.	Price per pkge.	Net weight.	Cost per pound.	Water.	Insoluble Matter.	Calcium Sulphate.	Calcium Chlorid.	Magnesium Chlorid.	Sodium Chlorid (by difference).
			cts.	lbs.	cts.						
19444	Diamond Crystal Salt Co., St. Clair, Mich. Diamond Crystal Salt	*New Haven:* F. J. Markle	9	5.1	1.8	0.00	0.01	0.45	0.00	0.04	99.50
19620	Diamond Crystal Salt	*Waterbury:* J. W. Reed	5	2.4	2.1	0.08	0.01	0.30	0.00	0.07	99.54
19571	The Great Atlantic and Pacific Tea Co., N. Y. Grandmother's Brand, A. P.	*New Haven:* Atlantic & Pacific Tea Co.	5	4.6	1.1	0.30	0.05	0.98	0.00	0.09	98.58
18672	Hecker's Opal Table Salt	*Hartford:* Cady & Lombard	10	2.5	4.0	0.15	0.02	1.23	0.26	0.16	98.04
18607	International Salt Co., N. Y. Purity Brand	*Meriden:* McBride's Cash Grocery	5	2.5	2.0	0.33	0.02	1.01	0.00	0.11	98.53
19522	International Salt Co., N. Y. Yorkshire Brand	*Middletown:* D. I. Chapman	10	4.1	2.4	0.40	0.06	1.19	0.00	0.04	98.31
19537	Miner, Read & Garrette, New Haven. Extra Quality Improved Prize Medal Salt	*Waterbury:* The White-Simmons Co.	5	3.0	1.7	0.37	0.02	0.97	0.00	0.21	98.43
19625	Miner, Read & Garrette, New Haven. Extra Quality Improved Prize Medal Salt	*Waterbury:* Penn. Merchandise Co.	5	2.8	1.8	0.42	0.01	1.08	0.00	0.17	98.32
19458	The Ohio Salt Co., Wadsworth, O. Chippewa Salt	*New Haven:* H. M. Tower	5	3.1	1.6	0.12	0.05	1.01	0.00	0.03	98.79
19493	The Twitchell Champlin Co., Portland and Boston. Hatchet Brand	*Danielson:* Danielsonville Cotton Co. Store	5	2.6	1.9	0.33	0.01	0.85	0.35	0.04	98.42
19604	Gold Medal Table Salt	*New Britain:* Union Trading Co.	5	2.4	2.1	0.59	0.08	0.67	0.29	0.10	98.27
19538	Huss Brand Table Salt	*Waterbury:* Waterbury Market Co.	5	2.4	2.1	0.46	0.04	0.86	0.18	0.02	98.44
18523	The Watkins Salt Co., Watkins, N. Y. Watkins Brand	*Bridgeport:* Village Store Co.	3	2.9	1.0	0.60	0.01	0.85	0.25	0.08	98.21
18541	The Watkins Salt Co., Watkins, N. Y. Watkins Brand	*Bridgeport:* Logan Bros.	3	2.5	1.2	0.50	0.04	0.83	0.27	0.09	98.27
19437	Star Brand Salt	*New Haven:* D. M. Welch & Son	5	4.2	1.2	0.52	0.03	0.91	0.29	0.08	98.17
18524	Worcester Salt Co., N. Y. Worcester Brand	*Bridgeport:* Helbig's Market	5	2.7	1.9	0.20	0.01	0.59	0.19	0.07	98.94
19569	Fine Brunswick Salt	*Danbury:* New York Grocery	5	3.1	1.6	0.32	0.04	0.88	0.14	0.10	98.52
19596	Columbia Crystal Salt Refined	*Bridgeport:* H. Isenberg & Co.	5	2.9	1.7	0.25	0.06	1.01	0.15	0.12	98.41
18671	Cerebos Ltd., London. Cerebos Nutritive Table Salt	*Hartford:* Cannon & Flannagan	15	1.6	9.4	0.09	*2.92	‡0.12	0.00	0.05	95.45
18683	Diamond Crystal Salt Co., St. Clair, Mich. Prepared Shaker Salt	*New Haven:* D. M. Welch & Son	10	2.2	4.5	0.00	†1.61	0.48	0.00	0.09	97.82
19548	Worcester Salt Co., N. Y. Ivory Compound Salt	*Waterbury:* Cruess Bros.	10	3.3	3.0	0.10	0.41	§0.63	0.00	0.66	98.20

* Calcium Phosphate.
† Calcium Carbonate.
‡ { 1.10 Sodium Sulphate. 0.27 Magnesium Carbonate.
§ 0.27 Calcium Carbonate.

indicates but mere traces of organic matter. "The recommendation of such preparations is based upon the groundless assumption that an ordinary mixed diet is too poor in phosphorus to be able adequately to supply our need of that substance. It may be remarked, in this connection, that we know of no diseased condition which can be clearly traced to a deficiency of phosphorus in the diet" (Hutchinson, "Food and the Principles of Dietetics," 1906, 293). If for any reason it is desired to increase the amount of phosphorus in the food, we have at our disposal organic foods rich in phosphorus, such as yolk of egg, thymus, fish-roe, calves' brains and wheat germs. The recent experiments of Bergell ("Fortschr. der. Med." 1898, **16**, 1) seem to remove all doubt that such organic forms are well absorbed in the body.

Shaker Salt. Made by Diamond Crystal Salt Co., St. Clair, Mich. Guaranteed to contain 98.05 per cent of sodium chlorid, 1.75 of calcium carbonate and 0.20 of calcium sulphate. Our analysis shows 97.82, 1.61, and 0.48 per cent. respectively. The 1.61 per cent. of insoluble matter consists wholly of calcium carbonate.

Ivory Compound Salt. Made by Worcester Salt Co., New York City. Contains 98.20 per cent. of sodium chlorid, 0.41 per cent. of insoluble matter, consisting chiefly of calcium carbonate, and a magnesium salt, probably the chlorid.

The samples of salt were purchased in containers of varying capacity. Each was weighed and the result of the weighings, together with the calculated cost per pound, is shown in the table. In the samples sold as pure salt, the cost per pound varies from 1.0 to 2.4 cents, with the exception of Hecker's Opal Salt, which costs 4.0 cents per pound. The price of the compound salts varies from 3.0 to 9.4 cents per pound. The price of Cerebos Salt seems unnecessarily high, especially when we consider that it contains less actual sodium chlorid than any of the other brands analyzed, and that the added mineral matter, in the opinion of leading physiologists, gives it no increased food value.

INFANT AND INVALID FOODS.

The number of proprietary infant foods is constantly increasing and the terms "the best food," "the perfect substitute for mother's milk," etc., are very familiar. While in general the "best food" for infants is their mothers' milk, and while there is no such thing as a "perfect substitute" for it, yet some fairly successful formulas have been devised for modifying cow's milk so that it may closely resemble human milk in composition. This is effected by dilution, the addition of cream, dilution with a solution of milk sugar, or by the so-called humanized milks. In some cases the digestion of the cow's milk is facilitated by partial peptonization, suitable powders being prepared for this purpose. Another form of infant food is condensed milk, which is too well known to make further comment necessary.

We are here especially concerned with the various proprietary preparations, which are intended to be used as substitutes for milk or in connection with it. In such preparations the form in which the nutriment is offered and its solubility are of vital importance. It must be relatively rich in tissue-building material, proteins and mineral matter, and relatively poor in carbohydrates, which are chiefly useful as a source of energy. It should also contain an abundance of fat. Unaltered starch is but very imperfectly digested by very young infants and any excess of either starch or sugar is likely to cause intestinal disturbance.

Twenty-four samples of infant and invalid foods have been collected and analyzed. A description of the samples appears in Table VII, while in Table VIII the detailed analyses are given.

These preparations may be roughly divided into four classes; first, those prepared from cow's milk with various additions or alterations; second, farinaceous foods, in which the starch has been partly or wholly converted into malt-sugar or dextrin, and which are fed with cow's milk; third, milk preparations with no addition of cereals; and fourth, miscellaneous preparations.

The first class, or those which are prepared from cow's milk with various additions or alterations, includes:

Allenburys' Milk Food, No. 1.
Allenburys' Milk Food, No. 2.
Nestlé's Food.
Carnrick's Soluble Food.
Cereal Milk.
Borden's Malted Milk.
Meadow's Malted Milk.
Horlick's Malted Milk.
Lactated Food.

The solids of human milk contain 13.2 protein (factor 6.25), 26.4 fat, 52.4 carbohydrates in form of milk sugar and 2.1 per cent. ash. Compared with this standard all these foods are deficient in fat and all contain a large excess of carbohydrates; in two cases there is also a marked deficiency in protein. Five of them contain no starch or only traces, but three samples, Nestlé's Milk, Carnrick's Soluble Food and Lactated Food, contain 15.90, 16.20 and 41.94 per cent. of starch, a portion of it in Nestlé's Food being in the raw condition. These foods, with exception of the three just named, are largely soluble in water and, besides the carbohydrates, from 43 to 96 per cent. of the protein and from 80 to 98 per cent. of the ash are soluble in water. On the other hand, in Nestlé's Food only 31 per cent., in Carnrick's Soluble Food only 29 per cent., and in Lactated Milk only 12 per cent. of the protein is soluble in water; in the last named food, too, only 53 per cent. of the ash is water-soluble. Allenburys' Milk Food, No. 1 and No. 2, contain much more fat than the other foods of this class.

The second class, farinaceous foods in which more or less of the starch has been rendered soluble, includes

Allenburys' Malted Food, No. 3.	Mellins Infant Food.
Benger's Food.	Sunbright's Cal. Baby Food.
Imperial Granum.	Taroena.
Fessenden's Food.	Ridge's Food.
Just Food.	

In these foods the starch has either been rendered soluble during the process of manufacture, or a ferment is present which secures the same effect when the food is prepared for use. All of these foods contain much less fat than those of the first class, and the directions for feeding most of them prescribe the addition of more or less milk, which supplies fat. They are all essentially carbohydrate foods, although some of them contain considerable protein. They all contain starch, with the single exception of Mellins Food, varying from 2.64 to 73.97 per cent. Even granting the presence of a suitable ferment which may convert the starch during the food's preparation for use, a lack of care on the part of the person mixing the food and the fact, often proved, that the conversion of the starch is not complete, even when the directions are strictly followed, make it probable that

much unaltered starch will be present at the time of feeding. The water extract of these foods, with the exception of Fessenden's, Just's and Mellins, shows that only a small part of the carbohydrates is soluble, varying from 2.26 to 15.42 per cent. The proteins show similar insolubility, while the ash is highly soluble in nearly every case.

The third class includes Plasmon and Carnrick's Lacto-Preparata. Plasmon is practically dried milk casein. It is characterized by its high protein and ash content, and its deficiency in carbohydrates. It is especially adapted where a concentrated, easily digested, tasteless protein food is required. Experiments have shown that it is readily assimilated. Carnrick's Lacto-Preparata is a dried milk modified without the use of cereal carbohydrates. It contains but a small amount of starch, a large quantity of soluble carbohydrates, and a fair amount of protein, only a small part of which is soluble in water. It is decidedly deficient in fat.

The miscellaneous class includes Peptogenic Milk Powder, which is chiefly milk sugar and contains no starch; Eskay's Albumenized Food, a preparation made from egg albumen and cereals, containing considerable raw arrowroot starch and a rather low percentage of protein, most of which is insoluble in water; Wampole's Milk Food, made from malted cereals, beef and milk, partially digested. It contains no starch, and a large amount of soluble carbohydrates; it is also rich in protein, half of which is soluble in cold water.

The carbohydrates of these foods consist of lactose, maltose, dextrin, starch and possibly sucrose and other sugars. Much interesting and instructive data would be furnished by a separation of these various carbohydrate forms. An effort was made to do this, but the results secured do not warrant their publication. The various and indefinite solubilities of the sugars and their different copper-reducing power are not sufficiently marked to effect their differentiation, especially in complex mixtures. McGill's method of extraction with alcohol and then with water was tried on all the samples, but the results secured were absolutely unreliable.

Lactose was determined by the official mucic acid method, and while the results are recorded in the table they must be considered suggestive rather than absolute.

Fat was determined by both the official method of extraction used in the analysis of feeding stuffs and by the Roese-Gottlieb method. (Land. Vers. Stat., 40, p. 6.) It was easily demonstrated that simple extraction with ether gave low and entirely untrustworthy results; this

TABLE VII.—INFANT AND INVALID FOODS.

Station No.	Brand.	Dealer.	Price per package.	Net Weight of package.	Claims of Manufacturer.
			cts.	oz.	
19528	Allenburys' Milk Food No. 1. Allen & Hanburys, Ltd., London	*Willimantic.* City Drug Store	50	10.2	Pasteurized milk modified. Excess of casein removed, soluble vegetable albumen, milk sugar and cream added.
19577	Allenburys' Milk Food No. 2. Allen & Hanburys, Ltd., London	*New Haven.* Hull's Drug Store	45	10.4	Made from pasteurized milk and malted wheat, no unaltered starch. Contains all elements of human milk in natural proportions.
19475	Borden's Malted Milk, Eagle Brand. Borden's Condensed Milk Co.	*New London.* F. H. Davis & Co.	40	7.3	Made from rich cow's milk and strengthening cereals.
19581	Meadow's Malted Milk. Elgin Milkine Co., Elgin, Ill.	*New Haven.* Cippolba Bros.	40	7.5	Made from full-cream milk and malted cereals.
19462	Horlick's Malted Milk. Horlick's Malted Milk Co., Racine, Wis	*New Haven.* J. H. Buckley	39	7.2	Made from full-cream milk and malted grains.
18546	Nestlé's Food, Henry Nestlé, Vevey, Switzerland	*Bridgeport.* Hartigan's Pharmacy	45	11.6	Made from concentrated milk, sugar and soluble elements of baked wheat flour.
19612	Carnrick's Soluble Food. Reed & Carnrick, Jersey City, N. J.	*Hartford.* James Duggan & Co.	50	10.3	Made from cow's milk, the fat removed and replaced by cocoa butter, and malted wheat. To be boiled when using.
18624	Cereal Milk. Wells, Richardson & Co., Burlington, Vt.	*New Britain.* Bergquist Bros.	10	2.1	Made from milk, sugar of milk, wheat gluten flour and best barley malt. No free starch. Add hot water for use.
18631	Lactated Food. Wells, Richardson & Co., Burlington, Vt.	*New Britain.* W. C. Hillard	25	5.1	Contains the most important elements of mother's milk with the nutritive principles of the cereal grains.
19599	Allenburys' Malted Food No. 3. Allen & Hanburys, Ltd., London	*Bridgeport.* Atlantic Hotel Pharmacy Co.	30	12.9	Made from wheat flour and malt. A cooked food ready for use of children over 6 months.
18657	Benger's Food for Infants, etc. Benger's Food, Ltd., Manchester, Eng.	*Hartford.* Brown, Thomson & Co.	25	4.3	Made from wheat flour and pancreatic extract. Mix with warm milk or water when using.
18583	Imperial Granum Food. John Carle & Sons, N. Y.	*Stamford.* A. L. Embree	25	5.4	Extract of wheat. Prepare with boiling water and milk.
19529	Fessenden's Food. Fessenden Food Co., N. Y.	*Willimantic.* City Drug Store	50	9.4	Made from wheat, rye, arrowroot and malted barley. No cane sugar or unaltered starch. Hot water or milk to be used.
18604	Just's Dietetic Cereal Food. Just's Food Co., Syracuse, N. Y.	*Meriden.* Broderick & Curtin	45	9.6	Made from barley malt, wheat and corn. No cane sugar, sugar of milk, dried milk or raw starch. Use with fresh milk.
18545	Mellins Infant Food. Mellins Food Co., Boston, Mass.	*Bridgeport.* J. H. McNamara	45	4.8	Extract from wheat and malt. No cane sugar or starch.
19621	Sunbright's California Baby Food. Sunbright's California Food Co., Los Angeles, Cal.	*Waterbury.* H. W. Lake Drug Co.	25	6.9	A perfect modifier of cow's milk.
19565	Taroena. The Taro Food Co., Danbury, Conn.	*Danbury.* Kinner & Benjamin	50	11.0	Cooked product from the taro plant.
18603	Ridge's Food. Woolrich & Co., Palmer, Mass.	*Meriden.* W. W. Mosher	25	8.4	Baked flour. Mix with milk or water.
18598	Plasmon. The American Plasmon Syndicate, Ltd., N. Y.	*Meriden.* V. W. Smelzer	35	4.5	Milk casein.
19449	Carnrick's Lacto-Preparata. Reed & Carnrick, N. Y.	*New Haven.* J. J. Alling	25	9.1	Cow's milk modified to perfectly resemble human milk. No cereal carbohydrates.
19527	Peptogenic Milk Powder. Fairchild Bros. & Foster, N. Y.	*Willimantic.* Wilson's Drug Store	50	7.6	Chiefly milk sugar. No foreign substance, no digestive ferment, no aid to digestion.
18544	Eskay's Albumenized Food. Smith, Kline & French Co., Philadelphia	*Bridgeport.* Toucey's Pharmacy	25	4.2	Made from egg albumen and cereals.
19582	Wampole's Milk Food. Henry K. Wampole & Co., Philadelphia	*New Haven.* W. A. Spalding	45	8.0	Made from malted cereals, beef and milk, partially digested.

TABLE VIII.—INFANT AND INVALID FOODS.

Station No.	Brand.	Water.	Fat.	Fiber.	Ash.	Protein (N x 6.25).	Nitrogen-free extract.	Starch.
	Milk and Cereals:							
19528	Allenburys' Milk Food, No. 1	5.32	13.00	----	4.00	9.93	67.75	----
19577	Allenburys' Milk Food, No. 2	4.98	13.72	0.28	3.69	9.00	68.33	----
19475	Borden's Malted Milk	5.42	6.14	0.23	3.17	13.38	71.66	0.62
19581	Meadow's Malted Milk	4.04	4.11	0.26	3.22	13.88	74.49	0.62
19462	Horlick's Malted Milk	3.63	8.36	----	3.70	12.94	71.37	----
18546	Nestlé's Food	3.53	5.75	----	2.24	11.56	76.92	15.90
19612	Carnrick's Soluble Food	3.10	1.14	0.54	2.00	12.25	80.97	16.20
18624	Cereal Milk	5.32	4.06	0.03	2.20	10.38	78.01	2.93
18631	Lactated Food	7.12	0.72	----	1.19	8.13	82.84	41.94
	Malted Cereals:							
19599	Allenburys' Malted Food, No. 3	5.94	0.80	0.03	1.00	11.38	80.85	66.30
18657	Benger's Food for Infants	8.61	0.83	0.02	1.07	12.00	77.47	59.57
18583	Imperial Granum Food	5.86	0.44	0.04	0.45	13.13	80.08	73.97
19529	Fessenden's Food	5.95	0.40	0.08	1.60	6.00	85.97	35.69
18604	Just's Dietetic Cereal Food	6.30	0.04	----	0.41	0.81	92.44	2.64
18545	Mellins Infant Food	5.07	1.15	0.25	3.79	10.50	79.24	----
19621	Sunbright's California Baby Food	9.00	0.70	0.22	1.09	7.94	81.05	63.25
19565	Taroena	11.82	0.44	0.87	1.53	1.50	83.84	71.63
18603	Ridge's Food	9.24	1.04	0.05	0.60	11.81	77.26	69.46
	Milk Foods:							
18598	Plasmon	12.37	0.40	----	7.70	70.31	9.22	0.53
19449	Carnrick's Lacto-Preparata	2.45	2.26	----	2.94	11.44	80.91	2.81
	Miscellaneous:							
19527	Peptogenic Milk Powder	3.02	0.10	----	1.40	0.81	94.67	----
18544	Eskay's Albumenized Food	3.06	1.20	0.04	1.34	6.56	87.80	28.41
19582	Wampole's Milk Food	6.17	4.53	0.37	4.98	15.31	68.64	----

Station No.	Lactose.*	Reducing sugars as dextrose. Before inversion.	Reducing sugars as dextrose. After inversion.	Water extract. Total.	Water extract. Protein.	Water extract. Ash.	Water extract. Carbohydrates.	Microscopical examination.
19528	32.83	34.86	65.08	78.82	9.25	3.62	65.95	No starch.
19577	27.14	38.64	62.96	83.27	8.69	3.63	70.95	No starch.
19475	0.61	37.09	75.88	88.36	8.25	2.86	77.25	No starch; cereal chaff, hairs and gluten cells.
19581	0.43	38.50	73.00	90.12	10.50	2.55	77.07	No starch.
19462	0.39	42.74	73.28	88.58	8.75	3.42	76.41	No starch.
18546	0.21	20.92	56.72	67.20	3.75	2.07	61.38	Raw and cooked wheat starch.
19612	0.31	18.82	42.86	48.87	3.56	1.62	43.69	Cooked starch; wheat tissues.
18624	12.06	47.34	77.28	84.39	4.50	1.97	77.92	Small amount of starch.
18631	9.67	18.48	35.88	34.54	1.01	0.63	32.90	Distorted wheat starch.
19599	0.23	7.32	18.80	18.38	2.19	0.77	15.42	Slightly distorted starch.
18657	0.36	2.38	6.00	9.90	5.38	0.78	3.74	Raw wheat starch.
18583	0.21	----	2.48	3.27	0.63	0.38	2.26	Distorted wheat (?) starch.
19529	0.36	16.60	46.24	48.80	3.50	1.47	43.83	Raw arrowroot starch.
18604	0.13	16.22	93.40	88.43	0.68	0.36	87.39	No raw starch.
18545	0.37	32.14	76.16	83.97	4.81	3.55	75.61	No starch; gluten cells.
19621	0.19	1.26	5.84	6.84	0.82	0.87	5.15	Distorted cereal starch, probably barley.
19565	0.45	1.16	9.48	10.14	0.44	1.21	8.49	Cells filled with cooked starch; vessels.
18603	0.12	----	2.68	3.90	1.00	0.44	2.46	Raw wheat starch.
18598	0.48	----	0.70	14.81	8.75	3.27	2.79	No starch.
19449	63.71	51.42	70.80	79.65	1.94	2.19	75.52	Trace of starchy material.
19527	90.53	67.66	94.71	95.40	0.62	1.30	93.48	No starch or vegetable tissues.
18544	39.68	34.40	48.38	51.10	0.56	1.05	49.49	Raw arrowroot starch, cooked cereal starch.
19582	0.36	37.01	68.24	86.46	7.50	3.79	75.17	No starch.

*See page 601.

was especially marked in the malted milk preparations where the dried saccharine material appeared to encrust the fat particles and prevented the solvent action of the ether. The results reported in every case were secured by the Roese-Gottlieb method. The following comparative figures show the different amounts of fat secured by the two methods:

	Official.	Roese-Gottlieb.
Allenburys' Milk Food, No. 1	10.45	13.72
Borden's Malted Milk	1.22	6.14
Meadow's Malted Milk	1.39	4.11
Horlick's Malted Milk	1.63	8.36
Cereal Milk	0.88	4.06
Wampole's Milk Food	0.65	4.53

It will be observed from the table, that while in general the amount of water-soluble carbohydrates agrees quite closely with the reducing sugars found after inversion, the tendency in the milk preparations is towards high results. This is doubtless due to a partial emulsifying of the fat during the extraction with water. The effect of this error is likewise shown from the fact that in these samples the sum of the water-soluble carbohydrates and the starch is usually in excess of the total nitrogen-free extract. On the other hand, in certain samples, as 19612, 18631, 18657, 19621 and 18544, the water-soluble matter seems too low. This is doubtless due to peculiarities of these samples which make them resistant to the method used. While it is admitted that the figures for water extract are not absolute, still they represent in every case agreeing duplicates secured under exactly the same conditions and supply useful comparative data.

Another sample of a proprietary invalid food was examined, which is of an entirely different nature from those just reported. This is **19622** *Peptol,* made by The Peptol Co., Battle Creek, Mich., and sold by Apothecaries Hall Co., Waterbury, for $1.00 per can. It contained 17.66 per cent. water, 0.71 ash, 0.23 nitrogen and polarized direct +153.27 and after inversion +152.08, both at 23.5°C. It also contained a small amount of raw starch, probably chocolate.

MEAT EXTRACTS AND MEAT PREPARATIONS.*

The use of meat extract as a dietary adjunct dates back to the time of Hippocrates. The first publication relating to it was by Geoffroy in 1730. During the next hundred years a number of French chemists gave the subject special study, but it was not until in 1847, when Baron von Liebig published his classical studies on meat, that meat extracts became widely known. Following the suggestions of Liebig's work, Max vonPettenkofer devised a method for preparing the extract, which was admitted into the Bavarian Pharmacopœia in 1856. This method was used by a company acting under Liebig's authorization, and in 1864 a factory was established in South America, where a plentiful and cheap supply of cattle was obtainable. The name "Liebig's Extract," first applied to this preparation, is now applied to many extracts differing greatly from the original preparation in composition, properties and method of manufacture. The English courts† have decided that the name "Liebig's Extract" is public property, so that its appearance on a label by no means establishes that the product is manufactured by the Liebig's Extract of Meat Company, the original manufacturer, or that the Liebig process has been used.

THE ORIGINAL LIEBIG PROCESS.

By Liebig's original method finely chopped lean meat was treated with eight times its weight of cold water, the insoluble

* Credit for the analytical work herein reported is shared equally by E. M. Bailey, C. B. Morrison, H. R. Stevens and the writer.

† Allen. Commercial Organic Analysis, 1898, *4*, 306.

matter strained off, the liquid sufficiently heated to coagulate the dissolved albumin, filtered and evaporated to a syrupy consistency. By this method proteins, gelatin and gelatinoids were excluded from the extract. Later, however, Liebig modified the process by using water at 180° F., which may admit into the extract considerable quantities of gelatinoids and soluble noncoagulable proteins. Liebig stated that thirty-four pounds of meat are necessary to produce one pound of extract. It is obvious, therefore, that the extract can contain only a small part of the real nutriment of the meat. It contains practically no albumin or fat and very little gelatin, but consists chiefly of the salts and extractives of the meat, and according to Liebig's statement should contain from 16 to 21 per cent. of water, from 18 to 22 per cent. of mineral matter, and from 56 to 60 per cent. of extractives.

A few extracts now on the market show by their composition that the original Liebig process has been quite closely followed in their manufacture, but the larger number resemble Liebig's extract in little but name. Gelatin, blood albumin and meat fibrin are added in certain cases and in some the albumin has been partially peptonized. The great majority of extracts contain large quantities of common salt, due to the fact that they are not true meat extracts, but are made in part from evaporated pickling brines.

PHYSIOLOGICAL EFFECT OF MEAT EXTRACTS.

Liebig's views as to the value of meat extract are well shown in a letter to *The Times,* Oct. 1, 1872:

> "Neither tea nor extract of meat is nutriment in the ordinary sense; they possess a far higher importance by certain medicinal properties of a peculiar kind. . . . . Taken in proper proportions they strengthen the internal resistance of the body to the most various external injurious influences. . . . . It is surely a grave offence against all the laws of physiology to compare tea, coffee and extract of meat with the more common articles of food, and, because they are not that, to draw the inference that they are nothing at all. . . . . Extract of meat is beef-tea made from fresh meat—not roasted—in the purest state, condensed to the consistency of a thick honey, to which nothing whatever is added by the manufacturer."

The nutritive value of meat, as distinguished from its stimulating and appetizing effects, is chiefly in the proteins it contains, which are not and cannot be "extracted" and presented in a concentrated form in an extract. To add proteins to the extract, as is done by certain manufacturers, only reduces the amount of the extractives to which meat extract owes its real and peculiar value and substitutes relatively small quantities of nutriment at an unreasonable price.

Proteoses and peptones, because of their ready assimilation, doubtless possess nutrient value, but the amounts of these compounds present in meat extracts have been greatly exaggerated. In fact, no true peptones were found in any of the paste preparations which we have examined, this judgment being based on the failure to secure the biuret reaction in the filtrates from the zinc sulphate precipitation of the proteoses.* Furthermore, much of the nitrogenous matter precipitated by zinc sulphate and generally credited to forms of proteoses, is doubtless due to gelatin and gelatinoids, which have a subordinate food value.

The true value of a meat extract depends almost entirely upon the salts and extractives which it contains and upon its flavor.

The characteristic salts of true meat extracts are potassium dihydrogen phosphate and potassium monohydrogen phosphate, the former predominating.† Potassium chlorid is also present in considerable amount.

But it is the extractives that give meat extracts their chief value. These may be classed as nitrogenous and non-nitrogenous. The chemistry of the nitrogenous extractives is most complex and the properties of many of them are but little understood. Most of them are basic in character, some are amides, and all are classed under the somewhat loose term "meat bases." The most important physiologically are creatin, its anhydrid, creatinin, and the xanthin or purin bases. The purin bases most commonly found are xanthin, hypoxanthin, adenin and carnin. In recent years investigators have isolated a considerable number of others, but they are present in extremely small quantities and large amounts of the extracts must be used for their isolation and determination.

The meat bases are products of the breaking down of proteins in the vital processes of the body, are excreted for the most part unchanged and have little or no use as builders of tissue; neither have they any value as producers of heat or energy. They are, therefore, in no sense foods. Probably much larger amounts of

* See page 627.

† Trowbridge and Grindley, Jour. Amer. Chem. Soc., 1906, *28*, 471.

meat extracts are used to-day by hotels and restaurants for flavoring soups and other dishes than are used for invalids.

Many physiologists attribute to the meat extractives certain stimulating qualities, but the experiments supporting this view are by no means conclusive. There seems to be, however, quite certain evidence that they furnish relief to fatigued muscle and that they are powerful excitants of gastric secretion. As Hutchinson well says*:

> "They are thus eminently calculated to rouse appetite and aid the digestion of any food with which they may be taken. This, indeed, is their true function, both in health and disease. They are flavouring agents, and their proper place is in the kitchen, not by the bedside."

The non-nitrogenous extractive matters, in addition to the salts already considered, consist chiefly of lactic acid, lactates and glycogen. Little is known as to the actual amounts of these ingredients present.

Glycerol, glucose and milk sugar are occasionally found in the extracts and must be considered as adulterants; preservatives are also sometimes employed, especially in fluid extracts.

HOW TO VALUE AN EXTRACT.

The comparative value of a meat extract is shown by determinations of water, total ash and its chief constituents, total nitrogen, and the meat bases. These data show the concentration of the extract, the amount and nature of its ash, and the proportion of true meat extractives which it contains. There are a number of preparations on the market sold as meat extracts, which are prepared wholly from yeast. These resemble meat extracts in taste and appearance, but show marked chemical differences. The important extractives, creatinin and creatin, are absent; on the other hand, the purin bases are comparatively abundant. The amount of creatinin and creatin found is, therefore, a valuable guide as to the source of an extract.

STANDARDS OF COMPOSITION.

The Association of Official Agricultural Chemists and the Association of State and National Food and Dairy Departments have adopted standards for meat extracts, and these have likewise

* Food and the Principles of Dietetics, 1906, p. 94.

been adopted by this station. In so far as they concern this present examination, these are as follows:

Meat extract is the product obtained by extracting fresh meat with boiling water and concentrating the liquid portion by evaporation after the removal of fat, and contains not less than seventy-five (75) per cent. of total solids, of which not over twenty-seven (27) per cent. is ash, and not over twelve (12) per cent. is sodium chlorid (calculated from the total chlorin present), not over six-tenths (0.6) per cent. is fat, and not less than eight (8) per cent. is nitrogen. The nitrogenous compounds contain not less than forty (40) per cent. of meat bases, and not less than ten (10) per cent. of creatin and creatinin.

Fluid meat extract is identical with meat extract except that it is concentrated to a lower degree and contains not more than seventy-five (75) and not less than fifty (50) per cent. of total solids.

Meat juice is the fluid portion of muscle fibre, obtained by pressure or otherwise, and may be concentrated by evaporation at a temperature below the coagulating-point of the soluble proteids. The solids contain not more than fifteen (15) per cent. of ash, not more than two and five-tenths (2.5) per cent. of sodium chlorid (calculated from the total chlorin present), not more than four (4) nor less than two (2) per cent. of phosphoric acid (P_2O_5), and not less than twelve (12) per cent. of nitrogen. The nitrogenous bodies contain not less than thirty-five (35) per cent. of coagulable proteids and not more than forty (40) per cent. of meat bases.

Peptones are products prepared by the digestion of proteid material by means of enzymes or otherwise, and contain not less than ninety (90) per cent. of proteoses and peptones.

In the opinion of the writer the best standard as to what a true meat extract *should be* is found in Liebig's extract itself. This extract has always been one of the best preparations on the market, and repeated analyses show that it is carefully prepared and with only trifling variations in composition from year to year. Moreover, it contains no foreign constituents, like common salt, spices, etc.

THE ANALYSIS OF MEAT EXTRACTS.

A review of the literature of meat extracts shows that the analytical methods used by chemists have been so diverse that a satisfactory comparison of their results is impossible. In this present work the effort was made to secure all extract preparations sold in this State, subject them all to the same analytical procedure, and thus afford a basis for determining their comparative value. The paste extracts were in most cases purchased

in the usual small two-ounce jars, and this small quantity of material necessitated extreme economy in the analytical methods employed. The methods here given are compiled from various sources, modified in many particulars to conform to the analytical scheme adopted. They are given in considerable detail, as the writer is convinced that without such data the results would be of little value. The analytical figures presented in this report are the averages of closely agreeing duplicates secured by two analysts working independently.

Methods of Analysis.

1. *Solution A.* Dissolve 5 gms. of paste or powdered preparations in 125 cc. of tepid water, cool and dilute to exactly 250 cc. with cold water. Of fluid preparations weigh 50 gms. into a liter flask and fill to the mark with cold water.

2. *Solution B.* Dissolve 2.5 gms. of powders or 5 gms. of pastes in 125 cc. of tepid water, add 0.5 cc. of acetic acid (1-3), and boil for three minutes; cool, filter through a moistened folded filter, wash thoroughly with cold water and make up to 250 cc. Save residue remaining on filter for insoluble and coagulable nitrogen.

3. *Water.* Dry 2 gms. of powders, or about 3 gms. of pastes (dissolved in 25 cc. of warm water) with sufficient freshly ignited asbestos (about 3 gms.) to absorb the extract, in a flat-bottomed aluminum dish to constant weight at the temperature of boiling water (about 20 hours are required). With fluid preparations use 25 cc. of Solution A and proceed as above. If alcohol be present, make the necessary correction for it.

4. *Alcohol.* (For fluid preparations only.) Mix thoroughly equal quantities of the extract and water, and measure out about 55 cc. into a small flask. Cool to about 1° below the required temperature (15.6) and fill a 50 cc. pycnometer to the mark. Wipe free from condensed moisture and weigh at once. Transfer contents to a beaker, neutralize with dilute potassium hydroxid (about 20%), using litmus paper as the indicator, transfer again to a 500 cc. flask, attach to a condenser and distil over about 40 cc. into the original pycnometer. Fill nearly to the mark with boiled distilled water, mix thoroughly and cool to 15.6°. Finally make up to mark with water at the same temperature and weigh at once, wiping free from moisture as before. In case of frothing or bumping, a small quantity of tannic acid or pumice stone, or both, is used. From the proper alcohol tables calculate the amount of alcohol by weight or volume, as may be desired.

5. *Fat.* Grind up residue from water determination and transfer to an extraction tube with petroleum ether of low boiling point and extract with that solvent for 16 hours in a continuous extractor.

6. *Ash.* With pastes evaporate 50 cc. of Solution A in a tared platinum dish and ignite residue in a muffle at low redness until smoke or inflammable gases are no longer given off. Exhaust the charred mass with 10

cc. of hot water, filter, and wash three times with hot water. Transfer filter and contents to the original dish and ignite at bright redness until combustion is complete. Transfer the soluble portion to the dish, add a few drops of ammonium carbonate solution, evaporate to dryness, heat for a moment in a free flame to very low redness, cool in a desiccator and weigh. Save residues. With powders use one gram of the original material and with fluids 25 cc. of Solution A. (In the latter the extraction with hot water is rarely necessary.)

7. *Chlorin.* Dissolve about 1 gm. of the extract in 20 cc. of 5 per cent. sodium carbonate solution in a platinum dish; evaporate to dryness and ignite thoroughly and proceed as in the ash determination. Dissolve the residue in nitric acid, add to the filtrate, make up to 100 cc. and determine chlorin gravimetrically in 50 cc. of the filtered solution in the usual way. In fluid preparations use 25 cc. of Solution A.

8. *Phosphoric Acid.* Take up residue from the ash determination with 15 cc. of strong hydrochloric acid, transfer to a beaker, dilute to about 50 cc., boil for ten minutes and determine phosphoric acid in the whole solution.

9. *Potash.* Acidify residue from another ash determination with 2 drops of hydrochloric acid and transfer with water to a 100 cc. flask; precipitate with ammonia and ammonium oxalate, if necessary, and determine potash in 50 cc. of the solution.

10. *Total Nitrogen.* Determine nitrogen in about 0.5 gm. of the original sample by the Kjeldahl method. With fluid preparations use 50 cc. of Solution A. A preliminary test for nitrates should always be made.

11. *Insoluble Nitrogen.* Filter 50 cc. of Solution A, wash well with water and determine insoluble nitrogen in the residue; save filtrate for ammonia determination.

12. *Coagulable Nitrogen.* With pastes and powders determine nitrogen in the residue on the filter from Solution B for insoluble and coagulable nitrogen, and deduct insoluble nitrogen as found in (11). With fluid extracts coagulate 100 cc. of Solution A by adding 0.5 cc. of acetic acid (1-3) and boiling for three minutes. Filter and wash with water and make up to 150 cc. Determine insoluble and coagulable nitrogen in the residue; save filtrates for proteose and tannin-salt determinations.

13. *Ammonia.* Distill filtrate from (11) with an excess of magnesium oxid and titrate as usual.

14. *Acidity.* Titrate 25 cc. of Solution A with standard $\frac{N}{10}$ potassium hydroxid, after diluting the solution with 800 cc. of water, using phenolphthalein as indicator; also determine acidity in same amount of solution without dilution, using delicate neutral litmus paper as indicator. This is done by removing at intervals a drop of the solution by means of a capillary tube. Express the results as cubic centimeters of $\frac{N}{10}$ potassium hydroxid required to neutralize 100 gms. of the original extract.

15. *Syntonin.* With pastes and powders exactly neutralize 50 cc. of Solution B with dilute sodium hydroxid, using litmus as indicator, and allow to stand for several hours. If a precipitate settles in that time, filter through a folded filter, wash with water and determine nitrogen in the filter and precipitate. With fluid extracts coagulate 50 cc. of Solution A and proceed as above.

16. *Proteoses.* With pastes and powders pipette 50 cc. of Solution B into a beaker, or with fluid extracts 50 cc. of the solution obtained as in (12), acidify with 1 cc. of sulphuric acid (1-3), and saturate with powdered zinc sulphate. (About 75 gms. of the salt are necessary at ordinary temperatures.) Let stand several hours, preferably over night, filter and wash the precipitate with saturated zinc sulphate solution. Determine nitrogen in the filter paper and contents, washing out the last traces of the salt from the beaker into the Kjeldahl flask with a small quantity of water.

Biuret Test for Peptones. To about 6 cc. of the zinc sulphate filtrate in a small porcelain casserole add 25 cc. of 25 per cent. sodium hydroxid solution, warm slightly to aid solution of the flocculent precipitate of zinc hydrate, dissolve as much as possible and pour off the clear liquid into a test tube. Add a few drops of very dilute (0.2%) copper sulphate solution. In the presence of a peptone a well-marked rose coloration is produced, free from the violet tint produced by other proteids except proteoses.

17. *Tannin-Salt Precipitation.* With pastes and powders transfer 50 cc. of Solution B, or with fluid extracts 50 cc. of the solution obtained as in (12) to a 100 cc. flask, add 15 gms. of powdered sodium chlorid and 30 cc. of 24 per cent. tannin solution; fill to the mark with water. After shaking thoroughly to dissolve the salt and make a uniform mixture, place the flask at once in the ice box over night. Filter the solution at ice box temperature and determine the nitrogen in 50 cc. of the filtrate, also in an aliquot portion of the filtrate from a blank in which the reagents alone are employed. To determine nitrogen in the tannin-salt filtrates transfer the 50 cc. to a Kjeldahl flask, add 1 cc. of strong sulphuric acid, evaporate nearly to dryness on the steam bath, add 30 cc. of sulphuric acid and proceed as usual. The total nitrogen of the extract, minus the sum of the insoluble and coagulable nitrogen and the nitrogen of the above filtrate, properly corrected, gives the amount of nitrogen precipitated by the tannin-salt.

18. *Amido Nitrogen.* From the nitrogen found in the tannin-salt filtrate deduct the nitrogen found as ammonia in (13); the difference is nitrogen in amido forms.

19. *Creatinin.* Free 10 cc. of Solution A of coagulable and insoluble nitrogen, filter into a 500 cc. flask, wash with 25 cc. of hot water, cool, and add 15 cc. of saturated picric acid solution and 5 cc. of 10 per cent. sodium hydroxid. Shake the liquid twice and allow to remain undisturbed for five minutes. At the end of that time fill to the mark with water and shake well. Pour $\frac{N}{2}$ potassium bichromate solution into one tube of a Duboscq colorimeter and set accurately at 8 mm. Introduce into the second tube of the colorimeter a sufficient quantity of the solution prepared

as above and determine its colorimetric value by comparison with the 8 mm. of standard bichromate solution. The amount of creatinin corresponding to the colorimetric value is found by using the factor 8.1. For instance, if a reading of 7.2 mm. is obtained, the creatinin content of 10 cc. of the liquid will be $\frac{8.1}{7.2} \times 10 = 11.25$ mgm. The solution used should contain from 7 to 15 mgm. of creatinin per 500 cc. for the best results.

20. *Creatin.* Creatin is similarly determined by using 10 cc. of Solution A, coagulating, filtering and washing as above. Place this amount in a small flask or beaker, add 10 cc. normal hydrochloric acid and heat for 45 minutes in an autoclave at 116°-117° C. to effect complete dehydration. Cool, add 10 cc. normal sodium hydroxid and determine the total creatinin as before. The difference in the readings indicates the amount of creatinin derived from the conversion of the creatin, which multiplied by 1.16 gives the pre-formed creatin in mgms.

21. *Purin Bases.* Dissolve 3 gms. of pastes or powders in 100 cc. of water, or use with fluid extracts 100 cc. of Solution A. Transfer to a casserole and add 500 cc. of 1 per cent. sulphuric acid. Heat on the water bath for four hours, finally evaporating to about 75 cc.; neutralize with potassium hydroxid, using litmus as the indicator. Transfer to a beaker, add 15 cc. of a 15 per cent. solution of sodium bisulphite and from 15 to 20 cc. of a 15 per cent. solution of copper sulphate. Let stand several hours, or over night, filter and wash with dilute copper sulphate solution, wash the precipitate into the original beaker with hot water, stirring vigorously until the precipitate is in a very fine condition. Heat to boiling and add sodium sulphid (usually 10 cc. of a 20 per cent. solution is sufficient). Heat for several minutes, acidify with 10 per cent. acetic acid and continue heating until the copper sulphid collects in flakes and the supernatant liquid is practically clear. Filter, wash with hot water, and after the addition of 10 cc. of 10 per cent. hydrochloric acid, evaporate on the steam bath to dryness. Bring the bases in the residue again into solution by digesting on the steam bath with 10 cc. of 10 per cent. hydrochloric acid. Filter and wash with hot water. Make the filtrate ammoniacal with 25 cc. strong ammonia and add 10 cc. of a 3 per cent. solution of ammoniacal silver nitrate. Let stand over night, filter, wash out all ammonia with water and determine the nitrogen of the purin bases in the residue.

SAMPLES ANALYZED.

Fifty-one samples were collected and examined; twenty-two of paste extracts, three of meat powders, three of meat capsules or tablets and twenty-three of fluid preparations.

I. Paste Extracts.

Twenty-two samples were analyzed; these represented twenty-one distinct brands.

Table IX shows a list of the brands analyzed, the manufacturer or jobber, the dealer, the price per jar and the net weight of extract sold.

Net Weight and Selling Price. All of the samples were sold in the familiar white vitrified jars, with the exception of Patch's Extract, where a glass jar was used. While in only two cases, Liebig's Extractum Carnis and Mosquera Beef Jelly, was the claimed weight stated on the label, all of the samples, except the large sample of Smith's Extract, were evidently intended to represent the conventional two-ounce portion. The printed matter which accompanied the Michigan, Premium and Rex brands guaranteed a weight of two ounces. It seems justifiable, therefore, excluding No. 19473, to assume two ounces as the intended weight of all the samples, and thus make a direct comparison of the different amounts of extract supplied for the respective prices.

Premium Extract and Mosquera Beef Jelly fell slightly below, while the Michigan Brand furnished only 1.4 oz., against a claimed weight of 2 ounces, a deficiency of 30 per cent.

The selling prices were very divergent, ranging from 15 to 50 cents for practically equal amounts of extract. It does not necessarily follow, however, that the lower-priced extracts are actually cheaper, as will be shown later in the discussion of the analytical results. Still, the fact remains, that the variations in price are abnormally great; if the higher prices are fair because of the high quality of the extracts, it is important to determine why and how such a low price can be asked for the others; on the other hand, if it is shown that the lower-priced extracts are of equally good quality, the higher prices must be considered exorbitant.

THE CHEMICAL COMPOSITION.

Table X gives the analytical data as obtained in the original samples; Table XI, on the water-free basis. The organic matter is calculated by deducting the sum of the water and ash from 100; the meat bases, by deducting from the total nitrogen the sum of the insoluble, coagulable, ammonia nitrogen and that precipitated by tannin-salt. The nitrogen has not been calculated as protein by using the conventional factor 6.25, as in most cases a large part is present in non-protein forms, and the use of the factor would give results far from the truth.

TABLE IX.—MEAT EXTRACTS. PASTE PREPARATIONS.

Station No.	Brand.	Manufacturer.	Dealer.	Price per jar.	Net weight of materials.
				cts.	oz.
18600	Premium Brand Beef Extract	American and Continental Extract Co., Chicago and Hamburg	*Meriden:* Kibbe's Pharmacy	35	1.9
18633	A. D. S. Extract of Beef	American Druggists' Syndicate, New York	*New Britain:* W. H. Crowell	35	1.7
18601	Armour's Extract of Beef	Armour & Co., Chicago, Ill.	*Meriden:* A. M. Campbell	45	2.0
18636	Armour's Soluble Beef	Armour & Co., Chicago, Ill.	*New Britain:* Radom's Pharmacy	50	1.7
18661	Rex Extract of Beef	The Cudahy Packing Co., Omaha, Neb.	*Hartford:* Boston Branch Grocery	38	2.2
18575	A. and P. Brand Extract of Beef	Prep. for The Great Atlantic and Pacific Tea Co.	*Stamford:* Atlantic and Pacific Tea Co.	20	1.7
18602	Michigan Brand Beef Extract	Frederick F. Ingram & Co., Detroit, Mich.	*Meriden:* H. T. Graeber	35	1.4
18485	Extractum Carnis Liebig	The Liebig's Extract of Meat Co., Ltd., London	*Bridgeport:* C. E. Pickard & Co.	50	2.0
19564	Malto-Meat Extract	Malto-Meat Extract Co., Scranton, Pa.	*Danbury:* Phil. Simon	50	2.3
19455	Durham Brand Extract of Beef	Melbourne Trading Co., Boston, Mass.	*New Haven:* D. M. Welch & Son	15	2.0
19563	Mosquera Beef Jelly	Mosquera-Julia Food Co., Detroit, Mich.	*Danbury:* Baldwin & McDonald	45	1.9
18581	Smith's Sterilized Extract of Beef	Mfd. for the New York Beef Extract Co., New York	*Stamford:* W. W. Waterbury	20	1.7
19473	Smith's Sterilized Extract of Beef	Mfd. for The New York Beef Extract Co., New York	*New London:* The Mohican Co.	50	3.4
18599	Patch's Extract of Beef	The E. L. Patch Co., Boston, Mass.	*Meriden:* W. W. Mosher	45	2.2
18580	Patca Brand Australian Extract of Beef	Patterson-Cabell Co., New York	*Stamford:* Borg Bros. & Co.	45	2.0
18679	Liebig Process, Extract of Beef	Prep. for John A. Pilgard, Hartford, Conn.	*Hartford:* Union Grocery	25	1.8
18660	Marshall's Liebig Process, Extract of Beef	The Pioneer Packing Co., Omaha, Neb.	*Hartford:* S. Vogel	25	2.1
18500	Marshall's Extract of Beef, Original Process	The Pioneer Packing Co., Omaha, Neb.	*South Norwalk:* United Grocery Co.	25	1.7
18522	Southwick Brand, Liebig's Extract of Beef	Southwick Manufacturing Co., Hamilton, Canada	*Bridgeport:* Lee's Pharmacy	25	1.9
18570	Swift's Beef Extract	Swift & Co., Chicago, Ill.	*Stamford:* J. K. Lawrence	40	2.0
19456	Star Brand Pure Extract of Beef	D. M. Welch & Co., New Haven, Conn.	*New Haven:* D. M. Welch & Son	15	2.4
18632	Williams' Soluble Extract of Beef	Prep. for The Williams & Carleton Co., Hartford, Conn.	*New Britain:* F. Dobson	25	1.9

Water.

The samples varied in water content from 14.79 to 36.54 per cent., with an average of 21.52 per cent. Seven samples exceed Liebig's maximum of 21 per cent., and four of these, Durham, Southwick, Star and Williams brands, exceed the standard of 25 per cent.; none of these samples can be considered a highly concentrated extract.

Acidity.

The acidity of flesh is due to the acid phosphates, organic acids and proteins present. The greater part of the flesh proteins is insoluble in water, so that in a meat extract the acidity is due chiefly to the acid phosphates and organic acids. As already stated, the chief acid phosphates of meat are potassium dihydrogen and potassium monohydrogen phosphate. The former is

TABLE X.—COMPOSITION OF MEAT EXTRACTS.

Station No.	Brand.	Water.	Organic matter.	Ash.	Petroleum Ether Extract (Fat).	Chlorin.	Phosphoric acid.	Potash.
18600	Premium Brand	19.92	50.82	29.26	0.05	10.56	1.74	6.75
18633	A. D. S. Extract	18.27	52.45	29.28	0.07	9.53	3.11	6.41
18601	Armour's Extract	19.96	58.27	21.77	0.08	4.01	5.27	8.30
18636	Armour's Soluble Beef	17.95	67.60	14.45	0.09	2.50	3.44	4.68
18661	Rex Extract	16.08	55.96	27.96	0.08	6.97	3.47	8.02
18575	A. and P. Brand	19.67	53.20	27.13	0.05	9.70	4.23	6.51
18602	Michigan Brand	18.21	53.18	28.61	0.12	9.63	2.43	5.24
18485	Liebig's	20.49	61.94	17.57	0.17	1.92	5.01	7.59
19564	Malto-Meat Extract	14.79	48.93	36.28	0.09	15.64	5.21	5.35
19455	Durham Brand	36.54	36.18	27.28	0.21	13.50	1.43	2.29
19563	Mosquera Beef Jelly	24.88	50.77	24.35	0.04	8.25	3.59	5.31
18581	Smith's Extract	23.80	55.20	21.00	0.05	5.99	3.48	6.13
19473	Smith's Extract	19.61	53.92	26.47	0.09	6.65	4.61	7.94
18599	Patch's Extract	15.56	53.65	30.79	0.07	6.17	6.22	12.65
18580	Patca Brand	18.88	54.58	26.54	0.05	7.58	4.19	7.14
18679	Pilgard's Liebig Process	17.60	54.29	28.11	0.07	10.07	3.45	5.38
18660	Marshall's Liebig Process	20.15	49.51	30.34	0.05	10.93	2.44	6.21
18500	Marshall's Original Process	18.54	49.32	32.14	0.05	11.66	1.55	6.15
18522	Southwick Brand	30.37	41.38	28.25	0.44	13.62	1.15	3.20
18570	Swift's Extract	22.81	51.75	25.44	0.08	7.70	3.95	7.23
19456	Star Brand	27.70	37.28	35.02	0.50	17.81	1.70	3.42
18632	Williams' Extract	31.36	39.06	29.58	0.43	14.39	1.54	3.00

acid to phenolphthalein, while the latter is neutral to this indicator.* Lactic acid is the chief organic acid found in flesh and is present in all true meat extracts. Phenolphthalein is the only indicator known to give at all satisfactory results with lactic acid. Trowbridge and Grindley† have shown that all the protein preparations thus far obtained from flesh react acid to phenolphthalein. The determination of the true acidity of a meat extract is, therefore, a matter of much difficulty. In the present work, both litmus and phenolphthalein have been used as indicators, and the results are published largely for reference, as few satisfactory conclusions can be drawn from them. The suggestion often made, to calculate the acidity figure thus obtained in terms of lactic

* Trowbridge and Grindley, Jour. Amer. Chem. Soc., 1906, *28*, 471.
† Loc. cit.

PASTE PREPARATIONS.

Station No.	Acidity = cc. $\frac{N}{10}$ KOH to neutralize 100 gms. of extract.		Forms of Nitrogen.										
										Meat Bases.			
	Phenolphthalein.	Litmus.	Total.	Insoluble.	Coagulable.	Ammonia.	Ppt. by Tannin-Salt.	Meat Bases (by difference).	Ppt. by Zinc Sulphate.	Creatinin.	Creatin.	Purin.	Undetermined.
18600	1100	550	6.25*	0.11	----	0.29	3.72	2.13	1.55	0.45	0.35	0.38	0.95
18633	780	420	7.26*	0.07	0.01	0.55	4.12	2.51	2.20	0.45	0.25	0.59	1.22
18601	1175	540	8.07	0.16	0.13	0.30	4.27	3.21	2.10	0.36	0.49	0.62	1.74
18636	835	500	10.47	0.08	0.15	0.35	7.89	2.00	5.04	0.22	0.10	0.44	1.24
18661	925	480	8.19	0.02	0.11	0.43	3.97	3.66	1.80	0.64	0.62	0.53	1.87
18575	1098	725	6.15	0.05	0.09	0.13	3.49	2.39	1.55	0.40	0.06	0.48	1.45
18602	710	380	7.36†	0.17	0.07	0.47	4.61	1.31	1.96	0.46	0.07	0.48	0.30
18485	1265	840	9.41	0.09	----	0.37	4.51	4.44	2.36	0.86	1.30	0.76	1.52
19564	1040	520	5.20	0.06	0.03	0.39	2.54	2.18	0.44	0.07	0.03	0.83	1.25
19455	374	190	5.45*	----	0.26	0.21	4.12	0.86	3.42	0.17	0.22	0.16	0.31
19563	795	320	7.72	----	0.24	0.40	4.79	2.29	2.30	0.24	0.38	0.38	1.29
18581	900	467	7.81	----	0.08	0.52	4.66	2.55	3.05	0.39	0.08	0.57	1.51
19473	1090	520	6.98	----	0.16	0.38	3.79	2.65	1.30	0.25	0.58	0.53	1.29
18599	1450	907	7.82*	----	0.03	0.21	3.21	4.37	0.76	1.85	0.47	0.64	1.41
18580	1010	575	7.54*	----	0.20	0.57	3.27	3.50	1.47	0.85	0.54	0.56	1.55
18679	1036	520	6.50	----	0.23	0.21	4.17	1.89	2.50	0.21	0.16	0.50	1.02
18660	820	400	5.94*	0.11	0.11	0.21	3.10	2.41	1.32	0.42	0.16	0.40	1.43
18500	790	500	5.68*	0.22	----	0.19	2.93	2.34	1.27	0.56	0.41	0.43	0.94
18522	548	480	5.54*	0.34	----	0.22	3.94	1.04	3.16	0.15	0.06	0.38	0.45
18570	1250	740	7.14	0.10	----	0.74	3.16	3.14	1.72	0.46	0.87	0.64	1.17
19456	450	250	5.02*	----	0.18	0.28	3.93	0.63	2.31	0.08	0.07	0.25	0.23
18632	470	320	5.91*	0.20	0.02	0.27	4.78	0.64	3.25	0.23	0.09	0.18	0.14

* Contains traces of nitrates. † Contains 0.73 per cent. of nitrate nitrogen.

acid, is without question erroneous, as a great part of the acidity in meat extracts is due to the potassium acid phosphates and not to lactic acid. An accurate quantitative determination of lactic acid would be of much value in judging an extract, as this acid is characteristic of dead flesh. Fletcher and Hopkins* have suggested a method for the determination of lactic acid in muscle which promises to be of value, but lack of time and material prevented its use in the present investigation.

The acidity is expressed in the table as cubic centimeters of $\frac{N}{2}$ potassium hydroxid necessary to neutralize 100 grams of extract. The difficulty of using phenolphthalein as an indicator in the highly colored meat extract solutions was obviated by diluting the 25 cc. taken to 800 cc. with water.

* Jour. of Physiol., 1907, *35*, 247-310.

TABLE XI.—COMPOSITION OF MEAT EXTRACTS.

Station No.	Brand.	Organic matter.	Ash.	Petroleum Ether Extract (Fat).	Chlorin.	Phosphoric acid.	Potash.
18600	Premium Brand	63.47	36.53	0.06	13.19	2.18	8.44
18633	A. D. S. Extract	64.18	35.82	0.09	11.66	3.81	7.85
18601	Armour's Extract	72.81	27.19	0.10	5.01	6.58	10.37
18636	Armour's Soluble Beef	82.40	17.60	0.11	3.05	4.19	5.70
18661	Rex Extract	66.68	33.32	0.10	8.31	4.14	9.56
18575	A. and P. Brand	66.23	33.77	0.06	12.08	5.27	9.10
18602	Michigan Brand	65.02	34.98	0.15	11.78	2.97	6.41
18485	Liebig's	77.90	22.10	0.21	2.42	6.30	9.55
19564	Malto-Meat Extract	57.42	42.58	0.11	18.36	6.12	6.28
19455	Durham Brand	56.98	43.02	0.33	21.28	2.25	3.61
19563	Mosquera Beef Jelly	67.58	32.42	0.05	10.98	4.78	7.07
18581	Smith's Extract	72.44	27.56	0.07	7.86	4.57	8.04
19473	Smith's Extract	67.07	32.93	0.10	8.27	5.74	9.88
18599	Patch's Extract	63.53	36.47	0.08	7.31	7.36	14.98
18580	Patca Brand	67.29	32.71	0.06	9.35	5.17	8.80
18679	Pilgard's Liebig Process	65.89	34.11	0.08	12.22	4.19	6.53
18660	Marshall's Liebig Process	62.00	38.00	0.06	13.68	3.05	7.77
18500	Marshall's Original Process	60.54	39.46	0.06	14.31	1.90	7.55
18522	Southwick Brand	59.43	40.57	0.63	19.55	1.65	4.60
18570	Swift's Extract	67.04	32.96	0.10	9.98	5.12	9.37
19456	Star Brand	51.56	48.44	0.07	24.63	2.35	4.73
18632	Williams' Extract	56.91	43.09	0.63	20.97	2.24	4.37

In every case the acidity, as determined with phenolphthalein, is much higher than with litmus, on the average about 80 per cent. higher. The acidity bears quite a definite relation to the potash present, the four brands, Durham, Southwick, Star and Williams, showing the lowest acidity, also yielding the lowest percentages of potash. The determination is, therefore, of some value in supplying cumulative evidence of the inferior quality of the four preparations named.

Organic Matter.

The organic matter varies from 51.56 to 77.90 per cent. in the water-free substance, and from 36.18 to 67.60 per cent. in the original material. Liebig set 56 per cent. as the minimum amount permissible in a true extract; only four of the brands exceed this minimum, while four contain less than 42 per cent. The percentage of nitrogen in the fat-free organic matter also shows wide

(WATER FREE BASIS) PASTE PREPARATIONS.

Station No.	Forms of Nitrogen.										
								Meat Bases.			
	Total.	Insoluble.	Coagulable.	Ammonia.	Ppt. by Tannin-Salt.	Meat Bases (by difference).	Ppt. by Zinc Sulphate.	Creatinin.	Creatin.	Purins.	Undetermined.
18600	7.81*	0.13	----	0.36	4.65	2.67	1.94	0.56	0.44	0.47	1.20
18633	8.89*	0.09	0.01	0.67	5.04	3.08	2.69	0.55	0.31	0.72	1.50
18601	10.08	0.20	0.16	0.37	5.33	4.02	2.62	0.45	0.61	0.77	2.19
18636	12.76	0.10	0.18	0.43	9.62	2.43	6.14	0.27	0.12	0.54	1.50
18661	9.76	0.02	0.13	0.51	4.73	4.37	2.15	0.76	0.74	0.63	2.24
18575	7.66	0.06	0.11	0.16	4.35	2.98	1.93	0.50	0.08	0.60	1.80
18602	9.00†	0.21	0.08	0.57	5.64	1.60	2.40	0.56	0.09	0.59	0.36
18485	11.84	0.11	----	0.47	5.67	5.59	2.97	1.08	1.64	0.96	1.91
19564	6.10	0.07	0.04	0.46	2.98	2.55	0.52	0.08	0.04	0.97	1.46
19455	8.59*	----	0.41	0.33	6.49	1.36	5.39	0.27	0.35	0.25	0.49
19563	10.29	----	0.32	0.53	6.38	3.06	3.06	0.32	0.51	0.51	1.72
18581	10.25	----	0.10	0.68	6.11	3.36	4.00	0.51	0.10	0.75	2.00
19473	8.68	----	0.20	0.47	4.71	3.30	1.62	0.31	0.72	0.66	1.61
18599	9.26*	----	0.04	0.25	3.80	5.17	0.90	2.19	0.56	0.76	1.66
18580	9.30*	----	0.25	0.70	4.03	4.32	1.81	1.05	0.67	0.69	1.91
18679	7.89	----	0.28	0.25	5.06	2.30	3.04	0.25	0.19	0.61	1.25
18660	7.44*	0.14	0.14	0.26	3.88	3.02	1.65	0.53	0.20	0.50	1.79
18500	6.98*	0.27	----	0.23	3.60	2.88	1.56	0.69	0.50	0.53	1.16
18522	7.96*	0.49	----	0.32	5.66	1.49	4.54	0.22	0.09	0.55	0.63
18570	9.25	0.13	----	0.96	4.10	4.06	2.23	0.60	1.13	0.83	1.50
19456	6.94*	----	0.25	0.39	5.44	0.87	3.19	0.11	0.10	0.35	0.31
18632	8.61*	0.29	0.03	0.39	6.96	0.94	4.74	0.34	0.13	0.26	0.21

* Contains traces of nitrates. † Contains 0.90 per cent. of nitrate nitrogen.

variations, ranging from 10.65 to 15.51. If all of the nitrogen were due to proteins, it should make up about 16 per cent. of the fat-free organic matter, but, as will be shown later, from 11 to 56 per cent. of the nitrogen is in the form of meat bases, and as these compounds, at least those most frequently found in meat extracts, contain much more nitrogen than proteins, we would expect to find the nitrogen to make up even more than 16 per cent. of the organic substance. These low "nitrogen numbers," as we may call them, indicate roughly the amount of non-nitrogenous organic ingredients present in the extracts. The "nitrogen numbers" for all the extracts are given in Table XIV, page 626.

Fat.

Fat is a detrimental ingredient in a meat extract, and in any considerable amount indicates an imperfect method of manufacture, and seriously affects the keeping qualities of the extract. The amount of fat found in the extracts is very small, varying from 0.04 to 0.50 per cent. The highest percentages are found in the Southwick, Star and Williams brands, which are shown in other ways to be inferior preparations.

Ash Constituents.

Total Ash. Liebig permitted as high an ash as 22 per cent., the official standards as high as 27 per cent. of the total solids, or a maximum of 20.25 per cent. In the original material the ash content ranged from 14.45 to 36.28, with an average of 27.16 per cent.; eighteen exceeded Liebig's maximum, and nineteen the official standard. On the dry basis the ash percentages are even more striking, the ash constituting from 17.60 to 48.44 per cent. of the dry matter. These high figures are conclusive evidence of the addition of mineral matter to the extracts, or what is equivalent, failure to remove the excess of salt during manufacture, and the chlorin percentages found show common salt to be the mineral used.

Chlorin. In 1872 Liebig considered the assertion that common salt was added to meat extracts as "an unjustifiable invention." At the present time, with very few exceptions, it would be equally unjustifiable to assert that salt was *not* added (see p. 623), and in large quantities, too. The salt is used chiefly because of its preservative qualities, but that it also preserves the high profits of the manufacturers is probably also an important incentive to its use, or its incomplete removal. The fact that in certain brands it is not added and that our experience shows that these non-salted brands keep quite as well as those to which a large excess has been added—no decomposition taking place in over three months after opening and being kept at laboratory temperature—prove that salt, especially in large amounts, is not necessary to keep the extracts sweet and wholesome.

Sodium chlorid is a very minor constituent of meat, the chlorin present existing almost entirely as potassium chlorid. Allen* suggests "making an allowance of say 0.06 per cent. of sodium chlorid for every unit per cent. of dry solid matter present in the preparation, any excess may be fairly regarded as having been added in the

* Commercial Organic Analysis, 1898, *4*, 307.

form of *common salt*." It is obviously unscientific and inaccurate to calculate all of the chlorin as sodium chlorid, as is so generally done. The official standard permits not over 12 per cent. of sodium chlorid in the dry matter calculated from the total chlorin present. This standard is not only unscientific, but, as will be shown later, is a direct encouragement to the manufacturer to add salt unnecessarily to his product. Table XII has been calculated according to Allen's suggestion, and shows the amounts of natural chlorids and the sodium chlorid added.

TABLE XII.—*ADDED SODIUM CHLORID.

Station No.	Dry Matter.	Chlorin.	Sodium Chlorid. Cl x 1.65.	Natural Chlorids. Dry Matter x.06.	Added Sodium Chlorid.
18600	80.08	10.56	17.42	4.81	12.61
18633	81.73	9.53	15.72	4.90	10.82
18601	80.04	4.01	6.62	4.80	1.82
18636	82.05	2.50	4.13	4.92	−0.79
18661	83.92	6.97	11.50	5.04	6.46
18575	80.33	9.70	16.01	4.82	11.19
18602	81.79	9.63	15.89	4.91	10.98
18485	79.51	1.92	3.17	4.77	−1.60
19564	85.21	15.64	25.81	5.11	20.70
19455	63.46	13.50	22.28	3.81	18.47
19563	75.12	8.25	13.61	4.51	9.10
18581	76.20	5.99	9.88	4.57	5.31
19473	80.39	6.65	10.97	4.82	6.15
18599	84.44	6.17	10.18	5.07	5.11
18580	81.12	7.58	12.51	4.87	7.64
18679	82.40	10.07	16.62	4.94	11.68
18660	79.85	10.93	18.03	4.79	13.24
18500	81.46	11.66	19.24	4.89	14.35
18522	69.63	13.62	22.47	4.18	18.29
18570	77.19	7.70	12.71	4.63	8.08
19456	72.30	17.81	29.39	4.34	25.05
18632	68.64	14.39	23.74	4.72	19.02
Standard.	75.00	7.27	12.00	4.50	7.50

* Added is used in the sense that the excess of salt is not natural to the meat. It may have been either added intentionally or may have been incompletely removed during the working up of the waste products into meat extracts.

The chlorin varies from 1.92 to 17.81 in the dry matter, with an average of 9.31 per cent.; fifteen brands exceed even the high official standard of 7.27 per cent., equivalent to 12 per cent. sodium chlorid. Armour's Soluble Beef and Liebig's Extract are the only brands showing no added sodium chlorid, the other brands containing from 1.82 to 25.05 per cent.; five brands exceed 18 per cent. Such statements as "absolutely pure, contains no foreign matter whatever," "contains only the stimulating salts of beef," and others of a similar tone, are untrue when applied to samples containing these excessive quantities of salt. In such materials the consumer pays high prices for common salt.

Phosphoric Acid. Emmett and Grindley,* in their extended study of the phosphorus content of flesh, found that phosphoric acid made up the following percentages of the total ash:

Raw beef round	19.87
Boiled beef round	21.28
Pot-roasted beef round	20.52

About 20 per cent. of the ash, therefore, should consist of phosphoric acid. The same authors have also shown that the water-soluble organic phosphorus of aqueous extracts of flesh is not in combination with the coagulated protein, with the proteoses, or with the peptones, but is due to non-protein bodies.† The phosphoric acid of meat extracts is due, therefore, to the natural inorganic salts of the meat and to certain of the nuclein bodies included among the extractives.

The following tabulation shows the quantities of phosphoric acid and potash in 100 parts of the total ash. The phosphoric acid makes up from 5 to 29 per cent. of the ash, varying from 1.15 to 6.22 per cent. in the original sample. In only four brands, Armour's, Armour's Soluble Beef, Liebig's and Patch's, are Emmett and Grindley's figures satisfied. In the other samples these ratios, together with the high percentages of ash, show very clearly that the ash is not due exclusively to the natural mineral ingredients of meat. In eight samples, less than 10 per cent. of the ash is phosphoric acid and the addition of extraneous minerals is again confirmed.

Potash. The potash ratios show even greater variations, from 8 to 43 per cent. There is little available data as to the potash content of meat; the potassium salts are its characteristic salts and we should expect to find relatively large quantities in meat extracts. The percentages in the original material vary from 2.29

* Jour. Amer. Chem. Soc., 1906, *28*, 56.
† Do., p. 63.

to 12.65, the low percentages in all cases being accompanied by low acidity and low phosphoric acid. The standard extract, Liebig's, shows a higher proportion of potash in the ash than any of the others, all but two of the other brands showing much lower ratios. It is clearly shown, by a study of the ash constituents, that the Durham, Southwick, Star and Williams brands are markedly deficient in the natural salts of meat.

TABLE XIII.

PHOSPHORIC ACID AND POTASH IN THE TOTAL ASH.

Phosphoric Acid.				Potash.			
Station No.	Percentage.	Station No.	Percentage.	Station No.	Percentage.	Station No.	Percentage.
18600	6	18581	17	18600	23	18581	29
18633	11	19473	17	18633	22	19473	30
18601	24	18599	20	18601	38	18599	41
18636	24	18580	16	18636	32	18580	27
18661	12	18679	12	18661	29	18679	19
18575	16	18660	8	18575	24	18660	20
18602	8	18500	5	18602	18	18500	19
18485	29	18522	4	18485	43	18522	11
19564	14	18570	16	19564	15	18570	28
19455	5	19456	5	19455	8	19456	10
19563	15	18632	5	19563	22	18632	10

The Nitrogenous Constituents of the Extracts.

Total Nitrogen. The percentage of total nitrogen varies from 5.02 to 10.47 in the original extracts and from 6.10 to 12.76 in the water-free material. As shown by Table XIV, the nitrogen makes up from 10.65 to 15.51 per cent. of the fat-free organic matter. Liebig's extract contains 9.41 per cent. of nitrogen, a percentage exceeded only by Armour's Soluble Beef. Ten samples show satisfactory percentages of from 7 to 8 per cent., while seven contain less than 6 per cent., or, in other words, contain less than two-thirds of the nitrogen contained in a high-grade, standard extract. Eight of the extracts fail to reach the standard of 8 per cent. of nitrogen in the dry matter.

It is the form in which the nitrogen exists, however, that is of importance in judging the value of a meat extract. The following tabulation shows the per cent. of the total nitrogen present in the different forms in the various extracts:

TABLE XIV.

RELATIVE AMOUNTS OF DIFFERENT FORMS OF NITROGEN.

Station No.	Total Nitrogen (dry basis).	Per cent. of Nitrogen in fat-free organic matter.	Per cent. of total Nitrogen in form of: Insoluble and coagulable.	Ammonia.	Ppt. by Tannin-salt.	Meat bases.	Ppt. by Zinc Sulphate.	Creatinin.	Creatin.	Purins.	Other basic Nitrogens.
18600	7.81*	12.31	1.7	4.6	59.5	34.2	24.8	7.2	5.6	6.0	15.4
18633	8.89*	13.86	1.1	7.5	56.7	34.7	30.3	6.2	3.5	8.1	16.9
18601	10.08	13.87	3.6	3.7	52.5	40.2	26.2	4.5	6.1	7.7	21.9
18636	12.76	15.51	2.2	3.4	75.5	18.9	48.2	2.1	0.9	4.2	11.7
18661	9.76	14.66	1.5	5.2	48.5	44.8	22.1	7.8	7.6	6.5	22.9
18575	7.66	11.57	2.2	2.1	56.8	38.9	25.3	6.6	1.0	7.9	23.4
18602	9.00†	13.87	3.2	6.3	62.7	17.8	26.7	6.2	1.0	6.6	4.0
18485	11.84	15.23	0.9	4.0	48.0	47.1	25.1	9.1	13.8	8.1	16.1
19564	6.10	10.65	1.8	7.5	48.9	41.8	8.5	1.3	0.7	15.9	23.9
19455	8.59*	15.15	4.8	3.8	75.5	15.9	62.7	3.1	4.1	2.9	5.8
19563	10.29	15.20	3.1	5.2	62.0	29.7	29.7	3.1	5.0	5.0	16.6
18581	10.25	14.16	1.0	6.6	59.6	32.8	39.0	5.0	1.0	7.3	19.5
19473	8.68	12.97	2.3	5.4	54.3	38.0	18.6	3.6	8.3	7.6	18.5
18599	9.26*	14.59	0.4	2.7	41.0	55.9	9.7	23.7	6.0	8.2	18.0
18580	9.30*	13.83	2.7	7.5	43.3	46.5	19.5	11.3	7.2	7.4	20.6
18679	7.89	11.99	3.5	3.2	64.1	29.2	38.5	3.2	2.4	7.7	15.9
18660	7.44*	12.01	3.8	3.5	52.1	40.6	22.2	7.1	2.7	6.7	24.1
18500	6.98*	11.53	3.9	3.3	51.6	41.2	22.3	9.9	7.2	7.6	16.5
18522	7.96*	13.53	6.2	4.0	71.1	18.7	57.0	2.8	1.1	6.9	7.9
18570	9.25	13.82	1.4	10.4	44.3	43.9	24.1	6.5	12.2	9.0	16.2
19456	6.94*	13.65	3.6	5.6	78.3	12.5	46.0	1.6	1.4	5.0	4.5
18632	8.61*	15.30	3.7	4.5	80.9	10.9	55.1	4.0	1.5	3.0	2.4

* Contains traces of nitrates.

† 10 per cent. of total nitrogen in nitric form.

Insoluble and Coagulable Nitrogen. The insoluble nitrogen varies from none at all to 0.34 per cent., only two brands containing over 0.20 per cent.; fifteen brands contained less than 0.10 per cent. Added meat fibre was, therefore, not present in any brand in important quantities. Coagulable nitrogen, likewise, was found in only small quantities, from none at all to 0.26 per cent.

Together the insoluble and coagulable nitrogen made up only from 0.4 to 6.2 per cent. of the total nitrogen, or an average of 2.7 per cent.

Proteose Nitrogen. The nitrogen precipitated by zinc sulphate represents the proteoses or albumoses present, together with certain gelatinoids. In the present investigation, no effort has been made to separate the various forms of nitrogen precipitated by this reagent. The testimony of different analysts as to the presence of gelatin in meat extracts is most contradictory. The original process of Liebig naturally excluded it, but since heat has been more generally, if not exclusively, employed, its appearance, or that of some gelatin decomposition products, is not only possible but extremely probable. Gelatin has only indirect and subordinate value as nutriment. When we consider that in all probability a large part of the nitrogen attributed to proteoses is due, in many cases, to gelatin or gelatinoids, it is apparent on what flimsy and unconvincing evidence rests the claim as to the high nutritive value of meat extracts. As their low nutritive value seemed to have been so firmly established, the detection of gelatin and its actual determination were omitted in this examination.

The nitrogen precipitated by zinc sulphate varied from 0.44 to 5.04 per cent., or from 8.5 to 62.7 per cent. of the total nitrogen. In Liebig's extract one-quarter of the nitrogen was precipitated, and in eleven others from 20 to 30 per cent. In Malto-Meat extract, a vegetable extract, and Patch's, an extract shown to be of excellent quality, less than 10 per cent. of the nitrogen was precipitated. In the four brands already referred to several times, Durham, Southwick, Star and Williams, from 46 to 62.7 per cent. of the nitrogen was precipitated by the reagent, and in Armour's Soluble Beef 48.2 of the nitrogen was precipitated.

The Biuret Test. The filtrates from the zinc sulphate precipitation were submitted to the biuret test, and in all cases furnished negative results. Other analysts of meat extracts have reported a similar experience, and for that reason the absence of peptones in meat extracts has met with a more or less general acceptation. While it seems from the evidence that no natural peptones are present in meat extracts, it is by no means proved that the biuret reaction is always a satisfactory test for peptones.

Bremer* has suggested that there may be substances in the zinc sulphate filtrate which interfere with the biuret reaction. Kruger† has also shown that while propeptone and peptone gave all the other reactions common to Kühne's original peptone, they did not respond to the biuret reaction as long as they were impure. Zuntz‡ has also observed that after the beginning of albumin digestion, products were formed which likewise did not give the biuret reaction. Fischer§ has given the name "polypeptides" to the amid-like anhydrids of the amino acids. He has also pointed out that the commercial products are very closely related to the natural peptones, and that the peptones are essentially a mixture of polypeptides. He has repeatedly pointed out|| that many of the polypeptides fail to give the biuret reaction, although on hydrolysis they yield the same amino acids as the original proteins, and concludes¶ that acid groups in the molecule interfere with the reaction. It is evident, therefore, that the failure of the biuret test is no proof of the absence of bodies of high molecular composition, closely related to the proteins. The biuret reaction may indicate the absence of natural peptones, while polypeptides may be present in abundance.

Nitrogen Precipitated by Tannin-Salt. The method employed was that of Schjerning,** as modified by Bigelow and Cook††. The latter showed, in experiments with a long series of amino bodies, separately, in mixtures, and in the presence of proteoses and peptones, that phenylene-diamin and creatin alone were precipitated to any extent by the strong tannin-salt solution employed. The former has not as yet been found in meat extracts, but creatin is always present as an important constituent. The authors suggested that creatin be determined in the tannin-salt filtrate and the proper correction made. We have given this suggestion a thorough trial and have found the Folin creatin method inapplicable to such a solution, the complete removal of the tannin being a matter of extreme difficulty, and the slightest traces of it interfering with the colorimetric readings. We have learned (by private communication) that the authors themselves have abandoned this correction. In their investigation they showed that a little less than one-fourth of the creatin was precipitated by tannin-salt. Our results, therefore, under that caption, are from 0.02 to 0.32 per cent. too high, the error exceeding 0.15 per cent. in only two cases.

* Chem. Ztg., 1900, *24*, 838.

† Archiv. Physiol., 1888, *43*, 255.

‡ Zeit. physiol. Chem., 1899, *28*, 171.

§ Untersuchungen über Aminosäuren, Polypeptide und Proteïne, Berlin, 1906, p. 23.

|| E. g., loc cit., p. 50.

¶ Ber. deut. Chem. Ges., 1902, *35*, 1095.

** Zeit. Anal. Chem., 1900, *39*, 545.

†† Jour. Amer. Chem. Soc., 1906, *28*, 1485.

The insoluble and coagulable nitrogen having been removed, the tannin-salt precipitate includes the proteoses, peptones, gelatinoids, a part of the creatin and polypeptides. By reference to the table, it will be seen that in every case the tannin-salt precipitate greatly exceeded that caused by zinc sulphate. This excess varied from 0.70 to 2.85 per cent., with an average of 1.92; with the exception of the Durham and Southwick brands, where the excess was but 0.70 and 0.78 per cent., respectively, the difference shows quite a remarkable constancy one side or the other of about 2 per cent. The part of the difference, due to the precipitation of creatin, is so small a proportion of the whole as to be negligible. We have already shown that the biuret reaction was obtained in no case, thereby excluding natural peptones, and it seems to be a reasonable assumption that this difference is largely due to the non-biuret-reacting polypeptides of Fischer. The proof of this contention and the isolation of these bodies, precipitated by tannin-salt and not by zinc sulphate, suggest an interesting line of future study.

Ammonia Nitrogen. The nitrogen yielded as ammonia, by boiling with an excess of magnesia, is considerable in nearly every case; varying from 0.13 to 0.74 per cent. of the extract, or from 2.1 to 10.4 per cent. of the total nitrogen. The ammonia in Swift's extract, 0.74 per cent., is abnormally high.

The Meat Bases.

The nitrogen of the meat bases is assumed to be the remainder left by subtracting the sum of the insoluble, coagulable, ammonia nitrogen and that precipitated by tannin-salt, from the total nitrogen. This varies in the samples examined from 0.63 to 4.37 per cent., with an average of 2.40 per cent. In only five extracts, Durham, Southwick, Michigan, Star and Williams, does the meat-base nitrogen fall much below 2 per cent. In these the respective amounts are 0.86, 1.04, 1.33, 0.63 and 0.64 per cent., or from 10.9 to 17.8 per cent. of the total nitrogen. Six of the brands contain more than 3 per cent. of nitrogen derived from meat bases, while Liebig's and Patch's extracts contain the high percentages of 4.34 and 4.37, respectively. In six brands the nitrogen of the meat bases makes up from 10 to 20 per cent. of the total nitrogen, in two from 20 to 30 per cent., in five from 30 to 40 per cent., and in nine over 40 per cent., the proportion required by the standard.

Creatinin and Creatin Nitrogen. Both the actual and relative variations in content of creatinin and creatin nitrogen are very great. The former varies from 0.07 to 1.85 per cent., with an average of 0.44 per cent.; the latter from 0.03 to 1.30 per cent., with an average of 0.33 per cent. The combined creatinin and creatin nitrogen varies from 0.10 to 2.32 per cent., an average of 0.77 per cent. Liebig's and Patch's extracts again far outrank the others, with 2.16 and 2.32 per cent., respectively, of these two forms of nitrogen and Rex, Patca and Swift's extracts also contain large percentages. Armour's Soluble Beef, Durham, Pilgard and Williams have very low percentages, while the total creatinin and creatin nitrogen in the Southwick, Star and Malto-Meat extracts ranges from 0.10 to 0.21 per cent. The Malto-Meat extract is not claimed to be a meat extract, except by its misleading name, and the practical absence of creatinin and creatin shows its non-animal source.

The standard requires that 40 per cent. of the nitrogenous compounds shall be in the form of meat bases, and that not less than 10 per cent. shall exist as creatinin and creatin. Applying this standard, it is found that nine brands exceed 10 per cent., two fall slightly below 10 per cent., seven brands contain from 5.5 to 7.6 per cent., while Armour's Soluble Beef, Malto-Meat, Southwick and Star extracts contain only 3.0, 2.0, 3.9 and 3.0 per cent., respectively, of their nitrogen in these basic forms. In the case of Armour's Soluble Beef, this low percentage of meat bases is due to its high content of nitrogen precipitated by zinc sulphate. The low percentages in the Southwick and Star brands not only emphasize their inferiority, but also raise serious doubt as to the

presence of any considerable quantity of genuine meat extract in these preparations.

It is noticeable that in the extracts examined, the amounts of creatinin and creatin nitrogen have no constant relation to each other. In certain extracts the creatinin is in large excess, while in others creatin predominates. Toppelius and Pommerehne,* Wörner† and Grindley and Woods‡ have shown that fresh meat gave no trace of creatinin. The latter also showed that by the evaporation of an aqueous extract of flesh upon the water-bath, in the presence of its natural acidity, creatin was changed to creatinin. It may be, therefore, that the relative amounts of these bases present may give some evidence as to the freshness of the extracts, as well as to the kind of meat employed in their manufacture.

Note on the Determination of Creatin. Hehner§ has criticised Folin's method for creatin and creatinin, as applied to meat extracts, claiming that the amount of picric acid specified was insufficient, and recommends 25 cc. of a 1.01 per cent. solution, together with a smaller amount of alkali. Benedict and Myers‖ and Emmett and Grindley¶ have studied the alleged defects in Folin's method and find, while on the whole Hehner's criticisms are not fully sustained by the facts, that in the determination of creatin, at least, certain modifications are advisable; namely, an increase in the quantities of picric acid and alkali used.

Our analyses were well under way before the publication of the papers referred to above, and we had already modified the method in that after the dehydration of the creatin in the autoclave we added 10 cc. of normal sodium hydroxid to neutralize the acid used, and then proceeded as in the regular Folin method. We have also made a few tests of the modification suggested by Emmett and Grindley and find that slightly higher results are in general obtained thereby. These gains are trivial, however, in nearly every case, and possess no significance in using the method with meat extracts.

* Arch. Pharm., 1896, *234*, 380.
† Zeit. physiol. Chem., 1899, *27*, 1.
‡ Jour. Biol. Chem., 1907, *2*, 309.
§ Pharm. Jour., 1907, *78*, 683.
‖ Amer. Jour. Physiol., 1907, *18*, 4.
¶ Jour. Biol. Chem., 1907, *3*, 491.

All the creatin determinations given in our tables were made with our modified method just described. A comparison of the results secured by our modification and by that of Emmett and Grindley is shown in the following tabulation:

TABLE XV.—COMPARATIVE RESULTS FOR CREATIN.

Station No.	Amount of Extract used.	Concentration.	Reagents used. Picric acid.	Reagents used. Alkali.	Colorimeter Reading.	Total Creatinin.	Original Creatinin.	Creatinin due to Creatin.	Creatin.	Creatin Nitrogen.
	gm.	cc.	cc.	cc.	mm.	%	%	%	%	%
19579	.7620	250	15	5	9.98	0.54	0.33	0.21	0.24	0.08
	.7528	250	15	5	11.20	0.48	0.33	0.15	0.17	0.05
	.7620	250	30	10	9.18	0.58	0.33	0.25	0.29	0.09
	.7528	250	30	10	10.20	0.53	0.33	0.20	0.23	0.07
19585	.4060	500	15	5	8.16	2.45	1.34	1.11	1.29	0.41
	.4156	500	15	5	8.35	2.33	1.34	0.99	1.15	0.37
	.4156	250	15	5	4.27	2.28	1.34	0.94	1.09	0.35
	.4156	250	30	10	4.05	2.41	1.34	1.07	1.24	0.40
	.4156	500	30	10	7.95	2.45	1.34	1.11	1.29	0.41
19563	.4000	250	15	5	5.50	1.85	0.63	1.22	1.42	0.46
	.4000	250	30	10	5.20	1.95	0.63	1.32	1.53	0.49
19563a	.4000	250	15	5	7.20	1.40	0.63	0.77	0.89	0.29
	.4000	250	30	10	6.50	1.55	0.63	0.92	1.07	0.34
19586	.2000	250	15	5	11.90	1.70	0.77	0.93	1.05	0.34
	.2000	250	15	5	11.10	1.82	0.77	1.05	1.22	0.39
	.2000	250	30	10	11.90	1.70	0.77	0.93	1.05	0.34
	.2000	250	30	10	12.50	1.60	0.77	0.83	0.96	0.31
18599	.2000	500	15	5	6.57	6.17	4.86	1.31	1.52	0.49
	.1600	500	30	10	7.30	6.31	4.86	1.45	1.68	0.54

Purin Nitrogen. The purin, or xanthin, bases are found in both animal and vegetable matter, and their presence in an extract throws but little light on its source. A high purin nitrogen, with no creatinin and creatin, however, is characteristic of yeast extracts. The purin nitrogen in the extracts examined varies from 0.16 to 0.83 per cent., an average of 0.49 per cent. It makes up from 2.9 to 15.9 per cent. of the total nitrogen. The Durham, Star and Williams brands show abnormally low percentages, while the Liebig and Malto-Meat extracts show a high content. The latter, a vegetable extract, clearly shows its identity by the high content of purin and the practical absence of creatinin and creatin.

Undetermined Basic Nitrogen. Reference to the table shows that all of the brands contain undetermined basic nitrogen, and, in some samples, in large quantities. It is impossible, with our present knowledge, to isolate and identify all of the meat bases in the extracts. The undetermined nitrogen of this form varies from 0.14 to 1.87 per cent., and makes up from 2.4 to 24.1 per cent. of the total nitrogen, and from 22 to 60 per cent. of the total meat bases. With the exception of the brands containing but small amounts of total bases, Armour's Soluble Beef, Durham, Southwick, Michigan, Star and Williams extracts, the relative amount of undetermined basic nitrogen is fairly constant, averaging about 20 per cent. of the total nitrogen.

Preservatives.

With three exceptions, the extracts contained considerable quantities of common salt, and the use of other preservatives was certainly unnecessary and hardly to be expected. The three brands low in chlorin, Liebig's, Armour's Soluble Beef and Armour's Extract, were tested for salicylic and benzoic acids, with negative results. All the samples were likewise tested for nitrates. With the ferrous sulphate-sulphuric acid method,* all the samples gave negative results. The highly colored solutions made this test difficult of application, and therefore all the samples were further subjected to the diphenylamine test as follows:—

0.5 gm. diphenylamine was dissolved in 100 cc. of strong sulphuric acid and 20 cc. of water added. About 0.2 gm. of the extract was dissolved in 25 cc. of water. A small quantity of this solution was placed in a porcelain dish and 5 cc. of the reagent added, a blue color indicating nitrates.

This extremely delicate test gave decided reactions in 11 of the 22 samples. Nitrates were then determined quantitatively by the Schlösing method and traces, ranging from 0.03 to 0.21 per cent., were found in 10 samples, while the Michigan Brand, **18602**, contained 0.73 per cent. of nitrates.

The following samples contained traces: **18600, 18633, 19455, 18599, 18580, 18660, 18500, 18522, 19456** and **18632**. The other 11 samples contained no nitrates.

