State of Connecticut

PUBLIC DOCUMENT No. 24.

TWENTY-SIXTH ANNUAL REPORT

OF

The Connecticut Agricultural Experiment Station

FOR THE YEAR ENDING OCTOBER 31

1902

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1903

CONNECTICUT AGRICULTURAL EXPERIMENT STATION.

OFFICERS AND STAFF.

STATE BOARD OF CONTROL.

Ex officio.

His Excellency GEORGE P. McLEAN, Simsbury, *President.*
E. H. JENKINS, New Haven, *Director and Treasurer.*

	Term expires.
Appointed by Connecticut State Agricultural Society:	
B. W. COLLINS, Meriden.	July 1, 1906
Appointed by Board of Trustees of Wesleyan University:	
Prof. W. O. ATWATER, Middletown.	1906
Appointed by Governor:	
EDWIN HOYT, New Canaan.	1904
JAMES H. WEBB, Hamden.	1905
Appointed by Board of Agriculture:	
T. S. GOLD, West Cornwall, *Vice-President.*	1904
Appointed by Governing Board of Sheffield Scientific School:	
W. H. BREWER, New Haven, *Secretary.*	1905

STATION STAFF.

Chemists.

Analytical Laboratory.

A. L. WINTON, PH.B., *Chemist in charge.*
A. W. OGDEN, PH.B. M. SILVERMAN, PH.B.
E. MONROE BAILEY, PH.B.

Laboratory for the Study of Proteids.

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

Botanist.

G. P. CLINTON, S.D.

Entomologist.

W. E. BRITTON, B.S.

Assistant to the Entomologist.

B. H. WALDEN, B.AGR.

In charge of Forestry Work.

WALTER MULFORD, F.E.

Grass Gardener.

JAMES B. OLCOTT, *South Manchester.*

Stenographers and Clerks.

Miss V. E. COLE.
Miss L. M. BRAUTLECHT.

In charge of Buildings and Grounds.

WILLIAM VEITCH.

Laboratory Helpers.

HUGO LANGE. WILLIAM POKROB.

Sampling Agent.

V. L. CHURCHILL, New Haven.

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ANNOUNCEMENT.

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

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

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

Through the State Forester, also a member of its staff, the Station is required to manage the State forest.

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

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

The Station makes analyses of fertilizers, feeds and other products, tests seeds, etc., for the citizens of Connecticut, without charge, provided—

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

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

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

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

Results of analysis or investigation that are of general interest are published in bulletins, of which copies are sent to each Post Office in this State, and to every citizen of the State who applies for them. These results are summed up in the annual reports made to the Governor.

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

Instructions and Forms for taking samples sent on application.

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

AGRICULTURAL EXPERIMENT STATION,

NEW HAVEN, CONN.

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

The Station has Telephone connection and may be spoken from all parts of the State at all hours between 7.30 A. M. and 9.30 P. M.

VISITORS ARE ALWAYS WELCOME.

REPORT OF THE BOARD OF CONTROL

OF THE

CONNECTICUT AGRICULTURAL EXPERIMENT STATION.

To His Excellency, George P. McLean, Governor of Connecticut:

The Board of Control of the Connecticut Agricultural Experiment Station herewith respectfully submits its Report for the year ending October 31st, 1902:

During March, April and May our sampling agent, Mr. V. L. Churchill, visited ninety-six towns and villages in all parts of this State and drew for analysis nearly five hundred samples of commercial fertilizers. These represented all but three of the two hundred and thirty-eight brands which have been entered for sale this year in Connecticut.

Of these, and other samples of fertilizers and manurial waste products, three hundred and ninety-five analyses have been made by Messrs. Winton, Ogden and Silverman, with the assistance of Mr. Lange. The detailed account of the results of this work has been prepared for publication by the director and is now in the printer's hands.

During the year our agent has visited twenty-eight towns and villages, to buy various food products for examination. There have been examined in the Station laboratory five hundred and sixty-six samples collected by our own agent, besides those sent by the Dairy Commissioner and his Deputy. The microscopic work involved has been wholly done by Mr. Winton; the chemical work by Messrs. Winton, Ogden, Silverman and Bailey.

During the last few months the sampling agent has visited forty-nine towns and villages of this State and collected three hundred and five samples of commercial feeding stuffs. These are now being analyzed and the results will be printed in bulletin form at the earliest possible moment.

In addition to the routine microscopic work necessary in the examination of food products, Mr. Winton has made three special and extended studies. One is on the microscopic structure of the seeds of a number of the common small fruits; a second is on the weed seeds found in wheat screenings and their microscopic structure, and the third is on the microscopic characters of various species of the sorghum family. These papers, fully illustrated with original microscopic drawings, are important contributions to the general knowledge of these subjects and will appear in the forthcoming annual report of the Station staff.

Under an Act Concerning the Purchase of Milk and Cream the Station has examined, marked and returned to their owners,—creameries and dairymen—without charge, five hundred and fifty-five pieces of glass apparatus such as pipettes, milk test bottles and cream test bottles.

During the twelve months covered by this Report there have been examined for the Dairy Commissioner four hundred and seventy-seven samples of molasses, forty-one of butter, one of vinegar and three of honey.

Dr. Osborne, with the assistance of Mr. Harris, has concluded his study on the nucleic acid of the wheat embryo and has published his results.

Studies have been made of the different forms in which nitrogen is found in a large number of protein substances and of the solubility of globulin in saline solutions.

An investigation as to the presence of a carbohydrate group in a large number of proteids is nearly done and ready for publication.

Owing to the resignation of the botanist, no botanical work was undertaken during the winter and spring months. Dr. Clinton began his work on July 1st and has since been engaged in studying some of the more important fungus diseases.

Four hundred and twenty-three samples of seeds, chiefly of vegetable and garden crops, have been tested as to their vitality, in the interests of seed growers and purchasers, by Mr. V. L. Churchill.

The entomological work done by Mr. Britton has been chiefly the inspection of nurseries and orchards, and experimenting to destroy the San José scale-insect. During the period covered by this Report, twenty-four nurseries have been inspected, and thirty-two orchards and gardens visited, to examine trees and advise treatment.

Spraying experiments to kill the scale have been carried on in New Haven, Bridgeport and Terryville.

A special study of the White-Fly has been undertaken and is still continued.

One hundred and sixty-eight specimens of insects have been examined for farmers and plant growers. These have been identified when possible and such facts regarding them and the methods of fighting them have been given to the senders as would enable them to combat the insects intelligently.

Under the direction of Mr. Mulford a new nursery, one acre in area, has been made and now contains about two hundred thousand seedlings and transplants of forest trees. There is also some stock remaining in the temporary nursery established last year.

About fourteen thousand trees have been set on the Lockwood field and extensive seedings of white and red oaks and of chestnut have been made. The work on the Lockwood field is purely experimental, to test methods of nursery practice, methods of sowing tree seeds on a forest site, ways of setting trees, effects of shading, pruning, etc.

Some cutting and tree planting have also been done on Mundy Hollow, which was burned over two years ago.

Mr. Mulford has prepared plans for the Board of Water Commissioners of Middletown, which contemplates planting about one hundred and fifty acres of open land on its watershed. He has also prepared plans for tree planting and has directed improvement cutting for several individual owners of woodland and waste open land.

As State Forester, Mr. Mulford has spent much time in a detailed inspection of over seven thousand acres, being the lands offered as possible sites for the State forest. This area is in twenty-four tracts, located in twenty towns scattered throughout the State. Negotiations are in progress for the purchase of the property, which is apparently the best adapted for the desired objects.

The field experiment in growing, curing and fermenting

wrapper leaf tobacco of Sumatra type, and the experiment on fertilizing peach orchards have both been continued during the present year under the supervision of the director of the Station.

Prof. William H. Brewer, who has been the Treasurer of this Station since its establishment in 1877, resigned this office in January, 1902, on account of the pressure of other duties, and E. H. Jenkins was chosen to fill the vacancy.

Dr. William C. Sturgis, who has for eleven years discharged most acceptably the duties of botanist, resigned during the year. Dr. G. P. Clinton was appointed as his successor and entered on the duties of the position in July, 1902.

Mr. Charles J. Rice, who has been in charge of the buildings and grounds for twenty years, resigned in the spring of 1902, and Mr. William Veitch was appointed in his place.

E. M. Bailey, Ph.B., a graduate of Yale University, entered on his duties as a chemist to the Station in July, 1902.

Mr. C. E. Preston was employed for three months at the Station on microscopic work.

The twenty-fifth Report of this Station, a volume of 446 pages, has been issued in an edition of 10,500 copies. Under the present statute the State pays for the printing of but 7,000 copies, too small a number to meet the calls for them from farmers within the State.

Our mailing list now contains over 10,500 names and every effort has been made to keep it revised to date. We are obliged constantly to refuse requests for the Report from other states, because the edition is so nearly exhausted. The Food Report and the Report on Fertilizers are specially sought after by people outside of the State.

The following bulletins have also been issued during the year in editions of 10,500 copies:—Bulletin 135, The San José Scale-Insect. Its Appearance and Spread in Connecticut, December, 1901, 14 pages, 5 plates. Bulletin 136, Preliminary Experiments in Spraying to kill the San José Scale-Insect. Season of 1901, February, 1902, 12 pages, 1 plate. Bulletin 137, The Growing of Tobacco under Shade in Connecticut, February, 1902, 20 pages. Bulletin 138, Commercial Feeding Stuffs in the Connecticut Market, April, 1902, 39 pages. Bulletin 139, The Apple Tree Tent Caterpillar, July, 1902, 12 pages, 3 plates. Bulletin 140, The White Fly or Plant-house Aleyrodes, 17 pages, 4 plates. A postal card bulletin regarding what could be done immediately to fight the Elm Leaf-beetle was issued and mailed to Connecticut citizens in July last.

More than 3,800 letters and manuscript reports of fertilizer and other analyses have been written on Station business.

During the autumn months there have been meetings and basket picnics on the Station grounds of the New Haven Co. Pomona Grange and of the State Pomological Society.

Two afternoons have also been devoted to the members of the senior class of the New Haven State Normal School who were specially concerned with the methods and results of the work in the chemical, botanical and entomological laboratories.

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

All of which is respectfully submitted.

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

NEW HAVEN, October 31, 1902.

REPORT OF THE TREASURER.

E. H. JENKINS, in account with the Connecticut Agricultural Experiment Station for the fiscal year ending September 30, 1902.

RECEIPTS.

Balance on hand Oct. 1, 1901	Analysis Fees $494.83		$ 694.83
	Insect Pest Fund... 200.00		
State Appropriation, Agriculture		$10,000.00	
State Appropriation, Foods		2,500.00	
State Appropriation, Insect Pests		3,000.00	
United States Treasurer		7,500.00	
Analysis Fees		3,233.95	
Sale of Tobacco		1,241.00	
From the Lockwood Income		5,008.87	
Miscellaneous Receipts		58.69	
			$32,542.51
			$33,237.34

DISBURSEMENTS.

E. H. Jenkins, Salary		$2,800.00
W. H. Brewer, "		400.00
V. E. Cole, "		800.00
L. M. Brautlecht, "		525.00
A. L. Winton, "		2,008.34
T. B. Osborne, "		1,800.00
A. W. Ogden, "		1,700.00
I. F. Harris, "		900.00
Max Silverman, "		625.00
G. P. Clinton, "		500.00
W. E. Britton, "		1,275.00
Walter Mulford, "		833.34
J. B. Olcott, "		800.00
H. Lange, "		720.00
E. M. Bailey, "		118.33
C. J. Rice, "		258.34
Wm. Veitch, "		345.00
V. L. Churchill, "		660.00
C. E. Preston, "		150.00
Labor		1,327.51
Publications		1,181.48
Postage		215.26
Stationery		252.15

Telephone and Telegraph	$ 85.04	
Freight and Express	75.81	
Gas and Kerosene	229.85	
Coal	971.70	
Water	147.00	
Chemicals and Laboratory Supplies	838.03	
Agricultural and Horticultural Supplies	90.39	
Miscellaneous Supplies	222.43	
Fertilizers	11.25	
Feeding Stuffs	94.86	
Library and Periodicals	865.56	
Tools and Machinery	46.91	
Furniture and Fixtures	360.76	
Scientific Apparatus	183.73	
Traveling by the Board	62.26	
Traveling by the Staff	139.66	
Tobacco Experiment	1,501.71	
Fertilizer and Food Sampling	557.07	
Insect Pest Appropriation to State Entomologist	3,200.00	
Contingent	357.53	
Lockwood Expenses and Forestry	1,801.13	
Betterments	219.55	
Repairs	856.32	
Grounds	124.04	
		$33,237.34

The accounts of the Treasurer have been duly audited by the State Auditors of Public Accounts. The Report of the Treasurer for the fiscal year of the United States, ending June 30, 1902, was duly rendered to the Secretary of the Treasury of the United States, and a duplicate to the Secretary of Agriculture. The same classification of receipts and disbursements used in previous years is continued in the above account.

Following the death of Mr. William Lockwood of South Norwalk, in May, 1902, this Station received in trust that portion of the estate of Mr. William R. Lockwood, of which his son had the life use.

E. H. JENKINS, *Treasurer.*

COMMERCIAL FERTILIZERS.*

During 1902 thirty-nine manufacturing firms have entered for sale in this State two hundred and thirty-eight distinct brands of fertilizers, viz.:

Special manures for particular crops	98
Other nitrogenous superphosphates	85
Bone manures and "bone and potash"	26
Fish, tankage, castor pomace and chemicals	29
	238

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

THE FERTILIZER LAW OF CONNECTICUT.