* U. S. Depart. Agr., Bur. of Chem., Bull. 107, 8.

The presence of nitrates indicates that concentrated brines have been used wholly or in part in the preparation of the extract, and that the extract is not a high-grade article.

Claims of the Manufacturers.

The manufacturers of many of the extracts make certain claims for their products, either on the label or in the literature accompanying the samples, and it is important to point out to what extent these claims are substantiated. Any misleading statement on the label constitutes misbranding, under the Connecticut Food and Drug Law. With those samples where no specific claim is made, we have only to consider their relation to standard meat extract, as shown by their chemical composition.

18600. *Premium Brand Beef Extract.* "Absolutely pure, contains no foreign matter whatever, either flavor or filler, but only the nutritious portion of beef in concentrated form combined with its stimulating salts." The claim is false, as the extract *contains about 12 per cent. of added salt. It contains also an excess of ash, and traces of nitrates.*

18633. *A. D. S. Extract of Beef.* "This extract is recommended by all leading physicians." "Manufactured according to the formula of Baron Liebig." "Comparison with any other beef extract made will establish the great superiority of this brand." The first claim is ridiculous. The second statement is untrue, as the Liebig formula calls for no added salt; this brand *contains over 10 per cent. of added salt.* As to the third claim, a glance at Table X will show that nine brands are superior *to it* in total nitrogen and eight in meat bases. *It contains traces of nitrates.*

18601. *Armour's Extract of Beef.* "Made only from the finest quality of fresh beef." We have no evidence to the contrary. The extract corresponds with all the official standards and contains a minimum of added salt.

18636. *Armour's Soluble Beef.* "Is highly nutritious and palatable. It is the actual substance of prime beef predigested, readily assimilable and recommended for the invalid convalescent or wherever a nourishing and stimulating food is desired." "Prepared from pure beef and nothing but beef." This preparation, though included in our tabulation, is not strictly a meat extract; in fact, no such claim is made by the manufacturer. Of all the

paste preparations, it contains the highest total nitrogen, of which nearly one-half is precipitated by zinc sulphate and three-fourths by tannin-salt, and therefore possesses relatively high nutritive value. It contains no added salt, but is low in the natural salts of meat, and less than one-fifth of its nitrogen is in the form of meat bases.

18661. *Rex Extract of Beef.* "Is prepared from the best quality of prime lean-meat, and represents about forty-five pounds of lean meat to one pound of solid extract. It is a food, wholesome, delicious and refreshing; and a happy combination of stimulation and nutrition." "It is absolutely pure and entirely free from preservatives and adulterants of any kind, conforming fully to all pure food laws." "Careful comparison by food experts establishes Cudahy's Rex Beef extract as absolutely the best." In the circular accompanying a second sample of this brand the last two claims are omitted. The extract satisfies all the requirements of the official standard, except that it is a trifle high in ash; it contains about 6 per cent. of added salt, slightly below what is permitted by the standard. The objection to the use of the word "food" in connection with meat extracts applies to this as well as to all others.

18575. *A. and P. Brand Extract of Beef.* No claims made. The extract *is below the nitrogen standard and is low in combined creatin and creatinin. It contains about 11 per cent. of added salt.*

18602. *Michigan Brand Beef Extract.* Exactly the same claims as for 18600. Claims are false, as *it contains nearly 11 per cent. of added salt, and an excess of ash, and is low in combined creatin and creatinin. It contains 0.73 per cent. of nitrates,* 10 per cent. of the total nitrogen.

18485. *Extractum Carnis Liebig.* "Manufactured by a special process invented for the Company by Baron Justus von Liebig." "It is the only meat extract ever prepared under the control of Justus von Liebig and that of his successors." The extract satisfies all the official standards and contains no added salt. It makes no claim to be a "food."

19564. *Malto-Meat Extract.* "Is a pure extract of malt in a form which possesses all the merits, with none of the disadvantages of beef extract. Being a purely vegetable compound, it is entirely free from that most dangerous ingredient of animal extracts, uric acid." "Far superior to beef extract in nitrogenous matter—soluble albumen and peptones—as proved by chemical analysis." "It is the only product of its kind which is not affected by heat or cold, keeping for any length of time without forming mould on top, so often found in beef extracts." This article is *misbranded* by the use of the word "meat" on its label. It does not "possess all the merits" of beef extract, in that *only 2 per cent. of its nitrogen is in the form of creatinin and creatin,* which give meat extract its chief value. It is not "a purely vegetable compound," as *it contains over 20 per cent. of added salt.* It is not "far superior to beef extract in nitrogenous matter," etc., *containing 2 per cent. less total nitrogen than the standard.* It contains practically *no "soluble albumen,"* as claimed. *It contains no true peptones,* but possibly does contain a high relative percentage of polypeptides. It was not found to keep any better than the meat extracts during a period of three months. The extract is high in purin nitrogen.

19455. *Durham Brand Extract of Beef.* No claims made. It *exceeds the moisture standard by 11.54 per cent., contains over 18 per cent. of added salt,* and *is far below standard in meat bases,* particularly creatinin and creatin. Its acidity is also very low and *it contains a low percentage of the natural salts of meat. It contains traces of nitrates.* The reason for its relatively low price is apparent.

19563. *Mosquera Beef Jelly.* "As distinguished from the ordinary extracts of beef, which are devoid of nutritive value, Mosquera Beef Jelly is a concentrated food that represents the nourishing constituents of fresh beef, from which it is made, in a soluble and palatable form. It is, in fact, the only nutritious and palatable extract of beef in existence. This claim is based on the fact that in the manufacture of Beef Jelly the solid meat fiber or Fibrin is rendered soluble by treating it with the pineapple digestive ferment." "Contains all the soluble extractive portion of the meat, same as the ordinary beef extracts, and, in addition, the artificially digested meat fiber, which constitutes the actual nutriment." This extract contains a satisfactory percentage of total nitrogen, three-fourths of which is precipitated by tannin-salt. It contains no true peptones. *The proportion of meat bases is below standard and it is low in creatinin and creatin. It contains about 9 per cent. of added salt.* Its nutritious and palatable qualities are much exaggerated in the above claims.

18581. *Smith's Sterilized Extract of Beef.* "Of full strength and flavor. Manufactured under the original formula." *It is low in total creatinin and creatin,* otherwise conforming to the standards.

19473. *Smith's Sterilized Extract of Beef.* Same claims as for last sample, with which it is not uniform in composition. *It contains an excess of ash,* due to added salt.

18599. *Patch's Extract of Beef.* No claims made. A high-grade extract, particularly rich in meat bases, especially creatinin. *It exceeds the ash standard by 3.79 per cent.,* due chiefly to an abnormally high potash content. *It contains traces of nitrates.*

18580. *Patca Brand—Australian Extract of Beef.* "We guarantee this Extract of Meat to be made in a thoroughly sanitary, clean and wholesome manner from only the edible portions of the meat and to be free from preservatives or diluents of any kind." It is a high-grade extract, but *contains over 7 per cent. of added salt,* slightly in excess of the standard. The claim that it contains no diluent is, therefore, not met. *It also contains traces of nitrates.*

18679. *Pilgard's Liebig Process Extract of Beef. It contains an excess of ash, over 11 per cent. of added salt,* and *is below standard in creatinin and creatin. It is misbranded,* as the Liebig process calls for no added salt and requires a high percentage of meat bases.

18660. *Marshall's Liebig Process Extract of Beef.* No other claims made. *It is misbranded, as it contains over 13 per cent. of added salt; it contains an excess of ash, is below standard in total nitrogen, and is deficient in creatinin and creatin. It contains traces of nitrates.* Its composition does not indicate that it was made by the Liebig process.

18500. *Marshall's Extract of Beef, Original Process.* "Contents of this package absolutely unadulterated. Contains no added ingredient as a preservative." *It is misbranded* and the above claim is false, *as it contains over 14 per cent. of added salt. It exceeds the standard in ash and chlorin and is 1 per cent. deficient in total nitrogen. It contains traces of nitrates.*

18522. *Southwick Brand, Liebig's Extract of Beef.* "Contains more of the nutritive portion of the beef than any other Beef

Extract, besides being rich in all of the stimulating salts." *It contains 5.37 per cent. excess of water, 1.25 per cent. excess of ash, a great deficiency in meat bases, and only traces of creatinin and creatin.* To call this product Liebig's Extract is *obvious misbranding,* as besides the above variations from standard, *it contains over 18 per cent. of added salt.* It contains *much less* of the nutritive portion of the beef than many other extracts, and is *markedly deficient* in all of the stimulating salts. *It also contains traces of nitrates.*

18570. *Swift's Beef Extract.* "A wholesome and palatable article of food." "Is made from the best quality of prime American beef, guaranteed to be pure and uniform, and to keep in any climate." The use of the word "food" is objectionable. It is *slightly above the standard for chlorin, as it contains about 8 per cent. of added salt.* It contains satisfactory quantities of the meat bases. Its ammonia content of 0.74 per cent. is abnormally high, indicating a very complete breaking down of much of the original protein matter.

19456. *Star Brand Pure Extract of Beef.* "Is twice as strong as any fluid beef." This statement is *false,* as the analyses on a later page show that fourteen of the fluid preparations contain more than half as much nitrogen and meat bases as this extract, while one actually contains more. The only respect in which it is "twice as strong as any fluid beef" is in its chlorin content, scarcely a recommendation. It contains less nitrogen than any paste extract examined, *being over 1 per cent. below the standard.* It contains *an excess of water, a great excess of ash, 8.02 per cent., and about 25 per cent. of added salt.* It is very low in total meat bases and *contains practically no creatinin or creatin.* Its acidity is low and *it contains but small quantities of the natural salts of meat. It contains traces of nitrates.* The reason for its low price is apparent.

18632. *Williams' Soluble Extract of Beef.* No claims made. This is likewise *a low-grade extract. It contains an excess of water, an excess of ash, and about 19 per cent. of added salt. It contains the lowest proportion of meat bases of any extract examined, and is very low in creatinin and creatin.* The acidity is low, and *it contains but small quantities of the natural salts of meat. It contains traces of nitrates.*

Summary.

Summarizing the above detailed descriptions of the various extracts, it is found that certain ones satisfy the legal standards in all particulars, some are deficient in one or more respects, while others, because of false statements concerning them, must be considered as misbranded. In the classification given below, the official standards have been followed strictly, allowing a variation of 10 per cent. for the different ingredients. The writer must, however, again express his opinion that the permission to use any added salt whatever is ill-advised and unnecessary.

Extracts Properly Branded and Up to Standard.

18601. Armour's Extract of Beef.
18661. Rex Extract of Beef.
18485. Extractum Carnis Liebig.
18599.* Patch's Extract of Beef.
18580.* Patca Brand Extract of Beef.
18570. Swift's Beef Extract.
19473. Smith's Sterilized Extract.

Extracts Misbranded† and Varying from Standard.

18600.* Premium Brand. High in ash and chlorin.

18633.* A. D. S. Extract. High in ash and chlorin.

18602. Michigan Brand. High in chlorin, low in total meat bases, and creatinin and creatin; large quantity of nitrates.

19564. Malto-Meat Extract. High in ash and chlorin, low in nitrogen and creatinin and creatin.

18679. Pilgard's Extract. High in chlorin, low in total meat bases and creatinin and creatin.

18660.* Marshall's Liebig Process. High in ash and chlorin, low in nitrogen.

18500.* Marshall's Original Process. High in ash and chlorin, low in nitrogen.

18522.* Southwick Brand. High in water and chlorin, low in total meat bases, creatinin and creatin, and the natural salts of meat.

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* Contains traces of nitrates.

† For nature of misbranding see previous pages.

19456.* Star Brand. High in water, ash and chlorin, low in nitrogen, total meat bases, creatinin and creatin, acidity and the natural salts of meat.

Extracts Properly Branded but Varying from Standard.

18575. A. and P. Brand. High in chlorin, low in nitrogen and creatinin and creatin.

19455.* Durham Brand. High in water and chlorin, low in total meat bases, creatinin and creatin, acidity and the natural salts of meat.

19563. Mosquera Beef Jelly. High in chlorin, low in total meat bases and creatinin and creatin.

18581. Smith's Sterilized Extract. Low in creatinin and creatin.

18632.* Williams' Soluble Extract. High in water, ash and chlorin, low in total meat bases, creatinin and creatin, acidity and the natural salts of meat.

II. Fluid and Semi-Fluid Preparations.

Twenty-three samples were analyzed, representing as many brands. The particulars regarding them are given in Table XVI.

Net Weight and Selling Price. The preparations and packages differ so widely that no satisfactory comparison of weight or price can be made; they vary in weight from about one ounce to a pound and in price from twenty-five cents to one dollar.

A. Fluid Meat Extracts.

Thirteen samples were analyzed, representing ten manufacturers.

Table XVII gives the analyses of the extracts and the same calculated to the water-free basis. The figures not obtained by direct determinations were secured in the same way as explained under paste extracts.

Water. The official standard requires that fluid meat extract shall contain not more than 50 per cent. of water. Nine of the extracts exceed this maximum, but the excess is large in only three, viz., Asparox, Cibils and Mosquera Beef Jelly, which contain 68.37, 64.21 and 64.99 per cent., respectively.

* Contains traces of nitrates.

TABLE XVI.—FLUID MEAT PREPARATIONS.

Station No.	Brand.	Manufacturer.	Dealer.	Price per jar.	Net weight of material.
				cts.	oz.
18664	Liquid Peptonoids	The Arlington Chemical Co., Yonkers, N. Y.	L. H. Tracy, Hartford	100	16.3
19578	Asparox	Armour & Co., Chicago, Ill.	Johnson & Bro., New Haven	25	4.2
19597	Armour's Concentrated Fluid Beef Extract	Armour & Co., Chicago, Ill.	R. T. Whiting, Bridgeport	38	3.5
18610	Vigoral	Armour & Co., Chicago, Ill.	H. E. Bushnell, Meriden	40	1.7
18659	Bovinine	The Bovinine Co., N. Y. City	J. J. Seinsoth, Hartford	60	6.1
18629	Bovox	The Bovox Co., Boston, Mass.	J. R. Halloran, New Britain	50	6.6
20145	Bovril	Bovril Limited, London	W. A. Spalding, New Haven	50	2.0
18701	Pepto-Mangan "Gude"	M. J. Breitenbach Co., N. Y. City	E. F. McGuinness, New Haven	79	11.7
19588	Cibils Fluid Extract of Beef	Cibils Co., N. Y. City	W. A. Spalding, New Haven	100	8.3
19509	Colden's Liquid Beef No. 2	The Chas. H. Crittenton Co., N. Y. City	Henry Woodward, Middletown	90	16.8
19611	Cudahy's Rex Fluid Beef Extract	The Cudahy Packing Co., Omaha, Neb.	Goodwin's Drug Store, Hartford	100	5.6
18702	Panopepton	Fairchild Bros. & Foster, N. Y. City	E. A. Gesner, New Haven	45	6.5
19541	Maggi's Bouillon	The Maggi Co., Kempital, Swit.	McCarthy's Pharmacy, Waterbury	60	4.4
19439	Mason's Essence of Beef	Mason Concentrated Food Co., N. Y. City	E. L. Washburn, New Haven	75	2.8
19494	Superior Fluid Extract of Beef	Nelson Morris & Co., Chicago, Ill.	Smith's Drug Store, Norwich	40	2.4
19516	Mosquera Fluid Beef Jelly	Mosquera-Julia Food Co., New York and Detroit	Lincoln's Drug Store, Middletown	50	4.6
19583	Pre-Digested Beef	H. K. Mulford Co., Philadelphia, Pa.	W. A. Spalding, New Haven	40	8.6
19448	Murdock's Liquid Food	Murdock Liquid Food Co., Boston, Mass.	Gamble-Desmond Co., New Haven	49	5.4
19590	*Murray's Beef Extract		Edward Gannon, Bridgeport	35	4.1
19495	Sinuox	Sinuox Co., N. Y. City	C. C. Treat, Norwich	50	2.8
20136	Sinuox for Invalid's Use	Sinuox Co., N. Y. City	Utley & Jones, Norwich	50	3.6
18658	Valentine's Preparation Meat Juice	Mann S. Valentine, Richmond, Va.	Goodwin's Drug Store, Hartford	75	2.4
18700	Wyeth's Beef Juice	John Wyeth & Bro., Philadelphia, Pa.	C. H. Conway, New Haven	75	2.4

* Statement of dealer.

TABLE XVII.—

Station No.	Brand.	Water.	Alcohol by weight.	Organic matter.	Ash.	Petroleum Ether Extract (Fat).	Chlorin.	Phosphoric acid.	Potash.
19578	*Asparox	68.37	0.00	17.12	14.51	0.02	6.10	0.96	2.27
19597	*Armour's Fluid Beef	42.03	0.00	36.41	21.56	0.00	6.32	2.72	5.46
18610	*Vigoral	43.15	0.00	41.14	15.71	0.19	3.54	2.85	5.34
18629	Bovox	51.74	0.00	30.25	18.01	0.29	8.53	0.88	1.76
20145	Bovril	43.12	0.00	41.07	15.81	0.62	4.78	2.48	3.55
19588	Cibils Fluid Extract	64.21	0.00	19.95	15.84	0.00	7.61	1.38	1.98
19611	Rex Fluid Beef	51.53	0.00	33.29	15.18	0.05	2.99	2.87	4.81
19541	Maggi's Bouillon	49.34	0.00	29.32	21.34	0.00	11.44	1.01	1.64
19494	Morris' Fluid Extract	51.80	0.00	32.39	15.81	0.13	5.96	1.78	3.36
19516	*Mosquera Fluid Beef Jelly	64.99	0.00	23.73	11.28	0.10	4.98	0.99	1.73
19590	Murray's Beef Extract	54.07	0.00	29.84	16.09	0.08	7.68	1.07	1.97
19495	Sinuox	57.33	0.00	26.76	15.91	0.00	7.10	1.36	2.37
20136	Sinuox for Invalids	51.57	0.00	29.51	18.92	0.16	7.55	2.18	3.48

WATER-FREE BASIS.

Station No.	Brand.	Water.	Alcohol by weight.	Organic matter.	Ash.	Petroleum Ether Extract (Fat).	Chlorin.	Phosphoric acid.	Potash.
19578	Asparox	----	----	54.15	45.85	0.06	19.28	3.03	7.17
19597	Armour's Fluid Beef	----	----	62.81	37.19	0.00	10.90	4.69	9.42
18610	Vigoral	----	----	72.37	27.63	0.33	6.23	5.02	9.40
18629	Bovox	----	----	62.68	37.32	0.60	17.67	1.82	3.65
20145	Bovril	----	----	72.21	27.79	1.09	8.40	4.36	6.24
19588	Cibils Fluid Extract	----	----	55.74	44.26	0.00	21.26	3.86	5.53
19611	Rex Fluid Beef	----	----	68.68	31.32	0.10	6.17	5.92	9.92
19541	Maggi's Bouillon	----	----	57.88	42.12	0.00	22.58	1.99	3.24
19494	Morris' Fluid Extract	----	----	67.20	32.80	0.27	12.37	3.69	6.97
19516	Mosquera Fluid Beef Jelly	----	----	67.78	32.22	0.29	14.22	2.83	4.94
19590	Murray's Beef Extract	----	----	64.97	35.03	0.17	16.72	2.33	4.29
19495	Sinuox	----	----	62.72	37.28	0.00	16.64	3 19	5.56
20136	Sinuox for Invalids	----	----	60.93	39.07	0.33	15.59	4.50	7.19

* Contains salicylic acid.

Acidity. The acidity shows wide variations, Asparox, Bovox, Cibils and Murray's being somewhat deficient in this respect.

Organic Matter. This is very variable, ranging from 17.12 to 41.14 per cent. Nitrogen makes up from 8.51 to 15.67 per cent. of the organic matter. In Asparox, Vigoral, Maggi's and the two Sinuox extracts this ratio is 10 per cent. or less, indicating the presence of considerable non-nitrogenous organic matter. All the extracts were tested for alcohol and no more than a trace was found in any case.

FLUID MEAT EXTRACTS.

Station No.	Acidity = cc. $\frac{N}{10}$ KOH to neutralize 100 gms. of substance.		Forms of Nitrogen.							Meat Bases.			
	Phenol-phthal-ein.	Litmus.	Total.	Insoluble.	Coagulable.	Ammonia.	Ppt. by Tannin-Salt.	Meat Bases (by difference).	Ppt. by Zinc Sulphate.	Creatinin.	Creatin.	Purins.	Undeter-mined.
19578	240	164	1.78	0.10	0.01	0.11	†0.64	0.92	0.38	0.16	0.13	0.14	0.49
19597	611	424	4.01	0.00	0.10	0.42	1.50	1.99	0.45	0.43	0.48	0.36	0.72
18610	664	384	4.09	0.26	0.07	0.26	1.53	1.97	0.55	0.46	0.15	0.31	1.05
18629	304	118	4.02	0.06	0.00	0.16	†2.80	1.00	1.58	0.19	0.10	0.07	0.64
20145	520	310	5.36	0.99	0.04	0.45	2.33	1.55	1.33	0.49	0.30	0.35	0.41
19588	297	200	2.79	0.14	0.00	0.18	1.40	1.07	0.60	0.28	0.18	0.17	0.44
19611	576	382	4.48	0.10	0.06	0.19	1.83	2.30	0.66	0.31	0.58	0.34	1.07
19541	432	228	2.88	0.00	0.00	0.18	0.82	1.88	0.33	0.05	0.01	0.06	1.76
19494	368	220	4.04	0.13	0.09	0.42	1.92	1.48	0.81	0.00	0.00	0.15	1.33
19516	342	180	2.90	0.00	0.06	0.13	1.41	1.30	0.31	0.19	0.07	0.12	0.92
19590	288	152	4.22	0.00	0.02	0.20	†3.20	0.80	1.59	0.22	0.08	0.13	0.37
19495	468	328	2.28	0.00	0.00	0.58	0.83	0.87	0.57	0.29	0.04	0.18	0.36
20136	592	356	2.70	0.00	0.05	0.28	0.95	1.42	0.31	0.42	0.22	0.26	0.52

WATER-FREE BASIS.

Station No.	Phenol-phthal-ein.	Litmus.	Total.	Insoluble.	Coagulable.	Ammonia.	Ppt. by Tannin-Salt.	Meat Bases (by difference).	Ppt. by Zinc Sulphate.	Creatinin.	Creatin.	Purins.	Undeter-mined.
19578	--	--	5.62	0.32	0.03	0.35	2.02	2.90	1.20	0.51	0.41	0.44	1.54
19597	--	--	6.92	0.00	0.17	0.72	2.59	3.44	0.78	0.74	0.83	0.62	1.25
18610	--	--	7.20	0.46	0.12	0.46	2.69	3.47	0.97	0.81	0.26	0.55	1.85
18629	--	--	8.32	0.12	0.00	0.33	5.80	2.07	3.27	0.39	0.21	0.15	1.32
20145	--	--	9.42	1.74	0.07	0.79	4.10	2.72	2.34	0.86	0.53	0.62	0.71
19588	--	--	7.80	0.39	0.00	0.50	3.91	3.00	1.68	0.78	0.50	0.47	1.25
19611	--	--	9.24	0.21	0.12	0.39	3.78	4.74	1.36	0.64	1.20	0.70	2.20
19541	--	--	5.69	0.00	0.00	0.36	1.62	3.71	0.65	0.10	0.02	0.11	3.48
19494	--	--	8.38	0.27	0.19	0.87	3.98	3.07	1.68	0.00	0.00	0.31	2.76
19516	--	--	8.29	0.00	0.17	0.37	4.04	3.71	0.89	0.54	0.20	0.34	2.63
19590	--	--	9.19	0.00	0.04	0.44	6.97	1.74	3.46	0.48	0.17	0.28	0.81
19495	--	--	5.34	0.00	0.00	1.36	1.95	2.03	1.34	0.68	0.09	0.42	0.84
20136	--	--	5.58	0.00	0.10	0.58	1.96	2.94	0.64	0.87	0.45	0.54	1.08

† Gave biuret reaction for peptones in zinc sulphate filtrate.

Fat. The fat content is very low, ranging from none at all to 0.29 per cent. in Bovox.

Total Ash. All of the extracts contain large amounts of ash in relation to their concentration. In the paste extracts, 34.80 per cent. of the dry matter is ash; in the fluid extracts, 36.15 per cent. The excessive ash in all cases consists of added salt.

Chlorin. The chlorin ranges from 2.99 to 11.44 per cent. The amounts of added salt are in general somewhat lower than in the pastes, but in certain extracts are very considerable, varying from

2.02 to 15.84 per cent. Vigoral, Bovril and Rex Fluid Beef contain but little added salt, while Asparox, Bovox, Cibils, Murray's, the two Sinuox extracts and Maggi's contain a good deal, amounting in the last named to 15.84 per cent. The following tabulation, calculated in the same way as for paste extracts, shows the amount of added salt found in the different brands.

Table XVIII.—Added Sodium Chlorid.

Station No.	Dry Matter.	Chlorin.	Sodium Chlorid Cl. x 1.65.	Natural Chlorids. Dry Matter x .06.	Added Sodium Chlorid.
19578	31.63	6.10	10.07	1.90	8.17
19597	57.97	6.32	10.43	3.48	6.95
18610	56.85	3.54	5.84	3.41	2.43
18629	48.26	8.53	14.07	2.90	11.17
20145	56.88	4.78	7.89	3.41	4.48
19588	35.79	7.61	12.56	2.15	10.41
19611	48.47	2.99	4.93	2.91	2.02
19541	50.66	11.44	18.88	3.04	15.84
19494	48.20	5.96	9.83	2.89	6.94
19516	35.01	4.98	8.22	2.10	6.12
19590	45.93	7.68	12.67	2.76	9.91
19495	42.67	7.10	11.72	2.56	9.16
20136	48.43	7.55	12.46	2.91	9.55

Phosphoric Acid and Potash. The phosphoric acid varies from 0.88 to 2.87 per cent., and makes up from 5 to 19 per cent. of the ash. In Asparox, Bovox, Cibils, Maggi's, Mosquera, Murray's and Sinuox, less than 10 per cent. of the ash is phosphoric acid; Vigoral and Rex show the highest actual and relative amounts. The low phosphoric acid ratios in may cases are due to the added salt.

The potash varies from 1.64 to 5.46 per cent., the lowest percentages accompanying low percentages of phosphoric acid.

Nitrogenous Constituents.

Total Nitrogen. This ranges from 1.78 to 5.36 per cent., with an average of 3.50. Bovril shows much the highest percentage; six of the brands contain from about 4.0 to 4.5 per cent.; the other brands contain from 2.28 to less than 3.0 per cent., except Asparox, which shows the low percentage of 1.78.

The fluid extracts differ materially from the pastes, not only in the total amount of nitrogen, but in the forms in which it exists, as Table XIX will show.

Table XIX.—Relative Amounts of Different Forms of Nitrogen.

Station No.	Total Nitrogen (dry basis).	Per cent. of Nitrogen in Fat-free Organic Matter.	Per cent. of Total Nitrogen in form of								
			Insoluble and Coagulable.	Ammonia.	Ppt. by Tannin Salt.	Meat Bases.	Ppt. by Zinc Sulphate.	Creatinin.	Creatin.	Purins.	Other Basic Nitrogen.
19578	5.62	10.39	6.2	6.2	35.9	51.7	21.4	9.1	7.3	7.8	27.5
19597	6.92	11.02	2.5	10.4	37.4	49.7	11.3	10.7	12.0	8.9	18.1
18610	7.20	10.00	8.1	6.4	37.4	48.1	13.5	11.3	3.6	7.6	25.6
18629	8.32	13.42	1.4	4.0	69.7	24.9	39.3	4.7	2.5	1.8	15.9
20145	9.42	13.25	19.2	8.4	43.5	28.9	24.8	9.1	5.6	6.6	7.6
19588	7.80	13.99	5.0	6.4	50.1	38.5	21.5	10.0	6.4	6.0	16.1
19611	9.24	13.47	3.6	4.2	40.9	51.3	14.7	6.9	13.0	7.6	23.8
19541	5.69	9.83	---	6.3	28.5	65.2	11.4	1.8	0.4	1.9	61.1
19494	8.38	12.52	5.5	10.4	47.5	36.6	20.0	---	---	3.7	32.9
19516	8.29	12.28	2.1	4.5	48.7	44.7	10.7	6.5	2.4	4.1	31.7
19590	9.19	14.18	0.4	4.8	75.8	19.0	37.6	5.2	1.9	3.0	8.9
19495	5.34	8.51	---	25.5	36.5	38.0	25.1	12.7	1.7	7.9	15.7
20136	5.58	9.21	1.8	10.4	35.1	52.7	11.5	15.6	8.1	9.7	19.3

Insoluble and Coagulable Nitrogen. The insoluble nitrogen varies from none at all to 0.99 per cent. On the average it is greater than in the paste extracts. In only two of the brands, however, is there an important amount present; namely, Vigoral and Bovril, which contain 0.26 and 0.99 per cent., respectively, representing in one case 6.4 per cent. and in the other 18.5 per cent. of the total nitrogen. This comes from added meat fiber and has a distinct food value, but it would take a large quantity of either of these extracts to supply the same amount of nutriment as a pound of good, lean meat.

The coagulable nitrogen is insignificant, not exceeding 0.10 per cent. in any of the extracts. Maggi's Bouillon and Sinuox contain neither insoluble nor coagulable nitrogen.

Ammonia Nitrogen. All of the extracts contain quantities of ammonia, varying from 0.11 to 0.58 per cent. In Armour's, Morris', and Sinuox for Invalids, the ammonia makes up about 10 per cent. of the total nitrogen, while in Sinuox it amounts to 25.5 per cent.

Proteose Nitrogen. The nitrogen precipitated by zinc sulphate varies from 0.31 to 1.59 per cent., or from 10.7 to 37.6 per cent. of the total nitrogen. The quantity of proteoses in the fluid extracts is both actually and relatively smaller than in the pastes. Only three of these extracts, Bovox, Bovril, and Murray's, contain over 1 per cent. of proteose nitrogen. Bovril, because of its relatively high proteose and insoluble nitrogen content, may justly claim a distinct, though very moderate food value.

Nitrogen Precipitated by Tannin-Salt. None of the filtrates from the proteose determinations in the paste extracts gave the biuret reaction. Of the fluid extracts, Asparox, Bovox and Murray's alone gave positive peptone reactions. The common practice is to credit the difference between nitrogen precipitated by tannin-salt and that precipitated by zinc sulphate to peptone nitrogen, and Asparox, Bovox and Murray's would be credited with 0.26, 1.22 and 1.61 per cent., respectively. With our present knowledge we are not justified in assigning these amounts of peptones to the extracts named, for, as pointed out on page 628, it is more than probable that a part of this difference consists of polypeptides, many of which do not give the biuret reaction. This fact is emphasized by a consideration of the other ten extracts, none of which gave the biuret test in the zinc sulphate filtrate. In every case the nitrogen precipitated by tannin-salt exceeded that precipitated by zinc sulphate, varying from 0.26 to 1.61 per cent., with an average of 0.90. Following the same line of reasoning as used with the paste extracts, it is not unjustifiable to assume that these differences may be largely due to non-biuret-reacting polypeptides. How closely the polypeptides and true peptones are allied in physiological effects is still an unsolved problem.

The Meat Bases.

The meat bases should constitute about forty per cent. of the total nitrogenous matter. In the fluid extracts the meat-base nitrogen varies from 0.80 to 1.99 per cent., or from 19.0 to 65.2 per cent. of the total nitrogen. In two brands it makes up from 20 to 30 per cent. of the total, in three about 38 per cent., in seven from 45 to 65 per cent., and in one, Murray's extract, less than 20 per cent.

Creatinin and Creatin Nitrogen. Creatinin nitrogen varies from 0.00 to 0.49 per cent.; creatin nitrogen from 0.00 to 0.58 per cent.; the combined nitrogen in these two forms from 0.00 to 0.91 per cent. The standard requires that not less than 10 per cent. of the nitrogen shall exist in these forms. Here they vary from 0.00 to 23.7 per cent. Morris' Fluid Beef is entirely deficient in these forms of nitrogen and Maggi's Bouillon, Bovox, Mosquera Fluid Beef and Murray's are below the standard. On the other hand, Cibils, Rex, Bovril, the Armour and Sinuox preparations are rich in these forms.

Purin Nitrogen. This varies from 0.06 to 0.36 per cent., or from 1.9 to 9.7 per cent. of the total nitrogen. Morris' Fluid Beef, from the absence of creatinin and creatin, suggests a yeast extract. The low percentage of purin nitrogen, however, seems to exclude it from that class of extracts.

Undetermined Basic Nitrogen. In the majority of the fluid extracts, the amount of undetermined basic nitrogen is lower than in the paste extracts. In Maggi's Bouillon, however, this amounts to 1.76 per cent., or 61.1 per cent. of the total nitrogen. In Morris' extract practically all of the meat base nitrogen comes under this classification.

Preservatives.

All of the extracts were tested for saltpeter, alcohol, salicylic and benzoic acids. No nitrates or benzoic acid were found and not more than traces of alcohol. Asparox, Armour's Fluid Beef, Vigoral and Mosquera Fluid Beef Jelly contained salicylic acid; this was indicated on the labels only in the case of the last-named extract. The manufacturer of the others named states that the use in them of salicylic acid has been discontinued.

Claims of the Manufacturers.

Each brand will now be considered in connection, not only with its relation to the standards, but also with the claims made by the manufacturers, either on the label or the literature accompanying the sample.

19578. *Asparox.* "Is selected Oyster Bay Asparagus and Armour's Extract of Beef." "Asparox contains in a concentrated form all the well-known beneficial properties of Choice Asparagus and Beef. It is an excellent diuretic and tonic that may be taken as desired." It is not a concentrated preparation, as *it contains more water and less nitrogen than any of the fluid extracts examined, and contains 8.17 per cent. added salt.* It also *contains salicylic acid,* and as labeled at present, *cannot be legally sold in this State.*

19597. *Armour's Fluid Beef Extract.* "All that is nourishing, sustaining and palatable in Fresh Beef of prime quality . . . . superior to anything of the kind previously offered to the public." "Is especially suited for making Beef Tea for invalids on account of the slight amount of salt contained in it and from the fact that it is made only from the best material and retains the actual flavor of the Beef." This extract *does not contain all* that is nourishing in fresh beef, nor is it "superior to anything of the kind previously offered." It is, however, a high-grade fluid extract, with a maximum of meat bases. The amount of added salt, 6.95 per cent., is small compared with other extracts. However, it *contains salicylic acid,* and as labeled at present, *cannot be legally sold in this State.*

18610. *Vigoral.* "Concentrated Beef. For strength, nourishment and refreshment." "A combination of all the strengthening and stimulating properties of prime lean beef, deliciously seasoned." "It is Not a Medicine, but a food, which, indeed, shall be both 'meat and drink,' and which shall repair waste tissue and build up the body." The claim as regards nourishment is exaggerated, but it contains more of the nourishing forms of nitrogen than the same firm's fluid extract, with about the same amount of total nitrogen. It contains but little added salt, but *contains salicylic acid,* and as labeled at present, *cannot be legally sold in this State.*

18629. *Bovox.* "An essence of beef, stimulating, palatable, nutritious." "Contains a large proportion of nutriment, as well as all of the stimulating salts and in a concentrated form." The extract *is deficient in the natural salts of beef and contains 11.17 per cent. of added table salt.* It is relatively rich in proteoses and peptones, but is *below standard in creatinin and creatin.*

20145. *Bovril.* "The most perfect form of concentrated food known. It is unequalled for its strengthening, stimulating and nourishing qualities." "Is prepared from the finest beef and is guaranteed absolutely pure." "This preparation contains a perceptible powder, 1 oz. of which yields more muscular nourishment than 50 of Meat Extract or clear Beef Tea." The first and last of these claims are exaggerated. The extract does contain an unusually high percentage of insoluble nitrogen, meat fibrin, more than in any other paste or fluid extract examined by us, and this of course has a high value as nutriment. While one ounce of this powder would yield more nourishment than fifty ounces of many of the meat extracts examined, it must be remembered that less than one-fifth of Bovril consists of this nourishing powder. Bovril is a high-grade fluid extract, containing much of the nourishment of beef, with a high content of the creatinin and creatin, and with but little added salt.

19588. *Cibils Fluid Beef Extract.* "Three great advantages over the solid or pasty extracts are claimed for this new product: the avoidance of overcooking . . . . the close analogy, if not exact identity, in taste, color and flavor of the soup made from this extract with that obtained from best butchers' chopped beef, boiled down very strong . . . . utmost digestibility." "In the less violent process which produces this fluid extract, the albumen and other associated elements are not destroyed and are only gently coagulated, while the gelatin is dissolved out and removed. Our extract is specially rich in Kreatine. Its constituents group themselves into: Fibrine and Kreatine dissolved in a watery solution of the salts found in the flesh and blood, 60.96 parts, slightly coagulated albumen, emulsified with a small proportion of fat, 36.30 parts, microscopic fibres of muscle, undestroyed, 2.74 parts." This guarantee is very misleading. If the figures refer to the relative proportion of the different forms in one hundred parts of the total nitrogen, they are in the main true; but only 2.79 per cent. of the extract is nitrogen. A correct guarantee would, therefore, change the above figures to 1.70, 1.01 and 0.08 parts, respectively. The extract *contains an excess of water* and *10.41 per cent. of added salt.* It contains an amount of creatinin and creatin in excess of that required by the standard, but is not "specially rich" in creatin, four of the brands showing a larger amount. It also contains a relatively small quantity of the natural salts of meat as indicated by the low acidity and the low percentages of phosphoric acid and potash.

19611. *Cudahy's Rex Fluid Beef Extract.* "Contains the same food and medicinal properties as Rex Solid Beef Extract." This statement appears to be true, the fluid extract simply being less concentrated. It contains but little added salt and conforms to the standard in all particulars.

19541. *Maggi's Bouillon.* "For flavouring and improving Soups, Stocks, Entrées, etc." "Is a highly concentrated preparation, which must be used sparingly and in such proportions, that its characteristic flavour is not allowed to predominate." *It contains 15.84 per cent. of added salt, and is low in the stimulating salts of meat.* It is concentrated only in the sense that the proportion of nitrogen in basic forms is exceptionally high, 65.2 per cent. *It is deficient, however, in creatinin and creatin,* only 2.2 per cent. of its nitrogen existing in these forms. A careful reading of the literature accompanying this sample fails to disclose any direct claim that meat has been used in its preparation, other than its brand name. The leading lexicographers agree in defining "bouillon" as a liquid food, made by the slow boiling of meat, usually beef or mutton, in water. Maggi's preparation *contains practically none of the characteristic nitrogenous extractives of meat.*

19494. *Morris' Fluid Extract of Beef.* "Is made from the best parts of the beef, of which it is the *pure essence.*" "Is entirely free from fat, albumen and gelatin." It contains 6.94 per cent. of added salt, not a great excess, *and contains no creatinin or creatin,* the characteristic bases of true meat extract.

19516. *Mosquera Fluid Beef Jelly.* "A concentrated, palatable Bouillon representing the nourishing principles of predigested Prime Lean Beef." "Must not be confounded with other concentrated Bouillons and Fluid Extracts of beef, which contain but little beef and are made to appear stronger by an excess of salt and condiments. This product is free from such additions. . . . . To aid in its preservation we have added a minute proportion of pure salicylic acid." *It contains an excess of water* and 6.12 per cent. of added salt, which is a small amount, however, compared with that found in many other extracts. It is low in acidity and *deficient in the stimulating salts of meat.* The amounts of creatinin and creatin are *below standard.* The presence of salicylic acid is not indicated on the main label, and the *sale* of this product, as labeled at present, *is illegal in this State.*

19590. *Murray's Beef Extract.* No claims made; bought in bulk from a druggist. *It contains 9.91 per cent. of added salt and is deficient in the stimulating salts of meat.* It is *below standard in meat bases, and in creatinin and creatin.*

19495. *Sinuox.* **20136.** *Sinuox for Invalids' Use.* "A deliciously seasoned fluid beef." "Made by a new process that does away with the use of preservatives of a harmful nature. It has all the advantages of a paste Extract of Beef without its offensive

odor and taste. It gives better results and is more economical and convenient to use, is made only from the edible portions of fresh meats." Aside from the additional sticker on the second sample, "For Invalids' Use," the claims for the two preparations on the label are identical. They differ but little in composition, the regular Sinuox containing more water and less added salt and meat bases than the other. Both conform to the standards in all particulars, except that Sinuox *contains a slight excess of water and 9.16 per cent. of added salt.* Sinuox for Invalids *contains 9.55 per cent. of added salt.* The proportion of meat bases, especially creatinin and creatin, is high in both products.

Summary.

Our findings are summarized below, following the same method as used for paste extracts:

Extracts Properly Branded and Up to Standard.

19611. Rex Fluid Beef Extract.
20145. Bovril (label misleading, but passed).

Extracts Misbranded and Varying from Standard.

19578. Asparox. Salicylic acid not indicated; high in water and chlorin; low in nitrogen.*

19588. Cibils Fluid Extract. Label misleading; high in water.

19516. Mosquera Fluid Beef Jelly. Salicylic acid not properly indicated; high in water; low in natural salts of meat, and creatinin and creatin.

Extracts Misbranded Only.

19597. Armour's Fluid Beef. Salicylic acid not indicated.*
18610. Vigoral. Salicylic acid not indicated.*

Extracts Properly Branded but Varying from Standard.

18629. Bovox. High in chlorin; low in natural salts of meat, and creatinin and creatin.

19541. Maggi's Bouillon. High in chlorin; low in natural salts of meat, and creatinin and creatin.

19494. Morris' Fluid Extract. Contains no creatinin or creatin.

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* See page 647.

Table XX.—Meat Juices and Proprietary Preparations.

Station No.	Brand.	Water.	Alcohol by weight.	Organic Matter.	Ash.	Petroleum Ether Extract (Fat).	Chlorin.	Phosphoric acid.	Potash.	Acidity = cc. $\frac{N}{10}$ KOH to neutralize 100 gms. of substance. Phenolphthalein.	Acidity: Litmus.	Forms of Nitrogen. Total.	Insoluble.	Coagulable.	Ammonia.	Ppt. by Tannin-Salt.	Meat Bases (by difference).	Ppt. by Zinc Sulphate.	Meat Bases. Creatinin.	Creatin.	Purins.	Undetermined.
Meat Juices.																						
18659	Bovinine	68.21	6.33	30.18	1.61	0.09	0.74	trace	0.18	38	34	2.57	0.06	0.14	0.04	2.26	0.07	2.39	0.00	0.00	0.03	0.04
19439	Mason's Essence of Beef	88.18	0.00	10.46	1.36	0.09	0.14	0.42	0.62	98	35	1.30	0.00	0.05	0.06	0.85	0.34	0.77	0.08	0.05	0.05	0.16
18658	Valentine's Meat Juice	55.72	0.00	32.75	11.53	0.10	0.90	2.67	5.18	692	434	3.13	0.05	0.00	0.26	0.90	1.92	0.12	0.22	0.13	0.37	1.20
18700	Wyeth's Beef Juice	53.81	0.00	29.02	17.17	0.02	4.75	3.06	4.48	660	472	3.25	0.12	0.41	0.19	0.85	1.68	0.20	0.18	0.11	0.16	1.23
Water-Alcohol-Free Basis.				*																		
18659	Bovinine	----	----	93.68	6.32	0.37	2.91	trace	0.71	----	----	10.09	0.24	0.55	0.14	8.88	0.28	9.39	0.00	0.00	0.12	0.16
19439	Mason's Essence of Beef	----	----	88.49	11.51	0.76	1.18	3.55	5.25	----	----	11.00	0.00	0.42	0.51	7.19	2.88	6.51	0.68	0.42	0.42	1.36
18658	Valentine's Meat Juice	----	----	73.96	26.04	0.23	2.03	6.03	11.70	----	----	7.07	0.11	0.00	0.59	2.03	4.34	0.27	0.50	0.29	0.84	2.71
18700	Wyeth's Beef Juice	----	----	62.83	37.18	0.04	10.28	6.62	9.70	----	----	7.04	0.26	0.89	0.41	1.84	3.64	0.43	0.39	0.24	0.35	2.66
Fluid Proprietary Meat Preparations.																						
18664	Liquid Peptonoids	68.43	13.05	30.66	0.91	0.06	0.22	0.12	0.18	76	30	0.83	0.00	0.00	0.05	0.58	0.20	0.27	0.02	0.03	0.00	0.15
18701	Pepto-Mangan "Gude"	81.17	13.25	17.98	†0.85	0.02	trace	trace	0.02	26	17	0.16	0.00	0.02	0.12	0.07	trace	0.04	0.00	trace	0.00	0.00
19509	Colden's Liquid Beef No. 2	68.85	16.53	30.98	0.17	0.04	0.04	trace	0.09	20	11	0.05	0.00	0.00	0.00	----	----	----	----	----	----	----
18702	Panopepton	61.82	14.19	37.04	1.14	0.00	0.32	0.18	0.33	202	108	1.12	0.00	0.00	0.04	0.72	0.36	0.29	0.03	0.06	0.03	0.24
19583	Mulford's Predigested Beef	74.30	12.52	25.32	0.38	0.00	0.26	0.02	0.10	144	80	0.50	0.00	0.00	0.00	‡0.31	0.19	0.13	0.02	0.02	0.03	0.12
19448 (19548)	Murdock's Liquid Food	73.53	8.60	25.75	0.72	0.30	0.19	0.04	0.14	110	28	1.98	0.39	0.00	0.13	§1.18	0.28	1.28	0.00	0.00	0.00	0.28
Water-Alcohol-Free Basis.				*																		
18664	Liquid Peptonoids	----	----	95.09	4.91	0.32	1.19	0.65	0.97	----	----	4.48	0.00	0.00	0.27	3.13	1.08	1.46	0.11	0.16	0.00	0.81
18701	Pepto-Mangan "Gude"	----	----	84.76	15.24	0.36	trace	trace	0.36	----	----	2.87	0.00	0.36	2.15	1.25	trace	0.72	0.00	trace	0.00	0.00
19509	Colden's Liquid Beef No. 2	----	----	98.84	1.16	0.27	0.27	trace	0.62	----	----	0.34	0.00	0.00	0.00	----	----	----	----	----	----	----
18702	Panopepton	----	----	95.24	4.76	0.00	1.33	0.75	1.38	----	----	4.67	0.00	0.00	0.17	3.00	1.50	1.21	0.13	0.25	0.13	0.99
19583	Mulford's Predigested Beef	----	----	97.12	2.88	0.00	1.97	0.15	0.76	----	----	3.79	0.00	0.00	0.00	2.35	1.44	0.99	0.15	0.15	0.23	0.91
19448	Murdock's Liquid Food	----	----	95.97	4.03	1.68	1.06	0.22	0.78	----	----	11.08	2.18	0.00	0.73	6.60	1.57	7.16	0.00	0.00	0.00	1.57

* Not including alcohol. † Contains 0.41 per cent. Fe_2O_3 and 0.16 per cent. MnO.

‡ Gave biuret reaction for peptones. § Contains 0.38 per cent. syntonin nitrogen.

19590. Murray's Beef Extract. High in chlorin; low in natural salts of meat, total meat bases, and creatinin and creatin.

19495. Sinuox. High in water and chlorin.

20136. Sinuox for Invalids. High in chlorin.

B. Meat Juices.

Four samples of this class were analyzed, Bovinine, Mason's Essence of Beef, Valentine's Meat Juice and Wyeth's Beef Juice. Descriptions of these samples will be found on pages 654, 655.

The official standard for meat juice requires that it shall be "the fluid portion of muscle fibre, obtained by pressure or otherwise, and may be concentrated by evaporation at a temperature below the coagulating-point of the soluble proteids. The solids contain not more than 15 per cent. of ash, not more than 2.5 per cent. of sodium chlorid (calculated from the total chlorin present), not more than 4 nor less than 2 per cent. of phosphoric acid and not less than 12 per cent. of nitrogen. The nitrogenous bodies contain not less than 35 per cent. of coagulable proteids and not more than 40 per cent. of meat bases."

Table XX gives the analytical data secured in the original matter, and also calculated to the water-alcohol-free basis.

These samples offer little opportunity for direct comparison; they will be considered individually, in connection with the claims made for them by the manufacturers.

18659. *Bovinine.* "The Original Beef Juice." "The vital Principles of Beef Concentrated. Alcohol 8 per cent." "The Original Raw Food Preparation." "The vital extracts of the blood of beeves in a raw or uncoagulated condition." The material contains 68.21 per cent. of water and 2.57 per cent. of nitrogen, equivalent to 16.06 per cent. of protein. The non-alcoholic organic matter amounts to 23.85 per cent., showing that about one-third of it is non-proteid. Chittenden asserts* that it is prepared largely from blood. Our analysis confirms this and shows that *it is not true meat juice,* by which is meant the fluid portion of muscle fiber. It is very low in ash constituents, containing only a trace of phosphoric acid. Aside from a small quantity of insoluble and coagulable nitrogen, practically all of its nitrogen is in the form of proteoses, a nutritious and easily assimilable form. *It is practically free of meat bases and contains no creatinin or creatin,* for which, in fact, it makes no claim, save through its somewhat misleading label. It contains 6.33 per cent. of alcohol by weight, equivalent to 8.13 per cent. by volume, doubtless added for preservative purposes, as it contains but little sodium chlorid. Nor does it contain any nitrates or salicylic or benzoic acids.

It is a rather common assumption, that blood must be a food of high value, but such is not the case. "The misconception proceeds from a neglect of the fact that blood is not *in itself* the food of the tissues, but is merely the vehicle by means of which nourishment is carried from the intestines to the places where it is wanted in the body."† The assertion that Bovinine is a concentrated food, therefore, seems untenable.

19439. *Mason's Essence of Beef.* "Is guaranteed to consist solely of the juice of the finest fresh Beef, without the addition of gelatin or any other added matter whatsoever." "A condensed, nourishing, easily assimilated food." *This is in no sense a concentrated food,* containing as it does 88.18 per cent. of water and only 1.30 per cent. of nitrogen. About 60 per cent. of its nitrogen,

* Medical News, 1891, *58,* 716.

† Hutchinson: Food and the Principles of Dietetics. New York, 1906, 72.

however, is in the form of proteoses, or forms precipitated by tannin-salt. The meat bases make up but 26 per cent. of the total nitrogen. It contains no alcohol, nitrates, or salicylic or benzoic acids.

18658. *Valentine's Meat Juice.* "The two-ounce oval bottle . . . . contains the condensed essence of one and one-half pints of liquid juice, which is obtained from the flesh of beef." *It is nearly five per cent. below the standard in nitrogen. It contains no coagulable nitrogen* and a minimum of proteoses. Tannin-salt precipitates 29 per cent. of its nitrogen, and a rather high percentage of ammonia is found. Over 60 per cent. of its nitrogen is in the form of meat bases, 18 per cent. of which is creatinin and creatin. It contains no added salt, and no alcohol, nitrates, or salicylic or benzoic acid.

18700. *Wyeth's Beef Juice.* "A liquid preparation of the choicest beef, containing the nutritive albuminous principles in an unaltered and soluble form." "Each bottle represents all the nutriment contained in three pounds of selected beef." "While we frankly state our recognition that it does not replace meat, owing to the lack of fiber, it will, if administered diluted in water, stimulate with a very marked allied nutrient advantage, more quickly than the same amount of roast beef." It is a meat juice of moderate concentration, to which about 5 per cent. of salt has been added. *It is nearly five per cent. below the standard in nitrogen.* About one-eighth of its nitrogen is coagulable and only a small part is found as proteoses; about one-quarter of the nitrogen is precipitated by tannin-salt, and over one-half exists as meat bases, 17 per cent. of which is creatinin and creatin. It contains no alcohol, nitrates, or salicylic or benzoic acids.

III. Fluid Proprietary Meat Preparations.

We have also analyzed six products in whose preparation more or less meat has been used, but which cannot be classed either with meat extracts or meat juices.

Table XX gives the analytical data secured in the original matter, and also calculated to the water-alcohol-free basis.

18664. *Liquid Peptonoids.* "Beef, milk and wheat (predigested). Alcohol (by volume), 17.95, proteids (peptones and propeptones), 5.25, lactose and dextrose, 11.3, cane sugar, 2.5, mineral constituents (ash), 0.95, total solids, 20 per cent. A sustaining, stimulating, auxiliary food, rich in all the nutritive principles of beef, milk and wheat (except the fat), predigested by pepsin and pancreatin, ready for immediate absorption and assimilation." It contains 19.52 per cent. of total solids, 5.19 of proteins, 0.91 of ash and 16.85 of alcohol by volume, all of which agree very closely with the guaranteed analysis. The individual carbohydrates were not determined, but combined to make up 12.36 per cent. It contains no true peptones, as indicated by the biuret test, but 70 per cent. of its nitrogen is precipitated by tannin-salt, and of this 47 per cent. is also precipitated by zinc sulphate (proteoses). Meat bases are present in but small amounts. It contains no nitrates or salicylic or benzoic acids.

18701. *Pepto-Mangan "Gude."* "A neutral organic combination." "An ideal pharmaceutical combination for chlorosis, anæmia, etc." "No simple solution of manganese and iron peptonate, but a highly scientific combination, a medicinal compound of a mildly aromatic, non-astringent taste, pleasing to the eye in its wine-like appearance." "Dose: Adults. A tablespoonful three to four times daily, either alone or in a sweet wine (red wines having tannic acid are precluded), or in milk." The preparation contains 81.17 per cent. of water, 13.25 of alcohol by weight, and 5.58 per cent. of solid matter, of which 0.85 per cent. is ash. The percentage of total nitrogen is but 0.16 per cent., and three-fourths of this is liberated as ammonia by boiling with magnesia. The ash consists of 0.41 per cent. iron oxid, 0.16 per cent. manganese oxid and traces of chlorin, phosphoric acid and potash. The material shows only a very slight acid reaction to either litmus or phenolphthalein. Being offered simply as a medicine, Pepto-Mangan cannot be discussed in the same manner as if food value was claimed for it. It does contain manganese and iron and probably in the form of peptonates.

The National Formulary recognizes Liquor Ferri Peptonati cum Mangano—Solution of Peptonate of Iron with Manganese. This is made by dissolving 45 gms. of ferric peptonate in 250 cc. of distilled water, adding 13 cc. of ammonia water and then 50 cc. of alcohol; 8 gms. of soluble manganese citrate, or 26 gms. of manganese peptonate, are then dissolved in 100 cc. of distilled water and added to the first solution; 50 cc. of aromatic elixir are then added, with enough distilled water to make 1000 cc. of the

solution. As far as the essential ingredients are concerned, Pepto-Mangan shows a close resemblance to the Formulary preparation. Pepto-Mangan "Gude," however, is a proprietary preparation, not recognized either in the U. S. Pharmacopœia or National Formulary. The quantity of alcohol present must, therefore, be stated on the label, in order to make its sale legal in this State under the new law.

19509. *Colden's Liebig's Liquid Extract of Beef and Tonic Invigorator, No. 2, Without Iron.* "Its tonic and nutritive qualities are sufficient to sustain the body without the addition of solid food." "Consisting of the Extract of Beef (prepared by Baron Liebig's process), the very best Brandy, Cinchona and Gentian." The label on the bottle contains the following very remarkable analysis, attributed to Arthur Hill Hassall, M.D., President of the Royal Analytical Association, London:

"20 per cent. saccharine matter.
25 per cent. glutinous or nutritious matter obtained in the condensation of the beef.
25 per cent. spirit rendered non-injurious to the most delicate stomach by the extraction of the fusel-oil.
30 per cent. of aqueous solution of several herbs and roots, among which are most discernible Peruvian and Calisaya Barks."

This analysis contains little definite and useful information and what it does supply is generally false and misleading. It is obviously misbranding to label such a preparation "Liquid Beef" or to attach to it in any way the name "Liebig's Extract," for it contains but 0.05 per cent. of nitrogen. It contains but 0.17 per cent. ash and 14.62 per cent. of solid matter. On the other hand, it shows 68.85 per cent. of water and 16.53 per cent. of alcohol by weight. Whatever nutriment it contains is due to the saccharine matter and alcohol; it is practically devoid of any nitrogenous nutriment. The vegetable medicinal ingredients, which it may contain, are certainly secured at a high price in such a preparation. The quantity of alcohol was not stated on the label, which is now necessary to make its sale legal in this State under the new law.

18702. *Panopepton.* "The Nutritive Constituents of Beef and Wheat in a soluble and freely absorbable form. A nourishing, restorative, stimulant liquid food of incomparable value for the nutrition of the sick." It is shown to be a meat and carbohydrate preparation of moderate concentration. It contains 1.12 per cent. nitrogen, equivalent to 7.00 protein ($N \times 6.25$), 64 per cent. of which is precipitated by tannin-salt and 32 per cent. of which exists as meat bases. It contains 61.82 per cent. of water and 14.19 per cent. of alcohol by weight. The quantity of alcohol present is not stated on the label, which is now necessary to make its sale legal in this State under the new law. A sample of this preparation received later bore the proper alcohol guaranty on the label.

19583. *Pre-Digested Beef (Liquor Carni Peptonatus, Mulford).* "Alcohol, 16 per cent. in the form of wine, is added to insure its permanency. An easily assimilated and predigested food. Each fluid ounce contains all of the nutritive substances found in 100 grains of selected lean meat in a predigested and easily assimilable form." It contains 12.52 per cent. alcohol by weight, or 15.90 per cent. by volume, agreeing closely with the amount guaranteed. One fluid ounce (30 cc.) of this preparation weighs 30.236 gms., or 465 grains. According to the manufacturer's claim, quoted above, 21.5 per cent. of this, or 100 grains, exists as the nutritive substances of lean meat. Raw lean beef round contains about 3.40 per cent. of nitrogen; 100 grains would contain, therefore, 3.4 grains of nitrogen. One fluid ounce of this sample contains 2.3 grains of nitrogen, or about two-thirds of the amount claimed. The sample contains 74.3 per cent. of water, 13.18 per cent. of solid matter, and only 0.50 per cent. of nitrogen, 26 per cent. of which exists as proteoses, 36 per cent. as peptones, and 38 per cent. as meat bases. The nitrogen is present in useful and easily assimilable forms, but the quantity furnished is extremely small in this very dilute preparation.

19448. *Murdock's Liquid Food, or Extract of Beef, Mutton and Fruits.* "The only extract known that contains more soluble albumen than beef and mutton." "Superior to beef tea and all tonics, as it is a food, and will strengthen as well as nourish the system." "Contains corpuscles and 12½ per cent. soluble albumen, and free from drugs, minerals, acids and salts." It contains 73.53 per cent. of water and 8.60 per cent. of alcohol by weight, 0.30 per cent. of fat and 0.72 per cent. of ash. It contains 1.98 per cent. of nitrogen, 0.39 per cent. of insoluble nitrogen (fibrin) and 0.28 per cent. of meat bases; 64.6 per cent. of its nitrogen is in the form of proteoses, and 19.2 per cent. as syntonin. This is the only meat

preparation included in this report in which syntonin was found. The soluble nitrogen found agrees closely with that guaranteed, but the only part which can be classed strictly with albumen is that found as syntonin, which, using the factor 6.25, is equivalent to 2.38 per cent. No coagulable nitrogen was found. The claim of "12½ per cent. of soluble albumen" is, therefore, not correct. The alcohol content is not stated on the label, which is now necessary in order to make its sale in this State legal.

IV. Meat Powders and Meat Capsules.

Three samples of meat powders and three of meat capsules were analyzed. A description of these samples is found in Table XXI.

Meat Powders.

Ordinary meat contains about 25 per cent. of solid matter; if all of the water were removed the residue would contain about 87 per cent. of proteids and albuminoids, 8 per cent. of extractives and about 5 per cent. of ash. This more or less complete removal of water is the practice followed in the preparation of meat powders. In some preparations, not only is the greater part of the water removed, but the proteid matter is treated by an appropriate ferment and a predigested or peptonized product results. Unlike meat extracts, meat powders, if properly prepared, are highly nutritious, and are the only means of securing the full nutritive value of meat in small bulk. Certain authorities have maintained that they are difficult of digestion, but later experiments have controverted this position, and they are now quite generally recommended as being readily digested and assimilated.

The three meat powders herewith reported are totally unlike each other and represent three distinct types of this class of preparations.

On opening the sample of Mosquera Beef Meal, the upper part, about one-fifth of the whole, was almost solid with living beetles, which Dr. Britton, the State Entomologist, identified as the common drug store beetle (*Sitodrepa panicea*). The sample was purchased in a metal container and, therefore, the contamination must have occurred at the time of preparation and not during its storage at the druggist's. The remainder of the sample was found to be uncontaminated and was used for analysis. No purchaser

Table XXI.—Meat Powders and Meat Capsules.

Station No.	Brand.	Manufacturer.	Station No.	Dealer.	Price per package.	Net weight of material.
	Meat Powders.				cts.	oz.
19600	Beef Peptonoids	The Arlington Chemical Co., Yonkers, N. Y.	19600	*New Britain:* Clark & Brainard Co.	1.00	6.5
19584	Somatose	Farbenfabriken of Elberfeld Co., New York	19584	*New Haven:* W. A. Spalding	.90	2.1
19480	Mosquera Beef Meal	Mosquera-Julia Food Co., Detroit, Mich.	19480	*New London:* Moon's Pharmacy	.75	*
	Meat Capsules.					
19579	Armour's Beef Extract and Vegetable Tablets	Armour & Co., Chicago, Ill.	19579	*New Haven:* Johnson & Bro.	.25	2.1
19585	Mason's Beef Tea Lozenges	Mason-Heublein Co., Hartford and New York	19585	*New Haven:* W. A. Spalding	.50	1.2
19586	Anker's Bouillon Capsules	Royal Specialty Co., New York	19586	" W. A. Spalding	.30	1.4

Analysis (Original Material).

Station No.	Brand.	Water.	Organic Matter.	Ash.	Petroleum Ether Extract (Fat).	Chlorin.	Phosphoric acid.	Potash.
19600	Beef Peptonoids	5.06	89.69	5.25	3.29	0.71	0.02	1.16
19584	Somatose	11.19	82.72	6.09	0.09	0.02	1.47	0.13
19480	Mosquera Beef Meal	12.58	82.23	5.19	8.56	0.60	1.45	2.24
19579	Armour's Beef Extract and Vegetable Tablets	10.21	60.22	29.57	0.36	13.59	2.24	3.73
19585	Mason's Beef Tea Lozenges	10.82	79.50	9.68	0.06	1.36	2.70	4.03
19586	Anker's Bouillon Capsules	8.61	44.30	47.09	0.07	23.26	6.12	4.90

Station No.	Acidity—cc. $\frac{N}{10}$ KOH to neutralize 100 gms. of material.		Forms of Nitrogen.							Meat Bases.			
	Phenol-phthalein.	Litmus.	Total.	Insoluble.	Coagulable.	Ammonia.	Ppt. by Tannin-Salt.	Meat Bases (by difference).	Ppt. by Zinc Sulphate.	Creatinin.	Creatin.	Purins.	Undetermined.
19600	120	75	4.07	1.42	1.83	0.06	† 0.68	0.08	0.58	0.00	0.00	0.03	0.05
19584	170	150	12.64	0.00	0.05	0.14	†12.19	0.26	10.60	0.00	trace	0.04	0.22
19480	610	230	12.25	6.73	0.00	0.26	† 4.15	1.11	0.63	0.17	0.11	0.04	0.79
19579	550	365	4.43	1.63	0.14	0.13	1.85	0.68	0.52	0.13	0.07	0.40	0.08
19585	823	477	‡13.04	0.80	0.30	0.14	‡ 9.64	2.16	8.24	0.51	0.40	0.50	0.75
19586	340	190	5.54	0.15	0.06	0.24	3.09	2.00	1.12	0.29	0.37	0.27	1.07

Water-Free Basis.

Station No.	Brand.	Water.	Organic Matter.	Ash.	Petroleum Ether Extract (Fat).	Chlorin.	Phosphoric acid.	Potash.
19600	Beef Peptonoids	----	94.47	5.53	3.46	0.75	0.02	1.22
19584	Somatose	----	93.14	6.86	0.10	0.02	1.65	0.15
19480	Mosquera Beef Meal	----	94.07	5.93	9.79	0.69	1.66	2.56
19579	Armour's Beef Extract and Vegetable Tablets	----	67.07	32.93	0.40	15.14	2.50	4.16
19585	Mason's Beef Tea Lozenges	----	89.14	10.86	0.07	1.52	3.03	4.52
19586	Anker's Bouillon Capsules	----	48.48	51.52	0.08	25.46	6.70	5.36

Station No.	Phenol-phthalein.	Litmus.	Total.	Insoluble.	Coagulable.	Ammonia.	Ppt. by Tannin-Salt.	Meat Bases (by difference).	Ppt. by Zinc Sulphate.	Creatinin.	Creatin.	Purins.	Undetermined.
19600	----	----	4.29	1.49	1.93	0.06	0.72	0.09	0.61	0.00	0.00	0.03	0.06
19584	----	----	14.23	0.00	0.06	0.16	13.72	0.28	11.94	0.00	trace	0.05	0.23
19480	----	----	14.01	7.71	0.00	0.30	4.75	1.25	0.72	0.19	0.13	0.05	0.88
19579	----	----	4.94	1.82	0.16	0.14	2.06	0.76	0.58	0.14	0.08	0.45	0.09
19585	----	----	14.62	0.90	0.34	0.16	10.80	2.42	9.24	0.57	0.45	0.56	0.84
19586	----	----	6.06	0.16	0.07	0.26	3.38	2.19	1.23	0.32	0.40	0.29	1.18

* See page 659. † Biuret reaction for peptones in zinc sulphate filtrate.
‡ Contains much gelatin.

would have returned this sample without vigorous protest to the manufacturers, and as they are a thoroughly responsible firm, a new package would have undoubtedly been supplied. The contamination, however, existed, and we are obliged to report our finding.

19600. *Beef Peptonoids.* "Contains the solid constituents of beef and milk with gluten." "Is prepared largely from the nitrogenous or flesh-forming principles of beef, wheat and milk, constituting a food of the highest value, and showing about 95 per cent. of nutritive matter." Practically all of the nitrogen in this material is in the form of protein compounds, the latter amounting to 25.44 per cent. Of this, 35 per cent. exists as insoluble and 45 per cent. as coagulable proteins. Four-fifths of the remaining nitrogen is precipitated by tannin-salt, 85 per cent. of which is proteoses and the balance biuret-reacting peptones. Ammonia and meat bases are present only in very small amounts. The ash analysis indicates a slight addition of sodium chlorid, by no means excessive. The preparation contains a large amount of carbohydrate matter, amounting to 64.25 per cent. It also shows a rather high content of fat, 3.29 per cent. It does not contain nitrates or salicylic or benzoic acids.

We are advised by the manufacturers that this Beef Peptonoids has been superseded for the past two years by a new preparation, *Dry Peptonoids Soluble,* "a preparation which is entirely soluble and contains 40 per cent. nitrogenous compounds ($N \times 6.25$), composed almost entirely of partially digested proteins obtained from Beef, Milk and Wheat and but a very small proportion of meat bases. The balance of Dry Peptonoids is composed of the carbohydrates of Milk and Wheat and their nutritive salts. All starch has been completely changed by malt and pancreatin."

It is only just to the manufacturers to call attention to the fact that the analysis herewith reported does not represent the product at present supplied by them. It was impossible to secure a sample of the new preparation in the open market in time for inclusion in this report.

19584. *Somatose.* "An easily digested food made from meat." "A highly concentrated and stimulating meat preparation, containing all the essential food constituents in a soluble and easily digested form." "It contains the nourishing elements of meat in a readily soluble form, 80 grains of Somatose being equivalent to about 1½ ounces of fresh beef (1-8). The salts present in Somatose correspond to the nutritive salts of fresh meat, among which occurs the phosphate of potassium, so important in the formation of bone and muscle." The claims for this preparation appear to be well founded. It contains 12.64 per cent. of nitrogen, equivalent to 79.00 per cent. of proteins, 84 per cent. of which exists as proteoses and 13 per cent. as biuret-reacting peptones. The remainder of the nitrogen consists of a coagulable nitrogen, ammonia and meat bases, all present in small quantities. It contains no added salt, only a trace of fat, and no nitrates, or salicylic or benzoic acids.

19480. *Mosquera Beef Meal.* "Is the only preparation in the market which truly represents all the constituents of prime lean beef, *viz.:* the albuminoids, the fat, the extractive substances and the mineral salts." "Is the most concentrated, assimilable and palatable product ever introduced." "Represents in actual nutritive value at least six times its weight of good lean beef." This product differs widely from the two discussed above in that it contains a very high percentage of fat and more than half of its nitrogen is insoluble. It is also comparatively rich in meat bases. The claims quoted above, therefore, appear, in the main, to be substantiated. It contains 12.25 per cent. of nitrogen, equivalent to 76.56 proteins, if we apply the usual factor 6.25 and disregard the fact that 1.11 per cent. of nitrogen is present as meat bases; 55 per cent. of the nitrogen exists in insoluble forms, 5 per cent. as proteoses, 29 per cent. as biuret-reacting peptones and 9 per cent. as meat bases. It contains but little added salt, and no nitrates, or salicylic or benzoic acids.

Meat Capsules.

Three samples were examined, varying widely in character and composition.

19579. *Armour's Beef Extract and Vegetable Tablets.* "These tablets contain no gelatine, they are made from Armour's celebrated extract of beef with vegetables." They contain 4.43 per cent. of nitrogen, 85 per cent. of which exists in nutritive forms, the balance being meat bases. They contain a high percentage of chlorin, 13.59, *equivalent to about 21 per cent. of sodium chlorid;* 37 per cent. of the nitrogen is in an insoluble form, and 41 per cent. is precipitated by tannin-salt. About one-third of the tablet consists of carbohydrate matter.

19585. *Mason's Beef Tea Lozenges.* "Are made solely from the finest beef, and are guaranteed to be absolutely pure. They contain all the stimulating and invigorating properties of the meat, and in a form readily assimilated by the digestive organs." These lozenges contain 13.04 per cent. of nitrogen, a large proportion of which exists as *gelatin,* which has very subordinate food value. They contain considerable insoluble and coagulable nitrogen, and a relatively high percentage of meat bases, nearly half of which is made up of creatinin and creatin. They contain but little sodium chlorid.

19586. *Anker's Bouillon Capsules.* "The most dainty and convenient form of perfect Extract of Beef." The analysis of these capsules indicates that they consist of a concentrated meat extract, to which a *large amount of salt, over 30 per cent., has been added.* They are comparatively rich in proteoses and meat bases, and in the stimulating salts of meat.

Bibliography.

A quite complete review has been made of the literature of meat extracts, and a bibliography of the subject is appended. This is intended primarily to cover the analytical part of the subject, and only those references to the physiological action of the extracts are included which contain analytical data, or which aid in the interpretation of the results obtained by the methods specified. Much of the voluminous literature of urinary analysis has a more or less direct bearing on the analysis of meat extracts, and here, too, a selective method had to be followed, in order to keep the bibliography within reasonable limits. The list includes 221 titles.

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BEEF, WINE AND IRON.

(*Vinum Carnis et Ferri.*)

Beef, Wine and Iron is a National Formulary preparation, having the following formula:

"Extract of Beef	33	grms.
Tincture of Citro-Chloride of Iron (N. F.)	32	cc.
Compound Spirit of Orange (U. S. P.)	1	cc.
Water, hot	62.5	cc.
Alcohol	125	cc.
Syrup (U. S. P.)	125	cc.
Sherry Wine, a sufficient quantity to make	1000	cc."

The Formulary states that "the Extract of Beef suitable for this preparation is that which is prepared by Liebig's Method."

There are but few published analyses of Beef, Wine and Iron, and we, therefore, prepared a quantity according to the directions of the Formulary, as a basis for comparison. It was evident that wide variations in composition might arise from the quality of sherry wine and meat extract used. Furthermore, many pharmacists substitute iron and ammonium citrate for the tincture of citro-chloride of iron, because of its greater solubility, and it is clear that this substitution changes the quantity of iron present in the preparation.

Three mixtures were made: in two of these, a high-grade meat extract (nitrogen 8.07 per cent.) was used, nearly corresponding to Liebig's extract. In one of the two tincture of iron was used, in the other an equivalent amount of iron in the form of iron and ammonium citrate. The alcohol was not removed from either by distillation, as directed by the Formulary, and the alcoholic content is, therefore, considerably higher than that of the strictly official preparation. The two mixtures were brought to the proper volume with sherry, and each divided into equal portions; one of these was filtered and sherry added to make up to the original volume, while the other was not filtered. In the third preparation a lower grade meat extract was used, but with the quantity sufficiently increased to supply the same amount of nitrogen as 33 gms. of Liebig's extract; the exact procedure of the Formulary was followed, including the double filtration. A different sherry was likewise used in the third mixture. The analysis of the two unfiltered and the three filtered preparations follows:

TABLE XXII.—TEST PREPARATIONS OF BEEF, WINE AND IRON.

Preparation.	Specific Gravity.	Alcohol by volume.	Extract.	Ash.	Iron (Fe).	Total Nitrogen.	Nitrogen as Ammonia.
		%	%	%	%	%	%
No. 1. High grade extract; tincture of iron; not filtered	1.02165	27.18	14.12	1.113	0.123	0.250	0.007
No. 1*a*. High grade extract; tincture of iron; filtered	1.01562	26.20	12.36	0.723	0.011	0.178	0.007
No. 2. High grade extract; citrate of iron; not filtered	1.02660	23.82	14.09	1.138	0.121	0.295	0.066
No. 2*a*. High grade extract; citrate of iron; filtered	1.02564	24.12	13.94	1.162	0.107	0.278	0.064
No. 3. Low grade extract; tincture of iron; filtered	1.02664	19.50	12.95	1.401	0.024	0.216	0.009
Sherry used in Nos. 1 to 2*a*	0.99602	21.50	5.53	----	----	----	----
Sherry used in No. 3	0.99939	22.75	6.75	----	----	----	----

The quantity of alcohol in the first four preparations is excessive, because the added alcohol was not removed by distillation, as directed by the Formulary; and as already stated, only No. 3 can be considered as a standard, as it was the only preparation made strictly according to directions throughout. The non-official preparations, however, give interesting data as to the influence of the different iron salts, as well as the effect of filtration on the quantity of nitrogen and iron present. Where the tincture of iron is used, filtration removes 35 per cent. of the ash, 91 per cent. of the iron and 29 per cent. of the nitrogen. Where the iron and ammonium citrate is used, filtration removes negligible quantities of these three ingredients. This is a strong argument for the use of the citrate and indicates that a change in the official formula would greatly improve the preparation. The ash content of No. 3 is higher than that of the other preparations, because the meat extract used was high in ash and salt. The same deficiency, however, in iron is observable; 500 cc. of the preparation should contain 0.631 gm. of metallic iron, while it actually contains but 0.123 gm., a loss of 80 per cent. The same quantity of the preparation should contain 1.534 gms. of nitrogen; the first filtration removed 0.168 gm. and the second 0.274 gm. of nitrogen, a total of 0.442 gm. The mixture should, therefore, contain after filtration 1.092 gms. of nitrogen, while the actual determination showed 1.109 gms., a very close agreement. The loss of nitrogen by filtration was, therefore, 29 per cent. of the total amount supplied. As most meat extracts, especially high-grade preparations, contain but small amounts of nitrogen as ammonia, an ammonia determination gives a quite accurate indication of the use of iron ammonium citrate, preliminary tests having shown that this salt yields all of its ammonia on distillation with magnesium oxid. The above table shows that where the citrate is used, the ammonia increases from 0.007 to 0.066 per cent. and makes up 22.4 per cent. of the total nitrogen, instead of 2.8 per cent. where the tincture is used.

While a great part of the Beef, Wine and Iron on the market is made by the large wholesale drug houses, nearly every druggist puts out a brand under his own name, so that practically there are as many nominally different brands as there are druggists. This has doubtless resulted in much duplication in our analyses, which was unavoidable, as we were ignorant of the original source of the preparations. Ninety-two samples were collected from the stocks of druggists and department stores in various parts of the State, and were tested for specific gravity, alcohol, extract, ash, iron, nitrogen and ammonia. The methods of analysis used are given on page 685.

Results of Analysis.

In Table XXIII are given the analyses of these samples, in the order of their nitrogen content, that being deemed the most important ingredient.

Volume and Selling Price.

The volume sold was accurately measured in every case and together with the selling price appears in the table. The containers, with few exceptions, were evidently intended to be pints or half-pints, that is, 16 or 8 fluid ounces.

Study of the table shows that in some cases only little more than eleven ounces were sold at the usual price of sixteen (one pint), and only six ounces for eight. It also shows that a full pint of this preparation is sold at prices ranging from 36 to 85 cents.

The cost of materials of excellent quality for making Beef, Wine and Iron does not exceed $1.35 per gallon. If sold at $4.00 per gallon, the usual price, the profit would seem to be sufficient

TABLE XXIII.—BEEF, WINE AND IRON.

Station No.	Brand.	Dealer.	Volume of Material.	Price of Material.	Specific gravity.	Alcohol by volume.	Alcohol guaranteed on label.	Extract.	Ash.	Iron. (Fe.)	Total Nitrogen.	Nitrogen as Ammonia.
			fl. oz.	cts.								
19589	W. A. Spalding, New Haven	New Haven	15.8	50	1.0440	19.61	....	17.54	1.313	.102	.539	.066
19441	A. F. Wood's Sons Pharmacy, New Haven	New Haven	16.0	50	1.0167	18.19	....	10.04	0.998	.148	.272	.063
18618	Linsley Ave. Pharmacy, Meriden	Meriden	15.5	50	1.0198	17.91	....	10.76	1.693	.142	.269	.012
19544	Lucien Pratte, Waterbury	Waterbury	16.2	50	1.0216	18.68	....	11.44	1.278	.181	.243	.106
18652	E. F. Mattison Co., Providence, R. I. (N. F. 1899)	Hartford: Brown, Thomson & Co.	16.2	45	1.0197	15.19	12.00	10.01	2.157	.122	.223	.014
19498	F. H. Woodworth, Norwich	Norwich	16.0	50	1.0266	21.55	....	13.49	1.152	.171	.211	.073
18697	Hull's Corner Drug Store, New Haven. Henri's	New Haven	15.2	39	1.0490	19.28	....	18.74	0.768	.085	.209	.042
18582	Borg Bros. & Co., Stamford	Stamford	7.7	35	1.0405	18.33	....	16.26	1.053	.355	.204	.106
18613	Victor W. Schmelzer, Meriden	Meriden	13.2	50	1.0237	12.98	....	10.45	0.801	.130	.200	.059
18653	F. E. Graves, Hartford	Hartford	8.2	25	1.0712	18.08	....	24.25	0.926	.140	.199	.062
19499	Smith's Prescription Store, Norwich	Norwich	14.7	60	1.0252	22.81	....	13.47	1.019	.118	.195	.060
18655	Louis B. Pike, Hartford	Hartford	16.5	50	1.0389	17.57	....	15.66	1.231	.183	.194	.045
19542	Apothecaries Hall Co., Waterbury	Waterbury	14.8	50	1.0433	13.87	....	15.81	1.504	.130	.189	.009
18614	Apothecaries Hall Co., Waterbury	Meriden: Kibbe's Pharmacy	14.8	50	1.0430	14.33	....	15.84	1.489	.133	.184	.007
19560	G. Leslie Dexter & Co., Waterbury	Waterbury	15.3	50	1.0424	18.04	....	16.70	0.838	.145	.180	.055
18649	Wm. H. Coleman, Hartford	Hartford	14.7	50	1.0624	14.30	....	20.91	0.994	.127	.179	.054
18517	Prep. for F. B. Brill, Bridgeport	Bridgeport	15.5	49	1.0320	24.55	24.00	15.71	1.062	.271	.178	.081
19491	A. G. Beckley, Danielson	Danielson	15.0	39	1.0256	22.46	....	13.49	1.031	.103	.177	.042
19512	The Wm. S. Merrell Chem. Co., Cincinnati, O.	Willimantic: J. J. Hickey & Co.	15.7	50	1.0408	19.78	....	16.73	0.443	.032	.175	.016
18648	Frank L. Palmer, Hartford	Hartford	14.7	50	1.0529	16.75	....	19.08	1.045	.163	.173	.046
19511	Put up for The Hartman Drug Co., Middletown	Middletown	15.2	45	1.0314	20.85	23.00	14.56	1.879	.150	.172	.011
18483	C. E. Pickard & Co., Bridgeport	Bridgeport	15.3	50	1.0122	22.18	....	9.91	1.850	.123	.172	.013
18640	Hillard & Crowell, New Britain	New Britain	15.7	50	1.0532	17.21	....	19.31	1.430	.155	.171	.023
19536	The Bristol Drug Store, Ansonia	Ansonia	7.5	40	1.0279	19.30	....	13.23	0.751	.149	.165	.054

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TABLE XXIII.—BEEF, WINE AND IRON—*Continued.*

Station No.	Brand.	Dealer.	Volume of Material.	Price of Material.	Specific gravity.	Alcohol by volume.	Alcohol guaranteed on label.	Extract.	Ash.	Iron. (Fe.)	Total Nitrogen.	Nitrogen as Ammonia.
			fl. oz.	cts.								
18642	Joseph H. Lutz, New Britain. Peptonized	New Britain	15.3	50	1.0517	15.91	....	18.56	1.490	.156	.163	.019
18481	John Wyeth & Bro., Philadelphia	Bridgeport: The Cyrus Pharmacy	15.8	75	1.0359	20.22	....	15.55	1.172	.070	.157	.011
18638	T. J. Odell, New Britain	New Britain	14.8	50	1.0334	23.75	....	15.84	0.876	.274	.156	.084
18482	Geo. A. Jamison, Bridgeport	Bridgeport	15.0	50	1.0590	21.71	....	21.94	0.773	.083	.153	.043
18616	H. T. Graeber, Meriden	Meriden	15.7	50	1.0361	23.04	....	16.36	0.884	.300	.151	.090
19445	Chas. A. Lamb, New Haven	New Haven	15.7	39	1.0476	20.70	....	18.74	0.992	.175	.151	.061
19464	United Drug Co., Boston, Mass. Rexall Predigested	New London: Starr Bros.	15.8	45	1.0328	21.92	24.00	15.22	1.347	.100	.150	.006
19496	Prep. for Charles C. Treat, Norwich. Clinton's	Norwich	15.7	50	1.0346	23.24	24.00	16.02	0.831	.288	.150	.131
18641	American Druggists' Syndicate, N. Y. Premium Peptonized Wine	New Britain: W. H. Crowell	15.3	50	1.0343	14.55	17.00	13.65	0.357	.027	.148	.054
18639	Bergquist Bros., New Britain	New Britain	15.0	50	1.0288	24.30	....	14.80	0.729	.142	.147	.050
19442	J. J. Alling, New Haven	New Haven	15.5	50	1.0569	10.64	....	18.45	1.561	.109	.146	.005
19515	Bergquist Bros. New Britain	Middletown: Bergquist Bros.	6.3	25	1.0353	20.85	....	15.58	1.007	.124	.141	.045
18654	Cantarow's Pharmacy, Hartford	Hartford	11.7	35	1.0131	15.75	....	8.48	1.469	.090	.139	.008
19467	American Druggists' Syndicate, N. Y. Premium Peptonized Wine	New London: Taylor's Pharmacy	15.7	50	1.0339	14.51	....	13.52	0.390	.025	.135	.052
19626	Prep. for Edward Gannon, Bridgeport	Bridgeport	15.3	50	1.0397	20.03	20.00	16.49	0.791	.088	.135	.035
18651	Prep. for T. J. Blake, Jr., Hartford	Hartford	14.7	50	1.0431	17.42	20.00	16.73	0.756	.088	.134	.032
19489	Prep. for Putnam Pharmacy, Putnam	Putnam	15.0	50	1.0502	18.71	15.00	18.92	0.810	.080	.133	.027
19535	E. S. Schoonmaker, Ansonia	Ansonia	7.7	25	1.0471	14.76	....	17.04	0.651	.113	.130	.037
19510	Prep. for Lincoln's Drug Store, Middletown	Middletown	16.2	50	1.0437	17.85	20.00	16.99	0.749	.087	.129	.036
19466	H. A. Chippendale, New London	New London: Small's Pharmacy	15.0	50	1.0271	18.21	....	12.77	0.369	.063	.120	.029
19500	N. D. Sevin & Son, Norwich	Norwich	13.3	50	1.0308	20.69	....	14.38	0.447	.073	.119	.028

TABLE XXIII.—BEEF, WINE AND IRON—*Continued.*

Station No.	Brand.	Dealer.	Volume of Material.	Price of Material.	Specific gravity.	Alcohol by volume.	Alcohol guaranteed on label.	Extract.	Ash.	Iron. (Fe.)	Total Nitrogen.	Nitrogen as Ammonia.
			fl. oz.	cts.								
19545	North American Remedy Co., Philadelphia. Narco	Waterbury: Buckingham Pharmacy Co.	15.5	50	1.0187	17.34	17.00	10.35	0.581	.151	.117	.065
19465	Nichols & Harris, New London	New London	15.7	50	1.0150	20.80	----	10.27	0.606	.066	.111	.032
19446	The John T. Doyle Co., New Haven	New Haven: F. J. Markle	13.3	30	1.0174	24.86	----	11.99	0.614	.115	.109	.042
18699	Prep. for Le Grand B. Cannon, New Haven	New Haven	12.0	35	1.0206	17.89	17.00	10.97	0.545	.098	.105	.046
18698	C. H. Conway, New Haven	New Haven	15.5	50	1.0231	18.99	----	11.91	0.382	.159	.104	.043
18637	Radom's Pharmacy, New Britain	New Britain	11.7	50	1.0173	19.73	----	10.61	0.524	.090	.103	.032
19447	Henry K. Wampole & Co., Philadelphia	New Haven: Gamble-Desmond Co.	15.3	39	1.0400	18.69	20.00	16.23	0.623	.088	.099	.032
18695	Hance Bros. & White, Philadelphia	New Haven: J. T. Hillhouse	15.3	50	1.0196	17.63	17.00	10.66	0.685	.152	.098	.050
19483	Sayle's Pharmacy, New London	New London	15.5	50	1.0105	22.22	----	9.47	0.992	.241	.097	.079
19490	Prep. for Henry L. Burt, Putnam. Improved	Putnam	14.2	50	1.0326	18.32	20.00	14.20	0.591	.087	.094	.032
19561	E. M. Baldwin & Son, Danbury	Danbury: Baldwin & McDonald	15.3	50	1.0494	18.24	----	18.58	0.484	.204	.089	.066
19508	J. A. Caryl, New Haven	New Haven	12.5	50	1.0067	25.46	----	9.36	0.601	.142	.087	.051
19551	Put up for the Brass City Drug Co., Waterbury	Waterbury	14.8	50	1.0013	18.19	----	6.07	0.930	.080	.083	.005
18579	Parker & Ward, Stamford. Peptonized	Stamford	16.5	50	1.0398	13.64	----	14.82	0.559	.081	.082	.025
19443	The Harris Co., New York. Liebig's	New Haven: The Edw. Malley Co.	11.3	39	1.0252	18.65	19.20	12.38	0.421	.036	.079	.011
19524	Prep. for Chas. de Villers, Willimantic. Wine of Beef and Iron	Willimantic	16.2	50	1.0406	18.90	20.00	16.47	1.207	.120	.073	.004
19562	Kinner & Benjamin, Danbury	Danbury	15.5	50	1.0247	18.41	----	12.19	0.440	.125	.073	.044
18515	Hartigan's Pharmacy, Bridgeport	Bridgeport	16.0	50	1.0441	19.50	----	17.51	1.274	.115	.072	.004
18519	Chester W. Griffin, Bridgeport	Bridgeport	16.0	50	1.0360	17.17	----	14.80	0.430	.057	.064	.018
18559	Stillson-Powell Corp., So. Norwalk	So. Norwalk	15.8	50	1.0150	18.34	----	9.62	0.405	.085	.061	.030
18513	G. C. Hamilton, Bridgeport	Bridgeport	15.3	50	1.0168	18.98	----	10.27	0.406	.085	.059	.032
19523	City Drug Store, Willimantic	Willimantic	15.7	50	1.0141	17.92	----	9.31	0.450	.090	.059	.031

TABLE XXIII.—BEEF, WINE AND IRON—*Concluded.*

Station No.	Brand.	Dealer.	Volume of Material.	Price of Material.	Specific gravity.	Alcohol by volume.	Alcohol guaranteed on label.	Extract.	Ash.	Iron. (Fe.)	Total Nitrogen.	Nitrogen as Ammonia.
			fl. oz.	cts.								
19530	Henry B. Peck, Derby	Derby	15.7	50	1.0205	18.05	----	11.00	0.438	.099	.058	.032
18561	H. Glendening & Co., Norwalk	Norwalk	15.3	50	1.0152	18.32	----	9.70	0.449	.092	.058	.029
18617	W. W. Mosher, Meriden	Meriden	15.5	50	1.0151	18.19	----	9.62	0.434	.086	.058	.030
19440	Irondequoit Wine Co., Rochester, N.Y. Wine of Pomelo, or Grape Fruit with Beef and Iron	New Haven: E. L. Washburn	15.5	60	1.0472	17.17	17.00	17.72	0.419	.113	.058	.028
18506	Plaisted's Drug Store, So. Norwalk	So. Norwalk	15.3	50	1.0099	19.05	----	8.48	0.405	.091	.057	.031
18643	Jas. R. Halloran, New Britain	New Britain	15.3	50	1.0121	20.24	----	9.39	0.422	.096	.057	.030
18656	L. G. Harris, Hartford. Harris' Beef Tonic	Hartford	15.3	50	1.0191	19.39	----	10.97	0.394	.077	.054	.027
19506	James T. Eagny, New Haven	New Haven	15.0	50	1.0159	17.28	----	9.60	0.395	.081	.052	.028
18514	Prep. for H. A. Dupee, Bridgeport	Bridgeport	15.8	50	1.0386	18.56	15.00	15.84	0.476	.046	.051	.005
18696	Quinnipiac Pharmacy, New Haven	New Haven	14.7	50	1.0192	19.31	----	11.09	0.359	.063	.050	.023
19543	The McCarthy Pharmacy, Waterbury	Waterbury	13.0	50	1.0468	15.15	----	17.07	0.344	.110	.047	.031
19550	Waterbury Drug Co., Waterbury	Waterbury	15.7	50	1.0248	19.45	----	12.48	0.339	.078	.045	.025
18650	The Gladding Drug Co., Hartford	Hartford	15.3	50	1.0321	17.02	18.00	13.73	0.757	.081	.044	.005
18578	Goulden's Pharmacy, Stamford	Stamford	15.3	50	1.0394	17.32	18.00	15.74	0.463	.068	.044	.003
18518	Jos. N. McNamara, Bridgeport	Bridgeport	15.5	50	1.0376	16.28	----	14.95	0.944	.122	.043	.005
19513	Sold by Fred Rogers, Willimantic	Willimantic	15.8	50	1.0323	16.21	18.00	13.57	0.680	.071	.043	.004
18591	The Prudential Drug Co., New York	Greenwich: The Greenwich Drug Store	15.3	50	1.0568	16.44	15.00	20.05	0.365	.029	.040	.003
18560	Edward P. Weed, Norwalk	Norwalk	15.3	50	1.0641	16.63	----	21.99	0.358	.100	.039	.002
19497	Wm. H. Nicholson, Norwich	Norwich	15.7	50	1.0372	16.26	15.00	14.85	0.366	.030	.039	.005
19549	W. H. Pickett & Co., Waterbury	Waterbury	15.8	50	1.0372	16.34	15.00	14.87	0.369	.032	.034	.004
18615	Fred F. Ingram & Co., Detroit, Mich.	Meriden: Broderick & Curtin	15.7	50	1.0576	16.28	20.00	20.20	1.158	.100	.033	.003
19457	John P. Crowley, New Haven	New Haven	15.7	50	1.0426	15.71	----	16.13	0.303	.037	.032	.012
18516	Fred. F. Ingram & Co., Detroit, Mich.	Bridgeport: Lee's Pharmacy	15.2	50	1.0603	16.87	----	21.04	0.864	.079	.026	.002
19482	Prep. for Moon's Pharmacy, New London	New London	15.7	50	1.0452	19.63	20.00	17.85	1.065	.106	.024	.004
19559	A. C. Walker, Waterbury	Waterbury	7.5	25	1.0725	8.48	----	21.86	0.495	.060	.018	.002

without giving short pint measure, as is done in the majority of cases, or using inferior materials, as is done in very many. At its best, the preparation has practically no nutritive value and very slight medicinal value in relation to its cost.