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

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

1. In case of *all* fertilizers or manures, except stable manure and the products of local manufacturers of less value than ten dollars a ton, the law holds the SELLER responsible for *affixing a correct label or statement* to every package or lot sold or offered, as well as for the *payment of an analysis fee* of ten dollars for each fertilizing ingredient which the fertilizer contains or is claimed to contain, *unless* the MANUFACTURER OR IMPORTER has provided labels or statements and has paid the fee. Sections 4581 and 4583.

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

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

2. The law also requires, *in the case of every commercial fertilizer,* that a *sealed sample* shall be deposited with the Director of the Station by the MANUFACTURER OR IMPORTER, and that a *certified statement* of composition, etc., shall be filed with him. Section 4582.

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 to nitrogen" may likewise be stated.

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

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

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

For Potash Salts the percentage of Potash (potassium oxide) should always be given: that of Sulphate of Potash or Muriate of Potash may also be stated.

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

3. It is also provided that EVERY PERSON in the State, who sells *any commercial fertilizer of whatever kind or price,* shall annually report certain facts to the Director of the Experiment Station, and on demand of the latter shall deliver a sample for analysis. Section 4584.

4. All "CHEMICALS" that are applied to land, such as Muriate of Potash, Kainit, Sulphate of Potash and Magnesia, Sulphate of Ammonia, Nitrate of Potash, Nitrate of Soda, etc., are considered to come under the law as "Commercial Fertilizers." Dealers in these chemicals must see that packages are suitably labeled. They must also report them to the Station, and see that the analysis fees are duly paid, in order that the Director may be able to discharge his duty as prescribed in Section 4589 of the Act.

The State exacts no license tax either for making or selling fertilizers. For the safety of consumers and the benefit of honest manufacturers and dealers, the State requires that it be known what is offered for sale, and whether fertilizers are what they purport to be. With this object in view the law provides, in Section 4589, that all fertilizers be analyzed,

and it requires the parties making or selling them to pay for these analyses in part; the State itself paying in part by maintaining the Experiment Station.

STATUTES CONCERNING COMMERCIAL FERTILIZERS.

Chapter 256 of the General Statutes of Connecticut.

SECTION 4581. Every person who shall sell, offer, or expose for sale, any commercial fertilizer or manure except stable manure, and the products of local manufacturers of less value than ten dollars a ton, shall affix conspicuously to every package thereof a plainly printed statement clearly and truly certifying the number of net pounds of fertilizer in the package, the name, brand, or trademark under which the fertilizer is sold, the name and address of the manufacturer, the place of manufacture, and the chemical composition of the fertilizer, expressed in the terms and manner approved and usually employed by the Connecticut agricultural experiment station. If any such fertilizer be sold in bulk, such printed statement shall accompany every lot and parcel sold, offered, or exposed for sale.

SEC. 4582. Before any commercial fertilizer is sold, offered, or exposed for sale, the person who causes it to be sold, or offered for sale, within this state, shall file with the director of the Connecticut agricultural experiment station two certified copies of the statement prescribed in section 4581, and shall deposit with said director a sealed glass jar or bottle containing not less than one pound of the fertilizer, accompanied by an affidavit that it is a fair average sample thereof.

SEC. 4583. The manufacturer, importer, agent, or seller of any commercial fertilizer shall pay on or before the first of May, annually, to the director of the Connecticut agricultural experiment station, an analysis fee of ten dollars for each fertilizing ingredient contained or claimed to exist in said fertilizer: *provided,* that when the manufacturer or importer shall have paid the fee herein required for any person acting as agent or seller for such manufacturer or importer, such agent or seller shall not be required to pay the fee prescribed in this section.

SEC. 4584. Every person in this state who sells, or acts as local agent for the sale of, any commercial fertilizer of whatever kind or price, shall annually, or at the time of becoming such seller or agent, report to the director of the Connecticut agricultural experiment station his name, residence and post office

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

SEC. 4585. No person shall sell, offer, or expose for sale, any pulverized leather, raw, steamed, roasted, or in any form, as a fertilizer or as an ingredient of any fertilizer or manure, without an explicit printed certificate of the fact, conspicuously affixed to every package of such fertilizer or manure, and accompanying every parcel or lot of the same.

SEC. 4586. Every manufacturer of fish guano, or fertilizers of which the principal ingredient is fish or fish mass from which the oil has been extracted, shall, before manufacturing or heating the same, and within thirty-six hours from the time such fish or mass has been delivered to him, treat the same with sulphuric acid or other chemical, approved by the director of said experiment station, in such quantity as to arrest decomposition: but in lieu of such treatment such manufacturer may provide a means for consuming all smoke and vapors arising from such fertilizers during the process of manufacture.

SEC. 4587. Any person violating any of the foregoing provisions of this chapter shall be fined one hundred dollars for the first offense, and two hundred dollars for each subsequent offense.

SEC. 4588. The foregoing sections of this chapter shall not apply to persons manufacturing, importing, or purchasing fertilizers solely for their own private use.

SEC. 4589. The director of the Connecticut agricultural experiment station shall pay the analysis fees received by him to the treasurer of the station, and shall cause one or more analyses of each fertilizer to be made and published annually. Said director may, in person or by deputy, take samples for analysis from any lot or parcel of manure or fertilizer in the possession of any dealer.

SEC. 4590. The director of the Connecticut agricultural experiment station shall, as bulletins of said station may be issued, mail two copies, at least, of such bulletins to each post-office in the State.

OBSERVANCE OF THE FERTILIZER LAW.

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, 1903:

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

Firm.	*Brand of Fertilizer.*
American Agricultural Chemical Co., The,—*continued.*	Wheeler's Corn Fertilizer, " Potato Manure, " Havana Tobacco Grower, " Superior Truck Fertilizer, " Bermuda Onion Grower, " Grass and Oats Fertilizer, Williams & Clark's High Grade Special, " " " Americus Ammoniated Bone Superphosphate, " " Potato Phosphate, " " Americus Potato Manure, " " Americus Corn Phosphate, The A. A. C. Co.'s High Grade Tobacco Manure, " " Complete Manure with 10% Potash, " " Grass and Lawn Top Dressing, " " Tobacco Starter and Grower, " " Dry Ground Fish, " " Fine Ground Bone, Nitrate of Soda, Muriate of Potash.
American Farmers' Fertilizer Co., 133 Front St., N. Y. City.	American Farmers' Market Garden Special, " " Complete Potato, " " Corn King, " " Ammoniated Bone, " " Grain Grower.
Armour Fertilizer Works, The, Baltimore, Md.	Armour's Grain Grower, " High Grade Potato, " All Soluble, " Bone, Blood and Potash, " Ammoniated Bone with Potash, " Bone Meal.
Baker, H. J. & Bro., 100 William St., N. Y. City.	Castor Pomace.
Berkshire Fertilizer Co., Bridgeport, Conn.	Berkshire Complete Fertilizer, " Potato and Vegetable Phosphate, " Ammoniated Bone Phosphate, " Pure Bone.
Boardman, F. E., Route No. 1, Middletown, Conn.	Boardman's Complete Fertilizer for Potatoes and General Crops.
Bohl, Valentine, Waterbury, Conn.	Self-Recommending Fertilizer.

Firm.	*Brand of Fertilizer.*
Bowker Fertilizer Co., 43 Chatham St., Boston, Mass.	Stockbridge Special Corn Manure, " Potato and Vegetable Manure, " Grass Top Dressing Manure, Bowker's Potato and Vegetable Fertilizer, " " Phosphate, " Hill and Drill Phosphate, " Farm and Garden or Ammoniated Bone Fertilizer, " Fish and Potash, Square Brand, " Tobacco Starter, " Sure Crop Phosphate, " Market Garden Fertilizer, " Corn Phosphate, " Tobacco Ash Elements, " Early Potato Manure, " Fisherman's Brand Fish and Potash, " Dry Ground Fish, " Fairfield Onion, " Complete Alkaline Tobacco Grower, " 25% Ash Compound, Nitrate of Soda, Muriate of Potash, Fresh Ground Bone, Canada Hardwood Ashes, Acid Phosphate, Castor Pomace.
Buckingham, C., Southport, Conn.	XX Special Formula.
Coe, E. Frank Co., 133 Front St., N. Y. City.	E. Frank Coe's High Grade Ammoniated Bone Superphosphate, " Fish Guano and Potash FP Brand, " Gold Brand Excelsior Guano, " Red Brand Excelsior Guano, " Long Islander Market Garden Special, " Columbian Corn Fertilizer, " Columbian Potato Fertilizer, " Celebrated Special Potato Fertilizer, " XXX Ground Bone.
Connecticut Valley Orchard Co., The, Berlin, Conn.	C. V. O. Co.'s Complete High Grade Fertilizer.
Cooper's Glue Factory, Peter, 17 Burling Slip, N. Y. City.	Bone Dust.
Dennis, E. C., Stafford Springs, Conn.	Ground Bone.
Downs & Griffin, Derby, Conn.	Ground Bone.

Firm.	*Brand of Fertilizer.*
Ellsworth, F., Hartford, Conn.	Shoemaker's Swift Sure Bone Meal, " " Superphosphate for Potatoes, " " Superphosphate for General Use.
Frisbie, L. T. Co., The, Hartford, Conn.	Frisbie's Fine Bone Meal.
Ernest L. James, Warrenville, Conn.	James' Bone Phosphate, " Ground Bone.
Kelsey, E. R., Branford, Conn.	Bone, Fish and Potash.
Lederer, J. & Co., 133 Park St., New Haven, Conn.	Bone, Tankage.
Listers Agricultural Chemical Works, Newark, N. J.	Listers Success Fertilizer, " Potato Manure, " Animal Bone and Potash, " Special Corn and Potato, " Increase Crescent Bone Dust, " Standard Superphosphate of Lime.
Lowell Fertilizer Co., 44 No. Market St., Boston, Mass.	Swift's Lowell Ground Bone, " Bone Fertilizer, " Animal Fertilizer, " Potato Manure, " " Phosphate, " Market Garden Manure, " Tobacco Manure, " Dissolved Bone and Potash.
Ludlam, Frederick, 108 Water St., N. Y. City.	Cecrops-Cereal Brand, Cecrops-Dragon's Tooth Brand.
MacCormack, Wm., Wolcott, Conn.	Mad River Strictly Pure Ground Bone.
Manchester, E. and Sons, Station A, Winsted, Conn.	Manchester's Formula.
Mapes, F. & P. G. Co., The, 143 Liberty St., N. Y. City.	Potato Manure, Tobacco Starter, Improved, " Manure, Wrapper Brand, Fruit and Vine Manure, Economical Potato Manure, Vegetable Manure, or Complete Manure for Light Soils, Average Soil Complete Manure, Corn Manure, Top Dresser, Improved, Half Strength, Complete Manure ("A" Brand), Dissolved Bone, Cereal Brand, Seeding Down Manure, Tobacco Ash Constituents.

Firm.	*Brand of Fertilizer.*
National Fertilizer Co., Bridgeport, Conn.	Chittenden's Market Garden Manure, " Complete, " Potato Phosphate, " Ammoniated Bone, " Fine Ground Bone, " Universal Phosphate, " Fish and Potash, " H. G. Special Tobacco Manure, " Complete Tobacco Fertilizer, Plain Superphosphate.
Ohio Farmers Fertilizer Co., The, Columbus, Ohio.	Potato and Tobacco Special, General Crop Fish Guano, Ammoniated Bone and Potash.
Olds & Whipple, Hartford, Conn.	O. & W. Castor Pomace, Complete Tobacco Fertilizer, Vegetable Potash, Special Phosphate, Potato Fertilizer.
Peck Bros., Northfield, Conn.	Pure Ground Bone.
Plumb & Winton Co., The, Bridgeport, Conn.	Ground Bone.
Pouleur, Auguste, Windsor, Conn.	Pouleur's Pure Carbonate of Potash Tobacco Starter.
Rogers & Hubbard Co., The, Middletown, Conn.	Hubbard's Fertilizer for Oats and Top-Dressing, " Grass and Grain Fertilizer, " Soluble Corn and General Crops Manure, " Soluble Potato Manure, " Soluble Tobacco Manure, " All Soils and All Crops Phosphate, " Corn Phosphate, " '02 Top-Dress Phosphate, " Raw Knuckle Bone Flour, " Strictly Pure Fine Bone, " Potato Phosphate.
Rogers Mfg. Co., The, Rock Fall, Conn.	All Round Fertilizer, Complete Potato and Vegetable Fertilizer, H. G. Complete Corn and Onion Manure, Fish and Potash, Pure Fine Flour Bone, H. G. Soluble Tobacco and Potato Manure, H. G. Fertilizer for Oats and Top Dressing, H. G. Grass and Grain Fertilizer, H. G. Soluble Tobacco Manure.

Firm.	*Brand of Fertilizer.*
Russia Cement Co., Gloucester, Mass.	Essex Corn Fertilizer, " XXX Fish and Potash, " Complete Manure for Corn, Grain and Grass, " Complete Manure for Potatoes, Roots and Vegetables, " Market Garden and Potato Manure, " A 1 Superphosphate, " Tobacco Starter, " Special Tobacco Manure, " Odorless Lawn Dressing, " Fine Bone Meal, " Dry Ground Fish.
Sanderson Fertilizer & Chemical Co., New Haven, Conn.	Sanderson's Formula A., " " B., " Corn Superphosphate, " Potato Manure, " Fine Ground Fish, " Fine Ground Bone, " Special with 10% Potash, " Top Dressing, " Superphosphate with Potash, Muriate of Potash, Nitrate of Soda, Double Manure Salt, Plain Superphosphate, Luce Bros.' Bone, Fish and Potash.
Shay, C. M., Groton, Conn.	Mystic Gilt Edge Potato Manure, Pure Ground Bone.
Shoemaker, M. L. & Co., *see Ellsworth, F.*	
Stroup, J., Son & Co., 170 Summer St., Boston, Mass.	Canada Hardwood Ashes.
Wilcox Fertilizer Works, The, Mystic, Conn.	Wilcox' Potato, Onion and Tobacco Manure, " Grass Fertilizer, " Complete Bone Superphosphate, " High Grade Fish and Potash, " Potato Manure, " Special Superphosphate, " Fish and Potash, " Dry Ground Fish Guano, " Pure Ground Bone, Acid Phosphate, Nitrate of Soda, Muriate of Potash.
Woodruff, S. D. & Sons, Orange, Conn.	Home Mixed Fertilizer.

SAMPLING AND COLLECTION OF FERTILIZERS.

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

Litchfield County	8
Hartford County	28
Tolland County	4
Windham County	12
New London County	10
Middlesex County	10
New Haven County	16
Fairfield County	8
	96

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

The sampling agent could not find the following brands on sale in the State, and it was, therefore, impossible to make analyses of them as provided by the fertilizer law. The missing brands are:

Bowker's Potato Phosphate.
" Fish and Potash.
" Square brand.

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

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

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

1. From dealer's stock of less than one ton.
2. From stock which has lain over from last season.

3. From stock which evidently is improperly stored, as in bags lying on wet ground,, or exposed to the weather, etc.

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

ANALYSES OF FERTILIZERS.

During the year 396 samples of commercial fertilizers and manurial waste-products have been analyzed. A classified list of them is given on page 19 and the results of their examination are given in detail in the following pages. When the contrary is not stated, the samples were drawn by an agent of the Station.

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

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

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

The Elements of Fertilizers.

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

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

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

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

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

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

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

porated with the soil, it "reverts" and becomes insoluble, or very slightly soluble, in water.

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

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

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

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

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

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

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

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

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

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

Valuation of Fertilizers.

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

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

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

Trade-Values of Fertilizer Elements for 1902.*

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 1901, were as follows:

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*Adopted at a conference of representatives of the Connecticut, Massachusetts, New Jersey and Rhode Island Stations held in March, 1902.

	Cents per pound
Nitrogen in nitrates	15
in ammonia salts	16½
Organic nitrogen, in dry and fine-ground fish, meat and blood, and in mixed fertilizers	16½
in fine* bone and tankage	16
in coarse* bone and tankage	12
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 and in forms free from muriate (or chlorides)	5
as muriate	4¼

The foregoing are, as nearly as can be estimated, the prices at which, during the six months preceding March last, the respective ingredients were retailed for cash, in our large markets, in those raw materials which are the regular source of supply. The valuations obtained by use of the above figures will be found to correspond fairly with the average retail prices, at the large markets, of standard raw materials, such as the following:

Sulphate of Ammonia,
Nitrate of Soda,
Dried Blood,
Azotin,
Ammonite,
Muriate of Potash,
Sulphate of Potash,
Plain Superphosphate,
Dry Ground Fish,
Bone and Tankage,
Ground South Carolina Rock.

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

The Organic Nitrogen in these classes of goods is reckoned at the price of nitrogen in raw materials of the best quality,‡ 16½ cents.

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

†Dissolved from 2 grams of the fertilizer, previously extracted with pure water, by 100 cc. neutral solution of ammonium citrate, sp. gr. 1.09, in thirty minutes, at 65° C., with agitation once in five minutes. Commonly called "reverted" or "backgone" Phosphoric Acid.

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

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

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

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

In 1902 the average selling price of Ammoniated Superphosphates and Guanos was $30.14 per ton, the average valuation was $21.19, and the difference $8.95, an advance of 42.2 per cent. on the valuation and on the wholesale cost of the fertilizing elements in the raw materials.

In case of special manures the average cost was $33.35, the average valuation $24.05 and the difference $9.30 or 38.7 per cent. advance on the valuation.

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

In case of *Ground Bone and Tankage,* the sample is sifted into the two grades just specified (see foot note, page 16), and we separately compute the nitrogen-value of each grade by multiplying the pounds of nitrogen per ton by the per cent. of each grade, multiplying one-tenth of that product by the trade-value per pound of nitrogen in that grade, and taking this final product as the result in cents. Summing up the separate values of each grade thus obtained, together with the values of each grade of phosphoric acid, similarly computed, the total is the valuation of the sample of bone.

Uses and Limitations of Fertilizer Valuation.

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

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

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

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

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

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

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

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

Agricultural Value of Fertilizers.

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

CLASSIFICATION OF FERTILIZERS ANALYZED.

1. *Containing Nitrogen as the chief valuable ingredient.*

Nitrate of Soda	7
Sulphate of Ammonia	2
Dried Blood	2
Cotton Seed Meal	38
Castor Pomace	5

2. *Containing Phosphoric Acid as the chief valuable ingredient.*

Dissolved Bone Black	1
Dissolved Rock Phosphate	8

3. *Containing Potash as the chief valuable ingredient.*

Carbonate of Potash	2
High Grade Sulphate of Potash	1
Double Sulphate of Potash and Magnesia	5
Muriate of Potash	9

4. *Containing Nitrogen and Phosphoric Acid.*

Bone Manures	31
Slaughter House Tankage	6
Dry Ground Fish	7

Mixed Fertilizers.

Bone and Potash	3
Nitrogenous Superphosphates	93
Special Manures	110
Home Mixtures	7

Miscellaneous Fertilizers and Manures.

Tobacco Stems	4
Wood Ashes	29
Leached Wood Ashes	1
Bowker's 25 per cent. Ash Compound	2
Ashes of Tobacco Stalks	1
Ashes of Tobacco Stems	2
"Vegetable Ash"	4
Cotton Hull Ashes	3
Stone Lime	3
Lime Kiln Ashes	3
Waste Lime from gas manufacture	1
"Mexican Potash"	1
Garbage Tankage	2
Sheep Manure	1
Land Plaster	1
"Fertilizer"	1
Total	396

DESCRIPTION AND ANALYSES OF FERTILIZERS.

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

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

In order to avoid all 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, a new system was adopted with the year 1900, beginning the numbering again at unity.

I. RAW MATERIALS CHIEFLY VALUABLE FOR NITROGEN.

NITRATE OF SODA OR SODIUM NITRATE.

Nitrate of Soda is mined in Chili and purified there before shipment. As offered in the Connecticut market it contains about 15.70 per cent. of nitrogen, equivalent to 95.3 per cent. of pure sodium nitrate, and is quite uniform in composition.

Seven samples from the Connecticut market have been received as follows:

4678. Sold by Lowell Fertilizer Co., Boston, Mass. Stock of Andrew Ure, Highwood.

4767. Sold by American Agricultural Chemical Co., New York. Stock of E. N. Austin, Suffield.

4871. Sold by American Agricultural Chemical Co., New York. Stock of J. G. Schwink, Meriden.

5010. Sold by The Wilcox Fertilizer Works.

4869. Sold by Bowker Fertilizer Co., Boston. Stock of E. E. Burwell, New Haven.

4870. Sold by Sanderson Fertilizer and Chemical Co., New Haven.

4677. Stock of S. D. Woodruff & Sons, Orange.

ANALYSES OF NITRATE OF SODA.

	4678	4767	4871	5010	4869	4870	4677
Percentage amounts of							
Nitrogen found	15.70	15.80	15.52	15.76	15.58	15.76	15.84
Equivalent nitrate of soda	95.3	95.9	94.2	95.7	94.6	95.7	96.1
Nitrogen guaranteed	----	----	----	15.5	15.0	15.6	----
Equivalent nitrate of soda guaranteed	----	----	----	94.1	91.1	94.7	----
Cost per ton	$40.00	46.00	45.00	47.00	48.00	50.00	----
Nitrogen costs cents per pound	**12.7**	**14.5**	**14.5**	**14.9**	**15.4**	**15.8**	----

All the samples of nitrate of soda examined in 1902 were of good quality. The cost of nitrogen per pound ranged from 12.7 to 15.8 cents.

SULPHATE OF AMMONIA.

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

4766. Bought of the American Agricultural Chemical Co., New York. Sampled and sent by E. W. Austin, Suffield.

5087. Bought of the Sanderson Fertilizer and Chemical Co., New Haven. Sampled and sent by M. W. Frisbee & Son, Southington.

ANALYSES OF SULPHATE OF AMMONIA.

	4766	5087
Percentage of nitrogen	20.40	20.66
Cost per ton	$70.00	72.00
Nitrogen costs cents per pound.	**17.1**	**17.4**

DRIED BLOOD.

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

4680. Sold by the Lowell Fertilizer Co., Boston. Sampled from stock of Andrew Ure, Highwood.

5060. Sold by Bowker Fertilizer Co., Boston. Sampled from stock of E. E. Burwell, New Haven.

ANALYSES OF DRIED BLOOD.

	4680	5060
Percentage of nitrogen found	9.85	10.73
Percentage of nitrogen guaranteed	8.2	9.9
Cost per ton	$30.00	38.00
Nitrogen costs cents per pound	**15.2**	**17.7**

COTTON SEED MEAL.

This material is of two kinds, which are known in trade respectively as undecorticated and decorticated. In their manufacture cotton seed is first ginned to remove most of the fiber, then passed through a "linter" to take off the short fiber or lint remaining, then through machines which break and separate the hulls. The hulled seed is ground and the oil expressed. The ground cake from the presses is used as a cattle food and fertilizer. Formerly the hulls were burned for fuel in the oil factories and the resulting ashes, which contained from 20 to 30 per cent. of potash, were used in this State as a tobacco fertilizer.

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

In the table, pp. 23, 24, are given the percentages of nitrogen found in thirty-seven samples. The percentage of phosphoric acid in cotton seed meal ranges from 2.69 to 3.44, and that of potash from 1.64 to 2.00, the average being 3.15 and 1.90, respectively. The cost per pound of nitrogen is determined in each case by deducting $4.42—the valuation of the phosphoric acid and potash—from the ton price, and dividing the remainder by the number of pounds of nitrogen in a ton of meal.

The average ton cost of cotton seed meal has been $27.64, a dollar and a half higher than last year.

The percentage of nitrogen found in the samples examined has ranged from 5.35 to 8.20, the average, excluding the single sample with least nitrogen, being 7.08, 0.15 per cent. less than in the two years immediately previous.

The cost of nitrogen has ranged from 14.4 to 18.8 cents per pound

ANALYSES OF COTTON SEED MEAL.

Station No.	Dealer and Brand.	Sampled by	Per cent. of nitrogen.	Cost per ton.	Nitrogen costs cents per pound.
4658	Olds & Whipple, Hartford, dark	E. P. Brewer, Silver Lane	8.20	28.00	14.4
4626	Oil Seed Pressing Co., New York City	Unknown	5.35	20.00	14.6
4848	Arthur Sikes, Mapleton	Arthur Sikes, Mapleton	7.24	26.00	14.9
4641	H. K. Brainard, Thompsonville, H. & B. Brand	J. E. Phelps, Thompsonville	7.62	27.45	15.1
4828	Arthur Sikes, Suffield, dark, off color	Charles H. Wells, Suffield	7.17	26.00	15.1
6115	" " "	E. N. Austin, Suffield	7.42	27.00	15.2
6116	" " "	" "	7.40	27.50	15.6
4849	" " bright meal	Arthur Sikes, Suffield	7.39	27.50	15.6
4606	Geo. W. Eaton, Bristol, Ga. Cotton Oil Co.	William J. Johnson, Plainville	7.65	28.50	15.7
4962	B. C. Patterson, Torrington, Dixie Brand	Thomas J. Stroud, Shaker Station	7.44	27.85	15.7
4645	H. K. Brainard, Thompsonville, H. & B. Brand	Joseph H. Pierce, Enfield	7.48	27.90	15.7
4642	Daniels Mill Co., Hartford	Jason Graham, Hartford	7.08	27.00	15.9
4643	" "	" "	7.07	27.00	15.9
4632	H. K. Brainard, Thompsonville, H. & B. Brand	L. Carlton, Thompsonville	7.28	27.90	16.1
4657	Olds & Whipple, Hartford	E. P. Brewer, Silver Lane	7.62	29.00	16.1
4607	Geo. W. Eaton, Bristol, Green Diamond Brand	Wm. J. Johnson, Plainville	7.40	28.50	16.3
4995	H. K. Brainard, Thompsonville, dark	Francis McNamara, Thompsonville	7.39	28.50	16.3
4634	" " Red Tag, Am. Cotton Oil Co.	L. Carlton, Thompsonville	7.18	27.90	16.4

ANALYSES OF COTTON SEED MEAL.—*Continued.*

Station No.	Dealer and Brand.	Sampled by	Per cent. of nitrogen.	Cost per ton.	Nitrogen costs cents per pound.
4631	Daniels Mill Co., Hartford	I. B. Davis, Bloomfield	7.46	29.00	16.5
4633	H. K. Brainard, Thompsonville, Green Diamond Brand	L. Carlton, Thompsonville	6.93	27.90	16.9
4787	Arthur Sikes, Mapleton	The Bissell Graves Co., Suffield	6.84	27.50	16.9
4655	" " Suffield	F. B. Hatheway, Suffield	6.89	28.00	17.1
4656	" " Mapleton	C. D. Burbank, Thompsonville	6.89	28.00	17.1
4619	H. K. Brainard, Thompsonville	G. A. Douglass, Thompsonville	6.66	27.45	17.3
4620	" "	" "	6.65	27.45	17.3
4823	Spencer Bros., Suffield	Spencer Bros., Suffield	6.94	28.50	17.3
4734	A. R. Manning & Co., Yantic, Planters Cotton Oil Co.	Dealer	7.12	29.00	17.3
4609	Arthur Sikes, Mapleton	O. B. Phillips, Suffield	6.74	28.00	17.5
4625	A. H. Barnum, Danbury	A. W. Camp, Danbury	7.04	29.00	17.5
4618	C. H. Dexter & Sons, Windsor Locks	H. H. Ellsworth, Windsor	6.68	28.00	17.6
4617	H. K. Brainard, Thompsonville, Am. Cotton Oil Co.	Joseph Watson, Enfield	6.52	27.65	17.8
4610	H. K. Brainard, Thompsonville	Patrick T. Manning, Thompsonville	6.53	27.65	17.8
5056	Auguste Pouleur, Windsor	J. J. Samuel, Windsor	6.92	29.00	17.8
5055	C. D. Clark, Copper Hill	Alfred H. Griffin, Granby	6.63	28.25	17.9
4735	Olds & Whipple, Hartford	Clark Bros., Poquonock	6.58	29.00	18.7
4996	H. K. Brainard, Thompsonville, light	Francis McNamara, Thompsonville	6.39	28.50	18.8
4997	Unknown	D. L. O'Neill, New Haven	6.41	------	------

and has averaged 16.0 cents, 1.1 cents higher than last year. Seventeen of the thirty-seven samples had less than seven per cent. of nitrogen, which is the amount usually guaranteed in cotton seed meal. None of the samples were found adulterated.