Alcohol by volume is very variable, the maximum being 25.46, the minimum 8.48, and the average 18.39 per cent. The content of alcohol depends largely on the completeness of the removal of the alcohol used in preparing the material, and on the quality of the sherry used; the latter may contain from 8 to 22 per cent. of alcohol. Twenty-seven of the samples bear a guaranty as to alcohol on the label, and substantially the amount guaranteed is found in every case.

Extract varies from 6.07 to 24.25, with an average of 14.55 per cent. This consists of the solids of the meat extract, the syrup and the wine. Ten per cent. would seem to be the minimum amount of extract permissible in a well-made preparation; the table shows that twelve of the samples contained less than this amount.

Ash varies from 0.303 to 2.157, with an average of 0.804 per cent. A properly made Beef, Wine and Iron should contain from 1.00 to 1.25 per cent. of ash. Forty-three of the samples contain less than 0.75 per cent., these samples likewise generally containing low percentages of iron and nitrogen. Six samples contain more than 1.50 per cent., indicating that the meat extract used contained much salt.

Iron ranges from 0.025 to 0.355, with an average of 0.114 per cent. The amount of iron present depends of course on whether the tincture or citrate of iron was used. While the use of citrate of iron increases the strength of the preparation, a strict reading of the law would require that this substitution for the tincture should be stated on the label. In forty-six samples this is done, while in seven the tincture and in one phosphate of iron is given as the source of the iron; in the other thirty-eight samples there is no statement as to the iron. The average iron content where the citrate is stated to have been used is 0.119 per cent.; where the tincture was used 0.090 per cent., or 24 per cent. less.

Nitrogen varies from 0.018 to 0.539, with an average of 0.121 per cent. Only nine samples contain over 0.20 per cent., the amount found in our own preparation, made according to formula; forty-two contain from 0.10 to 0.20 per cent., twenty-six

from 0.05 to 0.10 per cent., and fifteen less than 0.05 per cent. As already stated, filtration of the preparation causes a considerable loss of nitrogen, and while one fluidrachm may "represent" 12.2 mgms. of nitrogen, the actual content may be as low as 7.2 mgms. per fluidrachm, even if made strictly according to the formula. Admitting 7.0 mgms. per fluidrachm as the minimum standard, Table XXIV shows that only twenty-three of the samples reach this figure; thirty contain from 4.0 to 6.8 mgms., twenty-five from 2.0 to 3.9 mgms., and fourteen less than 2.0 mgms. per fluidrachm. In other words, fifty-five samples, or 60 per cent., contain less than half the minimum standard. These figures indicate very clearly what an insignificant amount of meat extract these preparations contain. All the samples from No. 19536 down to the end of the table must be considered below N. F. strength as regards nitrogen, especially as in the majority of them their nitrogen is not derived exclusively from meat extract.

Ammonia varies from 0.002 to 0.131, with an average of 0.033 per cent. The samples made with citrate of iron and ammonia averaged 0.042, or 34 per cent. of the total nitrogen, while those made with the tincture of iron averaged 0.008, or 7 per cent. of the total nitrogen. That such a large part of the nitrogen is due to the iron ammonium citrate again emphasizes how little meat extract many of the samples contain.

The Formulary states that "4 cc. (1 fluidrachm) represent 0.13 gm. (2 grains) of extract of beef, and 0.128 cc. (2 minims) of tincture of citro-chloride of iron." Translated into metrical and chemical terms, if a high-grade meat extract is used, as directed, one fluidrachm should contain 12.2 mgms. of nitrogen and 5.8 mgms. of metallic iron. Our own preparations contained in one fluidrachm as follows:

	Nitrogen. mgms.	Iron. mgms.
No. 1 unfiltered	10.2	5.0
No. 1 filtered	7.2	0.4
No. 2 unfiltered	12.1	5.0
No. 2 filtered	11.4	4.4
No. 3 filtered	8.9	1.0

These figures obtained on preparation of known origin show the difficulty of establishing standards, especially for iron. In the light of the above data, the use of the word "represent" in the Formulary is explainable. Extreme care has been taken not to state that one fluidrachm contains, but that it "represents" so much meat extract and iron. This statement of the Formulary certainly opens the way for gross misrepresentation in the sale of Beef, Wine and Iron. Where the tincture of iron is used and filtration is practiced, nearly all the iron is removed and about one-third of the nitrogen. If as much as one milligram of metallic iron is present in a fluidrachm, therefore, it is impossible to assert with certainty that the preparation is not made by the official formula.

In the case of the nitrogen, while our own preparations show that the filtered material may contain only from 7.2 to 8.9 mgms. per fluidrachm, instead of 12.2 mgms., as calculated from the Formulary requirement of two grains of meat extract, the question of a minimum standard is not so difficult, for by no possible manipulation of the formula, provided meat extract of good quality is used, could much less than 7 mgms. of nitrogen be furnished per fluidrachm, even if iron and ammonium citrate is not used. It appears that by the method described in the Formulary, certain amounts of iron and of beef extract are put into the mixture and then by further manipulation nearly all of the iron and a third of the nitrogen are taken out and rejected. If one fluidrachm "represents" two grains of extract of beef and two minims of tincture of iron, it represents them only on paper and not to the patient.

Table XXIV has been calculated to show the actual amounts of nitrogen and iron contained in one fluidrachm of each of the preparations.

Claims of the Manufacturers.

It is somewhat difficult to understand why a preparation of such doubtful efficacy should have been admitted into the National Formulary. For all practical purposes it is generally a poor grade sherry wine to which have been added small quantities of meat extract and either tincture or citrate of iron. Meat extract is recognized as possessing but very slight nutritive value, and the amount used in the manufacture of most of the mixtures analyzed would not have much value even as a tonic or stimulant. In certain cases the iron in these preparations doubtless might be of value as a tonic during convalescence, or in certain blood dis-

Table XXIV.—Relation to N. F. Strength.

Station No.	One fluidrachm contains		Station No.	One fluidrachm contains		Station No.	One fluidrachm contains	
	N	Fe		N	Fe		N	Fe
	mgm.	mgm.		mgm.	mgm.		mgm.	mgm.
Nat. Form	**12.2**	**5.8**	19464	6.2	4.1	19562	3.0	5.1
19589	22.5	4.3	19496	6.2	11.9	18515	3.0	4.8
19441	11.1	6.0	18641	6.1	1.1	18519	2.7	2.4
18618	11.0	5.8	18639	6.0	5.8	18559	2.5	3.5
19544	9.9	7.4	19442	6.2	4.6	18513	2.4	3.5
18652	9.1	5.0	19515	5.8	5.1	19523	2.4	3.7
19498	8.7	7.1	18654	5.6	3.6	19530	2.4	4.0
18697	8.8	3.6	19467	5.6	1.0	18561	2.4	3.7
18582	8.5	14.8	19626	5.6	3.7	18617	2.4	3.5
18613	8.2	5.3	18651	5.6	3.7	19440	2.4	4.7
18653	8.5	6.0	19489	5.6	3.4	18506	2.3	3.7
19499	8.0	4.8	19535	5.4	4.7	18643	2.3	3.9
18655	8.1	7.6	19510	5.4	3.6	18656	2.2	3.1
19542	7.9	5.4	19466	4.9	2.6	19506	2.1	3.3
18614	7.7	5.6	19500	4.9	3.0	18514	2.1	1.9
19560	7.5	6.0	19545	4.8	6.2	18696	2.0	2.6
18649	7.6	5.4	19465	4.5	2.7	19543	2.0	4.6
18517	7.3	11.2	19446	4.4	4.7	19550	1.8	3.2
19491	7.3	4.2	18699	4.3	4.0	18650	1.8	3.3
19512	7.3	1.3	18698	4.3	6.5	18578	1.8	2.8
18648	7.3	6.9	18637	4.2	3.7	18518	1.8	5.1
19511	7.1	6.2	19447	4.1	3.7	19513	1.8	2.9
18483	7.0	5.0	18695	4.0	6.2	18591	1.7	1.2
18640	7.2	6.5	19483	3.9	9.7	18560	1.7	4.3
19536	6.8	6.1	19490	3.9	3.6	19497	1.6	1.2
18642	6.9	6.5	19561	3.7	8.6	19549	1.4	1.3
18481	6.5	2.9	19508	3.5	5.7	18615	1.4	4.2
18638	6.4	11.3	19551	3.3	3.2	19457	1.3	1.5
18482	6.5	3.5	18579	3.4	3.4	18516	1.1	3.4
18616	6.3	12.4	19443	3.2	1.5	19482	1.0	4.4
19445	6.3	7.3	19524	3.0	5.0	19559	0.8	2.6

orders, but it could be obtained much more cheaply and could be used much more accurately and intelligently in other forms and under a physician's directions.

The fact remains, however, that this is a Formulary preparation, and it is only for us to point out its true composition and the accuracy or inaccuracy of the claims made for it. Even the use of the word "Beef" is objectionable in connection with a material of this character, as only in rare cases is beef itself used; extract of beef contains but little of the nutriment of the original beef, and its only virtue lies in the stimulating power of the meat extractives and the natural salts of meat. The many false and misleading statements of the labels of these preparations are summarized below:

The labels of Nos. 18481, 18559, 18561, 18656, 18696, 19482, 19523, 19561, 19562 and 19626 all state that one-half fluid ounce contains the strength of one ounce of beef. The strength of beef is its nitrogen, and one ounce of fresh lean beef contains about 16.3 grains of nitrogen, or 3.4 per cent. These samples are all misbranded, in that they contain only from 0.06 to 0.38 grains of nitrogen in the quantity stated.

Nos. 18516 and 18615 are claimed to contain the strength of one ounce of beef in each ounce. The claim is obviously false and impossible. Likewise the claim of Nos. 18650 and 19513, that each fluid ounce contains one ounce of essence of beef. If this were true, the material would be essence of beef and not beef, wine and iron.

No. 19524 claims that one tablespoonful contains the equivalent of 1½ ounces of lean meat. This is untrue, in that one tablespoonful contains only 0.17 grains of nitrogen, instead of the 25 grains claimed.

Nos. 18518, 18650 and 19513 claim to contain the valuable nutritious qualities of fresh lean beef. As they contain but 0.043, 0.043 and 0.044 per cent. of nitrogen, these nutritious qualities are only present in minimum amounts and the claim is false and misleading.

Misleading information is also given by Nos. 18617, 18513, 19543 and 19497, which claim that "the beef food is chosen with special regard to its high percentage of nitrogenous matters." These samples contain from 0.039 to 0.058 per cent. of nitrogen, and are among the lowest grade samples analyzed.

No. 19489 bears two labels on the bottle. The main label claims that each fluid ounce contains *all the strength of 2 oz.* of prime, fresh, lean beef; the other label claims that each fluid ounce contains *the extractive strength of ½ oz.* of prime, fresh, lean beef. The statements are directly contradictory and the former is grossly false and misleading.

No. 19512 claims that each half fluid ounce contains the virtues of 2 ozs. of fresh beef; this is obviously false.

Nos. 19530, 19551, 19535, 18698 and 19443 either claim to be made directly from "the world-renowned Liebig's extract of beef," or carry the word "Liebig" in their brand name. The natural inference is that the use of this standard extract has given them special value and strength. They contain only from 0.058 to 0.130 per cent. of nitrogen, or from one-fifth to one-half the N. F. strength.

To summarize, sixty-nine samples are below N. F. strength in nitrogen, twenty-nine are misbranded, and all but one of the misbranded samples are likewise low in nitrogen. Only twenty-two samples satisfy the calculated N. F. requirement of 7.0 mgms. of nitrogen per fluidrachm.

Speaking of medicated wines in general, Hutchinson states in "Food and the Principles of Dietetics," 1906, p. 383: "The use of these wines can on no grounds be recommended. In the first place, they are not worth the price charged for them, for it is far cheaper, and also better for the invalid to get beef or malt extract separately and take along with them, if need be, a definite quantity of sound wine of known antecedents. . . . The use of such liquors by an invalid on his own responsibility, or even by prescription, exposes him to great danger of becoming by degrees the unconscious victim of alcoholism."

Methods of Analysis.

The determinations of specific gravity, alcohol and extract were made according to the official methods described in Bulletin 107 of the Bureau of Chemistry of the United States Department of Agriculture.

Ash:—Evaporate 25 cc. in a platinum dish on the water bath to a thick syrup, or nearly to dryness; continue heating over asbestos, breaking bubbles with a stream of air. After driving off volatile matter, burn in a muffle to a brown ash and proceed in the usual manner. In the case of a refractory ash, exhaust with hot water, ignite residue with strong heat, add soluble ash, evaporate to dryness, cool in a desiccator and weigh.

Iron:—Take up the ash of 25 cc. of material with dilute hydrochloric acid (10 cc. concentrated acid diluted to 25 cc. with water) and digest on the steam bath until all the ferric oxid is dissolved. Transfer the solution to a 200 cc. flask and dilute to about 150 cc. Pass hydrogen sulphid through the solution until the odor of the gas persists on shaking, boil to about half the volume, or until the vapors no longer react for hydrogen sulphid. Dilute, cool to room temperature and determine iron by titrating with standard potassium permanganate.

Nitrogen:—Determine nitrogen in 25 cc. of the material by the Kjeldahl method, using a very low heat until the bulk of the water and alcohol is driven off.

Ammonia:—Pipette 25 cc. of material into a Kjeldahl flask, add 150 cc. of water, an excess of magnesium oxid and a little paraffin, and distill off the ammonia in the usual way.

HEADACHE PREPARATIONS.

The use of headache powders, pills and tablets has become very prevalent, because of their convenience, cheapness and effectiveness in relieving, for a time, at least, headache and neuralgia.

Their effectiveness is due chiefly to one or more drugs which are active depressants of heart action and which should be used only under the direction of a competent physician. That the use of these preparations is dangerous is recognized by many of the manufacturers, in the common caution, "Do not take more than two of these powders in a half an hour." In some of the mixtures, not only is the quantity of the drug, guaranteed to be present, equal to the average dose permitted by the U. S. P., but in many of them, due to careless compounding, the drug is present in quantities from 50 to 100 per cent. greater than that guaranteed. The danger to health, and even to life, in indiscriminate and undirected use of these preparations is, therefore, clearly apparent.

The drugs commonly used in these mixtures are acetanilid, acetphenetidin, or their derivatives, caffein, monobromated camphor, sodium bicarbonate and camphor. Sometimes antipyrin, or some opium or morphine preparation, is also used. The new Food and Drug law of this State requires the label on such preparations to state "the quantity or proportion of any alcohol, morphine, opium, cocaine, heroin, alpha or beta eucaine, chloroform, cannabis indica, chloral hydrate, or acetanilid, or any derivatives or preparations of any of the said substances contained therein." Of the drugs enumerated in the law, acetanilid and its derivatives are the only ones commonly used in headache powders and they have received our chief attention in this examination.

In recent years, the disastrous effects arising from the use of certain headache powders have been widely exploited in the public press, and as in most cases acetanilid was the chief active drug present, the public has had brought forcibly before it the danger in its indiscriminate use. As a result, acetanilid has found much disfavor with many consumers of headache powders, and the wary manufacturer, in certain instances, has labeled his powders "Contain no acetanilid," and the uninformed purchaser, confident of the absence of the dreaded drug, uses them, in ignorance of the fact that they contain instead phenacetin, or acetphenetidin, a derivative of acetanilid, and almost as objectionable. The present law will prevent this abuse, as the presence of acetanilid or *any of its derivatives* must be indicated on the label.

Acetanilid is "the monacetyl derivative $[C_6H_5NH(CH_3.CO)]$ of aniline, and may be obtained by the interaction of glacial acetic acid and aniline." It is not a patented preparation and is, therefore, obtainable at a low price.

A common synonym is antifebrin.

The following statements as to its use are quoted from the United States Dispensary, 19th ed., p. 9:

"The effects of acetanilid upon man are very similar to those produced by antipyrin,—namely, after small doses, quietness; after very large doses, malaise, a little headache, singing in the ears, weakness, and a peculiar cyanosis, with some tendency to somnolence, mydriasis, and, if there has been fever, marked fall of temperature usually accompanied by, but not dependent upon, a profuse sweat. After enormous doses complete coma and collapse have been noted. It has in rare instances caused collapse and cardiac failure, and a peculiar measles-like eruption is not very uncommon. Large toxic doses have caused in animals and in man anæsthesia, loss of reflex activity, tremors, irregular failing respiration, convulsions, coma and general paralysis. . . . Death has, in a number of cases, been produced by acetanilid when used for medicinal purposes. Five grains (0.32 gm.) are alleged to have caused fatal heart failure (Ind. Med. Jour., Sept. 1890); but there have been instances of recovery after the dose of an ounce. . . . There is a widespread but perhaps not well-grounded belief in the profession that accidents are more rare after acetanilid than after antipyrin, but the medicinal application of acetanilid seems to be identical with that of antipyrin, save only as it is modified by the insolubility of acetanilid."

The average dose (U. S. P.) is 0.250 gm. (= 4 grains).

Acetphenetidin is a "phenol derivative, the product of the acetylization of para-amidophenetol."

A common synonym is phenacetin.

"Acetphenetidin would seem to be one of the safest, as it certainly is one of the most efficient, drugs of its class. It is asserted that its antipyretic action is more gradual, more prolonged, and less apt to be attended with disagreeable symptoms than that of antipyrin and other allied drugs" (U. S. D., 19th ed., p. 11).

The average dose (U. S. P.) is 0.500 gm. (= 7.5 grains).

Of the other active drugs used in headache powders, caffein or caffein citrate, and monobromated camphor are most commonly found. *Caffein and caffein citrate* have very similar properties. They are important as heart stimulants and as diuretics. In stimulating the heart, caffein counteracts to some extent the depressant effect of acetanilid and drugs of its class. There have been a few cases of poisoning by caffein, but the usual effect on the healthy individual is a peculiar wakefulness, an increased mental activity and some increase of the urinary secretion and force of the pulse.

Monobromated camphor is a substitution product of camphor. Its chief use is as a nerve sedative, and its therapeutic action resembles other bromids. It is necessary to use it cautiously, as given too freely it may be followed by epileptiform convulsions.

Samples Examined.

Sixty-nine samples of headache preparations were purchased at various drug stores in the State and examined for acetanilid, acetphenetidin, monobromated camphor, camphor and carbonates. Several of the powders, or pills, of each of the different preparations were weighed, to ascertain the degree of care used in their compounding. Fifty-two preparations contained acetanilid as the active ingredient, 15 acetphenetidin or phenacetin, and 2 both acetanilid and acetphenetidin. Forty-nine contained carbonates, 4 camphor and 13 monobromated camphor, used either alone or in combination with one of the more active drugs.

Methods of Analysis.

Acetanilid was determined by the method suggested by Seidell.* Prepare standard potassium bromate by adding bromin in excess to a cold, almost saturated aqueous solution of 100 gms. of potassium hydroxid. Dilute with water and heat to expel the excess of bromin, filter and dilute to 2,000 cc. To standardize the solution, boil 0.5 gm. of pure acetanilid with 60 cc. of hydrochloric acid (1-4) for five minutes and titrate while hot with the potassium bromate solution. It was found convenient to make 1 cc. of the bromate solution equal to 0.0130 gm., or 0.2 grain of acetanilid.

* Jour. Amer. Chem. Soc., 1907, *29*, 1091.

Weigh accurately a whole powder, pill, or the contents of a wafer, transfer to a 150 cc. flask, add 60 cc. of hydrochloric acid (1-4) and boil briskly for five minutes. Titrate while hot with the bromate solution to the permanent appearance of the yellow color, and from the number of cubic centimeters of the standard solution used calculate the quantity of acetanilid.

In case the saponification of the acetanilid causes a darkening of the solution, which would hinder the subsequent titration, clear with a small quantity of animal charcoal, filter, wash and titrate as before.

If acetphenetidin is present, it will be evidenced by the purple coloration caused by the addition of a few drops of the bromate solution. Where both acetanilid and acetphenetidin are present, the above method is inapplicable. There is no thoroughly satisfactory method for determining acetphenetidin quantitatively and we have been content in this report with its qualitative determination.

Acetanilid Preparations.

Fifty-two preparations contained acetanilid and two acetphenetidin as well. Forty-three of these samples indicated the presence and quantity of acetanilid on the label, 3 indicated acetanilid but not the quantity and 8 gave no indication whatever on the label that acetanilid was present. The quantity guaranteed was stated, either as so much per powder or pill, or so much per ounce of the preparation; in one sample the guaranty was in per cent. Without question, a guaranty that states the quantity of the drug in each powder, or pill, is the preferable method, as in that way the consumer is informed as to the actual amount of the drug he is introducing into his system by taking the prescribed dose. To state the amount of acetanilid per ounce complies with the letter of the new law, but aside from warning the consumer as to the presence of the drug, is of little use to him.

The quantities of acetanilid guaranteed ranged from 2 to 5 grains per powder, pill or capsule, and from 12 to 240 grains per ounce. At least three powders or pills of each preparation were accurately weighed and the acetanilid determined in them. While the percentage of acetanilid in the individuals of each preparation generally varied within reasonable limits, the actual amount of the drug present was extremely variable, due to the lack of uniformity in the weights of the powders or pills. The pills as a rule were more constant in weight than the powders. In certain samples, this variation in weight amounted to an actual danger; for instance, in No. 20205, the powder was guaranteed to contain the large quantity of 5 grains of acetanilid per powder. The four powders analyzed contained 4.34, 4.80, 5.84 and 7.11 grains, respectively, due chiefly to the fact that the powders varied in weight from 8.45 to 13.15 grains. The dose of acetanilid is from 5 to 8 grains (U. S. D.), and a powder, not to say two powders, containing as much as 7.11 grains, could be taken by few people with impunity. The following tabulation shows the extent of this variation in acetanilid content in three or more powders of each preparation:

19 varied less than 0.25 grain of acetanilid.
11 " from 0.26 to 0.50 grain of acetanilid.
17 " " 0.51 to 1.00 " " "
4 " " 1.01 to 1.42 grains " "
1 " more than 2.75 " " "

In considering the agreement between guaranty and actual composition, we have disregarded a variation not more than 10 per cent. above or below the guaranty. On this basis, 16 samples satisfied their guaranty, 14 varied widely from their guaranty and 24 were either unguaranteed, or their sale was illegal for reasons which will be stated later.

Of the samples which satisfied their guaranties, only one calls for special comment. No. 19897 is labeled "Aceton," a name occupying a definite place in the U. S. P. While there would be no likelihood of confusion between this particular headache powder and the U. S. P. liquid Acetone, the use of the name for any other than the official preparation is highly objectionable.

The 14 samples varying widely from guaranty were quite as often above as below, one or more of the powders analyzed differing from the guaranty by more than 10 per cent., in some cases amounting to over one grain.

Illegal Acetanilid Preparations.

Twenty-four samples have been classed as illegal in one or more particulars. In these, either the label did not supply the information required by law, or it supplied misinformation, as that it was a "sure-cure" or that its ingredients were "absolutely harmless," etc.

Samples 19920, 20142, 20079, 20109, 20035, 20117, 20068, 19942, 20042 and 20192 were labeled a "cure" or "sure remedy," which constitutes misbranding, in that the statement is false and misleading.

Samples 20111, 20374, 20046, 20092, 20093, 20179 and 20081 did not indicate on the label the presence and quantity of acetanilid. Samples 20108, 20037 and 20036, besides not having the legal guaranties for acetanilid, were illegally labeled a "cure."

Samples 20080 and 19939 were falsely labeled "harmless" and "contain nothing injurious," as they contained 4.14 and 4.21 grains of acetanilid, respectively, per powder.

Sample 20071 was doubly illegally labeled a "cure" and to contain nothing "harmful."

Sample 20205 is illegal, in that the guaranty was written very illegibly and that the powders were dangerously ununiform in weight and content of acetanilid.

Acetphenetidin Preparations.

Fifteen preparations contained acetphenetidin, or phenacetin, as the active drug. As already stated, in these mixtures we have only determined the acetphenetidin qualitatively. In 13 of the samples, the presence and quantity of the drug was stated on the label; in two this information was wanting. The guaranties ranged from 2 to 5.6 grains per powder, and from 22 to 336 grains per ounce. As in the case of the acetanilid preparations, at least three of each of the different powders or tablets were weighed, to determine their uniformity. They weighed from 5.82 to 21.73 grains, and certain brands showed inexcusable variations in weight. The worst offender in this particular was No. 20095, Headache Wafers, sold by Joseph A. Smith, Waterbury. The weights of the contents of four of these wafers were 8.46, 9.98, 11.78 and 13.19 grains, respectively, a most objectionable degree of variation.

Eleven brands were labeled legally. Two brands, Nos. 20095 and 20157, did not contain a statement as to the presence or quantity of the drug, the latter bearing no label whatever. No. 20038 was illegally labeled a "cure." No. 20141 bore a very confusing and indefinite guaranty.

Table XXV.—Headache Powders. Acetanilid Preparations. Guaranty Satisfied.

Station No.	Brand.	Dealer.	Contents of package.	Price per package.	Guaranty.	Weight of powder in grains.	Acetanilid in powder or tablet. Grains.	Per cent.	Remarks.
				cts.					
19897	Aceton. The Aceton Medical Co., Mystic, Conn.	*New London:* Moon's Pharmacy	12 powders	25	240 grs. acetanilid per oz.	5.01 6.05 6.27 *Average* *5.78*	2.56 3.14 3.24 *2.98*	*51.6*	Carbonates. No camphor monobrom.
19628	Callahan's Headache Powders. E. Callahan, Jr., New London	*New London:* E. Callahan, Jr.	12 powders	40	3½ grs. acetanilid per powder.	9.30 10.46 9.27 *Average* *9.68*	3.40 3.74 3.37 *3.50*	*36.2*	Carbonates. No camphor monobrom.
20106	Effervescent Bromo-Lithia. Bromo-Lithia Chem. Co., Philadelphia, Pa.	*New Haven:* John A. Caryl	---------	25	12 grs. acetanilid per oz. Sodium phosphate, lithium bitartrate, sodium bromide, caffeine citrate, sodium bicarbonate and pure fruit acid.	in bulk			Carbonates. Contained acetanilid. No camphor monobrom.
19931	Dr. James' "Miniature" Headache Powders. J. W. James Co., Wheeling, W. Va.	*Willimantic:* Wilson's Drug Store	12 powders	30	3 grs. acetanilid per powder.	7.88 7.72 7.56 *Average* *7.72*	2.96 2.94 2.90 *2.93*	*38.0*	Carbonates. No camphor monobrom.
20115	Dr. Jones' Grip and Cold Tablets. Mfd. for Ozark Medicine Co., Springfield, Mo.	*Hartford:* P. J. Cavanaugh	24 tablets	25	2½ grs. acetanilid per tablet, with a heart tonic and other ingredients.	4.88 4.88 4.76 *Average* *4.84*	2.46 2.46 2.40 *2.44*	*50.0*	No carbonates or camphor monobrom. Camphor present.
20063	Headache Powders. Prep. for Lee's Apothecaries Hall, Winsted	*Winsted:* Lee's Apothecaries Hall, G. L. Fancher, Prop.	12 powders	40	4 grs. acetanilid per powder.	7.46 7.64 7.94 8.08 *Average* *7.78*	3 88 4.30 4.10 3.92 *4.05*	*52.1*	Carbonates. No camphor monobrom.
19918	Headache Powders. Prep. for Wm. H. Nicholson, Norwich	*Norwich:* Wm. H. Nicholson	12 powders	40	36½ grs. acetphenetidin and 146 grs. acetanilid per oz.	11.49 10.90 10.70 *Average* *11.03*	---- ---- ---- ----		Presence of phenacetin interfered with titration of acetanilid. Carbonates.
20044	Instant Headache Remedy. Crowell, New Britain	*New Britain:* W. H. Crowell	10 wafers	25	5 grs. acetanilid per powder.	11.75 11.82 11.17 *Average* *11.58*	5.05 5.04 4.76 *4.95*	*42.7*	No carbonates or camphor monobrom.
20206	Instant Headache Wafers. Prep. for Chas. A. Lamb, New Haven	*New Haven:* Chas. A. Lamb	12 wafers	25	3½ grs. acetanilid per wafer.	7.60 7.76 8.16 *Average* *7.84*	3.24 3.26 3.38 *3 29*	*41.9*	Carbonates. No camphor monobrom.
20159	Nyal's Headache Wafers. Prep. for New York and London Drug Co., New York	*Bridgeport:* Brinkerhoff Bros.	12 wafers	25	4 grs. acetanilid and 1 gr. caffeine alkaloid per wafer.	9.83 10.34 10.09 *Average* *10.09*	4.08 4.30 4.14 *4.17*	*41.3*	No carbonates. Camphor monobrom.

Table XXV.—Headache Powders. Acetanilid Preparations.—*Continued.*

Guaranty Satisfied.

Station No.	Brand.	Dealer.	Contents of package.	Price per package.	Guaranty.	Weight of powder in grains.	Acetanilid in powder or tablet. Grains.	Acetanilid in powder or tablet. Per cent.	Remarks.
20135	Phenyo-Caffein. Phenyo-Caffein Co.	*Hartford:* T. J. Blake, Jr.	25 pills	cts. 25	2 grs. acetanilid per pill. Caffein, camphor, etc.	3.27 3.84 3.54 3.62 *Average* *3.57*	1.88 2.08 2.04 1.95 *1.99*	*55.8*	Carbonates. Camphor. Small amount, insoluble in HCl.
19896	Quick Relief Headache Powders. Prep. for The Quick Relief Chem. Co., New London, Conn.	*New London:* Wm. Sayles	10 powders	25	3½ grs. acetanilid per powder.	9.47 8.95 9.41 *Average* *9.28*	3.58 3.46 3.60 *3.55*	*38.3*	Carbonates. No camphor monobrom.
20043	Radom's Headache Wafers. Mfd. for Radom's Pharmacy, New Britain	*New Britain:* Radom's Pharmacy	12 wafers	25	3⅓ grs. acetanilid, ½ gr. acetphenetidin per powder, with caffeine, soda bicarbonate, etc.	10.09 10.61 9.84 *Average* *10.18*	3.70 3.78 3.58 *3.69*	*36.2*	Phenacetin, carbonates. No camphor monobrom.
20190	Simon's Head-Ache-Pills. Prep. for Simon's Pharmacy, Danbury	*Danbury:* Simon's Pharmacy	25 pills	25	2 grs. acetanilid per pill.	4.26 4.18 4.38 *Average* *4.27*	1.87 1.82 1.87 *1.85*	*43.3*	No carbonates or camphor monobrom. Camphor present.
19919	Smith's Headache Tablets. Put up by Smith, the Druggist, Norwich, Conn.	*Norwich:* Smith's Drug Store	30 tablets	25	3 grs. acetanilid per tablet.	4.70 4.80 4.66 *Average* *4.72*	2.82 2.91 2.80 *2.84*	*60.2*	Carbonates. No camphor monobrom.
19898	Taylor's Headache Wafers. Mfd. for Taylor's Prescription Pharmacy, New London	*New London:* Taylor's Pharmacy	12 wafers	25	3½ grs. acetanilide per powder.	10.02 10.68 9.24 *Average* *9.98*	3.58 3.88 3.38 *3.61*	*36.2*	Carbonates. No camphor monobrom.

Varying Widely from Guaranty.

Station No.	Brand.	Dealer.	Contents of package.	Price per package.	Guaranty.	Weight of powder in grains.	Acetanilid in powder or tablet. Grains.	Acetanilid in powder or tablet. Per cent.	Remarks.
19899	Dr. Davis' Anti-Headache or Half-Hour Headache Helper. Fred C. Keeling, Chicago, Ill.	*New London:* Nichols & Harris	10 powders	25	3½ grs. acetanilid per powder.	5.18 4.95 4.54 5.25 *Average* *4.98*	3.26 2.93 2.76 3.20 *3.04*	*61.0*	Carbonates. No camphor monobrom.
19940	El-Ce-Dee Headache Wafers. Prep. for Lincoln's Drug Store, Middletown	*Middletown:* Lincoln's Drug Store	12 wafers	25	2¾ grs. acetanilid per wafer.	12.55 9.57 10.78 *Average* *10.97*	2.76 2.10 2.56 *2.47*	*22.5*	Carbonates. No camphor monobrom.
20114	Goodwin's Headache Remedy. Prep. for Goodwin's Drug Store, Hartford	*Hartford:* Goodwin's Drug Store	12 wafers	25	164 grs. acetanilid per oz.	11.31 10.69 10.65 *Average* *10.88*	4.26 4.10 4.00 *4.12*	*37.9*	Carbonates. No camphor monobrom. Contains 182 grs. acetanilid per oz.
20173	Goulden's Headache Wafers. Prep. for Goulden's Pharmacy, Stamford	*Stamford:* Goulden's Pharmacy	12 wafers	25	164 grs. acetanilid per oz.	10.39 10.98 10.00 *Average* *10.46*	4.06 4.20 3.76 *4.01*	*38.3*	No carbonates or camphor monobrom. Contains 184 grs. acetanilid per oz.
20188	Headache Konseals. Prep. for Edw. W. Kelley, Jr., So. Norwalk	*So. Norwalk:* Edw. W. Kelley, Jr.	12 wafers	25	4½ grs. acetanilid per wafer.	9.43 10.77 10.42 10.92 *Average* *10.39*	3.66 4.02 4.50 4.10 *4.07*	*39.2*	Carbonates. No camphor monobrom. Six wafers broken.

Table XXV.—Headache Powders. Acetanilid Preparations.—*Continued.*

Varying Widely from Guaranty. (cont.)

Station No.	Brand.	Dealer.	Contents of package.
19936	Headache Powders. Prep. for The Woodward Drug Store, Middletown	*Middletown:* The Woodward Drug Store	12 powders
20110	Headache Wafers. J. Linde & Son, New Haven	*New Haven:* J. Linde & Son	6 wafers
20207	Headache Wafers. Prep. for Wilson's Pharmacy, New Haven	*New Haven:* Wilson's Pharmacy	12 wafers
20200	Nugent's Headache Wafers. Sold by Nugent's Pharmacy, Waterbury	*Waterbury:* Nugent's Pharmacy	12 wafers
19938	Pelton's Headache Powders. Prep. by C. A. Pelton, Middletown	*Middletown:* C. A. Pelton	12 powders
20156	Stanley Headache Powders. Distributed by The Atlantic Hotel Pharmacy Co., Bridgeport	*Bridgeport:* Atlantic Hotel Pharmacy Co.	10 powders
20062	Superior Headache Powders. Prep. for Buck's Pharmacy, Winsted	*Winsted:* Buck's Pharmacy	10 powders
20158	W. & H. Headache Konseals or Wafers. Prep. for Wolff & Hitch, Bridgeport	*Bridgeport:* Wolff & Hitch	9 wafers
20191	Wheeler's Headache Wafers. Prep. for W. B. Wheeler, Danbury	*Danbury:* W. B. Wheeler	12 wafers

Station No.	Price per package.	Guaranty.	Weight of powder in grains.	Acetanilid in powder or tablet. Grains.	Per cent.	Remarks.
	cts.					
19936	40	164 grs. acetanilid per oz.	10.83 10.64 10.80 *Average* *10.76*	4.10 4.04 4.02 *4.05*	*37.6*	No carbonates or camphor monobrom. Contains 181 grs. acetanilid per oz.
20110	20	150 grs. acetanilid per oz.	9.58 8.30 8.76 *Average* *8.88*	3.51 2.94 3.12 *3.19*	*35.9*	Carbonates. No camphor monobrom. Contains 172 grs. acetanilid per oz.
20207	40	4 grs. acetanilid per wafer.	9.50 10.00 9.51 9.84 *Average* *9.71*	3.36 3.60 3.38 3.54 *3.47*	*35.7*	No carbonates. Camphor monobrom. Some matter insoluble in HCl.
20200	25	4 grs. acetanilid and 1 gr. caffeine per wafer.	7.96 6.80 8.30 *Average* *7.69*	3.23 2.70 3.28 *3.07*	*39.9*	Carbonates. No camphor monobrom.
19938	40	5 gr. acetanilid per powder.	8.79 7.54 7.92 7.26 7.51 *Average* *7.80*	5.04 4.08 4.64 4.12 4.04 *4.36*	*55.9*	Carbonates. No camphor monobrom.
20156	25	4 grs. acetanilid per powder.	12.22 12.08 11.34 10.16 *Average* *11.45*	4.92 4.82 4.32 3.90 *4.49*	*39.2*	Carbonates. No camphor monobrom.
20062	25	2¾ grs. acetanilid per powder.	12.40 11.05 12.12 12.48 *Average* *12.01*	3.01 2.59 3.20 2.94 *2.94*	*24.5*	Carbonates. No camphor monobrom.
20158	30	4 grs. acetanilid per wafer.	11.28 8.05 11.72 *Average* *10.35*	4.45 3.14 4.56 *4.05*	*39.1*	Carbonates. No camphor monobrom.
20191	25	5 grs. acetanilid per powder.	8.79 9.48 10.91 *Average* *9.73*	4.58 4.84 5.68 *5.03*	*51.9*	Carbonates. No camphor monobrom.

Label Illegal in One or More Particulars.

Station No.	Brand.	Dealer.	Contents of package.
19920	A. D. S. Headache Wafers. Prep. for American Druggists' Syndicate, N. Y.	*Norwich:* Woodworth's Pharmacy	10 wafers

Station No.	Price per package.	Guaranty.	Weight of powder in grains.	Acetanilid in powder or tablet. Grains.	Per cent.	Remarks.
19920	25	4 grs. acetanilid per wafer, sugar of milk and caffein.	9.00 9.27 10.32 *Average* *9.53*	3.66 3.82 4.24 *3.91*	*41.0*	No carbonates or camphor monobrom. Illegally labeled a "cure."

Table XXV.—Headache Powders. Acetanilid Preparations.—*Continued*:

Label Illegal in One or More Particulars. (cont.)

Station No.	Brand.	Dealer.	Contents of package.	Price per package.	Guaranty.		Weight of powder in grains.	Acetanilid in powder or tablet. Grains.	Acetanilid in powder or tablet. Per cent.	Remarks.
				cts.						
20111	Five Grain Antikamnia Tablets. The Antikamnia Chem. Co., St. Louis, Mo. (Sold in original container.)	*New Haven:* E. Wadewitz	12 tablets	25	None.	 *Average*	5.03 4.83 4.86 *4.91*	2.98 2.90 2.94 *2.94*	*59.9*	Carbonates. Camphor monobrom. Presence of acetanilid not stated.
20374	Antikamnia Tablets, 5 gr. (Sold in bulk.)	*New Haven:* E. Wadewitz	12 tablets	25	None.	 *Average*	5.32 5.25 *5.29*	3.12 3.14 *3.13*	*59.2*	Carbonates. Camphor monobrom. Presence of acetanilid not stated.
20142	Conway's Headache Konseals or Wafers. Prep. for Conway's New Drug Store, New Haven	*New Haven:* C. H. Conway	12 wafers	25	4 grs. acetanilid per powder.	 *Average*	8.90 7.40 8.43 *8.24*	3.61 3.02 3.40 *3.34*	*40.5*	Carbonates. No camphor monobrom. Illegally labeled a "cure."
20079	Headache Cure. Prep. for The Bristol Drug Co., Ansonia	*Ansonia:* Bristol Drug Co.	12 wafers	25	2¾ grs. acetanilid per powder.	 *Average*	11.13 10.07 10.62 *10.61*	2.69 2.48 2.56 *2.58*	*24.3*	Carbonates. No camphor monobrom. Illegally labeled a "cure."
20109	Headache Cure. Prep. for J. A. Notkin & Bros., New Haven	*New Haven:* J. A. Notkin & Bros.	12 wafers	25	2¾ grs. acetanilid per wafer.	 *Average*	10.86 13.39 12.15 *12.13*	2.58 3.08 2.94 *2.87*	*23.7*	Carbonates. No camphor monobrom. Some matter insoluble in HCl. Illegally labeled a "cure."
20035	Headache Konseals. Broderick & Curtin, Meriden	*Meriden:* Broderick & Curtin	12 wafers	25	4½ grs. acetanilid per powder.	 *Average*	12.15 11.63 11.25 *11.68*	4.20 4.08 3.83 *4.04*	*34.6*	No carbonates or camphor monobrom. Three wafers broken. Illegally labeled a "cure."
20117	Headache Konseals or Wafers. Prep. for James Duggan & Co., Hartford	*Hartford:* James Duggan & Co.	12 wafers	25	4 grs. acetanilid per powder.	 *Average*	9.21 11.16 11.45 *10.61*	3.67 4.52 4.60 *4.26*	*40.1*	Carbonates. No camphor monobrom. Illegally labeled a "cure."
20046	Headache Powders. Halloran's Drug Store, New Britain	*New Britain:* Halloran's Drug Store	12 powders	25	None.	 *Average*	10.95 12.12 12.93 *12.00*	3.75 4.04 4.46 *4.08*	*34.0*	No carbonates or camphor monobrom. Presence of acetanilid not stated.
20092	Improved Headache Powders. Geo. A. Jamieson, Bridgeport	*Bridgeport:* Geo. A. Jamieson	3 powders	10	None.	 *Average*	13.08 8.97 12.51 *11.52*	4.40 3 06 4.10 *3.85*	*33.4*	No carbonates. Presence of acetanilid not stated.
20205	Headache Powders. Whalley Ave. Pharmacies, New Haven	*New Haven:* J. E. Wetherwax	12 powders	40	5 grs. acetanilid per powder.	 *Average*	13.15 8.45 11.22 9.26 *10.52*	7.11 4.34 5.84 4.80 *5.52*	*52.5*	Carbonates. No camphor monobrom. Guaranties written very illegibly. Powders very ununiform in weight.
20093	Headache Wafers. Myles A. McCarthy, Waterbury	*Waterbury:* Myles A. McCarthy	12 wafers	25	None.	 *Average*	11.90 13.44 12.45 *12.60*	5.08 5.60 5.22 *5.30*	*42.1*	Carbonates. No camphor monobrom. Presence of acetanilid not stated.
20080	Hoffman's Harmless Headache Powders. The Hoffman Drug Co., Buffalo, N. Y.	*Ansonia:* E. S. Schoonmaker	10 powders	25	45% acetanilid.	 *Average*	8.47 10.41 8.52 *9.13*	3.81 4.74 3.88 *4.14*	*45.3*	Carbonates. No camphor monobrom. Illegally labeled "harmless."

Table XXV.—Headache Powders. Acetanilid Preparations.—*Concluded.*

Label Illegal in One or More Particulars. (conc.)

Station No.	Brand.	Dealer.	Contents of package.	Price per package.	Guaranty.	Weight of powder in grains.	Acetanilid in powder or tablet. Grains.	Per cent.	Remarks.
				cts.					
19939	Instant Headache Remedy. Prep. for John J. Murphy, Middletown	*Middletown:* John J. Murphy	12 wafers	25	164 grs. acetanilid per oz.	10.08 11.62 11.18 10 45 *Average* *10.83*	3.90 4.54 4.30 4.08 *4.21*	*38.9*	No carbonates or camphor monobrom. Illegally labeled "contains nothing injurious."
20108	Matchless Headache Cure. Buckley's Pharmacy, New Haven	*New Haven:* Buckley's Pharmacy	12 wafers	25	Caffeine and acetanilid.	9.69 9.95 9.63 *Average* *9.76*	4.19 4.30 4.14 *4.21*	*43.1*	No carbonates or camphor monobrom. Illegally labeled a "cure" and quantity of acetanilid not stated.
20037	Matchless Headache Cure. F. M. Kibbe & Co., Meriden	*Meriden:* F. M. Kibbe & Co.	12 wafers	25	Caffeine and acetanilid.	9.57 9.48 9.70 *Average* *9.58*	4.04 3 96 4.04 *4.01*	*41.9*	No carbonates or camphor monobrom. Illegally labeled a "cure" and quantity of acetanilid not stated.
20179	Migrain Tablets	*Stamford:* Champagne's Pharmacy	12 tablets	10	None.	3.28 3.27 3.32 *Average* *3.29*	1.94 1.96 2.02 *1.97*	*59.9*	No carbonates or camphor monobrom. Camphor. Presence of acetanilid not stated.
20068	Narco Headache Remedy. North American Remedy Co., Philadelphia	*Torrington:* G. L. Morse.	12 wafers	25	3 grs. acetanilid per wafer.	5.28 3.79 5.24 *Average* *4.77*	2.86 2.10 2.86 *2.61*	*54.7*	Carbonates and camphor monobrom. Illegally labeled a "cure."
20071	"Old B's" Headache Tablets. Prep. at Claxton's Pharmacy, Torrington	*Torrington:* Claxton's Pharmacy	36 tablets	25	Contain no opium or any harmful ingredient.	6.27 6.36 6.32 *Average* *6.32*	3.40 3.45 3.42 *3.42*	*54.1*	Carbonates. No camphor monobrom. Illegally labeled a "cure" and to contain nothing "harmful."
19942	Orangeine Powders. Prep. by The Orangeine Chem. Co., Chicago	*Middletown:* J. P. Kinsella	6 powders	25	Acetanilid, 2.4 gr., caffein, 0.6 gr.	4.41 4.81 5.00 *Average* *4.74*	2.20 2.44 2.58 *2.41*	*50.1*	Carbonates. No camphor monobrom. Illegally labeled a "cure."
20036	Parker's Headache Cure. John H. Parker, Meriden	*Meriden:* A. M. Campbell	12 wafers	25	Caffeine and acetanilid.	9.24 9.07 9.51 *Average* *9.27*	4.74 4.76 4.90 *4.80*	*51.8*	No carbonates or camphor monobrom. Amount of acetanilid not stated. Illegally labeled a "cure."
20081	Reliable Headache Wafer. E. S. Schoonmaker, Ansonia	*Ansonia:* E. S. Schoonmaker	8 wafers	40	None.	7.04 6.94 8.67 *Average* *7.55*	3.64 3.60 4.38 *3.87*	*51.3*	Carbonates. No camphor monobrom. Presence of acetanilid not stated.
20042	Shac. Stearns' Head Ache Cure. Prep. for Stearns & Curtius, New York	*New Britain:* J. H. Lutz	12 wafers	25	4 grs. acetanilid per wafer.	7.01 8.38 7.96 *Average* *7.78*	3.64 4.34 4.04 *4.01*	*51.5*	No carbonates or camphor monobrom. Illegally labeled a "cure."
20192	Sure Remedy Headache Powders. Prep. for Martin J. Coughlin, Danbury	*Danbury:* Martin J. Coughlin	12 powders	40	164 grs. acetanilid per oz.	11.37 10.83 10.90 *Average* *11.03*	4.32 4.04 4.14 *4.17*	*37.8*	No carbonates or camphor monobrom. Illegally labeled "sure remedy." Contains 181 grs. acetanilid per oz.

TABLE XXVI.—HEADACHE POWDERS. ACETPHENETIDIN PREPARATIONS. LEGALLY LABELED.

Station No.	Brand.	Dealer.	Contents of package.	Station No.	Price per package.	Guaranty.	Weight of powder in grains.	Remarks.
					cts.			
20094	Budd's Headache Wafers. Prep. for John B. Ebbs, Waterbury	*Waterbury:* John B. Ebbs	12 wafers	20094	25	5 grs. acetphenetidin per wafer.	9.80 8.81 10.05 *Average* 9.55	Acetphenetidin. Camphor monobrom. Carbonates.
20204	Dr. Howard's Headache Powder. T. P. Gillespie & Co., New Haven	*New Haven:* T. P. Gillespie & Co.	12 powders	20204	40	3½ grs. phenacetin per powder.	8.59 6.34 6.30 7.21 *Average* 7.11	Acetphenetidin. No camphor monobrom. Carbonates. Very variable in weight.
19937	Dr. Kohler's Antidote for Headache and Neuralgia. Kohler Mfg. Co., Baltimore, Md.	*Middletown:* Hartman Drug Co.	8 powders	19937	25	5⅝ grs. acetphenetidin per powder.	6.98 7.33 6.97 *Average* 7.09	Acetphenetidin. Camphor monobrom. No carbonates.
20045	Dr. Poyer's Headache Powders. Prep. for City Drug Store, New Britain	*New Britain:* City Drug Store	12 powders	20045	40	5 grs. acetphenetidin per powder.	10.02 10.12 9.84 *Average* 9.99	Acetphenetidin. Carbonates. No camphor monobrom.
20076	Emerson's Bromo-Seltzer. Emerson Drug Co., Baltimore, Md.	*Ansonia:* E. T. Vance		20076	25	22 grs. acetphenetidin per oz.	In bulk.	Acetphenetidin. Carbonates. Camphor monobrom.
20067	Headache Powders. Prep. for E. F. Nolan, Torrington	*Torrington:* E. F. Nolan	10 powders	20067	25	5 grs. acetphenetidin per powder.	9.87 10.35 9.90 *Average* 10.04	Acetphenetidin. Carbonates. No camphor monobrom.
20118	Rapport's Headache Powders. Prep. for Geo. L. Rapport, Hartford	*Hartford:* Geo. L. Rapport	10 powders	20118	25	5 grs. acetphenetidin per powder.	11.18 11.82 11.45 *Average* 11.48	Acetphenetidin. Carbonates. No camphor monobrom.
20155	"Rex" Headache Powders. Prep. for J. N. McNamara, Bridgeport	*Bridgeport:* J. N. McNamara	12 powders	20155	40	5 grs. acetphenetidin per powder.	9.49 8.35 8.47 *Average* 8.77	Acetphenetidin. Carbonates. No camphor monobrom.
19895	Rexall Headache Powders. United Drug Co., Boston, Mass.	*New London:* Starr Bros.	12 powders	19895	20	5 grs. acetphenetidin per powder.	8.20 7.83 7.67 *Average* 7.90	Acetphenetidin. Camphor monobrom. No carbonates.
20116	Tracy's Headache Wafers. Prep. for L. H. Tracy, Hartford	*Hartford:* L. H. Tracy	12 wafers	20116	25	5 grs. acetphenetidin per powder.	9.76 10.16 11.77 *Average* 10.56	Acetphenetidin. Camphor monobrom. Carbonates. Very variable in weight.
20107	Wood's Improved Headache Powds. Prep. by A. F. Wood's Sons, New Haven	*New Haven:* A. F. Wood's Sons	12 powders	20107	25	336 grs. acetphenetidin per oz.	8.21 8.50 8.49 *Average* 8.40	Acetphenetidin. Camphor monobrom. Carbonates.

TABLE XXVI.—HEADACHE POWDERS. ACETPHENETIDIN PREPARATIONS.—*Continued.*

LABEL ILLEGAL IN ONE OR MORE PARTICULARS.

Station No.	Brand.	Dealer.	Contents of package	Price per package.	Guaranty.	Weight of powder in grains.	Remarks.
20141	Dr. Shoop's 20 Minute Headache Tablets. Dr. Shoop, Racine, Wis.	*New Haven:* S. L. Salisbury	20 tablets	cts. 25	2 grs. acetphenetidin, 1 gr. septozone, ½ gr. citrated caffein per tablet (?).	21.08 21.04 21.73 *Average 21.28*	Acetphenetidin. No camphor monobrom. Carbonates. Guaranty indefinite and confusing.
20095	Headache Wafers. Joseph A. Smith, Waterbury	*Waterbury:* Joseph A. Smith	12 wafers	25	None.	8.46 13.19 11.78 9.98 *Average 10.85*	Acetphenetidin. Camphor monobrom. Carbonates. Presence of phenacetin not stated. Very variable in weight.
20038	Hufeland's Sure Headache Cure. H. Theodore Graeber, Meriden	*Meriden:* H. Theodore Graeber	36 tablets	25	3½ grs. acetphenetidin per tablet.	5.82 5.88 5.90 *Average 5.87*	Acetphenetidin. No camphor monobrom. Carbonates. Illegally labeled a "cure."
20157	Toucey's Headache Wafers. No label on box.	*Bridgeport:* Edward Toucey	12 wafers	30	None.	8.89 8.78 8.93 *Average 8.87*	Acetphenetidin. Camphor monobrom. Carbonates. Presence of phenacetin not stated.

AMMONIA WATER.

The U. S. Pharmacopœia recognizes two solutions of ammonia gas in water:

Aqua Ammoniæ (*Ammonia Water*), "an aqueous solution of ammonia, containing 10 per cent. by weight, of gaseous ammonia." Specific gravity, 0.958 at 25°.

Aqua Ammoniæ Fortior (*Stronger Ammonia Water*), "an aqueous solution of ammonia, containing 28 per cent., by weight, of gaseous ammonia." Specific gravity, 0.897 at 25°.

They are both colorless, transparent liquids, having a very pungent odor, a caustic and alkaline taste, and a strongly alkaline reaction on red litmus paper.

Fifty-one samples were bought at various drug stores in the principal towns of the State, and examined for specific gravity and content of gaseous ammonia. The specific gravity was determined in a pycnometer at 25° C., the ammonia by weighing 3 cc. of the sample in a stoppered weighing bottle, quickly diluting with 50 cc. of distilled water and titrating with normal sulphuric acid, using methyl orange as indicator.

In many cases, the labels and the statement of the dealer failed to agree. The best evidence of the intent in selling is the label itself, but the dealer's statement to the purchaser is also noted in the table under the caption "sold as." We are, therefore, obliged to pass several samples, which are of distinctly low quality. In all cases where a sample did not fall more than 10 per cent. below the U. S. P. standard, it has been passed. The sale of 20 per cent. ammonia as "dilute ammonia" is very objectionable, and its use by an ignorant purchaser, accustomed to the more dilute solution, might be followed by serious consequences.

Eighteen samples either conform to the U. S. P. standard, or for the reasons stated above, we are obliged to pass. None of the five samples containing the largest quantities of ammonia was labeled "Fortior" or "Stronger," while they were sold as "strong," "pure" or "dilute," terms having no pharmacopœial significance. None of these reaches the "Fortior" strength of 28 per cent. Eleven samples were evidently intended to be Aqua Ammonia. These varied from 9.00 to 12.41 per cent. of ammonia. No. 20144, LeGrand B. Cannon & Co., New Haven, although

TABLE XXVII.—AQUA AMMONIAE (AMMONIA WATER). BELOW STANDARD.

Station No.	Labeled.	Sold as	Dealer.	Price per bottle.	Specific gravity at 25°.	Per cent. of Ammonia (NH_3).
				cts.		
20151	Aqua Ammonia	Strong Ammonia	*Bridgeport*: Dupee's Pharmacy	10	.9595	8.74
20217	Ammonia Aq.	Dilute Ammonia	*New Haven*: J. E. Wetherwax	10	.9590	8.72
20125	Ammonia Water	Weak Ammonia	*Hartford*: G. L. Rapport	10	.9589	8.70
19928	Aqua Ammonia	Diluted Ammonia	*Willimantic*: J. J. Hickey & Co.	10	.9589	8.58
20027	Aqua Ammonia	Strong Ammonia	*Meriden*: A. M. Campbell	10	.9613	8.45
20152	Aqua Ammonia	Ammonia	*Bridgeport*: Wolff & Hitch	10	.9612	8.33
20150	Aqua Ammonia	Strong Ammonia	*Bridgeport*: Jennie Hamilton's Pharmacy	15	.9607	8.30
20084	Aqua Ammonia	Weak Ammonia	*Waterbury*: A. C. Walker	10	.9625	8.21
20194	*Aqua Ammonia	Weak Ammonia	*Danbury*: James P. Doran	15	.9614	8.13
20170	Aqua Ammonia	Ammonia	*Stamford*: Marron's Pharmacy	15	.9618	8.01
20184	Ammonia Water, 10%	Weak Ammonia	*South Norwalk*: Frank H. Baxter	20	.9626	7.93
20143	Aqua Ammonia	Strong Ammonia	*New Haven*: J. T. Hillhouse	15	.9661	7.18
20074	Aqua Ammonia	Weak Ammonia	*Ansonia*: E. T. Vance	15	.9658	7.15
20026	Aqua Ammonia	Weak Ammonia	*Meriden*: Meriden House Drug Store	10	.9664	7.11
20128	†Aqua Ammonia	Strong Ammonia	*Hartford*: L. H. Tracy	15	.9667	7.07
19925	*Ammonia	Pure Ammonia	*Norwich*: Charles C. Treat	10	.9668	6.98
20129	Ammonia Water	Strong Ammonia	*Hartford*: John K. Williams	15	.9679	6.71
20180	Aqua Ammonia	Ammonia	*Norwalk*: Edward P. Weed	15	.9693	6.58
20130	‡Ammonia Water, 10%	Ammonia, 10%	*Hartford*: Cantarow Drug Co.	15	.9698	6.44
20029	Aqua Ammonia	Weak Ammonia	*Meriden*: Broderick & Curtin	10	.9702	6.44
20216	Aqua Ammonia	Dilute Ammonia	*New Haven*: Charles A. Lamb	10	.9700	6.27
20153	Aqua Ammonia	Strong Ammonia	*Bridgeport*: McNamara's Pharmacy	10	.9713	5.90
20096	Ammonia Water	Strong Ammonia	*New Haven*: John A. Caryl	10	.9719	5.89
19943	*†Aqua Ammonia	Weak Ammonia	*Middletown*: Bergquist Bros.	10	.9666	5.87
20171	†Aqua Ammonia	Weak Ammonia	*Stamford*: Borg Bros. & Co.	15	.9708	5.86
20127	Aqua Ammonia	Strong Ammonia	*Hartford*: A. Marwick, Jr.	15	.9727	5.59
19927	Ammonia Water	Pure Ammonia	*Willimantic*: City Drug Store	10	.9743	5.24
20148	Aqua Ammonia	Weak Ammonia	*Bridgeport*: C. E. Pickard & Co.	10	.9795	4.20
20215	Aqua Ammonia	Strong Ammonia	*New Haven*: J. A. Hodgson	15	.9793	4.20
20083	Aqua Ammonia	Strong Ammonia	*Waterbury*: Brass City Drug Co.	10	.9795	4.16
20126	†Ammonia Water, 10%	Ammonia, 10%	*Hartford*: Jacob P. Barnetts	10	.9831	3.45
19900	*Ammonia Water	Weak Ammonia Water	*New London*: E. Callahan	10	.9823	3.37
20172	Aqua Ammonia	Dilute Ammonia	*Stamford*: Goulden's Pharmacy	15	.9871	2.38

* Not labeled poison. † Contained considerable insoluble matter. ‡ Solution colored.

sold as 15 per cent. ammonia, was not so labeled; it contained 10.13 per cent. No. 20147, G. C. Hamilton, Bridgeport, although sold as dilute ammonia, was labeled "Ammonia for Household Purposes"; it was indeed dilute, containing but 2.23 per cent. of ammonia. No. 20154, sold by J. H. Clampett, Bridgeport, was not labeled "poison," as required by the statute. The samples sold by Bristol Drug Co., Ansonia, Rulon's Pharmacy, Meriden and LeGrand B. Cannon & Co., New Haven, contained insoluble matter.

Table XXVII contains the analyses of the other 33 samples, all of which were labled "Aqua Ammonia" or "Ammonia Water," and should contain 10 per cent. of ammonia. They range from 8.74 to 2.38 per cent. The selling price bears no relation whatever to the strength of the ammonia, the lower grades costing quite as much as, if not more than, the higher.

Four of the samples below standard were not labeled "poison," four contained considerable insoluble matter, and one was highly colored from the presence of iron.

TINCTURE OF IODINE.

Tincture of Iodine (*Tinctura Iodi*) of the U. S. P. is made by triturating 70 gms. of iodine and 50 gms. of potassium iodide rapidly in a mortar, to a coarse powder, and transferring at once to a graduated bottle. The mortar is rinsed with several portions of alcohol and the rinsings poured into the bottle. Alcohol is then added with occasional shaking, until complete solution is effected and the tincture is made up to 1000 cc. with alcohol. The tincture, therefore, should contain 7 gms. of iodine per 100 cc.

An important change in the older formula is the addition of about 5 per cent. of potassium iodide, which allows dilution of the tincture with water without precipitating the iodine, thereby permitting its administration internally; it also greatly increases the stability of the tincture.

The tincture is now employed almost exclusively as an external remedy. Undiluted, it is a powerful irritant to the skin, inflammation, desquamation of the cuticle, etc., resulting. It is important, therefore, that the purchaser should receive the standard 7 per cent. U. S. P. tincture, and a tincture much above

U. S. P. strength is to be deprecated almost as much as one notably weak.

Ninety-two samples were examined. The U. S. P. method of diluting 5 cc. of the tincture with about 25 cc. of water and titrating with decinormal sodium thiosulphate solution was followed.

The following tabulation shows a summary of the results obtained:

1	sample over 200 per cent. U. S. P. strength.
8	samples from 110 to 133 per cent. U. S. P. strength.
53	" " 90 to 110 " " " "
10	" " 80 to 90 " " " "
9	" " 70 to 80 " " " "
3	" " 60 to 70 " " " "
4	" " 50 to 60 " " " "
4	" less than 40 per cent. U. S. P. strength.

One sample, **20105**, sold by Apothecaries Hall, New Haven, contained the abnormal amount of 15.96 gms. of iodine per 100 cc., resembling in composition *Churchill's Tincture of Iodine,* a N. F. preparation. However, it was sold for, and was intended to be the ordinary tincture. Its use by inexperienced persons, assuming it to be of U. S. P. strength, might be followed by very serious results. A second sample bought at the same place conforms to the U. S. P. strength. **20167**, sold by Hartigan's Pharmacy, Bridgeport, likewise is objectionably strong, being 133 per cent. of U. S. P. strength.

The average of all the samples was 6.43 gms. of iodine per 100 cc., or 91.9 per cent. of U. S. P. strength.

If the tinctures were made by the present U. S. P. formula, as must be assumed, for the contrary was not stated on the label, the large number of deficient samples cannot be accounted for by instability of the tincture. Too often the preparation of this and other tinctures is left by the druggist to inexperienced clerks, or they are not prepared strictly according to the U. S. P. method. As long as these conditions prevail, the wide discrepancies noted in the table must be expected. Thirty-nine, or 42 per cent., of the samples, vary more than 10 per cent. from the standard. On the other hand, 43, or 47 per cent., are within 5 per cent. of the standard, showing that careful pharmacists can prepare the tincture of U. S. P. strength, and that its strength can be maintained.

The following is a list of the druggists whose samples were more than 10 per cent. below the standard. The figures in parentheses indicate percentage of U. S. P. strength.

From 90 to 80 per cent. U. S. P.

J. A. Leverty & Bro., Bridgeport (89.0).
West End Pharmacy, Meriden (88.6).
A. B. Hall, New Haven (87.6).
T. J. Blake, Jr., Hartford (87.4).
J. H. Buckley, Jr., New Haven (86.7).
Edward Toucey, Bridgeport (86.4).
Anton Hellman, Hartford (85.9).
Shepard's Pharmacy, Danbury (85.7).
Chas. Fleischner, New Haven (82.6).
Kinner Pharmacy, Danbury (81.7).

From 80 to 70 per cent. U. S. P.

Wm. C. Baur, Norwalk (79.0).
Waterbury Drug Co., Waterbury (78.4).
Wm. H. Mills, Winsted (77.1).
Moon's Pharmacy, New London (77.1).
C. H. Conway, New Haven (75.7).
West End Drug Store, Waterbury (73.3).
E. Wadewitz, New Haven (73.3).
Plaisted's Drug Store, South Norwalk (72.4).
Wm. H. Crowell, New Britain (70.1).

From 70 to 60 per cent. U. S. P.

Claxton's Pharmacy, Torrington (69.1).
Champagne's Pharmacy, Stamford (62.7).
James Duggan & Co., Hartford (62.6).

From 60 to 50 per cent. U. S. P.

Coughlin's Pharmacy, Danbury (59.1).
Morris' Pharmacy, New Haven (57.9).
J. P. Connors, New Britain (57.9).
Phelps Pharmacy, Winsted (51.6).

Less than 40 per cent. U. S. P.

Buell & Blatchley, Middletown (38.3).
P. J. Cavanaugh, Hartford (35.9).
Chas. A. Pelton, Middletown (35.1).
J. T. Hillhouse, New Haven (32.3).

BORAX.

Sodii Boras (*Sodium Borate*) of the U. S. P. "should contain in the uneffloresced condition not less than 99 per cent. of pure sodium tetraborate."

The salt is found in commerce in two forms, the ordinary prismatic borax, the pharmaceutical preparation, which contains 10 molecules of water, and which on ignition loses all its water of crystallization, about 47 per cent., and the octahedral modification, used chiefly for technical purposes, which contains only 5 molecules of water of crystallization. On account of its ready loss of water, the salt should always be kept in well-stoppered bottles. Practically all of the samples came to the laboratory either in pasteboard cartons, or in the paper bags in which they were sold in bulk. Doubtless, therefore, they had lost some water in the dealers' stores, and none showed the required loss of 47 per cent. on ignition, the highest found being 45.73 per cent.

Borax has frequently been found adulterated with bicarbonate of soda, or saleratus, but none of the 30 samples examined this year showed the presence of any carbonates whatever. All showed slight traces of chlorids and no sulphates, or at most slight traces. The brands were found to be of a high state of purity.

Five samples lost 31 per cent. or less of water on ignition, and suggest the possibility of their being composed wholly or largely of the octahedral modification. These include **20023**, sold by Graeber's Pharmacy, Meriden (31.08); **19935**, 20 Mule Team Borax, sold by Woodward Drug Store, Middletown (30.64); **20039**, sold by Bergquist Bros., New Britain (31.61); **20183**, sold by H. Glendening & Co., Norwalk (30.03), and **20066**, sold by E. F. Nolan, Torrington (30.06).

Only four samples bore distinct brand names; the others bore simply the druggists' label or were sold in bulk.

19915. Black Diamond Pure Powdered Borax, Archibald & Lewis, New York, sold by Lee & Osgood, Norwich; loss on ignition 39.57 per cent.; no carbonates, traces of chlorids and sulphates.

20 Mule Team Borax Powdered, Pacific Coast Borax Co., New York, Chicago, San Francisco; **19930**, sold by City Drug Store, Willimantic; **19935**, sold by Woodward Drug Store, Middletown, and **20040**, sold by S. P. Storrs, New Britain. None contained carbonates, all traces of chlorids, and the last two traces of sulphates. The respective losses on ignition were 41.90, 30.64 and 35.88 per cent.

The weights of the material sold agreed closely with the claimed weights, in most cases somewhat exceeding the latter. The selling prices were either 5 or 10 cents for the same quantity of borax.

DIABETIC FOODS.

Three preparations, made by Callard, Stewart & Watt, Ltd., London, England, sent by James W. Thompson, Bridgeport, bore the following names: 19436, "Casoid Dinner Rolls, made from pure vegetable albumen and contain less than 4 per cent. of starch"; 19434, "Casoid Biscuits, Plain, No. 2. Free from starch, sugar and drugs"; 19435, "Casoid Biscuits, sweet, No. 3. Free from starch, sugar and drugs."

19436 contained 80.81 per cent. of protein and 3.33 per cent. starch.*

19434 contained 58.12 per cent. of protein and no starch.

19435 contained 54.69 per cent. of protein and 0.54 per cent. of starch.

ALBULAC.

20072. Bought of W. A. Spalding, New Haven. Stated to be, "Natural whey condensed at a temperature not exceeding 140° F. to a degree approximating 60 per cent. solids and 40 per cent. water." Davis, Williams & Co., Detroit, Mich.

Its percentage composition was as follows:

Water	39.32
Ash	5.52
Protein	7.50
Lactose	45.96
Fat	2.27
	100.57

* By direct acid hydrolysis calculated as starch.

MISCELLANEOUS MATERIALS SENT BY PRIVATE INDIVIDUALS.

Milk. Forty-eight samples of milk were tested, the results of which are not of general interest.

Cream. Fifteen samples were tested; the percentage of fat ranged from 12.38 to 38.10. Four samples were below standard.

Diabetic Flour. Two samples contained 38.00 per cent. and 17.81 per cent. of protein, respectively.

Maple Syrup. The one sample examined was not found adulterated. It was labeled, however, "sugar" instead of "syrup."

Apple Brandy. A single sample examined contained 50.82 per cent. of alcohol by volume, and no wood alcohol.

Witch Hazel. A single sample examined contained 12.05 per cent. of alcohol by volume, and no wood alcohol or formaldehyde.

Standard Alkali. A sample of $\frac{N}{10}$ alkali was found to be 98.35 per cent. of alleged strength.

One sample each of skim milk and mustard, two samples each of butter, potato starch and iodine, and three of vinegar were examined and found pure and of standard strength.

FOOD AND DRUG PRODUCTS EXAMINED FOR THE DAIRY COMMISSIONER IN THE YEAR ENDING JULY 31, 1908.

The following samples were referred to this station by the Dairy Commissioner for examination:

Black Pepper. Of six samples examined, one was found to be adulterated with olive stones, coffee hulls, and traces of cayenne and a wheat product.

Butter and Butter Substitutes. Of one hundred and four samples examined, forty-six were unadulterated, twenty-seven were oleomargarine and thirty-one were renovated butter. The illegality of the sale of these fifty-eight samples consisted in most cases in failure to display the proper sign, or to stamp properly at the time of sale. Nine other samples of renovated butter and eight of oleomargarine were found true to name.

Chile Sauce. Of three samples examined, one was adulterated with artificial color, one with benzoic acid, and one was marked "Compound."

Chocolate and Cocoa. Of six samples examined, one was adulterated with cornstarch.

Coffee. One sample was misbranded "Java and Mocha," and was found to be low-grade Santos coffee.

Visco Cream. Five samples of cream thickened with viscogen were examined.

Ginger. Of seven samples examined, one contained turmeric, while another contained an excess of ash and sand.

Lemon Extract. Of twenty samples examined, ten were below standard and two were labeled "Compound."

Maple Syrup. The one sample examined was labeled "Compound."

Milk. Of fifty-nine samples examined, forty-six were unadulterated, two were skimmed, one was watered, eight were both watered and skimmed and two were below the standard for total solids.

Molasses. Of two hundred and twenty-nine samples examined, two were adulterated with glucose.

Mustard. Of three samples examined, one was not found adulterated, one was adulterated with cornstarch, a wheat product and turmeric, and one with cornstarch, a rice product and turmeric.

Olive Oil. Of eleven samples examined, none was found to be adulterated.

Vanilla Extract. Of sixteen samples examined, eight were not found to be adulterated, one was adulterated with coumarin, one with coumarin and artificial color, one was illegally labeled and five were labeled "Compound."

Vinegar. Two hundred and thirteen samples were examined. Of one hundred and eighty-two samples of cider vinegar, sixty-four were below standard or misbranded; of sixteen samples of malt vinegar, fourteen were below standard or misbranded; of six samples of distilled vinegar, two were below standard; of seven samples of sugar vinegar, one was below standard, and of two samples of wine vinegar, one was below standard.

Ammonia Water. Of twenty-two samples examined, six of which were sold as Aqua Ammonia and sixteen as Aqua Ammoniæ Fortior, all were below standard, and two were further illegal in that they bore no poison label.

Catarrh Remedies. Of six samples examined, all contained cocaine, and their sale in this State was, therefore, illegal.

Headache Powders. Of nineteen samples examined, thirteen were illegally labeled.

Tincture of Iodine. Of twenty-three samples examined, fifteen were below standard.

TABLE XXVIII—SUMMARY OF RESULTS OF EXAMINATION OF FOOD AND DRUG PRODUCTS IN 1908.

	Not found adulterated.	Adulterated or below standard.	Compound.	Total number examined.
Sampled by Station.				
Albulac	----	----	----	1
Arrowroot Starch	2	----	----	2
Corn Starch	26	----	----	26
Diabetic Preparations	----	----	----	3
Ginger	71	7	----	78
Infant and Invalid Foods	----	----	----	24
Jams and Preserves	4	6	47	57
Jellies	8	----	17	25
Jelly Powder	----	----	1	1
Meat Extracts	10	25	----	35
Meat Juice	1	3	----	4
Other Meat Preparations	----	----	----	12
Potato Flour	1	----	----	1
Syrup	----	----	1	1
Table Salt	18	----	3	21
Ammonia Water	18	33	----	51
Beef, Wine and Iron	22	70	----	92
Borax	30	----	----	30
Headache Preparations	27	42	----	69
Tincture of Iodine	53	39	----	92
Total	291	225	69	625
Sampled by Dairy Commissioner.				
Black Pepper	5	1	----	6
Butter and Butter Substitutes	46	58	17	121
Chile Sauce	----	2	1	3
Chocolate and Cocoa	5	1	----	6
Coffee	----	1	----	1
Cream, Visco	----	----	----	5
Ginger	5	2	----	7
Lemon Extract	8	10	2	20
Maple Syrup	----	----	1	1
Milk	46	13	----	59
Molasses	227	2	----	229
Mustard	1	2	----	3
Olive Oil	11	----	----	11
Vanilla Extract	8	3	5	16
Vinegar	131	82	----	213
Ammonia Water	----	22	----	22
Catarrh Remedies	----	6	----	6
Headache Powders	6	13	----	19
Tincture of Iodine	8	15	----	23
Total	507	233	26	771

TABLE XXVIII.—SUMMARY OF RESULTS OF EXAMINATION OF FOOD AND DRUG PRODUCTS IN 1908.—*Continued.*

	Not found adulterated.	Adulterated or below standard.	Compound.	Total number examined.
Sampled by Health Officers, Consumers and Dealers.				
Apple Brandy	1	----	----	1
Butter	2	----	----	2
Cream	11	4	----	15
Diabetic Flour	----	----	----	2
Maple Syrup	1	----	----	1
Milk	40	8	----	48
Mustard	1	----	----	1
Potato Starch	2	----	----	2
Skim Milk	1	----	----	1
Tincture of Iodine	2	----	----	2
Vinegar	3	----	----	3
Witch Hazel, Extract of	1	----	----	1
Standard Alkali	----	----	----	1
Total	65	12	---	80
Total from all sources	863	470	95	1476

PART X.

COMMERCIAL FEEDING STUFFS.

BY E. H. JENKINS AND J. P. STREET.

For the law regulating the sale of feeding stuffs, explanations of the meaning of the analyses and remarks concerning their value and use, the reader is referred to pages 165 to 168 of this biennial report.

During the fall of 1908 the station's sampling agent visited 44 towns and villages of the State and gathered 218 samples of feeds as prescribed by law. The results of the chemical and microscopical examinations of these samples are here given and discussed.

There are also given 55 analyses of samples sent by individuals.

OIL SEED PRODUCTS.

Cotton Seed Meal, sampled by the Station.

(ANALYSES ON PAGES 742 AND 743.)

Of the twelve samples, one, **21536**, had neither brand nor guaranty as required by law. One of each of the following brands failed to meet their guaranties in one or both particulars.

Eagle Brand.	Protein deficient by 2.25 per cent.,	fat by 0.77 per cent.
Purity	" " " 4.13	" " ....
Humphreys, Godwin & Co's.	....	fat by 1.19 " "
Dixie Brand.	Protein deficient by 4.50 per cent.,	" " 1.47 " "
" "	....	" " 0.67 " "

Purity Brand and one sample of the *Dixie Brand* contained excessive amounts of hulls, as shown by the high per cent. of fiber.

The average per cent. of protein is 40.30, one and a half per cent. higher than last year, while the price is practically the same.

Cotton Seed Meal, sampled by Purchasers.

19963. Sent by F. A. Rolston, South Manchester, contained 36.75 per cent. of protein.

19968. *Dixie Brand,* Humphreys, Godwin & Co., Memphis, Tenn., guaranteed 38 per cent. of protein, 9 per cent. of fat; sent by E. F. Miller, Ellington; contained 40.37 per cent. of protein.

19984. Sold by Chapin & Co., Boston; sent by W. W. Palmer, Chestnut Hill; contained 38.25 per cent. of protein.

19985. Sent by M. D. Leonard & Co., Watertown, guaranteed 41 per cent. of protein, contained 49.12 per cent., an amount very seldom found in meal sold in this State.

19991. *Yellow Diamond Brand,* Chapin & Co., Boston, guaranteed 38.5 per cent. of protein, 9 per cent. of fat; sent by H. K. Brainard, Thompsonville; contained 38.56 per cent. of protein.

20007. *Green Diamond Brand,* Chapin & Co., Boston, guaranteed 41 per cent. of protein, 9 per cent. of fat; sent by C. T. Davis, Middletown; contained 38.19 per cent. of protein.

20016. Sold by Meech & Stoddard, Middletown; sent by Pierson & Kirkpatrick, Cromwell; contained 37.62 per cent. of protein and 9.17 per cent. of fat.

21735. Sold by Grovania Fert. & Oil Co., Grovania, Ga., guaranteed 41 per cent. of protein; sent by D. W. Ives, Wallingford; contained 8.15 per cent. of water, 39.50 per cent. of protein and 10.25 per cent. of fat.

21723. *Dixie Brand,* Humphreys, Godwin & Co., Memphis, Tenn., guaranteed 41 per cent. of protein, 9 per cent. of fat; sent by F. D. Lawton & Son, Unionville; contained 39.06 per cent. of protein.

Linseed Meal, sampled by the Station.

(ANALYSES ON PAGES 742 AND 743.)

Two samples of new process meal and three of old process meal are of standard quality and meet their guaranties.

WHEAT PRODUCTS.

Whole Wheat.

21208, *Red Wheat,* grown by Harvey Jewell, Cromwell, and **21209,** *Red Wheat,* sold by Meech & Stoddard, Middletown, both sent by Mr. Jewell, contained 10.69 and 11.56 per cent. of protein respectively.

Bran from Winter Wheat.

(ANALYSES ON PAGES 742 TO 745.)

Michigan Vimco Bran, made by the Valley City Milling Co., Grand Rapids, did not have the guaranty required by law. The other nine samples were properly guaranteed and all of them met their guaranties.

Bran from Spring Wheat.

(ANALYSES ON PAGES 744 AND 745.)

All of the fourteen samples examined have the required guaranty. Seventeen per cent. of protein was guaranteed in the Groton Milling Co.'s bran as against 15.87 per cent. found by analysis. This latter figure is the average amount contained in all the samples.

Middlings from Winter Wheat.

(ANALYSES ON PAGES 744 AND 745.)

The middlings made by the Hecker-Jones-Jewell Milling Co., the Valley City Milling Co. and Williams Bros. Co. were not guaranteed as required by law. The other five samples were properly guaranteed and had the guaranteed amounts of protein and fat.

Middlings from Spring Wheat.

(ANALYSES ON PAGES 746 AND 747.)

Middlings made or sold by Boutwell Milling and Grain Co., Troy, N. Y., and Wm. Hamilton & Son, Caledonia, N. Y., were not guaranteed as they should have been. The other thirteen samples met their guaranties except Winona Middlings, which had 0.63 per cent. less of fat than guaranteed.

Wheat Feed from Winter Wheat.

(ANALYSES ON PAGES 746 TO 749.)

Feed sold as from the following manufacturers or dealers did not have the guaranty required by law: Harter Milling Co., Toledo, Ohio; Hecker-Jones-Jewell Milling Co., N. Y.; Lawrenceburg Milling Co., Lawrenceburg, Ind.; National Milling Co., Toledo, Ohio; Henry Russell, Agt., Albany, N. Y.; F. W. Stock & Co., Hillsdale, Mich.; David Stott, Detroit, Mich.; Valley City Milling Co., Grand Rapids, Mich., and Wagoner-Gates Milling Co., Independence, Mo.

The other manufacturers complied with the law and their feeds substantially meet the guaranties given.

Wheat Feed from Spring Wheat.

(ANALYSES ON PAGES 748 AND 749.)

Feeds sold as from C. R. Lull & Co., Milwaukee, Wis., and Sleepy Eye Milling Co., Sleepy Eye, Minn., were not guaranteed. The others substantially met their guaranties.

An examination of the table of analyses shows that the wheat feeds found in our market are uniform in composition and of good quality as far as their chemical analyses indicate.

The middlings contain a little more protein, 17.33 per cent., than either the mixed feed, which has 16.19 per cent., or the bran, which averages 15.70 per cent.

The middlings also contain slightly more fat and less fibre than the others, but all these differences are quite small. The differences in composition between the feeds made from winter and spring wheats are also quite insignificant.

Wheat Feeds, sampled by Purchasers and Others.

20320, bran, sent by Meech & Stoddard, Middletown, contained 15.75 per cent. of protein. **20258**, *Buckeye Mixed Feed,* sold by Quaker Oats Co., and sent by L. C. Daniels Grain Co., Hartford, contained 17 per cent. of protein. **21797**, *Standard Middlings,* guaranteed 17.60 per cent. of protein, 11.08 per cent. of fat, sent by Meech & Stoddard, Middletown, contained 17.50 per cent. of protein and 6.44 per cent. of fat. **21798**, *Big Diamond Wheat Middlings,* guaranteed 19 per cent. of protein, 5 per cent. of fat, sent by Geo. H. Jennings, Jewett City, contained 17.00 per cent. of protein and 9.43 per cent. of fat.

Red Dog Flour.

This is a waste product finer than middlings used sometimes as a feed and also for the manufacture of paste. Its analysis, on pages 748 and 749, shows that it contains considerably less fiber, ash and fat than wheat feed and correspondingly more non-nitrogenous extract, starch, etc.

MAIZE PRODUCTS.

Maize Meal.

Two samples of corn meal, sold by F. U. Wadhams, Torrington, **19977**, sent by J. S. Gunn, Thomaston, and **19980**, sent by R. S. Goodwin, Torrington, contained 9.50 and 9.25 per cent. of protein and 2.00 and 1.98 per cent. of fat, respectively.

Maize for Ensilage.

T. A. Stanley of New Britain sent a sample, **21713**, of Leaming corn, raised by him from Illinois seed, consisting of four plants cut at the proper time for silage and weighing twenty-five pounds; also a sample of four stalks of Eureka corn, grown by him from seed bought of Ross & Co., Springfield, cut at the same time with the other and weighing thirty-two pounds.

The analyses are as follows:—

	As received.		Water-free.	
	Leaming.	Eureka.	Leaming.	Eureka.
	21713	21714	21713	21714
Water	76.93	81.80	....	....
Ash	1.22	1.13	5.30	6.20
Protein	1.68	1.45	7.30	7.96
Fiber	5.39	5.60	23.36	30.77
Nitrogen-free Extract	14.33	9.69	62.10	53.24
Fat	0.45	0.33	1.94	1.83
	100.00	100.00	100.00	100.00

It should be said that no very certain conclusions can be drawn from analyses of such small samples as these.

The accurate sampling of a crop like corn is a most difficult thing. It should always go with weighing of the crop, for neither the analysis of the crop nor the accurate weight of the crop, *by itself,* gives any fair idea of the yield of real feed. Thus if one variety gives fifteen tons of silage to the acre and another only twelve tons, it might be inferred that the former was the best yielder. But if it contains 81 per cent. of water while the latter contains 76, the yield of dry matter is nearly the same, while to get it from the former requires the hauling of three tons of useless water.

Probably the best way to take samples is from the silo while the crop is being put in. A shovelful should be taken at intervals and put in a bag kept in the silo until 500 to 1000 pounds have been gathered. This should then be dumped in a heap on a clean floor, shoveled over, mixed quickly and thoroughly and from it 50 to 75 pounds taken for analysis and *immediately* weighed.

It will be seen that one ton of Leaming corn *of the quality represented by the analyses* contains as much dry matter as one and one-quarter tons of Eureka; that the Eureka contains two-thirds of one per cent. more of protein than the Leaming; but that the non-nitrogenous extract of the Eureka contains over 7 per cent. more of woody fiber and correspondingly less starch and sugar than the Leaming.

Gluten Feed, sampled by the Station.

(ANALYSES ON PAGES 748 TO 751.)

This is a by-product from the manufacture of cornstarch and its derivatives. The corn is steeped in water containing a small amount of sulphurous acid and then ground with water. From this ground mass the germ is separated by mechanical means and also the corn bran and gluten, leaving the starch in nearly pure condition. The bran and gluten, dried by themselves, sometimes with the germs added after the extraction of their oil, make gluten feed.

Artificial Color in Gluten Feed.

Of late years some factories have evaporated the steep water, and after neutralizing it, have mixed it with the bran and gluten and finished the drying of the two together. This addition changes the color of the mixture.

For this reason and also because the factories must change from yellow corn to white corn and back again, according to market conditions, it has been found difficult or impossible to give the gluten feed a uniform yellow color.

Believing that uniform color and appearance were necessary in order to avoid trouble in selling, some companies have secured this uniformity by bringing their whole output to a uniform color with an aniline dye. If the dye used is harmless to health, if it is not used to conceal inferiority and if due notice of its use is given with the statement of composition, the practice is not contrary to law.

The use of color is declared on the statement of composition of *Buffalo, Diamond and Globe Gluten Feed,* at least on some of the packages.

Of the samples examined this year coal tar color has been found in the following brands of gluten feed: Buffalo, Pekin, Globe, Warner, Cream of Corn Gluten, Jenks, Western Glucose Co.'s, Munn Bros., and that sold by Soper & Co., Boston. It is not present in Douglass & Co.'s gluten.

The "Acidity" of Gluten Feeds.

In the following table are given the "acidities" of the gluten feeds examined in 1908, expressed in terms of the number of cubic centimeters of $\frac{N}{10}$ sodium hydroxid which are required to make the aqueous extract of one gram of feed neutral to the indicators named.

It will be seen that the "acidity" may be twice as large with one indicator as with another. The reason is that the several indicators react very differently with the things to which gluten feed normally owes its acidity; namely, protein bodies and

ACIDITY OF GLUTEN FEEDS.

Station No.	Brand.	cc. $\frac{N}{10}$ sodium hydroxid to neutralize 1 grm. of feed.			Protein.	Ash.
		Phenolphthalein.	Litmus.	Toepfer reagent.		
21435	Buffalo	3.40	1.80	3.50	23.37	3.41
21448	"	2.55	1.20	3.10	26.62	3.01
21454	"	3.40	1.60	3.65	26.06	4.87
21470	"	3.35	1.65	3.65	26.31	3.13
21548	"	2.70	1.10	2.70	25.00	4.18
21583	"	0.25	0.15	0.20	26.75	0.83
21456	Cream of Corn	2.60	1.20	3.00	24.75	2.83
21604	Diamond	2.40	1.40	2.55	26.50	4.63
21518	Douglass	0.40	0.25	0.35	20.12	1.29
21416	Globe	3.55	1.85	3.80	25.87	4.28
21439	"	3.40	1.85	3.50	26.00	4.12
21490	"	3.80	1.90	3.70	26.94	4.52
21502	"	2.95	1.45	2.90	26.37	4.73
21549	"	3.40	1.35	3.45	25.06	3.84
21593	Jenks	0.65	0.40	0.70	26.62	0.79
21469	Pekin	2.85	1.70	3.20	26.75	3.03
21570	Warner	3.30	2.40	3.60	26.12	3.74
21615	Western	1.25	0.85	1.50	22.62	1.91
21573	(American Maize Prod. Co.)	2.20	1.50	2.55	24.44	2.23
21487	(Corn Products Co.)	3.65	1.60	3.80	28.19	5.17
21516	(Muns Bros.)	0.50	0.40	0.70	22.75	1.45
21553	(J. E. Soper & Co.)	1.05	0.60	1.30	21.62	1.44

mineral salts, chiefly phosphates natural to the corn from which the gluten is made. In general, low ash—*i. e.*, absence of notable quantities of mineral matter—accompanies low "acidity."