Owing to the increased export of cotton seed meal, to its more extensive use as a feed at home and to the fact that it is handled now by a few large companies rather than, as formerly, by a multitude of small producers, it is not likely that it will hereafter be what it was for years in this State, the cheapest as well as one of the very best forms of organic nitrogen in fertilizers.

CASTOR POMACE.

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

Five samples have been examined, as follows:

4845. Stock of Olds & Whipple, Hartford. Sampled and sent by J. A. DuBon, Poquonock.

4878. Sampled by Station agent from stock of Olds & Whipple, Hartford.

4654. Stock of J. C. Eddy, Simsbury. Sampled and sent by F. B. Hatheway, Suffield.

4877. Made by H. J. Baker & Bro., New York City. Sampled by Station agent from stock of W. F. Andross, East Hartford.

4879. A mixture of two samples of stock sold by Bowker Fertilizer Co., Boston; one sample drawn by Station agent from stock of E. E. Burwell, New Haven; the other from Newell St. John, Simsbury.

ANALYSES OF CASTOR POMACE.

	Olds & Whipple.		Eddy.	H. J. Baker.	Bowker Fert. Co.
Percentage amounts of	4845	4878	4654	4877	4879
Nitrogen	6.05	5.22	4.98	4.86	4.31
Phosphoric acid	2.30	----	1.47	----	----
Potash	.97	----	.88	----	----
Cost per ton	$23.00	23.00	23.00	23.00	25.00
Nitrogen costs cents per pound	**16.7**	**19.7**	**21.0**	**21.2**	**26.2**

This material, prized by some as a tobacco fertilizer, is very variable in composition and is usually a very expensive form of organic nitrogen. Thus in the five analyses above given the percentage of nitrogen ranges from 6.05 to 4.31, making the cost of nitrogen per pound range from 16.7 to 26.2 cents, while in cotton seed meal the average price of nitrogen is but 16 cents.

The ton price charged for castor pomace is, as a rule, out of all proportion to its value as a fertilizer.

II. RAW MATERIALS CHIEFLY VALUABLE FOR PHOSPHORIC ACID.

DISSOLVED BONE BLACK.

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

The supply of this material now on the market is very small, because bone black has been largely superseded by other materials as decolorizing agents. Only one sample has been analyzed.

4652. Sent by S. D. Woodruff & Sons of Orange, contained:

Phosphoric acid, water-soluble	16.56 per cent.
Phosphoric acid, citrate-soluble*	0.51 "
Phosphoric acid, insoluble	0.07 "
Phosphoric acid, total	17.14 "

DISSOLVED ROCK PHOSPHATE OR ACID ROCK.

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

Eight samples of this article have been analyzed, as follows:

4824. Bought of Sanderson Fertilizer and Chemical Co., New Haven. Sampled and sent by Robt. B. Fowler, Guilford.

5069. Bought of Sanderson Fertilizer and Chemical Co., New Haven. Sampled by Station agent from stock of M. W. Frisbie & Son, Southington.

* See foot note, page 16.

ANALYSES OF DISSOLVED ROCK PHOSPHATE.

	Sanderson.	Sanderson.	Bowker.	Am. Ag. Chem. Co.	Wilcox.	National.	Lowell.	Woodruff.
Percentage amounts of	**4824**	**5069**	**5084**	**4876**	**5082**	**5025**	**4676**	**4675**
Water-soluble phosphoric acid	7.62	11.66	11.47	11.26	12.99	10.24	10.48	10.08
Citrate-soluble* phosphoric acid	6.21	3.95	3.11	3.55	3.63	4.14	2.40	3.82
Insoluble phosphoric acid	2.26	.56	3.10	1.01	.36	.78	2.34	2.73
Total phosphoric acid	16.09	16.17	17.68	15.82	16.98	15.16	15.22	16.63
"Available" phosphoric acid found	13.83	15.61	14.58	14.81	16.62	14.38	12.88	13.90
"Available" phosphoric acid guaranteed	----	----	**14.00**	**14.00**	**15.00**	**14.00**	**12.00**	**14.00**
Cost per ton	$13.00	14.50	15.00	16.00	18.00	20.00	----	----
"Available" phosphoric acid costs cents per pound	**4.3**	**4.6**	**4.7**	**5.3**	**5.4**	**6.8**	----	----

* See foot note, page 16.

5084. Bought of Bowker Fertilizer Co., Boston. Sampled by Station agent from stock of E. E. Burwell, New Haven.

4876. Bought of American Agricultural Chemical Co., New York. Sampled by Station agent from stock of J. G. Schwink, Meriden.

5082. Sampled by Station agent from stock of Wilcox Fertilizer Works, Mystic.

5025. Bought of National Fertilizer Co., Bridgeport. Sampled by Station agent from stock of Gault Bros., Westport.

4676. Bought of Lowell Fertilizer Co., Boston, Mass. Sampled by Station agent from stock of Andrew Ure, Highwood.

4675. Sampled by Station agent from stock of S. D. Woodruff & Sons, Orange.

In all cases but one the percentage of available phosphoric acid is larger than the guaranteed percentage.

The cost of available phosphoric acid in these analyses ranged from 4.3 to 6.8 cents per pound. Careful buyers have, however, bought it in many cases for considerably less money.

III. RAW MATERIALS OF HIGH GRADE CONTAINING POTASH. CARBONATE OF POTASH.

Carbonate of Potash has been used with excellent results as a tobacco fertilizer, being, in our experience, a much safer form of potash for this crop, in Connecticut, than the sulphate which, in our five year tests, had an unfavorable effect on the burning quality of wrapper leaf.

4846. Sent by Auguste Pouleur, Windsor.

4960. Sent by Jos. Amstead, Windsor Locks, with statement that it was the ashes of sugar beet refuse.

ANALYSES.

	4846	4960
Percentage of potash found	60.84	44.90
Potash guaranteed	61.3	----
Chlorine	----	1.55
Cost per ton	----	$50.00

Actual potash, in form of carbonate, usually costs between seven and eight cents per pound, while in form of sulphate it costs about five. Nevertheless for tobacco, the carbonate, in some form, is to be preferred. Other forms of carbonate, in ashes from various sources, will be described on the following pages.

At $50 per ton the potash in **4960** costs only about 5.6 cents per pound, which makes it a very economical potash fertilizer for tobacco.

HIGH GRADE SULPHATE OF POTASH.

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

The analysis of a single sample appears in the table, page 30.

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

DOUBLE SULPHATE OF POTASH AND MAGNESIA.

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

Five analyses of this sulphate are given in the table on page 30, and all fully meet the guaranteed quality.

The cost of actual potash per pound in these samples ranged from 4.9 to 5.5 cents; the percentages of chlorine ranged from 0.93 to 2.53. These quantities of chlorine are not large enough to injuriously affect the burning quality of tobacco when the double sulphate is applied in the usual quantities as a fertilizer.

MURIATE OF POTASH.

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

In the table on page 30 are given nine analyses of muriate of potash.

POTASH SALTS. PERCENTAGE COMPOSITION AND

Station No.	Drawn from Stock in possession of	Sampled and sent by
	High Grade Sulphate of Potash.	
4768	E. N. Austin, Suffield	E. N. Austin, Suffield
	Double Sulphate of Potash.	
4874	J. G. Schwink, Meriden	Station Agent
4954	M. W. Frisbie & Son, Southington	" "
4873	Sanderson Fertilizer and Chemical Co., New Haven	" "
4872	E. E. Burwell, New Haven	" "
4807	E. N. Austin, Suffield	E. N. Austin, Suffield
	Muriate of Potash.	
4674	Andrew Ure, Highwood	Station Agent
4994	M. W. Frisbie & Son, Southington	" "
4732	Berkshire Fertilizer Co., Bridgeport	Newton M Curtis, Sandy Hook
4867	E. E. Burwell, New Haven	Station Agent
4868	J. G. Schwink, Meriden	" "
4769	E. N. Austin, Suffield	E. N. Austin, Suffield
5011	Wilcox Fertilizer Works, Mystic	Station Agent
4866	Sanderson Fertilizer and Chemical Co., New Haven	" "
4673	S. D. Woodruff & Sons, Orange	" "

Three of them have less than the usual percentage of potash, and considerably less than is guaranteed.

The cost of actual potash has ranged from 3.8 cents to 4.6 cents per pound, the average being 4.3 cents.

Samples **4769** and **4868** were bought of the American Agl. Chem. Co., New York. Sample **4867** was bought of the Bowker Fertilizer Co., Boston.

IV. RAW MATERIALS CONTAINING NITROGEN AND PHOSPHORIC ACID.

BONE MANURES.

The terms "Bone Dust", "Ground Bone", "Bone Meal" and "Bone" applied to fertilizers, sometimes signify material made from dry, clean and pure bones; in other cases these terms refer to the result of crushing fresh or moist bones which have been thrown out either raw or after cooking, with more or less meat, tendon and grease, and—if taken from garbage

COST PER POUND OF POTASH.

Station No.	Percentages found. Chlorine.	Potash Soluble in water.	Equivalent Muriate.	Equivalent Sulphate.	Percentages guaranteed. Muriate.	Sulphate.	Cost per ton.	Potash costs cents per pound.
4768	1.38	48.56	----	89.84	----	----	$49.00	5.0
4874	1.01	27.48	----	50.84	----	50.0	27.00	4.9
4954	2.53	27.08	----	50.10	----	50.0	26.50	4.9
4873	0.93	26.76	----	49.51	----	48.0	28.00	5.2
4872	1.03	27.78	----	51.39	----	48.0	29.00	5.2
4807	1.82	26.46	----	48.95	----	----	29.00	5.5
4674	----	51.70	81.69	----	80.0	----	39.00	3.8
4994	----	50.04	79.06	----	79.0	----	40.00	4.0
4732	----	49.56	78.30	----	80.0	----	43.00	4.3
4867	----	50.46	79.73	----	79.0	----	44.00	4.3
4868	----	49.12	77.61	----	80.0	----	42.00	4.3
4769	----	51.72	81.72	----	---	----	46.00	4.4
5011	----	50.08	79.13	----	79.8	----	45.00	4.5
4866	----	48.70	76.95	----	80.0	----	45.00	4.6
4673	----	51.04	80.64	----	80.0	----	----	----

or ash heaps—with ashes or soil adhering; again they denote mixtures of bone, blood, meat and other slaughter-house refuse which have been cooked in steam tanks to recover grease, and are then dried and sometimes sold as "tankage"; or finally, they apply to bone from which a large share of the nitrogenous substance has been extracted in the glue manufacture. When they are in the same state of mechanical subdivision the nitrogen of all these varieties of bone probably has about the same fertilizing value.

The method adopted for the valuation of bone manures, which takes account of their mechanical condition as well as chemical composition, is explained on page 17.

1. *Bone Manures Sampled by Station Agents.*

In the table on pages 32 and 33 are given twenty-six analyses of samples of this class.

Percentage Composition and Valuation of Bone Manures.

Station No.	Name of Brand.	Manufacturer.	Dealer.	Dealer's cash price per ton.	Valuation per ton.	Percentage difference between cost and valuation.	Chemical Analysis. Nitrogen. Found.	Nitrogen. Guaranteed.	Phosphoric acid. Found.	Phosphoric acid. Guaranteed.	Mechanical Analysis. Finer than 1-50 inch.	Coarser than 1-50 inch.
	Sampled by station agents.											
4893	Ground Bone	L. T. Frisbie Co., Hartford	Manufacturer	$25.00	$28.32	11.7*	4.46	3.3	20.64	22.0	68	32
4890	Cooper's Pure Bone Dust	Peter Cooper's Glue Factory, N. Y.	Geo. Beaumont, Wallingford	24.00	25.13	4.5*	1.15	0.9	30.41	26.7	59	41
			Auguste Pouleur, Windsor	30.00								
4882	Raw Bone Flour	Rogers Mfg. Co., Rockfall	Meeker Coal Co., Norwalk	33.00	30.05	0.2*	3.84	3.7	25.69	25.0	66	34
			Rockville Milling Co., Rockville	30.00								
4887	Fine Ground Bone	Am'n. Agricultural Chemical Co., N. Y.	F. S. Bidwell, Windsor Locks	29.00	28.38	2.2	2.92	2.5	26.56	22.8	71	29
			J. A. Lewis & Co., Willimantic	28.00								
			A. R. Manning & Co., Yantic	30.00								
4885	Essex Bone Meal	Russia Cement Co., Gloucester, Mass.	J. A. Lewis & Co., Willimantic	28.00	27.24	2.8	4.36	3.3	20.60	18.0	58	42
			Henry Davis, Durham Center	27.00								
4889	Fresh Ground Bone	Bowker Fertilizer Co., Boston	Bowker's Branch, Hartford	28.00	26.47	5.8	2.88	2.3	25.66	24 0	56	44
4883	Swift-Sure Bone Meal	M. L. Shoemaker & Co., Phila., Pa.	Olds & Whipple, "	35.00	32.77	6.8	5.34	4.1	24.28	21.5	59	41
			J. P. Barstow & Co., Norwich	37.00								
4899	Ground Bone	Plumb & Winton Co., Bridgeport	Manufacturer	28.00	26.06	7.4	4.37	---	19.64	----	51	49
4988	Pure Ground Bone	Wilcox Fertilizer Works, Mystic	"	29.00	26.75	8.4	3.12	2.5	24.66	22.0	60	40
4884	Pure Bone Dust	C. M. Shay, Groton	"	30.00	26.99	11.2	2.12	2.6	28.30	25.0	67	33
4894	Swift's Lowell Ground Bone	Lowell Fertilizer Co., Boston	H. A. Bugbee, Willimantic	30.00	27.76	11.7	2.30	2.5	27.91	25.0	74	26
			J. P. Barstow & Co., Norwich	32.00								
				31.00								
4886	Armour's Bone Meal	Armour Fertilizer Co., Baltimore, Md.	E. A. Buck & Co., Willimantic	28.00	25.04	11.8	2.69	2.5	23.83	24.0	62	38
			F. C. Benjamin & Co., Danbury	32.00								
			Daniels Mill Co., Hartford	27.00								
4892	Pure Ground Bone	Downs & Griffin, Derby	Manufacturer	30.00	26.50	13.2	2.81	4.0	26.51	28.8	51	49
4900	Hubbard's Raw Knuckle Bone Flour	The Rogers & Hubbard Co., Middletown	J. H. Burrill, Liberty Hill	34.00	29.70	14.5	3.95	3.5	25.00	24.5	64	36
			F. T. Blish Hardware Co., South Manchester	33.00								
4888	Fine Ground Bone	Berkshire Fertilizer Co., Bridgeport	H. F. Childs, Woodstock	30.00	26.12	14.8	4.55	2.5	18.59	20.0	55	45
4904	Self-Recommending Fertilizer	Valentine Bohl, Waterbury	D. B. Wilson & Co., Waterbury	28.00	24.32	15.1	3.17	3.7	22.68	24.6	44	56
			P. J. Bolan, Waterbury	28.00								
4898	Ground Bone	Peck Brothers, Northfield	W. H. Scott & Co., Pequabuck	30.00	25.81	16.2	4.43	4.0	21.98	21.0	25	75
			Manufacturer	29.00								
4902	Ground Bone	Sanderson Fertilizer and Chemical Co., New Haven	"	28.00	24.00	16.7	2.99	2.5	21.10	20.0	63	37
			R. H. Hall, East Hampton	27.00								
4895	Ground Bone	Lederer & Co., New Haven	Manufacturer	30.00	24.76	21.2	4.25	----	21.33	----	23	77
5085	E. Frank Coe's XX Ground Bone	E. Frank Coe Co., New York	J. P. Kingsley & Son, Plainfield	30.00	24.34	23.3	2.33	----	25.25	----	52	48
4897	Chittenden's Fine Ground Bone	National Fertilizer Co., Bridgeport	F. Hallock, Derby	32.00	25.41	25.9	2.60	2.5	24.79	20.8	61	39
			John Clark, Simsbury	28.00								
4903	James' Ground Bone	E. L. James, Warrenville	Manufacturer	28.00	21.62	29.5	3.90	----	20.44	----	----	100
4891	Ground Bone	E. C. Dennis, Stafford Springs	"	28.00	21.45	30.5	3.35	4.2	19.11	20.5	30	70
4901	Hubbard's Strictly Pure Fine Bone	The Rogers & Hubbard Co., Middletown	J. M. Page & Co., Naugatuck	37.00	26.15	41.5	4.02	3.5	22.26	22.0	41	59
			R. H. Hall, East Hampton	32.00								
4896	Ground Bone, Mad River Brand	Wm. MacCormack, Wolcott	Manufacturer	30.00	20.93	43.3	3.80	----	18.68	----	9	91
5036	Increase Crescent Bone Dust	Listers' Agricultural Chemical Works, Newark, N. J.	S. A. Billings, Meriden	25.00	14.51	72.3	2.40	2.2	12.00	11.0	36	64
	Sampled by purchasers.											
4733	Pure Bone	Berkshire Fertilizer Co., Bridgeport	Manufacturer	25.00	25.94	3.6*	4.48	2.5	18.92	20.0	52	48
4957	Sanderson's Fine Ground Bone	Sanderson Fertilizer & Chemical Co., New Haven	O. G. Beard, Shelton†	28.00	24.29	15.3	2.29	2.5	25.83	20.0	47	53
6120	Bone Fertilizer	Plumb & Winton Co., Bridgeport	H. A. Mayse, Bridgeport†	28.00	23.82	17.5	4.19	----	17.08	----	52	48
4805	James' Ground Bone	Ernest L. James, Warrenville	Manufacturer	28.00	21.99	27 3	4.06	----	20.42	----	----	100
6109	Bone ground from common bones	A. J. Doolittle, Westville		----	26.15	----	4.14	----	19.65	----	61	39
6110	Bone ground from selected bones	" " "		----	26.54	----	3.15	----	24.78	----	55	45
4630	Clean Bone		J. H. Webb, New Haven†	----	33.27	----	4.00	----	26.99	----	87	13
4629	Soiled Bone Dust		" " "	----	31.17	----	3.93	----	26.06	----	73	27
4628	Grinding Bone		" " "	----	31.15	----	4.03	----	25.52	----	74	26

* Valuation [illegible] † [illegible]

PERCENTAGE COMPOSITION AND

Station No.	Manufacturer.	Sampled from stock of
	Sampled by station agents.	
4875	Am'n. Agricultural Chemical Co., New York	J. G. Schwink, Meriden
4905	Bowker Fertilizer Co., Boston	E. E. Burwell, New Haven
		C. S. Gillette. Cheshire
5037	Lederer & Co., New Haven	Manufacturer
4679	G. F. Taylor & Co., New York	S. D. Woodruff & Sons, Orange
	Sampled by purchasers.	
4825	Sanderson Fertilizer and Chemical Co., New Haven	Manufacturer
4959	Plumb & Winton Co., Bridgeport	Wm. O. Burr, Fairfield

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

The average cost of these bone manures is $29.42 per ton; the average valuation $25.62; showing that the Station valuation is somewhat lower than the average selling price of ground bone in Connecticut.

Guarantees.

Three brands of ground bone contained less than the guaranteed percentage amounts of both nitrogen and phosphoric acid. These were:

4904. Bohl's Self-Recommending Fertilizer. Nitrogen found 3.17 per cent., guaranteed 3.7. Phosphoric acid found 22.68 per cent., guaranteed 24.6.

4891. Dennis' Ground Bone. Nitrogen found 3.35, guaranteed 4.2. Phosphoric acid found 19.11, guaranteed 20.5.

4892. Downs & Griffin's Ground Bone. Nitrogen found 2.81, guaranteed 4.0. Phosphoric acid found 26.51, guaranteed 28.8.

Shay's Pure Bone Dust, **4884,** and Swift's Lowell Ground Bone **4894,** also contains less than the guaranteed amount of nitrogen, while Frisbie's Ground Bone **4893,** Armour's Bone Meal **4886,** and Berkshire Ground Bone **4888,** contain less than the guaranteed percentage of phosphoric acid.

VALUATION OF TANKAGE.

Station No.	Dealer's cash price per ton.	Valuation per ton.	Percentage difference between cost and valuation.	Chemical Analysis.				Mechanical Analysis.	
				Nitrogen		Phosphoric acid.			
				Found.	Guaranteed.	Found.	Guaranteed.	Finer than 1-50 inch.	Coarser than 1-50 inch.
4875	$27.00	$25.27	6.8	5.34	**6.0**	14.94	----	48	52
4905	**33.00** 30.00	27.50	20.0	5.90	**4.9**	14.71	**14.0**	59	41
5037	**30.00**	23.24	29.1	4.62	----	14.43	----	53	47
4679	----	28.02	----	6.94	**7.0**	12.15	**11.5**	51	49
4825	**28.00**	27.56	1.6	6.27	**5.8**	13.52	**10.0**	57	43
4959	**25.00**	17.24	45.0	3.88	**7.0**	9.40	**4.0**	46	54

Fineness.

On the average, 53 per cent. of ground bone, like the samples examined, consists of particles which will pass a mesh with circular holes $^1/_{50}$ inch in diameter. The phosphoric acid and potash of bone which will pass this mesh are given a higher valuation than the same things in coarser bone. This is done because finely ground bone is more expensive as an article of trade. It is also true that up to a certain point fine bone is easier to sow and is more quickly available to plants than coarse bone.

2. *Bone Sampled by Purchasers.*

In the table on page 32 are four analyses of samples in this class, which do not call for special notice.

SLAUGHTER-HOUSE TANKAGE.

After boiling or steaming meat scrap, bone and other slaughter-house waste, fat rises to the surface and is removed, the soup is run off and the settlings are dried and sold as tankage. As analyses show, tankage has a very variable composition. In general, it contains more nitrogen and less phosphoric acid than bone. Garbage tankage made in a somewhat similar way from city garbage will be described in the following pages:

In the table above are given six analyses of this material.

These analyses show the usual differences in chemical composition.

The sample of tankage from the American Agricultural Chemical Co., **4875**, contained 0.6 per cent. less of nitrogen than was guaranteed.

DRY GROUND FISH.

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

Seven analyses are given below:

4748. Dry Ground Fish Guano; made by Wilcox Fertilizer Works, Mystic; sampled from stock of Olds & Whipple, Hartford.

4806. Wilcox Dry Fish; sampled by E. N. Austin, Suffield, from his own stock.

5080. Fine Ground Fish; from Sanderson Fertilizer and Chemical Co., New Haven; sampled from stock of J. H. Hackett, Wapping.

5009. Essex Dry Ground Fish; made by Russia Cement Co., Gloucester, Mass.; sampled from stock of J. A. Lewis & Co., Willimantic.

5032. Fine Ground Dry Fish; from Bowker Fertilizer Co., Boston, Mass.; sampled from stock of W. F. Andrus, East Hartford.

5071. Dry Ground Fish; made by the American Agricultural Chemical Co., N. Y.; sampled from stock of Joseph Warner, Glastonbury.

6121. Sampled and sent by R. E. Buell, Gilead; stated to have been bought of C. A. Hutchinson, Bolton.

All of the samples, excepting the last, appear to be of good quality and unadulterated.

In most cases the difference between cost and valuation is small, showing that the cost of nitrogen and phosphoric acid in fish has been about the same as in the Station schedule of trade values of these articles.

Guarantees.

The percentage of nitrogen in the fish from the Russia Cement Co. is a little less than in the guaranteed per cent., and in the fish from the American Agricultural Chemical Co. the percentage of phosphoric acid found is nearly three per cent. less than what is guaranteed.

PERCENTAGE COMPOSITION AND VALUATION OF DRY FISH.

	Wilcox's.	Wilcox's	Sanderson's.	Russia Cement Co's.	Bowker's.	Am'n Agric. Chem. Co.'s.	Hutchinson's.
	4748	**4806**	**5080**	**5009**	**5032**	**5071**	**6121**
Nitrogen as ammonia	.24	.17	.15	.10	.31	.58	
Organic nitrogen	8.66	8.75	8.35	7.76	7.73	8.75	
Total nitrogen found	8.90	8.92	8.50	7.86	8.04	9.33	5.97
Total nitrogen guaranteed	**8.50**	----	**8.24**	**8.00**	**8.00**	**8.27**	
Soluble phosphoric acid	.64	.56	.66	.64	.56	.46	
Reverted phosphoric acid	4.91	4.48	4.11	8.22	4.37	1.36	
Insoluble phosphoric acid	1.88	1.92	3.01	5.11	1.16	2.32	
Total phosphoric acid found	7.43	6.96	7.78	13.97	6.09	4.14	
Total phosphoric acid guarante'd	**6.00**	----	**6.00**	**11.00**	**6.00**	**7.00**	
Cost per ton	$35.00	35.00	34.00	37.00	34.00	37.00	35.00
Valuation per ton	35.18	34.80	33.62	36.02	31.48	33.40	
Percentage difference between cost and valuation	0.5*	0.6	1.1	2.7	8.0	10.8	

* Valuation exceeds cost.

The commercial fertilizers described in preceding pages are raw materials, being for the most part manufacturing by-products which are dried, ground and sold without further preparation to fertilizer factories. They are some of the materials which are mixed in the factory to make the "Complete Manures" or "Special Manures" of the fertilizer trade. They are also the materials which are bought by many farmers for use either singly, or mixed together on the farm.

MIXED FERTILIZERS.

BONE AND POTASH.

Three samples bearing this brand have been analyzed as follows:

4756. Darling's Dissolved Bone and Potash, made by the American Agricultural Chemical Co., New York. Sampled from stock of J. A. Lewis & Co., Willimantic, F. A. Chamberlain, Terryville and of Hotchkiss & Templeton, Waterbury.

4703. Swift's Lowell Dissolved Bone and Potash, made by the Lowell Fertilizer Co., Boston, Mass. Sample from stock of Standard Feed Co., Bridgeport, and of C. W. Lines, New Britain.

5028. Lister's Animal Bone and Potash, made by Lister's Agricultural Chemical Works, Newark, N. J. Sampled from stock of S. A. Billings, Meriden.

ANALYSES OF BONE AND POTASH.