These figures do not give any reason to suspect the presence of a mineral acid. Twenty grams of sample 21416, which showed the highest acidity, were ignited, with precautions to prevent loss of free acid, and the total chlorine carefully determined. This amounted to 0.035 per cent., a quantity not too large to consider as normal to the grain and quite too small to have any significance in the feed.

Fourteen brands of gluten feed are sold in Connecticut. They are as follows:

Buffalo Gluten Feed, made by the Corn Products Co., Chicago. The six samples had the required guaranties and all met the guaranty of 23 per cent. protein and 2.50 per cent. fat. The guaranty on one sample, 21548, notes that it is artificially colored.

Cream of Corn Gluten, made by the American Maize Products Co., N. Y. The single sample meets its guaranty. The same is true of *Diamond Gluten Feed,* made by the Corn Products Co., which is stated to be artificially colored.

Douglass Gluten Feed, made by Douglass & Co., Cedar Rapids, Iowa, has 3 per cent. less of protein than is guaranteed. The low ash, 1.29, is probably due to the fact that no steep water residue has been added to the gluten. It is free from artificial color.

Globe Gluten Feed, made by the Corn Products Co., N. Y. One sample had a guaranty of 23 per cent. protein and three had 26 per cent. guaranteed. The three with the higher guaranties were marked "artificially colored." All of them substantially met their guaranties.

Jenks Gluten Feed, made by the Huron Milling Co., Harbor Beach, Mich., meets its guaranty. It contains a low per cent. of ash with a high per cent. of fat, 10.35 per cent., coming perhaps from added germ.

Pekin Gluten Feed and the *Warner Gluten Feed,* both made by Corn Products Co., Chicago, have about the same composition as the feed from other factories of this company.

Western Gluten Feed, made by the Western Glucose Co., Chicago, has a lower percentage of protein than most of the other brands.

A sample, **21573**, stated to be from the American Maize Products Co., New York, and another, **21553**, stated to be from J. E. Soper & Co., Boston, did not have the statement of guaranty required by law. The latter had an exceptionally low percentage of protein.

Most of these gluten feeds have from 25 to 30 per cent. of protein, as appears in the table on pages 740 and 741 and have proved to be excellent concentrated dairy feeds.

Gluten Feeds, sampled by Purchasers and Others.

20017. *Globe Gluten Feed,* sent by Pierson & Kirkpatrick, Cromwell, contained 26.81 per cent. of protein and 2.78 per cent. of fat. Another sample of the same brand, **20922,** sent by Geo. W. Eaton Est., Bristol, contained 24.12 per cent. of protein. A third, **21207,** sent by Abner Hendee, New Haven, contained 25.87 per cent. of protein. Excepting the second sample, these satisfy the usual guaranty of 26 per cent. of protein.

21206. *Gluten Feed,* sent by Abner Hendee, New Haven, contained 27.44 per cent. of protein.

Three samples of *Atlantic Gluten Meal,* Atlantic Starch Works, Westport, Conn., were analyzed, **19978** and **20269** sent by the manufacturer, and **20422** sent by E. C. Birge, Westport, the first two guaranteed 38 per cent. of protein, 1 per cent. of fat; the last 30 per cent. of protein, 1 per cent. of fat. These contained respectively 42.50, 45.75 and 30.44 per cent. of protein.

20228. *Gluten Meal,* sold by Atlantic Starch Works, No. Wilbraham, Mass., through Olds & Whipple, Hartford, and sent by R. C. Hyde, Windsor, contained 73.63 per cent. of protein; guaranteed, 65 per cent.

Hominy Feed.

(ANALYSES ON PAGES 750 TO 753.)

Twenty of these feeds have been analyzed. Those sold by M. F. Barringer, Philadelphia, A. B. Porter & Son, Philadelphia, and the Quaker Oats Co., Chicago, did not have a guaranty, as required by law. Of those which complied with the law, one, sold by Wm. H. Payne & Son, New York, contained 1.3 per cent. less protein than the high guaranty of 11.49. Several others contained somewhat less fat than was guaranteed.

Hominy feed is essentially starchy, containing little more than 10 per cent. of protein.

Two samples of hominy feed, **20226**, sent by H. S. Lyman, Manchester, and **21788**, sent by Little & McKinney, So. Manchester, contained 10.00 and 10.06 per cent. of protein respectively.

Star Feed.

This material, made by the Toledo Elevator Co., has a guaranty of composition with which it corresponds. It has considerably less protein even than hominy and more than twice as much fibre, due to the presence of ground cob.

Rye Products.

(Analyses on pages 752 to 755.)

Two samples of rye feed and one of rye meal, none of which bore the required guaranty, were analyzed.

Rye feed has about the usual composition.

The rye meal ground from the whole grain has considerably less protein. We are advised that **21491** is used chiefly in the Torrington brass factories, very little of it being sold as feed.

Buckwheat Products.

(Analyses on pages 754 and 755.)

The only feed of this class is the middlings made by the Quinnebaug Mill in this State, which has the usual high percentage of protein, 30.31.

Barley Products.

(Analyses on pages 754 and 755.)

A single sample of malt sprouts from the American Malting Co., New York, showed a rather lower percentage of protein than is usual.

Dried Distiller's Grains.

(Analyses on pages 754 and 755.)

As has been explained on page 176, these grains consist of barley and corn residues and may also contain rye. They have been popular as dairy feeds on account of their high per cent. of protein and the practical results got by their use.

The four brands examined are *Ajax Flakes, Biles' Fourex Grains, Continental Gluten* and Dewey Bros. Co.'s *Distillers' Grains.*

The last-named company gives a guaranty of 45 per cent. "protein and fat," which does not meet the requirement of the law. The sum of protein and fat in the sample analyzed was only 31.81 per cent., which does not at all meet the requirement of the guaranty.

Four samples of distillers' grains were sent by purchasers. **20233** and **20234**, *Oneex or A 1 Distillers' Grains,* The J. W. Biles Co., Cincinnati, Ohio, sent by E. Manchester & Sons, Winsted, contained 23.25 and 22.12 per cent. of protein respectively; guaranteed 26 per cent. **20710**, sent by Meech & Stoddard, Middletown, guaranteed 30 per cent. protein, 15 per cent. fat, contained 24.62 per cent. of protein. **20458**, *Biles' Union Grains,* sent by Daniels Bros., Middletown, guaranteed 24 per cent. protein, contained 24.12 per cent.

Dried Brewers' Grains.

(Analyses on pages 754 and 755.)

These are the dried residue of the mash from beer brewing and consist chiefly of barley grains deprived of their starch, with some exhausted hops. The three samples have about the usual composition, those from the Farmers' Feed Co., N. Y., having 1.36 per cent. less protein than was guaranteed.

Mixed Feeds.

Wheat and Corn Cob Feeds.

(Analyses on pages 756 and 757.)

These mixtures are now generally sold under the names of *Jersey Mixed Feed* or *Jersey Middlings,* with statements on the tags that they consist of "bran, middlings and corn cob," or "low grade flour, middlings and corn cob."

Their sale as "mixed feed," unqualified or unexplained, is illegal. **21538**, from M. F. Barringer, Philadelphia, did not bear the guaranty required by law.

Flax Feed and Flax Flakes.

(Analyses on pages 756 and 757.)

Both samples bearing these very misleading names have the guaranty of 17.34 per cent. of protein and 17.37 per cent. of fat, but neither of them meet it. Moreover, both samples are full of weed seeds; screenings, which are removed from grain in order to make it marketable, now are rescued from the dump where they belong and are put on the market, mixed with other things and called "flax feed." To buy them is to buy enormous quantities of pestilent weed seeds with which to stock meadows and pastures. See special reference to the presence of weed seeds in feeds on page 736.

Corn and Oat Feeds.

(ANALYSES ON PAGES 754 TO 757.)

Here are included seven feeds, chiefly composed of corn and oat products and bearing names which in themselves suggest superior excellence and challenge comparison: *Defi, Boss, Monarch, Regal* and *Victor.*

The most valuable food ingredient in them, protein, ranges from 7.50 to 9.44 per cent., the fat from 3.27 to 4.38, and the fibre—least valuable of the ingredients—from 4.55 to 12.43. The amounts of these ingredients found in corn and oats of average quality are:

	Protein.	Fat.	Fiber.
Corn (dent)	10.3	5.0	2.2
Corn (flint)	10.5	5.0	1.7
Oats	11.8	5.0	9.5

It is clear from this statement that the feeds named are not made of corn and oats of good quality, but are residues from cleaning or manufacturing processes, and are quite inferior to either good corn or oats for feeding purposes. The retail prices of these inferior feeds range from $30.00 to $33.00 per ton and average $32.00. This is the average price of cotton seed meal and gluten feeds, which contain from two and one-half to four times as much protein as these "Monarch," "Regal," "Victor" and "Boss" mixtures.

All of them bear guaranties. The *Victor* contains 1.5 per cent. less protein and three-quarters of one per cent. less fat, and the Buffalo Cereal Co.'s *Corn and Oats* contains half a per cent. less protein and six-tenths per cent. less fat than was guaranteed in each case.

Proprietary Horse Feeds.

(ANALYSES ON PAGES 756 AND 757.)

Of the six samples examined, one, **21472**, bore no guaranty as it was being prepared for the first time and had not been on the market. The others met their protein guaranty, but four of them were below it in fat.

Sucrene Horse Feed, **21497**, contains barley, corn and wheat products, oat hulls, a little linseed meal, molasses and many weed seeds. See page 736.

Buffalo Cereal Co.'s Horse Feed consists of cracked corn, oat products and a small amount of wheat product.

Corno Horse and Mule Feed contains cracked corn, oat products and ground alfalfa.

Daisy Horse Feed contains oat product (many hulls), cotton seed meal, a little alfalfa and molasses.

Bonnie Horse Feed contains ground corn and oats.

International Sugared Horse Feed, **21578**, contains wheat and corn products, oat hulls, a little cotton seed meal, molasses and many weed seeds. See remarks on weed seeds, page 736.

Proprietary Dairy and Stock Feeds.

(ANALYSES ON PAGES 756 TO 759.)

All of these feeds bore guaranties and substantially met their requirements with exception of *Union Grains,* **21525**, which was 1 per cent. low in protein, and *Badger Dairy Feed,* **21513**, which was 2.25 per cent. low in protein.

Unicorn Dairy Ration contains cotton seed and linseed meals, wheat, corn and brewery products.

Biles' Union Grains contains linseed meal, malt sprouts, wheat bran and corn and oat products.

New England Stock Feed consists chiefly of ground corn and oats.

The Wirthmore and Haskell's Stock Feeds contain corn products and oats.

The Bonnie Dairy Feed and the Sterling and Husted Stock Feeds contain corn, oat and wheat products.

Molac Dairy Feed contains wheat, oat and corn products, weed seeds and molasses. See remarks concerning weed seeds on page 736.

Daisy Dairy Feed contains corn, oat and wheat products, malt sprouts, barley residues, some weed seeds and molasses.

Sucrene Dairy Feed contains distillery products, oat products, linseed meal, weed seeds and molasses. See remarks concerning weed seeds on page 736.

International Sugared Dairy Feed contains distillery products, a little linseed meal, oat hulls, wheat products, molasses and many weed seeds. See remarks concerning weed seeds on page 736.

Badger Dairy Feed contains distillery product, malt sprouts, oat chaff, small amount of corn product, some weed seeds and molasses.

Buffalo Creamery Feed contains corn, wheat and oat products and cotton seed meal.

Schumacher's Stock Feed contains corn, oat and barley products.

Diamond Stock Feed contains corn products, with perhaps a little cotton seed meal.

Schumacher's Calf Meal contains ground oats, linseed meal, small amounts of wheat product and cotton seed meal.

Blatchford's Calf Meal contains linseed meal, bean meal, cotton seed meal and fenugreek.

These dairy and stock feeds differ widely in composition and value. A few of them supply a well-balanced grain ration, five of them contain less protein and more woody fibre than oats or good dent corn and are therefore less valuable than the feed which can be and should be produced on the farm. The greatest problem of the dairyman is to get concentrated feed for his herd at prices which will make it possible for him to stay in the business. The use of low-grade dairy and stock feeds, made up in part of factory refuse, weed seeds and cheap molasses, and sold at the same price or nearly the same price as the standard high-grade feeds, which bring relatively large amounts of digestible protein to his stock and incidentally nitrogen to his land—the use of these low-grade feeds is in part responsible for the statement, true in too many cases, that "there is no money in the dairy business."

Dairy Feeds, sampled by Purchasers and Others.

20459. *Daisy Dairy Feed,* Great Western Cereal Co., Chicago, Ill., guaranteed 16 per cent. of protein, 3 per cent. of fat; sent by R. G. Waterous, Willimantic, contained 13.25 per cent. of protein.

20918. *Badger Dairy Feed,* sent by H. S. Lyman, Manchester, contained 14.56 per cent. of protein.

21200. *Unicorn Dairy Ration,* Ajax Milling and Feed Co., Buffalo, N. Y., guaranteed 26 per cent. of protein, 6 per cent. of fat; sent by C. E. May, East Woodstock, contained 9.78 per cent. of water, 25.94 per cent. of protein and 7.08 per cent. of fat.

21732. *Sugarota Dairy Feed,* guaranteed 18 per cent. protein, 15 per cent. fat; sent by F. B. Newton, Plainville, analyzed as follows:

Water	11.88
Ash	4.84
Protein	15.69
Fiber	10.49
Nitrogen-free Extract	52.89
Fat	4.21
	100.00

20002. *Molasses Grains,* sent by Geo. Hopson, Wallingford, contained 14.87 per cent. of protein. The sample consisted chiefly of oats, oat hulls, brewery products, cotton fibre, a few weed seeds and molasses.

21813. *Unicorn Dairy Ration,* sent by L. H. Healey, No. Woodstock, contained 27.35 per cent. of protein, agreeing closely with the analyses given on pages 756 and 757.

Proprietary Poultry Feeds.

(Analyses on pages 760 and 761.)

Of the twelve samples, all but the *Fattening Feed,* made by the Park & Pollard Co., Boston, are guaranteed as required by law. The guaranties correspond with the composition except in case of *Purina Alfalfa Meal,* which has 3.75 per cent. less protein than is guaranteed, and *Purina Mill Feed Mash,* which has 1.06 per cent. less protein.

American Poultry Feed, Park & Pollard Co.'s Growing Feed and *Fattening Feed, H. O. Poultry Feed, Buffalo Cereal Co.'s Poultry Feed* and *Bonnie Poultry Feed* consist essentially of wheat, corn and oat products.

Purina Mill Feed Mash contains corn and wheat products, ground alfalfa and some animal matter (dried blood?).

Smith, Northam & Co.'s Reliable Dry Mash Feed contains wheat bran, corn and ground alfalfa, and the *Husted Poultry Feed* contains the same things with oat products.

Park & Pollard Co.'s Dry Mash Feed contains wheat bran, corn products, oats, ground alfalfa and some animal matter.

Proprietary Poultry Feeds, sampled by Purchasers and Others.

20263. *Dry Mash,* Park & Pollard, Boston, Mass., sent by Mrs. C. C. Atwell, Durham, guaranteed 23 per cent. of protein, contained 20.62 per cent.

20264. *Growing Feed,* Park & Pollard, Boston, Mass., sent by Mrs. C. C. Atwell, Durham, contained 12.62 per cent. of protein.

21722. *Bent's Milk Albumen,* The Bent-Croissant Co., Antwerp, N. Y., guaranteed 43 per cent. of protein, 1.15 per cent. of fat; sent by F. M. Peasley, Waterbury, analyzed as follows:

Water	9.48
Ash	27.80
Protein	46.00
Fiber	1.47
Nitrogen-free Extract	13.93
Fat	1.32
	100.00

20869. *Charcoal,* sent by The Frank S. Platt Co., New Haven, contained 1.63 per cent. insoluble in hydrochloric acid; no injurious metals were found.

Meat Scrap.

Six samples of meat scrap used for poultry feed were sent by purchasers for analysis.

20232. *Evaporated Boiled Beef and Bone,* D. W. Romaine, Jersey City, N. J., sent by F. M. Peasley, Waterbury.

20495. *Beef Scrap,* C. M. Shay Fertilizer Co., Groton, sent by W. H. H. Miller, Glastonbury.

21201. *Swift's Lowell Beef Scrap,* sent by Wheeler & Co., Bridgeport.

21708. *Beef Scraps,* The L. T. Frisbie Co., Hartford, sent by F. M. Peasley, Waterbury.

21709. *Pawtucket Pure Ground Beef Scrap,* Pawtucket Rendering Co., Pawtucket, R. I., sent by F. M. Peasley, Waterbury.

21710. *Blue Ribbon Meat Scraps,* Park & Pollard, Boston, Mass., sent by F. M. Peasley, Waterbury.

	Guaranteed. Protein.	Guaranteed. Fat.	Found. Protein.	Selling Price.
20232	45	15	43.31	$46.00
20495	..	..	43.50	....
21201	..	..	52.00	....
21708	40	15	44.87	50.00
21709	50	10	50.50	50.00
21710	74	..	77.88	60.00

Miscellaneous Feeds, sampled by Station Agent.

(Analyses on pages 760 and 761.)

Aloras contains wheat middlings and wheat screenings, but appears to be free from any considerable amount of whole weed seeds.

Star Cotton Feed contains a corn product with very little if any cotton seed meal.

Miscellaneous Feeds, sampled by Purchasers and Others.

20003. *Dried Beet Pulp,* Larrowe Milling Co., New York, sent by H. D. Johnson, Highwood, contained 9.12 per cent. of protein.

20012. *Spent Hops,* sent by H. D. Johnson, Highwood, contained 4.30 per cent. of protein.

20018, made and sent by Pierson & Kirkpatrick, Cromwell, contained 26.25 per cent. of protein and 6.49 per cent. of fat.

A sample of feed without name, **20224**, sent by W. H. Cowles, Plantsville, contained 9.37 per cent. of protein.

Two small samples of the seed of *Carum copticum, Benth.,* **20496**, sent by A. E. Brunn, Woodstock, and **21795**, sent by Chas. E. Hull, Fairfield, analyzed as follows:

	20496	21795
Water	6.54	6.00
Ash	9.85	9.52
Protein	16.12	17.75
Fiber	11.37	12.34
Nitrogen-free Extract	23.49	24.90
Fat	32.63	29.49
	100.00	100.00

This is a residue left from the distillation of a volatile oil used as an aromatic and for the preparation of thymol. We know of no tests of its digestibility or healthfulness as a cattle feed. Mr. Brunn reports that it is readily eaten by poultry.

21796. *Rice "feed,"* sold by W. S. Travis, New York, sent by S. C. Ingersoll, Stamford, contained 3.57 per cent. of protein and 36.67 per cent. of fiber; it was almost entirely rice hulls and was offered at about $16.00 per ton.

21800. *Dried Milk,* sent by J. S. Gunn, Thomaston, contained 31.62 per cent. of protein and 1.27 per cent. of fat.

Summary.

The following table shows the number of samples analyzed, the numbers sold without the required guaranty and also the number which failed to meet the manufacturer's guaranty.

Class	No. of Samples.	No. with Guaranty.	No. without Guaranty.	Low in— Protein.	Fat.	Both.
Cotton Seed Meal	12	11	1	1	2	2
Linseed Meal	5	5	..	..	..	..
Wheat Bran	26	24	2	1	1	..
Wheat Middlings	26	21	5	..	3	..
Wheat Feed	34	22	12	..	5	..
Gluten Feed	22	18	4	2	2	..
Hominy Feed	20	17	3	1	4	..
Star Feed	3	3	..	..	..	..
Rye Feeds	3	..	3	..	..	..
Buckwheat Middlings	1	1	..	..	..	..
Malt Sprouts	1	1	..	..	..	1
Distillers' Grains	5	4	1	..	1	1
Brewers' Grains	3	3	..	..	..	1
Corn and Oat Feeds	7	7	..	..	1	1
Wheat and Corn Cob Feeds	3	2	1	..	..	..
Flax Feed	2	2	..	..	..	2
Horse Feeds	6	5	1	..	4	..
Dairy and Stock Feeds	22	21	1	1	2	1
Poultry Feeds	12	10	2	..	5	2
Miscellaneous	5	5	..	..	2	..
	218	182	36	6	32	11

In this tabulation deficiencies of less than 1 per cent. protein are ignored.

Digestibility of Feeding Stuffs.

Explanation regarding digestion coefficients and their use is given on pages 183 to 185 of this report. For convenience of reference the table of digestion coefficients is here repeated:

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

(Lindsley's Compilation, Eighteenth Report Massachusetts (Hatch) Agricultural Station 1905, page 240 *et seq.*)

	Protein.	Fiber.	Nitrogen-free Extract.	Fat.
Cotton Seed Meal	84	35	78	94
Linseed Meal, new process	84	74	80	89
Linseed Meal, old process	89	57	78	89
Corn Meal	66	..	92	91
Hominy Meal and Star Feed	65	67	89	92
Gluten Feed	85	76	89	83
Wheat Bran	77	39	71	63
Wheat Middlings	77	30	78	88
Wheat Mixed Feed	78	62	77	87
Rye Feed	80	..	88	90
Oats	77	31	77	89
Buckwheat Middlings	85	17	83	89
Malt Sprouts	80	34	69	100
Dried Distillers' Grains	73	95	81	95
Brewers' Grains	81	49	57	89
Quaker Dairy Feed	70	55	59	74
Corn and Oat Feed, Provender	71	48	83	87
Wheat and Corn Cob	63	28	71	92
Sucrene Dairy Feed	61	72	73	95

THE AVERAGE COMPOSITION, DIGESTIBILITY AND SELLING PRICE OF COMMERCIAL FEEDS.

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

The average quantity of nitrogen, phosphoric acid and potash contained in the feeds is shown in the table on page 191 of this report.

The feeds examined are tabulated in six groups. The following statement gives the average quantities (in pounds) of digestive protein, fiber and nitrogen-free extract and fat purchasable for one dollar in each of these groups.

NUTRIENTS PURCHASABLE FOR ONE DOLLAR.

		Protein.	Fiber and Nitrogen-free Extract.	Fat.
1	Feeds containing over 30 per cent. protein	17.3	19.3	4.6
2	" " 25 to 30 " "	13.4	28.5	2.7
3	" " 20 to 25 " "	12.4	32.4	2.4
4	" " 15 to 20 " "	8.4	30.1	2.5
5	" " 10 to 15 " "	5.5	35.5	2.7
6	" " less than 10 " "	3.7	38.2	3.0

Excluding the first, the amount of digestible fat is nearly the same in the different groups. The chief difference is in the amounts of the other two ingredients. Protein is by far the more expensive of these two, more than one-sixth of it being nitrogen, the element most generally lacking in our soils, most expensive to buy in fertilizers and most necessary to "balance" the feed of our stock.

If the feeder is mainly concerned in getting protein for his grain feed he certainly cannot afford to buy feeds of the last three groups, containing less than about 20 per cent. of nitrogen. But even if he wishes to buy starchy food, he can get more for the same money in group three than in four, and considering that he gets more than twice as much protein along with his carbohydrates in group three than in groups five and six, the economy of buying these very low protein foods even for the starchy matter in them is more than doubtful.

COMMERCIAL FEEDS, CONTAINING WEED SEEDS.

There are a number of mixtures sold as feeds in this State which contain large quantities of seeds of undesirable and pestilent weeds of which a considerable portion are alive and will, under proper conditions, promptly germinate and grow.

The weed seeds are not always quickly detected by casual inspection, because they are variously mixed with chaff and oat hulls, with linseed, barley and corn products and are often mixed or smeared with molasses.

These facts are naturally not mentioned in the statements of composition, yet they are more important to the buyer than the chemical analysis.

A moderate food value may be granted to *ground* weed seeds, or to some species of them, but it is very doubtful if small whole seeds are broken up and digested by the animal.

It has been proved that fermenting manure kills many weed seeds when they are kept in it for some time, but common experience fully justifies the belief that the farm may be stocked with weeds which come along with the manure.

Weed seeds which are scattered abundantly wherever feed and feed residues are scattered, will surely make their appearance in the fields. Thus charlock appeared last year quite abundantly on the station land, where it had not been seen for twenty-six years at least. On searching for the cause, it appeared that the junkos or snowbirds had been fed with wheat screenings on a flat roof in the neighborhood during a severe winter and the charlock seeds in the screenings had no doubt been blown from the roof to the lawn.

Within the last biennial period we have found weed seed very abundant in the feeds named in the following table.

This table shows in sufficient detail the results of a careful examination of the samples, made by Miss M. H. Jagger of this station.

There are given the total number of seeds present in each pound of the mixture or "feed" and the number of each of the four commonest and most dangerous kinds of weeds. The vitality of most of them was determined and is given in the table.

Seeds of the false foxtails or bottle grasses (*Chætochloa*), pigweeds or lambs' quarters (*Chenopodium*), knot weed or bindweed (*Polygonum*), are found abundantly in all the feeds named; black mustard and charlock (*Brassica*) are abundant in most of them, and ragweed (*Ambrosia*), the worthless panics (*Panicum capillare, filiforme and sanguinale*), sorrel and dock (*Rumex*), the common and Canada thistle and catchfly (*Silene*) are also found in most of them.

Every pound of each of these mixtures brings to the farm from five thousand to eighty-six thousand seeds, of which, in some cases a hundred, in others more than twenty-two thousand are alive.

NUMBER AND VITALITY OF WEED SEEDS IN ONE POUND OF THE FEEDS NAMED.

	Molasses grains, Mueller's.	International Sugared Dairy Feed.	Molac Dairy Feed.			Molac Horse Feed.	Sucrene Horse Feed.		Sucrene Dairy Feed.		H. J. Flax Feed.		
Cost per ton at date of sampling	$28.00	$30.00	$29.00	$31.00	$27.00	$26.00	$31.00	$32.00	$30.00	$28.00	$25.00	$28.00	$25.00
Station No.	19874	21577	19860	19847	21580	19855	19876	21497	19877	21486	19703	19761	21436
Total number of weed seeds per pound	11528	7800	5234	29324	6030	22224	8574	27100	8160	10360	48663	21267	86000
Pig weeds, number per pound	3364	4400	2217	11988	2265	2872	2509	20680	2786	7120	31752	10231	41080
" germinating	1285	1188	199	2397	521	603	27	207	128	99	13814	2250	9859
Knot weeds, number per pound	1814	1160	705	648	2355	1512‡	1622	1600	1101	1440	†	705	1040
" germinating	522	none	*	*	none	453	none	*	none	*	----	*	*
Charlock and black mustard, number per pound	378	320	300	1490	362	8316	453	160	192	80	1749	1159	1720
" germinating	*	*	*	905	*	3476	*	*	*	*	*	598	774
Bottle grasses, number per pound	5443	1520	1612	13446	670	5241	3458	4240	3466	1360	14320	8618	36440
" germinating	3810	912	none	8443	402	2568	103	509	311	453	6444	4136	13118
Other weed seeds	529	400	400	1652	378	1159	532	440	615	360	842	554	5720

* Undetermined. † None found.

‡ Besides 3124 seeds of other species of Polygonum.

Certain manufacturers claim to destroy the vitality of the weeds which they mix with feed, but in no one of those above reported has even this measure of protection to the purchaser been thoroughly done. It has been apparently attempted only in case of the sucrene feeds.

All of these weeds are characteristic of grain screenings which are the refuse separated from grain, in order to make the latter marketable or fit for milling. These screenings vary a good deal in quality. Thus an analysis recently made here of wheat screenings showed about 33 per cent. of flax and shrunken cereal, 15 per cent. of foxtails, 8 per cent. of bindweeds and pigweeds, 15 per cent. of weed seeds of other species and 21 per cent. of dust, broken seed and sand. Even such a mixture is much better than many others, which often contain very little, if any, wheat or flax.

An average price for screenings is $12.00 a ton in Chicago or $16.00 in Connecticut.

Mixed with molasses and chaff or hulls, and in some cases with really good feed materials, some of them sell at prices which are nearly as high as those paid for first-class feeds.

Made in considerable part of inferior materials and charged with weed seeds, they are dangerous on the farm.

A sample of Barley Sprouts, sent by a prospective buyer, contained:

Barley sprouts	70.5	per cent.
Weed seeds	29.5	" "
	100.0	

The weed seeds were

Corn Cockle (*Vaccaria*)	14.0	per cent.
Wild oats (*Avena fatua*)	10.0	" "
Bindweed (*Polygonum*)	2.8	" "
Four other species of weeds	2.7	" "
	29.5	

Further particulars regarding the presence of weed seeds in feeds will be found in Bulletins 156 of the Maine Station and 131 of the Vermont Station.

TABLE II.—AVERAGE COMPOSITION OF FEEDS 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 (N x 6.25.)	Fiber.	Nitrogen-free Extract (Starch, etc).	Ether Extract (fat).	Protein.	Fiber.	Nitrogen-free Extract.	Fat.	Cost per ton.
I. Protein over 30 per cent.											
Cotton Seed Meal	8.77	5.80	40.30	8.98	27.80	8.35	33.9	3.1	21.7	7.8	$32.42
Linseed Meal, old process	10.16	4.96	36.14	7.32	34.31	7.11	32.2	4.2	26.8	6.3	36.67
" " new process	10.68	5.77	34.88	8.66	36.24	3.77	29.3	6.4	29.0	3.4	35.00
H. G. Dried Distillers' Grains	7.36	2.12	32.56	11.53	32.55	13.88	23.8	11.0	26.4	13.2	33.17
Buckwheat Middlings	12.28	4.87	30.31	6.12	38.15	8.27	25.8	1.0	31.7	7.4	30.00
II. Protein 30-25 per cent.											
Continental Gluten Feed	8.05	3.21	28.06	11.39	37.88	11.41	20.5	10.8	30.7	10.8	33.00
Unicorn Dairy Ration	8.67	3.63	27.25	10.02	44.01	6.42	----	----	----	----	33.50
Gluten Feed, Pekin	8.93	3.03	26.75	7.30	52.04	1.95	22.7	5.5	46.3	1.6	33.00
" " Jenks	7.76	0.79	26.62	5.84	48.64	10.35	22.6	4.4	43.3	8.6	33.00
" " Diamond	10.22	4.63	26.50	6.52	49.69	2.44	22.5	5.0	44.2	2.0	32.00
Dried Brewers' Grains	7.70	3.51	26.29	13.69	41.95	6.86	21.3	6.7	23.9	6.1	29.67
Gluten Feed, Warner's	8.50	3.74	26.12	7.44	51.69	2.51	22.2	5.7	46.0	2.1	32.00
" " Globe	8.46	4.30	26.05	7.16	51.28	2.75	22.1	5.4	45.6	2.3	33.20
" " Buffalo	9.39	3.24	25.69	7.36	51.56	2.76	21.8	5.6	45.9	2.3	32.67
III. Protein 25-20 per cent.											
Gluten Feed, Cream of Corn	7.98	2.83	24.75	7.27	53.68	3.49	21.0	5.5	47.8	2.9	32.00
Union Grains, Biles' Ready Ration	8.47	6.05	24.35	10.18	43.78	7.17	----	----	----	----	33.00
Malt Sprouts	9.42	5.75	23.75	13.99	45.96	1.13	19.0	4.8	31.7	1.1	24.00
L. G. Distillers' Grains	9.09	3.81	23.19	10.32	44.97	8.62	16.9	9.8	36.4	8.2	32.00
Gluten Feed, Western	8.70	1.91	22.62	6.42	57.19	3.16	19.2	4.9	50.9	2.6	32.00
" " Douglass	7.59	1.29	20.12	7.97	57.61	5.42	17.1	6.1	51.3	4.5	33.50
Buffalo Creamery Feed	10.27	3.94	20.12	8.62	52.21	4.84	----	----	----	----	34.00
IV. Protein 20-15 per cent.											
Daisy Dairy Feed	9.24	7.59	19.75	9.34	51.67	2.41	----	----	----	----	31.00
Sucrene Dairy Feed	11.18	6.45	17.87	9.39	51.21	3.90	10.9	6.8	37.4	3.7	28.00
Sugared Dairy Feed	10.38	6.05	17.75	10.77	49.97	5.08	----	----	----	----	30.00

TABLE II.—AVERAGE COMPOSITION OF FEEDS AND SELLING PRICE—*Continued.*

	In 100 pounds of feed are contained pounds of						In 100 pounds of feed are contained pounds of digestible				
	Water.	Ash.	Protein (N x 6.25.)	Fiber.	Nitrogen-free Extract (Starch, etc).	Ether Extract (fat).	Protein.	Fiber.	Nitrogen-free Extract.	Fat.	Cost per ton.
Molac Dairy Feed	10.29	8.14	17.47	12.28	47.30	4.52	----	----	----	----	$27.50
Wheat Middlings	11.30	4.00	17.33	5.41	56.99	4.97	13.3	1.6	44.5	4.4	31.05
Aloras	11.20	4.92	16.62	6.96	54.32	5.98	----	----	----	----	29.00
Wheat Mixed Feed	10.71	5.13	16.19	7.06	56.19	4.72	12.6	4.4	43.3	4.1	30.36
Badger Dairy Feed	12.00	6.59	15.75	11.62	50.08	3.96	----	----	----	----	-----
Wheat Bran	10.72	6.34	15.70	9.08	53.53	4.63	12.1	3.5	38.0	2.9	28.35
Flax Feed	10.56	6.45	15.53	10.85	45.66	10.95	----	----	----	----	24.50
V. Protein 15-10 per cent.											
Sucrene Horse Feed	10.47	6.32	14.75	9.12	55.98	3.36	----	----	----	----	32.00
Sugared Horse Feed	9.99	5.47	14.75	11.90	54.10	3.79	----	----	----	----	35.00
Rye Feed	11.48	3.05	14.12	3.30	65.11	2.94	11.3	----	57.3	2.6	31.50
Daisy Horse Feed	7.44	7.48	12.87	13.64	56.77	1.80	----	----	----	----	-----
Buffalo Horse Feed	10.40	3.48	11.81	9.07	60.89	4.35	----	----	----	----	35.00
Diamond Stock Feed	9.50	2.98	11.56	9.24	60.20	6.52	----	----	----	----	30.00
Wheat and Corn Cob Feed	9.61	3.71	11.41	13.32	59.15	2.80	7.2	3.7	42.0	2.6	28.00
Schumacher's Stock Feed	9.08	4.31	11.19	10.64	60.40	4.38	----	----	----	----	35.00
Star Cotton Feed	8.46	2.80	10.94	9.02	62.63	6.15	----	----	----	----	32.00
Sterling Stock Feed	8.69	4.02	10.94	10.34	60.87	5.14	----	----	----	----	34.00
Hominy Feed	9.83	2.56	10.35	4.35	65.00	7.91	6.7	2.9	57.9	7.3	32.35
Corno Horse and Mule Feed	11.18	4.23	10.31	13.76	56.75	3.77	----	----	----	----	36.00
Wirthmore Stock Feed	8.43	3.27	10.06	6.59	63.90	7.75	----	----	----	----	33.00
VI. Protein under 10 per cent.											
Husted Stock Feed	7.94	3.26	9.62	8.61	65.01	5.56	----	----	----	----	31.00
Rye Meal	12.37	1.93	9.50	1.67	72.79	1.74	----	----	----	----	40.00
Haskell's Stock Feed	9.76	3.27	9.44	5.54	65.09	6.90	----	----	----	----	32.00
Corn and Oat Feeds	10.38	3.35	8.67	9.21	64.49	3.90	6.2	4.4	53.5	3.4	32.71
Star Feed	8.28	2.57	8.64	10.52	63.29	6.70	5.6	7.0	56.3	6.2	31.00
New England Stock Feed	9.13	3.78	8.62	10.92	63.12	4.43	----	----	----	----	32.00

Table III.—Analyses of Commercial Feeds Sampled in 1908.

Station No.	Brand.	Retail Dealer.	Analyses.						Price per ton.
			Water.	Ash.	Protein. (N x 6.25.)	Fiber.	Nitrogen-free Extract. (Starch, gum, etc.)	Ether Extract. (Fat.)	
	Oil Seed Products.								
	Cotton Seed Meal.								
21623	Eagle Brand. American Brokerage Co., Memphis, Tenn.	*Putnam:* Bosworth Bros.	9.12	6.04	38.75	8.87	29.99	7.23	$31.00
21613	Battle Brand. W. P. Battle & Co., Memphis, Tenn.	*Moosup:* T. E. Main & Sons	7.75	5.95	42.12	6.62	28.42	9.14	32.00
21555	Purity Brand. Blackstone Smith, New Orleans, La.	*Hartford:* L. C. Daniels Grain Co.	8.80	5.48	36.87	11.42	30.26	7.17	32.00
21474	——. Humphreys, Godwin & Co., Memphis, Tenn.	*Norwalk:* Holmes, Keeler & Selleck	9.39	5.76	37.75	9.46	29.83	7.81	32.00
21483	Dixie Brand. Humphreys, Godwin & Co., Memphis, Tenn.	*Waterbury:* D. L. Dickinson & Son.	9.88	5.63	36.50	11.84	28.62	7.53	33.00
21515	Dixie Brand, Humphreys, Godwin & Co., Memphis, Tenn.	*Meriden:* Meriden Grain & Feed Co.	8.12	5.75	40.25	9.92	27.59	8.37	34.00
21564	Dixie Brand. Humphreys, Godwin & Co., Memphis, Tenn.	*Hartford:* Smith, Northam & Co.	8.67	5.78	40.62	9.72	26.88	8.33	34.00
21428	Soper's Choice. J. E. Soper & Co., Boston, Mass.	*New Haven:* R. G. Davis	8.50	5.78	45.06	4.78	26.79	9.09	32.00
21532	" " " " "	*Willimantic:* E. A. Buck	8.88	6.68	41.75	8.02	25.67	9.00	33.00
21566	" " " " "	*New Britain:* C. W. Lines Co.	8.50	5.72	41.50	8.11	27.28	8.89	33.00
21630	Star Brand. J. Lindsay Wells Co., Memphis, Tenn.	*Bristol:* W. O. Goodsell	8.69	5.48	40.31	9.52	26.62	9.38	31.00
21536	No tags or analysis	*Colchester:* Colchester Grain Co.	8.95	5.55	42.12	9.42	25.70	8.26	32.00
		Average guaranty	----	----	40.73	----	----	8.09	
		Average of these 12 analyses	**8.77**	**5.80**	**40.30**	**8.98**	**27.80**	**8.35**	**32.42**
		Average digestible	----	----	**33.9**	**3.1**	**21.7**	**7.8**	
	Linseed Meal, New Process.								
21414	American Linseed Co., Chicago, Ill.	*New Haven:* Abner Hendee	10.76	5.99	33.75	8.80	37.00	3.70	36.00
21541	" " " "	*Rockville:* Edward White	10.61	5.55	36.00	8.52	35.49	3.83	34.00
		Average guaranty	----	----	33.00	----	----	1.00	
		Average of these 2 analyses	**10.68**	**5.77**	**34.88**	**8.66**	**36.24**	**3.77**	**35.00**
		Average digestible	----	----	**29.3**	**6.4**	**29.0**	**3.4**	
	Linseed Meal, Old Process.								
21531	American Linseed Co., New York	*Willimantic:* E. A. Buck	9.73	5.18	36.75	7.77	34.41	6.16	35.00
21596	Kelloggs & Miller, Amsterdam, N. Y.	*East Winsted:* F. Woodruff & Sons	10.58	4.85	37.06	6.90	33.23	7.38	37.00
21595	Mann Bros. Co., Buffalo, N. Y.	*West Winsted:* Platt & Coe	10.16	4.84	34.62	7.29	35.29	7.80	38.00
		Average guaranty	----	----	33.00	----	----	5.67	
		Average of these 3 analyses	**10.16**	**4.96**	**36.14**	**7.32**	**34.31**	**7.11**	**36.67**
		Average digestible	----	----	**32.2**	**4.2**	**26.8**	**6.3**	
	Wheat Products.								
	Bran from Winter Wheat.								
21589	Cain's Bran. The Cain Mill Co., Atchison, Kans.	*West Winsted:* E. Manchester & Sons	10.72	6.69	17.37	8.34	52.71	4.17	27.00
21563	Norfolk Bran. Chapin & Co., St. Louis	*Plainville:* G. W. Eaton	10.73	6.21	15.81	8.29	54.89	4.07	29.00
21605	Newport Bran. Chas. M. Cox Co., Boston	*Yantic:* A. R. Manning	10.27	7.49	16.87	8.39	53.14	3.84	27.00
21415	Hunter Bros. Mill Co., St. Louis	*New Haven:* Abner Hendee	10.88	6.14	15.31	7.52	54.95	5.20	29.00
21529	Empire Bran. Hunter Bros. Mill Co., St. Louis	*Willimantic:* H. A. Bugbee	12.28	6.25	14.87	7.82	54.62	4.16	27.00
21519	Climax Bran. Kansas Mill Co., Wichita, Kans.	*Middletown:* Meech & Stoddard	11.50	6.05	18.00	8.67	51.29	4.49	28.00

TABLE III.—ANALYSES OF COMMERCIAL FEEDS SAMPLED IN 1908—*Continued.*

Station No.	Brand.	Retail Dealer.	Analyses. Water.	Ash.	Protein. (N x 6.25.)	Fiber.	Nitrogen-free Extract. (Starch, gum, etc.)	Ether Extract. (Fat.)	Price per ton.
	WHEAT PRODUCTS—*Continued.* *Bran from Winter Wheat.*								
21511	Northwestern Elev. Co., Londonville, O.	*Meriden:* Meriden Grain and Feed Co.	10.53	6.61	15.00	8.52	54.50	4.84	$30.00
21507	Michigan Vimco Bran. Valley City Mill Co., Grand Rapids, Mich.	*Waterbury:* J. A. Spencer.	11.14	5.33	14.81	8.14	55.96	4.62	28.00
21558	Marquette Roller Mill Co., Marquette, Kans.	*Hartford:* Smith, Northam & Co.	9.92	6.31	19.00	8.92	51.80	4.05	30.00
		Average of these 9 analyses	**10.89**	**6.34**	**16.34**	**8.29**	**53.76**	**4.38**	**28.20**
		Average digestible	----	----	**12.6**	**3.2**	**38.2**	**2.7**	
	Bran from Spring Wheat.								
21489	Atlas Bran. Atlas Flour Mills, Milwaukee, Wis.	*Torrington:* D. L. Talcott	10.65	6.12	15.12	10.00	53.76	4.35	30.00
21627	Commander Bran. Commander Mill Co., Minneapolis	*Putnam:* F. M. Cole	9.71	6.58	14.75	9.22	55.41	4.33	28.00
21598	Eagle Roller Mill Co., New Ulm, Minn.	*Danbury:* F. C. Benjamin & Co.	10.33	6.03	15.75	10.19	52.54	5.16	27.00
21544	Eclipse Bran. Elysian Milling Co., Elysian, Minn.	*Rockville:* Rockville Mill Co.	10.91	6.12	15.50	9.98	52.28	5.21	26.00
21539	Clover Leaf Bran. Gardner Mill, Hastings, Minn.	*Stafford Springs:* G. L. Dennis	10.17	5.78	14.75	11.04	54.01	4.25	30.00
21621	Groton Milling Co., Groton, So. Dak.	*Danielson:* Young Bros. Co.	10.45	6.78	15.87	7.77	53.92	5.21	28.00
21527	Jennison Bros. & Co., Janesville, Minn.	*Willimantic:* H. A. Bugbee	10.52	6.48	16.00	9.79	52.55	4.66	26.00
21554	Fancy Bran. La Grange Mills, Red Wing, Minn.	*Hartford:* L. C. Daniels Grain Co.	10.72	7.41	14.37	11.27	51.18	5.05	33.00
21432	Waterloo and Cedar Falls Union Mills Co., Waterloo, Ia.	*New Haven:* J. T. Benham Est.	11.35	6.53	16.06	9.43	52.26	4.37	27.00
21427	Northwestern Consol. Mills Co., Minneapolis	*New Haven:* R. G. Davis	11.18	6.31	14.62	9.87	53.27	4.75	28.00
21462	Phoenix Mill Co., Minneapolis	*Bridgeport:* W. H. Terry & Co.	11.98	6.34	15.12	8.98	52.54	5.04	30.00
21458	Pillsbury's Bran, Minneapolis	*Bridgeport:* W. H. Terry & Co.	10.68	6.80	14.81	10.83	52.13	4.75	26.00
21609	Bixota Bran. Red Wing Mill Co., Red Wing, Minn.	*Norwich:* Chas. Slosberg	10.85	6.87	15.00	9.39	52.50	5.39	27.00
21616	Snow's Flaky Bran. E. S. Woodworth, Minneapolis	*Moosup:* T. E. Main & Sons	10.32	6.42	15.00	9.42	54.16	4.68	29.00
		Average of these 14 analyses	**10.70**	**6.47**	**15.19**	**9.80**	**53.04**	**4.80**	**28.44**
		Average digestible	----	----	**12.0**	**3.8**	**37.7**	**3.0**	
	Bran, unclassified.								
21452	Peerless Bran. Allen Baker Com. Co., St. Louis	*Guilford:* G. F. Walter	11.43	6.64	15.06	8.54	53.85	4.48	30.00
21585	Gilt Edge Flakes. Chapin & Co.	*Suffield:* Spencer Bros.	9.62	5.83	16.62	8.72	53.96	5.25	30.00
21592	Chas. R. Lull, Milwaukee, Wis.*	*West Winsted:* E. Manchester & Sons	10.00	4.74	16.62	7.12	57.03	4.49	27.00
	Middlings from Winter Wheat.								
21446	H. Middlings. Hecker-Jones-Jewell Mill Co., New York	*Branford:* S. V. Osborn	12.21	4.54	17.31	6.34	54.55	5.05	29.00
21419	Hunter Bros. Mill Co., St. Louis	*New Haven:* Abner Hendee	10.50	3.19	19.06	4.21	57.53	5.51	32.50
21442	Milbourne Mill Co., Philadelphia, Pa.	*Shelton:* Ansonia Flour & Grain Co.	12.86	3.68	17.62	7.06	54.96	3.82	32.00
21509	Northwestern Elev. Co., Londonville, O.	*Meriden:* Meriden Grain & Feed Co.	10.81	4.59	17.12	5.77	56.69	5.02	32.00
21449	Shorts. Southwestern Mill Co., Kansas City, Mo.	*Branford:* S. V. Osborn	11.21	5.37	21.12	5.91	51.41	4.98	30.00
21506	Choice Vimco Middlings. Valley City Mill Co., Grand Rapids, Mich.	*Waterbury:* J. A. Spencer	11.42	3.23	15.25	3.89	61.77	4.44	33.00
21611	Fancy Middlings. Williams Bros. Co., Kent, O.	*Norwich:* Norwich Grain Co.	10.76	3.47	16.12	4.39	60.57	4.69	31.00
21552	Wm. Hamilton & Son, Caledonia, N. Y.*	*Plainville:* F. B. Newton	11.66	3.01	16.75	3.44	60.41	4.73	34.00
		Average of these 8 analyses	**11.43**	**3.88**	**17.54**	**5.13**	**57.24**	**4.78**	**31.31**
		Average digestible	----	----	**13.5**	**1.5**	**44.7**	**4.2**	

* Statement of Dealer.

Table III.—Analyses of Commercial Feeds Sampled in 1908—*Continued.*

Station No.	Brand.	Retail Dealer.	Analyses.						Price per ton.
			Water.	Ash.	Protein. (N x 6.25.)	Fiber.	Nitrogen-free Extract. (Starch, gum, etc.)	Ether Extract. (Fat.)	
	Wheat Products—*Continued.* *Middlings from Spring Wheat.*								
21499	Standard Middlings. Banner Milling Co., Buffalo, N. Y.	*Litchfield:* Litchfield Grain Co.	11.11	4.39	17.25	7.74	54.42	5.09	$30.00
21501	Banner Flour Middlings. Banner Milling Co., Buffalo, N. Y.	*Litchfield:* Litchfield Grain Co.	12.19	3.61	17.37	5.41	56.50	4.92	33.00
21438	Winona Middlings. Bay State Milling Co., Winona, Minn.	*Ansonia:* Ansonia Flour & Grain Co.	10.84	4.25	18.31	6.12	55.36	5.12	30.00
21514	Boutwell Mill and Grain Co., Troy, N. Y.	*Meriden:* August Gurlich	11.74	3.37	15.37	4.47	61.76	3.29	
21586	White Middlings No. 8. Chapin & Co., Milwaukee	*Suffield:* Spencer Bros.	10.32	3.92	17.31	4.79	58.69	4.97	34.00
21629	Commander Middlings. Commander Mills, Minneapolis	*Putnam:* F. M. Cole	10.94	3.59	17.12	3.17	59.86	5.32	29.00
21492	J. G. Davis Co., Rochester, N. Y.	*Torrington:* D. L. Talcott	11.47	3.71	17.56	4.29	56.75	6.22	32.00
21543	Eclipse Standard Middlings. Elysian Mill Co., Elysian, Minn.	*Rockville:* Rockville Mill Co.	10.66	4.15	17.37	6.21	55.96	5.65	30.00
21423	Seal of Minn. New Prague Flour. Mill Co., New Prague, Minn.	*New Haven:* Abner Hendee	11.33	4.58	18.06	6.07	54.35	5.61	29.00
21537	Seal of Minn. New Prague Flour. Mill Co., New Prague, Minn.	*Colchester:* Colchester Grain Co.	10.50	4.56	18.37	7.14	53.29	6.14	28.00
21453	Pillsbury's B Middlings, Minneapolis	*Wallingford:* E. E. Hall	11.77	5.24	16.56	7.78	53.90	4.75	29.00
21478	Pillsbury's A Middlings, Minneapolis	*New Milford:* F. R. Green	11.15	4.53	17.25	5.32	56.98	4.77	32.00
21603	Fine Middlings. Sheffield King Mill Co., Minneapolis	*New London:* P. Schwartz	10.08	4.62	17.37	6.64	55.83	5.46	30.00
21561	Star and Crescent Milling Co., Chicago	*Plainville:* G. W. Eaton	11.03	4.18	16.37	6.94	56.42	5.06	33.00
21457	Standard Middlings. Washburn-Crosby Co., Minneapolis	*Bridgeport:* W. H. Terry & Co.	11.64	5.19	16.94	7.69	53.47	5.07	28.00
		Average of these 15 samples	**11.12**	**4.27**	**17.24**	**5.99**	**56.22**	**5.16**	**30.50**
		Average digestible	----	----	**13.3**	**1.8**	**43.9**	**4.5**	
	Middlings, unclassified.								
21451	Liberty Middlings. Allen Baker Com. Co., St. Louis	*Guilford:* G. F. Walter	12.26	3.26	16.69	4.22	58.86	4.71	31.00
21588	Chas. R. Lull. Milwaukee, Wis.	*West Winsted:* E. Manchester & Sons	10.77	3.62	17.44	4.49	58.59	5.09	
	Mixed Feed from Winter Wheat.								
21562	Acme Feed. Acme Mill Co., Indianapolis, Ind.	*Plainville:* G. W. Eaton	10.94	5.73	17.12	7.49	54.13	4.59	30.00
21540	Apex Fancy. Allen Baker Co., St. Louis	*Rockville:* Edward White	10.45	5.66	16.25	7.22	55.78	4.64	30.00
21443	Bull's Eye. Blish Mill Co., Seymour, Ind.	*Derby:* Peterson-Hendee Co.	11.14	6.05	16.37	3.49	58.40	4.55	31.00
21510	Harter's. The Harter Milling Co., Toledo, O.	*Meriden:* Meriden Grain & Feed Co.	10.56	4.64	15.37	7.39	57.57	4.47	32.00
21425	Queen. Hecker-Jones-Jewell Mill Co., New York	*New Haven:* R. G. Davis	9.26	5.62	14.94	8.19	57.38	4.61	28.00
21571	Manhattan. Hecker-Jones-Jewell Mill Co., New York	*Hamden:* J. W. Beers	10.30	5.54	16.62	7.99	54.68	4.87	29.00
21444	Matchless. Hunter Bros. Mill Co., St. Louis	*Derby:* Peterson-Hendee Co.	11.57	5.52	15.31	6.55	56.37	4.68	31.00
21495	Sunshine. " " "	*Torrington:* F. U. Wadhams	10.36	5.81	15.75	7.49	55.69	4.90	32.00
21434	Kehlor. Kehlor Mills Co., St. Louis	*New Haven:* J. T. Benham Est.	11.19	5.93	16.00	7.58	54.90	4.40	27.00
21494	Snowflake. Lawrenceburg Mill Co., Lawrenceburg, Ind.	*Torrington:* F. U. Wadhams	10.51	5.26	15.31	6.99	57.47	4.46	32.00
21579	Uniform. The O. L. Marshall Mill Co., Buffalo, N. Y.	*New Britain:* Stanley-Svea Grain Co.	10.71	4.00	16.37	6.62	58.30	4.00	33.00

Table III.—Analyses of Commercial Feeds Sampled in 1908—*Continued.*

Station No.	Brand.	Retail Dealer.	Water.	Ash.	Protein. (N x 6.25.)	Fiber.	Nitrogen-free Extract. (Starch, gum, etc.)	Ether Extract. (Fat.)	Price per ton.
	Wheat Products—*Concluded.* *Mixed Feed from Winter Wheat.*								
21424	Milbourne. Milbourne Mill Co., Philadelphia, Pa.	*New Haven:* R. G. Davis	11.10	4.68	14.87	5.77	58.91	4.67	$29.00
21608	Pennant. National Milling Co., Toledo, O.	*Yantic:* A. R. Manning	10.44	4.58	15.37	6.14	59.32	4.15	31.00
21488	Buckeye. Quaker Oat Co., Chicago	*Thomaston:* L. E. Blackmer	11.63	4.67	16.19	6.69	56.30	4.52	33.00
21559	" " " "	*Southington:* Southington Lumber Co.	10.54	5.41	16.37	8.47	54.61	4.60	32.00
21480	Regular. Henry Russell (Agt.), Albany, N. Y.	*New Milford:* Ackley, Hatch & Marsh	11.75	4.16	16.56	6.98	55.81	4.74	31.00
21597	Try-Me. Sparks Milling Co., Alton, Ill.	*Danbury:* F. C. Benjamin & Co.	10.39	5.95	17.75	7.27	54.09	4.55	27.00
21550	Superior. F. W. Stock & Co., Hillsdale, Mich.	*Bristol:* W. O. Goodsell	11.50	5.01	15.06	7.09	56.95	4.39	31.00
21530	Honest. David Stott, Detroit, Mich.	*Willimantic:* E. A. Buck	10.61	4.46	15.00	6.94	58.42	4.57	30.00
21535	Thornton & Chester Mill Co,, Buffalo, N. Y.	*Colchester:* Colchester Grain Co.	10.82	4.93	16.75	8.04	54.49	4.97	28.00
21505	Vimco Mixed Cow Feed. Valley City Mill Co., Grand Rapids, Mich.	*Waterbury:* J. A. Spencer	10.82	4.84	14.69	6.89	58.10	4.66	30.00
21545	Wagoner-Gates Mill Co., Independence, Mo.	*Manchester:* Little & McKinney	11.35	5.38	17.62	7.12	54.20	4.33	30.00
		Average of these 22 analyses	**10.82**	**5.17**	**15.98**	**7.02**	**56.45**	**4.56**	**30.32**
		Average digestible	----		**12.5**	**4.4**	**43.5**	**4.0**	
	Mixed Feed from Spring Wheat.								
21482	Winona. Bay State Mill Co., Winona, Minn.	*Waterbury:* D. L. Dickinson & Son	11.43	4.71	17.06	6.70	55.49	4.61	31.00
21584	Vermont Brand. Chapin & Co., Milwaukee	*Suffield:* Spencer Bros.	9.43	5.23	16.87	6.74	56.29	5.44	34.00
21626	Claro. Claro Milling Co., Lakeville, Minn.	*Putnam:* Bosworth Bros.	10.44	5.27	16.94	7.17	55.19	4.99	28.00
21628	Commander. Commander Mills, Minneapolis	*Putnam:* F. M. Cole	10.42	5.22	17.50	6.67	54.70	5.49	30.00
21542	Boston. Duluth Superior Mill Co., Duluth, Minn.	*Rockville:* Rockville Milling Co.	11.21	4.59	16.06	7.40	55.76	4.98	30.00
21569	C. R. Lull & Co., Milwaukee	*East Haven:* F. A. Forbes	9.91	6.14	16.75	8.97	52.55	5.68	28.00
21500	Northwestern Consol. Mill Co., Minneapolis	*Litchfield:* Litchfield Grain Co.	11.00	5.39	16.87	7.72	54.18	4.84	32 00
21476	Fancy. Pillsbury, Minneapolis	*New Milford:* F. R. Green	10.64	5.46	15.94	6.45	56.87	4.64	32.00
21624	Occident. Russell Milling Co., Minneapolis	*Putnam:* Bosworth Bros.	10.31	4.47	16.56	5.79	57.86	5.01	28.00
21437	Gold Mine. Sheffield King Mill Co., Minneapolis	*Ansonia:* Ansonia Flour & Grain Co.	10.52	5.30	16.37	7.24	55.61	4.96	31.00
21526	Sleepy Eye Milling Co., Sleepy Eye, Minn.	*Willimantic:* H. A. Bugbee	9.93	4.25	16.00	7.79	57.28	4.75	29.00
21477	Superior. Washburn-Crosby Co., Minneapolis	*New Milford:* F. R. Green	10.94	4.76	16.00	6.77	56.77	4.76	32.00
		Average of these 12 analyses	**10.51**	**5.07**	**16.58**	**7.12**	**55.71**	**5.01**	**30.42**
		Average digestible	----	----	**12.9**	**4.4**	**42.9**	**4.4**	
	Red Dog Flour.								
21484	Bay State Mill Co., Winona, Minn.	*Waterbury:* D. L. Dickinson & Son	12.37	2.05	17.62	1.22	63.08	3.66	34.00
	Maize Products. *Gluten Feed.*								
21435	Buffalo Gluten Feed. Corn Products Co., Chicago*	*New Haven:* J. T. Benham Est.	9.77	3.41	23.37	6.77	53.81	2.87	32.00
21448	" " " " "	*Branford:* S. V. Osborn	9.67	3.01	26.62	7.38	50.26	3.06	32.00
21454	" " " " " *†	*Wallingford:* E. E. Hall	9.22	4.87	26.06	6.24	50.92	2.69	32.00
21470	" " " " "	*So. Norwalk:* M. T. Hatch	9.19	3.13	26.31	7.14	51.71	2.52	34.00
21548	" " " " " ‡	*Bristol:* W. O. Goodsell	10.37	4.18	25.00	7.64	49.99	2.82	34.00
21583	" " " " "	*Thompsonville:* H. K. Brainard	8.10	0.83	26.75	8.97	52.75	2.60	32.00
		Average guaranty	----	----	**23.67**	----	----	**2.50**	
		Average of these 6 analyses	**9.39**	**3.24**	**25.69**	**7.36**	**51.56**	**2.76**	**32.67**
		Average digestible	----	----	**21.8**	**5.6**	**45.9**	**2.3**	

* From C. M. Cox Co., Boston. † Statement of dealer.
‡ Labeled "Artificially colored."

TABLE III.—ANALYSES OF COMMERCIAL FEEDS SAMPLED IN 1908—*Continued.*

Station No.	Brand.	Retail Dealer.	Analyses. Water.	Ash.	Protein. (N x 6.25.)	Fiber.	Nitrogen-free Extract. (Starch, gum, etc.)	Ether Extract. (Fat.)	Price per ton.
	MAIZE PRODUCTS—*Continued.* *Gluten Feed.*								
21456	Cream of Corn Gluten Feed. American Maize Products Co., New York	*Bridgeport:* W. H. Terry & Co.	7.98	2.83	24.75	7.27	53.68	3.49	$32.00
		Guaranty	----	----	23.00	----	----	2.50	
		Digestible	----	----	21.0	5.5	47.8	2.9	
21604	Diamond Gluten Feed. Corn Products Co., Chicago*	*New London:* Beebe & Bragaw	10.22	4.63	26.50	6.52	49.69	2.44	32.00
		Guaranty	----	----	23.00	----	----	2.50	
		Digestible	----	----	22.5	5.0	44.2	2.0	
21518	Gluten Feed. Douglass & Co., Cedar Rapids, Ia.†	*Middletown:* Meech & Stoddard	7.59	1.29	20.12	7.97	57.61	5.42	33.50
		Guaranty	----	----	23.00	----	----	4.00	
		Digestible	----	----	17.1	6.1	51.3	4.5	
21416	Globe Gluten Feed. Corn Products Co., New York†	*New Haven:* Abner Hendee	8.05	4.28	25.87	6.71	52.42	2.67	32.00
21439	" " " " " " " *	*Ansonia:* Ansonia Flour and Grain Co.	9.58	4.12	26.00	6.91	51.01	2.38	35.00
21490	" " " " " " " *	*Torrington:* D. L. Talcott	7.98	4.52	26.94	6.78	51.62	2.16	32.00
21502	" " " " " " " *	*Litchfield:* Litchfield Grain Co.	8.60	4.73	26.37	8.33	48.84	3.13	33.00
21549	" " " " " " Chicago†	*Bristol:* W. O. Goodsell	8.10	3.84	25.06	7.09	52.51	3.40	34.00
		Average guaranty	----	----	25.25	----	----	2.50	
		Average of these 5 analyses	8.46	4.30	26.05	7.16	51.28	2.75	33.20
		Average digestible	----	----	22.1	5.4	45.6	2.3	
21593	Jenks Gluten Feed. Huron Mill. Co., Harbor Beach, Mich.	*West Winsted:* Platt & Coe	7.76	0.79	26.62	5.84	48.64	10.35	33.00
		Guaranty	----	----	27.00	----	----	7.50	
		Digestible	----	----	22.6	4.4	43.3	8.6	
21469	Pekin Gluten Feed. Corn Products Co., Chicago	*Stamford:* W. L. Crabb	8.93	3.03	26.75	7.30	52.04	1.95	33.00
		Guaranty	----	----	24.00	----	----	2.50	
		Digestible	----	----	22.7	5.5	46.3	1.6	
21570	Warner Gluten Feed. Corn Products Co., Chicago†	*East Haven:* F. A. Forbes	8.50	3.74	26.12	7.44	51.69	2.51	32.00
		Digestible	----	----	22.2	5.7	46.0	2.1	
21615	Western Gluten Feed. Western Glucose Co., Chicago	*Moosup:* T. E. Main & Sons	8.70	1.91	22.62	6.42	57.19	3.16	32.00
		Guaranty	----	----	23.00	----	----	2.50	
		Digestible	----	----	19.2	4.9	50.9	2.6	
21573	Gluten Feed. American Maize Products Co., N.Y.†	*Westville:* W. E. Warner & Bro.	8.49	2.23	24.44	8.09	53.66	3.09	31.00
		Digestible	----	----	20.8	6.1	47.8	2.6	
21487	Gluten Feed. Corn Products Co., New York†	*Thomaston:* L. E. Blackmer	7.76	5.17	28.19	6.64	50.23	2.01	34.00
		Guaranty	----	----	24.00	----	----	2.50	
		Digestible	----	----	24.0	5.0	44.7	1.7	
21516	Gluten Feed. Muns Bros., New York†	*Middletown:* Meech & Stoddard	8.75	1.45	22.75	8.39	54.93	3.73	32.00
		Guaranty	----	----	24.00	----	----	2.50	
		Digestible	----	----	19.3	6.4	48.9	3.1	
21553	Gluten Feed. J. E. Soper & Co., Boston†	*Hartford:* L. C. Daniels Grain Co	7.20	1.44	21.62	7.84	56.81	5.09	33.00
		Digestible	----	----	18.4	6.0	50.6	4.2	
	Hominy Feed.								
21520	American Hominy Co., Indianapolis, Ind.†	*Middletown:* Meech & Stoddard	10.19	2.45	10.12	4.62	64.37	8.25	32.00
21556	" " " " "	*Hartford:* L. C. Daniels Grain Co.	9.31	2.67	10.44	4.14	65.28	8.16	32.00
		Guaranty	----	----	8.75	----	----	7.00	
		Average of these 2 analyses	9.75	2.56	10.28	4.38	64.82	8.21	32.00
		Average digestible	----	----	6.7	2.9	57.7	7.6	

* Labeled "Artificially colored." † Statement of Dealer.

TABLE III.—ANALYSES OF COMMERCIAL FEEDS SAMPLED IN 1908—*Continued.*

Station No.	Brand.	Retail Dealer.	Analyses. Water.	Ash.	Protein. (N x 6.25.)	Fiber.	Nitrogen-free Extract. (Starch, gum, etc.)	Ether Extract. (Fat.)	Price per ton.
	MAIZE PRODUCTS—*Concluded.* *Hominy Feed.*								
21581	American Cereal Co., Chicago	*Thompsonville:* H. K. Brainard	8.25	2.59	11.37	4.64	64.51	8.64	$33.00
21504	M. F. Baringer, Philadelphia*	*Waterbury:* D. L. Dickinson & Son	9.55	2.66	10.94	4.49	63.83	8.53	33.00
21468	Buffalo Cereal Co., Buffalo, N. Y.	*Stamford:* W. L. Crabb	10.65	2.03	9.37	3.42	67.92	6.61	33.00
21508	" " " " "	*Meriden:* A. H. Cashen	10.72	2.37	10.25	3.94	65.49	7.23	33.00
		Guaranty	----	----	**10.25**	----	----	**8.00**	
		Average of these 2 analyses	**10.68**	**2.20**	**9.81**	**3.68**	**66.71**	**6.92**	**33.00**
		Average digestible	----	----	**6.4**	**2.5**	**59.4**	**6.4**	
21433	Wirthmore. Chas. M. Cox Co., Boston	*New Haven:* J. T. Benham Est.	11.37	2.68	10.12	4.06	64.09	7.68	32.00
21455	" " " " " " *	*Wallingford:* E. E. Hall	10.04	2.72	10.19	4.27	65.16	7.62	32.00
		Guaranty	----	----	**9.50**	----	----	**7.50**	
		Average of these 2 analyses	**10.70**	**2.70**	**10.16**	**4.16**	**64.63**	**7.65**	**32.00**
		Average digestible	----	----	**6.6**	**2.8**	**57.5**	**7.0**	
21481	Evans Milling Co., Indianapolis, Ind.	*Bethel:* Johnson & Morrison	9.84	2.70	10.00	4.53	63.79	9.14	32.00
21607	" " " " "	*Yantic:* A. R. Manning	9.79	2.78	10.69	4.72	63.13	8.89	31.00
		Guaranty	----	----	**10.00**	----	----	**7.75**	
		Average of these 2 analyses	**9.81**	**2.74**	**10.35**	**4.62**	**63.46**	**9.02**	**31.50**
		Average digestible	----	----	**6.7**	**3.1**	**56.5**	**8.3**	
21614	Lenox. R. J. Hardy & Sons, Boston	*Moosup:* T. E. Main & Sons	9.10	2.35	10.62	4.14	65.76	8.03	32.00
21546	Husted Milling Co., Buffalo, N. Y.	*Manchester:* G. W. Kuhney	9.86	2.99	10.25	5.21	62.56	9.13	32.00
21575	Steam-Cooked. Miner-Hilliard Mill. Co., Wilkes-barre, Pa.	*East Hartford:* G. M. White & Co.	10.49	2.71	10.69	4.82	63.23	8.06	33.00
21498	Miner-Hilliard Mill. Co., Wilkesbarre, Pa.*	*Torrington:* F. U. Wadham	10.26	2.61	10.12	4.24	64.99	7.78	34.00
		Average guaranty	----	----	**10.00**	----	----	**7.25**	
		Average of these 2 analyses	**10.37**	**2.66**	**10.41**	**4.53**	**64.11**	**7.92**	**33.50**
		Average digestible	----	----	**6.8**	**3.0**	**57.1**	**7.3**	
21551	The Patent Cereals Co., Geneva, N. Y.	*Bristol:* G. W. Eaton	10.87	2.33	10.00	4.15	65.70	6.95	33.00
21465	Wm. H. Payne & Son, New York	*New Canaan:* C. H. Fairty	9.71	2.35	10.62	3.56	66.35	7.41	32.00
21524	" " " " "	*Willimantic:* H. A. Bugbee	8.92	2.34	10.19	3.59	67.84	7.12	32.00
21599	" " " " "	*Danbury:* F. C. Benjamin & Co.	9.50	2.33	10.25	3.41	67.28	7.23	32.00
		Average guaranty	----	----	**11.16**	----	----	**8.00**	
		Average of these 3 analyses	**9.38**	**2.34**	**10.35**	**3.52**	**67.16**	**7.25**	**32.00**
		Average digestible	----	----	**6.7**	**2.4**	**59.8**	**6.7**	
21590	A. B. Porter & Son, Philadelphia*	*West Winsted:* E. Manchester & Sons	9.79	2.52	10.00	4.19	65.98	7.52	32.00
21631	Quaker Oats Co., Chicago*	*Bristol:* W. O. Goodsell	8.36	3.11	10.69	6.84	62.70	8.30	32.00
		Average guaranty of all	----	----	**9.97**	----	----	**7.50**	
		Average of all (20) analyses	**9.83**	**2.56**	**10.35**	**4.35**	**65.00**	**7.91**	**32.35**
		Average digestible	----	----	**6.7**	**2.9**	**57.9**	**7.3**	
21521	Star Feed. Toledo Elevator Co., Toledo, O.	*Middletown:* Meech & Stoddard	7.87	2.66	8.37	11.49	62.81	6.80	31.00
21594	" " " " " " "	*West Winsted:* Platt & Coe	8.37	2.38	9.00	10.84	62.73	6.68	32.00
21622	" " " " " " "	*Danielson:* Young Bros. Co.	8.60	2.68	8.56	9.24	64.30	6.62	30.00
		Guaranty	----	----	**7.00**	----	----	**6.50**	
		Average of these 3 analyses	**8.28**	**2.57**	**8.64**	**10.52**	**63.29**	**6.70**	**31.00**
		Average digestible	----	----	**5.6**	**7.0**	**56.3**	**6.2**	
	RYE PRODUCTS.								
21417	Dandy Rye Feed. Bouttell Mill. & Grain Co., Troy, N. Y.	*New Haven:* Abner Hendee	11.01	3.16	14.62	3.42	64.71	3.08	29.00

*Statement of Dealer.

TABLE III.—ANALYSES OF COMMERCIAL FEEDS SAMPLED IN 1908—*Continued.*

Station No.	Brand.	Retail Dealer.	Analyses.						Price per ton.
			Water.	Ash.	Protein. (N x 6.25.)	Fiber.	Nitrogen-free Extract. (Starch, gum, etc.)	Ether Extract. (Fat.)	
	RYE PRODUCTS—*Concluded.*								
21491	Rye Feed. H. D. Stone Mill. Co., Rochester, N. Y.*	*Torrington:* D. L. Talcott	11.96	2.94	13.62	3.17	65.51	2.80	$34.00
21528	Rye Meal	*Willimantic:* H. A. Bugbee	12.37	1.93	9.50	1.67	72.79	1.74	40.00
	BUCKWHEAT PRODUCTS.								
21618	Buckwheat Middlings	*Danielson:* Quinebaug Grist Mill	12.28	4.87	30.31	6.12	38.15	8.27	30.00
		Digestible	----	----	25.8	1.0	31.7	7.4	
	BARLEY PRODUCTS. *Malt Sprouts.*								
21429	American Malting Co., New York	*New Haven:* R. G. Davis	9.42	5.75	23.75	13.99	45.96	1.13	24.00
		Guaranty	----	----	25.00	----	----	2.00	
		Digestible	----	----	19.0	4.8	31.7	1.1	
	Dried Distillers' Grains.								
21582	Ajax Flakes. Ajax Mill. & Feed Co., New York	*Thompsonville:* H. K. Brainard	6.89	3.23	32.87	11.94	33.73	11.34	33.50
21610	" " " " " " "	*Norwich:* Chas. Slosberg	7.68	1.50	31.75	11.42	33.00	14.65	33.00
		Average guaranty	----	----	31.00	----	----	12.00	
		Average of these 2 analyses	7.28	2.37	32.31	11.68	33.36	13.00	
21612	Biles Fourex Grains. The J. W. Biles Co., Cincinnati, O.	*Norwich:* Norwich Grain Co.	7.52	1.63	33.06	11.22	30.91	15.66	33.00
		Guaranty	----	----	33.00		----	11.00	
21591	Continental Gluten Feed. Continental Cereal Co., Peoria, Ill.*	*West Winsted:* E. Manchester & Son	8.05	3.21	28.06	11.39	37.88	11.41	33.00
21517	Distillers' Grains. Dewey Bros. Co., Blanchester, O.*	*Middletown:* Meech & Stoddard	9.09	3.81	23.19	10.32	44.97	8.62	32.00
		Average guaranty of 5 samples	----	----	31.67	----	----	11.67	
		Average of these 5 analyses	7.84	2.68	29.79	11.25	36.10	12.34	32.90
		Average digestible	----	----	21.7	10.7	29.2	11.7	
	Dried Brewers' Grains.								
21587	Anheuser-Busch Co., St. Louis	*Suffield:* Arthur Sikes	7.69	3.66	26.87	13.22	41.29	7.27	28.00
		Guaranty	----	----	24.00	----	----	7.50	
21475	Farmers' Feed Co., New York	*Norwalk:* Holmes, Keeler & Selleck	8.28	3.49	24.94	14.09	42.34	6.86	32.00
		Guaranty	----	----	26.30	----	----	7.60	
21606	Jos. Schlitz Brewery, Milwaukee	*Yantic:* A. R. Manning	7.13	3.37	27.06	13.77	42.23	6.44	29.00
		Guaranty	----	----	21.50	----	----	6.50	
		Average of these 3 samples	7.70	3.51	26.29	13.69	41.95	6.86	29.67
		Average digestible	----	----	21.3	6.7	23.9	6.1	
	MIXED FEEDS. *Corn and Oat Feeds.*								
21441	Chop Feed. Buffalo Cereal Co., Buffalo, N. Y.	*Shelton:* Ansonia Flour and Grain Co.	11.33	2.54	8.87	6.52	66.99	3.75	33.00
		Guaranty	----	----	7.50	----	----	3.50	
		Digestible	----	----	6.3	3.1	55.6	3.3	
21496	Corn and Oats. Buffalo Cereal Co., Buffalo, N. Y.	*Torrington:* F. U. Wadhams	12.00	2.01	9.44	4.55	67.62	4.38	33.00
		Guaranty	----	----	10.00	----	----	5.00	
		Digestible	----	----	6.7	2.2	56.1	3.8	
21420	De Fi Corn and Oat Feed. F. Ellsworth & Co., Buffalo, N. Y.	*New Haven:* Abner Hendee	8.48	4.34	8.75	11.94	62.94	3.55	32.00
		Guaranty	----	----	8.30	----	----	3.00	
		Digestible	----	----	6.2	5.7	52.2	3.1	
21418	Boss Chop Feed. Great Western Cereal Co., Chicago	*New Haven:* Abner Hendee	11.67	3.36	8.44	8.64	63.72	4.17	32.00
		Guaranty	----	----	8.00	----	----	2.50	
		Digestible	----	----	6.0	4.1	52.9	3.6	

* Statement of Dealer.

TABLE III.—ANALYSES OF COMMERCIAL FEEDS SAMPLED IN 1908—*Continued.*

Station No.	Brand.	Retail Dealer.	Analyses. Water.	Ash.	Protein. (N x 6.25.)	Fiber.	Nitrogen-free Extract. (Starch, gum, etc.)	Ether Extract. (Fat.)	Price per ton.
	MIXED FEEDS—*Continued.* *Corn and Oat Feeds.*								
21479	Monarch Chop Feed. Husted Mill Co., Buffalo, N. Y.	*New Milford:* Ackley, Hatch & Marsh	10.88	3.80	9.12	9.78	62.56	3.86	$32.00
		Guaranty	----	----	7.50	----	----	3.00	
		Digestible			6.5	4.7	51.9	3.4	
21601	Regal Chop Feed. Husted Mill Co., Buffalo, N. Y.	*New London:* P. Schwartz	8.87	3.39	8.56	10.62	64.24	4.32	30.00
		Guaranty	----	----	7.00	----	----	3.00	
		Digestible	----	----	6.1	5.1	53.3	3.8	
21422	Victor Feed. Quaker Oats Co., Chicago	*New Haven:* Abner Hendee	9.45	4.00	7.50	12.43	63.35	3.27	32.00
		Guaranty	----	----	9.00	----	----	4.00	
		Digestible			5.3	6.0	52.6	2.8	
		Average all Corn and Oat Feeds (7)	10.38	3.35	8.67	9.21	64.49	3.90	32.71
		Average Digestible	----	----	6.2	4.4	53.5	3.4	
	Wheat and Corn Cob Feeds.								
21538	Jersey Mixed Feed. M. F. Baringer, Philadelphia*	*Colchester:* Colchester Grain Co.	9.04	4.46	11.62	15.14	56.98	2.76	25.00
21619	Jersey Middlings. Indiana Milling Co., Terre Haute, Ind.	*Danielson:* Young Bros. Co.	9.99	2.07	10.75	11.02	63.87	2.30	31.00
21421	Jersey Mixed Feed. Indiana Milling Co., Terre Haute, Ind.	*New Haven:* Abner Hendee	9.81	4.59	11.87	13.79	56.60	3.34	28.00
		Guaranty	----	----	10.00	----	----	2.00	
		Average of these 3 analyses	9.61	3.71	11.41	13.32	59.15	2.80	28.00
		Digestible			7.2	3.7	42.0	2.6	
	Flax Feed.								
21436	H. J. Flax Feed. H. Jennings	*Ansonia:* Ansonia Flour and Grain Co.	10.71	6.75	15.19	11.48	46.53	9.34	25.00
21568	Ground Flax Flakes. C. R. Lull & Co., Milwaukee	*East Haven:* F. A. Forbes	10.42	6.15	15.87	10.22	44.78	12.56	24.00
		Guaranty	----	----	17.34	----	----	17.37	
		Average of these 2 analyses	10.56	6.45	15.53	10.85	45.66	10.95	24.50
	Proprietary Horse Feeds.								
21497	Sucrene Horse Feed. American Mill Co., Chicago	*Torrington:* F. U. Wadhams	10.47	6.32	14.75	9.12	55.98	3.36	32.00
		Guaranty	----	----	13.50	----	----	3.00	
21426	Horse Feed. Buffalo Cereal Co., Buffalo, N. Y.	*New Haven:* R. G. Davis	10.40	3.48	11.81	9.07	60.89	4.35	35.00
		Guaranty	----	----	12.00	----	----	4.50	
21461	Horse and Mule Feed. Corno Mills Co., East St. Louis	*Bridgeport:* W. H. Terry & Co.	11.18	4.23	10.31	13.76	56.75	3.77	36.00
		Guaranty	----	----	10.00	----	----	5.50	
21557	Daisy Horse Feed. Great Western Cereal Co., Chicago	*Hartford:* L. C. Daniels Grain Co.	7.44	7.48	12.87	13.64	56.77	1.80	
		Guaranty	----	----	12.00	----	----	3.50	
21472	Bonnie Horse Feed	*So. Norwalk:* M. T. Hatch	11.60	2.08	10.50	3.87	67.89	4.06	34.00
21578	Sugared Horse Feed. International Sugar Feed Co., Minneapolis	*New Britain:* Stanley-Svea Grain Co.	9.99	5.47	14.75	11.90	54.10	3.79	35.00
		Guaranty	----	----	12.50	----	----	5.00	
	Proprietary Dairy and Stock Feeds.								
21560	Unicorn Dairy Ration. Ajax Mill and Feed Co., Buffalo, N. Y.	*Plainville:* G. W. Eaton	9.15	3.46	27.25	9.57	44.03	6.54	34.00
21567	Unicorn Dairy Ration. Ajax Mill and Feed Co., Buffalo, N. Y.	*East Haven:* F. A. Forbes	8.19	3.81	27.25	10.47	43.98	6.30	33.00
		Guaranty	----	----	26.00	----	----	6.00	
		Average of these 2 analyses	8.67	3.63	27.25	10.02	44.01	6.42	33.50

* Statement of Dealer.

TABLE III.—ANALYSES OF COMMERCIAL FEEDS SAMPLED IN 1908—*Continued.*

Station No.	Brand.	Retail Dealer.	Analyses. Water.	Ash.	Protein. (N x 6.25.)	Fiber.	Nitrogen-free Extract. (Starch, gum, etc.)	Ether Extract. (Fat.)	Price per ton.
	MIXED FEEDS—*Continued.* *Proprietary Dairy and Stock Feeds.*								
21486	Sucrene Dairy Feed. American Mill Co., Chicago	*Thomaston:* L. E. Blackmer	11.18	6.45	17.87	9.39	51.21	3.90	$28.00
		Guaranty	----	----	16.50	----	----	3.50	
		Digestible	----	----	10.9	6.8	37.4	3.7	
21503	Union Grains, Ready Ration. The J. W. Biles Co., Cincinnati, O.	*Waterbury:* D. L. Dickinson & Son	8.60	6.30	23.87	10.67	43.55	7.01	33.00
21525	Union Grains, Ready Ration. The J. W. Biles Co., Cincinnati, O.	*Willimantic:* H. A. Bugbee	8.50	6.04	23.00	10.24	44.70	7.52	32.00
21547	Union Grains, Ready Ration. The J. W. Biles Co., Cincinnati, O.	*Southington:* Thos. Holt	8.31	5.81	26.19	9.64	43.08	6.97	34.00
		Guaranty	----	----	24.00	----	----	7.00	
		Average of these 3 analyses	**8.47**	**6.05**	**24.35**	**10.18**	**43.78**	**7.17**	**33.00**
21493	Calf Meal. Blatchford's Calf Meal Fact., Waukegan, Ill.	*Torrington:* D. L. Talcott	10.53	4.40	27.62	5.02	47.28	5.15	70.00
		Guaranty	----	----	25.00	----	----	5.00	
21512	Creamery Feed. Buffalo Cereal Co., Buffalo, N.Y.	*Meriden:* Meriden Grain and Feed Co.	10.27	3.94	20.12	8.62	52.21	4.84	34.00
		Guaranty	----	----	20.00	----	----	5.00	
21534	Wirthmore Stock Feed. Chas. M. Cox Co., Boston	*Colchester:* Colchester Grain Co.	8.43	3.27	10.06	6.59	63.90	7.75	33.00
		Guaranty	----	----	10.00	----	----	4.00	
21464	Daisy Dairy Feed. Great Western Cereal Co., Chicago	*New Canaan:* C. H. Fairty	9.24	7.59	19.75	9.34	51.67	2.41	31.00
		Guaranty	----	----	14.00	----	----	3.00	
21450	Sterling Stock Feed. Great Western Cereal Co., Chicago	*Guilford:* G. F. Walter	8.69	4.02	10.94	10.34	60.87	5.14	34.00
		Guaranty	----	----	11.00	----	----	4.00	
21467	Stock Feed. W. H. Haskell, Toledo, O.	*Stamford:* Scofield & Miller	9.76	3.27	9.44	5.54	65.09	6.90	32.00
		Guaranty	----	----	8.50	----	----	4.00	
21473	Bonnie Dairy Feed	*So. Norwalk:* M. T. Hatch	11.24	2.84	15.87	5.53	60.37	4.15	35.00
21460	New England Stock Food. H. O. Co., Buffalo, N. Y.	*Bridgeport:* W. H. Terry & Co.	9.13	3.78	8.62	10.92	63.12	4.43	32.00
		Guaranty	----	----	9.00	----	----	4.00	
21600	Stock Feed. Husted Mill Co., Buffalo, N. Y.	*New London:* P. Schwartz	7.94	3.26	9.62	8.61	65.01	5.56	31.00
		Guaranty	----	----	8.00	----	----	4.00	
21577	Sugared Dairy Feed. International Sugar Feed Co., Minneapolis	*New Britain:* Stanley-SveaGrain Co.	10.38	6.05	17.75	10.77	49.97	5.08	30.00
		Guaranty	----	----	16.50	----	----	3.50	
21513	Badger Dairy Feed. Charles A. Krause Mill. Co., Milwaukee	*Meriden:* August Gurlich	12.00	6.59	15.75	11.62	50.08	3.96	
		Guaranty	----	----	18.00	----	----	4.50	
21447	Molac Dairy Feed. Quaker Oats Co., Chicago	*Branford:* S. V. Osborn	11.67	8.20	16.44	10.59	48.83	4.27	28.00
21580	Molac Dairy Feed. Quaker Oats Co., Chicago	*Thompsonville:* H. K. Brainard	8.92	8.07	18.50	13.97	45.77	4.77	27.00
		Guaranty	----	----	15.50	----	----	3.00	
		Average of these 2 analyses	**10.29**	**8.14**	**17.47**	**12.28**	**47.30**	**4.52**	**27.50**
21625	Schumacher's Calf Meal. Quaker Oats Co., Chicago	*Putnam:* Bosworth Bros.	9.65	2.73	21.19	2.62	55.83	7.98	65.00
		Guaranty	----	----	19.00	----	----	8.00	
21440	Schumacher's Stock Feed. Quaker Oats Co., Chicago	*Ansonia:* Ansonia Flour and Grain Co.	9.08	4.31	11.19	10.64	60.40	4.38	35.00
		Guaranty	----	----	12.00	----	----	4.00	
21533	Diamond Stock Feed. Toledo Elev. Co., Toledo, O.	*Colchester:* Colchester Grain Co.	9.50	2.98	11.56	9.24	60.20	6.52	30.00
		Guaranty	----	----	10.00	----	----	6.50	

Table III.—Analyses of Commercial Feeds Sampled in 1908—*Concluded.*

Station No.	Brand.	Retail Dealer.	Analyses.						Price per ton.
			Water.	Ash.	Protein. (N x 6.25.)	Fiber.	Nitrogen-free Extract. (Starch, gum, etc.)	Ether Extract. (Fat.)	
	Mixed Feeds—*Concluded.* *Proprietary Poultry Feeds.*								
21463	Poultry Feed. Buffalo Cereal Co., Buffalo, N. Y.	*New Canaan:* C. H. Fairty	10.17	3.51	16.12	5.47	60.12	4.61	$38.00
		Guaranty	----	----	**17.00**	----	----	**5.00**	
21471	Bonnie Poultry Feed	*So. Norwalk:* M. T. Hatch	11.60	2.77	14.75	4.64	62.78	3.46	40.00
21459	Poultry Feed. H. O. Co., Buffalo, N. Y.	*Bridgeport:* Standard Feed Co.	10.39	3.79	18.06	5.49	57.75	4.52	39.00
		Guaranty	----	----	**17.00**	----	----	**5.50**	
21602	Poultry Feed. Husted Mill. Co., Buffalo, N. Y.	*New London:* P. Schwartz	10.49	3.48	14.37	6.72	60.74	4.20	36.00
		Guaranty	----	----	**12.00**	----	----	**5.00**	
21522	Dry Mash Feed. The Park & Pollard Co., Boston	*Middletown:* Meech & Stoddard	9.52	12.67	19.94	6.64	47.91	3.32	38.00
		Guaranty	----	----	**20.00**	----	----	**3.00**	
21576	Fattening Feed. The Park & Pollard Co., Boston	*East Hartford:* G. M. White & Co.	10.71	2.49	11.37	3.69	68.15	3.59	39.00
21523	Growing Feed. The Park & Pollard Co., Boston	*Middletown:* Meech & Stoddard	11.42	3.87	16.37	3.19	60.83	4.32	38.00
		Guaranty	----	----	**14.00**	----	----	**3.00**	
21572	Pure Ground Alfalfa. M. C. Peters. Mill. Co., Omaha	*Hamden:* J. W. Beers	8.58	9.83	15.50	26.52	37.31	2.26	39.00
		Guaranty	----	----	**13.00**	----	----	**3.00**	
21430	Purina Alfalfa Meal. Purina Mills, St. Louis	*New Haven:* J. T. Benham, Est.	10.19	8.49	14.25	31.82	34.12	1.13	40.00
		Guaranty	----	----	**18.00**	----	----	**2.00**	
21431	Purina Mill Feed Mash. Purina Mills, St. Louis	*New Haven:* J. T. Benham, Est.	10.64	4.96	15.94	9.22	57.01	2.23	42.00
		Guaranty	----	----	**17.00**	----	----	**5.00**	
21485	American Poultry Feed. Quaker Oats Co., Chicago	*Waterbury:* D. L. Dickinson & Son	11.54	3.06	12.75	4.47	64.02	4.16	37.00
		Guaranty	----	----	**12.00**	----	----	**3.50**	
21565	Reliable Dry Mash Feed	*Hartford:* Smith, Northam & Co.	11.44	5.82	10.69	4.14	65.46	2.45	
		Guaranty	----	----	**10.50**	----	----	**3.00**	
	Miscellaneous Feeds.								
21445	Aloras. New Occidental Mill. Co., Minneapolis	*Derby:* Peterson-Hendee Co.	11.54	4.84	16.62	6.66	54.31	6.03	30.00
21574	Aloras. New Occidental Mill. Co., Minneapolis	*Westville:* W. E. Warner & Bro.	11.19	5.15	16.25	8.42	53.02	5.97	29.00
21620	Aloras. New Occidental Mill. Co., Minneapolis	*Danielson:* Young Bros. Co.	10.87	4.76	17.00	5.79	55.63	5.95	28.00
		Guaranty	----	----	**16.00**	----	----	**5.00**	
		Average of these 3 analyses	**11.20**	**4.92**	**16.62**	**6.96**	**54.32**	**5.98**	**29.00**
21466	Star Cotton Feed. Toledo Elev. Co., Toledo, O.	*New Canaan:* C. H. Fairty	8.46	2.80	10.94	9.02	62.63	6.15	32.00
		Guaranty	----	----	**10.00**	----	----	**6.50**	
21617	Force Screenings. H. O. Co., Buffalo, N. Y.	*Moosup:* T. E. Main & Son	11.28	1.96	10.31	0.54	74.12	1.79	32.00
		Guaranty	----	----	**11.00**	----	----	**3.00**	

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 IV.—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 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
Alfalfa Meal	1.0
Molasses or Sugar Feed	1.1
Victor Corn and Oat Feed	0.7

EIGHTH REPORT

OF THE

STATE ENTOMOLOGIST

OF

CONNECTICUT

FOR THE YEAR 1908

BY

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

New Haven, Conn.
1909

PART XI.