	Darling's.	Swift's Lowell.	Lister's.
Percentage amounts of	4756	4703	5028
Nitrogen in nitrates	1.00	----	----
Nitrogen, organic	1.77	1.90	----
Total nitrogen, found	2.77	1.90	----
Nitrogen guaranteed	**2.4**	**1.7**	----
Soluble phosphoric acid	5.14	7.20	8.61
Reverted " "	2.66	2.82	1.23
Insoluble " "	0.54	1.03	0.45
Total " " found	8.34	11.05	10.29
" " " guaranteed.	**7.0**	**10.0**	**10.0**
Available " " found	7.80	10.02	9.84
" " " guaranteed.	**6.0**	**9.0**	**9.0**
Potash found	10.35	2.48	3.24
" guaranteed	**10.0**	**2.0**	**5.0**
Cost per ton	$34.00	30.00	23.00
Valuation per ton	$26.77	18.53	12.96
Percentage difference	27.0	61.9	77.5

These three articles claim by their brands to be mixtures of bone and potash. The name in the case of two of these is a misnomer. Lister's "Bone and Potash" contains no bone whatever in the ordinary meaning of that word. Bone black is no more bone than anthracite coal is "vegetable matter." More than a third part of the nitrogen in Darling's Dissolved Bone and Potash is in form of nitrate of soda.

NITROGENOUS SUPERPHOSPHATES AND GUANOS.

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

1. *Samples drawn by Station Agent.*

In the tables on pages 44 to 57 are given analyses of eighty-two samples belonging to this class, arranged according to the percentage differences between their cost prices and valuations.

Of the eighty-two analyses of nitrogenous superphosphates given in the tables, more than one-fourth of the whole number are below the manufacturer's minimum guarantee in respect of one or more ingredients.

In ten cases there is a deficiency of nitrogen, in seven cases deficiency of phosphoric acid, and in twelve cases deficiency of potash.

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

5041. Armour's Blood, Bone and Potash. Phosphoric acid found 9.31 per cent., guaranteed 10.0. Potash found 6.63, guaranteed 7.0.

4694. Mapes' Complete for Average Soils. Available phosphoric acid found 6.76, guaranteed 7.0.

5066. Coe's Gold Brand Excelsior Guano. Potash found 5.33, guaranteed 6.0.

5065. Coe's Red Brand Excelsior Guano.* Nitrogen found 2.80, guaranteed 3.4. Potash found 4.32, guaranteed 6.0.

4970. American Farmers' Market Garden Special.* Potash found 6.28, guaranteed 7.0.

4671. Lowell Animal Brand Fertilizer. Potash found 3.78, guaranteed 4.0.

4944. Wheeler's Superior Truck Fertilizer. Nitrogen found 3.07, guaranteed 3.3.

4985. Darling's Blood, Bone and Potash. Nitrogen found 3.98, guaranteed 4.1.

5062. Coe's Long Islander Market Garden Fertilizer.* Nitrogen found 2.98, guaranteed 3.4. Potash found 5.06, guaranteed 6.0.

4858. Chittenden's Fish and Potash. Nitrogen found 2.78, guaranteed 3.0.

5003. Great Eastern Garden Special. Nitrogen found 2.78, guaranteed 3.3.

4856. Berkshire Complete Fertilizer. Available phosphoric acid found 7.88, guaranteed 8.0.

5076. Bowker's Market Garden Fertilizer.* Potash found 8.54, guaranteed 10.0.

4760. Bowker's Market Garden Fertilizer. Potash found 8.82, guaranteed 10.0.

4811. Hubbard's All Soils All Crops.* Nitrogen found 1.81, guaranteed 2.3. Potash found 2.38, guaranteed 3.0.

4952. Sanderson's Special with 10 per cent Potash. Nitrogen found 2.03, guaranteed 2.5. Phosphoric acid found 8.78, guaranteed 9.0.

5029. Lister's Standard Superphosphate. Nitrogen found 2.20, guaranteed 2.5.

5042. Armour's All Soluble. Nitrogen found 2.76, guaranteed 2.9. Phosphoric acid found 8.87, guaranteed 10.0.

4813. Read's Standard Superphosphate. Potash found 3.83, guaranteed 4.0.

4764. Berkshire Ammoniated Bone Phosphate. Available phosphoric acid found 7.87, guaranteed 8.0.

4820. Great Eastern General Fertilizer. Potash found 3.77, guaranteed 4.0.

4950. Sanderson's Superphosphate with Potash. Available phosphoric acid found 8.60, guaranteed 9.0. Potash found 3.46, guaranteed 5.0.

* See page 40.

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

Analyses requiring special notice.

The E. F. Coe Co. stated that the American Farmers' Market Garden Special, No. **5077,** page 44, should run very much higher in potash and asked that a new sample of this brand be drawn for analysis. This was done, samples being secured from two other dealers. The analysis, **4970,** page 46, which appears in the table, shows, however, practically the same composition as sample No. **5077.**

The E. F. Coe Co. also stated that the analyses of their Long Islander Market Garden Special, No. **5062,** page 46, and Red Brand Excelsior Guano, No. **5065,** page 44, should run much higher in percentages of plant food, and asked that other samples of these brands be drawn and analyzed. An effort was made to do this, but the goods could not be found at the time by our sampling agent.

The Rogers & Hubbard Co. objected that the analysis, No. **4811,** page 50, of their All Soils All Crops Phosphate showed a lower percentage of both nitrogen and potash than the average goods of this brand on the market contained, and requested that other samples be drawn and analyzed. This was accordingly done and the analysis, No. **5079,** page 46, was made, which shows percentages of both nitrogen and potash much higher than those in No. **4811,** and fully up to the guarantee.

The Bowker Fertilizer Co. asked that another sample of their Market Garden Fertilizer be drawn and examined, as the sample **5076,** page 48, showed a deficiency of potash which they believed would not be found in this brand on the average. Two samples were accordingly drawn, mixed in equal parts and analyzed. The results, No. **4760,** page 48, were substantially like those obtained on the other sample.

Cost and Valuation.

Cost.

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

The sampling agents inquire and note the price at the time each sample is drawn. The analysis, when done, is reported to each dealer from whom a sample was taken, as well as to the manufacturer of the article, in order to give opportunity for explanation or correction as regards the price or the analysis itself. When the data thus gathered show a wide range of prices further correspondence is required and the manufacturers are also consulted.

From the data thus obtained the average prices are computed.

Valuation.

The valuation has been computed in all cases in the usual manner as explained on page 16.

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

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

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

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

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

The average cost of the superphosphates is $30.14 per ton, the average valuation is $21.19, and the average percentage difference 42.2.

Last year the corresponding figures were:—Average cost, $28.43; average valuation, $20.91; percentage difference, 36.0.

These valuations, it must be remembered, are based on the assumption that the nitrogen, phosphoric acid and potash in each fertilizer are of good quality and readily available to farm crops. Chemical examination shows conclusively whether this is true in respect of potash and phosphoric acid.

The average percentage composition of these 82 nitrogenous superphosphates is:

Nitrogen	2.51
Available phosphoric acid	8.69
Potash	4.44
Cost	$30.14

How wide a range of composition there is in these 82 fertilizers and how widely different the cost of plant food in them is, may be seen from the following statement of the average amounts of nitrogen, phosphoric acid and potash which are purchasable for $30.00 spent in these factory mixed goods.

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

	Average cost per ton.	Nitrogen, pounds.	Available phosphoric acid, pounds.	Potash, pounds.
In the first 15 samples in the table	$30.90	68	162	151
In the next following 15 samples in the table	32.00	57	178	97
" " 15 " "	31.10	54	154	99
" " 14 " "	30.21	40	180	85
" " 12 " "	28.90	37	191	58
" " 11 " "	26.50	27	190	49

These figures, which are totally independent of the Station's valuation, being taken directly from the chemical analyses and the selling prices, show first, that those fertilizers which stand nearest the beginning of the tables of analyses, and therefore those in which the valuation and the cost most nearly coincide, are the ones in which can be bought the most plant food for a given sum.

Second:—These figures also show that *as a rule* in fertilizers sold at the lowest prices ("cheap fertilizers"), the plant food actually costs more than in higher priced fertilizers.

For instance, fifteen fertilizers which had the highest average selling price, $32.00, contained twice as much nitrogen and twice as much potash and only one sixteenth less of phosphoric acid than twelve other fertilizers whose average selling price was the lowest of all, $26.50. To get plant food as cheaply in these latter, as in the goods which cost $32.00 a ton, it would be necessary to buy them for about $14.00 per ton instead of $26.00. These figures are averages of groups of fertilizers. If single fertilizers were discussed, the comparison would be much more striking.

Regarding the availability of the nitrogen, it can only be said that there is no reason to believe that the nitrogen in the high-priced superphosphates is inferior in quality to that in the lower priced mixtures. Inferior stock or inferior work is more likely to be found in "cheap goods."

It is amazing that anyone can be found who will buy fertilizers having such composition as is guaranteed for some of those found in the tables below. It is not difficult to find brands in this table which contain three and a half times as much nitrogen, four and a half times as much potash, and as much phosphoric acid as other brands which sell for the same price.

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

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

PERCENTAGE COMPOSITION.

Year.	Nitrogen.	Available phosphoric acid.	Potash.	Cost per ton.
1902	2.51	8.69	4.44	30.14
1901	2.52	8.77	4.48	28.43
1900	2.48	8.77	4.54	30.00

2. *Sampled by Purchasers.*

On pages 56 and 57 are tabulated analyses of eleven samples of guanos and nitrogenous surperphosphates which were sent by interested persons to the Station for analysis. The Station assumes no direct responsibility for the sampling of these articles.

NITROGENOUS SUPERPHOSPHATES.

Station No.	Name of Brand.	Manufacturer.	Dealer.	Dealer's cash price per ton.	Valuation per ton.
	1. *Sampled by Station Agent.*				
4981	Bone, Fish and Potash	E. R. Kelsey, Branford	S. G. Cook, Branford	**$21.00**	$21.51
5004	Complete H. G. Fertilizer	Conn. Valley Orchard Co., Berlin	John Watrous, Kensington	25.00	23.13
			Manufacturer	**25.00**	
5078	Buckingham's XX Special Formula	C. Buckingham, Southport	Manufacturer	**31.00**	27.84
5063	E. Frank Coe's Fish and Potash	E. Frank Coe Co., New York	F. H. Rolf, Guilford	**21.00**	18.62
4983	Boardman's Complete Fertilizer for Potatoes and General Crops	F. E. Boardman, Westfield	Manufacturer	**30.00**	25.72
4817	Quinnipiac Market Garden Manure	American Agricultural Chemical Co., N. Y.	C. C. Pierce, Putnam	34.00	26.30
			C. Buckingham, Southport	31.00	
				32.00	
5058	Complete Manure with 10% Potash	American Agricultural Chemical Co., N. Y.	William B. McKinney, Farmington	**34.00**	27.72
5041	Armour's Blood, Bone and Potash	Armour Fertilizer Works, Baltimore	Daniels Mill Co., Hartford	**36.00**	29.08
4742	Mapes' Vegetable Manure or Complete for Light Soils	Mapes' F. & P. G. Co., New York	Mapes' Branch, Hartford	**40.00**	32.30
			J. P. Barstow & Co., Norwich	41.00	
4694	Mapes' Average Soils Complete Manure	Mapes' F. & P. G. Co., New York	Mapes' Branch, Hartford	**34.00**	27.28
			Birdsey & Raven, Meriden	35.00	
4837	Wilcox's H. G. Fish and Potash	Wilcox Fertilizer Works, Mystic	Manufacturer	**29.00**	22.86
			W. A. Howard, Woodstock	30.00	
5066	E. Frank Coe's Gold Brand Excelsior Guano	E. Frank Coe Co., New York	C. O. Jelliff & Co., Southport	**30.00**	23.60
4947	Williams & Clark's H. G. Special Fertilizer	American Agricultural Chemical Co., N. Y.	F. B. Austin, Silver Mine	35.00	26.61
			R. H. Hall, East Hampton	**34.00**	
5077	Am'n Farmers' Market Garden Special*	Am'n Farmers' Fertilizer Co., N. Y.	E. F. Strong, Colchester	33.00	26.34
				34.00	
5065	E. Frank Coe's Red Brand Excelsior Guano*	E. Frank Coe Co., New York	C. O. Jelliff & Co., Southport	**32.00**	24.79
4819	Packers' Union Gardeners' Complete Manure	American Agricultural Chemical Co., N. Y.	Chester Clark, Durham	31.00	24.68
			T. A. Tillinghast, Brooklyn	33.00	
				32.00	

* See page 40.

ANALYSES AND VALUATIONS.

Station No.	Percentage difference between cost and valuation.	Nitrogen					Phosphoric Acid.							Potash.		
		Nitrogen as Nitrates.	Nitrogen as Ammonia.	Nitrogen Organic.	Total Nitrogen. Found.	Total Nitrogen. Guaranteed.	Soluble.	Reverted.	Insoluble.	Total. Found.	Total. Guaranteed.	Available. Found.	Available. Guaranteed.	Found. As Muriate.	Found. Total.	Guaranteed.
4981	2.4*	---	0.72	2.73	3.45	**2.5**	2.29	4.03	0.74	7.06	**5.0**	6.32	----	4.59	4.59	**4.0**
5004	8.1	---	0.65	1.96	2.61	**2.5**	7.97	2.25	1.14	11.36	**11.0**	10.22	**9.0**	4.78	4.78	**4.0**
5078	11.4	---	1.01	3.21	4.22	**4.1**	4.61	2.77	1.60	8.98	**8.0**	7.38	**7.0**	7.27	7.27	**7.0**
5063	12.8	---	---	2.13	2.13	**2.0**	6.42	2.16	3.45	12.03	**7.0**	8.58	**6.0**	2.17	2.17	**2.0**
4983	16.6	0.05	---	2.70	2.75	**2.5**	5.41	2 72	0.33	8.46	----	8.13	**8.0**	10.20	10.20	**10.0**
4817	21.7	0.68	0.38	2.36	3.42	**3.3**	6.18	2.73	1.29	10.20	**9.0**	8.91	**8.0**	7.13	7.13	**7.0**
5058	22.7	0.42	0.50	2.43	3.35	**3.3**	5.74	2.22	1.46	9.42	**7.0**	7.96	**6.0**	9.96	9.96	**10.0**
5041	23.8	1.50	---	3.03	4.53	**4.1**	7.52	1.40	0.39	9.31	**10.0**	8.92	**8.0**	6.63	6.63	**7.0**
4742	23.8	3.37	0.14	2.15	5.66	**4.9**	2.53	4.60	1.94	9.07	**8.0**	7.13	**6.0**	1.04	7.34	**6.0**
4694	24.6	2.47	0.11	2.03	4.61	**4.1**	2.96	3.80	1.43	8.19	**8.0**	6.76	**7.0**	0.97	6.01	**5.0**
4837	26.9	---	0.29	3.37	3.66	**3.3**	4.34	2.47	0.49	7.30	**6.0**	6.81	----	4.73	4.73	**4.0**
5066	27.1	---	0.55	1.87	2.42	**2.4**	8.06	1.76	1.66	11.48	**9.0**	9.82	**7.5**	0.15	5.33	**6.0**
4947	27.8	0.80	0.50	2.17	3.47	**3.3**	6.18	2.83	1.30	10.31	**9.0**	9.01	**8.0**	7.23	7.23	**7.0**
5077	29.1	---	0.74	2.65	3.39	**3.0**	6.78	1.98	1.70	10.46	**9.5**	8.76	----	5.40	6.72	**7.0**
5065	29.1	---	0.62	2.18	2.80	**3.4**	9.12	1.78	1.47	12.37	----	10.90	**9.0**	0.52	4.32	**6.0**
4819	29.7	1.44	---	1.14	2.58	**2.4**	3.79	2.58	1.11	7.48	**7.0**	6.37	**6.0**	0.86	10.18	**10.0**

* Valuation exceeds cost.

NITROGENOUS SUPERPHOSPHATES.

Station No.	Name of Brand.	Manufacturer.	Dealer.	Dealer's cash price per ton.	Valuation per ton.
	1. *Sampled by Station Agent.*				
5079	Hubbard's All Soils, All Crops*	The Rogers & Hubbard Co., Middletown	Manufacturer	$30.00	$22.81
5047	Mapes' Dissolved Bone	Mapes' F. & P. G. Co., New York	Mapes' Branch, Hartford	30.00	22.78
4970	Am'n Farmers' Market Garden Special*	Am'n Farmers' Fertilizer Co., N. Y.	P. J. Kingsley & Son, Plainfield	34.00	25.80
			H. T. Childs, Woodstock	35.00	
5024	Swift-sure Superphosphate for General Use	M. L. Shoemaker & Co., Philadelphia	Olds & Whipple, Hartford	35.00	26.51
			E. B. Clark Co., Milford	34.00	
			C. A. Meeker, Southport	30.00	
4671	Animal Brand Fertilizer	Lowell Fertilizer Co., Boston	Andrew Ure, Highwood	25.00	22.69
				30.00	
4944	Wheeler's Superior Truck Fertilizer	American Agricultural Chemical Co., N. Y.	John Luby, Burlington	33.00	24.91
			H. E. Cleveland, Winsted	33.00	
4836	Wilcox's Compl'e Bone Superphosphate	Wilcox Fertilizer Works, Mystic	Lewis Ford, Norwich	29.00	21.85
			Manufacturer	29.00	
5045	Swift's Lowell Market Garden Manure	Lowell Fertilizer Co., Boston	Spencer Bros., Suffield	38.00	28.48
4985	Darling's Blood, Bone and Potash	American Agricultural Chemical Co., N. Y.	M. D. Stanley, New Britain	38.00	28.31
5062	E. Frank Coe's Long Islander Market Garden*	E. Frank Coe Co., New York	W. L. Merwin, Milford	34.00	25.32
4972	Am'n Farmers' Ammoniated Bone	Am'n Farmers' Fertilizer Co., N. Y.	H. A. Bugbee, Willimantic	25.00	20.07
			F. H, Rolf, Guilford	28.00	
			P. J. Kingsley & Son, Plainfield	27.00	
4858	Chittenden's Fish and Potash	National Fertilizer Co., Bridgeport	G. A. & H. B. Williams, E. Hartford	31.00	22.31
			W. H. Cashen, Meriden	30.00	
4709	Fish and Potash, Fisherman's Brand	Bowker Fertilizer Co., Boston	E. E. Burwell, New Haven	23.00	17.83
			Bowker's Branch, Hartford	25.00	
				24.00	
4779	Chittenden's Complete Fertilizer	National Fertilizer Co., Bridgeport	Harry Jennings, Southport	32.00	26.32
			F. Hallock, Derby	40.00	
			G. & A. Williams, East Hartford	37.00	
				36.00	

* See page 40.

ANALYSES AND VALUATIONS—*Continued.*

Station No.	Percentage difference between cost and valuation.	Nitrogen: Nitrogen as Nitrates.	Nitrogen: Nitrogen as Ammonia.	Nitrogen: Nitrogen Organic.	Nitrogen: Total Nitrogen. Found.	Nitrogen: Total Nitrogen. Guaranteed.	Phosphoric Acid: Soluble.	Phosphoric Acid: Reverted.	Phosphoric Acid: Insoluble.	Phosphoric Acid: Total. Found.	Phosphoric Acid: Total. Guaranteed.	Phosphoric Acid: Available. Found.	Phosphoric Acid: Available. Guaranteed.	Potash. Found. As Muriate.	Potash. Found. Total.	Potash. Guaranteed.
5079	31.5	1.14	---	1.48	2.62	**2.3**	6.19	4.46	2.92	13.57	**12.0**	10.65	**10.0**	3.69	3.69	**3.0**
5047	31.7	0.30	0.18	2.18	2.66	**2.1**	5.23	9.02	1.87	16.12	----	14.25	**12.0**	----	----	----
4970	31.8	---	0.70	2.63	3.33	**3.4**	6.69	2.19	1.70	10.58	**9.5**	8.88	**8.0**	5.37	6.28	**7.0**
5024	32.0	0.87	---	2.03	2.90	**2.8**	7.92	3.37	3.60	14.89	----	11.29	----	0.52	4.89	**4.5**
4671	32.2	---	0.20	2.64	2.84	**2.5**	8.40	1.46	0.99	10.85	**10.0**	9.86	**9.0**	3.78	3.78	**4.0**
4944	32.5	0.42	0.62	2.03	3.07	**3.3**	6.78	2.13	0.79	9.70	**9.0**	8.91	**8.0**	6.92	6.92	**7.0**
4836	32.7	0.27	0.26	2.21	2.74	**2.1**	4.64	4.62	2.37	11.63	**9.0**	9.26	**8.0**	3.69	3.69	**3.0**
5045	33.4	1.58	---	2.93	4.51	**4.1**	4.98	2.61	1.39	8.98	**8.0**	7.59	**7.0**	0.57	6.26	**6.0**
4985	34.2	1.02	0.27	2.69	3.98	**4.1**	4.43	4.95	0.39	9.77	**8.0**	9.38	**7.0**	7.58	7.58	**7.0**
5062	34.3	---	1.02	1.96	2.98	**3.4**	8.35	2.13	1.55	12.03	**10.0**	10.48	**8.5**	3.11	5.06	**6.0**
4972	34.5	0.32	0.25	1.61	2.18	**2.0**	7.60	2.38	2.06	12.04	**9.5**	9.98	**8.0**	0.54	2.49	**2.0**
4858	34.5	---	---	2.78	2.78	**3.0**	5.74	2.11	1.39	9.24	**6.0**	7.85	----	0.31	4.99	**4.0**
4709	34.6	---	0.34	2.29	2.63	**2.3**	2.03	3.15	1.54	6.72	**6.0**	5.18	----	4.31	4.31	**4.0**
4779	36.7	---	0.73	2.83	3.56	**3.3**	6.90	2.29	0.92	10.11	**10.0**	9.19	**8.0**	6.17	6.17	**6.0**

NITROGENOUS SUPERPHOSPHATES.

Station No.	Name of Brand.	Manufacturer.	Dealer.	Dealer's cash price per ton.	Valuation per ton.
	1. *Sampled by Station Agent.*				
4794	Sanderson's Formula A	Sanderson Fertilizer & Chemical Co., New Haven	Manufacturer	$35.00	$25.60
			J. G. Schwink, Meriden	35.00	
			Morse & Son, Guilford	35.00	
4839	Wilcox's Fish and Potash	Wilcox Fertilizer Works, Mystic	Manufacturer	26.00	18.83
			Olds & Whipple, Hartford	28.00	
4700	Swift's Lowell Animal Brand	Lowell Fertilizer Co., Boston	Standard Feed Co., Bridgeport	30.00	22.43
			J. C. Lincoln Berlin	32.00	
				31.00	
5003	Great Eastern Garden Special	American Agricultural Chemical Co., N. Y.	F. M. Loomis, North Granby	34.00	24.61
5000	Cecrops or Dragon's Tooth Brand	Fred'k Ludlam, N. Y.	S. A. Smith, Clintonville	34.00	24.59
			J. M. Beckwith, Chesterfield	35.00	
4757	Darling's Farm Favorite	American Agricultural Chemical Co., N. Y.	A. R. Manning & Co., Yantic	30.00	21.67
			F. A. Chamberlain, Terryville	30.00	
			Hotchkiss & Templeton, Waterbury	30.00	
4706	Essex XXX Fish and Potash	Russia Cement Co., Gloucester, Mass.	Spencer Bros., Suffield	31.00	21.60
			E. N. Pierce & Co., Plainville	32.00	
				30.00	
4982	James' Bone Phosphate	E. L. James, Warrenville	Manufacturer	30.00	21.43
4797	Fish and Potash	Rogers' Mfg. Co., Rockfall	Meeker Coal Co.	30.00	20.24
			Rockville Milling Co., Rockville	27.00	
				28.50	
4856	Complete Fertilizer	Berkshire Fertilizer Co., Bridgeport	Manufacturer	33.00	23.33
			Otis Bros., Norwich	33.00	
			L. Mullaley, Windsor	34.00	
5052	Wilcox's Special Superphosphate	Wilcox Fertilizer Works, Mystic	Manufacturer	25.00	17.66
4701	O. & W.'s Special Phosphate	Olds & Whipple, Hartford	Manufacturer	34.00	23.84
4802	Bradley's Farmers' New Method Fertilizer	American Agricultural Chemical Co., N. Y.	D. L. Clark, Milford	28.00	19.51
			E. C. Dennis, Stafford	28.00	
5076	Bowker's Market Garden Fertilizer*	Bowker Fertilizer Co., Boston	Bowker's Branch, Hartford	34.00	23.68
4760	Bowker's Market Garden Fertilizer*	Bowker Fertilizer Co., Boston	Bowker's Branch, Hartford	35.00	23.53
			O. H. Meeker, Danbury	34.00	

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ANALYSES AND VALUATIONS—*Continued.*

Station No.	Percentage difference between cost and valuation.	Nitrogen: Nitrogen as Nitrates.	Nitrogen: Nitrogen as Ammonia.	Nitrogen: Nitrogen Organic.	Nitrogen: Total Nitrogen. Found.	Nitrogen: Total Nitrogen. Guaranteed.	Phosphoric Acid: Soluble.	Phosphoric Acid: Reverted.	Phosphoric Acid: Insoluble.	Phosphoric Acid: Total. Found.	Phosphoric Acid: Total. Guaranteed.	Phosphoric Acid: Available. Found.	Phosphoric Acid: Available. Guaranteed.	Potash: Found. As Muriate.	Potash: Found. Total.	Potash: Guaranteed.
4794	36.7	0.11	0.50	3.11	3.72	**3.3**	3.36	3.73	3.07	10.16	**10.0**	7.09	**6.0**	6.37	6.37	**6.0**
4839	38.1	---	0.26	2.51	2.77	**2.5**	2.85	3.12	1.45	7.42	**6.0**	5.97	**5.0**	4.06	4.06	**3.0**
4700	38.2	---	---	2.84	2.84	**2.5**	6.57	2.67	0.99	10.23	**10.0**	9.24	**9.0**	4.34	4.34	**4.0**
5003	38.2	0.39	0.46	1.93	2.78	**3.3**	7.14	2.11	0.89	10.14	**9.0**	9.25	**8.0**	7.24	7.24	**7.0**
5000	38.3	1.14	---	2.04	3.18	**3.0**	5.20	2.42	2.42	10.04	----	7.62	**7.0**	7.16	7.16	**7.0**
4757	38.4	0.13	---	2.45	2.58	**2.1**	6.24	3.68	0.33	10.25	**9.0**	9.92	**8.0**	4.14	4.14	**3.0**
4706	38.8	0.50	---	2.02	2.52	**2.1**	6.13	3.04	3.90	13.07	**12.0**	9.17	----	3.53	3.53	**2.3**
4982	40.0	---	---	2.60	2.60	---	3.20	7.12	3.32	13.64	----	10.32	----	2.25	2.25	----
4797	40.8	---	---	3.26	3.26	**3.3**	2.42	2.77	2.40	7.59	**6.0**	5.19	**4.0**	4.25	4.25	**3.8**
4856	41.4	0.48	---	2.26	2.74	**2.5**	5.04	2.84	2.64	10.52	**10.0**	7.88	**8.0**	6.09	6.68	**6.0**
5052	41.6	0.22	0.20	1.39	1.81	**1.0**	2.30	7.23	2.75	12.28	**9.0**	9.53	----	2.16	2,16	**1.5**
4701	42.6	1.82	---	2.76	4.58	**4.1**	1.47	3.65	1.74	6.86	----	5.12	**4.0**	0.19	3.84	**3.3**
4802	43.5	0.30	0.12	1.80	2.22	**1.7**	5.66	3.20	2.30	11.16	**10.0**	8.86	**8.0**	3.30	3.30	**3.0**
5076	43.6	0.60	0.10	1.90	2.60	**2.3**	4.74	2.64	2.25	9.63	**7.0**	7.38	**6.0**	8.54	8.54	**10.0**
4760	44.5	0.79	0.16	1.69	2.64	**2.3**	3.65	3.21	2.52	9.38	**7.0**	6.86	**6.0**	8.82	8.82	**10.0**

NITROGENOUS SUPERPHOSPHATES.