EIGHTH REPORT

OF THE

STATE ENTOMOLOGIST OF CONNECTICUT

To the Director and Board of Control of the Connecticut Agricultural Experiment Station:

I hereby transmit my eighth annual report as state entomologist of Connecticut in compliance with the statutes. The financial statements cover the two fiscal years ending September 30th, 1908, but other administrative details are for the calendar years of 1907 and 1908.

Respectfully submitted,

W. E. BRITTON,

State Entomologist.

REPORT OF THE RECEIPTS AND EXPENDITURES OF THE STATE ENTOMOLOGIST FROM OCTOBER 1ST, 1906, TO SEPTEMBER 30TH, 1908.

FOR THE YEAR ENDING SEPTEMBER 30TH, 1907.

Insect Pest Account.

RECEIPTS.

From E. H. Jenkins, Treasurer		$3,750.00
Account of 1906, balance		18.53
Conn. Board of Agriculture, for gypsy moth work		100.00
		$3,868.53

EXPENDITURES.

For field, office and laboratory assistance	$1,330.85	
Printing and illustrations	83.35	
Postage	56.40	

Stationery	$1.25	
Telegraph and telephone	5.65	
Express, freight and cartage	20.75	
Library	104.84	
Laboratory apparatus and supplies	86.06	
Office supplies	28.58	
Traveling expenses	268.66	
Gypsy moth control work	1,604.91	
Balance, cash on hand	277.23	
		$3,868.53

Gypsy Moth Control Account.

RECEIPTS.

From E. H. Jenkins, Treasurer		$2,500.00

EXPENDITURES.

For salary of superintendent, and labor	$2.210.43	
Printing	12.50	
Tools and supplies	232.54	
Express, freight and cartage	11.95	
Traveling expenses	29.66	
Balance, cash on hand	2.92	
		$2,500.00

FOR THE YEAR ENDING SEPTEMBER 30TH, 1908.

Insect Pest Account.

RECEIPTS.

From E. H. Jenkins, Treasurer		$3,000.00
" " " (expenses transferred to station account)		5.25
Account of 1907, balance		277.23
Sale of cabbages (experimental plot)		5.00
Sale of postage stamps		.19
		$3,287.67

EXPENDITURES.

For field, office and laboratory assistance	$1,738.18	
Printing and illustrations	162.03	
Postage	6.64	
Stationery	7.70	
Telephone and telegraph	2.30	
Express, freight and cartage	16.25	
Library	155.86	
Laboratory apparatus and supplies	76.94	
Office supplies	23.80	
Traveling expenses	318.50	
Balance cash on hand	779.47	
		$3,287.67

Gypsy Moth Control Account.

RECEIPTS.

From E. H. Jenkins, Treasurer		$2,500.00
Account of 1907, balance		2.92
		$2,502.92

EXPENDITURES.

For salary of superintendent, and labor	$2,105.61	
Printing	2.75	
Tools and supplies	203.71	
Rental	56.00	
Express, freight and cartage	5.37	
Traveling expenses	126.26	
Balance, cash on hand	3.22	
		$2,502.92

Memorandum:—This account of the state entomologist has been duly audited by the State Auditors of Public Accounts.

Office Force and Field Organization.

Throughout the two years covered by this report the state entomologist has been assisted by Mr. B. H. Walden as general assistant, who has had charge of the office in the absence of the entomologist; by Mr. G. H. Hollister, who has had charge of the field work of suppressing the gypsy moth; by Miss E. B. Whittlesey, who has been employed as stenographer and clerical assistant in the office. Messrs. Walden and Hollister have each year helped in the inspection of nurseries, and Mr. S. P. Hollister also assisted in this work for a few days during 1908. Miss Beatrice Ross was employed for two weeks on extra clerical work in January, 1908. All of these assistants have served faithfully and willingly, and they have contributed in no small measure to the success of the work of this office.

In the gypsy moth work at Stonington, Mr. Hollister has employed chiefly local help, and has been given full authority to hire or discharge anyone according to his judgment. About twenty men were kept at work cutting brush and turning bands during June and July, 1907, but in 1908 most of the brush had been cut and less than ten men were employed.

Lectures, Correspondence and Inspection Work.

During the calendar year of 1908, thirteen lectures have been given before granges and agricultural and scientific meetings, and

1,236 letters and 51 packages sent out on business pertaining to the work of the office. The force has also made forty-two inspections of nurseries, and forty-two certificates have been granted. Examinations have been made of forty orchards, gardens, etc., and one hundred and forty-seven samples of insects have been received for identification.

Collection and Equipment.

The collection of insects has been considerably increased during the past two years by exchanges and material collected within the state. Mention should here be made and thanks expressed to Mr. Charles R. Ely of Washington, D. C., who has enriched our collection with material collected at East River, Conn., supplying us with over sixty species, many of which were not in our collection, while some of them had not been recorded from the state. Also to Mr. F. A. Merrick of New Brighton, Pa., who supplied about one hundred and forty-seven species, one hundred and fifteen of which were new to the collection; Mr. C. A. Frost, of South Framingham, Mass., forty-eight species, forty-two of which were new to the collection; A. C. Samson of Boston, Mass., thirty-five species, fourteen new to the collection. Exchanges were effected with these persons, but in each case the station collection benefited by receiving many more species and specimens than we were able to give in return, the collectors expressing a desire to place their duplicates where they would be of use even though they did not receive specimen for specimen in return. This attitude is or should be the proper one for the scientist. Last but not least, thanks are due to Professor H. W. Foote of Yale University, who has for three seasons collected moths during July and August at Pemaquid Point, Me., and given them to the station collection.

The Lepidoptera (butterflies and moths) have now all been transferred to larger Schmitt boxes (11½ x 16 in. inside), which were made to order of the proper size to fill the space occupied by two ordinary boxes with the partition between them. Fifty-six of these boxes are now filled with butterflies and moths. Fourteen metal cases and several wooden cases are used to hold the collection, which now contains about 4,000 named species and over 26,000 specimens.

A colony of bees in a Cary hive has been procured for study; these swarmed in June, and the swarm was placed in a Danzenbaker hive, so there are now two hives. A Miller observation hive has also been purchased for the laboratory and is of much interest to visitors.

Publications from the Entomological Department 1907-1908.

Sixth Report of the State Entomologist (Part IV of the Station Report for 1906); 88 pages, 1 map, 13 text figures, XVI plates. 9,000 copies, distributed in March, 1907.

Seventh Report of the State Entomologist (Part V of the Station Biennial Report for 1907-1908); 73 pages, 6 text figures, XVI plates. 9,000 copies, distributed in March, 1908.

Bulletin 155. The Elm Leaf Beetle, by W. E. Britton. 15 pages, 6 figures. 10,000 copies. May, 1907.

Bulletin of Immediate Information No. 5. The Gypsy Moth Situation and the New Law. 4 pages. 1,000 copies. June, 1907.

Bulletin 157. Lead Arsenate and Paris Green. Part II. Directions for Their Use as Insecticides, by W. E. Britton. 12-13 pages. 10,000 copies. September, 1907.

Bulletin 159. Spray Calendar. Insect portion by W. E. Britton. 12,000 copies. January, 1908.

Occurrence of the Gypsy Moth in Connecticut, by W. E. Britton. A short paper read at the meeting of the Association of Economic Entomologists at New York, December, 1906. Published in Bulletin 67, Bureau of Entomology, U. S. Dept. of Agr., p. 22. 4 pages. 1907.

The Gypsy Moth in Connecticut, by W. E. Britton. Report of Connecticut Board of Agriculture for 1906. 13 pages, 5 text figures. 1907.

Some Connecticut Problems, by W. E. Britton. Proceedings New York State Fruit Growers' Association for 1907, p. 151. 1907.

Report of Committee on Injurious Insects, by W. E. Britton, Chairman. Report Connecticut Pomological Society, Vol. IX, p. 28. 1907.

Do. Vol. X, p. 23. 1908.

Some New or Little-Known Aleyrodidæ from Connecticut, by W. E. Britton. III. *Entomological News,* Vol. XVIII, p. 337. 6 pages, 2 plates. October, 1907.

Tests of Various Gases for Fumigating Nursery Trees, by W. E. Britton. *Journal of Economic Entomology,* Vol. I, p. 110. 3 pages. April, 1908.

Postal Card Bulletin on Canker Worms, by W. E. Britton. 5,000 copies. October, 1908.

Notes from Connecticut, by W. E. Britton. *Journal of Economic Entomology,* Vol. I, p. 313. October, 1908.

Notes on a New Sawfly (*Pamphilius persicum* MacG.) Attacking the Peach, by B. H. Walden. Bulletin 67, Bureau of Entomology, U. S. Dept. of Agr., p. 85. 2 pages, 1 plate. 1907.

The Peach Sawfly; A Correction, by B. H. Walden. *Journal of Economic Entomology,* Vol. I, p. 160. April, 1908.

Chief Lines of Work.

The general work of suppressing the gypsy moth, inspecting the nurseries, identifying insects and correspondence has consumed the usual amount of time and effort. Each of these is mentioned on another page of this report.

A study has been made of the insects attacking truck crops, and in this work tests have been made at Mount Carmel of various substances to prevent injury from the cabbage maggot. The squash borer has also been the object of similar tests.

Tests of various substances for fumigating to destroy San José scale on nursery stock have been continued, and some attention has been given to the question of preparing "soluble oils" for killing the San José scale. Further observations regarding the life history of the peach sawfly have been made by Mr. Walden, and several localities have been examined for mosquito-breeding areas.

Much time has been devoted to the insect collection and to the preparation of the papers on the Orthoptera and Hymenoptera of Connecticut which are to be published by the State Geological and Natural History Survey. The manuscript of the Orthoptera has been completed and is now awaiting publication.

Entomological Features of 1908.

From year to year the careful observer notes changes as regards the prevalence or scarcity of various kinds of insects, especially those which are pests attacking cultivated crops. The fluctuation is great with some species, such as the spiny elm caterpillar, *Euvanessa antiopa* Linn., and the apple leaf miner, *Tischeria malifoliella* Clem., which were exceedingly abundant in 1906, but have hardly been noticed since then. They are present each year, but they attract attention only when they become abundant. On the other hand, certain insects like the potato beetle, *Leptinotarsa decemlineata* Say, the cabbage butterfly, *Pontia rapæ* Linn., and the important currant worm, *Pteronus ribesii* Scop., are so constant in their appearance and numbers that the grower expects to combat them year after year, and thus makes control operations a part of his regular work and plans for it accordingly.

The winter of 1907-1908 was rather severe, and as the preceding winter was also a severe one, the San José scale in many

cases was killed so that it has not spread as much as usual. The reason apparently must be due to climatic conditions rather than to any particular predaceous or parasitic enemies which are effecting its control. At least, no such enemies have been observed in Connecticut which have not been present for several years, and those have not seemed to be more abundant than usual. In some instances the pest has not made any appreciable spread in two years, and some persons believe that it is no longer to be feared as a dangerous enemy to orchards; but in other cases, especially in young orchards and in some nurseries, the San José scale has multiplied sufficiently to leave no doubt in the minds of the owners or of any observer that it still must be reckoned with as the chief insect enemy of orchards in Connecticut. There should be no "let-up" in the thoroughness or regularity of the remedial treatment.

Canker worms, as predicted, were more abundant than in 1907, and defoliated many apple orchards and shade trees. They will doubtless be even more abundant in 1909, and everyone who wishes to save the foliage of his trees should band them. A detailed account of the two species of canker worms will be found on page 777 of this report.

The elm leaf beetle was more abundant and caused more injury to shade trees throughout the state than for several years. The precipitation was below the normal, especially during June and July, and this, following a dry season in 1907, prevented the development of the white fungus that normally kills large numbers of pupæ and adults. Many of the beetles, though of course a small proportion, were killed by the spined soldier bug, *Podisus malculiventris* Say (=*spinosus* Dall.), which was more than usually abundant. The elm leaf beetle may be expected to do fully as much damage in 1909, and all trees which were defoliated during the past season should be sprayed with poison next summer.

In the vicinity of New Haven beans were attacked and injured by a green striped caterpillar, which on rearing the adults proved to be the green clover worm, *Plathypena scabra,* which has not before been reported on beans in Connecticut. An article on page 828 gives an account of this insect.

Tussock moths of all kinds were abundant, but late in August and through September many dead caterpillars were found on the trunks of trees, having been killed by a fungus, the prevalence of which has undoubtedly been an important check to these insects and will render them less common next season.

Plant lice were abundant and checked the growth of young apple trees in orchards and nurseries.

Mites (probably *Tetranychus bicolor* Banks) were abundant everywhere on chestnut, and the same or an allied species was also on oak, causing the leaves to turn brown late in the summer. The pear leaf mite, *Eriophyes pyri* Nal., was prevalent, and specimens were received from several localities, where it formed reddish galls upon the leaves.

Nursery Inspection.

The annual inspection of nurseries, as provided for by the General Statutes (Sections 4388-4389), was begun this year on August 27th, or about a week earlier than usual. Fair weather prevailed and enabled us to nearly complete the work by the middle of October, though not wholly finished until November.

The condition of the nurseries of the state was on the whole found to be somewhat better than last year, but there is no decided change. Individual nurseries presented differences, some being better and some worse. In a region thoroughly infested with San José scale, where nurserymen have carefully sprayed their growing stock with soluble or miscible oil, one part in not more than fifteen parts of water, the plantations have been much improved, some being comparatively free from scale. On the other hand, where this treatment was done indifferently or carelessly, or neglected altogether, the stock was in bad condition and much of it was destroyed.

The inspections were made by Messrs. Britton, Walden, G. H. Hollister and S. P. Hollister, the first three being employed throughout the work and the last helping only about ten days in the large nurseries.

Two nurseries were inspected during the spring and forty in the fall, making forty-two inspections. Forty-two certificates were granted. The death of one nurseryman and the appearance of five new firms changes slightly the list, which follows:

List of Nursery Firms in Connecticut Receiving Certificates in 1908.

Name of Firm.	Location.	Inspection finished.	Certificate number.
Atwater, C. W.	Collinsville	Sept. 28,	297
Barnes Bros. Nursery Co.	Yalesville	Sept. 26,	294
Beattie, Wm. H.	New Haven	Sept. 28,	295
Bowditch, J. H.	Pomfret Center	Sept. 3,	286
Brainard, D. Wm. & C. F.	Thompsonville	Oct. 19,	313
Burroughs, Thos. E.	Deep River	Oct. 12,	309
Burr & Co., C. R.	Manchester	Sept. 22,	291
Comstock & Lyon	Norwalk	Oct. 27,	317
Conine Nursery Co., The F. E.	Stratford	Sept. 29,	296
Conn. Agricultural College	Storrs	Oct. 13,	310
Conn. Agr. Experiment Station, Forest Nursery (A. F. Hawes, State Forester, New Haven)	Rainbow (Windsor)	Oct. 5,	304
Conway, W. B.	New Haven	Oct. 24,	315
Dehn & Bertolf	Greenwich	Sept. 23,	292
Dwyer, John E.	Manchester	Nov. 12,	321
East Rock Park Nursery (G. X. Amrhyn, Supt.)	New Haven	Sept. 2,	285
Elizabeth Park Nursery (G. A. Parker, Supt.)	Hartford	Nov. 5,	320
Elm City Nursery Co,	New Haven	Sept. 5,	287
Gardner's Nurseries	Cromwell	Oct. 29,	318
Gurney & Co., H. H.	New Canaan	Sept. 22,	290
Hale, J. H.	So. Glastonbury	Oct. 12,	308
Holcomb, Irving	Granby	Sept. 18,	288
Houston & Sons, J. R.	Mansfield Depot	Oct. 9,	305
Hoyt's Sons Co., Stephen	New Canaan	Sept. 22,	289
Hubbard & Co., Paul M.	Bristol	Oct. 5,	301
Hunt & Co., W. W.	Hartford	Oct. 1,	298
Kellner, H. H.	Danbury (2)	Oct. 21,	314
Kelsey & Sons, David S.	West Hartford	Sept. 29,	299
Keney Park Nursery (G. A. Parker, Supt.)	Hartford	Nov. 5,	319
Malone, Geo. W.	Highwood	Oct. 26,	316
Phelps, J. Wesson	Bolton (2)	Oct. 9,	306
Pierson, A. N.	Cromwell	Sept. 1,	284
Platt Co., The Frank S.	New Haven	Oct. 13,	311
Purinton, C. O.	Hartford	Dec. 24,	323
Ryther, O. E.	Norwich	Oct. 16,	312
Schoonman, W. J.	Danielson	Dec. 7,	322
Scott, J. W.	Hartford	Oct. 10,	307
Sierman, C. H.	Hartford	Oct. 2,	300
Vidbourne & Co., J.	Hartford	Sept. 25,	293
Woodruff, C. V.	Orange	Oct. 5,	302
Woodruff & Sons, S. D.	Orange	Oct. 5,	303

ACCOUNT OF PROGRESS IN SUPPRESSING THE GYPSY MOTH IN CONNECTICUT.

For an account of the discovery of the gypsy moth in Connecticut at Stonington and the attempts to control this pest the reader is referred to the three preceding reports of this station (1905, p. 246; 1906, p. 235, and 1907-08, p. 300). Only a record of progress is here given.

Throughout the year Mr. G. H. Hollister has been the superintendent in immediate charge of the work. Commencing on November 18th, 1907, Mr. Hollister employed about five men for most of the time during the winter, cutting and burning brush, pruning trees and scouting for egg-masses. About ten rods of stone wall had to be overhauled and relaid, a number of wood and rubbish piles had to be looked over, and, of course, the trees examined.

In May the trees were banded, about 14,000 in all, including all those within the boundaries of the infested area and many outside, especially to the north. In doing this we used one and one-half bales of eight-ounce burlap cut into eight-inch strips.

During 1908 no indications were found that the pest had spread to the region outside of the area known to be infested the previous year, but on the contrary, over a portion of this area where caterpillars were taken in 1907 none were found in 1908. The size of the area actually known to be infested has therefore been decreased by the suppression work. The Stanton place was perhaps the worst center of infestation for the season, but during June about two hundred and seventy-five caterpillars were discovered on some low rosebushes in the loose stones beside the wall near the Ross estate. A careful search was here made and all caterpillars that could be found were destroyed. The spot was then oiled and burned.

On July 2d two of the men discovered some caterpillars on weeds and brush in and around the chicken yard of Mr. Kellar's residence on Bay View Avenue. In making a systematic hunt, about one hundred and twenty-five in all were found, and the weeds and useless bushes were immediately cut and burned and the stone wall burned out with a torch of flame. Fifty gallons of oil was used in burning out walls, stoneheaps and dumps. A few caterpillars were found each day at Walnut Grove, but not in important numbers. The seriousness of this infestation lies in

the character of the region, a dense grove of tall oak, hickory and other trees, which grow among rocks and boulders, making it difficult to control the pest should it once gain a foothold. Much searching was done here in addition to the regular work of examining bands. The men climbed the trees perhaps a dozen times during the summer, and in this way many of the caterpillars were found and destroyed.

All of the coniferous trees and part of the apple trees and ornamental shrubbery on the Stanton place, some shrubs of Japanese quince at Mr. Darrell's, the bushes near the water at Mr. Simmons', small fruit trees and Boston ivy at Mr. Koelb's and the quince bushes at Mrs. Thatcher's were sprayed with lead arsenate (three to five pounds in fifty gallons of water), thirty pounds of the poison being used. Mr. Hollister observed dead and dying caterpillars a few days after the applications. "Tree Tanglefoot" was applied to the trunks of the evergreens and apple trees adjoining in order to prevent the caterpillars from crawling up or down, about twelve pounds of this material being used.

Scouting for Egg-Masses.

All trees, and many of the fences, stone walls and buildings within the infested area were examined for egg-masses during the winter. A careful search was made around the places where caterpillars were taken during the preceding summer, and seventy-three egg-masses were found and destroyed by soaking them with creosote. Most of the scouting was done by Messrs. Hollister, Norman and McDermott, and before April 1st this was finished and Hollister and Norman had worked about two weeks around Hartford. Mr. Hollister had also visited several towns in the northeastern part of the state. According to agreement, Mr. Rogers furnished help to scout the infested region after it had been examined by our men, but on account of the great amount of work done in Massachusetts, Maine and New Hampshire, he could send only one man, Mr. G. D. Whitehead, who worked in Connecticut during the month of April, first going over the Stonington infested territory with Mr. Hollister (finding nine egg-masses), and then with him scouting the road to New London and then from New Haven to Hartford.

The scouting done outside of Stonington may perhaps be best described by the following notes by Mr. Hollister.

Scouting for the Gypsy Moth in Other Parts of the State.

Hartford Region—"An egg-mass of the gypsy moth having been found in Springfield, Mass., and Hartford being on the same route from Boston to New Haven and New York, it was thought advisable to spend some time scouting around the garages in that city, and then to scout the main highways leading to Springfield on each side of the Connecticut River.

"Scouting was commenced about the 24th of February, 1908, and continued two weeks in this vicinity by Mr. E. W. Norman and myself.

"On the west side of the river the towns of Windsor, Windsor Locks and Suffield were visited, the scouting being done along the main highway and including the shade trees, the orchards bordering on the highway, freight yards and garages. In the villages several of the streets other than the main one were scouted. On this side of the river scouting was carried on as far north as the road leading from Suffield to Thompsonville.

"East Hartford, South Windsor, East Windsor Hill, Warehouse Point, Enfield and Thompsonville were all visited, as well as all the territory between these villages along the main highway on the east side of the river. Considerable time was spent around the freight yard in East Hartford, as a great many of the cars pass through infested territory in Massachusetts.

"The scouts were on the lookout for any nests of the brown-tail moth as well as for those of the gypsy moth, but no evidences were found of either.

"It is estimated that a distance of one hundred and twenty-five miles was traversed.

Eastern Connecticut—"The latter part of March and first of April several of the larger towns were visited by the writer to look for evidences of the gypsy moth and brown-tail moth.

"Norwich, Plainfield, Danielson, Putnam, Grosvernordale, East Thompson, Willimantic and Middletown were visited. In these places, garages, freight yards, and some of the shade and fruit trees were examined.

"As Putnam is the largest town in the northeastern part of the state nearest the Massachusetts infestations, considerable time was spent there scouting the shade trees and orchards bordering on the highways. Quite a little time was occupied in scouting the village of East Thompson. At the other places above mentioned only the stations, freight yards, garages and the trees near the same were scouted. Not a sign of either the gypsy or brown-tail moth was found.

"A distance of forty miles was covered.

"Mr. G. D. Whitehead, a government scout, was sent to Stonington April 1st, and scouted in various parts of the state until May 2d. He and the writer scouted the main highway to Mystic, Noank and Midway, spending some time at the freight yard in the latter place.

"Three days were spent in New London, where the trees were examined on Main, Bank and Broad streets and on Montauk, Pequot and Ocean avenues. Several garages and the freight yards were scouted, also some of the trees along the banks of the Thames River near where automobiles attending the boat-races were stationed. The trees in Williams Park and around Williams Memorial Institute were scouted.

"About thirty-five or forty miles were traversed, and no evidence of moths were found.

New Haven to Hartford—"Mr. Whitehead and the writer left for New Haven the 23d of April, where they began scouting for the gypsy moth. Twenty-six garages were visited and the trees in the vicinity of the same were inspected. The freight yards were also examined.

"Scouting was then taken up along the main automobile route to Hartford, passing through the towns of North Haven, Wallingford, Yalesville, Meriden, Berlin Junction, New Britain and Newington to Hartford. Here, as on the other trips, the shade trees and orchards bordering on the highway were scouted, also the garages in Wallingford, Meriden and New Britain.

"New Britain Avenue and Farmington Avenue in Hartford were both scouted, as automobiles follow both routes into the city.

"No evidences of the gypsy moth or brown-tail moth were found after traversing a distance estimated at eighty miles.

"About a week was spent on this route, and then May 2d was spent scouting about in the village of Pomfret. This included the street trees and also the shade trees near Pomfret School. The street leading from the station past the school to the Putnam road was scouted, also another leading from the station out to some private estates a mile away.

"Here, as at the other places, no moths were found."

Funds.

The State Board of Control has seen fit to grant the funds necessary to carry on the work, $2,500 having been used during the fiscal year ending September 30th, 1908. It is hoped that the legislature will renew the provisions of the act, or at least provide funds to continue the suppression work until the pest has been exterminated from the state.

Infested Localities Near Connecticut.

During the year the Massachusetts authorities sent scouts to examine the main thoroughfares in various portions of that state, and this resulted in finding gypsy moth infestations in several new places, including Springfield, Greenfield, Palmer and Warren. Springfield being only a few miles from the Connecticut border, the fact that egg-masses were found there naturally caused some anxiety lest the whole region be infested, but a careful search of both sides of the river from the state line southward did not result in finding any signs of the pest.

The edge of the general infestation in Eastern Massachusetts, however, has been extended from year to year by the natural spread of the insect, aided by the usual methods of conveyance and traffic, until it now reaches well towards the boundary of Connecticut.

Present Condition of the Infested Area at Stonington.

The conditions are now more favorable for the extermination of the gypsy moth than they have been at any time since this pest was discovered to be in the state. The territory has been well cleaned up by cutting brush and disposing of rubbish, by pruning and scraping trees and cutting worthless ones, and filling and tinning cavities. The actual size of the infested area has been considerably reduced during the year, so that it will not be necessary to band as many trees next year. This will require a smaller force of help, and of course will be less expensive.

General Summary.

	1906	1907	1908
Egg-masses laid during preceding year, number destroyed	29	118	73
Egg-masses laid during same year, number destroyed	47	70	3
Caterpillars, number destroyed	10,000	2,936	2,560
Pupæ, number destroyed	47	200	44
Trees banded with burlap, number of	1,300	13,000	14,000
Funds expended by the state	$1,500	$4,550	$2,500
" " " " government	....	272	77

CANKER WORMS.

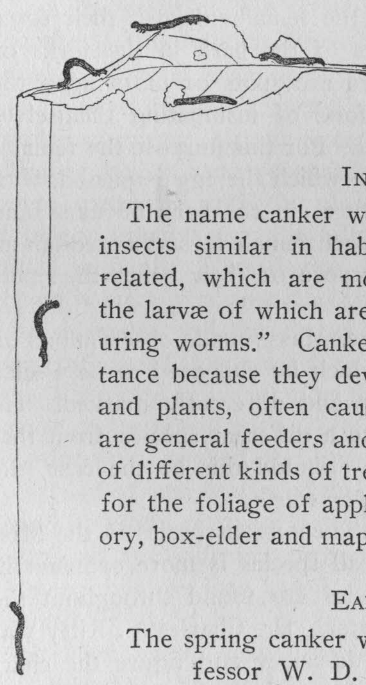

Fig. 9. Canker Worms on apple leaf. Reduced.

Spring Canker Worm, *Paleacrita vernata* Peck.
Fall Canker Worm, *Alsophila pometaria* Harris.

Introduction.

The name canker worm is applied to two species of insects similar in habits and appearance and closely related, which are moths of the family Geometridæ, the larvæ of which are known as "loopers" or "measuring worms." Canker worms are of economic importance because they devour the foliage of various trees and plants, often causing considerable injury. They are general feeders and therefore attack a large number of different kinds of trees, but seem to have a preference for the foliage of apple, elm, chestnut, pear, oak, hickory, box-elder and maple, in about the order named.

Early Records.

The spring canker worm was first described by Professor W. D. Peck in 1795. The difference between the sexes was known at this time, but there was supposed to be only one species, evidently *vernata.* The following is a quotation from Peck's original account as published by Ridley.*

* Seventh Annual Report on the Noxious, Beneficial and Other Insects of Missouri, 1874, p. 89.

"These insects (the Canker-worm) appear in the spring earlier than any other of the moth tribe—about the middle of March. Their rise, however, from the earth will be delayed or hastened according to the temperature of the atmosphere and state of the soil. They are found under a double form, the males being furnished with, and the females being destitute of, wings. This circumstance necessitates the females to ascend the tree by its trunk in order to deposit their eggs upon the branches. The males by their wings resort to them, and are found in the evenings hovering around the trees. In three or four days after they begin to rise, they are found *sub-copula*. This office is performed in eleven or twelve days after their first appearance. The males die and disappear. In thirteen days the females deposit their eggs. These they place in the crannies of the bark in the forks of small branches; and where there are spots of moss upon the smaller limbs, they seem most fond of insinuating themselves into the cavities between its leaves. For this purpose the females are furnished with a tube through which the egg is passed, with which she investigates the apertures in the bark or moss and ascertains their depth. * * * Each female lays at a medium an hundred eggs. The ultimate purpose of their being thus performed, they die."

Dr. T. W. Harris of Cambridge, Mass., made observations on canker worms of that section, which he supposed to be Peck's species, though somewhat larger and differently marked. He states:* "Perhaps they constitute a different species from that of the true canker worm moth. Should this be the case, the latter may be called *Anisopteryx pometaria*."

The spring canker worm was the common species in the Mississippi River valley, while the fall species is more common in New England, though both species are found throughout the eastern portion of the United States. Dr. Charles V. Riley was probably the first to accurately describe† and figure the characters of both kinds of canker worms, thus proving them to be distinct species.

* Insects Injurious to Vegetation, 1841, p. 333. Flint Edition, 1863, p. 402.
† Seventh Annual Report on the Noxious, Beneficial and Other Insects of Missouri, 1874, p. 80.

History in Connecticut.

Mr. Henry T. Blake of New Haven states* that "in 1839, by vote of the Common Council, one hundred and fifty maples and elms, principally maples, were set out on the public square. The maples were preferred at that time on account of the liability of elms to be ravaged by the measuring worm, or canker worm, as it was generally called. This worm has appeared at intervals since 1750, but the first serious experience of them within the present century occurred in 1838. Other visitations followed at frequent intervals down to 1850 and later, though in a modified degree. Prior to 1846 for several years before the middle of June the trees on the Green were stripped as bare as in the depths of winter. The fence, which was of wood, painted white, was so covered with worms as to appear entirely black. The walks were literally carpeted with them, and the air was full of their squirming forms descending from the barren branches. Many schemes were proposed for their extermination, but none were successful until the plan was adopted of surrounding the trunk of every tree in the fall of the year with large tin troughs filled with oil. This device was used quite generally, but the troughs were expensive and the oil was blown by the wind over the sidewalks and the clothes of passers-by. A smaller trough was then used, made of sheet lead, and these were placed upon the elms almost universally throughout the city, being kept in order and supplied with oil by annual contract. These remedies, continuously applied for several years, greatly diminished the pest, and of late the last of the lead troughs have disappeared. A band of cloth or paper coated with tar or printers' ink is now regarded as a sufficient protection."

According to Dr. Joseph Barratt, canker worms had disappeared in 1846,† and we have the statement of Mr. Robinson that they were again troublesome in 1866.‡ From what we know of the periodical occurrence of this pest, it is quite probable that an outbreak intervened, though we do not have a record of it. In 1884, Mr. P. M. Augur, then pomologist of

* Chronicles of New Haven Green, 1898, p. 30.
† Transactions Conn. Agr. Society for 1854, p. 120.
‡ Report Conn. Board of Agriculture for 1866, p. 81.

the Board of Agriculture, reported* that canker worms were abundant in some localities during the season and caused considerable damage.

Again in 1896, canker worms were abundant in the southern part of the state, and the writer published a short article† giving a brief description of the two species and recommending treatment. The fall canker worm was the more prevalent, and was responsible for most of the injury about the station grounds, though the spring species was present in apple orchards of the state.

From 1896, canker worms were present and caused damage to trees until 1900, when they became scarce at the station, so that it was difficult to find specimens. Their absence continued until the autumn of 1907, when adult males were noticed to be quite numerous, and early in the summer of 1908 orchard and shade trees in the southern part of the state were ravaged. During the season this office received four samples of canker worms and twenty-three letters regarding their work. The elm trees of New Haven were attacked and the leaves generally eaten, but most people attributed the injury wholly to the elm leaf beetle, which was also present in serious numbers. Canker worms even attacked privet hedges in some localities and defoliated portions of them. Though none of the trees on the station grounds were sprayed, the damage was sufficient to warrant the expense of banding the trees, and this was done in October.

A postal card bulletin was issued by this station, about October 1st, calling attention to the prevalence and injury of the canker worm and giving information about applying the sticky bands.

Life History.

The adults of the fall species appear during the warm days of November and December, often occurring in great numbers on foggy days during a thaw after the ground has been frozen. In 1908, the first females were observed around the bands October 28th, and from that time on they increased in abundance, being more in evidence than the males up to November 20th, when the males were apparently much in preponderance. Many eggs were

* Report Conn. Board of Agriculture for 1884, p. 290.
† Report Conn. Agr. Expt. Station for 1896, p. 234.

laid on the trees before the middle of November, and only a few males could be found. The females of both species are without wings, and must necessarily crawl up the trunks of the trees to lay their eggs on the twigs. Males, on the other hand, are provided with wings, and fly short distances at night and even during dark cloudy days. Many of the adults, however, do not emerge until March, and this is especially the case when the ground freezes early in the fall and does not thaw out until late in the winter.

In Saybrook, where the elm trees were considerably damaged by canker worms in 1907, sticky bands were applied about March 1st, 1908, as it was supposed to be the spring species that caused the injury; but it was found later that the fall species was the more abundant and that enough eggs had already been laid before the application of the sticky bands so that the trees were quite badly eaten by canker worms.

The eggs, though deposited in late fall or in early spring, hatch in Connecticut during the last of April or the first few days of May.

The young larvæ are at first very small, and they soon begin to feed on the tender unfolding leaves. They eat holes entirely through the leaves, or in fact devour all of the green tissue, leaving nothing but the veins. Later, as the foliage becomes firmer and more leathery, they often leave the greater portion of the network, especially in case of the apple (shown on Plate XLV) which turns brown in June and looks as if a fire had gone through the orchard.

The caterpillars feed from four to five weeks, during which time they spin down on threads of silk when disturbed, and molt three times. They then go to the ground and transform to the pupa or chrysalid stage. By June 6th, 1908, all canker worms had gone into the ground to pupate. They then remain in the pupa stage until the late fall, when the adults of the fall canker worm begin to emerge in November, and during warm days for two months they may be seen clustering on the trunks of trees; but some do not appear until March and April, at the same time that the spring species comes forth. There is but one generation each year.

Canker worms are always rather local in their attacks, and the writer has often seen large orchards defoliated in certain localities, while in adjoining towns no damage could be seen. During 1908, the most severe injury occurred near the coast, though the insect was present locally in the northern portions of the state.

Description.

Spring Canker Worm, *Paleacrita vernata* Peck.

Egg. Laid in irregular masses which, according to Quaintance,* contain from seventeen to one hundred and nineteen eggs, with an average of forty-seven. Usually in secreted places in the crevices of the bark. The shell is thin, delicate, and of a light brown color, but more or less iridescent. About 0.7 mm. in length, and two-thirds as broad as long. See Plate XLIV b.

Larva or *Caterpillar.* The larva or caterpillar is slender, about three-fourths of an inch long when full grown, and is longitudinally striped with fine pale lines. The general color is dark gray or brownish. The most distinguishing feature, however, is that *no pro-legs are borne on the eighth segment,* there being in all only two pairs of pro-legs. The head is distinctly mottled and spotted.

Pupa or *Chrysalis.* Pupa light brown, about 7 mm. in length, enclosed in a simple earthen cell lined with a few threads of silk. The cell can be easily broken. The pupa is somewhat pitted, the wing sheaths of the male extending to the sixth abdominal segment, while those of the female extend only to the rear edge of the fifth segment. The male pupa is tipped with a spine, which is generally simple. See Plate XLIX a.

Imago or *Adult Moth.*

Male. Wing expanse of from seven-eighths to one and one-fourth inches, antennæ with less than forty joints, the longest more than twice as long as wide. Palpi short, two-jointed. Wings brownish gray, semitransparent, the fore wings marked rather indistinctly with three dark lines. A short dark line also bisects the apical angle of the fore wing. There is no prominent white spot on the costal margin. The rear wings are somewhat lighter and are without markings. Shown on Plate XLVII a.

Female. Antennæ with thirty or more joints, the longest about three times as long as wide. Antennæ, legs and body pubescent,

* Bulletin 68, Bur. of Entomology, U. S. Dept. of Agriculture, p. 18.

usually with brown and white or gray scales. A black or dark brown stripe extends longitudinally along the back. Abdomen tapering and terminating in a two-jointed ovipositor, which can be exserted and is rather conspicuous. Wingless.

Fall Canker Worm, *Alsophila pometaria* Harris.

Egg. Shaped like a truncated cone, fastened endwise to the tree or object, with the thicker end outward and marked with a dark spot in the center and a dark circle near the margin. The eggs are deposited in rows, in compact clusters of between fifty and three hundred eggs each (averaging about one hundred), and are usually laid on the bark of the smaller branches, but may be found on the trunk, or even on fences or stones. When sticky bands are employed, the eggs are laid sometimes on the band itself or on the bark of the trunk just below the band. In color the eggs are brownish gray, but somewhat darker than those of the spring species. On hatching, the young larvæ emerge from the outer end of the eggs, leaving a round hole about the size of the circular ring. Egg-masses are shown on Plate XLIV.

Larva or Caterpillar. Pale olive green at first, with pale head; later a dark gray or brownish form is often found together with the light green caterpillars, both of which are similarly striped with whitish lines. Both forms emerge from the same mass of eggs. *A pair of pro-legs is borne on the eighth segment,* making in all three pairs of pro-legs. The head is dark and indistinctly spotted. About three-fourths or seven-eighths of an inch long when fully grown. Caterpillars are shown on various food plants on Plates XLV and XLVI.

Pupa or *Chrysalis.* Somewhat stouter or broader and darker brown than in the spring species. Male wing-sheaths reaching to the sixth abdominal segment. Apex more blunt than in *vernata,* and the spine decurved and *always forked.* About 7 mm. in length. Not pitted. Enclosed in a rather strong silken cocoon interwoven with particles of soil, making a cell that is not easily crushed. See Plate XLIX b.

Imago or *Adult Moth.*

Male. Wing expanse of from one to one and one-fourth inches. Brownish gray in color, with a slight purplish reflection. Antennæ with over fifty joints, the length of the longest being less than twice the diameter. Palpal joints indistinguishable. The wings are firmer, less transparent and darker in color than in the spring species. The fore wings are crossed by two whitish bands, the distal one being offset inward on the front margin, where it forms a prominent spot known as the costal spot. This outer band continues, though less conspicuous, across the rear wings. The inner band is much less prominent, or obsolete, and does not appear on the rear wings. Males are shown on Plate XLVII b.

Female. Antennæ with over fifty joints, the longest about as broad as long, not pubescent. Body and legs uniform ash-gray in color, without markings. Wingless. Abdomen without visible ovipositor. A female and egg-mass are shown on Plate XLIV a.

Number of Eggs Laid by the Fall Canker Worm.

On an average the female lays about one hundred eggs, usually in a single cluster, though sometimes in two clusters or in small scattered lots. The following figures show the number of eggs in isolated clusters collected from trees from which actual counts were made:

140	41	68	115	100
215	130	41	109	97
47	146	99	59	61
36	95	97	57	57
258	130	64	52	194
94	51	122	110	96
105	89	58	101	55
87	100	87	59	76
86	55	141	108	115
43	38	71	111	69
59	75	78	140	59
72	80	193	124	109
122	111	91	96	54
55	148	54	93	77
209	56	62	143	50
204	72	100	102	88
58	57	47	131	43
41	110	54	106	59
129	77	128	123	108
40	85	113	113	189
2,100	1,746	1,768	2,052	1,756

The above numbers of eggs in one hundred egg-masses show an average of about ninety-four eggs to the cluster and vary from thirty-eight to two hundred and fifty-eight. The smallest egg-masses probably each represent one of two clusters of eggs laid by one insect, or possibly the female was devoured by a bird or some other natural enemy before she had finished depositing eggs.

Eggs laid by females in captivity show a larger number in each mass than those collected from trees. The following numbers of eggs were laid by females collected November 20th, 1908:

165	81	140	92	206
111	90	78	89	251
114	149	95	96	231
256	126	148	128	292
148	160	108	145	242
133	173	38	112	256
240	132	102	162	191
285	102	103	109	229
135	109	146	104	181
154	157	230	51	
68	207	111	130	
202	102	233	99	
147	104	191	128	
141	114	118	148	
2,299	1,806	1,841	1,593	2,079

Thus these sixty-five egg-masses laid in confinement show an average of one hundred and forty-eight eggs, the smallest containing thirty-eight and the largest two hundred and ninety-two, while those collected from the trees out-of-doors average ninety-four each. It is hard to account for this difference. Still more curious is the fact that the numbers given in the first four columns represent eggs laid by females taken *in coitu,* and average one hundred and thirty-four to the cluster, while those in the last column were laid by females collected at random on the trees. It is not known whether these were impregnated or not, but the large average of two hundred and thirty-one to the cluster is difficult to explain. From a lot containing forty-three females, two laid no eggs and five laid eggs in irregular masses. A lot of fifty-four females had forty-two that deposited a single egg-mass each, eleven that laid two egg-masses, and one that laid three egg-masses.

Natural Enemies.

Apparently canker worms are not as highly parasitized as some other species of injurious insects, and little space is given in literature to natural enemies. Dr. Riley mentions* a mite, *Nothrus ovivorus* Pack., which Professor A. S. Packard observed feeding upon the eggs; a four-winged fly of the genus *Microgaster*, which parasitizes the caterpillars; a species of *Platygaster* that is a parasite of canker worm eggs; two large ground beetles, *Calosoma scrutator* and *Calosoma calidum*, which devour the caterpillars, and the potter wasp, *Eumenes fraternus*, which provisions its cells with the caterpillars. Mr. Robert Brown of Yale University has reared a small hymenopterous parasite from the eggs of the fall canker worm in New Haven, but at the time of this writing could not furnish any specimens and the insect remains unidentified.

In the manuscript of the "Hymenoptera of Connecticut," by Mr. Henry L. Viereck, *Ichneumon utilis* Cress. is stated to be a parasite of canker worms.

Many birds feed upon canker worms, the most important being the chickadee, bluebird, shrike, robin, creeper, thrush, cuckoo, warblers and woodpeckers.

Remedies.

Early Recommendations.

As the sex-differences were early known, so were the habits. Remedial treatment was also advocated in the eighteenth century, according to Dr. Samuel Deane, who wrote as follows:†

"This worm is produced from the eggs of an earth-colored bug, which having continued under ground during winter, passes up on the bodies of apple trees early in the spring. They are hatched as early as the end of May, and are so voracious that in a few weeks they destroy all of the leaves of a tree, prevent its bearing for that year, and the next, and give it the appearance of its having been burnt. As the perspiration of trees is stopped by the loss of their leaves, they sicken and die, in a few years.

* Second Annual Report on the Noxious, Beneficial and Other Insects of Missouri, 1870, p. 102.

† The Newengland Farmer or Georgical Dictionary, 1797.

"The worms let themselves down by threads in quest of prey, like spiders; by means of which the wind blows them from tree to tree; so that in a close orchard not one tree will escape them. But trees which stand singly are seldomer infested with these insects. As they are the most pernicious kind of insects with which Newengland is now infested, if any person could invent some easy, cheap, and effectual method of subduing them, he would merit the thanks of the publick, and more especially of every owner of an orchard.

"Several methods have been tried, with some degree of success: 1. Tarring. A strip of canvas or linen is put round the body of a tree, before the ground is open in the spring, and well smeared with tar. The females, in attempting to pass over it, stick fast and perish. But unless tarring be renewed every day, it will become hard, and permit the insects to pass safely over it. And renewing the tar in season is too apt to be neglected, through hurry of business and forgetfulness. If birdlime were to be had, it might answer the purpose better, as its tenacity will continue for some time. 2. Some tie straw round the bodies of the trees. This serves to entangle and retard the insects, and prevents the ascent of many of them. But they are so amazingly prolifick, that if ever so few of them get up, a tree is greatly damaged, at least for an ensuing season or two.

"The pasturing of swine in an orchard, where it can conveniently be done, I suppose to be an excellent method. With their snouts and their feet, they will destroy many of the insects, before they come out of the ground, or while they are coming out. And I have never known any orchard, constantly used as a hog pasture, wholly destroyed, or even made wholly unfruitful by these worms. But this method cannot always be taken; and if it could, I do not suppose it would be quite effectual. When the trees are young, the swine will be apt to injure them by tearing the bark.

"There are several experiments I could wish to have tried for subduing these insects: Such as burning brimstone under the trees in a calm time;—or piling dry ashes, or dry loose sand, round the roots of trees in the spring;—or throwing powdered quicklime, or soot, over the trees when they are wet; or sprinkling them, about the beginning of June, with sea water, or water in which wormwood, or walnut leaves, have been boiled;—or with an infusion of elder, from which I should entertain some hope of success. The liquid may be safely applied to all the parts of a tree by a large wooden syringe, or squirt.

"I should suppose that the best time for making trial of these methods would be soon after the worms are hatched; For at that stage of their existence they are tender, and the more easily killed. Sometimes a frost happening at this season has destroyed them. This I am told was the case in some places in the year 1794."

At a meeting of the Connecticut Board of Agriculture in 1866 the following statement was made by a Mr. Robinson:*

"The canker worm is also troublesome, and the farmers in my neighborhood have suffered much from its ravages. If you go out in March, about half an hour after sundown, you will see crowds of millers rising up from the ground. These crawl up the trees and deposit their eggs, from which the worm in June is hatched. Now, the best way to get rid of the future worm is to prevent the miller from ascending the tree. My trees are all guarded with a mixture composed of equal parts of tar and urine, put in a band around the tree. It is not necessary to put the tar upon cloth, because it does not hurt the tree to apply it directly, and if spread upon a cloth, the worms can crawl underneath it. This application must be renewed every day while the millers are ascending the tree. If an examination is made the morning after this application of tar and urine, the bark of the tree will be found to be coated white with millers."

In these early days it was not known that there are two distinct species of canker worm, though it was known that some of the adults appeared in fall and others in spring, as the following quotation shows:†

"Mr. David Lyman of Middlefield remarked that his section of the state was a good region for the finer qualities of apples. He had found his apples, too, to be a profitable crop. The canker worm had been his greatest pest. Against this worm he had used tar as an application which had to be repeated every evening for a long time, say forty times. The canker worm moth

* Report Conn. Board of Agriculture for 1866, p. 81.
† *Idem*, p. 84.

comes up out of the ground in the fall as well as winter. Mr. Lyman has found this out by observation. To more effectually defend his trees from the ravages of this pest, Mr. Lyman has used the so-called 'Tree-protector,' which is designed to prevent the progress of the insect up the tree. It was a little instrument like a tent, held away from the tree by a wire, having its outer edge like an umbrella, with smooth strips of isinglass projecting from the edge; the design of which was this, that if the insects could crawl to the edge they could get no further on account of the slippery foothold they would have. But the conclusion from the application of these tree-protectors was this, that they were good for nothing, and the canker worm ascended the tree just as well after their application as before. He had tried next the experiment of ploughing his orchards. This had the effect to diminish the number of worms during one season upon his apple trees in an old orchard where the experiment was tried. The ploughing ought to be followed by an application of bonedust."

Further recommendations were also made at this meeting:*

"Professor Brewer said that the Professor of Zoölogy in the Sheffield Scientific School had been investigating the subject of the different pests of our trees, and especially the history of the canker worm, as it appears upon the elm trees about New Haven. Whether this variety of the worm is the same as that infesting the apple tree, the Professor was not certain, but in this they are alike, they strip the tree of foliage. The variety of worm infesting our elm trees attains its growth between the first and seventh of June. It is a common thing to say that they leave about the tenth of June. When they have attained their growth upon the tree, they leave and go down into the ground to go through with their second stage of development there, and as has been said, they come out of the ground in the fall. Three-fourths of our people believe that if they attempt to protect their trees against the ravages of this worm, that it is sufficient if the attempt is made in the spring. It is not so. These worms may come out during the warm days of winter, and also in the spring. The females cannot get up the trees without crawling, for they are not provided with wings.

* Report Conn. Board of Agriculture for 1866, p. 85.

"There have been practiced different methods for the protection of our elm trees, and the cheapest and best is to cover the body of the tree two or three feet from the ground with paper smeared with printers' ink. This is better than the application of tar, for it remains sticky much longer. It does not gloss over like tar. It is the cheapest application that can be made, and has been tried with success in some parts of New Haven City. It must be put on in the fall and in the spring.

"The trees about the colleges were provided with a leaden rim surrounding the tree, fitting it like a collar, and having a hollow filled with oil between the rim and the tree. The idea was that the canker worm would tumble off in trying to climb around the shelving edge, or if he succeeded in getting around this that he would die in attempting to cross the intervening fluid. These were found not to work well.

"The best protection against these worms and other pests is to have their natural enemies flourish at the same time. There is an enemy of the canker worm, a green beetle, which has an enormous appetite, for they eat all the while. These beetles and the birds which live upon the pests of our trees are our best safeguards against the attacks of the worm.

"There is also a fly called the ichneumon fly, which attacks the eggs of the canker worm and blights them. All these enemies of the canker worm kill it, and diminish their numbers, so when it is noticed that during some seasons our trees are comparatively free from the worm, you may be sure that this decrease is owing to the fact that their natural enemies have increased in a corresponding ratio. When these enemies of the worm also die off, then you will notice that the elm trees are beginning to be laid bare again. And as one end of the scale goes up, the other end goes down."

Mr. T. S. Gold* made the statement that canker worms are abundant only on light soils, and advised as remedies fall plowing and the use of guards around the trunks treated with oil or tar, to prevent the wingless females from ascending to lay their eggs. At a similar meeting in 1881, Mr. P. M. Augur advised† spraying with a weak solution of Paris green or London purple as soon

* Report Conn. Board of Agriculture for 1866, p. 204.
† *Idem* 1881, p. 334.

as the young leaves appear. Three years later, the same speaker recommended* these poisons at the rate of from eight to twelve ounces in a forty-gallon cask of water.

In 1896, the writer advised† spraying the foliage with arsenical poisons and applying to the trunks of the trees bands of cloth, or paper covered with tar or printers' ink, to prevent the females from ascending. Later, tests of various substances were made, and it was found that printers' ink was about as satisfactory as anything that could be obtained for the price. Odds and ends of ink, consisting of various colors left over from job work, are sold under the name of "tree ink" at a lower price than that usually charged for printers' ink, and this is just as good for this purpose. It will harden, however, after a short time, and the writer found that by mixing with it a non-drying petroleum oil it could be kept longer in a viscid state. The oil could also be applied with a brush to the bands from time to time to keep them in proper condition. Pine tar and a preparation called caterpillar lime caused injury to some small trees, even when applied to a band of tarred paper. This method of banding trees was described by the writer in a paper read at the Fourteenth Annual Convention of the Association of American Agricultural Colleges and Experiment Stations at New Haven in 1900, and printed in the proceedings.‡

Since then a substance known as "tree tanglefoot" has been placed upon the market, and though this is a proprietary article, it is difficult to make anything for the price that equals it. It remains sticky for a long time and causes no injury to the tree, even though applied directly to the bark.

Modern Treatment.

We must still advise the same general lines of attack as were recommended years ago, namely, spraying the foliage with arsenical poisons and placing sticky bands around the trunks to prevent the ascent of the wingless females. Different substances can now be used for the purpose. The spraying method is advised in the apple orchard, where spraying is generally practised any-

* Report Conn. Board of Agriculture for 1881, p. 390.
† Report of this station for 1896, p. 235.
‡ Bulletin 99, Office of Experiment Stations, U. S. Dept. of Agriculture, p. 160.

way on account of codling moth and tent caterpillar. In Bailey's experiments* in Central New York, Paris green (one pound in two hundred gallons of water) gave as good results as a mixture twice as strong, and seemed more effective than lead arsenate used in similar proportions. In spraying trees at Stonington to kill gypsy caterpillars, last summer, lead arsenate was used in the proportions of three pounds in fifty gallons of water, and this was later increased to five pounds. Some of the trees and shrubs were infested with canker worms, which were readily killed. Quaintance's experiments† also confirm this.

Canker worms can be controlled by a careful and thorough spraying with lead arsenate (three pounds in fifty gallons of water), or with Paris green (one pound to fifty gallons of water, three pounds lime), but these quantities can be doubled if desired.

Where it is impracticable to spray the trees, canker worms can be controlled absolutely by sticky bands, if properly used.

How to Band the Trees.

The sticky substance may be applied directly to the bark, and this is often done in orchards and on woodland trees, but on shade trees on private places it is often desirable to remove the bands when they are no longer needed, and this can be done if the sticky material is placed upon a separate band. Tarred roofing paper answers the requirements, as it does not absorb the "tree tanglefoot" as cloth would do, and it is fairly durable. If the paper is placed around the trunk, the rough bark has many crevices through which the females can crawl. Hence the reason for using cotton batting to stop these.

First place around the trunk about six feet from the ground a strip of cotton batting (cheapest grade) about two inches wide. Then cover this with a band of single-ply tarred paper about five inches wide, fastened at the lap with three sharp-pointed tacks about three-fourths of an inch long. The paper should be drawn snugly enough to press the thick band of cotton into the crevices, but not enough to break the paper. If tacked in many places, the growth of the tree will break the paper. Of fifty-five bands applied in this manner none needed renewing for two seasons,

* Bulletin 101, Cornell Expt. Station, p. 496.
† Bulletin 68, Bur. of Entomology, U. S. Dept. of Agriculture, p. 21.

and while many had to be replaced the third year, fully one-half of them lasted through the fourth season.

"Tree tanglefoot" should then be spread upon the band, preferably the upper two thirds of its width, with a wooden paddle, leaving a smooth coating about one-eighth of an inch thick. If spread too thin it will become ineffective much sooner, and cannot be renovated by combing or scratching the surface, as is possible with a thicker coating. But the effect of the weather after a time will dry or harden the surface of the band so that it is necessary to add more "tanglefoot." Especially is this necessary where the moths are abundant and adhere to the bands in such numbers as to entirely cover the viscid surface and render it ineffective. Usually scratching or combing the surface of the "tanglefoot" every three weeks will keep it in good condition. The method of applying bands is shown on Plate XLVIII. Such a band as has just been described can be removed from the tree at any time without leaving any sign or scar, while if applied directly to the bark it will show as a disfiguring mark for many years. Moreover, so much more "tanglefoot" is necessary to fill the cracks of the bark and thus make an effective barrier that it costs about as much to apply it directly to the bark. No doubt some reader will ask or wonder why it is advised that the paper be so much wider than the cotton band. There are two reasons. In the first place, a narrow band of cotton fills the cracks just as well as a wide one and costs less. In the second place, it is unsightly to use a cotton band which shows either above or below the edges of the paper. For very large trees it is well to use a wider strip of paper, say six or seven inches, and for a very small tree four inches is ample width, but five inches is about right on the average.

In Connecticut the bands should be applied during October, as the moths appear about the first of November, and they should be kept in a viscid condition during this and the following months, and again in March, April, and the first part of May, in order to catch the spring females and the newly-hatched larvæ. A band of thick cotton batting is quite effective in preventing the ascent of the females, but this is more unsightly than the dark bands described above.

A band of wire cloth netting tacked by its upper edge so as to allow the lower margin to stand out one or two inches from the bark is also an effective barrier, but unless the eggs are destroyed below the band before hatching, the young larvæ will crawl through the meshes and up the tree.

Cost of Banding Trees.

The sticky bands of tarred paper and cotton batting such as have been described in this paper were applied to trees on the station grounds in October. All trees, including fruit trees, were banded, nearly one hundred in number, and averaging rather small. "Tree tanglefoot" costs from twenty-four to thirty cents per pound according to the quantity purchased, and is put up in one, three and twenty pound cans. Tarred paper costs seventy-five cents per roll, cotton batting ten cents, twelve-ounce upholstery tacks ten cents per package.

On the basis of these figures the bare cost of banding the trees was a little more than ten cents per tree, of which about half was for labor and half for materials. The cost will vary, of course, with the size of the trees and the cost of materials and labor.

Summary.

Canker worms have caused damage to trees in New England for more than one hundred years, according to our records, and from time to time during that period they have been injurious. Many orchard, shade and woodland trees were stripped in 1908. In the early days it was known that the females were wingless, and that they crawled up the trees to lay eggs, and tar bands were recommended as a remedy.

Though it was known that some of the adults appeared in fall and some in spring, they were at first supposed to belong to the same species, and it was not until 1874 that Dr. Riley published an accurate and detailed description of their characters, thus showing them to be distinct species.

The spring canker worm, *Paleacrita vernata* Peck, has long been destructive in the Southern and Middle Western States. The adults emerge from the ground during March and April and the females lay their whitish eggs, about fifty in number, in loose irregular clusters, usually under the edges of the rough bark. The eggs hatch early in May and the caterpillars feed upon the leaves. They are green, brown or dark gray in color, marked longitudinally with fine pale lines. They have *no pro-legs on the eighth segment.* They spin down on fine silken threads when disturbed, and become full grown about June 1st, going into the ground, making a simple earthen cell lined with a few threads of silk. The male pupa is tipped with a simple spine.

The adult male has a wing spread of about an inch and is of a brownish gray color. Wings are thin and semitransparent, with the markings rather indistinct. Female, brown or gray, with a black or dark brown stripe along the back and a two-jointed exsertile ovipositor.

The fall canker worm, *Alsophila pometaria* Harris, is far more common in New England than the spring species, though both occur. The adults appear in November and December, and the females lay dark gray eggs on the trees in compact clusters of about one hundred, arranged in rows, and each egg fastened by one end to the bark. The caterpillars hatch from the eggs early in May, and vary in color from light green to dark gray or brown, marked lengthwise with fine white lines. *A pair of pro-legs* is borne on the eighth segment. Like the spring species, they spin down on silken threads, and are about three-fourths of an inch long when full grown, about June 1st, when they go into the ground to pupate. The pupa is stouter than in the spring canker worm and the spine is curved and forked. It is enclosed in a silken cocoon interwoven with soil particles, making a strong cell.

The adult male is lightly larger than *vernata,* brownish gray in color, with a slight purplish tinge, wings are firmer, less transparent and darker gray in color. The fore wings are crossed by two whitish bands, the distal one being offset inward on the costal margin, forming a white costal spot. Female without wings, markings, or visible ovipositor, and uniform ash-gray in color.

Both kinds of canker worms devour the leaves of trees in the same way, and attack a large number of different kinds of trees. The fall species seems to be especially fond of apple orchards.

Spraying the trees with Paris green was first advised in the early eighties, while bands covered with tar and printers' ink have remained in use.

At the present time the best treatment for orchards is to spray with lead arsenate (three pounds in fifty gallons of water or

Bordeaux mixture), or with Paris green (one-half pound in fifty gallons). Shade and garden trees may be cared for by placing a band of sticky material, one of the best substances being "tree tanglefoot," about the trunk. This can be placed on the bark, or preferably a band of cotton batting should be placed around the trunk covered with a strip of tarred paper five inches wide, upon which the sticky material is placed. Banding is inexpensive and effective where the bands are properly cared for.

Where the fall canker worm is the destructive species, the bands should be applied during October, and kept in a sticky condition during November and December and again during March, April and May, in order to prevent both the adult female and the newly hatched caterpillars from ascending the trees. To control the spring canker worm, the sticky bands need be effective only during March, April and May.

FURTHER TESTS OF GASES TO DESTROY SAN JOSÉ SCALE ON NURSERY STOCK.

In the Report of this station for 1907, page 270, is an account of the value of various gases for fumigating nursery stock to destroy the San José scale. It was stated therein that the tests were preliminary and that conclusions based on them were scarcely warranted, yet that they indicated the desirability of making further tests with smaller quantities of carbon disulphide and carbon tetrachloride, and of longer fumigating periods with the former. Following along this line, therefore, the present paper deals with additional tests made during the last week of April, 1908. All trees were apple, and more or less infested with the scale, much more so than the trees used in the tests last year. This fact may in some measure explain the results, as it is probable that where trees are slightly infested a careful fumigation will often kill all of the scales, whereas with the same treatment the gas might not be able to reach and destroy every individual insect where the bark is thickly covered by them.

The work of fumigating and counting the scales was done by Mr. B. H. Walden.

The roots were in good condition, except where otherwise noted, and the buds had started but little. Portions of the trunk were

cut from each of nine different trees and the scales examined, with the following result:

Alive	7	4	3	3	17	8	5	26	40	= 113
Dead	18	10	4	7	5	16	4	8	10	= 82
										195

Number alive = 58 per cent.

Ten trees were used in each test with carbon disulphide and carbon tetrachloride except in No. 6, which had nine trees. Five each were used in the acetylene tests, making in all two hundred and twenty-four trees which were fumigated. These were set in nursery rows on the station grounds, where they could be watched during the season.

Carbon Disulphide.

The liquid was volatilized by putting it in iron frying pans heated to about 100° C., according to the method described in last year's report. The pans were placed on frames above the trees and near the top of the case. The fumigating was done in tin cases containing about six cubic feet. The figures in the table, as well as those in the text, are calculated for one hundred cubic feet. The quantities used, fumigation period and results, are shown in Table I. The effect upon the scales corresponds with the results of last year's tests in that ten fluid ounces or less of the liquid does not kill all of the scales unless acting during a long fumigation period. Thus in Nos. 1 and 2, ten ounces acting for one and two hours left over twenty per cent. of living scales, but in No. 5, where the same quantity was allowed to act for four hours, all were dead. In Nos. 6 and 9, five ounces did not kill all of the scales in two and four hours, but after being treated for six hours none survived.

As was the case in last year's tests, twenty or more ounces acting for one hour or longer killed all of the scales. Where thirty ounces acted for two hours, one tree (ten per cent.) failed to grow, though it started and afterward died.

Though not proven, our tests indicate that the limitations of carbon disulphide vary from a minimum of twenty fluid ounces for one hundred cubic feet with a fumigation period of one hour to a maximum of thirty fluid ounces for two hours. Less than the minimum may not kill all the scales, and more than the maximum may result in killing or injuring the trees. It should be understood that these tests apply only to apple and peach, and chiefly the former, and against the San José scale and no other insect.

Carbon Tetrachloride.

This liquid was used in exactly the same way as the carbon disulphide, the same metal cases and heated frying pans being used. The quantities used, period of fumigation and results, are given in Table I. The results do not correspond very closely with those obtained in last year's tests, in that some scales survived in each case, where last year all were killed. Last year it seemed that carbon tetrachloride was a promising material, and its good qualities were mentioned in the Report. Though further trials may still prove it to be of some value as an insecticide, in the light of the 1908 tests it does not appear as promising as it did a year ago. Nevertheless, the figures are given here for what they are worth without further comment than to state that carbon disulphide, in spite of the inflammability and bad odor, seems to be more desirable for fumigating nursery trees to kill the San José scale than carbon tetrachloride.

Acetylene.

This was generated in a granite iron dish from crushed calcium carbide, the largest pieces being about one inch in diameter. Instead of the metal case a long wooden box was used. In Test No. 21 this box was used right side up with a tight cover, the carbide weighed out and placed in the dish, and the water poured in by means of a funnel through a hole in the cover. In the other tests the box was inverted over the trees on the ground, and the earth banked up around the edges of the box to make it tight. A small box was sunk in the ground under the middle of the long box, and this, projecting outward from one side, served as a place to introduce the materials. The opening in the small box was then quickly covered and banked with earth.

The data regarding the tests with acetylene will be found in Table I, but do not show this gas to be very effective in destroying the scale when used in the quantities and for the fumigating periods used in this experiment.

It does not appear that any of the gases that can be commonly and simply generated will supersede hydrocyanic acid gas for fumigating nursery stock.

Table I.—Test of Gases for Fumigating Stock.

No. Expt.	Fluid ounces of liquid used for 100 cu. feet.	Fumigating period.	Number of Generating dishes.	Number of trees.	Effect on Scales.			Effect on Trees.	
					Alive.	Dead.	Per cent. Alive.	Alive.	Dead.
	Experiments with Carbon Disulphide.								
1	10 fluid oz.	1 hour	1 heated to 100°C.	10	35	138	20.2	10	0
2	10 "	2 "	1 " "	10	56	192	22.5	10	0
3	20 "	2 "	1 " "	10	0	123	00.0	10	0
4	20 "	1 "	1 " "	10	0	159	00.0	10	0
5	10 "	4 "	1 " "	10	0	112	00.0	10	0
6	5 "	4 "	1 " "	9	21	200	09.5	10	0
7	30 "	1 "	1 " "	10	0	101	00.0	10	0
8	30 "	2 "	1 " "	10	0	123	00.0	9	1*
9	5 "	2 "	1 " "	10	30	123	19.6	10	0
10	5 "	6 "	1 " "	10	0	160	00.0	10	0
	Experiments with Carbon Tetrachloride.								
11	10 fluid oz.	2 hour	1 heated to 100°C.	10	12	116	09.0	--	0
12	20 "	2 "	1 " "	10	4	172	02.2	9	1*
13	30 "	1 "	1 " "	10	28	123	18.5	10	0
14	30† "	2 "	1 " "	10	1	180	00.5	9	1
15	20 "	1 "	1 " "	10	3	111	02.6	10	0
16	5 "	2 "	1 " "	10	22	126	14.8	10	0
17	10 "	1 "	1 " "	10	29	200	12.6	10	0
18	10 "	4 "	1 " "	10	46	161	22.2	10	0
19	5 "	4 "	1 " "	10	33	175	15.8	10	0
20	5 "	6 "	1 " "	10	12	143	07.7	10	0
	Experiments with Acetylene.								
21	40 oz. ‡ av.	1 hour	1 heated to 100°C.	5	14	28	33.3	5	0
22	80 "	1 "	1 " "	5	22	85	20.5	5	0
23	120 "	1 "	1 " "	5	15	74	16.8	5	0
24	80 "	2 "	1 " "	5	15	50	23.0	5	0
25	80 "	½ "	1 " "	5	24	85	22.0	5	0

* Tree started to grow, then died.

† More than one-fourth of liquid had not volatilized at end of period.

‡ Of calcium carbide.

MOSQUITO WORK IN 1908.

In April, a request was received from Dr. John B. McCook of Hartford, Surgeon of the First Regiment, Organized Militia, State of Connecticut, for a report regarding the breeding of *Anopheles* in the vicinity of the state rifle range in East Haven. Though this territory was examined in a general way in 1904, and nothing was found there, it was thought best to make another survey of the place, as plans had been made for the regiment to be in camp there for a week in July.

Mr. Walden visited the place on June 24th, and not finding any serious mosquito breeding-places, a report to this effect was sent to Dr. McCook. Afterward Dr. McCook furnished us a blue print map of the region, and Mr. Walden again visited the range in order to locate more definitely some of the pools. Thus the more important features were mapped and numbered, and explanatory notes were sent to Dr. McCook under date of August 13th. Following is Mr. Walden's report:

The Mosquito Breeding Problem at the State Rifle Range, East Haven, Conn.

The state rifle range at East Haven was examined June 24th and again August 12th, for mosquito breeding-places. At the first examination no mosquito larvæ were found, but on the second date both *Anopheles* and *Culex* larvæ were found in two places. In a dry season the range is fairly safe from mosquito breeding, but there are several low areas which in wet seasons would hold water long enough for mosquitoes to breed.

During the warm part of the season only about a week is required for mosquitoes to develop from the egg to the adult. Therefore, any place that will hold water for a week or more is liable to breed mosquitoes, and as *Anopheles,* the malarial mosquito, may breed in any place where other mosquitoes breed, it is important that these low areas should be drained. This is a comparatively simple problem. The Farm River, a large stream well stocked with fish, runs lengthwise of the range, and the low places can be drained by running simple open ditches to the river. On the accompanying map the necessary ditches have been indicated. Ditches eighteen inches wide and fifteen inches deep at the point farthest from the river will furnish ample drainage. These may be made straight, or may curve to follow the natural drainage of the land, as seems best. The only requisites are that the bottom of the ditches be fairly smooth, and have enough fall so as to leave no places for the water to stand in pools. The edges should also be kept fairly clean.

Notes regarding a few details are as follows:

There is a depression ten or fifteen feet across, at the side of, and partly under, the bridge where the driveway crosses at the south end of the range. The bottom is more or less covered with rocks, between which the water stands. Water was present here June 24th, just after a long dry period. No mosquito larvæ found at this time. On August 12th larvæ of both *Anopheles* and *Culex* were present in small numbers. Filling the depression with dirt to the top of the rocks would make it safe.

A short distance north is a large brush-covered pondhole, which, though dry at the time of both examinations, would probably hold water even in a normally wet season. It will require a ditch several feet deep to drain it across the skirmish run. If this forms too much of an obstruction a tile or covered drain could be constructed.

Northeast from the building occupied by the quartermaster's department a low area extends inland from the main stream, in which is much standing water. Grass and weeds occur here, and it is more or less obstructed by fallen trees and brush. *Anopheles* larvæ were present August 12th. A wide ditch could be dug here, and the material used to fill, so as to make abrupt edges. These should be kept clean, so that the fish will be able to reach the edges.

To the north is a low area which can be easily drained.

Towards the north end of the range is an old choked ditch which should be cleaned out if there is any standing water in the vicinity.

The edges of the main stream should be kept clean from anything that would obstruct the fish, and any other places where water stands should be drained or filled as recommended above.

It would be hard to estimate the cost of eliminating all breeding-places, but to carry out the above recommendations, using simply open ditches, would probably cost less than one hundred dollars. Tile drains would of course cost much more, and are not necessary to do away with all possible mosquito breeding-places.

THE BEAVER SWAMP REGION.

Beaver Swamp, near New Haven, has long been regarded as unsanitary and as a source of malaria, even before the cause of malaria and its methods of transmission were known. In the mosquito survey made by this station in 1904,* this swamp was found to be the most prolific source of *Anopheles,* or malarial mosquitoes, about New Haven. The Board of Park Commissioners has been working for some time to have the city purchase this land on the grounds of sanitation, with the expectation that ultimately it may be used for park purposes. Thus a small area has been purchased each year for several years, until now nearly all of the land between Munson Street on the south and Willis Street on the north, extending from Fournier Street on the west to the proposed extension of Sherman Avenue on the east, is owned and controlled by the city.

In 1904 the results of our examination were made known to the Park Commission and to the health officer, and after another examination in 1908 the facts were communicated to the mayor, but so far nothing has been done by the city authorities to put this area in a sanitary condition.

The accompanying map (Figure 10), explained by the following numbered notes, shows where the more serious breeding-places are located:

No. 1. Small spring-like depression about three by five feet, containing *Culex* larvæ.

No. 2. Tested edge of main stream for fifty feet or so. Found a few *Anopheles* larvæ and many *Culex* larvæ.

No. 3. A sedgy depression about ten feet long, containing yellow pond lilies and breeding *Culex* larvæ. In a wet season a much larger area would be flooded.

No. 4. Large boggy area more or less covered with water, surrounding large pool with pond lilies growing in it. Found *Culex* larvæ in abundance.

No. 5. A large deep pool in edge of stream, with *Anopheles* larvæ along the irregular edge.

No. 6. A soggy area with more or less water covered with lily pads, sedges, cattails and bushes. Found many *Culex* and a few *Anopheles* larvæ.

* Report of this station for 1904, p. 293.

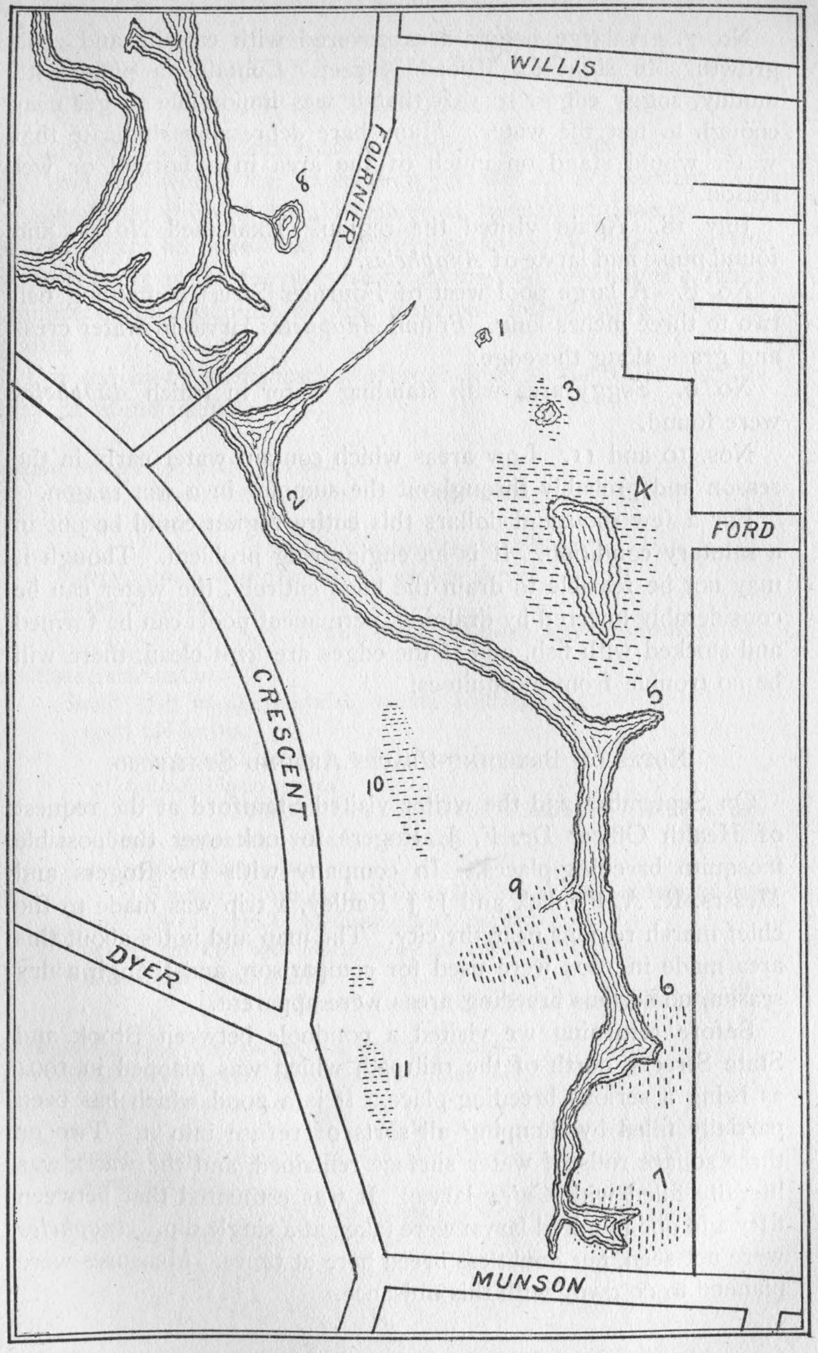

FIG. 10. Map of Beaver Swamp, New Haven, showing breeding-places of the malarial mosquito.

No. 7. A large boggy area covered with cattails and rank growth. In sight of Munson Street. Contains a pond with muddy, soggy edges, so soft that it was impossible to get near enough to test the water. Many bare depressions indicate that water would stand on much of the area in a normal or wet season.

July 18. Again visited the region. Examined No. 5, and found pupæ and larvæ of *Anopheles*.

No. 8. A large pool west of Fournier Street containing fish two to three inches long. Found *Anopheles* larvæ in water cress and grass along the edge.

No. 9. Soggy area with standing water in which *Anopheles* were found.

Nos. 10 and 11. Low areas which contain water early in the season and probably throughout the summer in a wet season.

For a few thousand dollars this entire region could be put in a salutary condition. It is an engineering problem. Though it may not be feasible to drain the bogs entirely, the water can be considerably lowered by draining, permanent pools can be formed and stocked with fish, and if the edges are kept clean, there will be no trouble from mosquitoes.

Notes on Breeding-Places Around Stamford.

On September 23d the writer visited Stamford at the request of Health Officer Dr. F. J. Rogers to look over the possible mosquito breeding-places. In company with Dr. Rogers and Messrs. R. A. Fosdick and J. J. Radley, a trip was made to the chief marsh regions near the city. The map and notes about this area made in 1904 were used for comparison, and though a dry season, no serious breeding areas were apparent.

Before returning we visited a pondhole between Brook and State Streets, north of the railroad, which was mapped in 1904 as being a serious breeding-place. It is a pond which has been partially filled by dumping all sorts of refuse into it. Two or three square rods of water surface remained, and the water was literally filled with *Culex* larvæ. It was estimated that between fifty and one hundred larvæ were taken at a single dip. *Anopheles* were not seen, but doubtless breed here at times. Measures were planned to do away with this nuisance.

INSECTS ATTACKING CUCURBITACEOUS PLANTS IN CONNECTICUT.

Cucurbitaceous plants such as cucumbers, squashes, pumpkins and melons, which are extensively grown in Connecticut, are attacked and injured by a number of species of insects. For several years we have been making observations on them, and the present paper is for the purpose of giving in a few pages a fairly comprehensive account of the principal insect pests of these plants.

For the hasty identification of such insects the following key may be found useful:

BORING IN THE ROOTS AND STEM—

Small, slender larvæ tunneling in the main root or stem below ground ....
Striped Cucumber Beetle, *Diabrotica vittata*, p. 807.

Large, stout larvæ boring in squash stems above ground ....
Squash Borer, *Melittia satyriniformis*, p. 806.

DEVOURING THE LEAVES—

Small (5-7 mm.) yellowish beetles feeding upon the leaves.

Body yellow, marked with three longitudinal black stripes ....
Striped Cucumber Beetle, *Diabrotica vittata*, p. 807.

Body greenish yellow, marked with twelve black spots ....
Southern Corn Root Worm, *Diabrotica xii-punctata*, p. 809.

Large (8-10 mm.) hemispherical beetle, orange marked with black spots, or yellow larva with black spines ....
Squash Lady-beetle, *Epilachna borealis*, p. 810.

SUCKING SAP FROM THE UNDER SIDE OF THE LEAVES—

Small dark green or brownish plant lice, often very abundant ....
Melon Aphis, *Aphis gossypii*, p. 813.

Larger bright green plant lice usually not abundant ....
Squash Aphis, *Nectarophora cucurbitae*, p. 814.

Gray bug with spicy odor (15 mm. when full-grown) ....
Squash Bug, *Anasa tristis*, p. 811.

Small greenish-white scale-like insects on the under leaf surface of plants growing under glass or near greenhouses. Pure-white moth-like adults resting on the leaves, and flying about ....

Greenhouse White-Fly, *Aleyrodes vaporariorum*, p. 815.

The Squash Borer.

Melittia satyriniformis Hübn.

This is the most important enemy of the squash and pumpkin in Connecticut, and causes the vines to wither in July and to die before maturing their crop. Melons and cucumbers are seldom attacked if squashes and pumpkins are plenty.

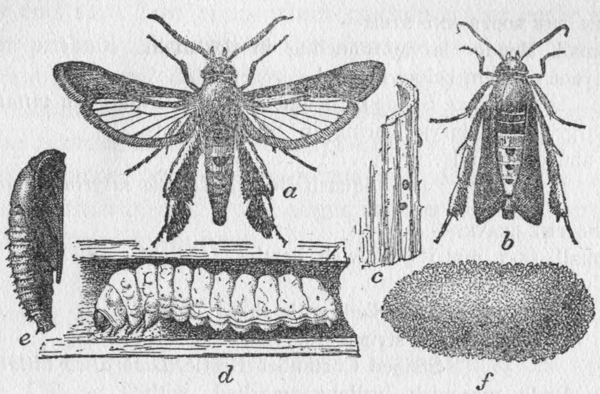

Fig. 11. The squash borer: *a*, male moth; *b*, female, with wings folded as when at rest; *c*, eggs on section of squash stem; *d*, full-grown larva in the stem; *e*, pupa; *f*, pupal cell. All one-third larger than natural size. (After Chittenden, Circular 38, Bureau of Entomology, U. S. Department of Agriculture.)

The adult is one of the clear-wing or sesiid moths, and is shown on Plate L of this report. It has a wing expanse of from one to one and one-fourth inches, and the fore wings are opaque and dark olive green in color with a metallic luster and a fringe of brownish black. Rear wings with transparent cells and a bluish reflection, veins and fringe black. Thorax and antennæ colored about like fore wings. Abdomen reddish brown, legs bright orange, with tarsi black with white bands. When at rest the wings are folded as in *b* of the accompanying illustration (Fig. 11).

This insect is distributed throughout the eastern half of the United States from Canada south to Mexico, and is thought to be a tropical species. The female lays eggs singly on the squash plant during June or early July in Connecticut, but may be abroad at a much earlier date farther south. The eggs are usually laid on the stem, but may often be found on the leaves or buds. The eggs are oval and dull red, and over two hundred may be laid by one moth. From one to two weeks are required for the eggs to hatch, and the larvæ become full grown in about four weeks. The newly hatched larva enters the main stem, where it tunnels through it lengthwise near the base, often going into the leaf petioles which branch from the main stem. As the larvæ increase in size they eat more and more each day, and the plant begins to wilt. This is usually the first sign of the attack, though an earlier examination would show the yellowish excrement which is thrown out of the holes in the stem. The stem usually begins to decay near its base, and is often severed at this point. The full-grown larva is about one inch long, rather stout and soft, is white with a black head and is shown with its injury on Plate L. It goes into the ground one or two inches, where it makes a cocoon of silk, to which adhere small particles of soil. There is only one generation each year in Connecticut, but in Washington, D. C., there are two broods.

In our experiments several remedies have been tried, including wrapping the stems with tarred paper, placing tarred paper disks around the stems at the base, and painting the stems with a thick mixture of lead arsenate. These three practices did not seem worth while. The only treatment that we can recommend is to plant early squashes for traps to be destroyed later; to cut into the stems, making a longitudinal incision, and killing the borers; to cover the stem with earth one or two feet from the base to induce secondary roots that will support the plant in case it should become severed at the base. It is also advisable to destroy all old vines as soon as the crop is secured.

The Striped Cucumber Beetle.

Diabrotica vittata Fabr.

A frequent and serious enemy of all cucurbits is the striped cucumber beetle, *Diabrotica vittata*. Soon after the seedling plants appear the beetles begin to feed upon the leaves and tender stems, eating away the epidermis, often causing the plants to wilt and die. They even burrow into the ground and attack them before they come up.

The beetles are about one-fifth of an inch long, with thorax and wing-covers yellow, the latter with three black longitudinal stripes; the head is also black. At the time the beetles are feeding upon the young plants they are also mating and laying eggs on the stem just below the surface of the ground. The larvæ

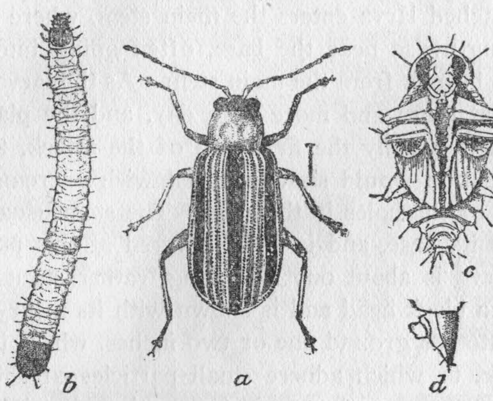

FIG. 12. The striped cucumber beetle: *a*, adult beetle; *b*, larva; *c*, pupa; *d*, side view of anal segment. All greatly enlarged. (After Chittenden, Circular 31, Bureau of Entomology, U. S. Department of Agriculture.)

hatching from these eggs are borers in the roots of the plants, sometimes causing considerable injury. A sample of this work is shown on Plate LI. Though the complete life history of this insect is not well known, it is believed that the larval period lasts for about a month. The full-grown larva is about one-third of an inch long, and is slender and whitish, with a black head (see Fig. 12). Pupation occurs within the ground. The pupa is white, like the larva, and the pupal stage lasts about a week. There are two generations in Connecticut each season, and the beetles are often found in large numbers late in the season assembled under the dead leaves of the plants. Melons, cucumbers, squashes and pumpkins are attacked.

The remedies consist either in keeping the beetles away from the plants or in the use of poison. The latter method is the one

practiced by most large growers. Paris green may be mixed with air-slaked lime or plaster at the rate of one pound of poison to seventy-five pounds of plaster, and the mixture sifted upon the plants. This, of course, cannot be used before the plants come up, and when the beetles are extraordinarily abundant much damage will often result to the plants in spite of the application of poison. Lead arsenate mixed with water at the rate of three to five pounds in fifty gallons of water and sprayed or sprinkled upon the plants is usually an excellent remedy.

In order to keep the beetles wholly away from the plants it is necessary to cover them with frames of netting. A barrel hoop may be cut in two equal parts and fastened together at right angles, the ends set in the ground, and the frame covered with netting. The ends of these semicircular hoops may be fastened to another hoop lying horizontally in order to make a portable frame, and the whole covered with netting. Boxes and various other forms of wood may be designed into protectors for this purpose, but they are chiefly for use in the home garden, and must be placed over the hills before the beetles appear. In some cases it is possible to drive away the beetles by a frequent dusting of the plants with fine coal ashes, air-slaked lime, or insect powder, and some growers use trap plants and practice burning all old plants and rubbish in the field after the crop is harvested.

THE SOUTHERN CORN ROOT WORM OR TWELVE-SPOTTED CUCUMBER BEETLE.

Diabrotica xii-punctata Oliv.

This insect is not usually included in a list of insects injurious to cucurbitaceous plants, but it has been so abundant in certain fields which have come under our observation that surely considerable damage must have been done by it, and for that reason it is listed here.

For many years the adults have been known to feed upon a large number of plants, including nearly all of the common vegetables and some of the fruit blossoms and field crops. The larvæ are a serious pest of corn roots in the Southern States, and also attack rye, millet and garden beans, sometimes doing considerable damage.

The eggs are laid in the soil, each female laying about seventy-five eggs, which hatch in about three weeks, and the larvæ tunnel in the roots of corn and other plants for nearly four weeks, pupating in an earthen cell from which the adult beetle emerges about a week afterward.

The adult beetle is somewhat larger and stouter than the striped cucumber beetle, and averages about 7 mm. in length. The wing-covers are greenish yellow, marked with twelve black spots arranged in three transverse rows, and varying in size. Thorax bright yellow, head black. Legs, except thighs, and antennæ blackish.

Where abundant enough to cause injury, the same remedial measures used against the striped cucumber beetle should be practiced.

The Squash Lady-Beetle.

Epilachna borealis Fabr.

Nearly all of the lady-beetles are carnivorous, and are considered beneficial because they feed upon injurious insects such as plant lice and scale insects. The squash lady-beetle, however, is an exception, and feeds upon the leaves of cucurbitaceous

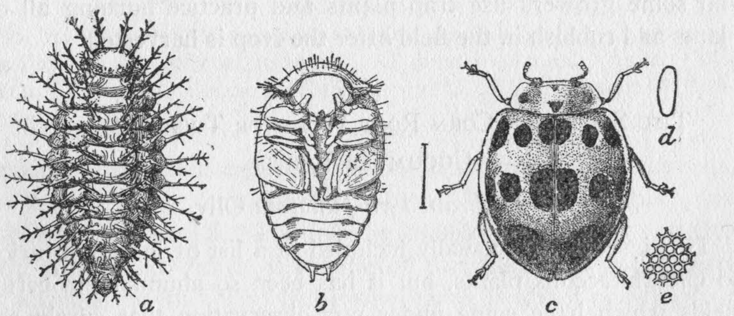

Fig. 13. The squash lady-beetle: *a*, larva; *b*, pupa; *c*, adult beetle, three times natural size; *d*, egg, four times natural size; *e*, surface of same highly magnified. (After Chittenden, Bulletin 19, Bureau of Entomology, U. S. Department of Agriculture.)

plants, but does more damage to squash than to the other plants of this group.

The adult beetles hibernate under bark or in other sheltered places, emerging in June, and toward the end of the month lay

their eggs on the under side of the leaves. The eggs hatch in about twelve days, and the larvæ at once commence to feed upon the leaves, attacking them from the under side. The larvæ appear about the middle of July and become full grown early in August, when they assume the pupa stage, which lasts six days before the adults emerge.

The adult is nearly hemispherical in shape, slightly oval, about one-third of an inch long and slightly over one-fifth of an inch broad. It is greatly convex, and of a yellowish or reddish brown color marked with black spots, seven on each wing-cover and three or four smaller ones on the thorax.

The larva is yellow, with black branching spines, and about half an inch in length. The spines are arranged in six longitudinal rows. This insect is shown in Figure 13 and on Plate LIII c. Its work is shown on Plate LII b.

The larvæ feed chiefly on the under sides of the leaves late in July and early in August, and the adults are generally found at the same time, as well as both earlier and later, feeding upon the upper surface. The adult has the peculiar habit of marking out with its mandibles a definite area on the leaf and then feeding within this area. It is thought that this procedure causes the tissues to wilt, and that this somehow better suits the insect.

A brief account of this insect was printed in the Report of this station for 1898, p. 269, and more extended accounts of it have been published by Professor John B. Smith, in Bulletin 94 of the New Jersey Station, and by Dr. F. H. Chittenden, in Bulletin 19, New Series (p. 11), of the Bureau of Entomology at Washington.

The squash lady-beetle can be controlled easily by the use of the arsenical poisons.

The Squash Bug.

Anasa tristis De Greer.

The squash bug, or "stink bug," is a serious pest of squashes and pumpkins, though it does not as a rule attack melons and cucumbers. It punctures the tissues of a vein on the under side of a leaf and, sucking out the sap, causes the leaf to wilt badly and die. The adult bugs are about three-fourths of an inch in length, dark gray or brownish, and are rather conspicuous objects on the under surface of the leaves. The eggs are dark brown and

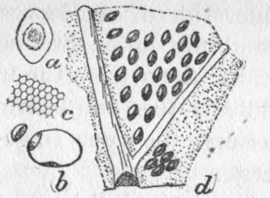

FIG. 14. Egg of squash bug as they are laid on the under side of a leaf. Enlarged. (After Chittenden, Bulletin 19, Bureau of Entomology, U. S. Department of Agriculture.)

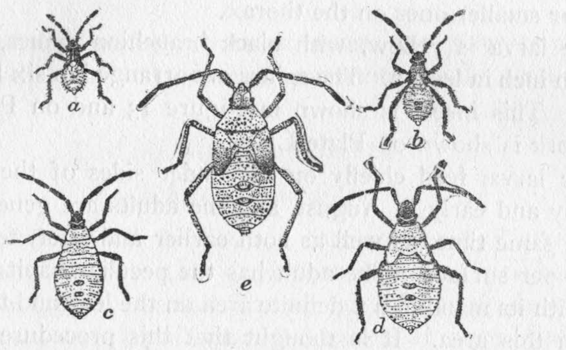

FIG. 15. Nymphs of the squash bug; different stages, about twice natural size. (After Chittenden, Bulletin 19, Bureau of Entomology, U. S. Department of Agriculture.)

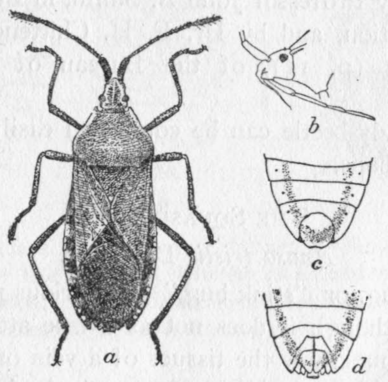

FIG. 16. The squash bug: *a*, mature female, twice natural size; *b*, side view of head showing proboscis; *c*, abdominal segments of male; *d*, same of female. Enlarged. (After Chittenden, Bulletin 19, Bureau of Entomology, U. S. Department of Agriculture.)

shining, and are laid in more or less regular rows in masses containing between twenty and forty each, as shown in Figure 14 and on Plate LII a. The young nymphs hatching from the eggs are ash-gray in color and pass through five distinct stages before reaching maturity, during which time they are found underneath the leaves, getting their nourishment from the sap. The nymphs and adults are shown on Plates LII and LIII. See also Figures 15 and 16.

The adults are hard to kill, but the young nymphs are quite susceptible to applications of kerosene emulsion. Hand-picking and the use of plant protectors such as are used against the striped cucumber beetle are to be advised. Above all, clean-cultural methods, such as burning the old vines after the crop is harvested, are essential.

THE MELON APHIS OR PLANT LOUSE.

Aphis gossypii Glover.

This is really one of the worst insect enemies of this class of crops. It is nearly always present, and being on the under surface of the leaves, where it sucks the sap, it escapes notice until the leaves begin to curl on account of it. On account of its position and the curling of the leaf, it is extremely difficult to strike it with a spray, though this can be done with the proper outfit. The melon aphis is much more injurious to cucumbers and melons than to squashes and pumpkins. When first born, the insects are yellowish green, but they soon take on a darker tinge and finally become brown. This aphis is pronounced by Chittenden* the most injurious plant louse in this country, and it attacks a great variety of plants, among which are cotton and several kinds of vegetables, in addition to the melon and cucumber. Besides these, it is found upon, and is doubtless able to subsist upon, a large number of common weeds. The entire life history of this insect is not known. The species is able to multiply so rapidly that plants are often very seriously injured in a short time, and late in summer it usually disappears very suddenly. See Figure 17.

Our common lady-beetles and syrphus flies prey upon the melon aphis.

* Circular 80, Bur. of Entomology, U. S. Dept. of Agriculture, 1906.

The most promising lines of treatment are as follows:

Spray the leaves from beneath with kerosene emulsion.

Cover the vines with boxes or tubs, and fumigate with carbon disulphide or hydrocyanic acid gas.

Dust with insect powder or tobacco dust applied by means of a powder gun. Place tobacco stems on the ground around the plants.

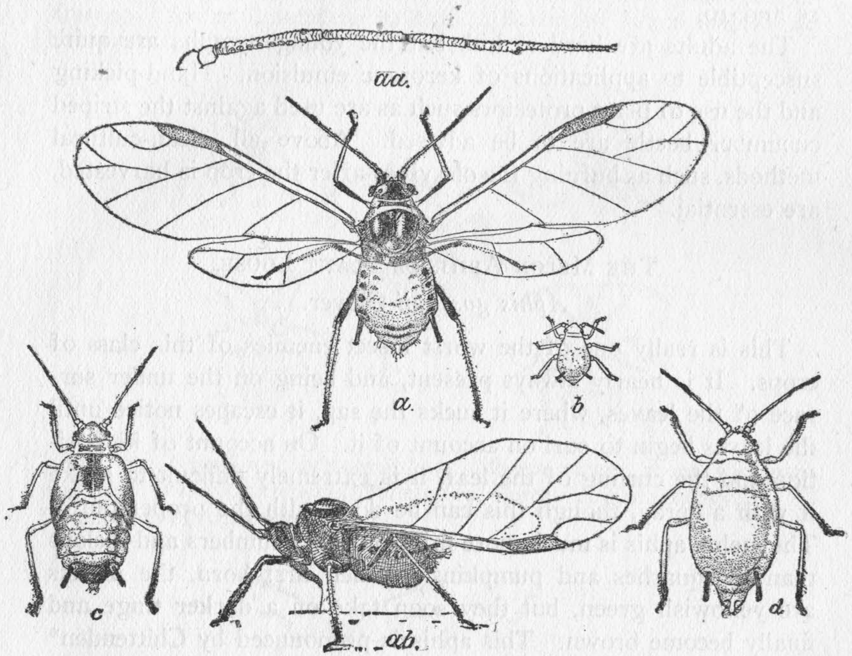

FIG. 17. The melon aphis: *a*, winged female; *aa*, enlarged antenna of same; *ab*, dark form, side view; *b*, young nymph; *c*, last stage of nymph; *d*, wingless female. All greatly enlarged. (After Chittenden, Circular 80, Bureau of Entomology, U. S. Department of Agriculture.)

THE SQUASH APHIS.

Nectarophora cucurbitæ Middleton.

This is a light green species, larger than the melon aphis. It is found chiefly on squashes and pumpkins, though not as a rule causing much damage. The same treatment advised for the melon aphis may be used against this species.

THE GREENHOUSE WHITE-FLY.

Aleyrodes vaporariorum Westw.

Cucurbits growing under glass or out of doors near greenhouses are often attacked and considerably injured by this white-fly. The insect is found on the under sides of the leaves, where the eggs are laid and where the nymphs attach themselves to the leaves. They are very light green, almost white, oval, and resemble scale insects. The empty pupa skins remain on the leaf, and these are silvery white. Adults are pure white and mealy in appearance, resembling tiny moths. They rest upon the under surface of the leaf, where they lay eggs, but fly about when disturbed.

Descriptions and figures of this insect will be found in the Reports of this station for 1902, p. 148, and for 1906, p. 275.

Frequent spraying of the under surface of the leaves with soap and water (one pound in eight gallons) will kill the adults and larvæ and keep the pest in check. Fumigating greenhouses with hydrocyanic acid gas, using one-half ounce of cyanide for each one thousand cubic feet of space, with an exposure of three hours, is perhaps the most effective remedy under glass, but this must be repeated frequently, because the eggs are not all killed by a single treatment, while if more cyanide be used or a longer exposure given, there is danger of injuring the plants.

THE ELM LEAF BEETLE.

Galerucella luteola Müll.

During the past summer (1908) the elm trees of Connecticut have been injured more seriously by the elm leaf beetle than for several years. Many persons thought that the pest had run its course, and that never again would it do much damage to the shade trees of this part of the country. But they were mistaken. In some parts of the state, and especially along the coast, the elm trees were partially defoliated by canker worms in May, with more or less feeding, of course, by the adult elm leaf beetles. The canker worms disappeared about June 1st, and were followed immediately by the newly hatched larvæ of the elm leaf beetle, which devoured the green substance of the under side of the leaves, in many cases completing the defoliation of the trees.

The season was a dry one, and though most of these trees put out a sickly growth of new leaves, it would have been much stronger in a wet season, and therefore less damaging to the trees.

Specimens of the elm leaf beetle were received from eleven different correspondents, representing the following parts of the state: Branford, Bridgeport, Ellington, Hartford, Meriden, Moosup, New Canaan, North Stonington, Rowayton and Wapping. From three of these localities (Branford, Meriden and Moosup), specimens of natural enemies of the beetle were received. These are discussed on page 821.

In addition to the samples received during the season, this office has received and answered fifty-five letters and many telephone calls regarding the pest. The inquiries came from all parts of the state, though most frequently from the southern half, Waterbury reaching first place in regard to the number of inquiries.

As no comprehensive account of the elm leaf beetle has been published in the later station Reports, and only scattered notes have been given therein from time to time, it was thought best to include the matter here. A portion of this paper appeared as Bulletin 155 in June, 1907, but a number of additions have been made to it as here given.

HISTORY AND DISTRIBUTION IN AMERICA.

The elm leaf beetle was introduced into this country probably more than seventy years ago. In its native country, Europe, where it had long been known, it had from time to time caused serious injury in Italy, Austria, and the southern portions of France and Germany. In Northern Europe the insect occurs sparingly, but can hardly be called a pest. Harris states* that the elm leaf beetle attacked and seriously injured the elm trees of Baltimore, Md., in 1838 and 1839. The beetle seemed to spread chiefly northward, though slowly, until Southern New England was reached in the early nineties, and much damage done. In the coast towns of Connecticut many fine old elms, including some historic trees, were killed by its depredations. Stamford, Norwalk, Bridgeport, Stratford, Milford and New Haven especially lost many noble trees. Later the inland cities were invaded, and the elm trees ravaged. In New Haven the pest was perhaps at its worst in 1895 and 1896. In 1896 many of the trees on the older streets about the center of the city were sprayed with poison by the street department. The following season the pest was less serious, and continued to subside until 1901, when it was again comparatively destructive. From 1902 it diminished in abundance until 1906, when considerable damage was done to the trees.

* Insects Injurious to Vegetation, page 124.

So far as is known the distribution of this insect in America is confined to the lower altitudes of Southern New England and the Alleghanian region. From Charlotte, N. C., its southern limit, the elm leaf beetle now extends as far north as North Conway, N. H. Up to this time, however, the beetle has done no particular damage in New Hampshire. Regions generally infested include the whole of Massachusetts, Rhode Island, Connecticut, Southeastern New York, New Jersey, Eastern Pennsylvania, Delaware, Maryland and a portion of Kentucky, though isolated outbreaks have occurred in Western New York, Pennsylvania, West Virginia, Ohio and North Carolina. It is of course found in Virginia, Vermont, New Hampshire, and probably in Maine. Kentucky, therefore, contains the western limit of the distribution of this insect, though we may expect that soon adjoining states may become infested. The insect exhibits a marked tendency to spread farther along river valleys than over mountains, and is distinctly a pest of city and village trees rather than of trees in the open fields and roadsides of the country.

LIFE HISTORY AND HABITS.

The overwintering beetles come out of their winter quarters during the warm days of early spring, mate, and as soon as the leaves unfold they begin to eat small round or oval-shaped holes through them. Many leaves are thus riddled as though shot had been sent through them, and appear like the illustration on Plate LIV b of this Report.

During the latter part of May and early in June females deposit small clusters of yellow eggs on the under sides of the leaves. The period of ovipositing extends over about four weeks, and each female may lay five or six hundred eggs. In about a week the eggs hatch and the young larvæ or grubs feed upon the under surface of the leaves, eating off the green tissue between the veins and leaving the veins and the upper epidermis, as is shown on Plate LIV a and c.

In about three weeks the larvæ or grubs are fully grown, and crawl down the trunks of the trees or drop from the ends of the branches to the ground and transform to the naked pupa stage. The great proportion of the pupæ are found close around the base of the tree or lodged in the crevices of the rough bark of the trunk and larger branches. Except for being in crevices, they are unprotected. The writer has seen trees in New Haven where it would be possible to gather several quarts of these pupæ at the base of a single tree.

The pupa stage lasts about ten days, then the adult beetles appear, and lay eggs for the second generation, which seldom does much harm in Connecticut. Those emerging late probably do not lay eggs for a second brood, but may be seen crawling and flying about for a time, feeding more or less, but early going into winter quarters, usually in church belfries, attics of houses, barns, sheds or other out-buildings. They also pass the winter in cracks of fences, telephone poles, or under the edges of the loose bark of the trees. In some of the cities worst infested the adults sometimes gather in church belfries in such numbers that they can be swept up by the half bushel. The elm leaf beetle often occurs with the two-spotted lady-beetle in dwellings, simply because they both seek the same kind of a place for hibernation. Correspondents frequently send both species to the writer and desire to know if they are not in some way responsible for the injuries to their carpets. There is, of course, no relationship or similarity in food habits of the three species. The lady-beetle is predatory, and in the larval stage destroys numbers of plant lice, and therefore should never be destroyed. The elm leaf beetles should, of course, be killed wherever they are found.

DESCRIPTION.

The *eggs* are bright yellow in color, bottle-shaped, and resemble the eggs of the Colorado potato beetle, but are smaller. They are fastened vertically to the under side of the leaf in clusters of from five to twenty-five arranged in two or three irregular rows.

When first hatched, the *larva* is dark or nearly black, covered with tubercles bearing black hairs. As the larva increases in size it molts several times and on becoming full grown is about one-half inch long, dull yellow in color, with a pair of longitudinal black stripes along the back. Head, legs, lateral tubercles and two rows of small tubercles between the dorsal stripes are black. The tubercles also bear black hairs.

The *pupa* is about one-fourth inch in length and bright orange yellow in color, with black hairs or spines. It is not enclosed in an earthen shell to protect it, but is found at the base of the tree perfectly naked and wholly unprotected.

The *adult beetle* is light yellow in color when it first emerges, but soon takes on a duller hue, and finally becomes a dull olive green. An indistinct black stripe extends from the base to the extremity of each wing-cover just inside of the margin. Small black spots or markings on the pronotum of the thorax vary greatly in size and shape. Legs and antennæ are yellow.

Eggs, larvæ, pupæ and adults are shown on Plate LV.

EFFECT UPON THE TREES.

It has previously been mentioned that the adult beetles do more or less feeding, always eating holes entirely through the leaves, as is shown on Plate LIV b. This of course injures the tree, but is much less serious than the damage caused by the larvæ, which eat away the under surface of the leaves. The larvæ are always more abundant than the adult beetles, and are more voracious in their feeding habits. The worst infested trees usually drop their leaves in Connecticut about the middle of July. If this happens, and is followed by a rainy season, new leaves will be put out, but in a season of a protracted drought the trees may fail to put forth new leaves. In either case the tree is undoubtedly weakened, and often seriously so. Sometimes the second crop of leaves is devoured by the second generation of beetles, but in Connecticut the white fungus mentioned in another part of this bulletin is apt to serve as an important check to the beetle in a wet season. Two complete defoliations, one succeeding the other, usually kill a tree. Usually, however, the defoliation is not quite complete, and the trees continue to exist in a greatly weakened and devitalized condition. In the cities and larger towns, on account of further injuries* by horses, by leaky gas pipes in the ground, and pavements which cut off the supply of moisture, many trees have died. In 1901 the writer was called to Norwich, where nearly every elm had died for a distance of about one and one-half miles on a prominent residential street. These trees had been weakened by the constant attacks of the beetle year after year, and a leaky gas main finally destroyed what little vitality remained. Most of the maple trees along the street survived.

In many cases young or newly planted trees seem to be especially subject to attack, and therefore should receive extra attention.

FOOD PLANTS.

Elms constitute the only food plants known for this insect, and the European species suffer more than the American ones. The English elm (*Ulmus campestris*) and its weeping variety known as the Camperdown elm are favorites of the beetle. The writer has seen these trees entirely defoliated in New Haven when the common white, or American elms, were uninjured. The American elm is, however, the next choice, followed by the Scotch elm (*U. montana*), and though no variety is wholly exempt from attack, the winged elm (*U. alata*), the slippery elm (*U. fulva*), the cork elm (*U. suberosa*) and the rock elm (*U. racemosa*) are much less frequently attacked.

NUMBER OF GENERATIONS.

According to Burgess,† "in New Jersey, Professor J. B. Smith has recorded only a single brood and sometimes a partial second brood, while in the latitude of Washington, D. C., according to the observations of Messrs. Riley, Howard and Marlatt, of the Division of Entomology, two annual broods and sometimes a partial third brood have been found."

Dr. E. P. Felt, state entomologist, of Albany, N. Y., finds‡ two well-marked broods and a partial third brood at Albany and Troy, N. Y.

* For a discussion of these injuries the reader should consult Bulletin 131 of this station.

† Bulletin No. 4, page 17, Ohio Dept. of Agriculture, Div. of Nursery and Orchard Inspection, 1905.

‡ Bulletin No. 57, N. Y. State Museum, p. 14, 1902.

The writer has not followed out this matter carefully in Connecticut, but all stages are found on the trees during the first half of September, so presumably there are at least two broods, but the egg-laying period of the adults is so prolonged that the lines of demarcation are nearly obliterated. In Connecticut the leaves of the trees severely attacked by the first brood generally turn brown and drop about the middle of July, when the larvæ are descending the trees to pupate.

NATURAL ENEMIES.

One of the most important natural enemies of the elm leaf beetle in Connecticut is a fungus known to botanists as *Sporotrichum globuliferum* Speg. (*S. entomophilum* Peck), which attacks the pupæ and adults in late summer, especially in a moist season. In 1902 this fungus was prevalent, and the following season the elm leaf beetle did little damage to the trees. In 1906 the beetles were abundant, but as the month of July was wet, the fungus developed and killed a great many beetles. Beetles attacked by this fungus are covered with white mold, as shown on Plate LV e.

In 1907 the elm leaf beetle, though doing some damage throughout the state, was much less serious than in 1906, but an extreme drought prevailed, almost no rain falling during July and August, and the fungus could not get in its work. Consequently most of the beetles matured and transformed, and were ready to attack the trees in 1908, doing serious damage. It was also very dry in 1908, and the *Sporotrichum* could not prevail. After a light rain late in July the writer saw a number of infested pupæ and adult beetles, but it was after most of them had transformed and the beetles flown away, and the rain soon dried up, making it impossible for the fungus to continue to develop. These conditions indicate, therefore, that the pest will be abundant and destructive next year, and all citizens should be ready to combat it.

The writer believes that the fungus just mentioned constitutes an important check on the beetle in seasons when there is much moisture at the time of pupation, and this view is also shared by Dr. G. P. Clinton, botanist of this station, who has observed its work in this vicinity.

In Europe there is a minute chalcidid parasite known as *Tetrastichus xanthomelænæ* Rond. which attacks the eggs of the elm leaf beetle, and at times proves an effective check. After many trials, this parasite has during the past season been introduced into this country through the efforts of Dr. L. O. Howard,* and has been distributed in Massachusetts, New York, New Jersey, and at Washington, D. C. It is hoped that it may survive here and prove an important aid in controlling this pest.

Predatory bugs of at least three species of the genus *Podisus,* called "soldier bugs," feed upon the larvæ and pupæ, and one of these, *P. maculiventris* Say (formerly *P. spinosus* Dall.), the spined soldier bug, was unusually abundant during 1908 and destroyed many larvæ, pupæ, and adult beetles, though of course the proportion destroyed is very small. The spined soldier bug was sent in from Branford, where its attack on the beetles was observed by Mrs. A. J. Tenney; from Meriden and from Moosup, where it had also been found preying upon the elm leaf beetles. From Bridgeport dead beetles were received, having been killed by one of these bugs. The writer observed a number of cases in New Haven where larva, pupa or adult had been attacked by the spined soldier bug, which impaled the victim upon its proboscis and waved it about in the air while sucking out the juice. These bugs were rather common on trees during the last of July and the first part of August, and are shown on Plate LV d. Dr. A. W. Morrill† has published a record of two of these bugs in confinement which during their last nymphal stage destroyed twenty-six elm leaf beetle larvæ, and after becoming adults destroyed two hundred and twenty elm leaf beetle larvæ and seven large caterpillars.

Riley records‡ two species of beetles, *Platynus punctiformis* and *Quedius molochinus,* as preying upon the elm leaf beetle, and states that an assassin bug, *Reduvius novenarius,* sucks the juices of both adults and larvæ upon the leaves, and that the larva of a species of *Chrysopa* feeds upon the eggs.

The praying mantis (*Stagmomantis carolina* Linn.) is also an enemy of the elm leaf beetle in the southern portion of its range.

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* Journal of Economic Entomology, Vol. I, p. 281, October, 1908.
† Bulletin No. 60, Bur. of Entomology, U. S. Dept. of Agriculture, p. 155. 1906.
‡ Bulletins No. 6, p. 10, and No. 10, p. 13, Bur. of Entomology, U. S. Dept. of Agriculture.

Birds of various kinds are known to feed upon the beetles in their larval, pupal and adult stages. Some of the creepers have been observed apparently feeding upon the pupæ.

REMEDIES.

Spraying with poison. Covering the foliage with some arsenical poison is the only sure means of preventing injury to the trees, and for this purpose arsenate of lead is unquestionably the most satisfactory of these poisons. It remains better in suspension and adheres to the foliage longer than Paris green or London purple, and is less liable to injure it. As there are now several brands of good arsenate of lead on the market, it will no longer pay to make it up each time from lead acetate and arsenate of soda. The standard brands of lead arsenate on the market are as a rule satisfactory and many of them have been used in our tests. If anyone desires to know the chemical composition of these preparations he should consult Bulletin 157, or the Report for 1907, p. 323, of this station, both of which give the analyses of most of the brands which were sold on the market in 1907. Since then a few new brands have been added, some of which have been examined here. It is fair to state that it is safe to purchase any of them if made by well-known and reliable firms, though as the published analyses show, there is considerable difference in the value on account of the composition and each purchaser should obtain guarantees and prices before buying in large quantities. There are also certain differences in mechanical condition which should be considered. Arsenate of lead should be used in the following proportions:—

Formula	Arsenate of lead	3–5 lbs.
	Water	50 gals.

There are two methods of spraying elms: (1) To spray as soon as the leaves unfold, the treatment being aimed especially at the parent beetles, and to forestall all injury. This treatment should be practiced wherever canker worms are destructive. As growth takes place, new leaves are constantly appearing, and these will not carry poison unless the application is from time to time repeated. This should be done often enough to keep the foliage well coated with poison until July 1st, when growth usually ceases, and both sides of the leaves should be coated.

(2) The other method is to spray the under sides of the leaves very thoroughly about June 1st, or soon after the eggs begin to hatch. This treatment is aimed at the larvæ, and sometimes a single spraying is sufficient, as the poison will remain throughout the season. By it the great bulk of damage will be prevented, but the leaves will show the small holes made by the parent beetles before the poison was applied.

If arsenate of lead cannot be procured and it seems desirable to use other poisons, Paris green can be substituted.

This should be used at the following rate:

Formula		
	Paris Green	1 lb.
	Fresh lime	3 lbs.
	Water	50 gals.

Paris green is quicker in its action upon the insects than arsenate of lead, but will not remain as long upon the trees. Unless the lime is added, there is danger of "burning" the leaves. Lime is not needed with arsenate of lead.

The cost of spraying elm trees will vary from ten cents each in case of small trees to five dollars or more for the largest trees, according to the price of labor and the efficiency of the outfit.

Destroying the pupæ. If the trees have not been protected by spraying, and have been attacked and injured by a horde of beetles and their larvæ, it is always advisable to destroy the insects in the pupa stage at the base of the trees, in order to reduce the crop for next year as much as possible. These can often be swept up in large quantities; they can be killed by sprinkling them with hot water; but best of all is to spray the ground not only close to the tree but as far away as the branches reach, and also spray the bark of the trunk and large branches, with kerosene emulsion or some other contact insecticide. The pupæ are easy to kill, but as they remain in the pupa stage only about ten days, it is essential that this work be done at the right time, and it is only when we observe that most of the larvæ descending the trunk have transformed to bright yellow pupæ that we can know when is the proper time to act.

Destroying the adult beetles. The beetles should of course be destroyed in attics, belfries and other places where they hibernate. This can best be done by sweeping them up before

they become very active in spring and dropping them into the fire, hot water or kerosene to kill them.

OUTFIT FOR SPRAYING ELM TREES.

The barrel hand-power pump can be used for spraying small trees or for a limited number of large trees, but if one expects to make a business of spraying street trees, it will pay to procure a power sprayer; this may be a steam or gasoline engine with pump; and still another kind is the "Niagara Gas Sprayer," which utilizes cylinders of carbonic acid gas to furnish pressure, thus doing away with a pump. Each large village and city should have at least one power sprayer that can be put to immediate use for spraying street or park trees. Strong one-half inch hose should be provided in long lines of from fifty to two hundred feet, and from four to six of these can be attached to each power sprayer. Even a larger number might be attached, but while in operation some workmen would be in the way of others, so that nothing would be gained. Mr. H. L. Frost of Boston, who is in the spraying business, informed the writer that four lines of hose is about the most economical number for each outfit. Each hose is furnished with an extension rod with closing valve at the lower end and a cluster of nozzles at the upper end. These rods should be of different lengths, from four to twelve or fourteen feet for the different kinds of work. Any of the standard nozzles such as "Vermorel," "Mistry," or "Spraymotor" will be found satisfactory, and if several are used together in a cluster one is able to cover more leaf surface in a given time.

For getting about in tall trees it will be necessary for the men to be provided with climbing irons and extension ladders.

On account of the serious condition of the trees throughout the state, and the many inquiries and misleading letters in the newspapers from individuals, the following statement was given to the press in July:

Many elm trees in various portions of the city have lost nearly all their leaves from the attacks of the elm leaf beetle. The injured leaves have been dropping for several days, and the trouble has been aggravated by the extreme drought. Had it been a wet season, many of the beetles would probably have been killed by the fungous disease which attacks them.

The damage has nearly all been done for this season, as the partial second brood is usually of little account. The larvæ or grubs are now crawling down the trees to transform to pupæ at the base. Many property owners have placed bands of sticky fly paper around their trees and have caught some of the larvæ, but most of them are prevented from coming down and will transform above the bands. It is probably better to let them descend where they can be reached easily and killed.

The bright yellow pupæ at the base of the tree and lodged in the crevices of the bark should be destroyed at once. This can be done easily by spraying them with kerosene emulsion or common laundry soap dissolved in water at the rate of one pound in eight gallons. They can also be swept up and burned or dropped into a pail of kerosene or of hot water.

Prompt action is necessary, for the pupa stage lasts only ten days, when the beetles appear and fly away. They do but little feeding, and go early into barns, attics and church belfries, where they pass the winter. The beetles can sometimes be gathered in large numbers and should always be destroyed.

Trees which have lost their leaves this season should be sprayed with poison (three pounds lead arsenate in fifty gallons of water) next year to preserve the foliage, for if completely defoliated for two or three seasons successively the trees will die. The poison should be applied in the form of a spray directed against the under surface of the leaves, where the larvæ or grubs feed.

People always become excited and wish to "save the trees" at this time of the year, after the damage has been done for the season. They should begin earlier, and spray the trees in time to prevent the injury.

WHAT TO DO.

1. Destroy all of the bright yellow pupæ at the base of the tree and in the crevices of the bark.
2. Hunt for beetles in houses, barns, attics, church belfries, and out-buildings during the fall, winter, and early spring, and destroy them.
3. Arrange to spray the trees with poison next year.

Information concerning this pest may be obtained at any time from the Connecticut Agricultural Experiment Station at New Haven. Bulletin 155 gives a complete account of the insect, and will be sent on request as long as the supply lasts.

W. E. Britton,
State Entomologist.

SUMMARY.

The elm leaf beetle was introduced into this country from Europe about seventy years ago, and caused serious injury to trees at Baltimore, Md., in 1838 and 1839. From this point it spread slowly, chiefly to the northward, reaching Connecticut in the early nineties, and injuring and killing many fine old trees in the coast towns. Later, inland towns were attacked, and the trees ravaged. The insect is now found from Charlotte, N. C., as far north as North Conway, N. H., and as far west as central Kentucky, but has not proven destructive to elm trees north of Massachusetts. It is preëminently a pest of shade trees in cities and towns, and seldom injures trees in the open fields. Since 1896 the attacks have diminished, but the pest was again serious in 1906.

The winter is passed by the adult beetles in attics, belfries and cracks in fences, and they come forth in April, and later feed and lay their yellow eggs upon the unfolding leaves. Beetles eat holes through the leaves, eggs hatch in a week, and the larvæ eat off the green tissue from the under surface, causing the leaves to turn brown and fall about the middle of July, at which time the larvæ are about full grown. Then they descend to the base of the tree and transform to naked pupæ; ten days later the adult beetles emerge and lay eggs for the second brood or go early into winter quarters.

Two complete defoliations in succession will kill a tree.

How to Fight the Elm Leaf Beetle.

1. Search all attics, church belfries and cupolas for the dormant beetles in winter and early spring. Sweep them up and burn them.

2. Spray the leaves with poison as soon as they have opened, if their shot-hole appearance shows that the beetles are there in abundance, and the under sides of the leaves should be coated about June 1st to destroy the larvæ or grubs.

3. When, later in the season, the yellow pupæ appear on the trunks of trees and the ground beneath, kill them with a spray of kerosene emulsion or by sweeping them up and burning or soaking with kerosene.

The first and third measures should be taken by each householder, church or social organization, at individual expense. The spraying, which is difficult and expensive if the trees are large, can only be done by concerted action of the town or borough authorities. For extensive spraying work power sprayers are desirable, but small elms or a few large trees can be treated successfully by means of a hand-pump of barrel size. The "Niagara gas sprayer" in operation is shown on Plate LVI.

THE GREEN CLOVER WORM A PEST OF BEANS.

Plathypena scabra Fabr.

Late in June the writer noticed that the bush and pole beans in his garden were being eaten by some insect, and during the first half of July complaints were received from five or six different persons who reported that their beans were being devoured. These complaints were mostly from around New Haven, but included one from Meriden. Similar injury to beans was observed upon the station grounds, and in several gardens, and was reported from the eastern portion of Massachusetts and from Virginia.

Though in the South there are several insects feeding upon the plant, it is quite unusual for beans in Connecticut to be attacked by any leaf-eating insect that noticeably defoliates them, and at first we supposed this pest to be *Ogdoconta cinereola* Guen., which Chittenden mentions* as a green striped caterpillar which feeds upon bean leaves.

Identity Established.

From a lot of caterpillars placed in breeding cages on July 14th, some of which began at once to pupate, about twenty

* Insects Injurious to Vegetables, p. 113.

specimens were raised, all of which proved to be *Plathypena scabra* Fabr., one of the commonest of our deltoid moths, usually known as snout-moths. No other species were reared from this material, so the evidence is conclusive that *P. scabra,* which is called the green clover worm, is responsible for the damage. After rearing the adults, the writer corresponded with Dr. Chittenden, who kindly called attention to his published article* on this insect, which up to that time had escaped the writer's notice. From this article are taken some of the facts herein set forth which were not observed by the writer.

Injury to Beans and other Food Plants.

Both common beans and Lima beans were attacked and the leaves more or less riddled with irregular-shaped holes. In the worst cases only the veins were left, and the pods were eaten in some instances. The caterpillars were usually found on the under side of the leaves, and on being disturbed the small ones would descend from silken threads, while the larger caterpillars would drop to the ground, wriggling violently and throwing themselves about. Different sized caterpillars were feeding at the same time, some being about full grown and others not more than one-third grown.

By the middle of July, after receiving the complaints and making observations, it was rather difficult to find an abundance of caterpillars, most of them having pupated, though evidences of their work remained. In one garden peas were devoured, and according to Chittenden† other food plants are clover, soy beans, tickweed (*Meibomia sp.*), vetch, strawberry and blackberry. Clover is considered as the usual food plant, but almost any species of the Leguminosæ may serve as food.

Life History.

A nice lot of material was brought to the laboratory on July 14th and was placed in breeding cages in the insectary. One caterpillar pupated in the box, and was not transferred to the breeding cage. On July 24th the adult emerged from this cocoon.

* The Green Clover Worm, Bulletin 30, Bur. of Entomology, U. S. Dept. of Agriculture, p. 45, 1901.

† *Idem.*

Another specimen emerged July 29th from a cocoon formed July 16th. Thus from ten to fourteen days are passed in the pupa stage. According to literature the eggs require from four to six days for hatching, and the larval stage occupies about twenty-five days. Chittenden finds three generations of this species in the latitude of the District of Columbia, though Coquillett found only two broods in Illinois. The moths do not appear with any particular regularity, as they are found throughout the latter part of the summer, specimens in the station collection bearing dates ranging from June to November.

Description.

Egg. The eggs of this species were not observed by the writer. Though adults were kept in the breeding cages with fresh material of the food plants, all died without laying eggs. Chittenden quotes* Coquillett's description in stating that they are globular and flattened, with the upper half deeply grooved and light in color. The average measurements showed them to be 0.5 mm. in diameter and 0.35 mm. in height.

Larva. About 25 mm. (one inch) long when fully grown, about 3mm. thick in thickest portion near middle, from which it tapers slightly toward the head and considerably toward the posterior extremity. Color light green, striped longitudinally with darker green and fine white or cream-colored lines. Head pale green, shining and hairy. Thoracic legs of the same color as the head. Three pairs of abdominal pro-legs in addition to the anal pro-legs. Each segment bears dorsally, ventrally and laterally a number of dark hairs.

The description just given is of the caterpillar in next to the last stage. In the last stage it is not striped, but nearly uniform in color, paler green and stouter than in the preceding stage. The larva loops in crawling, like the cabbage looper, but it is much more slender, and is not likely to be mistaken for that species.

Pupa. The first pupa obtained was formed in a pasteboard box, and was enclosed in a white silken web or cocoon of rather loose texture. Some larvæ pupated in a rolled leaf, though others went into the ground just beneath the surface and formed earthen cells by fastening together particles of earth with silk threads.

* Bulletin 30, Bur. of Entomology, U. S. Dept. of Agriculture, p. 45, 1901.

The naked pupa is dark brown in color, about 12 mm. (one-half inch) long and 3 mm. thick. A dorsal ridge extends from the head over the thorax and first four segments of the abdomen.

Adult. The moth has a wing expanse of from one to one and one-half inches, and in general is a dark purplish brown color with the fore wings more or less distinctly mottled with bluish gray, brown and black. The rear wings are very broad,

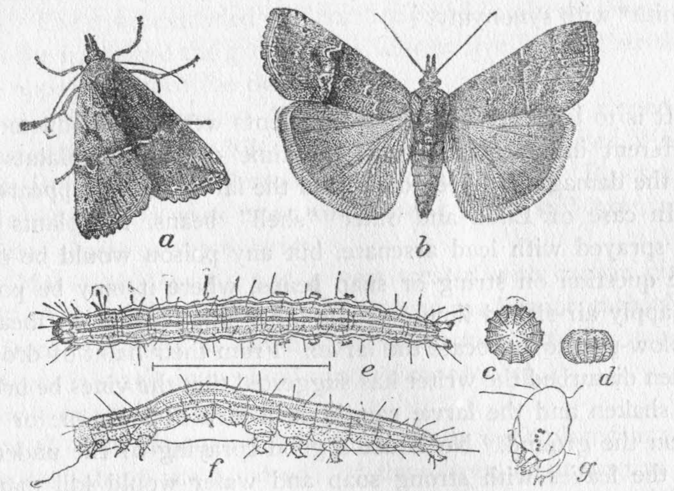


FIG. 18. The green clover worm: *a*, moth in natural position with wings folded; *b*, same with wings expanded; *c*, egg from above; *d*, side view of egg; *e*, penultimate stage of larva, dorsal view; *f*, same from side; *g*, head of larva. All enlarged. (After Chittenden, Bulletin 30, Bureau of Entomology, U. S. Department of Agriculture.)

smoky brown, and without markings. It is an extremely variable species, some specimens, especially males, being nearly uniform in color, while others, usually females, show very distinct markings. Ordinarily the females have somewhat less than half of the apical portion of the front edge of the fore wing marked with light bluish gray. Basally this extends across the wing in some cases, but apically it is limited by a blackish or brownish, more or less suffused mark, which extends diagonally from the apex of the fore wing, becoming less distinct toward the point where the base of the gray patch meets the rear margin of the wing.

The palpi are prominently elongated, and project in front of the head, as is the case with other members of this group, which on account of it are called snout-moths. They are called deltoid moths on account of the distinct triangular shape which they assume when at rest with wings folded.

The appearance of all stages of this insect is shown in Figure 18 on p. 831 and on Plate LVII of this Report. A technical description of the adult has been published by Professor J. B. Smith* with synonymy.

Remedies.

It is to be regretted that experiments were not conducted with different insecticides, but at the time of the complaints most of the damage had been done, and the larvæ had disappeared.

In case of Lima and other "shell" beans, the plants could be sprayed with lead arsenate, but any poison would be out of the question on string or snap beans, where it may be possible to apply air-slaked lime or some other fine powder by means of a blow-gun to suffocate the larvæ. From their habit of dropping when disturbed the writer has suggested that the vines be brushed or shaken and the larvæ caught in a dish of kerosene or killed upon the ground. No doubt a good spraying of the under side of the leaves with strong soap and water would kill many of the caterpillars, especially the smaller ones.

Usually this insect feeds upon clover, and the damage is so slight that no remedial treatment is necessary.

* Revision of the Deltoid Moths, Bulletin 48, U. S. National Museum, p. 111, 1895.

TREATMENT OF CABBAGE PLANTS TO PREVENT INJURY BY THE CABBAGE MAGGOT.

By W. E. Britton and B. H. Walden.

Mount Carmel Experiments.

In the Report of this station for 1906, page 301, there was published a note about dipping plants in a mixture of lead arsenate to prevent injury by the cabbage maggot, *Pegomyia brassicæ* Bouché. This practice was continued in 1907, but in both these

years the insect was so scarce that very little harm was done to the plants by it, consequently the experiments failed to show anything.

In the spring of 1908, tests of various substances and devices were made on the grounds of Mr. Howard C. Yale at Mount Carmel, where the crop had been troubled each season for several years by the maggot. The tests were made on thirteen rows of plants, each row containing about one hundred and thirty-five plants. The rows extended in a northerly and southerly direction, and at the north end the ground was four or five feet higher than at the opposite end of the field.

Rows 1 and 2 were set April 18th, and the plants dipped in lead arsenate (one pound in two gallons of water), Jersey Wakefield in Row 1 and Henderson's Summer in Row 2. Rows 3 to 8 were set about a week later, and Rows 9 to 12 still later, with untreated plants of these varieties.

On May 14th, Rows 3 and 4 were treated with carbon disulphide. A hole at least an inch deep was made near each plant and from one-third to one-half a teaspoonful of the volatile liquid was injected from an oil can and covered up.

Row 5 was left as a check.

Row 6. On May 4th tarred paper disks were placed around a portion (about one hundred) of the plants, beginning at the north end of the row. These disks were a year old and had become dry and stiff, and consequently did not fit as well around the stem nor as close to the ground as when fresh. On May 6th, placed fresh disks on the remaining plants in Row 6 and on the plants in Row 7. These disks were cut with a knife from a single-ply tarred paper.

Row 8, beginning at the north end, seventy-four plants were treated May 6th with the lime-carbolic mixture, made by slaking fresh quicklime, and one quart of the thick cream added to one gallon of water. To this was added about one teaspoonful of crude carbolic acid, as used by Professor J. B. Smith* of New Jersey. The mixture was then sprayed upon the soil around each plant in a circle six to eight inches in diameter.

On May 16th, all of the plants in Rows 8 and 9 were sprayed with the lime-carbolic mixture. Used eight ounces of lime to one

* Bulletin 200, New Jersey Agr. Expt. Station, p. 18, 1907.

gallon of water and 15 c.c. of crude carbolic acid. On this date we were not able to detect any signs of the work of the maggot.

Rows 9, 10, 11 and 12 were treated with salt on May 30th by the owner, nearly a teaspoonful to each plant being placed around the stem at hoeing time. This treatment was evidently too late, as the maggot had already begun its work on some of the plants in the other rows before this date.

Mr. Walden visited the field May 28th and examined the plants. A few were beginning to wilt from the attacks of the maggot on rows treated with lead arsenate, carbon disulphide and carbolic-lime mixture. On digging, maggots were found at the base of most of these wilted plants. The two rows treated with the tarred paper disks looked the best of any and showed no indication of the presence of maggots.

On May 29th and 30th, carbon disulphide was injected around each of the plants in the two rows which at setting had been dipped in lead arsenate, and likewise in the two rows treated earlier with carbon disulphide. This time a hole about one inch in diameter and three inches from the stem, slanting toward the root, was made with a pointed stick, and the liquid was injected through an oil can, using one pound to one hundred plants, or about one-sixth of an ounce per plant.

On June 6th, Mr. Walden visited the field and made a record of the infested plants. Rows 1 to 5 contained from two to nine infested plants per row, the first four rows each having more than the check (Row 5). Row 8 had four infested plants. Row 6 had none and Row 7 had but one. These two rows were treated with the tarred paper disks. Rows 9 to 12 showed no infestation, but as they were not set out until considerably later than the others, it is doubtful if the result should be attributed to the application of salt, which was made too late to entirely keep away the maggots.

Another examination of the plants was made July 3d, and they were found to be in about the same condition as on June 6th, except that those plants which had wilted beyond recovery had been removed, some slightly injured plants had recovered and were beginning to head, and no additional plants showed the attacks of the insect. A few of the plants were well headed and ready to cut.

The plants were all cultivated and hoed about every ten days, and an application of commercial fertilizer with the addition of nitrate of soda was made at the time of each hoeing.

Branford Experiments.

In the raspberry field of A. E. Plant & Son, Branford, cabbage plants were set between the rows of berries during April, without treatment. The field was on a side hill sloping to the south and west. The rows used in the experiments were on the upper side, and extended north and south. The soil was rather heavy except at the north end of the rows.

On May 12th treatment was given as follows:

Rows 1 and 2 were left as checks, no treatment.

Rows 3 and 4, containing ninety-nine and one hundred and ten plants respectively, were supplied with tarred paper disks.

Row 5, check, no treatment.

Row 6, ninety-one plants, Row 7, ninety-four plants, and Row 8, ninety-nine plants, were treated with carbon disulphide applied through an oil can in a hole an inch from the plant and one and one-half inches deep. After the material was introduced into the hole, it was covered with soil by the foot. One pound of the liquid was used for the three rows.

The plants were examined on June 5th. and only two plants infested with the maggot were found, one in a check row and the other in a row treated with carbon disulphide.

Value of Tarred Paper Disks.

Tarred paper disks and a tool for cutting them were first devised by Professor E. S. Goff of Wisconsin, and have since been used by Slingerland and others. They prevent (mechanically) the flies from laying their eggs at the base of the stem, and where made of tarred paper it is possible that the odor may have a repellent effect, though this is not certain.

In our tests these disks have given the best results of any form of treatment, and similar results have been obtained by other entomologists. It is important that they be applied before the eggs are laid, otherwise they are ineffective. Plants which have become badly injured by the maggot should be destroyed, those slightly damaged should be treated with carbon disulphide as herein described, and well fertilized to promote growth and vigor.

Making the Paper Disks.

During the previous season the tarred paper disks could be purchased from a New York firm, but this season we were unable

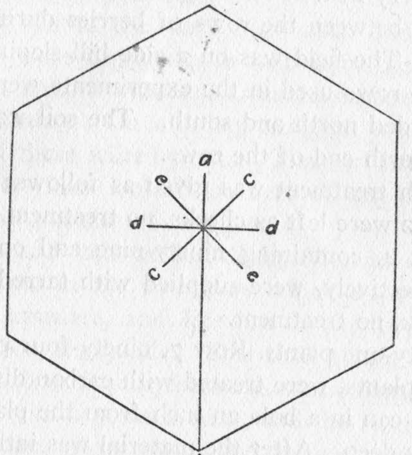


FIG. 19. Hexagonal disk of tarred paper for use on stems of cabbage plants.

to obtain them. We did not have a special tool for cutting them, so they were made in the following manner:

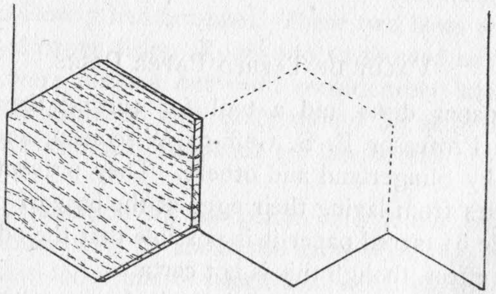


FIG. 20. Method of cutting hexagonal disks.

The disks were hexagonal in shape and four inches across, and were cut from a roll of single-ply tarred felt or paper. The paper was placed on a table and unrolled upon a smooth board as

needed. A hexagonal form was made of wood one-quarter inch thick, with a tack through the center to prevent the form from slipping and to mark the center of each disk. The form being placed on the paper, a sharp knife was used to cut around it. A row of disks were cut from the full width of the paper and then stacked together, when the cut *a-b* (Figure 19) was made with the knife; *c, d* and *e* were made with a sharp chisel, which in this case was 1⅛ inches wide. After the first row has been cut, the paper will have an edge with regular points, which should be used to form two sides of the next row of disks.

Figure 20 shows the form placed to start another row of disks, and the dotted lines show that but three cuts are required to make each succeeding disk.

While this method would not be practicable for a large commercial grower, it will answer where but a few thousand disks are needed. They can be made at odd times during the winter and early spring. If made much in advance of the time when needed, however, they should be tightly wrapped and kept in a rather moist place so that the tar will not dry out and the disks become hard.

EXPERIENCES WITH HOME-MADE SOLUBLE OILS AND SOME OTHER SPRAY MIXTURES.

By W. E. Britton and B. H. Walden.

Probably the most important development in spraying for San José scale in 1907 was the working out of formulas for the preparation of home-made soluble or miscible oils, so that the orchardist can make them on his own place.

Professor Charles L. Penny, now of the Pennsylvania Station, but formerly chemist of the Delaware Station, has done much investigating along this line, and the results of his efforts were published in Bulletins No. 75 (June 18, 1906) and No. 79 (August 1, 1907) of the Delaware Station.

Mr. C. D. Jarvis, horticulturist of the Storrs (Conn.) Station, had also been working on soluble oils, and in Bulletin 49 (November, 1907) recommends a formula which he found best for general purposes.

The bulletins by Professor Penny explain the principles of making these mixtures and the rôle played by each of the ingredients, chiefly from the chemical standpoint. A large number of formulas are given, thus showing the possibilities of the subject, though one is recommended as being the best for the average orchardist to use. The bulletin by Mr. Jarvis gives brief directions to the orchardist about procuring materials and preparing the mixtures after a single formula, which is quite similar to the one recommended by Professor Penny, containing the same ingredients in only very slightly different proportions, except that the former contains crude oil where the latter has paraffine oil.

As many inquiries were made at this station regarding these mixtures, it was deemed best to make a practical trial of preparing and using them so that we might more intelligently answer the inquiries. Therefore, a kettle or feed cooker was purchased, and the materials were procured in barrel lots, consisting of carbolic acid, menhaden or fish oil, rosin oil, crude petroleum, paraffine oil, kerosene, and a small quantity of caustic potash. The first cost of these materials was nearly one hundred dollars, and of course some of them will last for a long time. The outfit is shown on Plate LVIII b. We had no particular trouble in making up the first lot according to directions, and care had been taken to purchase only the grade of materials recommended. But on using up the first barrel of paraffine oil, we ordered a second barrel of exactly the same oil, and it failed to emulsify as the other had done when used in the same quantities with the other ingredients. It was then necessary to try varying proportions of some of them, and Mr. Walden worked on it two whole days before we could use it in making a spraying mixture. A different grade of oil had been sold us for the same oil, and it required considerable experience to learn how to use it. Oil experts have informed us that the common trade names of oils are meaningless so far as their exact chemical composition is concerned, and that there is little assurance of being able to obtain the same thing twice unless it comes from the same well and is drawn at about the same time. It seems to us that the first cost of the materials, together with the uncertainty of obtaining uniform oils, make it impracticable for any except the larger orchardists to prepare their own soluble oils.

Orchard tests were also made. All fruit trees on the station grounds were sprayed January 23d. The mixture worked nicely, except that a thickened oily residue formed in the pump barrel and

caused some trouble in clogging strainers and nozzles. This may have been due to an excess of rosin oil. The scale was kept well in check by the application, and no injury to the trees was noticed. Two barrels of this mixture, one made from crude and the other from paraffine oil, were furnished to Mr. F. H. Stadtmueller of Elmwood, who used it in April on rather large apple trees, applying it with a steam power sprayer. The residue was present in the tank, though not especially troublesome. The mixture was apparently effective in checking the scale and the owners were satisfied with the treatment.

A barrel of this mixture was used in the young apple orchard of A. E. Plant & Son of Branford, the spraying being done April 20th. An examination of this orchard December 10th showed that the trees are in good condition, and though most of them were only slightly infested at the time of treatment, it is now a difficult matter to find any living scales. Two or three trees which were badly infested two years ago showed but little live scale at this time.

Two barrels of the mixture made from crude oil were used in the apple and peach orchards of Mr. W. F. Griswold at Rocky Hill, in April. Mr. Griswold reported considerable trouble in using the material, and it did not seem to be very effective in holding the scale in check. Mr. Walden visited the orchard on December 2d and found the sprayed trees fully as scaly as those which were not treated. It is hard to explain why the treatment here was not more effective.

The trees on the station grounds were again sprayed with this material December 8th and 9th, 1908, and it worked satisfactorily, though the effect upon the trees and their scale insects cannot at this date be determined.

In all of the tests just mentioned the oil was mixed with water in the proportions of one part of oil to fifteen parts of water.

The cost of the materials actually used in making this home-made soluble oil was about twenty-one cents per gallon, not reckoning labor, the cost of the kettle, or interest on the money invested. Of course the cost would vary according to the fluctuating prices of the materials used.

This oil is now made by the Apothecaries Hall Company of Waterbury, and sold as "Victor Soluble Oil," in barrel lots, at thirty-five cents per gallon. It is also made by the J. T.

Robertson Company of Manchester, Conn., and sold as "Jarvis Spray Mixture" at thirty cents per gallon by the barrel.

Other Oils Tried.

A five-gallon can of the soluble oil made by the Thomsen Chemical Company of Baltimore, Md., was used in the Plant orchard at Branford. It worked satisfactorily and the trees were clean in the fall.

"San-U-Zay" scale oil, made by J. T. Southwick of Rochester, N. Y., was also given a trial. This oil requires a solution of sal soda to make it emulsify, but it seemed to work nicely, and, like the preceding, kept the trees clean. Both of these oils were used in the same proportions as the home-made oils mentioned above.

Another kind of oil was sent us by Professor H. W. Hillyer of Farmington. This came in two parts; one, marked "B," was the oil preparation, and the other, marked "A," contained the emulsifier, together with a copper solution which was supposed to make it a fungicide. This was also used one part to fifteen parts of water, and four small scale-infested apple trees were thoroughly sprayed with it. When examined the first week in July, about twenty-five per cent. of the scales were alive. It is evident that this mixture should have been used in more concentrated form.

New Prepared Lime and Sulphur Washes.

Since our work with the lime and sulphur mixtures a few years ago (see Reports for 1903, p. 233; 1904, p. 221; 1905, p. 196; and 1906, p. 279) several prepared lime and sulphur washes have been placed upon the market. Some of these we have tested and a few gave good results, but most of them contained so much sediment that they did not spray readily, failed to destroy the scale, or else were so costly as to be prohibitive.

Recently there have been put upon the market a number of prepared lime and sulphur washes which are clear liquids, that is, entirely soluble, and contain no sediment to clog strainers and nozzles. Some of these are being sold at a price low enough so that orchardists are buying them to spray orchards of several thousand trees.

Three of these mixtures, in small quantities, have been tested by us:

"Lion Brand California Wash," a concentrated lime, sulphur and salt mixture, made by the James A. Blanchard Company of New York. On April 19th four small apple trees were thoroughly sprayed with this mixture, following directions. The first week in July the trees were examined, and only 3.8 per cent. of the insects found to be alive.

"Swift's Concentrated Sulphur-Lime," made by the Merrimac Chemical Company of Boston, and "Sulfocide," made by the B. G. Pratt Company of New York, have each been tried on a few trees, but it is now too early to be certain of the results.

Of course these preparations must be tested on a large scale and under varying conditions before we can recommend them, but there still seems to be a demand for lime-sulphur washes, and if they can be made cheaply and satisfactorily, most of the smaller growers will prefer to purchase the prepared mixture.

Conclusions.

Our own experience in making soluble oils leads us to advise orchardists to purchase a prepared mixture, except that in some cases a large grower might find it profitable to buy the materials and make it at home. Materials left over will keep for a time, but do not improve, and some loss takes place through leakage and evaporation. It is also certain that where made in large quantities the product will run more uniform than it is possible to make it in small quantities, even with great care.

It is not claimed that any of these home-made oils are better than the best kinds on the market—they are simply cheaper and can be used for the purpose.

It is probable that soluble oils will continue to be used for spraying apple orchards, especially large trees, where it is difficult to coat the pubescent twigs with a lime-sulphur wash, and to reach the scale insects under the edges of the rough bark and the bud scales. They are also much to be preferred for use in the city garden, the public park and the nursery.

On the other hand, soluble oils have not entirely superseded lime-sulphur. Several orchardists have continued using the latter, and some others are going back to it. The lime-sulphur wash is certainly an effective scale destroyer on smooth-barked trees, and no better treatment is known for the peach orchard than to spray it in the spring with the lime-sulphur wash, which is an excellent fungicide and a good preventive of leaf-curl.

INSECT NOTES.

Snow-White Linden Moth Abundant. On July 8th the Associated Press and several New Haven newspapers telephoned to the entomologist's office regarding the reported occurrence of the brown-tail moth in Woodstock, where some newspaper correspondent had reported it as being abundant and swarming around the street lights. Through telephone and written communication with several reliable men in that part of the state, including Mr. L. H. Healey, Master of the State Grange, this report could not be verified and specimens could not be obtained.

A few days later the New York papers told about a pure white moth that swarmed about the electric lights in New York and Brooklyn. On July 19th a similar swarm of white moths appeared in New Haven, and the description was a feature of the newspapers the following day. These moths were present for about two days, then disappeared, but were very abundant while they lasted, and may be the same species as that reported from Woodstock. This moth is called the snow-white linden moth (*Ennomos subsignarius* Hübn.), and in some books is mentioned under the name of elm span worm. It feeds upon a variety of forest and shade trees, and is reported as causing much damage to beech trees in New York State in 1907,* though linden, elm, maple, chestnut and horse chestnut are often damaged.

This moth is pure white, has a wing expanse of about one and one-half inches and is shown on Plate LIX a. It is frail, with angulated wings, and belongs to the moth family Geometridæ, the larvæ of which are measuring worms or loopers. There is one generation each year, and both sexes have wings. Spraying the foliage with arsenical poison is about the only remedy.

Hickory Tussock Caterpillars Killed by a Fungus. In the Report for 1907 there is a short article about the hickory tussock

* Twenty-third Report of N. Y. State Entomologist for 1907, p. 23.

moth, *Halisidota caryæ* Harris, and its abundance in Connecticut during the past two years. It was also very abundant in the summer of 1908 and did some damage to various kinds of trees, but in September and October many dead caterpillars were observed adhering to the trunks and branches of trees and sometimes on fences and stone walls. These had been killed by a fungus which, according to Dr. Clinton, has been studied and named in manuscript by Professor Roland Thaxter of Harvard University, but the description and name have not yet been published. From the number of dead caterpillars seen while inspecting nurseries about the state, this fungus must be regarded as an important natural enemy of the species. In some cases a dozen of these dead caterpillars would be found on the base of the trunk of a single tree, and there were probably many more on the branches. The appearance of a fungus-killed caterpillar may be seen on Plate LIX b. Other species of caterpillars, notably *H. tessellaris* and probably *Estigmene acræa,* were killed in a similar manner by this or some other agency, though only a few of them were found.

Lead Arsenate vs. Paris Green for Spraying Potatoes. In the experimental field at Mt. Carmel, Doctors Clinton and East of this station have each year grown three or more acres of potatoes. During 1908 they made arrangements with the writer to take charge of the first sprayings to kill the Colorado beetle, before it was time to use Bordeaux mixture. Little damage was done, so the first treatment was given June 22d. On two plats of one acre each on the northwest corner of the field, conditions were practically uniform as regards the plants and their infestation. Here and there throughout, certain hills were badly eaten, though most of the plants had not been injured. The acre plat nearest the road was treated with Paris green, one-half pound in fifty gallons of water, and two pounds of lime added. The plat adjoining this on the east was sprayed the same day with lead arsenate, three pounds in fifty gallons of water. Both poisons were used upon the third acre. A hard shower came the next day. On June 27th, four days after the treatment, the potatoes were examined and the fewest larvæ were found on the field sprayed with lead arsenate, while no injury to the plants could be detected. Where Paris green was used, not only were the larvæ more abundant, but in spite of the fact that plenty of lime was used, there was some injury to the plants, shown by many leaves and tips of leaves becoming dry and dead a few days after the treatment. The poison was applied with the Niagara gas sprayer, covering four rows at once, as shown on Plate LVIII a. This sprayer does not have a satisfactory arrangement for agitating the liquid, but in most other respects it is fairly satisfactory.

The Three-Lined Leaf-Beetle on Potatoes. This insect was more than usually abundant on potatoes and in some cases did almost as much injury as the Colorado beetle, to which it is closely related, both belonging to the family *Chrysomelidæ*. The three-lined leaf-beetle, *Lema trilineata* Oliv., is of a pale yellow color, with three black longitudinal stripes on the back, and it resembles the striped cucumber beetle, though larger. It deposits yellow eggs in rows along the mid-rib on the under sides of the leaves. The larvæ are yellow and have the disgusting habit of covering themselves with their own excrement. There are two broods each year. The damage is similar to that caused by the Colorado beetle and the same remedies are to be advised. Larvæ of the three-lined leaf beetle were brought to the station on July 12th, with two other kinds of beetles which had been observed feeding upon them in New Haven. The predaceous beetles were *Lebia grandis* Hentz. and *Pterostichus lucublandus* Say, both common species of the family *Carabidæ*.

Leaf-Beetles Devouring Marsh Golden-Rod. During a collecting trip to the Stratford marsh, July 21st, it was noticed that the golden-rod (*Solidago sempervirens*) which grows in bunches commonly about the marsh was being eaten up by insects. On closer examination, two forms of injury were apparent and caused by two different kinds of beetles of the family *Chrysomelidæ*. The larger, *Trirhabda canadensis* Kirby, is dull yellow, with three blackish longitudinal stripes, and is about three-eighths of an inch in length. It feeds upon this golden-rod in both the larval and adult stages, and the plants were stripped of their topmost leaves and tender shoots by this insect. The lower leaves were less injured and were still green. In other clumps the leaves were entirely brown, many of them being rolled and containing large numbers of a beetle known as *Microrophala vittata* Fabr. This

beetle is one-fourth of an inch long, with the entire upper surface of the body pitted and striped longitudinally with dull red and blue. The larvæ are said to be miners in the leaves of this golden-rod. As the host plant is something of a nuisance to growers of salt marsh hay, perhaps these insects may be regarded as beneficial.

Chrysomelid Beetle Damaging Young Chestnut Trees. On June 10th specimens were received from Dr. Robert T. Morris of New York, who raises nuts on his summer place at Stamford, Conn. Small metallic green beetles a trifle over one-eighth of an inch in length were devouring the leaves and young shoots of choice young chestnut trees of the Japanese species (*Castanea Japonica*), threatening their destruction. The beetles had the habit of dropping from the leaves or flying away when disturbed. It was finally necessary to resort to spraying with Paris green in order to destroy them. The species proved to be *Nodonota puncticollis* Say.

New York Weevil Injuring Pear. On May 26th it was reported that an insect was injuring young pear trees in the orchard of W. A. Henry & Son at Wallingford. Mr. Walden visited the orchard and found that the New York weevil, *Ithycerus noveboracensis* Först, was the depredator. The adults were eating into the twigs at the base of the new growth, in some cases nearly severing it. There were from one to three on each tree, and on some of the newly-set trees the new growth had all been destroyed. The injury was confined mostly to the pears, though one plum tree showed the attacks of this insect.

The New York weevil is a beetle of the family *Curculionidæ*, commonly called "snout beetles" because the head is prolonged forward into a beak or snout, on the end of which the mandibles or jaws are located. In color it is gray or slightly reddish, with whitish, closely appressed pubescence arranged in rows lengthwise the body. It is marked with a number of small quadrate black spots, is from one-half to five-eighths of an inch long, and is shown on Plate LIX c.

The owners sprayed the trees with lead arsenate, and thought that it proved effective, as the beetles soon disappeared. As a rule, the beetles of this family are hard to kill with poisons, and hand picking is therefore advisable on small trees. Normally this beetle breeds in oak, beech and hickory twigs, and possibly visited the pear trees from the neighboring woodland. It has also been known to attack peach.

Snout Beetle Injuring Greenhouse Plants. On April 6th, beetles were received from Litchfield, where they had been eating the leaves of palms, lemon tree, *Tradescantia* and *Dracæna.* It proved to be *Otiorhyncus sulcatus* Fabr.

Strawberry Weevil. On June 3d specimens of the strawberry weevil, *Anthonomus signatus* Say were received from South Killingly and from Huntington, where at both places the stems of the buds and developing fruit had been eaten by the weevils. This insect is a snout beetle of the family *Curculionidæ,* and is less than one-eighth of an inch long and brown or black, with white markings.

The injury is caused by the female, which lays an egg in the bud just before it opens, then crawls down the pedicel and cuts it partly off, so that it fails to develop and later becomes separated and falls to the ground. The growing larva feeds upon the pollen inside of the bud, which after falling to the ground is kept moist and in a condition favorable to the development of the larvæ, which reach their full size in about three or four weeks.

The strawberry weevil when abundant is a difficult pest to control, and arsenical sprays are not very satisfactory. Pistillate varieties are not attacked, and growers are advised to grow only enough staminate plants for purposes of fertilization. Clean culture is also to be recommended.

Raspberry Sawfly. The raspberry sawfly, *Monophadnoides rubi* Harris, was present in a number of berry patches around New Haven, and was sent in from Stonington on July 8th. The larvæ are nearly three-quarters of an inch long when fully grown, dark green in color, and covered with lighter green forked spines. They devour the leaves of raspberry and blackberry, usually being found upon the upper surface. The eggs are white and are laid in the tissues of the leaf. The adult is a four-winged fly with a black thorax and dark reddish abdomen. Spraying with arsenites, or even with fresh hellebore, may be practiced as a remedy.

Leaf-Folder Injuring Apple. In many parts of the state apple trees were considerably damaged by a small larva which fed upon the leaves and folded and fastened the edges together. At Stonington this pest seemed to be more injurious than around New Haven. Though we did not obtain the adults, it was doubtless the apple leaf-folder, *Ancylus nubeculana* Clem., a small moth of the family *Tortricidæ,* having a wing-spread of about five-eighths of an inch, and brown and white in color. Ordinarily this insect is not troublesome, but was injurious enough at Stonington to warrant spraying. Lead arsenate is advisable for this.

Leopard Moth in Connecticut. This insect in its larval stage is one of the worst pests of shade trees in the vicinity of New York City, boring in the twigs and branches, the symptoms being dead limbs projecting above the leafy branches. The leopard moth, *Zeuzera pyrina* Fabr., was introduced probably by accident from Europe, and first noticed in this country near New York about 1882. Since then it has been spreading northward, but was not known to have reached Connecticut until July 1st, 1907, when Professor H. W. Foote captured in New Haven two specimens, which are now in the station collection. This insect is also serious in the vicinity of Boston. The adult has a wing expanse of about one and one-half inches, the wings being whitish or transparent, marked with a large number of small dark gray or black dots. The body is nearly black.

Infested branches will often wilt, and can be cut away and destroyed before the borers escape. Carbon disulphide may be injected into the burrows, and the opening stopped with clay, hard soap or putty, to kill the larvæ.

Appearance of Corn Ear-Worm or Boll-Worm, Heliothis obsoleta Fabr. Some larvæ and their work were brought to the station from Bethany on October 28th. The writer saw this insect in New Haven some twelve or thirteen years ago, but has never happened to see it since. The larva attacks corn, eating the unripe kernels at the tip of the ear, also tomato, cotton, and several other cultivated plants, though in the Northern States it is not a very serious pest. The adult is dull yellow, with dark markings, and the larva appears in a variety of colors, such as green, brown, pink and purple. About the only preventive measure necessary is to plant the corn earlier, so that it will ripen before October.

Abundance of the Pyramidal Caterpillar, Pyrophila pyramidoides Guen. This caterpillar is about one and one-half inches long, green, with a yellowish stripe along each side and a whitish stripe along the back, head whitish, mandibles tipped with black. The last segment is thickened dorsally, making almost a right angle.

In the writer's garden these caterpillars fed upon the new leaves and shoots of the pear trees and also attacked roses. Specimens received from Warren on June 12th had been eating pear, rose and quince. They were also found on *Rosa rugosa* on the station grounds.

The adult is a noctuid moth having a wing expanse of nearly two inches. The front wings are dark brown marked with lines and dots of paler brown and white. The rear wings are lustrous and of copper red color.

A New Forest Pest in Northern New England. During the past two years the caterpillars of a moth, *Heterocampa guttivitta* Walk., have damaged forests in Maine, New Hampshire and New York. In 1907 in the state of Maine much of the forest growth over large areas for a distance of forty miles was stripped, according to Miss Edith M. Patch,* entomologist of the Maine Station. According to Dr. E. P. Felt,† state entomologist of New York, this same insect appeared in that state in 1907. The same species denuded thousands of acres of hard wood trees in the White Mountain region of New Hampshire in 1908, and Director E. D. Sanderson of the New Hampshire Station issued a press bulletin regarding the matter. It is during July and August that the defoliation becomes noticeable, and several different kinds of trees are attacked, though the caterpillars seem to prefer beech, maple and apple foliage.

* Bulletin 148, Maine Agr. Expt. Station, p. 262, 1907.
† Twenty-third Report of N. Y. State Entomologist for 1907, p. 21.

PLATE XLII.

a.—Scraping apple trees.

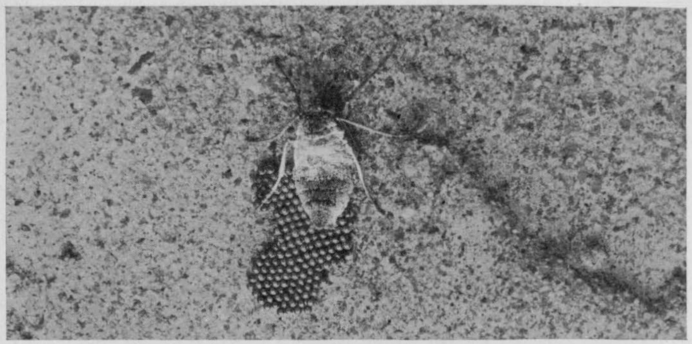
b.—Spraying infested spruce trees with lead arsenate.

GYPSY MOTH WORK AT STONINGTON.

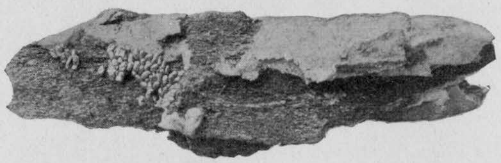
a.—View in a back-yard after cutting and burning infested weeds.

b.—A clump of wild roses growing on this spot contained 275 caterpillars.

GYPSY MOTH WORK AT STONINGTON.



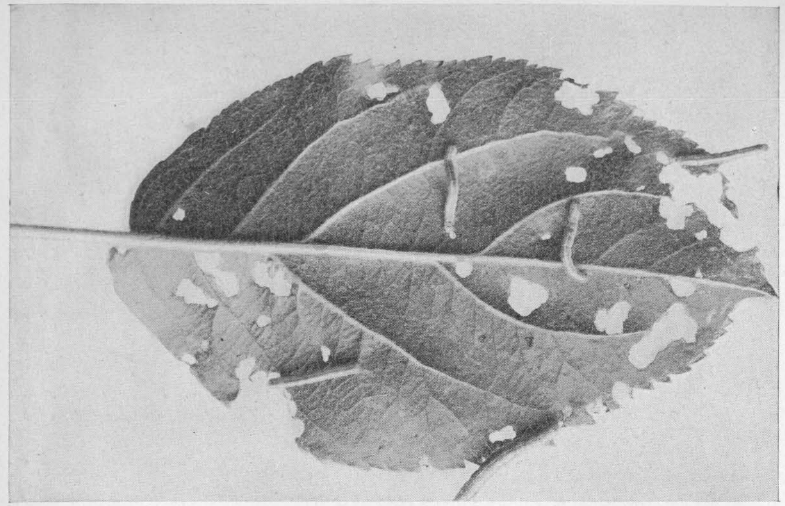
a.—Adult female and egg-mass of the fall canker-worm. Twice natural size.

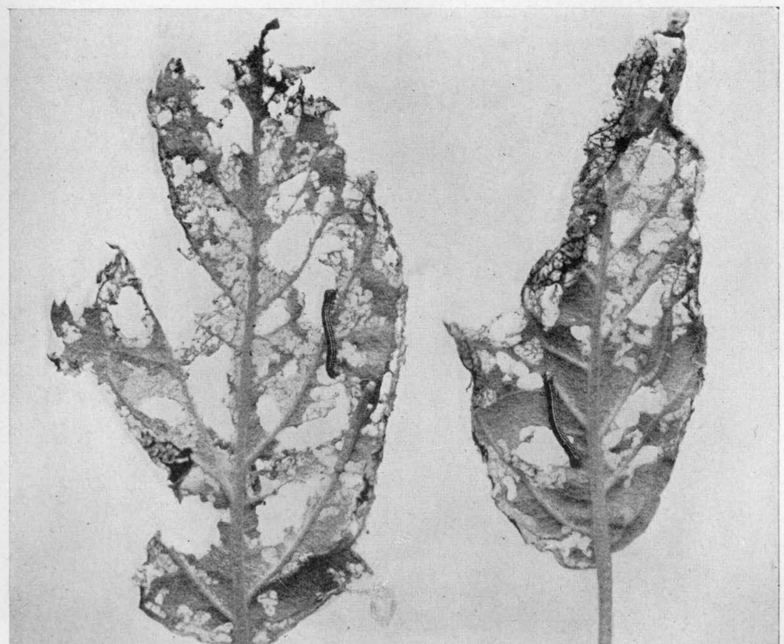


b.—Eggs of the spring canker-worm. Twice natural size.

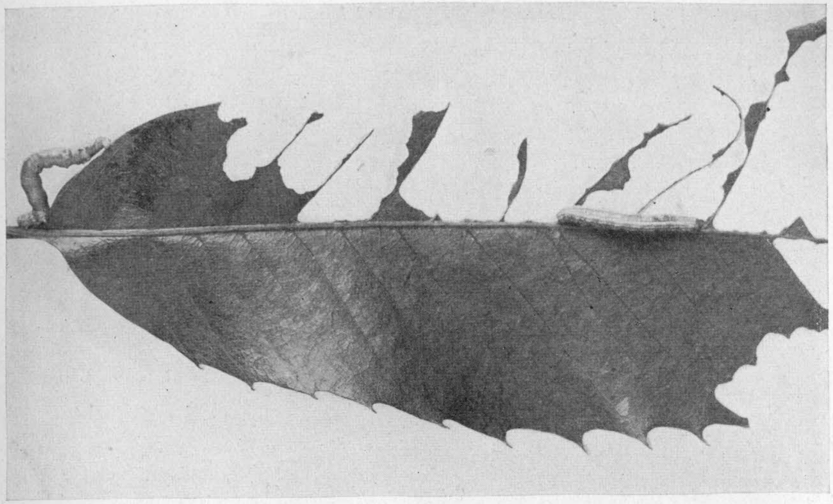
c.—Egg-masses of the fall canker-worm. Natural size at left, others twice natural size.

CANKER-WORMS.

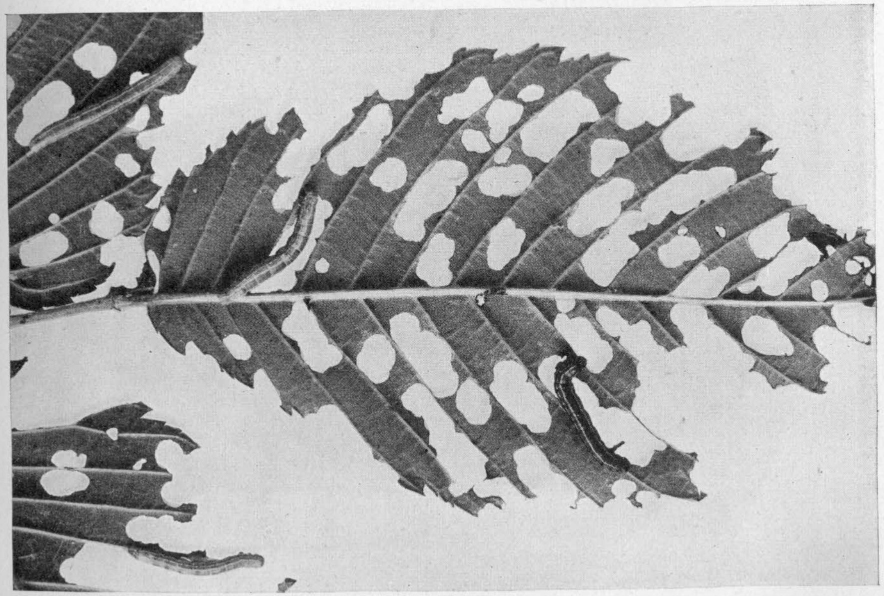




FALL CANKER-WORMS FEEDING ON APPLE. Both natural size.

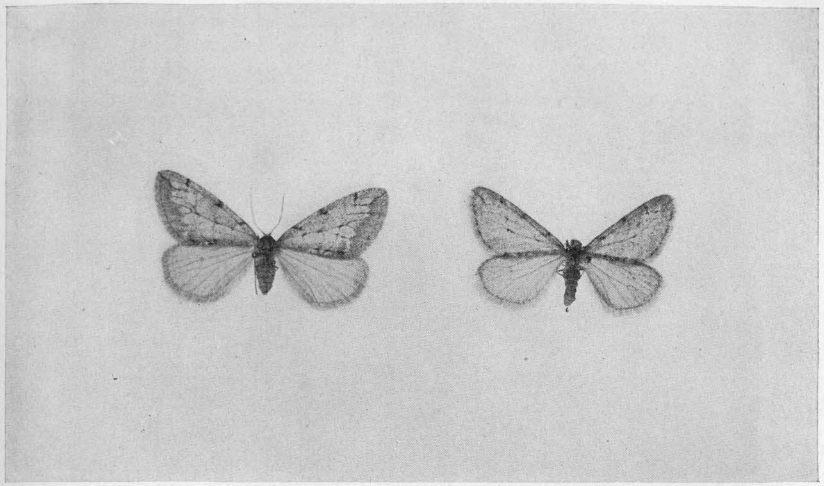


a.—Feeding upon chestnut. Natural size.

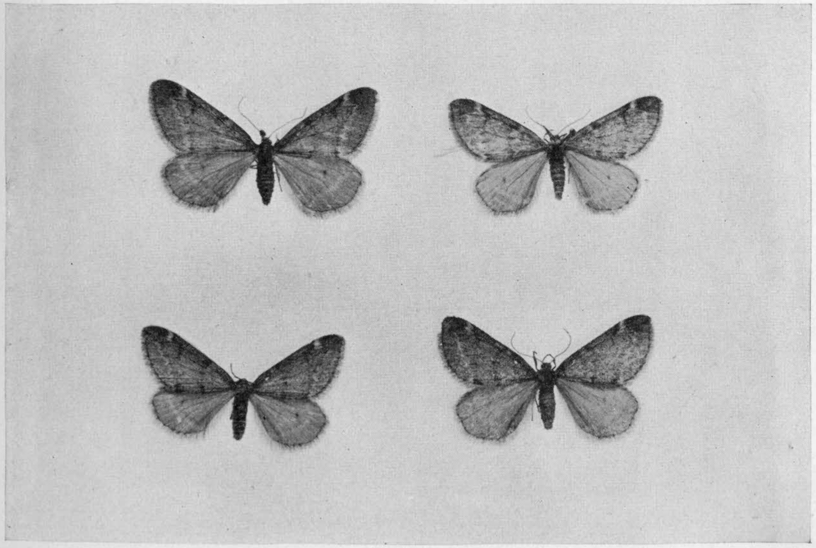


b.—Feeding upon elm. Natural size.

FALL CANKER-WORMS AND THEIR WORK.

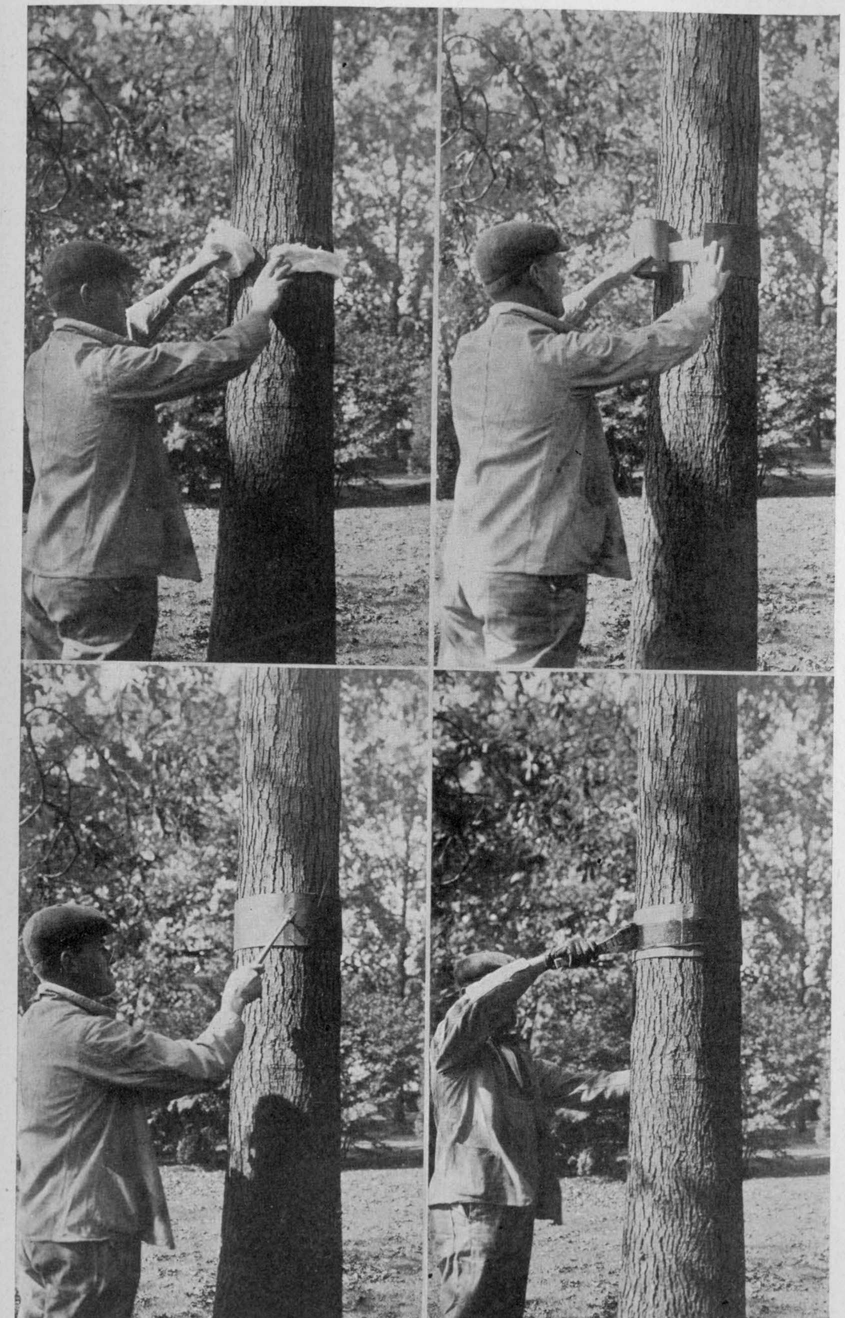


a.—Adult males of the spring canker-worm.

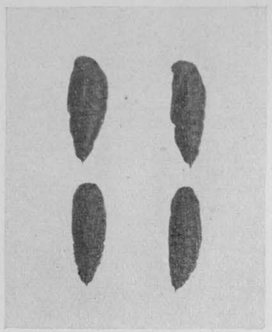


b-—Adult males of the fall canker-worm.

MALE CANKER-WORM MOTHS. All natural size.



METHOD OF APPLYING STICKY BANDS TO PROTECT TREES FROM CANKER-WORMS.

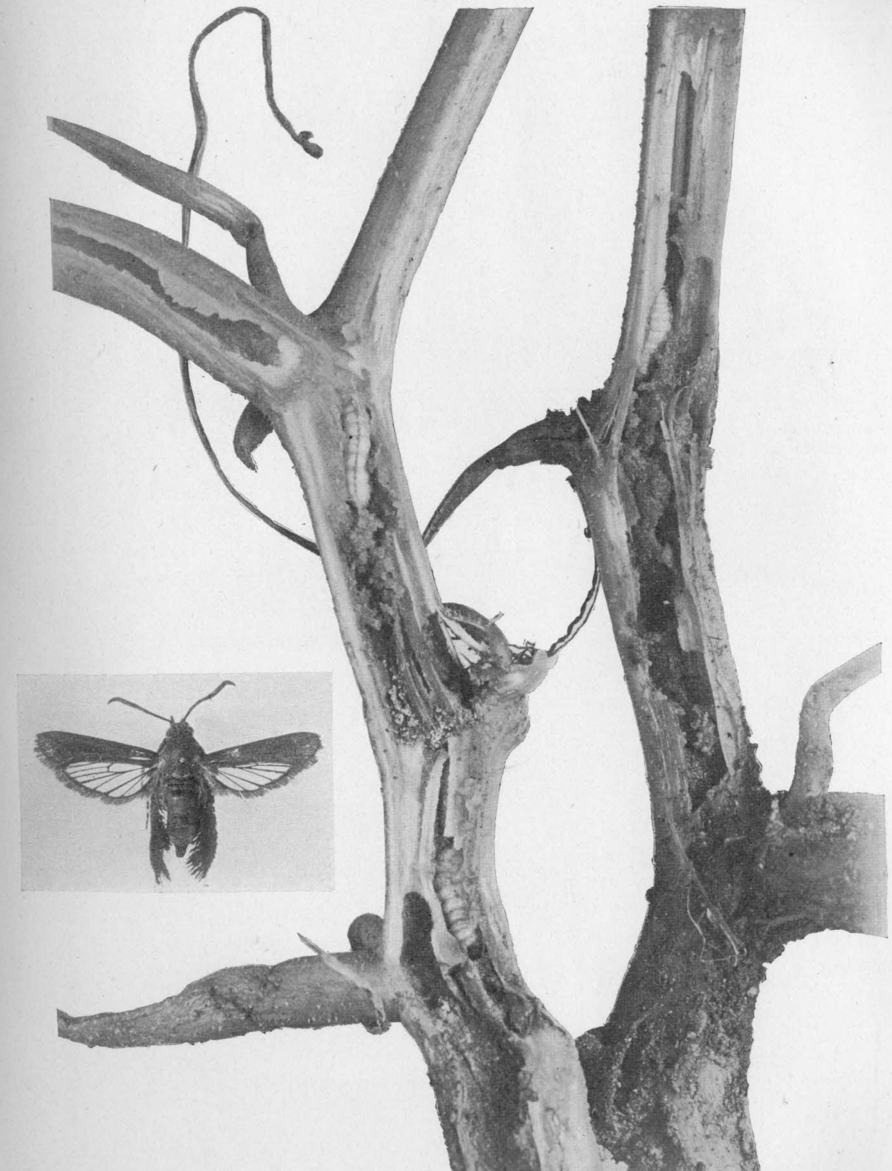


a.—Pupae of the spring canker-worm. Twice natural size.

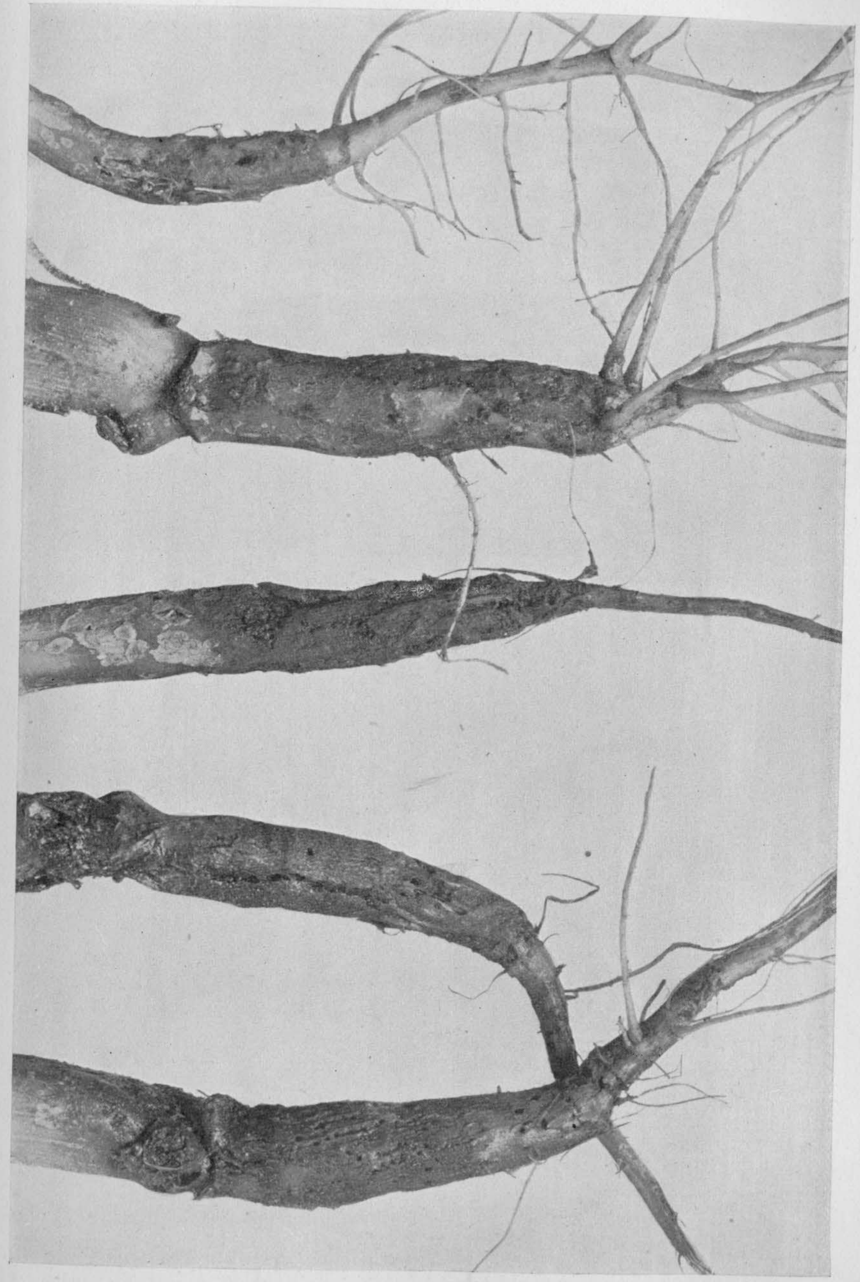
b.—Cocoons and pupae of the fall canker-worm. Twice natural size.

c.—Adult male and female moths, and egg-masses on sticky band.

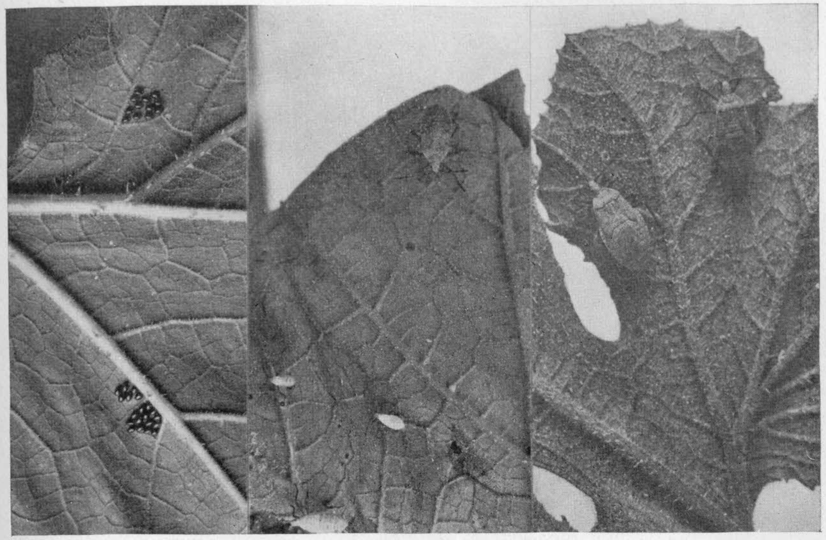
CANKER-WORM COCOONS AND ADULTS.



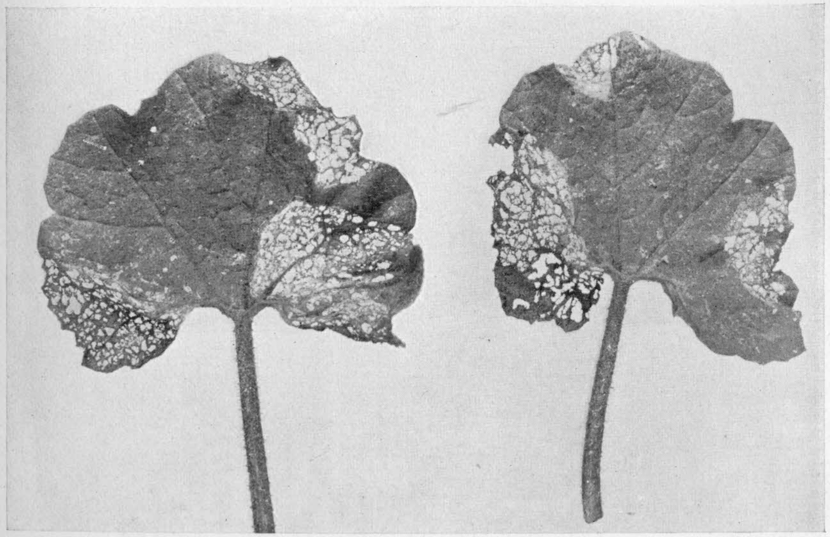
SQUASH BORER: ADULT AND WORK OF LARVAE IN SQUASH STEMS.
Slightly enlarged.



CUCUMBER PLANTS INJURED BY THE LARVAE OF THE STRIPED BEETLE.
Natural size.



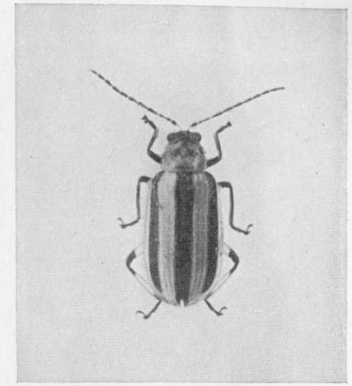
a.—Eggs and young squash bugs. All natural size.



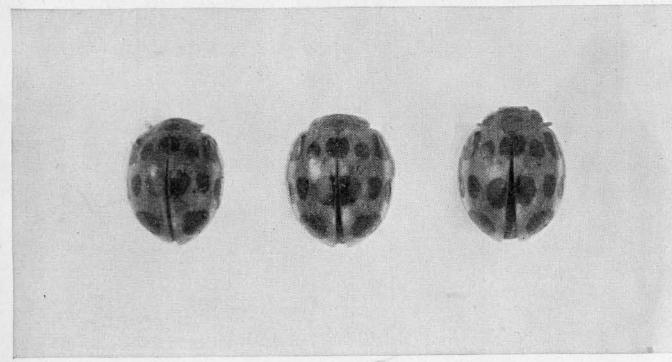
b.—Work of the squash lady-beetle. Greatly reduced.

SQUASH BUG AND WORK OF SQUASH LADY-BEETLE.

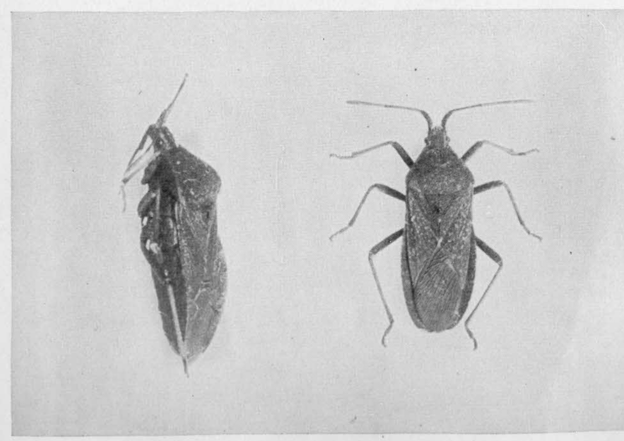
a.—Twelve-spotted cucumber beetle. Enlarged four times.



b.—Striped cucumber beetle. Enlarged four times.

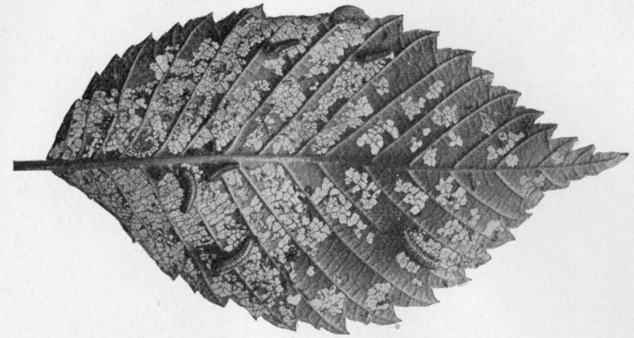


c.—Squash lady-beetle. Twice natural size.

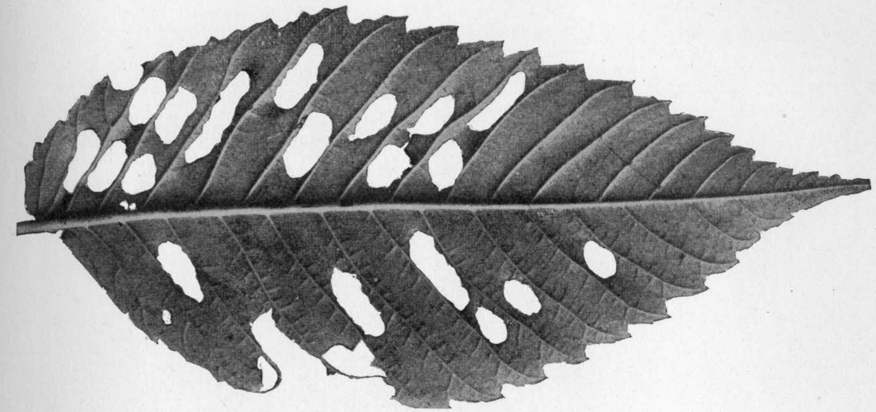


d.—Squash bug. Twice natural size.

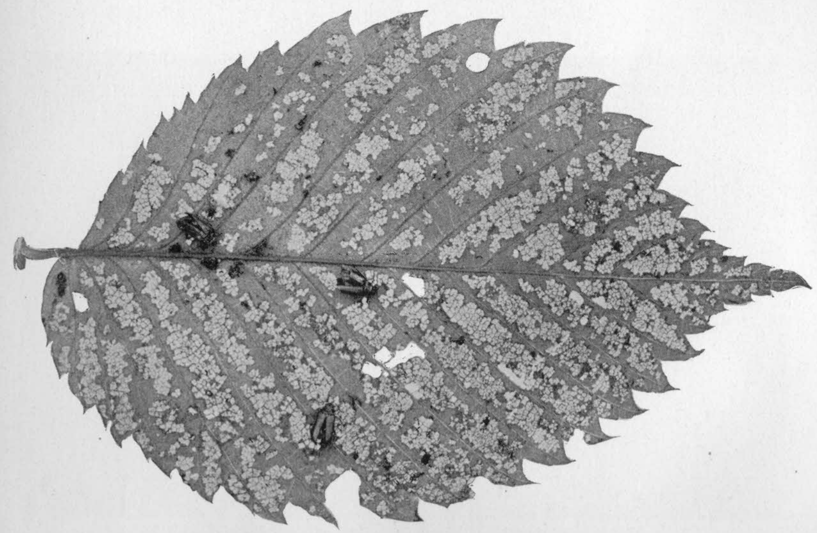
SQUASH AND CUCUMBER BEETLES AND THE SQUASH BUG.



a.—Larvae and their work.

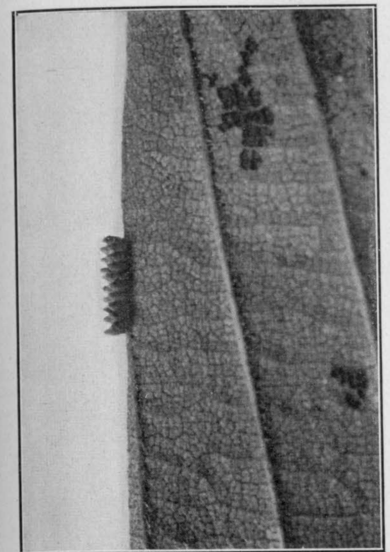


b.—Holes eaten by adult beetles.

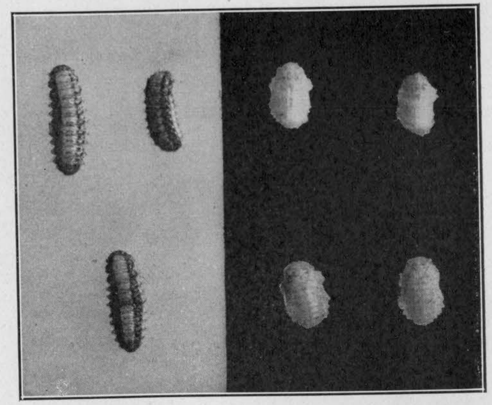


c.—Adult beetles killed by the spined soldier bug.

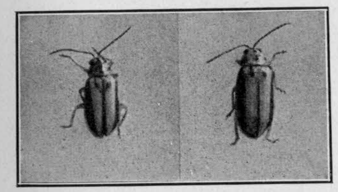
WORK OF ELM LEAF-BEETLE. All natural size.



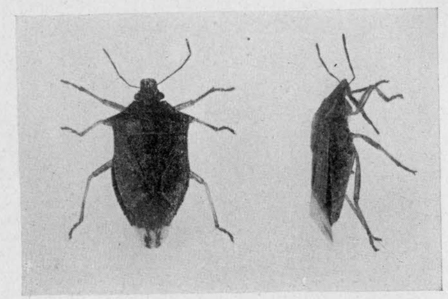
a.—Cluster of eggs; greatly enlarged.



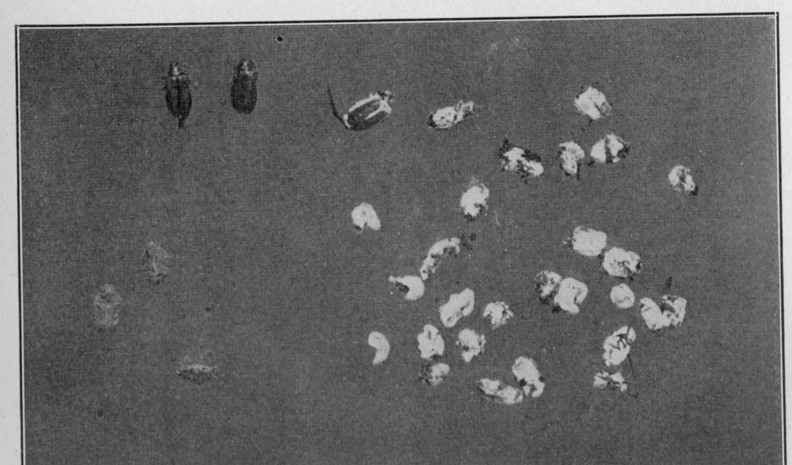
b.—Larvae and pupae; twice natural size.



c.—Adult beetles; twice natural size.

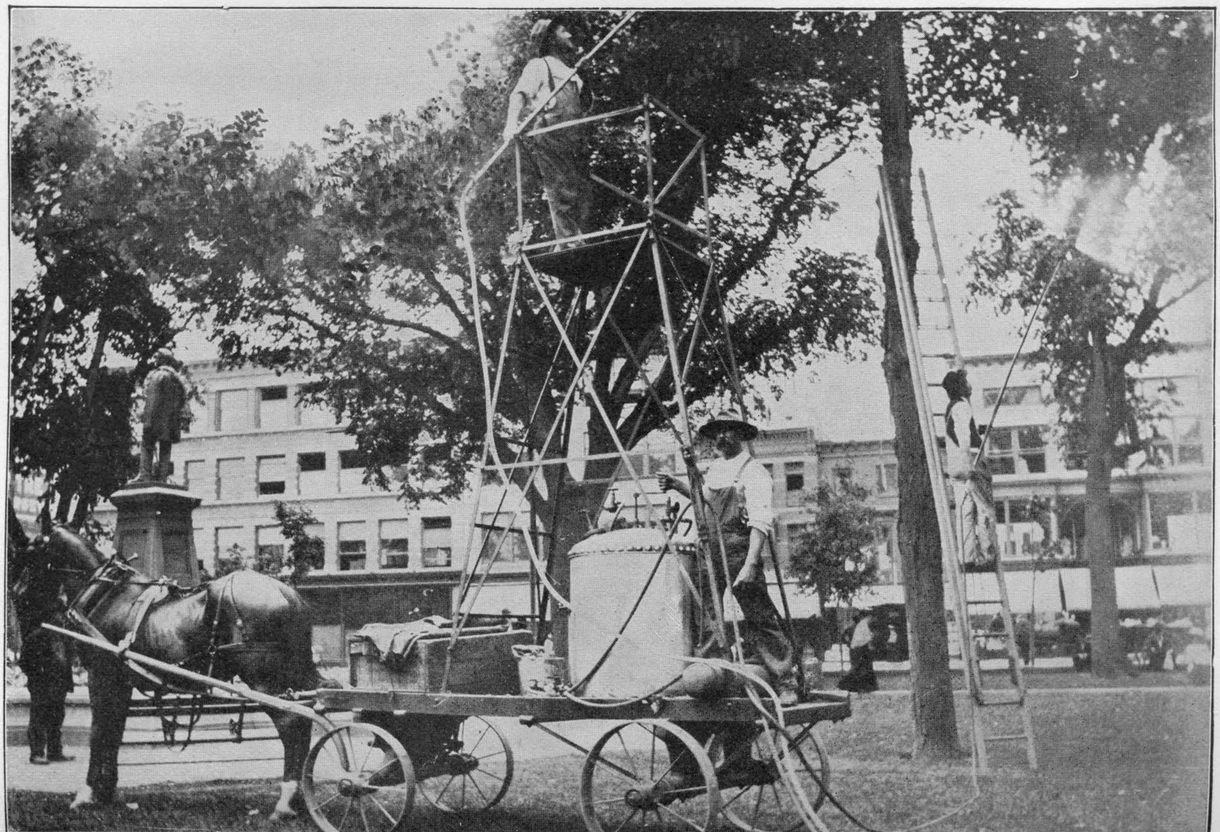


d.—The spined soldier bug, *Podisus maculiventris*, Say. Twice natural size.

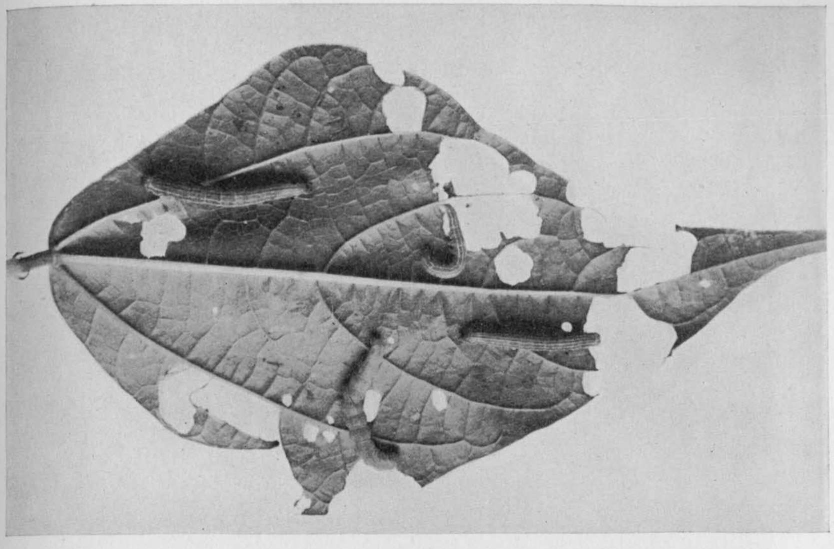


e.—Pupae and adults killed by fungus. Healthy specimens at the left, natural size.

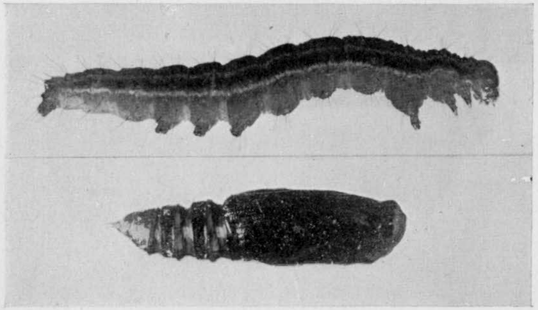
THE ELM LEAF-BEETLE.



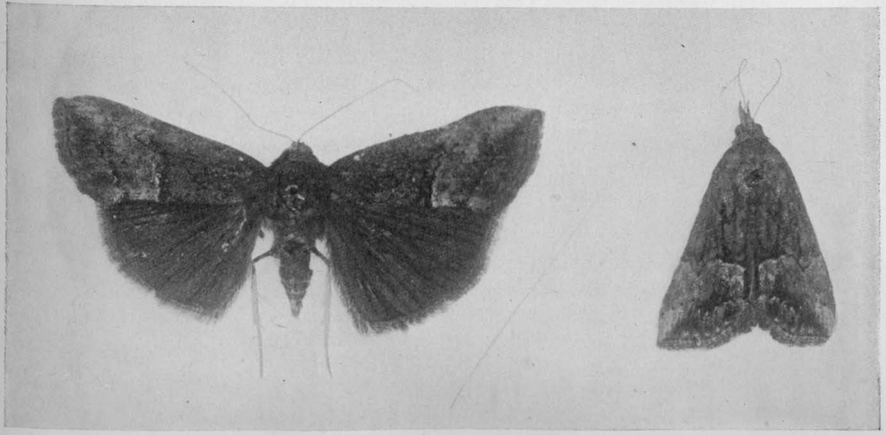
"NIAGARA GAS SPRAYER" AND OUTFIT FOR SPRAYING STREET TREES. (After Smith, Rep. N. J. Expt. Sta., 1905.)



a.—Larvae feeding upon bean. Natural size.



b.—Larvae and pupa. More than twice natural size.



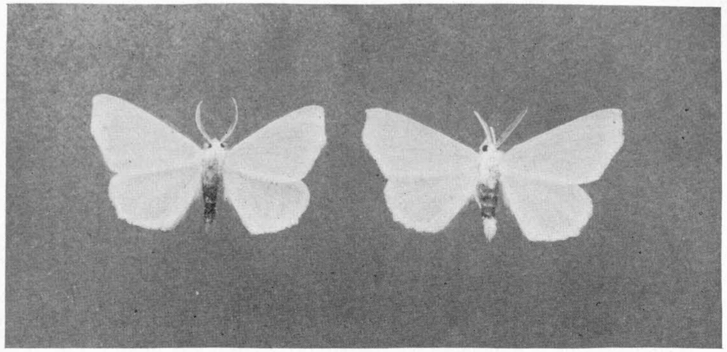
c.—Adult moths. Twice natural size.

GREEN CLOVER WORM.

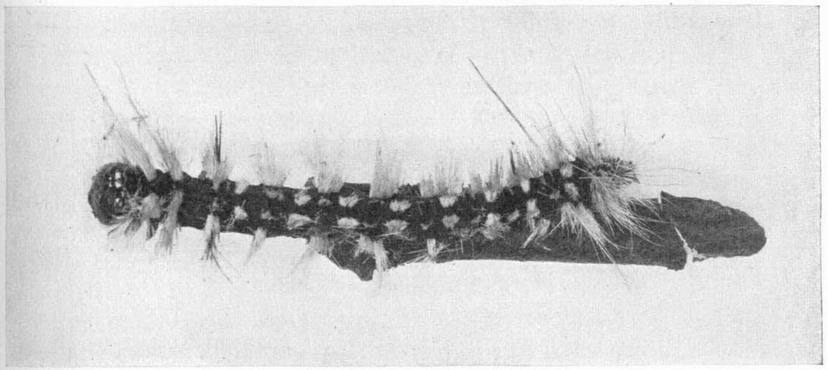
a.—Applying lead arsenate to potatoes.

b.—Outfit for making soluble oil.

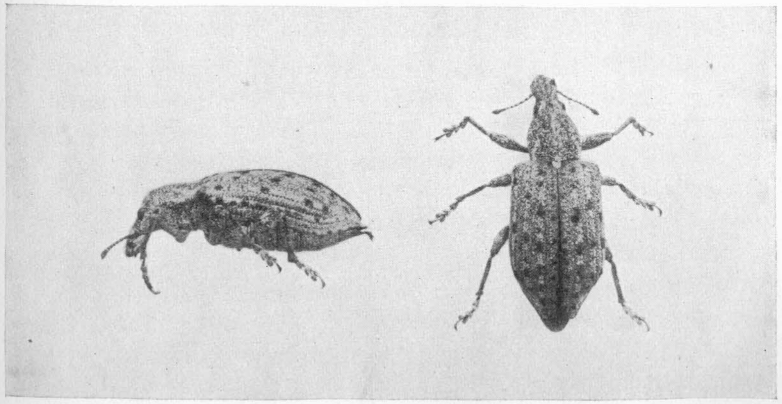
SPRAYING POTATOES: OUTFIT FOR MAKING SOLUBLE OIL.



a.—Snow-white Linden moth. Natural size.



b.—Hickory tussock caterpillar killed by a fungus. Twice natural size.



c.—New York weevil. Twice natural size.

LINDEN MOTH: PARASITIZED CATERPILLAR: NEW YORK WEEVIL.

PART XII.

REPORT OF THE BOTANIST FOR 1908.

G. P. Clinton, Sc.D.

I. NOTES ON FUNGOUS DISEASES, ETC., FOR 1908.

A. General Notes on Diseases Previously Reported.

Weather conditions. The winter of 1907-08 was on the whole rather mild, so that no very general winter injury resulted to the shrubs and trees. During the latter part of January and in February, however, the cold was sufficient to kill a good many of the peach buds. Likewise, certain peach trees suffered somewhat from the collar girdle injury, which is described elsewhere.

The spring of 1908 was one of the earliest and driest that we have had in some years, the early vegetables being a week or two in advance of the average year, and considerably more than that as compared with the year of 1907, which was unusually late.

The summer, like that of 1907, was unusually dry, but differed in that the drought came in two periods. The first drought extended into the middle of July. The latter part of that month and most of August were sufficiently moist for the needs of vegetation in general; but the last of August and practically all of September were again free from rains. The splitting of the drought by the scattered rains during midsummer had the effect of keeping down drought injury much below that of 1907, when the dry weather lasted from June until August.

While the drought did harm to certain of our crops, such as alfalfa, asparagus, potatoes and celery, on the other hand, some, like the peach, muskmelon and tobacco, were in the end benefited by the dry weather, especially by that of the late summer and fall. The comparatively dry weather of the growing season as a whole was sufficient to keep down most parasitic fungi, so that 1908, like the past few years, was not one in which these pests (with a few exceptions) did any great injury to our cultivated plants.

The fall frosts held off somewhat later than usual, the first one of consequence coming on October 12th, the slight frost of October 5th merely injuring the cucurbits.

Market garden and other plants. There were a number of complaints of the premature yellowing and dying of alfalfa plants, these being affected sometimes in spots. While we did not have the opportunity of examining the plants in the fields, from the absence of any sure signs of fungous or insect attack on the specimens sent to the station, we were inclined to believe that the trouble was due to the dry weather. Certain weeds, such as the pigweed, often showed similar injury, due to the drought.

While the *rust* of asparagus was more common than usual, it did not do as much harm as the drought. Nearly all asparagus beds suffered from the dry weather, so that the tops were frequently dead early in September. Such injury from drought is likely to show itself the following spring in a lower yield of tips.

The *anthracnose* of string beans was conspicuous by its absence this year, and the downy mildew of the Lima beans only appeared at the very end of the season, when it was too late to do any harm.

The muskmelons were better this year than for some years past, in yield and especially in quality. Connecticut melons on the Boston market were unusually fine. This was due to the warm, dry weather which is so essential to this crop, and which also helped to keep down its fungous enemies. However, during the latter part of the season many of the vines were injured or prematurely killed by the attacks of the *downy mildew* and the *leaf spot* blights.

The *blight,* or *downy mildew,* of the potato, so far as the writer could discover from a careful search during the season, did not occur at all, it being the first time in seven years, at least, that it was not found. This meant that there was no injury by rot to the tubers. But while the potatoes escaped the blight, due to the dry season, from the same cause they suffered unusually from *tip burn,* so that practically all the vines, especially of the late varieties, were prematurely killed, and the yield very greatly reduced. In some fields the tubers were scarcely marketable. There was some *scab,* it being reported as quite bad in certain fields.

The midsummer rains prevented much injury resulting from the drought to the tobacco fields, while the dry spell of the fall favored its harvest and curing in the barns. As a result the tobacco crop was unusually good. No complaint was made of serious *root rot* in the seed beds, and, so far as we have heard, the trouble in the fields, due to the *Thielavia* fungus and other causes, was not especially conspicuous in the Suffield region. In some fields there was more or less *calico.* (Plate LXVI b.) This is a trouble to which we have paid especial attention during the past two years, and we expect next year to give an account of these investigations.

Fruits and berries. While the apple crop was comparatively small and of rather poor quality, this was not due to any especial attacks from fungi. By far the most conspicuous apple fungus of the year was the *leaf rust* (*Roestelia pirata*). Conditions must have been unusually favorable in the spring for its spread from the "cedar apples," its winter stage on the red cedars, for it occurred on apple trees in some cases quite distant from any cedars. It was one of the fungi most frequently sent in for identification.

The peach apparently suffered more than any other fruit tree from fungous and physiological diseases the past year. While the *scab* and *brown rot* were less noticeable than usual, the latter largely because of the favorable dry weather at harvest time, the *bacterial spot* was more common than at any time since we first called attention to it in 1903. There was also considerable injury from *collar girdle* in some orchards. *Yellows* and *so-called yellows* were very prominent, especially in certain orchards. While the peach crop was not as large as some years, the quality was above the average.

With the quince, as with the apple, *rust* (Plate LX c) was unusually prevalent, especially in the vicinity of New Britain. The quince rust (*Rœstelia aurantiaca*), however, generally attacks the fruit and the young stems, especially the fruit-spurs. Its mycelium in the stem, so far as we have been able to learn, is not perennial, so that infection each year depends upon the "cedar apple" stage. It forms elongated but quite fragile white peridia that rise above the infected parts and are filled with bright orange-colored spores. The half-tone shows a quince in which these peridia have worn off.

Among the diseases of the small fruits, the *downy mildew* of the grape and the *yellows* of raspberries were the only ones to which our attention was called as being unusually common. We also noticed one case of *leaf spot* (*Septoria Rubi*) of raspberry which was as bad as any we have ever seen on this host.

Forest and shade trees. Because of the articles that have been written and the great damage it has caused, the *chestnut bark disease* is now attracting much more attention in this state than it has before. It is a question whether this trouble is on the increase or whether it is merely being reported in new localities because of the search that has been made for it. We treat of it more at length in a special paper later in this Report.

The fungus most frequently sent to the station for identification during the year was the *black spot* (*Rhytisma acerinum*) of the maple, and our own observation also showed that it was unusually common. This fungus is conspicuous because of the evident black spots, something like finger prints (see Plate LXIV a), that develop on the leaves. These are slightly elevated on the upper, and often concave on the lower surface, showing less prominently beneath. So far as known, this occurs only on the leaves and does not mature on them until the next spring. The evident method of combating it is to rake together and burn the leaves in the fall. While the cultivated cut-leaved variety of the soft maple is the one most commonly attacked, we have also found it on the soft and red maples.

The *blight* of white pine, which attracted so much attention last year, was very much less conspicuous this year and we received no complaints of it. Of course last year's leaves which were killed at the tips still showed the injury, and in some cases the leaves put out this year also showed the trouble somewhat. Early in the spring the Forester marked all of the injured young trees in a certain block at the state plantation at Rainbow. This block will be watched for a year or two to see if the trouble spreads and what its effect is on the trees already diseased. When examined last (fall, 1908), the trouble seemed not to have spread (at least to any extent) and the marked trees were improving, the leaves put out this year being usually in much better shape than those of last year. The results so far seem to confirm our statement made in the last Report, that this disease is not primarily due to fungous attack, as believed by some, but is rather the result of adverse weather conditions which culminated in the drought of last year.

The sycamore trees, which were severely injured last year by late frosts in May, just as the leaves were appearing, still show the effects by their scantier though healthy foliage. Some writers erroneously attributed this injury to the anthracnose.

B. NEW OBSERVATIONS ON DISEASES PREVIOUSLY REPORTED.

APPLE, *Pirus malus.*

Rust, *Gymnosporangium macropus* Lk. Plate LX a-b. The aecial stage of this fungus (*Roestelia pirata*), while common on apple leaves, has not before been reported on the fruit itself in this state. In the fall of 1907, Mr. A. B. Cook sent the first specimen that we have seen. The past year, because of the rust's unusual abundance, the fruit was also attacked more frequently than usual. On a roadside seedling near Meriden, in September, we found it quite abundant on the apples as well as on the leaves. The peridia on the fruit varied so in the character of their splitting open that we thought possibly both of the species of *Roestelia* which occur here were present, though the spores seemed the same. Mr. Kern, however, to whom we sent the two specimens shown in the halftone, pronounced them the same.

The infected apples showed a progressive development of the mycelium, so that eventually the whole apple became involved. Cutting across one of these apples, the presence of the mycelium was shown by its endochrome, which gave an orange tint to the invaded tissues. This infected area was always evident at the surface, narrowing down, in wedge shape, toward the core in the cross section. Another peculiarity that, so far as we know, has not been described before, was the development of immature pycnia within these tissues; and, in the seed cavities of the core, the formation, in a number of cases, of perfectly mature peridia.

As these apples offered an easy method of obtaining tissue containing the mycelium of the fungus free from other germs, for artificial cultures, attempts were made to grow the fungus in this way on apple juice agar, but in none of the cultures did the fungus develop. However, so far none of the rusts have been grown in such artificial cultures.

AZALEA, *Azalea* sps.

RUST, *Pucciniastrum minimum* (Schw.) Arth. In the Report of the station for 1903, p. 306, we reported the uredinial stage of this fungus under the name *Pucciniastrum Vacciniorum* (Lk.) Diet., to which it has commonly been referred. Arthur in N. A. Flora 7^2, p. 109, however, considers the rust on Azalea distinct from that on Vaccinium, and describes it under the name *P. minimum,* but states that the telial stage has never been reported. The past fall we again found this rust on *Azalea nudiflora* (and apparently other cultivated species) in the local nursery where it was seen before, and on specimens gathered the latter part of October we were able to find the telial stage. The sori of this stage are so inconspicuous that it is necessary to cut sections of the leaves in order to be sure of the presence of the spores. These compound spores are of the normal Pucciniastrum type, showing (when not too much crowded together) as four cells in surface view and two cells in longitudinal section. They occur, one or more, in the epidermal cells of the upper side of the leaves above the uredinial sori, but sometimes appear to be situated between the epidermal cells and the cuticle. They vary in size from 21 to 25μ, in surface view, to 23 to 29μ in longitudinal section. Their walls are reddish-brown in color. So far nothing is known of the aecial stage of this fungus, which is supposed to occur on some coniferous host, and the collections made by us give no clue to this stage or its possible hosts, though we have looked for suspicious Peridermia on the Coniferae in that vicinity.

GRAPE, *Vitis* sp.

DOWNY MILDEW, *Plasmopara viticola* (B. & C.) Berl. & De Toni. This fungus is not uncommon on the leaves and green fruit, but the past year for the first time we have found it here on the ripening fruit, causing the brown rot described by Scribner (Fungous Diseases of the Grape, etc., p. 48). In September specimens of rotting white grapes were sent to the station from Hartford by Mr. A. H. Newton. An examination showed that this fungus was responsible for the trouble, though the grapes were quickly infected by other fungi that fruited on them and so gave the appearance of being the primary cause of the rot.

On the young green grapes the conidial stage is developed on the exterior, but with the brown rot of the ripening fruit neither this stage nor the oospores developed, though the specimens were examined in all stages of decay, for the latter, until the end of the season. The characteristic haustoria of the mycelium, however, easily distinguishes the fungus.

As the mycelium penetrates all through the tissue of the grape, attempts were made to secure artificial cultures of the fungus, as we have done with the downy mildews of the potato and Lima bean, by placing infected tissue in nutrient agar medium in sterilized test tubes. In this case we did not succeed, for all the grapes apparently were contaminated with other fungi that prevented the development of the mildew, or else crowded it out.

The past year a careful search of grape leaves from different sources late in the fall disclosed the presence of the oospores occasionally in these. Farlow years ago reported finding these spores, but they are rarely found except when a very careful search is made for them. There is no external indication on the leaf of their presence, and the only way to find them is to boil small fragments of the suspected leaves in potash, crushing the tissues so that they can be examined under the microscope, and then search until the oospores are discovered. We were most successful in finding them in the tissue next the larger veins, but did not find them on the twigs, though they have been reported on these in France.

POWDERY MILDEW, *Uncinula necator* (Schw.) Burr. Plate LXII c. During September an unusual appearance of this common fungus of the grape was found (in a single variety only, on the station grounds) where it produced small circular discolorations on the stems of this year's growth, as shown in the illustration. These reddish spots, about one-quarter inch in diameter, appeared to be made up of much smaller, closely placed dots. The fungus in its conidial stage occurred inconspicuously on these and in time disappeared, so that the cause of the injury would then have been difficult to determine. The mycelium of this fungus ordinarily develops externally on the host, sending only short branches, haustoria, into the tissues for nourishment, but in this case there is a possibility that the mycelium secured a firmer foothold in the plant, which might enable it to live over the winter there.

PEACH, *Prunus Persica.*

Bacterial Spot, *Pseudomonas Pruni* Sm. Plate LXIX a. In the Station Report for 1903, p. 337, the writer noted an unnamed bacterial disease of peach leaves from Pomfret, Connecticut, this apparently being the first mention of the disease in literature. In the Report for 1905, p. 273, a bacterial spot of plums, causing a purple-black spotting of the fruit, was described from specimens sent from Bridgeport. This was determined to be the bacterial disease of plum named by Erwin F. Smith *Pseudomonas Pruni* (now called *Bacterium Pruni* by Smith), and it was suggested by the writer that these two bacterial diseases might be caused by the same organism. Recently Rorer (Mycologia 1: 23-7. 1909) has practically demonstrated the identity of the two diseases. Rorer found the peach trouble quite common in Arkansas, where it occurred on the twigs and fruit as well as on the leaves. In this state, on the peach, we have found the disease only on the leaves, where it causes small reddish-brown spots which often fall out, producing shot holes, and when abundant, the premature yellowing and fall of the leaves. This year it was more abundant and injurious than we have seen it before. We also received for the first time specimens of diseased plum twigs from Sound View that possibly were caused by this organism.

Collar Girdle and Root Injury. Plate LXVIII b-c. In a previous Report (1904, p. 323) we briefly mentioned winter injury of the roots of peach trees (Mr. Warner's of North Haven) caused by the severe winter of 1903-04. The winter of 1907-08 apparently caused more of this trouble—aggravated in part possibly by a weak condition of the trees due to the 1907 drought—than has yet been reported in the peach orchards of this state. The trouble was first called to the attention of the station by Mr. J. H. Hale, who asked for an investigation of the trouble. Mr. Hale wrote: "There has been a tremendous dying of peach trees around these parts the past two or three weeks, after they began to leaf out. Yesterday morning Albert Carini, who lives in the eastern part of South Glastonbury, came to me with a tale of practically six hundred dead and dying trees in an orchard that looked all right four or five days before." Other growers in the state lost occasional trees, but in few orchards was the injury so severe as in Mr. Carini's.

In the absence of the writer Dr. Britton investigated this trouble, and we are indebted to him for the photographs and notes used here. The examination showed that the diseased trees had started to develop their foliage, but this soon turned yellow and dropped off before maturing. Some of the trees by June 2d had dropped all of their foliage except small tufts at the end of the twigs, but the fruit still adhered. The trouble was found to be due to winter injury, which killed the roots and girdled the bark at the base of the tree, reaching above the ground two or three inches and forming the so-called "collar girdle." This bark could easily be peeled off, as shown in the illustration, Plate LXVIII b, and the demarcation between the injured and living bark was pronounced. Some indication of injury to the wood at the girdle was also shown by its brownish color. Some of the trees were dead only on one side, and in that case the roots were not all killed or the bark completely girdled; see Plate LXVIII c. The trouble at Mr. Carini's was chiefly on one variety, apparently a tender one, which had been bought for Elberta, but did not prove true to name.

This injury to peach trees is most likely to occur on places where the soil is not properly drained, or where the trees are exposed so that the snow is blown off from the ground around the trees. The snow acts as a mulch, and is of great value in protecting the roots and base of the tree. Cover crops or a vegetable mulch is of similar service where injury of this kind is likely to occur. Likewise, growers in this state have found it profitable, especially with young trees, to throw up the dirt around the base in the fall and then scrape it away again in spring.

TOMATO, *Lycopersicum esculentum.*

Chlorosis (Infectious). Plate LXVI b. In the last Report (1907, p. 362) we mentioned a chlorosis trouble of tomatoes seen in the field and supposed to be due to the effects of frost, the plants having been injured by it in the spring. Whether or not this was the cause we cannot say positively, but attempts to produce this trouble in young greenhouse plants by exposing them to the cold so that they were more or less seriously injured were not successful. The past season we saw this trouble again in two or three different fields, and by using juice from these plants in one case were able to produce the same disease on healthy tomatoes, and also on tobacco. This shows that this tomato chlorosis is infectious and of the same nature as the calico of tobacco. In greenhouse experiments we have frequently produced chlorosis in tomatoes from juice from calicoed tobacco and then carried it back to the tobacco again from the tomato. In one of these experiments (see illustration) the effect on the tomato was to produce little visible calico, but rather a severe bacterial-like disease of the tomatoes. This possibly (though we hardly think so) was of the nature of a burn, since it was worse in plants sprinkled with water after handling them with the calicoed juice on the hands to produce the infection. However, we have at other times seen these small bacterial-like spots both on calicoed and healthy tomatoes.

C. DISEASES NOT PREVIOUSLY REPORTED.

ASPARAGUS, *Asparagus officinalis.*

Smoke (*Gas*) *Injury.* Early in October the writer was called to examine a field of asparagus claimed by the owner to have been seriously injured some time before (late August or September) by the smoke from an adjacent brick kiln. It seems that in muggy weather, when the wind was right, the smoke was sometimes swept down across the field for a time, and the tops were killed or severely injured. In the previous year such injury had resulted and the owner of the brick kiln had paid damages for the same. This year the owner of the kiln claimed that before the smoke was blown over the field the plants were as nearly dead as when seen later by the writer. Refusing to pay damages, he was sued.

After a careful examination, the writer came to the conclusion that while there was some slight indication of gas injury to the field (as shown by a streak through the center with more completely dead tops in an adjacent field), the main injury had not been caused by the smoke of this year. The asparagus tops in fields in the near vicinity and elsewhere were in no better shape than those here at this time, due to the severe droughts of the year. The asparagus in this field had been very severely ridged, even for a wet season, and so must have suffered during the present dry one, which no doubt was largely responsible for the dead roots rather than the gas. As the tops had been injured the year before by the gas, this no doubt weakened the plants and made them more susceptible to injury by the drought. This previous injury, however, had been settled for. It is generally understood that it is the sulphurous gas in the smoke that causes injury to vegetation under such conditions.

AZALEA, *Azalea* sps.

POWDERY MILDEW, *Microsphaera Alni* (Wallr.) Wint. The mildew on this host seemed to confine itself to the under surface of the leaves, forming there a more or less conspicuous white coating, with the perithecia scattered. See also New Jersey Tea.

BALM, BEE, *Monarda didyma.*

RUST, *Puccinia Menthæ* Pers. This forms the II and III stages, frequently together, as light and dark, very small, dusty pustules, chiefly on the under side of the leaves, causing more or less spotting of the upper surface. It was found in a local nursery in September (rather abundant), on cultivated specimens of the above host and its variety *alba*. It is not an uncommon rust on some of the wild mints, especially the peppermint, *Mentha piperita*.

BEANS, *Phaseolus* sps.

Chlorosis (*Infectious?*). Plate LXI a. In the last Report of the station, 1907, p. 343, a chlorosis trouble of the Lima bean was described which did not seem to be infectious. (Plate LXI b of present report.) During September of the past year certain of the plants of both Lima and string beans on a market garden farm in Westville showed a chlorosis somewhat different from that noticed the year before, and which in general appearance resembled very closely the chlorosis (mosaic, or calico) troubles of tobacco, tomatoes and muskmelons (*q. v.*). The illustration gives a general idea of this trouble, the tissues around the veins showing usually the normal green, and those between a lighter green color, thus giving a mottled or mosaic effect. With the non-infectious chlorosis of the Lima bean mentioned above, the lighter green had more of yellowish cast, quite similar to insect or drought injury. Preliminary experiments in the greenhouse, using dried specimens of both Lima and string bean leaves three months old, soaked in water for a short time which was then applied to young Lima and string beans, were not successful in producing this disease, at least not very evidently. Neither did tobacco water from dried calicoed tobacco leaves produce it, though such water will easily produce calico in young tobacco plants. However, these experiments were not extended enough to say definitely that the disease is not infectious. Experiments with the fresh juice will be tried later, if possible, as we are strongly of the opinion that this is an infectious chlorosis.

BEETS, *Beta vulgaris.*

Drop Dampening-off, *Sclerotinia Libertiana* Fckl. The same fungus which caused the drop trouble of parsnips and lettuce (*q. v.*) at Farnham's, also caused a serious dampening off of seedling beets (also somewhat, apparently, of lettuce, cabbage and radishes) in the hotbeds about the middle of March, 1909. So many of the seedling beets were dampened off that some of the frames had to be replanted, and in these the seedlings again dampened off, but not nearly so badly as at first. This indicates that the extra warm condition of the hotbeds soon after making was an important factor in the trouble. Also with the later planting the beds could be aired, when necessary, with less danger. Unlike the greenhouse conditions, where this fungus damaged the parsley and lettuce, there was seen little growth of the mycelium exposed on the soil, probably because there was little dying vegetation there for its development.

About the time of the second planting, a portion of the bed, under two frames at the end, was treated with formalin (at the rate of one part formalin to eighty parts of water, and used at the rate of two-thirds gallon per square foot of bed). The bed was left for five days to allow the fumes to escape, and seeded again with beets. In this treated soil by far the best stand anywhere on the beds was obtained and practically no dampening off occurred. The only check in this experiment was the adjacent frames, reseeded eleven days before, where the dampening off had made the rows quite irregular. One objection to treatment in this way is that the beds after being made must lie vacant a week before seeding in order to allow the fumes to escape. Whether or not the compost used over the manure could be

treated some time before placing it in the beds, and the same results be obtained, can only be determined by experimentation. If so, then the beds could be seeded as soon after making as the temperature allowed.

CHRYSANTHEMUM (POMPON), *Chrysanthemum indicum.*

Rust, *Puccinia Chrysanthemi* Roze. We found this rust not uncommon on pompons, especially a variety called Sunset, last October, on outdoor plants in a local nursery; the rust, as on greenhouse chrysanthemums, formed only its uredinial stage. These uredinial sori, which occur on the under surface of the leaves, were, however, somewhat smaller than those on greenhouse varieties, but the spores did not appear to be different. The rust often kills the tissue so that variable-sized, reddish-brown spots show on both surfaces of the leaves.

DAHLIA, *Dahlia variabilis.*

Dry Weather Injury. During the past summer there were a number of complaints of injury to dahlias from some cause. In the vicinity of New Haven the writer observed that they did poorly, and the trouble apparently was noticed in other states than this. The trouble was something like the yellows of asters. The plants were more or less undersized, and the foliage (less luxuriant, somewhat misshapen, and turning yellowish at the margins) frequently slowly died. The plants also flowered much less than usual, and the flowers were of smaller size and often one-sided.

A careful examination of diseased plants sent by Mr. H. M. Robinson of Danbury, who complained that while the trouble showed somewhat in 1907, it was much worse in 1908, revealed no sign of any insect or fungus as the cause of the trouble. Cross sections of the stem under the microscope showed certain cells of the bark with discolored walls and contents shrunken; not infrequently lines of these injured cells extended out from the fibro-vascular bundles toward the surface of the stem. No signs of fungous threads were found as a cause of these diseased and dead cells. Everything taken into account, there seems to be no doubt that the trouble was a physiological one, due to the dry weather of the early part of the season, mention of which has already been made. Many of the ornamental plants suffered from this drought, but more or less recovered during the later, more moist weather. The injury to the dahlias, however, was sufficient to severely affect them, especially at the flowering period. Perhaps the injury may have been slightly accentuated by injury to the tubers from the drought of the previous season, in which case the plants the coming season may show the effect somewhat, even if it proves a favorable season.

DANDELION, *Taraxacum officinale.*

LEAF SPOT, *Ramularia Taraxaci* Karst. This forms roundish spots, at first purplish but finally brownish, on the leaves, having fine concentric rings and often a purplish border. They vary in size from a pin head to nearly half an inch. While not uncommon on the wild dandelion, it does comparatively little harm to the cultivated plants, probably because these are renewed each year from the seed rather than grown continuously from the roots. There seems to be little or no reason for considering Peck's species, *Ramularia lineola,* distinct from this.

GOURD, BOTTLE, *Lagenaria vulgaris.*

DOWNY MILDEW, *Peronoplasmopora cubensis* (B. & C.) Clint. This mildew was seen for the first time last summer, in a Westville garden, on this host. It was likewise on the common gourd, *Cucurbita Pepo.* In both cases the fungus produced on the leaves numerous conspicuous reddish-brown spots about one-quarter of an inch in diameter, which soon ran together. The fungus showed somewhat as a faint growth on the under surface. Although a careful search was made on these hosts, as well as on the numerous varieties of muskmelons in our experimental tests, throughout the entire season, we were still unable to discover the oospores, or winter stage, of this fungus.

LARKSPUR, *Delphinium* sp.

BACTERIAL SPOT, *Bacillus Delphini* Sm. Plate LXIV c. While we have seen this disease before, we have paid no especial attention to it, thinking it probably due to injury by sucking insects. The past summer cultivated specimens of larkspur on the Experiment Station grounds showed the trouble quite prominently. It is chiefly a leaf injury, developing as purple-black, irregular spots (evident on both surfaces) which vary from those scarcely discernible up to a quarter of an inch in diameter, and where thickly placed, become more or less merged. An examination of the diseased tissue under the microscope showed the presence of plenty of bacteria. No cultures or inoculations were made, however. So far as the writer is aware, the only mention of a bacterial disease of this host is in a short note by Erwin F. Smith (Science **19**: 417. 1904), which is an abstract of a paper given before the A. A. A. S. A brief account of this disease and the organism causing it (which is named as a new species), is given there. Smith produced the disease on various varieties of Delphinium from pure cultures. In his Bacteria in Relation to Plant Disease, 1905, Smith also gives a photograph of diseased leaves.

LETTUCE, *Lactuca sativa.*

DROP, *Sclerotinia Libertiana* Fckl. Plate LXIII. While this fungus has been known for some time as a serious enemy of greenhouse lettuce, especially in the great Boston lettuce district (see Bull. 69, Mass. Agr. Exp. Station, by Stone and Smith), and no doubt has occasionally done injury to some extent in this state, we have not previously come across it. In Mr. Farnham's greenhouse, where parsley (*q. v.*) was injured by this fungus, that crop was followed by lettuce without changing the soil. While some damage resulted to the lettuce, the injury on the whole was not so great as one might expect, knowing that sometimes as high as ninety per cent. of the lettuce heads have been killed by this fungus in Massachusetts. However, before setting out the lettuce, all the refuse containing the fungus was removed from the soil; the lettuce was frequently cultivated to keep the fungus from developing on the surface of the soil, and greater care was taken with watering, especially during cloudy weather. Out of the whole, only about five per cent. of the lettuce heads were finally carried off by the drop.

A portion of the soil in this greenhouse shortly before the lettuce was set out was treated with formalin, rate of one part of formalin to one hundred of water. This was sprinkled over the soil gradually until there was used about three-fourths of a gallon per square foot. The ground was covered with canvas for a day and then aired for a week before setting the lettuce. This, however, did not prove long enough for the fumes to get out of the soil, although it was also lightly spaded three days before use, and as a result the lettuce began to wilt the next day, and in less than a week was all dead. We have used the soil in greenhouse benches inside of eight days after treatment, but as this bed was on the ground itself, it did not dry out so easily. So it is not wise to use the treated soil under ten days where plants are set out, or for a week where it is seeded. The second set of plants, put out a few days after the first were removed, started off very nicely, and eventually formed the finest looking lot of heads in the greenhouse. They had a finer green color, grew somewhat faster and more uniformly, and not a single one was lost.

Possibly where the sclerotia are present abundantly in the soil, the formalin treatment would not be so effective. Stone and Smith found that the use of hot water, heating the soil up to 176° to 186°, was very beneficial in destroying the fungus and preventing subsequent trouble from the drop. Steam has also been used for the same purpose.

The trouble is called the drop because the fungus attacks the base of the leaves, rotting them there and causing them to fall over. This is shown very nicely by Plate LXIII c, which pictures a check and an inoculated plant. The inoculated plant had a small amount of the fungus from a pure culture placed on the base of the leaves that show the drop just two days before the photograph was taken; at the end of four days all of the leaves had fallen over, and by the end of the week the plant was entirely dead.

LILY, COMMON WHITE, *Lilium candidum.*

Bacterial Spot? Plate LXIV b. This disease was found on cultivated lilies during October in a local nursery. The oval spots are quite conspicuous, the largest varying from one-half inch to one inch in length. The greater portion of the spot is occupied by a semi-transparent portion in which the chlorophyll often entirely disappears, and surrounding this is a smaller purplish border. In dried specimens one can read print through the transparent portion if the leaf is placed on the page. The spots contain numerous bacteria, but also occasionally some mycelial threads of a fungus, though there was no sign of this fruiting on the exterior. As yet cultures and inoculations have not been made, so that it is not positively known that the disease is of bacterial origin, though from general appearances there seems to be little reason to disbelieve that it is such. So far, the writer has found in literature no mention of a similar trouble of lilies due to bacteria.

MUSKMELON, *Cucumis melo.*

Chlorosis (*Infectious?*). Plate LXI c. This physiological trouble was first seen the past summer on certain varieties of the muskmelons grown for the station by Mr. Frisbie of Southington. It appeared first and most prominently on the Extra Early Grand Rapids. In general, the appearance of the disease is very similar to the calico disease of tobacco, as the leaves are irregularly mottled with lighter and darker green areas, the darker green patches surrounding the larger veins, as shown in the illustration. The trouble is not severe enough to kill the tissue of the leaves, and therefore does not very seriously interfere with their normal functions. Mr. Frisbie said that he had observed this trouble before on muskmelons. So far as the writer is aware, it is not recorded in the literature of plant diseases on this host, though Selby of Ohio has briefly described the same or a very similar trouble on cucumbers (Ann. Rept. Ohio St. Hort. Soc. 1902: 109. 1903. *Ibid.* 1903: 128. 1904). In Bull. Ohio Agr. Exp. Station 156, p. 90, he says: "It seems now that we must class the mosaic disease of tobacco, the yellows of the peach, peach rosette, the mosaic disease of tomatoes, and the mosaic disease of forcing house cucumbers, which the writer has recently investigated at Ashtabula, Ohio, in one and the same group of maladies."

This disease is very similar in appearance to the calico of tobacco; and, as the melons were on land that had recently been in tobacco, it seemed quite likely that the disease was due to the same cause. In order to determine if it were infectious, the writer made a preliminary experiment in the field, similar to experiments that will produce the calico in tobacco. Some calicoed muskmelon leaves were crushed in the hands, and then seven healthy plants of different varieties at the end of the rows were handled, and bits of the crushed leaves left on them. Unfortunately, the plants were not examined until some three or four weeks later, when all of them showed more or less of the chlorosis, but as some of the neighboring untouched plants also showed the trouble it was impossible to say positively that the disease was induced by the touching in the experimental plants. Infection experiments will be tried again. The same, or a very similar trouble, was seen the past year on Lima and string beans and tomatoes, as well as on tobacco.

NEW JERSEY TEA, *Ceanothus americanus.*

POWDERY MILDEW, *Microsphaera Alni* (Wallr.) Wint. Plate LXVI a. This mildew was found on French seedlings of the above host in a local nursery. There seemed to be considerable difference as to its abundance on the different plants. It forms a white coating on both the upper and lower surface of the leaves, but showing more prominently on the upper. Sometimes this coating entirely covers the surface of the leaf, as if painted over with a white paint. In such cases the perithecia often stand out quite plainly in small circular dark colonies about a quarter of an inch across, as shown in the illustration. This same mildew is common on this host here in its wild state. We have reported it before only on the lilac, but in this Report it is listed also on the azalea and the Pagoda tree, *q. v.* Its appearance on these different hosts varies somewhat.

OAK, *Quercus* sp.

LIMB GALL (*Bacterial?*). Plate LXV a-b. For a long time the writer has observed galls on the limbs of various trees, such as the oak, hickory and maple, but has never definitely known the cause of these. They vary somewhat in size and duration on the different hosts, and may not, of course, all have the same causal agent, though their general character is the same. The general impression seems to be that these are the results of insect attack, but Dr. Britton states that the entomologists do not recognize them as such. The writer, in common with some other botanists, has believed that possibly they are the result of bacterial action, and since the researches of Smith and Townsend have shown that the galls of peach, etc., which in appearance have considerable in common with these galls, are due to bacteria, this belief has been strengthened.

The past winter the Hartford Superintendent of Parks, Mr. G. A. Parker, sent the writer specimens of the gall on oak, from Keney Park. Mr. Parker stated that the trouble was first noticed several years ago on a single tree, and had since slowly spread over the tree and to two adjacent trees. An examination showed that the galls varied in size from that of a pea up to a small-sized pumpkin. There was no evidence of insect work on them, though other small galls on the twigs were of that nature. The galls in cross section (see illustration) showed that the swelling was due to an unusual enlargement of the wood (and to a less degree, of the bark), and exhibited a semi-radiating structure from a common center, with black spots showing frequently in the otherwise normally colored wood. The large galls were apparently some years old, and had increased in size each year. Some idea of their age could be obtained by cross sections, though the annual rings of growth were not very distinct. In the largest knots, not more than ten or twelve of these rings could be made out, but usually after four or five years the galls seem to stop growth and begin their gradual decay. The largest knots had ceased to grow; the bark and wood were both dead, and the former was more or less decayed also. On the whole, the oak galls attain a larger size and are more lasting than the hickory galls, which seem to be largely annual, and perpetuate the trouble by new galls at the margin of the old ones. The surface of the galls shows a corrugated and rougher character than the bark of the limbs on which they occur. Unlike the crown gall, these galls occur on the limbs high up in the tree.

The writer, early in March, made a number of inoculations in Lima bean agar with tissue from the interior of these galls, but obtained no growths. Perhaps such growths were prevented by the tannin-like substance that diffused from the tissues and discolored the medium for some distance around. Possibly cultures from new galls in the spring might give different results.

OKRA, *Hibiscus esculentus.*

POWDERY MILDEW, *Erysiphe cichoracearum* DC. This fungus forms a greyish-white, mealy, and rather inconspicuous growth, in spots, or eventually covering the whole surface, on the upper sides of the leaves, rarely forming a very slight growth on the under surface. Only the conidial stage was found, as is always the case on the squash, pumpkin, etc., and as this stage cannot be distinguished from that on those hosts, I have placed it under the same species. Apparently the powdery mildews do not occur commonly on the Malvaceae, as Farlow lists only one host in his Host Index, and Salmon, in his monograph, apparently only two. Neither gives this host. deThümen, however, judging from his description (Grev. **6**: 102) described this fungus under the name *Oidium Abelmoschi,* having received it on this host from Egypt.

PAGODA TREE, *Sophora japonica.*

Powdery Mildew, *Microsphaera Alni* (Wallr.) Wint. This host is a small tree that comes from China and Japan and is occasionally grown for ornament here. The mildew, apparently, has not been reported on it before, at least this host is not in the host indexes of Farlow, Saccardo or Salmon, or in the latter's Hosts of Japanese Mildews. It was found not uncommon in a local nursery, where, in September, it formed a grayish-white mealy growth, chiefly on the upper sides of the leaves, usually covering the entire surface of the leaflets. Very few perithecia were formed. See also New Jersey Tea.

PARSLEY, *Petroselinum sativum.*

Drop, *Sclerotinia Libertiana* Fckl. Plate LXIII. In February, 1909, Mr. A. N. Farnham, the market gardener of Westville, called my attention to an unusual trouble he was having with parsley in his greenhouse. The parsley was grown on the ground in rows, much after the manner of its cultivation in the field. As the soil is changed each year, hitherto no trouble had been had with soil fungi, but this year the soil had become infected in some manner, perhaps from the manure used, and this, with difficulty in properly regulating the watering at the time the plants were well covering the ground, started the drop fungus to work in good shape. This fungus develops its sterile mycelium as a white growth on the surface of the ground, especially on the decaying vegetation, and also works into the living stems and leaves, rotting them off. Occasionally it forms small, black, tuber-like bodies, called sclerotia (see artificial culture shown in Plate LXIII b), slightly embedded in these rotted stems. Where the soil is used year after year this trouble is likely to become increasingly serious, as these sclerotial bodies carry the fungus over from year to year, even if the soil thoroughly dries out in the summer time. While the fungus in this case injured the plants so severely as to make an uneven growth, killing them out entirely in spots, after the first cutting, by gathering up all the refuse containing the fungus, and by cultivating the ground frequently and using extra care in watering, the trouble was kept down so that the injury was considerably lessened in the second cutting. This same fungus is often quite injurious to greenhouse lettuce. A fuller description is given here under that host, as part of the house was afterwards planted to that crop.

PEACH, *Prunus Persica.*

Gummosis. Plate LXVIII a. The branches shown in the illustration were from a small orchard in Centerville in which a number of the trees developed this trouble. An examination of the orchard showed that the wood of most of these trees had been more or less severely winter injured a few years previously, and had not been pruned since to start new growth. Apparently the gummosis trouble was a secondary result of this winter injury, due possibly to bacteria or fungi that gained entrance to the branches because of their weak condition and produced diseased places in the bark, which cracked open and formed a deposit of gum around the wound. Gummosis has been attributed to a variety of causes, but we doubt if any particular organism, in the present case, was wholly responsible for the trouble.

Little Peach. At the annual meeting of the Connecticut Pomological Society at Hartford in February, 1908, Mr. C. E. Lyman of Middlefield called attention to a trouble in his peach orchard which he took to be little peach. The past season this trouble has been definitely identified by Mr. M. B. Waite, of the United States Department of Agriculture, and has been noticed in other orchards, apparently more abundant than hitherto. As this trouble is said to be quite serious in Michigan, its appearance in this state is worthy of careful attention. Little peach was first investigated in Michigan, by Erwin F. Smith, who found the fibrous rootlets of the diseased trees more or less dried up. Mr. Waite holds that it is a trouble quite similar to the yellows and that it is contagious, so that infected trees should be promptly dug up and destroyed. By this means the trouble is said to be held in check in certain orchards in Michigan. The trees usually die quicker from little peach (about three years) than from the yellows.

Concerning this disease Waite (Rept. Conn. Pom. Soc. **1908**: 64) says: "The little peach resembles yellows in many respects, particularly in the foliage symptoms; and yet certain of its symptoms are exactly the opposite, namely, those of the fruit. Fruit on trees affected by little peach is undersized and belated in ripening. It is often a week, or two weeks or more belated. Its size may be only slightly reduced in mild cases, down to little tiny peaches less than three-fourths of an inch in diameter. Little peach trees rarely throw the wiry growth. I have only seen it produced where they were cut back, or on very vigorous young trees. It is rarely bushy and prominent, as in the case of the yellows. The foliage characters of the little peach are so nearly like peach yellows that when the fruit is absent and no wiry growth occurs, as is frequently the case on yellow trees, it is impossible to distinguish the two diseases."

The writer is inclined to believe that little peach, like much of our so-called yellows, is indirectly due to weather conditions, such as the droughts of 1907 and 1908, and possibly to winter injury. At least, it has shown up most prominently since the drought of 1907, and Smith's statement that the fibrous roots of the trees seem to be injured, goes along very well with the drought theory. See article relating to peach yellows and so-called yellows, later in this Report.

POPPY, *Papaver* sp.

BACTERIAL SPOT? During the past two seasons the writer has noticed the leaves on poppies in his yard badly spotted from some cause. These spots are dark reddish-brown, somewhat watery, irregular, and about one to three millimeters in length, and usually are quite numerous. An examination of dried specimens, collected last fall, shows these diseased spots crowded with bacteria, which appear to be the cause of the trouble. So far no such bacterial disease of this host seems to have been described, so that before a positive statement can be given, cultures and inoculations will have to be made.

RADISH, *Raphanus sativus.*

Spindling. This is a trouble which sometimes appears in radishes grown in hotbeds, where they have not been watched closely enough after they germinated. The trouble is due to too great heat at this time, so that the radishes grow too rapidly, forming a long slender hypocotyl, often two or three inches above the ground. Such radishes are largely worthless, and are usually pulled up and the bed reseeded, as the bottoms of the small turnip-shaped radish will not form or will be irregular under such conditions. The way to prevent such trouble is not to use the beds too soon after making, and to watch them carefully to see that the temperature is properly controlled by ventilation, so that the radishes will not grow too rapidly for a time after they break through the ground.

RHODODENDRON, *Rhododendron maximum.*

LEAF SPOT, *Phyllosticta maxima* E. & E. This is found occasionally on leaves, forming reddish-brown areas (often grayish with flaking away of the epidermis) of greater or less extent, usually at the margins or tips. Other fungi sometimes occur on the spots, so possibly this is not entirely the cause of the trouble.

SUNFLOWER, ORNAMENTAL, *Helianthus multiflorus.*

POWDERY MILDEW, *Erysiphe cichoracearum* DC. This forms a whitish-gray, mealy coating over the upper surface of the leaves. On these specimens, collected on September 12th, the perithecia were not present.

RUST, *Puccinia Helianthi* Schw. This rust was found on the same specimens with the above mildew, but was confined chiefly to the under surface of the leaves, the II and III stages showing as numerous minute, dusty, reddish or blackish outbreaks. Apparently the rust has not been reported often on this host, though on the various wild species it is quite common. (See Report of 1903, p. 361.)

II. PEACH YELLOWS AND SO-CALLED YELLOWS

General statement. During the seasons of 1907 and 1908 peach trees in Connecticut have shown an unusual amount of injury variously classed as yellows, so-called yellows, little peach, collar girdle, winter injury of wood, drought injury, leaf fall, gummosis, etc. Some persons have been inclined to lump these troubles largely into so-called "yellows," and others have made very nice distinctions, especially as to cause, apparently where such did not exist.

There is no question that there has been an unusual amount of typical yellows present, such as shown in Plate LXIX b (a photograph of a peach tree made by Dr. Britton in East Haven in 1902), and there is likewise no question that much of the so-called yellows has not been typical. For instance, many of the trees cut down last fall as suffering from yellows bore a crop of peaches of good quality, and often with no indication of the red streaking in the interior which is taken to be one of the very first signs of this trouble. What the writer wishes to bring out in this article is that these various troubles are largely the result of the unusual weather conditions that have prevailed during the past seven years. That secondary causes, such as germs and enzyms, may have afterward entered into the problem and produced the various differences that show in different trees, is quite possible, but these *alone* we do not believe are to be held responsible. What have been these weather conditions and their effects, as shown by our observations covering this entire period, and of which there can be no question? They are as follows:

Relation of Peach Troubles to Weather.

Winter injury in 1902. On December 9, 1902, after a very open fall in which late growing trees had no chance to properly mature their wood, there came a sudden drop to zero weather. As a result apple and peach trees in the nursery and those recently set out in the orchards had their wood prematurely killed or badly injured. Specimens were sent to the station by nurserymen immediately after this injury, and the writer also had abundant opportunity during the next two years to study such trees in the nurseries and orchards. Such trees showed the normally white wood darkened nearly or quite up to the bark, but when not too severely injured, the next year a small annual growth of white wood was formed around this. (See Plate X a, Rept. 1903.) Trees suffered most that were set out in low places, and in the nurseries where the trees had been stimulated to late growth by forcing them with chemical fertilizers and late cultivation.

No one seemed to know much about such a trouble, even among the nurserymen; one firm built a large storage shed the next summer to avoid future trouble to the season's stock. Some of the least injured of these trees were sold the following year, but where complaint was made that they died, the nurserymen made good the loss. In other cases the young nursery trees were cut back near to the ground and a new trunk started. In some instances such trees had to be cut back again the next year because of further winter injury. We have seen two orchards set out by nurserymen from these twice winter-injured and cut-back trees which the past year have gone with the so-called yellows. In one case the trees showed winter injury subsequent to setting the orchard, and in the other practically none. Now, we hold the winter injury, the severe pruning back, and the droughts of 1907 and 1908 as primarily responsible for the decline of these orchards, rather than yellows.

Severe winter of 1903-04. The winter of 1903-04 did not find the trees so unprepared, because of an open fall, as the previous year, yet it was so unusually severe that even greater injury was done. This was especially true in the older orchards. Many trees were killed outright all over the state. Most frequently the injury showed in the wood, which was blackened to the snow line, while the bark and roots were uninjured. Severe injury of course killed the cambium, and then the trees were past any help. This injured or prematurely killed wood undoubtedly set up unusual chemical activities that may have resulted in deleterious enzyms or other products that were carried in time to the new growth. Anyway, after some years I do not find that the sharp demarcation between the darkened winter-injured wood and the subsequent growth of normal white wood shows as plainly as it did at first.

In some places, often depending upon low elevation or exposure to moist winds, parts of, or even whole orchards, were so severely injured that they were taken up. Many of the trees least severely injured were severely pruned back and new growth started. The illustrations on Plate LXVII show two trees that were severely injured but not pruned back until the early spring of 1906; one of the trees failed to respond, but the other made in three years the vigorous growth shown in the illustration, and in 1908 bore a fine crop of fruit. Such trees, however, go much quicker than trees not injured, and where the injury was severe, even with the help of severe pruning, they have been dying from year to year, often from yellows or so-called yellows. No one has disputed the winter injury to the trees that were killed outright; but with the trees that have since gone into decline, the fact that they were thus handicapped has been overlooked by many who attribute this whole trouble to "yellows."

Subsequent winter injuries. Since the winter of 1903-04 (as, for instance, in 1906), there has been some further injury, chiefly to the young twigs and buds, but nothing nearly so severe or unusual. During the winter of 1907-08, however, winter injury from collar girdle and root killing was unusually evident, especially where the ground was not properly drained or where there was no mulch of snow to protect the base of the trees and the roots.

Droughts of 1907 and 1908. But while these subsequent winters have not been so severe, certain of the summers have been, especially the summers of 1907 and 1908, when unusual droughts prevailed. In 1907 by far the most injury resulted, as the dry period lasted from June to August, when the rainfall was less than half that of the average year. In 1908 the drought was broken by rains in midsummer, which lessened the otherwise severer injury that would have resulted from the unusual early and late dry spells.

After the summer drought of 1907, which at the time showed its effect on all vegetation, came the moist fall weather, and in many cases this set up a late growth of the dormant buds on the peaches. The yellow, curled leaves, due to the drought, and this premature fall growth of buds, were taken even by some experts to be the first symptoms of yellows. That such persons were mistaken in some cases, at least, was demonstrated with certain nursery trees showing these signs and pronounced typical yellows, by setting them out by themselves and keeping them

under observation the following year, when all trace of the so-called yellows disappeared. Likewise certain orchards pronounced infected with yellows, the next year under special care showed decided improvement. There seems to be little doubt that these dry seasons injured the trees partly through the death of the fibrous rootlets. We know of one orchard planted with winter-injured stock and showing subsequent winter injury, situated on the top of a high, very rocky hill, where all attempts at cultivation merely increased the loss of water from the soil during the drought, and where the fibrous rootlets were killed or severely injured. No wonder this orchard has since disappeared because of the unfavorable environmental conditions that have surrounded it!

Theories Concerning Yellows.

Winter injury theory. Now from the above we do not wish it to be understood that we believe that the yellows never can occur on trees not injured by unfavorable weather conditions. It is past dispute that it can be budded into healthy trees, and there seems to be some reason for supposing that it is even contagious, though no *positive* proof of this seems to exist. What we do wish to offer is that seasonal injuries are the starting point and main factor of these so-called waves of yellows. This is no new theory. William Saunders, of the U. S. Department of Agriculture, writing to Penhallow in 1883 (Bull. Houghton Farm III, 3: 53) said: "About thirty years ago I came to the conclusion that this disease was one which originated from frost acting on the unripened wood. I have never known a tree to have the yellows when placed in conditions where the wood became thoroughly ripened before frost, a circumstance, as you are aware, which never occurs in the Northern States. Any application which will hasten ripening of the wood, will, therefore, have a tendency to ward off the conditions which make it possible for the tree to show yellows. This disease is to be seen on other plants which are similarly placed, and it was that observation which first led me to look for the cause of peach yellows in that direction."

In support of this connection between yellows and winter injury, we present the following points: (1) The apparent relation of the present unusual development of yellows, not only in

Connecticut, but elsewhere, to the very severe and widespread winter injuries that have occurred to peaches since 1902. (2) The fact that both winter injuries and yellows come in unusual severity at irregular periods, and the seeming fact that the waves of yellows gradually develop some time after these severe winters, often not reaching full development for some years. Besides the present case, there seems to have been some relation between the severe winter of 1881 and the yellows that developed in New York, Connecticut and Delaware in the following years. (3) The apparent limitation of yellows to the northern part of the United States and the mountainous regions in the South, where winter injury occurs. (4) The fact that the peach is now a highly developed sensitive plant, as compared with its native condition, and is grown out of its natural climate, and so is more likely to succumb to unfavorable environment.

Potash theory. A second theory regarding the cause of yellows, not now held to any great extent, apparently, was that of soil exhaustion of the food elements necessary for the best development of the peach. Penhallow came to this conclusion, after a careful survey of the subject from all points of view, basing his belief largely on the chemical analyses of Dr. Goessman* of Massachusetts which showed a lack of potassium oxide in peach yellow fruit and wood. (Jenkins also later reported a similar result in this state.) Penhallow advocated fertilization with chemical fertilizers of which muriate of potash is a prominent constituent. The possible lack of potash in the diseased trees, the general need of fruits for this element, and its easy exhaustion from the soil, all are facts which are in favor of the use of potash fertilizers. Hale and others have found it of benefit, but Erwin F. Smith's extended experiments (U. S. Dept. Agr., Div. Veg. Path., Bull. 4. 1893) have shown that it is not a cure or preventive for yellows, and presumably its depletion in the soil is not the cause. Perhaps its value can be well summed up in the words of Hale (Rept. Conn. Bd. Agr., 1891, p. 65), who said: "My own experience has been that trees fertilized with muriate of potash and given the same treatment as other trees to which it was not applied have been freer from the yellows, have lived longer and produced better fruit, although

* Smith in his paper (Bull. 4) reports analyses at variance with this idea.

some of them have been diseased, than trees around which potash in that form was not used at all * * * It is not a cure-all, but it is to a certain extent a check." A good illustration of the effect of a potash fertilizer on a peach orchard not in good shape was shown in the case of one of Mr. Lyman's orchards at Middlefield the past season. The year before, apparently due to the drought, the orchard was in such shape that an expert pronounced it an incipient case of yellows. Mr. Lyman gave it a treatment with saltpeter (potassium nitrate), with the result that the orchard last season took a decided step forward instead of backward. Of course if the trouble really was yellows, such improvement will probably prove of only temporary benefit.

Enzym theory. A third explanation of yellows has been that it is a physiological disease somewhat of the nature of indigestion, due to derangement of the chlorophyll of the leaves, as is seen in variegated plants. Such trouble is thought to be brought about by the presence of some deleterious enzym in the plant, and it is this enzym, when carried by budding from diseased to healthy stock, that causes the yellows to develop in the latter. Smith (U. S. Dept. Agr. Farmers' Bull. 17: 10. 1894) and Woods (U. S. Dept. Agr., Bur. Pl. Ind. Bull. 18: 22. 1902) were the first to present this or a similar theory, though they did not account for the origin of the deleterious enzym. This theory, modified by the belief that it is the unfavorable weather conditions (winter freezing and summer drought) that are directly responsible for the development of the injurious enzyms or toxins, is the theory held by the writer. (See also in Rept. Conn. Pom. Soc. 1909, Report on Fungous Diseases for 1908.)

Germ theory. The fourth prominent theory to account for yellows is the bacterial, or germ theory. This was probably first advanced by Burrill. Smith, in a recent conversation, and Waite (Rept. Conn. Pom. Soc., 1908, p. 59), also, seem inclined to this view, though all admit that nothing definite has yet been found to support it. The chief point in its support is the supposed, but not definitely proven, contagious character of yellows.

Preventive Measures.

From the above consideration we may present the following precautionary measures for the guidance of Connecticut peach growers:

(1) *Location.* Peach orchards should be planted only in the southern half of the state, preferably not too close to the Sound. Along the Connecticut Valley they may extend farther north than the center of the state. Low lands should be avoided, and as a rule only the higher hills selected, where the exposure is such as to avoid as much as possible moist winds in winter and early development of the buds in spring. Good drainage is necessary to avoid root injuries.

(2) *Inspection.* Only the best nursery stock should be used, free from all suspicion of winter injury or yellows. Winter injury can be told by the blackened wood. As it is not always possible to detect yellows in nursery trees, the young orchard should be watched during the first few years, in order to promptly remove any suspicious trees, for it is generally supposed that yellows is contagious. In the bearing orchards, also, any tree showing signs of yellows should be promptly cut down and burned. Such trees are of little value anyway, and it is best to be on the safe side of the question. Such is also the practice of good orchardists in the best peach-growing districts.

(3) *Fertilization.* As shown above, potash is a very necessary element for peach growing, and so fertilizers should be well supplied with it. Care, however, should be used not to force trees too much, especially with late applications of commercial fertilizers. This is especially true of sodium nitrate. Such trees are apt to go into the winter with the wood in an immature condition, and are then especially subject to winter injury.

(4) *Cultivation.* Good and frequent cultivation during the first of the season is very desirable, but after midsummer should be discontinued, since late cultivation, like late applications of fertilizers, may prevent proper maturity of the wood. Perhaps after cultivation is over it will be well in some cases to seed down the land with a quick-growing leguminous cover crop which can be plowed under the next spring. This will help to supply the nitrogen, and also give more or less protection against winter injury to the roots, especially where the snow blows off or is lacking. Green (Ohio Agr. Exp. Station Bull. 157. 1904) found in the study of winter injury to peach trees in Ohio that where the trees were mulched or protected by crimson clover, or other cover crops, root injury was much less. A mulch of earth thrown up around the younger trees in the fall and removed in the spring also seems to be of value in lessening collar girdle.

III. CHESTNUT BARK DISEASE, *Diaporthe parasitica* Murr.

General statement. In the Report for 1907, p. 345, this serious trouble of chestnuts was briefly described. The writer first heard of the chestnut disease in 1905, through an article in a New York newspaper which discussed a serious disease of chestnuts in the Zoölogical Park. Specimens had been sent to the U. S. Department of Agriculture at Washington for identification and suggestions for control. Flora W. Patterson reported it as a species of Cytospora and suggested spraying with Bordeaux mixture.

A short time later, Dr. Murrill of the New York Botanical Garden, who has since made an extended study of the fungus and its havoc, sent the writer specimens of diseased chestnut bark for his opinion as to the cause. We reported the presence of a Cytospora, but from our experience with similar fungi at that time, stated that we believed it might be following winter injury to the trees rather than be the direct cause of the trouble. Dr. Murrill later found the Cytospora to be the conidial stage of an ascomycetous fungus which he described as a new species, *Diaporthe parasitica.* In his first articles Dr. Murrill noted that the trouble probably resulted in part from winter injury to the trees, but later he and all others who have written concerning the disease lay the responsibility entirely on the fungus.

Through the kindness of Dr. Murrill the writer has several times visited Bronx Park, where great damage was done, and has seen something of his experimental work with the fungus. Forest Park, Brooklyn, was also visited in the fall of 1908, and a number of localities in Fairfield and New Haven counties, this state, have been especially examined both by the writer and by Mr. Hawes. The writer has not aimed to make a special study of the particular fungus ordinarily associated with the trouble, as that has already been done very ably by Dr. Murrill (Jour. N. Y. Bot. Gard. **7**: 143-153. Je. 1906. *Ibid.* **7**: 203-11. S. 1906. *Ibid.* **9**: 23-30. F. 1908. Torreya **6**: 186-9. S. 1906). However, our extended experience since 1902 with trees of all kinds which have shown various unusual troubles, due primarily to seasonal injuries, does not permit us to agree entirely with

Dr. Murrill, and apparently Mr. Metcalf, that this trouble is due alone to the fungus *Diaporthe parasitica*.

General character of the disease. In the vicinity of New York City the disease took chestnut trees of all ages, the large trees suffering as much as the younger trees or the sprouts. In most places there the trouble has now made a pretty clean sweep, so that few living, or at least healthy, chestnut trees are left. But as we come over into Connecticut, the injury gradually diminishes, being as yet serious only in Fairfield County, and growing less toward its northern and eastern borders. Here, though many large trees were killed, not all were taken, and as we go toward its outer limits the damage is only to the chestnut sprouts and small trees. In New Haven County it seems to be almost entirely the sprout growth that was injured.

Where large trees are infected, they begin to die from the top, and their decline is gradual, until the tree is killed to the base. Whether the roots of such trees are ultimately killed I do not know, but in one tree examined by the writer at Middlebury, while the trunk was dead to the ground, the main roots did not yet show injury. This at least proved that the tree was not dying as the result of root injury, unless possibly to the very small fibrous rootlets. Sometimes these dead trees show no fungus growth, but usually in time there can be found the characteristic orange or chestnut-brown pustules of this fungus breaking through the cracks of the rough bark, being developed gradually lower and lower down the tree. The tree dies because the bark and cambium are killed, but the fungus does not develop into the wood very deeply.

On the sprout growth and younger trees with smooth bark, however, the trouble shows much more plainly (see Plate LXII b) through cankered areas in the apparently healthy bark, and these frequently completely girdle the trunk or branches. In late fall and winter the fruiting stage of the fungus shows on these as small, reddish- or chestnut-brown cushions thickly breaking through the bark. It is these cankered areas on the smooth bark that afford the best evidence that the trouble is entirely due to the fungus. Such cankered spots, however, usually start from a winter-killed twig or other injury.

General distribution. The trouble has now made a nearly clean sweep of the chestnut trees in the New York City and Brooklyn parks. Dr. Murrill (Bull. N. Y. Bot. Gard. 6: 137. 23 Mr. 1909) says concerning Bronx Park: "All of the chestnut trees on the grounds have either been killed or seriously damaged by it." Mr. J. J. Levison, arboriculturist of Brooklyn parks, writes concerning Prospect Park: "We have removed fourteen hundred chestnuts, practically all the trees of that species but six." He also reports (Mycologia 1: 36. Ja. 1909) concerning Forest Park that 16,695 chestnut trees were killed in 350 acres of woodland there. About seven thousand of these were over one foot in diameter. Mr. John Mickleborough has also made a somewhat similar report (Conservation 14: 585-8. N. 1908) concerning the condition of these two parks and elsewhere. He estimates the total damage in the eastern United States as at least ten million dollars.

Metcalf, of the U. S. Department of Agriculture (Bur. Pl. Ind. Bull. 121[6]: F. 1908), gives its distribution as follows: "The bark disease of the chestnut, caused by the fungus *Diaporthe parasitica* Murrill, has spread rapidly over Long Island, where it was first observed, and is now reported from Connecticut, Massachusetts, Vermont, New York as far north as Poughkeepsie, New Jersey, Pennsylvania, and possibly Delaware." Murrill adds Maryland, and possibly Virginia and Washington, D. C., to the list.

Distribution in Connecticut. This trouble was first called to our attention in this state in the fall of 1907 by Mr. F. V. Stevens of Stamford, Fairfield County, and it is in this county, which is in the southwest part of the state, next New York and the Sound, where the chief injury has occurred. The disease has been found also in New Haven County, which is on the Sound next to Fairfield, but it occurs here only on the sprout growth, and not usually doing any serious damage as yet. Outside of these two counties we do not know of the presence of the disease, as determined by the examination of specimens, though inquiries have come concerning it from Willimantic and Pomfret Center, in Windham County.

Mr. Robert T. Morris (Conservation 15: 226. Ap. 1909) has recently called attention to the serious damage done near Stamford and Greenwich, and states that unless soon cut, the large trees will be of little value for lumber. Because of the glut on the market, they are of little or no value for cordwood at present.

In New Haven County the disease has been reported in the following places: In the vicinity of New Haven the writer has found only a few specimens, with no damage whatever;—at Morris Cove, in a low grove, one or two sprouts were found with large cankers in fruiting condition; in Westville, along Beaver Creek, a few small trees were found with small cankers in the otherwise healthy bark, but no fruiting pustules except in one case. These cankered spots were almost all on the south side of the trees.

W. A. Henry sent specimens from Wallingford, where he says that "many sprouts show the disease, though none are yet dead."

We are indebted to Newton J. Peck of Woodbridge for the specimen shown in the illustration, Plate LXII b. This was on an eight-year-old sprout tree. Mr. Peck says that only the sprout growth is affected in Woodbridge, and that he has noticed the trouble there for four or five years. With Mr. Filley, the acting Forester, we recently (April, 1909) visited Mr. Peck's woods and also others in Woodbridge, and found considerable of the fungus present, but almost all of it on small sprout growth or small trees. We saw many cankers, often quite small, as yet showing no signs of the fungus; and by far the larger part of these were on the south or southwest side of the trees.

W. M. Shepardson of Middlebury reported the disease in that region, and the writer on a visit there found the fungus in two different woods. The situation here threw more light on the relation to weather conditions. On a dry hill on the Whittemore estate, many of the trees, oaks as well as chestnuts, showed that they were not in prime condition, especially their bark. Some few were dead, and others had dead bark on one side of the tree, but there was no evidence of the fungus. There is little question but that here the droughts of 1907 and 1908, especially of the former year, had seriously injured the trees. On a low spot in another grove, owned by Mr. Shepardson, over half the trees were injured or dead. While many of them showed characteristic Diaporthe cankers, others showed growths of different fungi, and some had no fungous growth at all! It looked to the writer as if winter injury and drought might just as well be

given the responsibility for the trouble here as the bark disease fungus.

Mr. Hawley, of the Yale Forest School, has reported the fungus common in the woods of the Water Company near Ansonia. Dr. Graves, of the Yale Bot. Dept., found specimens near the North Branford line on the road to Twin Lakes. Mr. Metzger reports a few infected sprouts in his woods at Mt. Carmel. No doubt other infected regions occur besides those given.

In Fairfield County, the writer has examined forests near Stamford and Danbury. At the former place, due to the kindness of F. V. Stevens, the writer and Mr. Hawes, in April, 1908, got a very good idea of the damage done in one of the most seriously affected districts in the state. This examination gave the writer his first evidence of possible relation to winter injury. In one place chestnut sprouts showing signs of winter injury (indicated by blackened wood) were found on the border of an old orchard that also showed the same trouble. In cutting through the diseased sprouts, nearly all showed this dark wood back about four years, when the severe winter of 1903-04 did much damage to trees of all kinds. Of course it is not always possible after several years to distinguish between winter-injured wood and the normally colored heartwood, but in our opinion the dark color of the inner wood of the sprouts (see Plate LXII a) as seen almost everywhere is too close to and sharply marked off from the sapwood to be natural.

In order to determine if this disease was contagious, the writer had Mr. Hawes send Mr. Stevens one hundred small healthy chestnut trees from the state nursery at Rainbow. These were set out among the diseased trees late last spring. In a recent letter Mr. Stevens states that these trees as yet show no sign of the fungus, and are all living except a few that died when set out. He also writes regarding sprouts showing the disease: "All the sprouts from the cut of 1906 were very badly infected, in fact, seventy-five per cent. of the season's sprouts on our place and elsewhere in the near vicinity are a total loss, but I have not found a single sprout of the cutting of the winter of 1907 that shows the least infection, although I have spent considerable time looking over the woodlands in our section of the state." This condition might be explained by the fact that the drought of 1907 was unusually hard on the sprout growth of that year, or possibly by the fact that the sprouts of 1908 have had only one season yet for infection, as compared with two for the others.

At Danbury the writer did not get into the worst infected woods, but the few diseased trees examined showed chiefly small, reddish-brown cankered spots on the smooth greenish bark, much like what winter injury will produce on pear and other fruit trees, and which Sorauer attributes to winter injury on various trees in Europe. These cankered spots usually had no fungous growth on them, and frequently were split through the center, but in some few cases the injury seemed to have been grown over. In one specimen brought back, that at the time was taken for the Diaporthe fungus, it was found on closer examination to be a species of Discomycetes, a species of Dermatea, as determined by E. J. Durand. The impression gained here was that these cankered spots might have resulted from winter injury, as they were most frequently found on the southwest side.

Mr. Hawes, in his recent forest survey of Fairfield County, had his assistants, Messrs. Moon and Hodgson, make notes in each town on the prevalence of the chestnut disease. I am indebted to Mr. Hawes for the following notes taken from their reports: "As I" (F. F. Moon) "came eastward from Stamford, where the effects were the worst, the number of infected trees decreased and the size and age as well. In the last three towns (Fairfield, Bridgeport, and Stratford) the infected trees seem to be almost wholly young sprouts along the road, while chestnut sprouts in the center of the stand seem to be free from the fungous disease." The record for the different towns in Fairfield County is as follows:

Bethel. "Disease spread over whole town and in a good many cases has done a good deal of damage."

Bridgeport. "A few cases of disease in open grown trees along road."

Brookfield. "Disease is scattered over town here and there, but not doing as much damage as further west."

Danbury. "The chestnut bark disease has spread from New York State into this town, all through its woodlands, and into adjoining towns. The affected trees are more numerous near the New York line, but they are in good numbers throughout the town. Upon examining a good many trees I find that most of the diseased branches and trees are discovered at a point near a wound, scar, or crack. In the crotch of two limbs which have slightly cracked apart seems to be a favorable place for the fungus to enter."

Darien. "The disease has its victims, but not over ten per cent. show the red branch of distress, and very few are killed."

Easton. "Disease scattered lightly over most of the town."

Fairfield. "Only small per cent. of trees infected with chestnut bark disease."

Greenwich. "Disease has infected fully forty per cent. of the trees, but has not killed many in the town. Most of the trees have one or two branches affected, but as far as any serious injury is concerned it does not seem anywhere nearly so grave as in Stamford."

Huntington. "No chestnut bark disease reported."

Monroe. "Town at present is not badly infested by the disease except in south central portion, where there are a few very badly damaged sprout stands."

New Canaan. "Disease found here, but not over ten to fifteen per cent. of the trees are infected, and these only slightly, not many dead trees being seen."

New Fairfield. "A few chestnuts along western boundary are affected with the disease."

Newtown. "Bark disease has appeared only on scattered trees along western boundary. It is quite certain that the town will be infected badly with it next year if the present rate of spreading continues."

Norwalk. "Disease is found here, but not to such a great extent as further down the coast. It seems to diminish as one comes eastward. From ten to fifteen per cent. of trees infected. Few have been cut."

Redding. "Disease is spread over whole town, but is not so bad in eastern part."

Ridgefield. "Disease has spread over entire town, and in some cases the trees are infected quite badly, though only a few trees killed."

Sherman. "Chestnut bark disease appearing in western part of township."

Stamford. "Estimated that fifty to sixty per cent. of all chestnut trees in township are infected by chestnut bark disease, and probably five per cent. killed. Conditions especially bad in northern part of town."

Stratford. "No signs of any disease barring a few cases of Diaporthe, which seem to occur chiefly on roadside trees."

Trumbull. "Chestnut bark disease has not as yet done much damage. Only a few scattered trees noticed that were attacked by it."

Westport. "Trees infected by chestnut bark disease estimated at five to ten per cent."

Weston. "Chestnut bark disease is generally distributed over town."

Wilton. "The disease is found here but not so much of it as in Stamford. Not over fifteen per cent. of the trees infected, and not over two or three per cent. killed."

The fungous agent. Whether or not the fungus always develops its fruiting stage in the cankers the first year, I cannot state. If it does not, then this fungus, rather than winter injury, might explain the numerous cankers seen without any fruiting pustules whatever. On some, however, the small fruiting cushions or pustules, much like lenticels in appearance at first, are to be found developing during the summer, but apparently not before September does their spore stage appear to any extent. At first these pustules are light orange-brown, but by winter become dark chestnut-brown. They are composed of fungous threads and plant cells. The fungus has two spore stages, both of which develop in these pustules.

The Cytospora spore stage appears usually during the fall, and can be found more or less abundant until late spring. In cavities which appear in these pustules, certain slender fungous threads produce on their extremities very minute oblong spores in great abundance. These ooze to the surface, under moist conditions, as minute tendrils or globules. One can easily see that because of their enormous production, they would, when washed by rains over the tree, soon infect it badly, if entrance was readily gained; or if carried by insects, birds, or the wind to other trees, how the disease would rapidly spread.

Usually, along the latter part of December, the second or winter spore stage reaches its maturity. These spores are formed in special small spherical receptacles, to be made out with a hand lens, something like light-colored insect eggs, down in the tissue at the base of the pustule and around its margin. These spore receptacles open to the exterior by long slender necks that run from the receptacle through the pustule. These necks can be seen as small black specks on the surface, or in cross section of the pustule when in their prime. The receptacles are filled with spore sacs (or asci), and each sac has eight oval to oblong spores arranged within it, usually in a single row. These spores are hyaline, and are divided at the center (often slightly constricted there) by a cross wall into two cells. These spores are also shed out of the cushions during the late winter and early spring, so that finally the pustules gradually disappear, leaving small cavities in the bark.

With care, artificial cultures of the fungus can be obtained by taking tissue from the inside of cankers in the early stage of their development. Such cultures of the fungus on Lima bean agar at first show a growth of whitish threads, but with the development of the spore stage the growth gradually changes to a bright orange. The threads form a rather hard crust on the surface of the medium, and in this the Cytospora fruiting stage develops as numerous small elevations. The spores, after maturity, ooze out on the pustules as lemon-yellow drops, which

later become light chestnut-brown in color. The asco-stage did not develop, and I believe Murrill has not obtained it in his cultures on various other media.

The writer has made no infection experiments. Murrill, however, found the fungus (in his inoculation tests) to be a wound parasite, but after it once gained entrance it killed the invaded tissues and eventually the young inoculated trees.

Relation to weather. From the preceding account one can readily see that the writer believes that the fungus alone is not entirely responsible for the havoc that has been wrought to the chestnut trees during the past few years. Winter injury in 1903-04, aggravated by the droughts, especially that of 1907, we believe to have been important factors in handicapping the trees so that the way was opened for further serious injury by the fungus. An account of the unusual weather conditions that have prevailed here since 1902 is given in the article relating to peach yellows and so-called yellows. We hold that these winter and drought injuries have affected chestnut trees as follows:

(1) Probably in some cases trees died outright from winter killing of the roots. In such cases no sprout growth would result.

(2) Serious injury occurred to the sapwood, changing it prematurely into heartwood, and thereby greatly reducing the capacity for carrying water to the leaves. Some sprouts, due to the droughts, now show only two annual rings of normal white wood, but most of them four or five, with a sharp demarcation between the white and colored wood indicating possible winter injury in 1903-04.

(3) Numerous cankered areas show in the smooth bark (often without any fruiting stage of the fungus on these sprouts), and in such cases these are chiefly on the south or southwest side of the trunk. These cankers often crack open, offering ready entrance for the fungus. Sometimes they heal over, or are not deep enough to cause subsequent injury.

(4) Numerous branches and twigs have been winter killed on otherwise healthy trees.

(5) Injury probably occurred to the fibrous rootlets from the droughts, especially on rocky knolls and hills, in 1907.

We give below briefly our reasons for believing that weather conditions are partially responsible for the chestnut disease.

(1) The chestnut disease was first noticed soon after the winter of 1903-04. Its appearance was sudden and widespread, and winter injuries rather than fungous troubles show up in this way. Since its appearance possibly it has spread further, but this may be more apparent than real, since discussion of the disease has caused persons to look for it in places where it was not looked for before.

(2) This trouble has gone over areas with greater total destructiveness than any purely fungous disease, especially of trees, that we have ever seen or heard of, and our experience has not been a limited one. We have known of winter injuries in peach orchards, however, just as severe, and both of these trees are here near their northern limit.

(3) The nature of the fungus is not such as to place it among the virulent parasitic forms. Murrill found it a wound parasite, and wound parasites are rarely, if ever, so aggressive as to totally destroy their hosts. We have seen cankers in apple trees produced, without doubt, by winter injury in 1903-04, very similar to the cankers of chestnut. On some of these cankers we found a Cytospora fungus which at first we thought might have caused them. We have also found Cytospora fungi on twigs of other trees killed by winter injury. The genus Diaporthe is made up almost entirely of saprophytic species, some of which occur on chestnut. We are not yet sure that *Diaporthe parasitica* has not been collected before under some other name. Professor Farlow calls our attention to the fact that it comes more naturally under the genus Endothia, and is closely related to *E. gyrosa.* In deThümen's Myc. Uni. No. 769 is a specimen under this name on *Castanea vesca* collected by Saccardo in Italy in 1876, whose Cytospora stage (the only stage showing in our specimen) seems quite like that of our chestnut fungus. Rehm (Ann. Myc. 5: 210. 1907) has placed *D. parasitica* under the genus Valsonectria.

(4) The distribution of the injury shows that the vicinity of New York City was the center of the trouble, which gradually lessens in severity as we go away from there and the Sound, except perhaps, as it heads up the Hudson and Housatonic Rivers. Now this means either that the disease is spreading from this center, or that this region, due to soil or atmospheric conditions, sustained severer injury to the chestnuts during the severe winter of 1903-04. If due to the former, why, in so distant a locality as Woodbridge, New Haven County, where the disease has been known for four or five years (as long as in New York) has not the disease spread to the old chestnut trees and worked similar havoc?

(5) While of the forest trees the chestnut has suffered far more than others, especially in the regions indicated, yet in both Massachusetts and Connecticut during the past few years Dr. Stone, of the Amherst Experiment Station, and the writer, have had called to their attention numerous cases of trees killed or injured, as we believe, by the unfavorable weather conditions since 1902. Dr. Stone, in a recent letter, says: "All through this region the winter of 1903-04 caused a great deal of injury to a large number of trees. The red maples have been dying by the hundreds here, due to root killing, and I have seen a great many oaks and large elms four or five feet in diameter injured at that time, although their death may not occur until three or four years afterward. It is interesting to note, in the diagnosis of trees, of which I do a great deal, that the injury can be traced backwards four or five years."

The writer has frequently called attention in his previous reports (Repts. 1903, pp. 280, 303, 324, 328, 341, 351; 1904, pp. 312, 323, 326, 327; 1906, pp. 310, 317, 320; 1907, pp. 353, 360) to winter injuries of apple, grape, Koelreuteria, peach, privet, white pine, raspberry, and sycamore. In a number of cases these troubles were afterwards complicated with fungous growths that to those unacquainted with the conditions would lead them to believe the fungus the only cause of the trouble. The past year we have also seen numerous red maples, as mentioned by Stone, that seemed to be dying from the effects of winter and drought injuries. We do not include the elm here because it is difficult to determine whether or not the elm leaf beetle has been entirely responsible for the death of many of these trees which have died in recent years.

(6) As we showed in a previous article, chestnuts have been subject to severe injuries of unknown cause in the past, and have not been annihilated thereby. The cause of their dying was not made evident at the time.

Future outlook. If the chestnut disease is due alone to the Diaporthe fungus, as Murrill and others now believe, then it seems quite likely that Metcalf is correct in his statement that unless something intervenes, it means the destruction of all the chestnuts in the Atlantic States. But both Murrill and Metcalf are puzzled to explain the sudden and devastating attack of the fungus. The latter has suggested that possibly the fungus is an importation from Japan, and that, while it is comparatively harmless to the Japanese species, on our native species it found a host upon which it developed with unusual virulence. Murrill, however, has shown the writer a Japanese chestnut upon which the disease was as aggressive as on the native species. He thinks that the fungus is a native species that has by some means acquired unusual virulence. To the writer neither of these theories explains the situation so well as the winter-drought explanation, which is not entirely theoretical, at least.

It means much to the Connecticut owners of forest land whether or not this disease is due alone to the fungus or is due in part to seasonal injuries. In the former case they may expect that they are just beginning to see the results of a devastating agent. In the latter case, the writer believes that the trouble is now probably about at the height of its development, so that not much additional harm may be expected, especially if the following summer or two prove reasonably moist and the winters are normal. No efficacious treatment for the prevention of the trouble has yet been found, though spraying, pruning and burning of infected trees have been advocated.

IV. ARTIFICIAL CULTURES OF PHYTOPHTHORA, WITH SPECIAL REFERENCE TO OOSPORES.

General Consideration.

Previous work. The downy mildews (Peronosporales) have not, to the writer's knowledge, been grown in pure artificial cultures, with the exception of the genus Phytophthora. Matruchot and Molliard of France (Bull. Soc. Myc. Fr. **16**: 209-10. 1900. Ann Myc. **1**: 540-3. 1903) were the first to grow the potato blight fungus, *Phytophthora infestans,* in such cultures, and the writer (Ann. Rept. Conn. Exp. Station, **1905**: 317-21) was the first one in this country to report somewhat similar results. Jones and Giddings of Vermont (Science **29**: 271. F. 1909) have also in recent years been working along this line. J. van Breda de Haan (Mededeel. Uit's Lands. Plantentuim XV. 1896), according to Matruchot and Molliard, has made cultures of the mildew of tobacco, *Phytophthora Nicotianae,* but the writer has not seen this publication. The writer (*loc. cit.* p. 296), at the same time with his work on the potato mildew, also gave the results of artificial cultures of the Lima bean mildew, *Phytophthora Phaseoli.* These references apparently include most of the work that has been done along this line.

This method of attack admits of a more thorough study of the life history of these mildews. All of these fungi are supposed to possess two spore stages in their life cycle, one asexual spores, conidia, and the other sexual spores, called oogonia. The oogonia, however, are not usually produced very abundantly or frequently, and so are rarely found. In fact, for some of the species they have never been discovered. This has been the case with the potato mildew; and unfortunately the artificial cultures did not throw any further light on this stage, as none of the investigators obtained them. With the Lima bean, however, the writer, in his first investigations, obtained these spores somewhat in moderation in the artificial cultures. They had only recently been found in nature.

The results of the writer in obtaining the oospores of the Lima bean mildew in artificial cultures, but not those of the potato, together with other considerations, led him to advance the theory that with this group of fungi there might exist distinct sexual strains of mycelia. In this case it would be necessary to have both strains of mycelia present for the formation of the oospores. A somewhat similar condition had been recently found for certain species of the related group of Mucorales, by Blakeslee. In our work at that time this phase of the subject was tried to a limited extent with the few cultures on hand, but nothing very definite was determined.

In our previous cultural work the media found most successful for growing these fungi were living plugs of potato, cut by aseptic methods and placed on moist cotton in a sterilized test tube; living Lima beans, taken from unbroken pods in the same way; corn meal, mixed with water or various juices, etc.; and potato, or pumpkin juice, agar. While the fungi grew on these media, there were certain drawbacks for each that made it rather difficult to obtain pure cultures that were easily renewed and made vigorous growths.

Present work. Last fall we had opportunity to obtain further cultures of both the potato and the Lima bean mildews, and their investigation was again taken up with two points chiefly in view; viz., 1st, to obtain a perfectly satisfactory medium for their artificial culture, and 2d, to determine if they possess mycelia of distinct sexual strains. As another mildew, *Phytophthora Thalictri,* on Thalictrum, including its oospores, was found here, some attention was paid to this in the hope that it might throw some light on the latter problem. In fact, we have had for consideration all of the species of Phytophthora that are known to occur in the United States.

Altogether over a thousand cultures of the potato and Lima bean mildews have been made on various media. The general results are given under the following accounts of the fungi. By far the most satisfactory medium, however, is that described under Lima bean juice agar. With this medium one can grow either of these fungi, but especially the Lima bean mildew, almost as easily as any saprophytic fungus. They make a progressive growth on this medium which often covers the whole surface. With the Lima bean mildew this growth retains its vitality for some months, so that cultures are readily renewed at any time. With the potato mildew the mycelium does not live so long; so the cultures have to be renewed more frequently, every three or four weeks, and more care is needed in its renewal.

As regards the sexual mycelia theory, we have worked from two points of attack. Our chief efforts have been with the downy mildew of the Lima bean, to lose the oospores. We have tried to accomplish this by Petrie dish separation cultures of the conidia, and by the use of very minute fragments of the mycelium from the edge of the cultures. We have not succeeded in a single instance in permanently doing away with the oospores by either of these methods, and in some cases we have tried both on the culture in hand. With unfavorable media one can temporarily prevent the formation of oospores, but these always readily develop when the transfer is made to a medium favorable for their growth. With the potato mildew, we have tried to produce the oospores by crossing the fungus with cultures from different sources. While we have had the fungus from only a few different localities, none of the crosses between these have given any indication of oospore formation. These results have thrown very considerable doubt upon the theory of sexual mycelia.

With the discovery of the oospores in both *P. Phaseoli* and *P. Thalictri,* their continued absence in *P. infestans,* especially when the theory of sexual mycelia does not seem to throw light on the subject, becomes a matter of still greater interest. In our previous report (p. 323) we gave some of the theories that have been advanced to explain their absence, of which one was that this species had lost the power to produce such bodies. Both Jones and the writer have found, under certain conditions, bodies in the cultures that possibly may indicate imperfect attempts on the part of the fungus to produce these spores. It is barely possible, with the continued renewal of the potato by the asexual method of propagating it by the tubers that the fungus has likewise been continually renewed asexually by its mycelium in these, and that both (the potato its seeds, and the fungus its oospores) have thus lost, at least largely, the power to reproduce themselves sexually. In this case one would probably find the oospores only where the fungus developed on the wild species of Solanum in its native habitat.

Phytophthora Thalictri Wilson & Davis.

Distribution. This species was first described by Wilson (Bull. Torr. Bot. Club **34**: 392. 1907) from specimens collected by Davis in June, 1907, on *Thalictrum purpurascens*, in Kenosha Co., Wisconsin. Dr. Davis informs the writer that he has since collected the fungus there and in another locality in the same state. On October 2, 1908, at Centerville, and again on October 10, at Westville, the writer found this species on *Thalictrum polygamum* in Connecticut. These collections are apparently the only ones that have yet been made, but from its occurrence in both Wisconsin and Connecticut it seems very likely that careful search will reveal its presence in at least the intervening states.

Life history. Davis did not find the oospores, so Wilson described only the conidial stage. The mycelium causes black spots on the leaves, practically like those of *P. infestans* on the potato leaves. The conidiophores are produced only sparingly on the under surface of the leaves. The most important of the minor differences which Wilson gives as distinguishing this mildew from that of the potato are the shorter and more slender conidiophores (300-400 x 5-7μ, with one or two branches), and slighter smaller and more elongated conidia (20-27 x 13-17μ). The writer found the conidiophores varying from 250-500μ, and with one to three branches, each bearing one to three conidial swellings.

The writer was fortunate in finding a few of the oospores which as yet had not been described. These were formed only rarely and in moderation in a few of the leaves found at the very end of the season. Their presence in the tissue could be determined only upon careful search with a microscope after boiling the leaf tissue in caustic potash and mashing it apart. Those seen by the writer did not differ very materially from the oospores of *P. Phaseoli*, so that we may expect those of *P. infestans*, when found, to be of similar character.

The oospores were not in all cases mature, but they seemed to have an oogonial wall somewhat more deeply tinted than those of *P. Phaseoli*. So far as could be determined, the antheridia and oogonia were developed from different mycelial threads. The oogonia are chiefly subspherical, with moderately thin, reddish-brown tinted walls, loosely enveloping the oospore, and 25-33μ in diameter. The oospores are spherical, hyaline or slightly yellowish tinted, with medium thick and smooth wall (3-4μ) and vary from 18.5 to 25μ in diameter.

As the Thalictrum does not have any thickened tissues within which the mycelium penetrates, having so far been found only in the leaves, it was impossible to obtain artificial cultures of this fungus after the manner employed with the other two species.

Infection experiments. Since *P. Thalictri* resembles *P. infestans* so closely, the writer has thought that possibly they might not be distinct species. Worthington G. Smith (Diseases of Field and Garden Crops, p. 275-6) gives a list of different hosts of *P. infestans* which include even two Scrophulariaceae. Our specimens were found only at the end of a very dry season, and were not in very good shape for inoculation tests. At that time there were no living plants of potato available for experimentation. Tests of the spores on the cut surface of a potato and on leaves of a young greenhouse tomato failed to give any results. Some of the infected specimens of Thalictrum were taken up and placed in a moist atmosphere in the greenhouse, but the disease did not develop much further. The past spring, on some of the check plants of Thalictrum, developed prematurely in the greenhouse, the writer failed to produce infection with spores from artificial cultures of *P. infestans*, though these succeeded on the potato. While these experiments were perhaps not extended enough to speak positively, still they at least indicate that these fungi are distinct strains, if not distinct species.

Phytophthora infestans (Mont.) DeBy.

Life history. This phase of the subject, especially with reference to the conidial stage, has been so thoroughly presented by DeBary and others that we will not enter particularly upon it here. Some idea of the character of the conidial stage may be obtained from the photomicrographs shown in Plate LXXI. In our former article (p. 304) we made some observations upon the manner of primary infection in potato fields, which were somewhat different from the views formerly held. Such observations as we have been able to make since are still in favor of this view. If it could be proven that oospores develop in the decaying seed-tubers, this would further strengthen it. But so far we have never been able to positively identify oospores in the tubers under any conditions, though one often runs across suspicious looking bodies in some of the tubers in the last stages of their dry decay.

Upon its host in nature this fungus confines its mycelium largely to the intercellular spaces of the tissues. This necessitates special branches, or haustoria, for penetration into the cells for the food supply. The haustoria are lacking in the artificial cultures on agar medium. The mycelium in cultures on living potato plugs, while invading superficial tissues and cells, does not penetrate very deeply or set up a special decay. This certainly suggests that in nature much of the soft rot following attack of the tubers is due to bacterial action. Often this latter becomes so bad as to crowd out the original invader. The haustoria often seem to develop further in storage tubers, or at least their walls become thickened. This thickening possibly may be due to an envelope of the plant cellulose. When one sees two of these knobbed, thickened haustoria within a cell bending towards each other as if about to conjugate, the impression is gained that this may be the first step toward the formation of oospores. But, though we have examined these haustoria carefully, even after the infected tubers were planted, we have never seen any further development along this line.

Smith (*loc. cit.* p. 295) claimed to have discovered the oospores of the potato fungus. We have tried to obtain specimens of these from him and others, but have not succeeded. Smith wrote us in 1906: "No doubt you know that the oospores became a kind of political subject—oospores of *P. infestans* or not oospores of *P. infestans?;* and I had no wish to go on. Botanists and popular writers followed what they took to be the safer authority, just as Saccardo has done; this is right enough in a way." Massee thinks that Smith's oospores were the chlamydospores of a Fusarium, as he writes me: "I have very carefully examined W. G. Smith's type slide preparation, and am positively certain that the so-called oospores are nothing more that the globose, thick-walled chlamydospores belonging to a Fusarium." From a study of Smith's drawings and an experience with the flora and fauna of decaying potatoes the writer is led to the conclusion that he did not find the oospores of *P. infestans;* or that, if he did, he also got other things mixed up with them. Our studies with the oospores of *P. Phaseoli* and *P. Thalictri* would also indicate that those described by him for *P. infestans* were too

different to be such. Since his time others, as Smorawski, have described what they called immature oospores, but the general belief to-day is that these bodies have not been found.

Our culture work has thrown very little light on this subject. In some few of the earlier cultures we found occasional bodies that looked something like an attempt at oospore formation. Jones recently (*loc. cit.*) has further studied these bodies, and has succeeded in producing them in considerable numbers in a special potato juice gelatine medium. Our impression of those seen in our own cultures has been that they might be unusual mycelial branches produced under unfavorable conditions (presence of certain bacteria, etc.); and from what we have seen of Jones' cultures and slides, they resemble chlamydospores as much as oogonia. In our experience with the oospores of *P. Phaseoli* the oogonia were developed after rather than before the antheridia, and in Jones' cultures we saw no signs of antheridia. It is possible, however, if there really are sexual mycelia, that this was an attempt of the female strain to produce the oogonia; or, on the other hand, if this species has lost the power of producing oospores, such cultures might indicate strains in which this process had not entirely disappeared.

Cultural methods. In our previous report we described the method by which cultures are obtained from the mycelium of infected tubers by taking out this tissue by aseptic methods and inserting it on cultural media. The chief precautions which have to be observed are the use of tubers in which the infection is in its first stages and so has merely tinted the superficial tissue reddish-brown without any soft rot; also the sterilized knife used to take out the infected tissues should be allowed to cool so that the cut surface is not seared. It is best not to have liquid in the bottom of the agar culture, or if so, to insert the tissue above this, as the water may spread bacteria that may be included, and so spoil the culture. Out of such cultures, at least some with pure growths, or growths that permit of pure transfers, can be obtained.

The potato mildew forms its growth more in the air and less embedded in the medium than the Lima bean mildew. Likewise the mycelium loses its contents quicker, and so renewal from old cultures is often unsuccessful. A series of cultures on Lima bean juice agar, varying from 44 to 64 days old, failed to grow;

others, from 21 to 34 days old, grew readily, and even in one case a culture 54 days old grew. It is best, however, to renew the cultures on this medium at least once every month. The mycelium in the air easily collapses, so that care has to be taken in making transfers; especially should the needle be completely cooled off before inserting. Both aerial and embedded material should be taken, preferably with a sharpened platinum wire, in these transfers.

Media. Of all the media tried the Lima bean juice agar gave by far the best results. The fungus on this, if properly started, formed a luxuriant growth in the air (see Plate LXX a) and usually a progressive growth, covering the surface of the agar. This medium likewise proved best for the Lima bean mildew, and as that mildew formed oospores unusually abundantly in it, it was thought that the potato mildew might make some effort in this direction, but there was no more indication of these bodies in this medium than in those in which the potato mildew grew poorly. The following notes give the result with the potato mildew on the various media tried.

Lima bean juice agar (50 + 10 + 500). While the fungus grew readily on both the weak Lima and white bean agars (made from sliced beans and so not as nutritious as when ground), on the whole, the strong Lima bean agar, as given below, was the most satisfactory. It makes on this a luxuriant aerial growth of mycelium and conidiophores, that tends to cover the surface eventually. Conidia were produced in abundance, but no oospores or peculiar swollen mycelial branches. One or two drops of lactic acid added to it usually prevented the development of the fungus. See illustration in Plate LXX b A-B.

As this medium has proved by far the most satisfactory for this mildew and that of the Lima bean, as well as for certain other fungi, we give our method of making it. We used a 50 + 10 + 500 formula; that is, 50 grms. of dried ground Lima beans, 10 grms. of agar-agar and 500 cc. of water. The beans are ground as fine as possible with a fruit grinder, and then 50 grms. soaked one-half hour in tepid water (use as much water as necessary, but of course not to exceed 500 cc. finally) and then simmered slightly for another half-hour. Strain off liquid through fine wire strainer, add agar-agar (better dissolved in small amount of water) and water necessary to make 500 cc. of medium; heat long enough to thoroughly mix agar-agar and strain again through wire and fine cheese cloth into test tubes.

Corn meal juice agar (50 + 10 + 500). This proved a far more satisfactory medium, as regards aerial growth, for this than for the Lima bean mildew. In general, it gave results about like those with potato juice agar; that is, a pure white, aerial growth around place of inoculation, but not generally progressive. There were no oospores, peculiar chlamydospore-like bodies, or unusual swellings of the mycelium. See Plate LXX b C.

Potato juice agar (150* + 10 + 500). This gives a localized but evident aerial growth, one-half to one inch in diameter around inoculation. Similar growths on pumpkin juice agar (see Plate XXV c, Report 1905) were obtained in 1905. Mycelium same as with corn meal agar. See Plate LXX b D.

Lima bean phaseolin agar; Nucleic acid peptone sugar agar; Phaseolin Pot. Phos. agar; sugar peptone water (see Lima bean mildew cultures) all proved unsatisfactory, as little or no growth resulted.

Lima bean juice gelatin (50 + 50 + 500). Not extensively tried, but apparently about the same, or a little better, than next.

Potato juice gelatin (150 + 50 + 500). Very poor medium, especially for aerial growth. In specially prepared potato juice gelatin in stab cultures, Jones succeeded with certain strains in getting the peculiar chlamydospore-like bodies (or immature oogonia?) spoken of earlier. In our cultures these did not appear as with him, though certain branches did produce unusual swellings that had a bacterial-like deposit around them.

Living plugs of potato, etc. As reported in 1905, living plugs of potato and of pumpkin, especially the former, offer a good medium for a (usually sparse) conidial growth of the fungus. These plugs should be on moist cotton. The growth does not cause any soft decay, though the superficial tissues often turn reddish-brown. The mycelium does not penetrate very deeply, but sometimes invades the cells. The haustoria are not formed so frequently as in nature. Jones found considerable difference in the growth on different varieties. This probably affords a means for testing resistance of varieties, but I am under the impression that those showing most resistance will prove to be undesirable varieties, as the less starchy, soggy ones. (See 1905 Report, Plate XXV a.)

Corn meal (moisten with water or potato juice). In my 1905 tests this proved the most satisfactory medium used, as when started it favored a luxuriant, progressive growth. The objection to it is that the corn meal dries out so that it is difficult to get cultures started, and the medium interferes somewhat with microscopic examination. (See 1905 Report, Plate XXV b.)

Cross cultures. In order to test the mycelial sexual strain theory, the writer has from time to time inoculated the above media with this mildew from different sources. The Lima bean juice agar affords by far the best one for such tests, as it allows progressive growths. The usual method has been to inoculate the bottom of the tube with a culture from one source and above this—one-half to one inch—with a culture from a second source. With the Petrie dish (see Plate LXX a) three or four inoculations can be made if extreme care is used against contamination. Such cross inoculations have been made with cultures obtained from tubers from several sources in Connecticut, and one each from Maine, Long Island, Vermont and Holland, the writer being indebted to Jones for cultures from the last two sources.

* Took 150 grms. peeled potato, thinly sliced, soaked in tepid water, and then simmered for half-hour, and used juice from this.

While these cultures have not been extended enough, perhaps, to speak positively, yet in none of them was there any indication of an unusual mycelial development or of the formation of oospores. We have noticed some difference in the vigor of these growths, as Plate LXX a shows, but this may be due to more material used in one inoculation than in another, or to the age of the cultures used, as a culture not frequently renewed tends to run out.

Hybrid? cultures. Blakeslee found that when certain distinct species of Mucoraceae were crossed with opposite strains there was an effort to form the sexual spores. As the Lima bean mildew cultures possessed both of these strains, if they exist, it was thought that cultures containing both *P. infestans* and *P. Phaseoli* might induce the former to make an attempt at oospore formation. Certain tubes, therefore, were inoculated with the Lima bean mildew below and the potato mildew above. Petrie dishes were also inoculated with the Lima bean mildew in the center and the potato mildew from several sources around this. Of course one would expect the Lima bean mildew to produce its oospores within the area covered by its own mycelium, but at the juncture of the area covered by the potato mildew one might look for attempted hybrid oospores if the same condition prevailed as with the mucors.

At first the writer was inclined to believe that such hybrid oospores did result. At the juncture of the cultures and within the area occupied by *P. infestans* occurred certain immature oogonia that were larger, somewhat thicker-walled, and of a darker reddish-brown tint than those produced by *P. Phaseoli* under ordinary conditions. One of these doubtful hybrid oogonia is shown in Plate LXXIV B. In all of these cultures there appeared in time mature oospores, more or less abundant, *around, in* and *under* the *P. infestans* colonies, but these were not different from the oospores of *P. Phaseoli.* Moreover, the renewal cultures made from the edge of the *P. infestans* colonies on the opposite side of the tube from the *P. Phaseoli* colony always gave what seemed to be pure growths of *P. Phaseoli.* These results apparently mean that the Lima bean mildew mycelium being more aggressive, penetrated into the potato mildew colony and, forming its oospores under somewhat unfavorable conditions (due to toxins in the medium produced by the growth of the former mildew), certain of these had been arrested or otherwise affected in their development, as sometimes occurs in unfavorable media. The potato mildew mycelium, being shorter lived, was entirely crowded out by the more aggressive Lima bean mildew when the renewals were made.

Phytophthora Phaseoli Thaxt.

Life history. In our previous report we gave rather complete details concerning the life history of this fungus. The general character of the mycelium, the conidia, and the conidiophores is shown by the photomicrographs of Plate LXXIII. Such information as has been gained during the present investigation has been chiefly concerning details in the development of the sexual spores. Due to improvement in cultural methods, we have been able to produce the oospores in great abundance in artificial cultures (see Plate LXXIV A). Usually it takes from six to ten days after the start of the culture before there are any very evident signs of these bodies, but with a favorable medium, such as strong Lima bean agar, they then develop very rapidly, so that practically full-grown oospores can be found in ten to fifteen days. If the culture gives a progressive growth, different stages may be found starting from the edge inward, the outermost growth, of course, being free from them. While the Lima bean juice agar gives by far the greatest development of oospores, it is not quite so favorable for their study, because of the usually abundant aerial growth, as corn meal juice agar. This latter medium gives a very scanty growth, there being practically no aerial development. The embedded threads are largely concerned in producing the oospores, which are very slowly developed, and in old cultures show all stages, most of them never reaching maturity.

The first step toward sexual reproduction seems to be the large, irregular swellings that develop in certain of the threads (see Plate LXXIV C). We have not been able to determine any fusion of the mycelial branches that proceeds or accompanies these swellings, but often they are more or less massed. Very frequently a terminal swelling develops a normal thread much like a germ-thread, into which the contents pass, and this may give rise to subsequent swellings. Such empty swellings in size and shape are often quite similar to the antheridia, and perhaps may be tentative antheridia that fail of full development because of lack of contact with tentative oogonial branches.

It is impossible in the majority of cases to determine whether the antheridium and the oogonium come from the same or from different mycelial branches. In quite a number of instances, however, we have been able to satisfy ourself that they originated on distinct branches (see Plate LXXIV J, K) and in some cases have traced these as independent for some distance. Of course such branches might originate finally from the same mycelium, but inasmuch as they remain independent as far as they can be traced, they admit of the possibility of distinct sexual mycelia. However, in a few cases (see Plate LXXIV H, I) we have seen them where they seemed to come from the same thread. Our results, in failing to permanently lose the oospores, would also indicate their final common origin.

In the development of the sexual stage, the antheridium is the first to appear, and is often apparently fully developed before there is much evidence of the oogonium (see Plates LXXIV E and LXXV A). Whether or not the peculiar swellings spoken of earlier develop into antheridia as a result of contact with certain other threads or swellings, it is difficult to determine, but it seems most probable (Plate LXXIV D). This potential oogonial thread, with or without a swelling, becomes attached to the base of the antheridium and grows up along its surface toward the apex. Very often it can be seen when it has only partially covered the length of the antheridium, as shown in Plate LXXV B. For a long time it was difficult to decide whether or not these threads did not actually penetrate the antheridium and grow through it, and we are not yet certain that this does not sometimes occur. Certainly the optical effect is frequently that of an internal thread with its apical wall very thin as compared with the side walls, as shown in Plate LXXV A, B. In time, however, the oogonial thread reaches the top of the antheridium, and curving around its apex, begins to swell into the oogonium (Plates LXXIV E and LXXV C), which by this time is usually cut off from its basal thread by a septum. The various stages of its enlargement are shown in Plate LXXIV F, G, H. After the full size is reached the contents begin to be differentiated, marking off the oosphere (Plate LXXIV G, H).

About this time fertilization by the antheridium usually takes place, but whether by means of a penetration tube or merely by a local opening where the walls of the two bodies are in contact, was not made out. If the oogonial thread really ever penetrates the antheridium, a union of certain of their protoplasmic contents no doubt takes place at that time.

After the demarcation of the oosphere by the thin wall, the subsequent evident change is in the gradual thickening of this wall until there is formed the fully developed oospore loosely enveloped by the oogonial sac (Plate LXXIV I-K). These oospores in cultures vary considerably in size (Plate LXXV D-G), and often there are a good many that never reach maturity. They are hyaline or slightly yellowish tinted. We have made no study of the cytological phenomena that accompany their formation, but the profusion with which they are developed in cultures should readily permit such study. We have not yet succeeded in germinating such spores, as they apparently require at least a winter's rest before this takes place.

Cultural methods. The Lima bean mildew may be obtained in cultures by care in selecting beans from pods recently attacked. It is usually best to use pods showing a fresh and comparatively slight growth that has barely penetrated into the interior, using the beans beneath that show little or no sign of attack to the naked eye. Such beans, if transferred by aseptic means to test tubes containing moist cotton, will in time give an aerial growth that is frequently uncontaminated by other fungi or even by bacteria. From these pure cultures on Lima bean juice agar can be secured.

In my previous work, the cultures finally ran out, after two or three months. This was because of contamination, and the use of poor media for growth. In my recent work, by getting pure cultures to start with, and the use of a favorable medium for growth, I have had no trouble of this kind. In fact, the mildew grows as readily (perhaps a little more slowly) as most saprophytic forms, and is easily renewed by transfers. In these renewals, the needle should be cooled after flaming, and then a quantity of the mycelium and agar should be dug out and embedded in the base of the new tube. By such means cultures have been kept growing for over seven months and there seems to be no reason why they cannot be continued indefinitely.

The mycelium of the Lima bean mildew lives in these cultures much longer than that of the potato mildew, probably because of a more embedded growth in the agar, due to the formation of oospores, and so the cultures are renewed much easier, and can be left without renewal for a longer time. A series of trials was made to determine how old a culture on Lima bean juice agar could be, and still retain its vitality. In the first test, ten cultures, varying from 28 to 43 days old, were used. These all grew readily. Renewals from the same cultures were made when they varied from 49 to 64 days old, again from these, when 65 to 95 days old, and still again, when 92 to 136 days old; and every one, except two spoiled by bacteria, made fine vigorous growth, with oospores in abundance. Renewals from cultures older than 136 days have not been tried, but presumably would be successful. As the oospores did not germinate, the renewed growth was made from the mycelium, since the conidia were probably too old for germination in most cases.

Media. As with the potato mildew, the strong Lima bean juice agar forms by far the best medium for the growth of the Lima bean mildew. Not only did the conidial stage develop a more or less luxuriant aerial growth, but oospores were formed usually in great luxuriance (see Plate LXXIV A), at the surface and slightly embedded in the agar. Usually there is no indication to the naked eye whether or not oospores are produced in the cultures, but in this medium with certain old cultures, after the aerial growth had collapsed or when formed less abundantly than usual, their presence in great abundance could be told by two or three reddish-brown bands showing somewhat faintly toward the outer, thinner part of the culture. These darker bands contained more oospores than the intervening lighter ones. In general, the oospores were produced more abundantly in the more nutritious media; also the presence of acid limited or prevented their formation. The details of the growth of the fungus in different media is given in the following notes.

Lima bean juice agar (50 + 10 + 500). While on this medium (Plate LXXII b B, C) the mildew formed a more or less vigorous aerial growth of mycelium and conidiospores, it was never quite so luxuriant as was the potato mildew. Oospores were always developed in abundance in the strong Lima bean agar, but were not so numerous in the weak Lima or white bean agar. A progressive growth of the fungus nearly always occurred on these media, often covering the surface. With the strong Lima bean agar, even when

it was apparently made up under about the same conditions, there was noticed considerable difference in the growth of the fungus on it. This was probably due to slight variations in the medium (differences in cooking, sterilizing, etc.) rather than to the fungus, as it showed most strongly in sets of tubes made at different times. This variation showed in greater or less luxuriance of aerial growth, and in greater or less luxuriance of oospore production, and especially in the banded appearance already spoken of. This latter usually occurred where less luxuriant aerial but progressive embedded growth took place above the base of the tube. A cultural medium made from fresh green Lima beans did not prove any more satisfactory than from the dried beans. The addition of one-half gram nucleic acid to weak Lima bean agar affected the growth somewhat unfavorably, often limiting it to a dense, white aerial development around the inoculation material. This was largely mycelium, as few conidia or conidiophores were formed, and oospore formation was almost, if not altogether, prohibited. One or two drops of lactic acid usually prevented any growth whatever. Powdered willow charcoal (one teaspoonful to 500 cc. of the medium) made a black background in striking contrast to the white aerial growth, but did not seem to affect particularly the development of the fungus. Cultures of the fungus grown on white bean juice agar failed to infect young white beans (always exempt in nature), though the young Lima beans inoculated at the same time were killed.

Corn meal juice agar (50 + 10 + 500). This gave practically no aerial growth, and but a slight embedded growth, that spread slowly for a short distance from the point of inoculation. The production of oospores took place, and because these showed in all stages (many failing entirely to develop further) and with no aerial growth to bother, such cultures were well adapted to the microscopical study of the sexual organs, merely by mashing small pieces of the medium under a cover glass. Plate LXXII b E.

Potato juice agar (150 + 10 + 500). The growth differed quite markedly from that of potato mildew on this medium, as there was no aerial development. The embedded growth was more evident than on the corn meal, and consisted of a rather matted development of mycelial threads, with very few conidiophores and conidia. Practically no oogonia were formed, and the few attempted did not produce oospores. The mycelium did not form irregular swellings so abundantly as usual, and so was more like that of *P. infestans.* Plate LXXII b D.

Sugar peptone agar (4 + 2 + 10 + 500). The fungus failed to grow, or made only a slight growth around the inserted material, but with one-half gram of nucleic acid added, it made a somewhat more evident growth at the point of inoculation. Very few conidia were formed, and practically no mature oogonia. Phaseolin Pot. Phos. agar (½ + ½ + 10 + 500) cultures practically failed to grow. Sugar peptone water (4 + 2 + 500) failed entirely to grow.

Lima bean juice gelatin (50 + 50 + 500). This is a poor medium, and usually only a slight aerial growth of mycelium and conidiophores with conidia takes place in surface cultures, and in stab cultures only a slight development of mycelium, with no chlamydospore-like bodies. No mature oospores occurred, and there were few attempts to start these, but the mycelium had more or less of the swellings. The walls of the imperfect oogonia were thicker and more strongly tinted than usual.

Potato juice gelatin (150 + 50 + 500). Similar to, but even poorer than the preceding, but with no sign of oospore production and mycelium even with few swellings. Surface of medium in time becomes darkened in color, due to oxidation, and the conidia, conidiophores and mycelium take on this tint somewhat. There was no development of the peculiar chlamydospore-like bodies found by Jones with the potato mildew in his special preparation of this medium.

Ground Lima beans (with just water enough to keep moist after sterilization). Used both green and dried beans, and also green beans with the pods ground with them, but the addition of the latter proved of no particular value. The fungus formed a rather luxuriant, fluffy, aerial growth, composed of mycelium and conidiophores. Some oospores formed in time in the tissues. On the whole, not so convenient a medium for study as the agar medium. Plate LXXII b A.

Living Lima beans. These were taken from the interior of unbroken pods by aseptic means, and placed in sterilized tubes on moist cotton, and then were inoculated. Or they were taken already inoculated from the infected pods. Sometimes an evident aerial growth of mycelium and conidiophores appeared on these, and sometimes, when the surface was unbroken, no external growth showed, though the seed coats were discolored by a reddish-brown dry rot. Oospores were formed more or less abundantly within the tissues.

Corn meal (with water enough to keep moist after sterilization). The fungus practically failed to grow in this medium. With our cultures in 1905, when it was mixed with ground Lima beans and pods, etc., growths were obtained. The drying out of this medium in itself often prevents growth starting, and corn meal certainly is not so favorable for this as for the potato mildew.

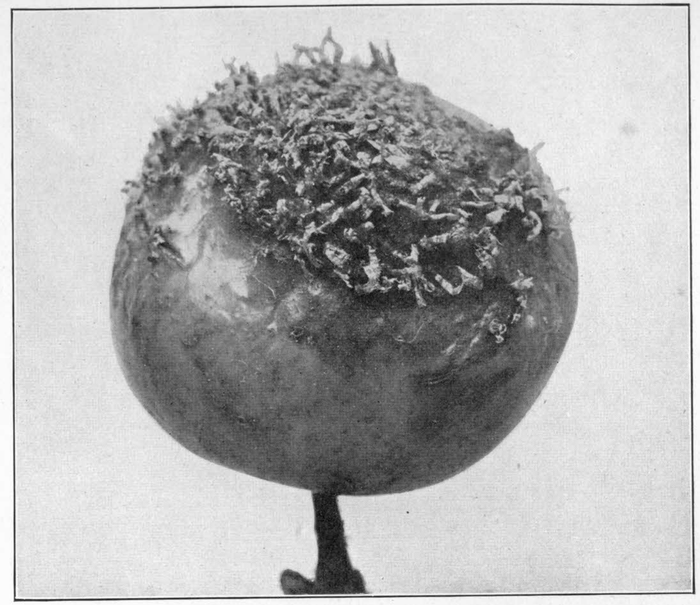
Attempts to lose oospores. Our cultures of this fungus obtained last fall were from seven infected beans from the Experiment Station grounds and a market garden at Westville. These cultures have been continued distinct ever since. Our idea in connection with the sexual strain theory had been that possibly by obtaining cultures of the fungus early in the season, certain ones might be run across in which oospore production did not take place owing to the presence of only a single strain. Last year the mildew did not appear on the Lima bean until the very end of the season, our first cultures being obtained September 29th. The cultures from these seven beans all produced oospores. In fact, they have continued to do so ever since, except when grown under unfavorable conditions.

It being settled that both strains were present, if such existed, the next attempts were to get rid of one by means of the Petrie dish separation method with the conidia. It was found by Van Tiegham cell tests with nutrient agar medium that these spores did not usually germinate very readily, and when they did it was by means of germ tubes that did not make a very extended growth. However, in the poured Petrie dishes from the melted Lima bean agar tubes, having the introduced mass of spore-

bearing mycelium shaken through them, it was found that usually numerous more or less isolated growths started up (see Plate LXXII a). These usually were so closely situated that they ran together, so that distinctly isolated colonies, presumably from a single spore, did not often occur after the first few days of growth. That these growths, at least sometimes, came from the germinating conidia rather than fragments of the mycelium, was shown on microscopic examination of the very young colonies. From the most isolated of these growths, and as early as possible, transfers were made to individual tubes. Petrie dish separation cultures were even made from these a second and a third time, but always with the result that the oospores eventually appeared if the medium used was a favorable one. In some cases where the medium was unfavorable, as potato juice agar, or where it was made acid, these oospores largely or entirely disappeared, but they always came back as abundantly as ever when transfers were made to strong Lima bean juice agar. These results are very strongly against the theory of distinct mycelial strains, the chief loophole being that the colonies were never from isolated spores, which seems quite improbable from the numerous transfers made from time to time.

The second method employed to get rid of the oospores was by means of transferring single isolated threads from the edge of the growth. This fungus does not afford a very good opportunity for such attempts. However, with the aid of a magnifier, one can sometimes get very small fragments from the mycelium that shows slightly embedded on the surface of the agar. Unless submerged hidden threads extended further than these visible ones, which seems improbable, it is certain that, in some of the numerous trials, fragments of a single thread were transferred. The results with these, however, were the same as with the ordinary renewals, namely, an abundance of oospores on the Lima bean juice agar.

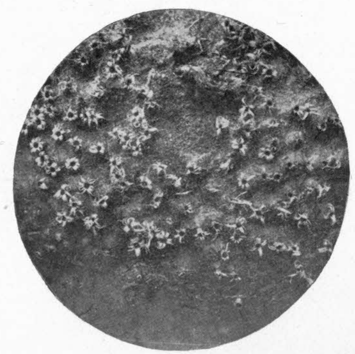
Apple, p. 853.



a. Showing peridia not split open. × 2.

Quince, p. 851.

Apple, p. 853.



b. Peridia split open. × 2.

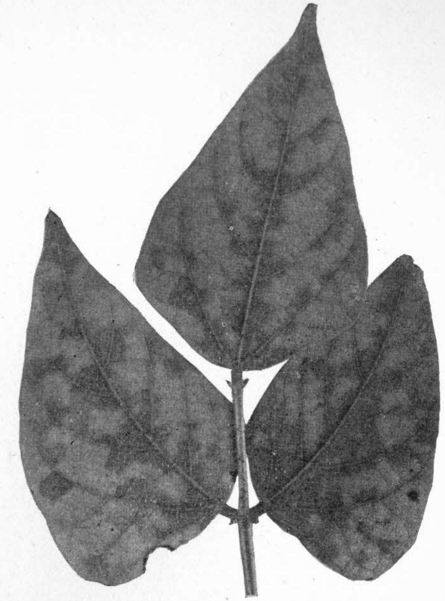
c. Peridia worn away.

RUSTS OF APPLE AND QUINCE.

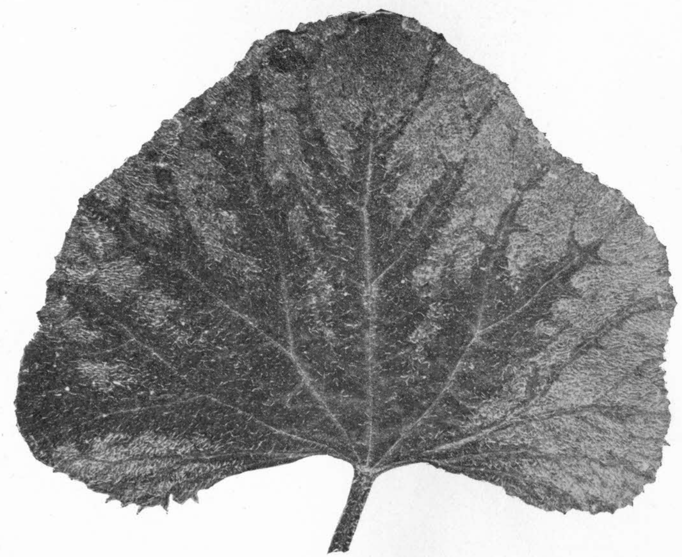
String Bean, p. 859.

a. Chlorosis (infectious ?).

Lima Bean, p. 859.



b. Chlorosis (non-infectious).

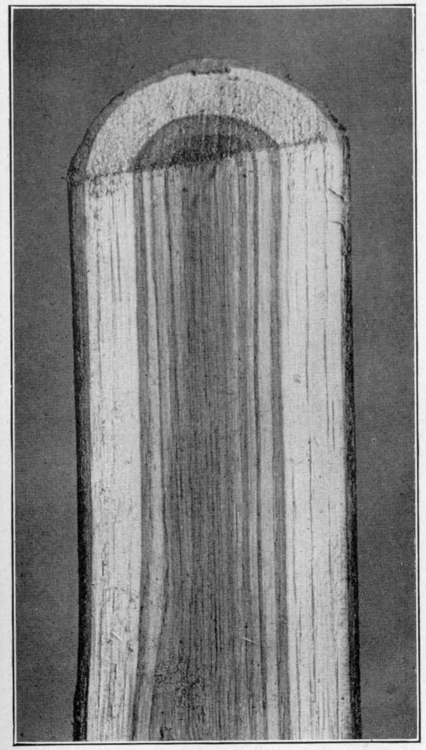


c. Chlorosis (infectious ?) of Musk Melon, p. 865.

CHLOROSIS TROUBLES OF BEANS AND MUSK MELON.

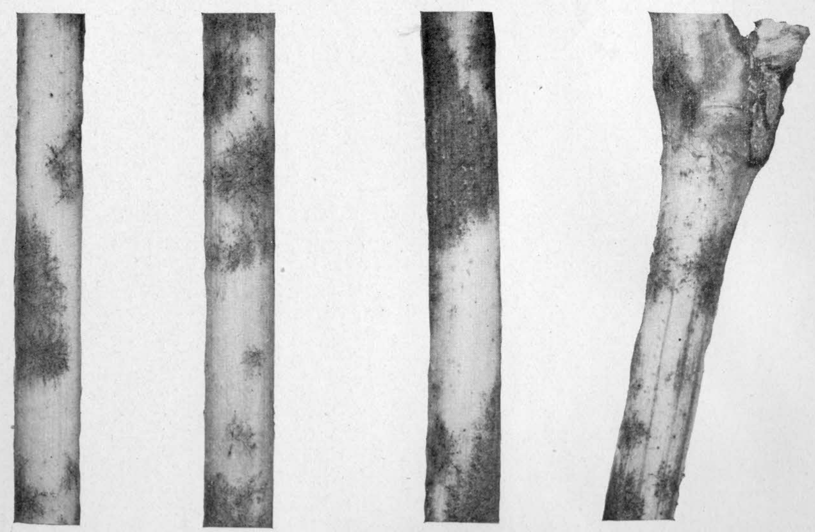
PLATE LXII.

Chestnut, p. 879.



a. Winter injury of wood ?

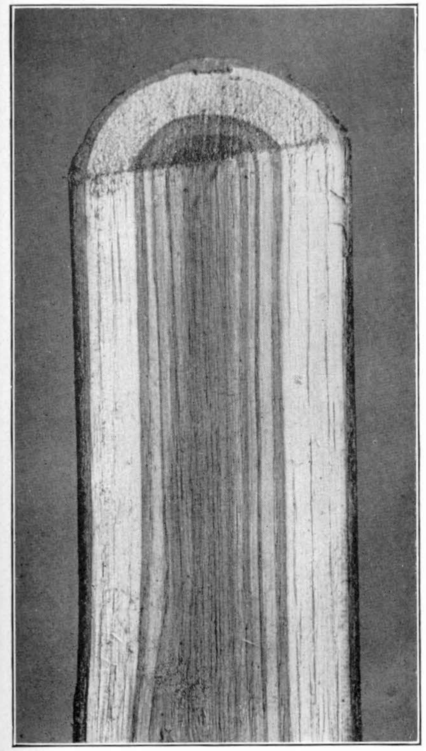
b. Diaporthe canker.



c. Powdery Mildew of Grape, p. 855. × 2.

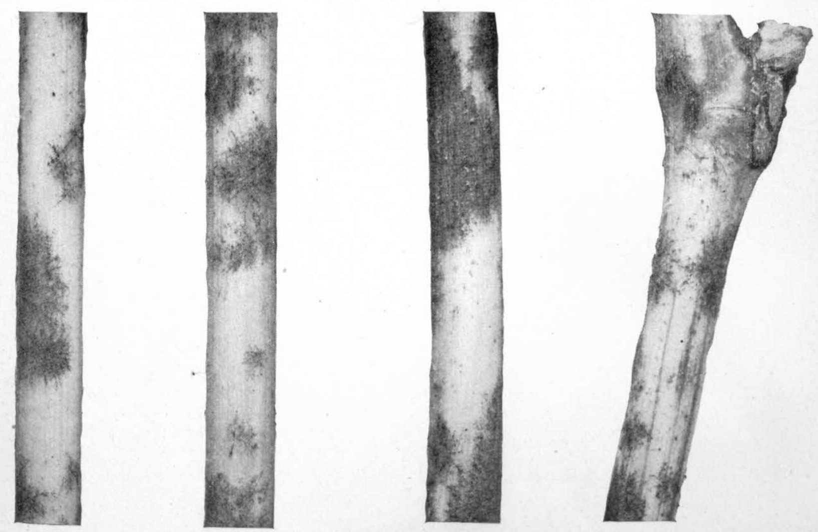
DISEASES OF CHESTNUT AND GRAPE.

Chestnut, p. 879.



a. Winter injury of wood ?

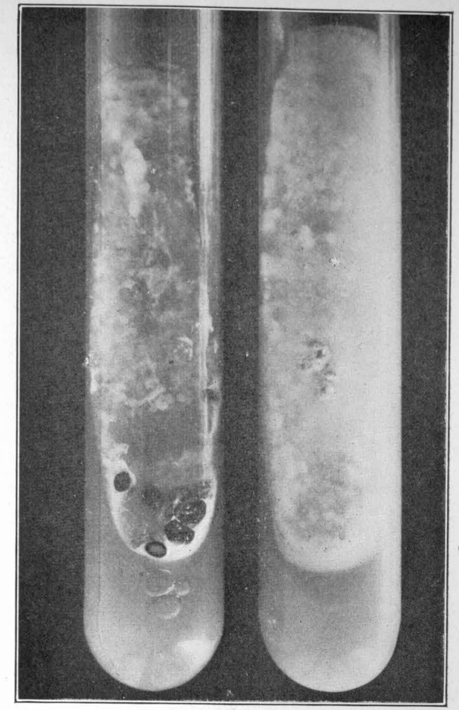
b. Diaporthe canker.



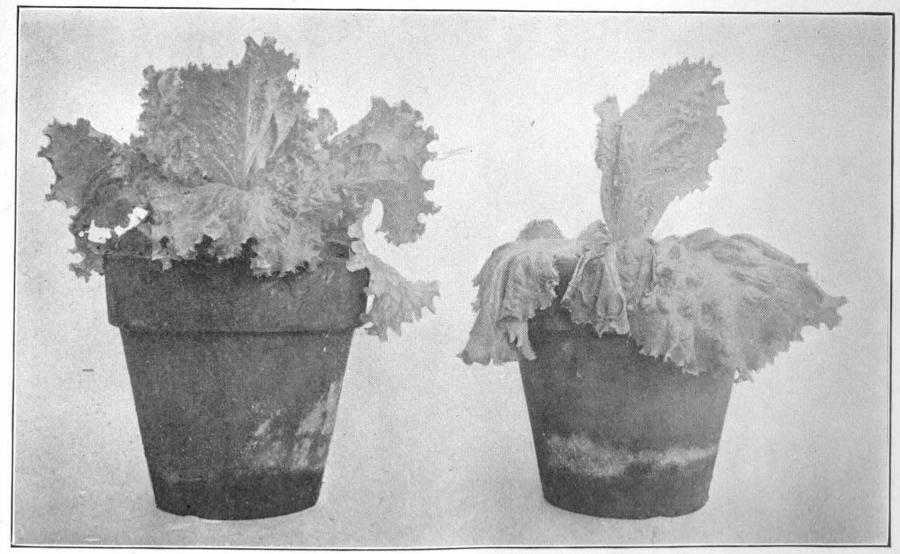
c. Powdery Mildew of Grape, p. 855. × 2.

DISEASES OF CHESTNUT AND GRAPE.

a. On parsley refuse, p. 868.



b. Artificial cultures, p. 869.

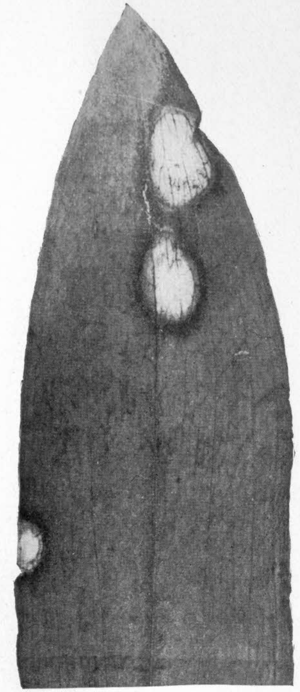


Check. Inoculated.

c. Showing drop of lettuce leaves two days after inoculation, p. 864.

DROP FUNGUS, *Sclerotinia Libertiana*, OF PARSLEY, LETTUCE, ETC.

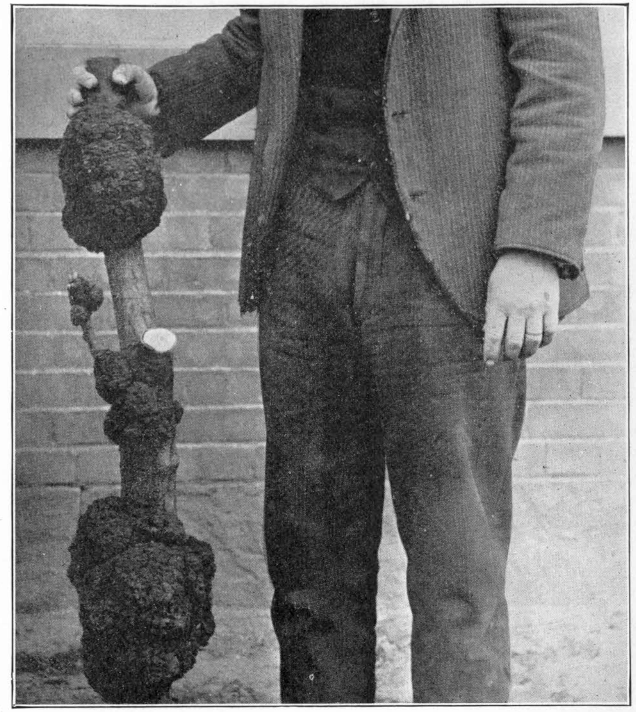
a. Black Spot of Maple, p. 852.



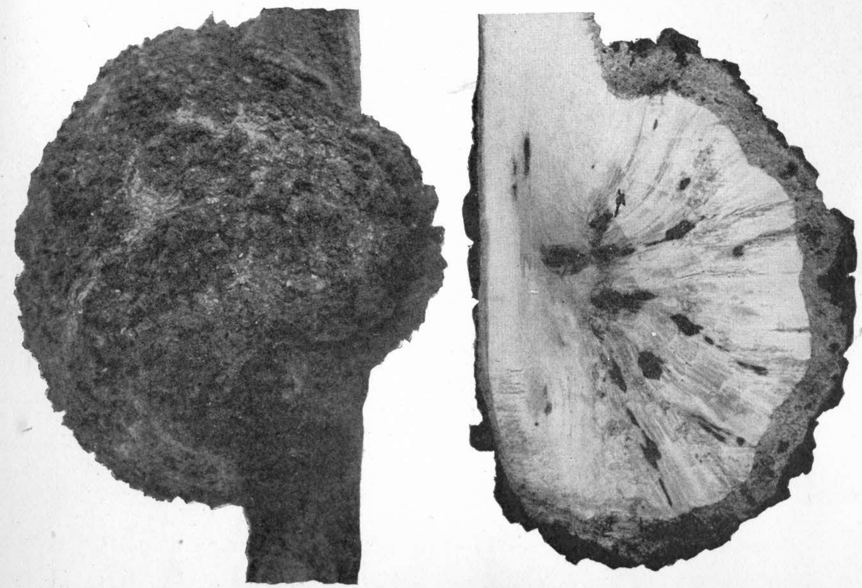
b. Bacterial Spot ? of Lily, p. 864.

c. Bacterial Spot of Larkspur, p. 862.

DISEASES OF MAPLE, LILY AND LARKSPUR.

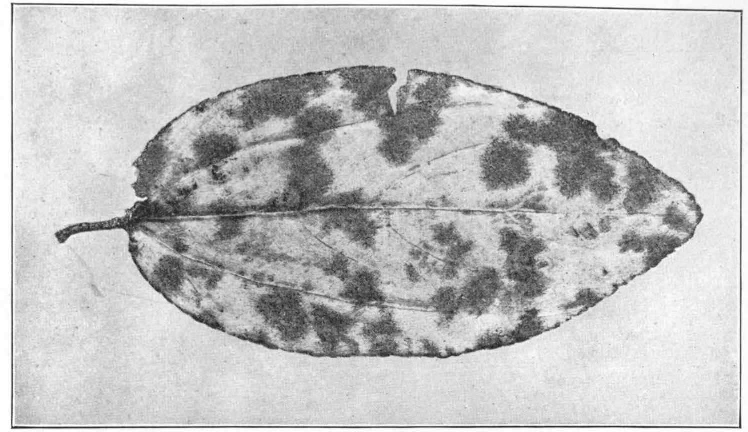


a. Showing large galls. Reduced.

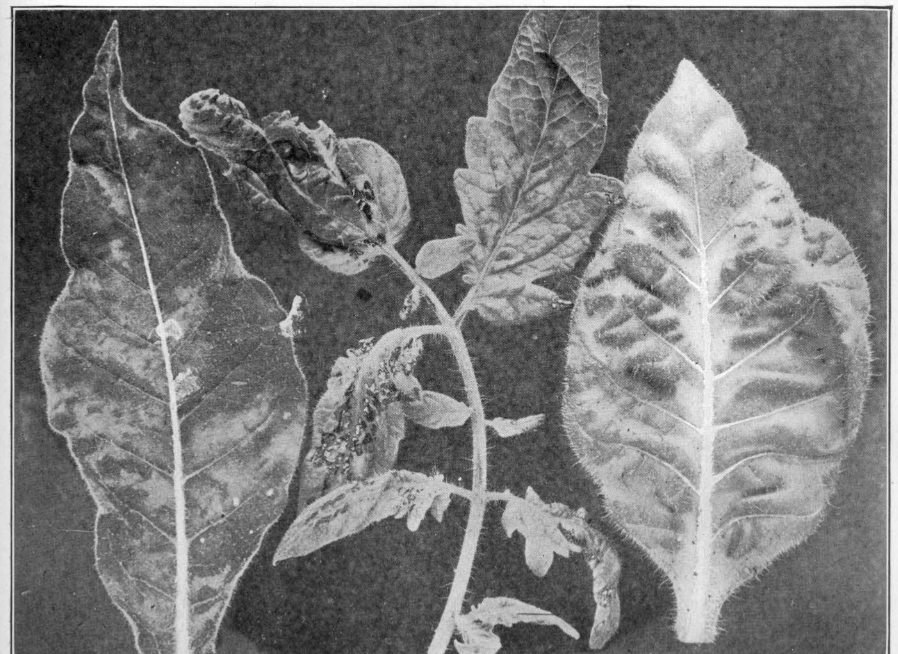


b. Showing structure of small galls. Natural size.

LIMB GALL OF OAK, p. 866.



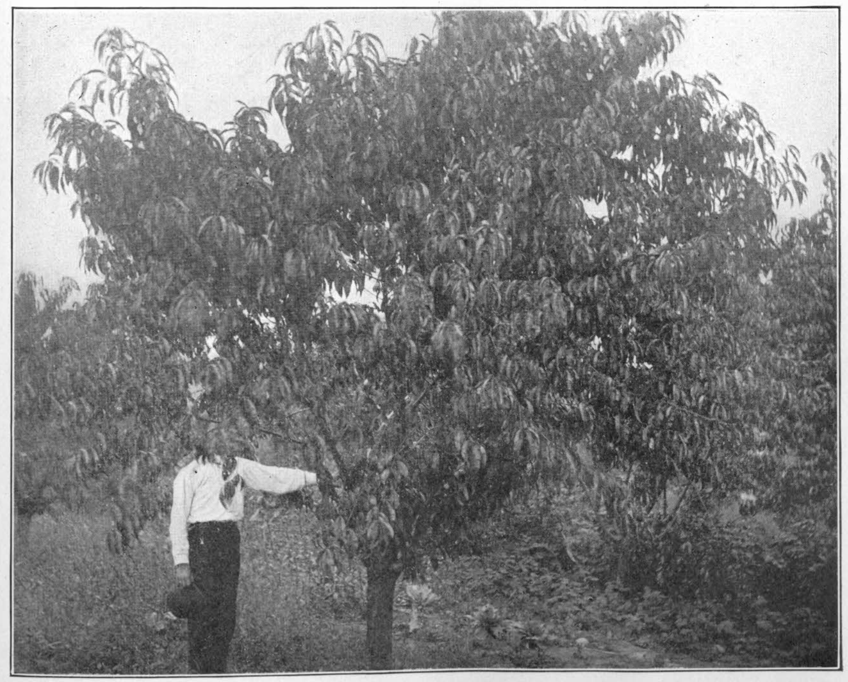
a. Powdery Mildew of New Jersey Tea, p. 866.



b. Calico from tobacco on tomato and then back to tobacco, p. 857.

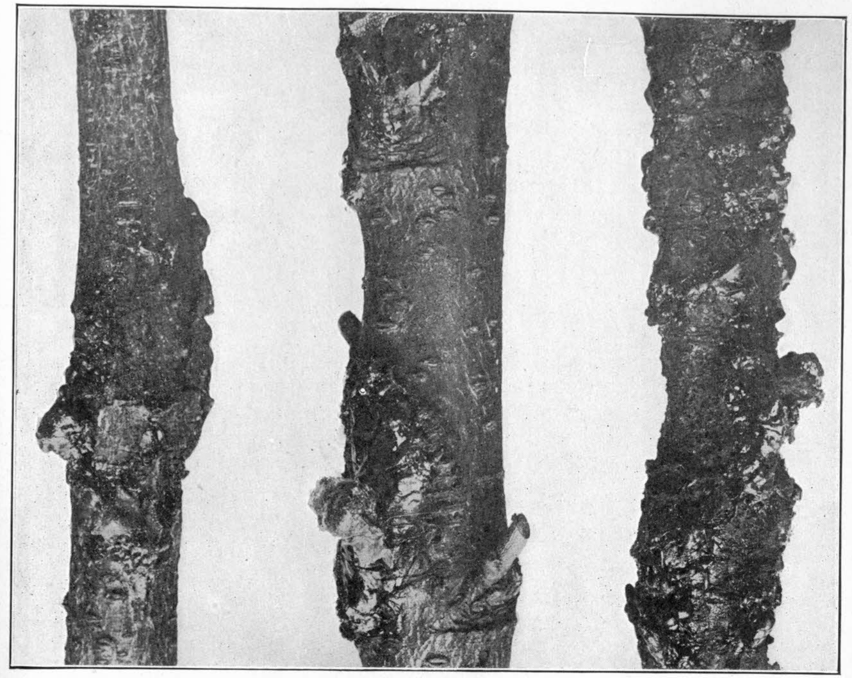
SOME DISEASES OF NEW JERSEY TEA, TOBACCO AND TOMATO.

a. Showing manner of cutting back, spring of 1906.

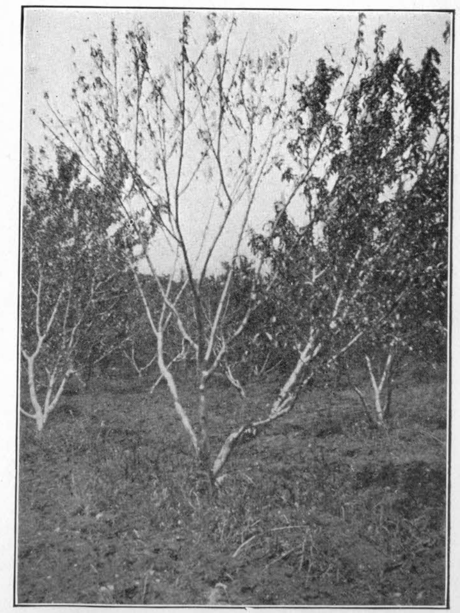


b. Showing growth made by fall of 1908.

PEACH TREES WINTER INJURED IN 1903–4, p. 874.

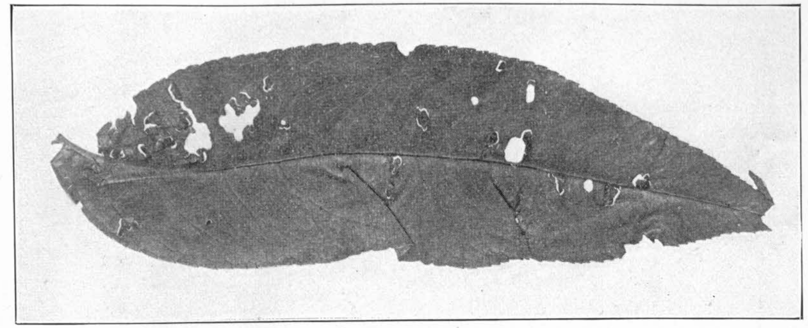


a. Gummosis, following winter injury, p. 869.



b. Collar Girdle with c. resulting death of tree ;
due to winter injury in 1907–8, p. 856.

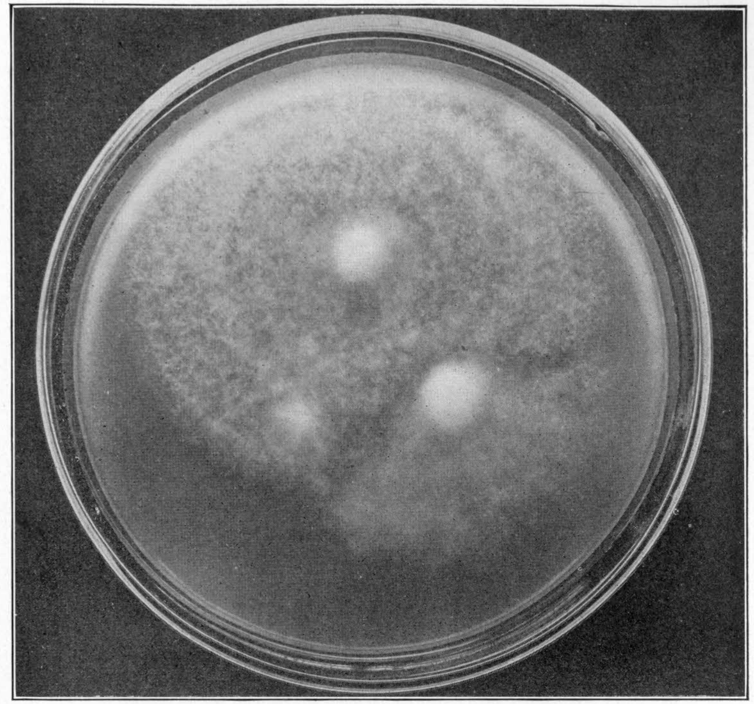
SOME RESULTS OF WINTER INJURY TO PEACH.



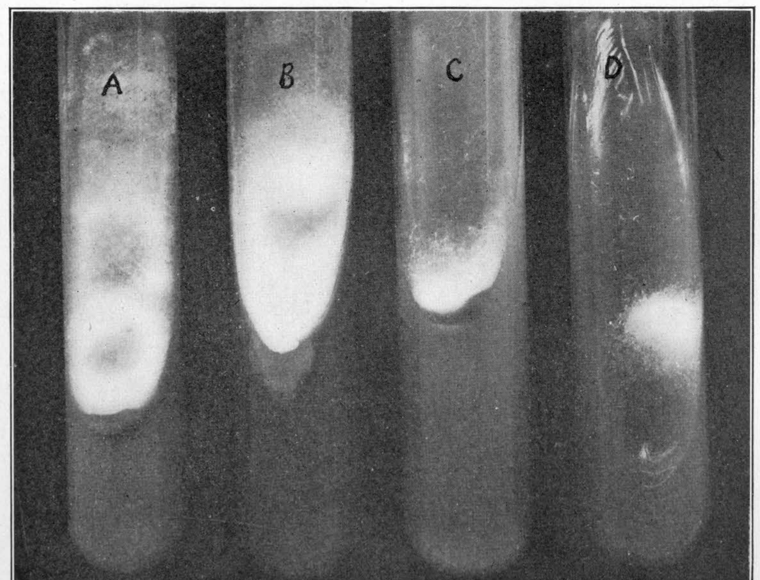
a. Bacterial Spot, showing shot hole effect, p. 856.

b. Last stage of Yellows, showing adventitious growths, p. 872.

SOME DISEASES OF THE PEACH.

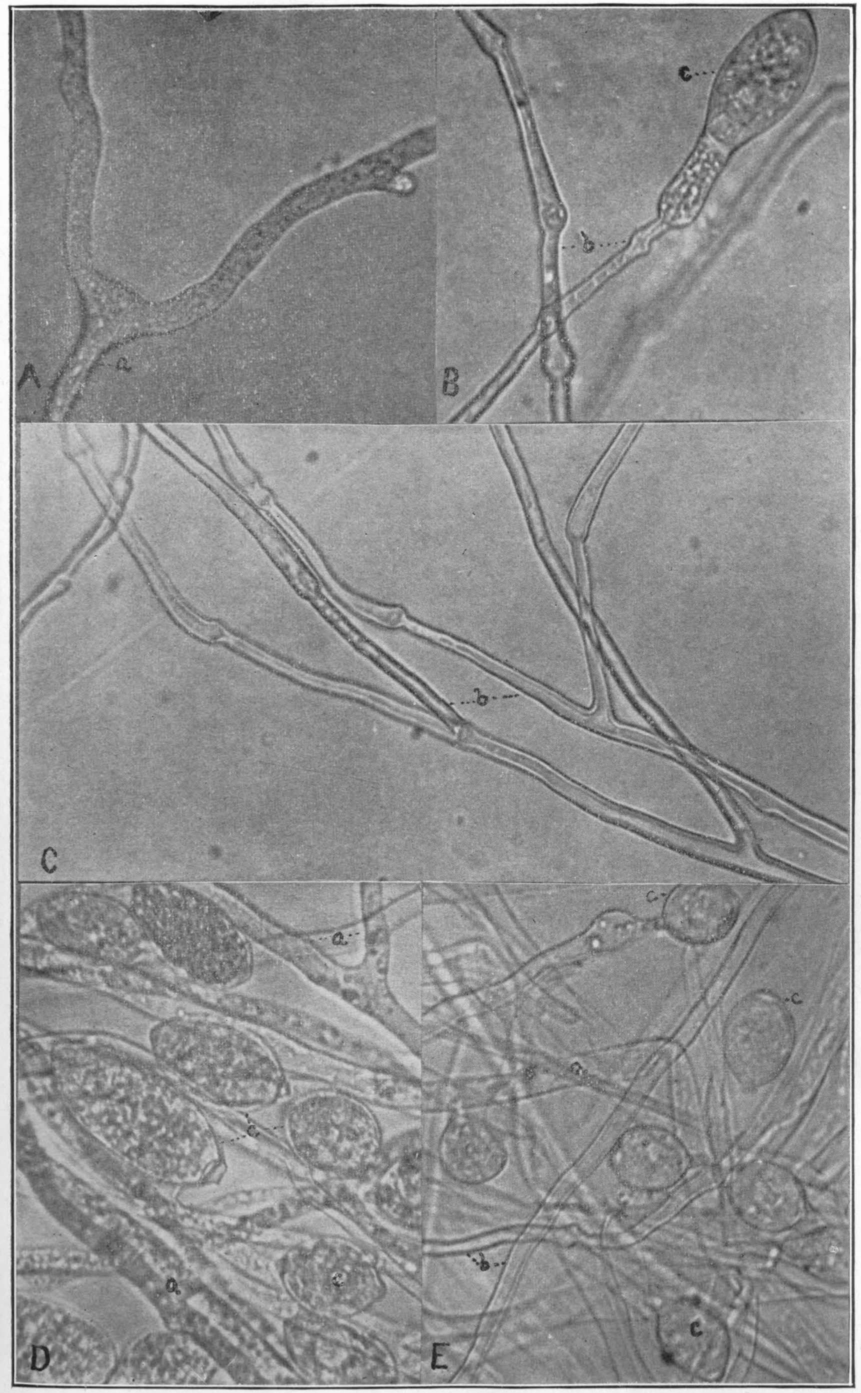


a. Petrie dish cross cultures from three sources, p. 899.



b. Growths on various media, p. 898.

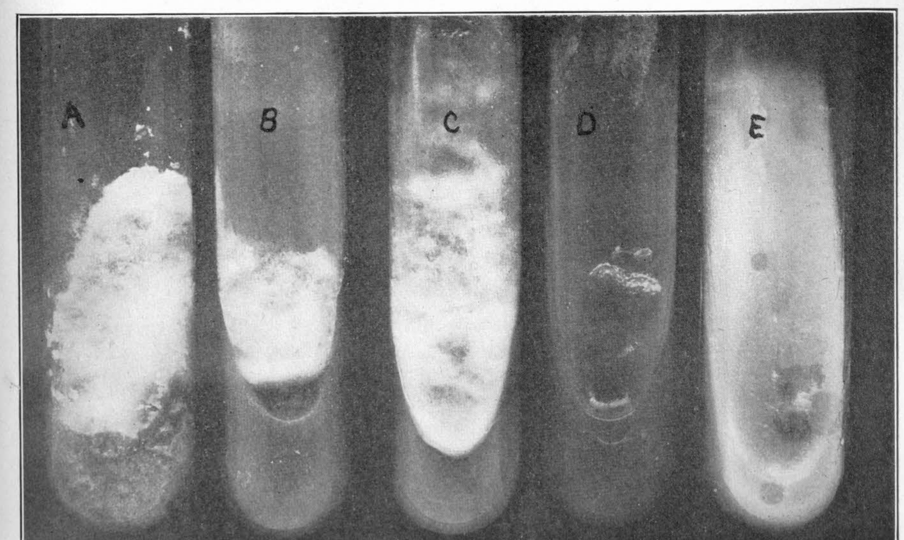
ARTIFICIAL CULTURES OF POTATO MILDEW, *Phytophthora infestans*.



a. mycelium; b. conidiophores; c. conidia. × 600 (about).

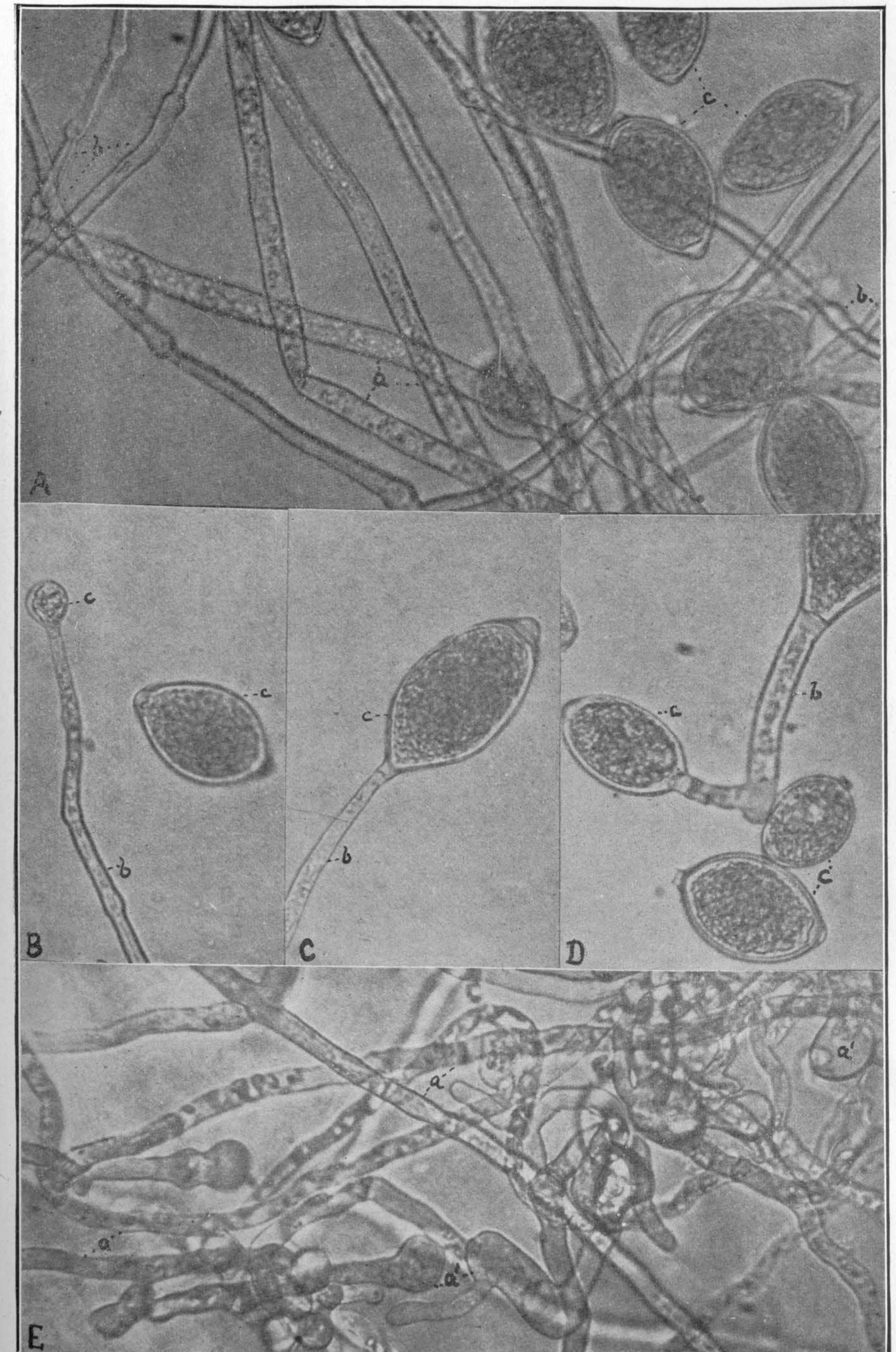
DETAILS OF CONIDIAL STAGE OF *Phytophthora infestans*, p. 895.

a. Petrie dish separation culture, p. 907.



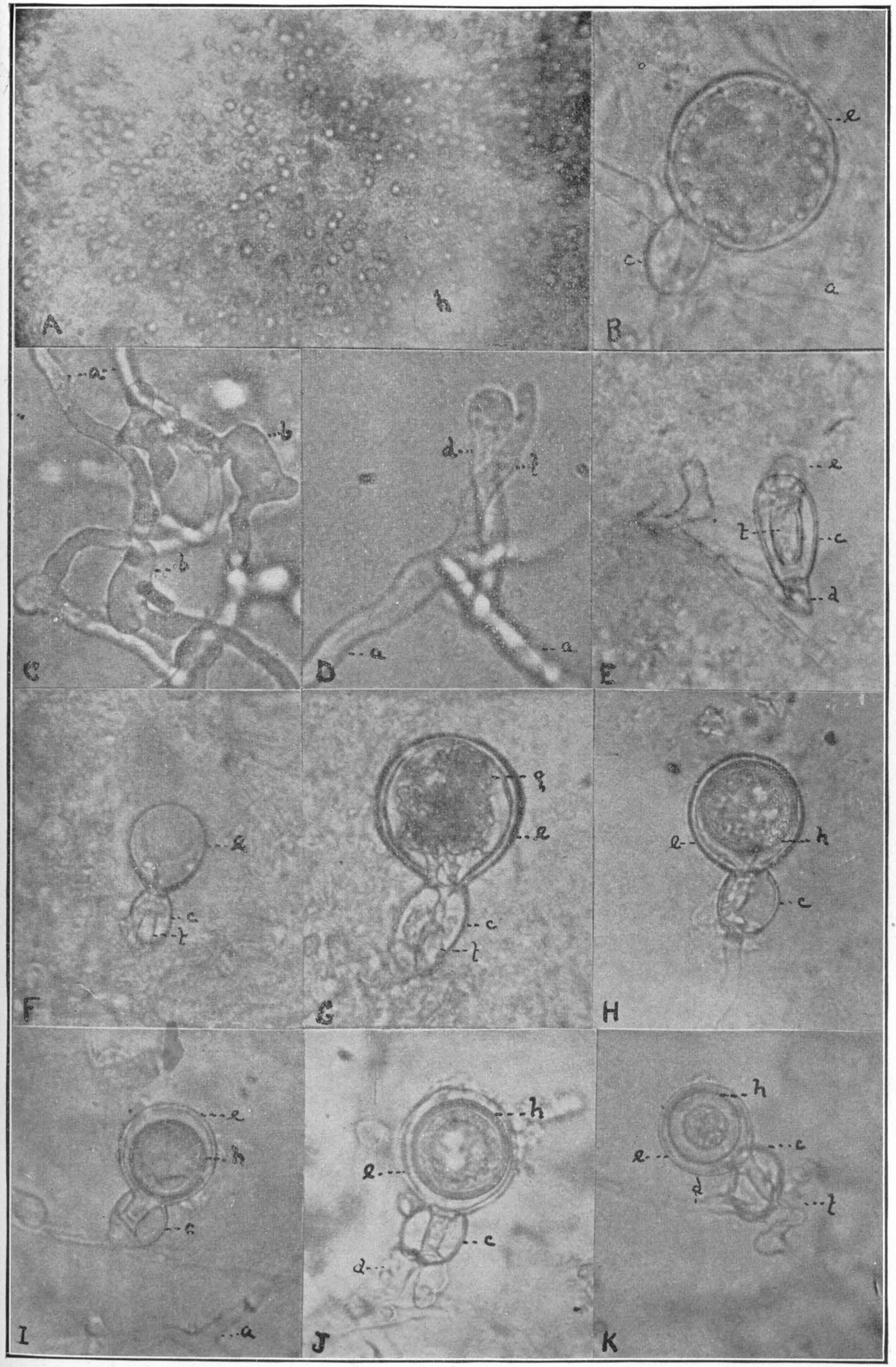
b. Growths on various media, p. 904.

ARTIFICIAL CULTURES OF LIMA BEAN MILDEW, *Phytophthora Phaseoli*.



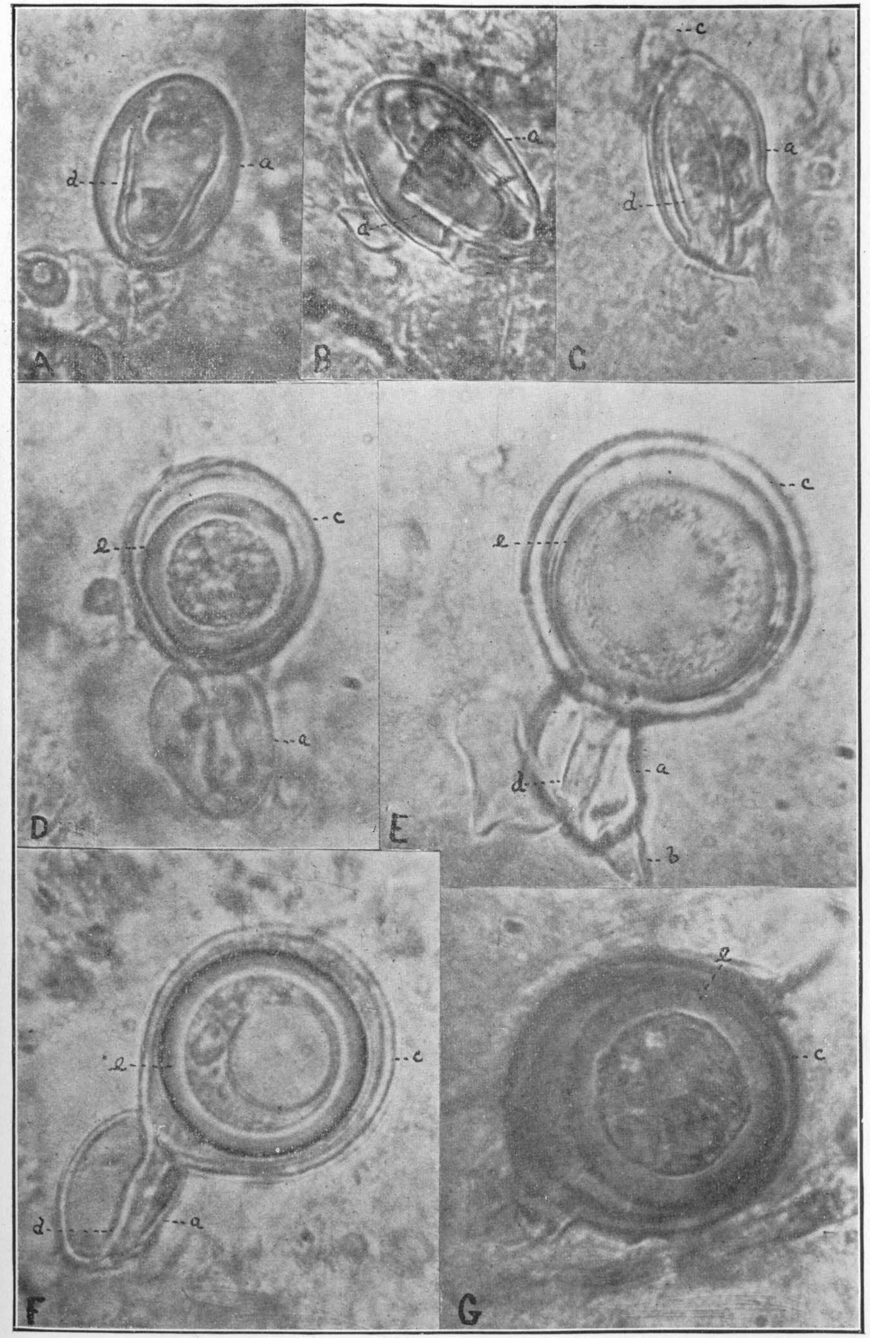
a. mycelium; a'. mycelial swellings; b. conidiophores; c. conidia. × 600 (about).

DETAILS OF CONIDIAL STAGE OF *Phytophthora Phaseoli*, p. 901.



a. mycelium; b. potential antheridia ? ; c. antheridia; d. antheridial threads; e. oogonia; f. oogonial threads; g. oosphere; h. oospores.
× 600 (about) except A.

DETAILS OF SEXUAL STAGE OF *Phytophthora Phaseoli*, pp. 901–3.



a. antheridia; b. antheridial threads; c. oogonia; d. oogonial threads; e. oospores. × 1200 (about); oil immersion; G. stained.

DETAILS OF ANTHERIDIA AND OOGONIA OF *Phytophthora Phaseoli*, pp. 902–3.

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