Station No.	Name of Brand.	Manufacturer.	Dealer.	Dealer's cash price per ton.	Valuation per ton.
	1. *Sampled by Station Agent.*				
4799	Hubbard's Corn and General Crops	The Rogers & Hubbard Co., Middletown	Schwarz Bros., Rockville	$35.00	$23.45
			R. H. Hall, East Hampton	34.00	
4780	Chittenden's Market Garden Fertilizer	National Fertilizer Co., Bridgeport	Harry Jennings, Southport	30.00	23.41
			F. Hallock, Derby	38.00	
				34.00	
4860	Ammoniated Bone and Potash	Ohio Farmers' Fertilizer Co., Columbus, Ohio	R. B. Witter, Brooklyn	25.00	16.97
			D. G. Arnold, Putnam	26.00	
4741	Mapes' Complete Manure, A Brand	Mapes' F. & P. G. Co., New York	J. P. Barstow & Co., Norwich	34.00	23.01
			Birdsey & Raven, Meriden	34.00	
			Southington Lumber Co., Southington	32.00	
4986	Crocker's New Rival	American Agricultural Chemical Co., N. Y.	F. M. Loomis, North Granby	25.00	16.82
4811	Hubbard's All Soils,* All Crops Phosphate	The Rogers & Hubbard Co., Middletown	John Bransfield, Portland	30.00	20.17
			J. H. Burrill, Liberty Hill	30.00	
4952	Sanderson's Special with 10% Potash	Sanderson's Fertilizer & Chemical Co., New Haven	F. O. Ives, West Cheshire	35.00	23.53
4857	Bowker's Hill and Drill Phosphate	Bowker Fertilizer Co., Boston	C. A. Young & Co., Danielson	30.00	20.82
			Southington Lumber Co., Southington	32.00	
				31.00	
5029	Lister's Standard Pure Bone Superphosphate of Lime	Lister's Agricultural Chem. Works, Newark, N. J.	A. N. Clark, Milford	32.00	21.30
4834	Luce Bros. Bone, Fish and Potash	Sanderson Fertilizer & Chemical Co., New Haven	Manufacturer	25.00	16.51
			E. B. Clark Co., Milford	26.00	
			Morse & Son, Guilford	25.00	
4798	All Round Fertilizer	Rogers Mfg. Co., Rockfall, Conn.	Manufacturer	28.00	18.47
			Rockville Milling Co., Rockville	26.00	
5042	Armour's All Soluble	Armour's Fertilizer Co., Baltimore	Meriden Grain and Feed Co., Meriden	38.00	20.95
			Ansonia Feed Co., Ansonia	32.00	
4699	Bradley's XL Superphosphate	American Agricultural Chemical Co., New York	Spencer Bros., Suffield	32.00	20.87
			F. S. Bidwell, Windsor Locks	32.00	

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ANALYSES AND VALUATIONS—*Continued.*

Station No.	Percentage difference between cost and valuation.	Nitrogen					Phosphoric Acid.							Potash.		
		Nitrogen as Nitrates.	Nitrogen as Ammonia.	Nitrogen Organic.	Total Nitrogen. Found.	Total Nitrogen. Guaranteed.	Soluble.	Reverted.	Insoluble.	Total. Found.	Total. Guaranteed.	Available. Found.	Available. Guaranteed.	Found. As Muriate.	Found. Total.	Guaranteed.
4799	45.0	1.17	---	1.33	2.50	**2.5**	3.44	3.97	2.04	9.45	**8.0**	7.41	**6.0**	9.08	9.08	**8.0**
4780	45.2	---	0.48	2.11	2.59	**2.5**	6.43	2.53	1.27	10.23	**9.0**	8.96	**8.0**	6.65	6.65	**6.0**
4860	47.3	0.04	---	1.12	1.16	**0.8**	5.07	4.01	2.25	11.33	**10.0**	9.08	**8.0**	4.20	4.20	**4.0**
4741	47.8	1.44	0.18	1.18	2.80	**2.5**	2.67	8.87	2.20	13.74	**12.0**	11.54	**10.0**	3.15	3.15	**2.5**
4986	48.6	---	---	1.10	1.10	**1.0**	8.16	2.52	1.47	12.15	**9.0**	10.68	**8.0**	2.55	2.55	**2.0**
4811	48.7	0.61	---	1.20	1.81	**2.3**	6.85	4.99	2.54	14.38	**12.0**	11.84	**10.0**	2.38	2.38	**3.0**
4952	48.7	---	0.22	1.81	2.03	**2.5**	4.69	2.68	1.41	8.78	**9.0**	7.37	**5.0**	10.79	10.79	**10.0**
4857	48.9	0.39	0.50	1.86	2.75	**2.3**	6.50	2.88	2.10	11.48	**11.0**	9.38	**9.0**	2.27	2.27	**2.0**
5029	50.2	---	0.80	1.40	2.20	**2.5**	9.28	1.61	1.29	12.18	**11.0**	10.89	**9.0**	1.77	3.06	**2.0**
4834	51.4	---	0.44	1.74	2.18	**1.7**	1.26	3.18	4.07	8.51	**6.0**	4.44	**4.0**	4.20	4.20	**4.0**
4798	51.6	trace	---	2.12	2.12	**1.7**	5.42	3.16	2.33	10.91	**10.0**	8.58	**8.0**	2.68	2.68	**2.0**
5042	52.7	1.35	---	1.41	2.76	**2.9**	8.19	0.58	0.10	8.87	**10.0**	8.77	**8.0**	4.12	4.12	**4.0**
4699	53.3	---	---	2.52	2.52	**2.5**	6.88	3.12	1.78	11.78	**11.0**	10.00	**9.0**	2.53	2.53	**2.0**

NITROGENOUS SUPERPHOSPHATES.

Station No.	Name of Brand.	Manufacturer.	Dealer.	Dealer's cash price per ton.	Valuation per ton.
	1. *Sampled by Station Agent.*				
4855	Church's Fish and Potash	American Agricultural Chemical Co., New York	J. H. Barker, Branford	$23.00	$16.89
			C. S. Gillette, Cheshire	28.00	
			J. & H. Woodford, Avon	28.00	
				26.00	
5002	Williams & Clark's Americus Ammoniated Bone Superphosphate	American Agricultural Chemical Co., New York	R. H. Hall, East Hampton	**32.00**	20.74
			D. B. Wilson, Waterbury	32.00	
4743	Quinnipiac Phosphate	American Agricultural Chemical Co., New York	F. S. Bidwell, Windsor Locks	**32.00**	20.69
			G. M. Williams Co., New London	32.00	
4964	East India A. A. Ammoniated Superphosphate	American Agricultural Chemical Co., New York	Edward White, Rockville	30.00	21.02
			W. F. Andrews, East Hartford	35.00	
			S. C. Hardin, Glastonbury	34.00	
				33.00	
4755	Success Fertilizer	Lister's Agricultural Chem. Works, Newark, N. J.	S. A. Billings, Meriden	29.00	17.60
			A. N. Clark, Milford	**28.00**	
4702	Swift's Lowell Bone Fertilizer	Lowell Fertilizer Co., Boston	Standard Feed Co., Bridgeport	28.00	
			J. C. Lincoln, Berlin	30.00	17.90
				29.00	
5034	Packer's Union Universal Fertilizer	American Agricultural Chemical Co., New York	Geo. W. Eaton, Bristol	28.00	16.66
			Rockville, Milling Co., Rockville	**27.00**	
			F. L. Mackey, Ellington	27.00	
5048	Mapes' Cereal Brand	Mapes' F. & P. G. Co., N. Y.	Mapes' Branch, Hartford	**27.00**	16.57
			A. N. Clark, Milford	29.00	
4813	Read's Standard Superphosphate	American Agricultural Chemical Co., New York	L. A. Fenton, Norwich Town	**27.00**	16.53
			Oren Russ, Mt. Hope	27.00	
5064	E. Frank Coe's Ammoniated Bone Superphosphate	E. Frank Coe Co., New York	J. P. Barstow & Co., Norwich	**32.00**	19.36
5001	Cereal Brand Cecrops Fertilizer	Fred'k Ludlam, New York	S. A. Smith, Clintonville	**24.00**	14.45
			J. M. Beckwith, Chesterfield	24.00	
4754	Chittenden's Ammoniated Bone Phosphate	National Fertilizer Co., Bridgeport	Harry Jennings, Southport	26.00	17.40
			Gault Bros., Westport	30.00	
			Mrs. E. R. Aiken, Silver Mine	30.00	
				29.00	

ANALYSES AND VALUATIONS—*Continued.*

Station No.	Percentage difference between cost and valuation.	Nitrogen					Phosphoric Acid.							Potash.		
		Nitrogen as Nitrates.	Nitrogen as Ammonia.	Nitrogen Organic.	Total Nitrogen. Found.	Total Nitrogen. Guaranteed.	Soluble.	Reverted.	Insoluble.	Total. Found.	Total. Guaranteed.	Available. Found.	Available. Guaranteed.	Found. As Muriate.	Found. Total.	Guaranteed.
4855	53.9	---	0.14	1.93	2.07	**2.1**	4.86	2.74	1.61	9.21	**7.5**	7.60	**6.0**	2.46	2.46	**2.0**
5002	54.3	0.54	---	2.05	2.59	**2.5**	6.43	3.72	1.73	11.88	**9.0**	10.15	**7.0**	2.21	2.21	**2.0**
4743	54.7	0.26	---	2.37	2.63	**2.5**	6.53	3.19	1.95	11.67	**11.0**	9.72	**9.0**	2.25	2.25	**2.0**
4964	57.0	0.42	0.50	1.77	2.69	**2.5**	7.49	2.09	1.38	10.96	**11.0**	9.58	**9.0**	2.77	2.77	**2.0**
4755	59.1	---	---	1.52	1.52	**1.2**	8.40	1.90	1.33	11.63	**11.0**	10.30	**9.0**	2.28	2.28	**2.0**
4702	62.0	---	---	2.01	2.01	**1.7**	6.27	1.98	0.78	9.03	**9.0**	8.25	**8.0**	3.42	3.42	**3.0**
5034	62.1	---	---	1.06	1.06	**0.8**	6.22	2.83	2.14	11.19	**10.0**	9.05	**8.0**	4.15	4.15	**4.0**
5048	62.9	0.57	---	1.36	1.93	**1.7**	3.09	4.32	1.56	8.97	**8.0**	7.41	**6.0**	3.26	3.26	**3.0**
4813	63.3	---	---	1.07	1.07	**0.8**	6.21	2.90	2.31	11.42	**10.0**	9.11	**9.0**	3.83	3.83	**4.0**
5064	65.3	---	0.45	1.57	2.02	**1.3**	7.78	2.10	1.92	11.80	**10.0**	9.88	**9.0**	0.28	2.29	**2.3**
5001	66.1	0.05	---	0.90	0.95	**0.8**	5.22	4.34	3.03	12.59	**10.0**	9.56	**8.0**	1.17	1.17	**1.0**
4754	66.6	---	---	1.75	1.75	**1.8**	6.48	2.55	1.68	10.71	**10.0**	9.03	**8.0**	2.55	2.55	**2.0**

NITROGENOUS SUPERPHOSPHATES.

Station No.	Name of Brand.	Manufacturer.	Dealer.	Dealer's cash price per ton.	Valuation per ton.
	1. *Sampled by Station Agent.*				
4764	Ammoniated Bone Phosphate	Berkshire Fertilizer Co., Bridgeport	Manufacturer	$26.00	$16.00
			F. C. Benjamin & Co., Danbury	28.00	
				27.00	
4969	Armour's Ammoniated Bone with Potash	Armour Fertilizer Works, Baltimore	F. C. Benjamin & Co., Danbury	28.00	17.11
			Meriden Feed Co., Meriden	38.00	
			Daniels Mill Co., Hartford	30.00	
				29.00	
4763	Bowker's Farm and Garden Phosphate	Bowker Fertilizer Co., Boston	Lightbourn & Pond Co., New Haven	33.00	17.08
			O. H. Meeker, Danbury		
				29.00	
4820	Great Eastern General Fertilizer	American Agricultural Chemical Co., New York	Frank Gates, East Hampton	30.00	16.48
			T. E. Greene, Plainfield	26.00	
			H. S. Harvey, Windham		
				28.00	
4984	Quinnipiac Climax Phosphate	American Agricultural Chemical Co., N. Y.	J. P. Lathrop, Plainfield	**26.00**	15.05
5074	Bowker's Sure Crop Phosphate	Bowker Fertilizer Co., Boston	Grant Grocery Co., Naugatuck	30.00	15.57
				27.00	
4832	Essex A1 Superphosphate	Russia Cement Co., Gloucester, Mass.	Henry Davis, Durham Center	23.00	14.30
			A. R. Manning & Co., Yantic	27.00	
				25.00	
4859	Chittenden's Universal Phosphate	National Fertilizer Co., Bridgeport	Gault Bros., Westport	26.00	14.15
			W. H. Cashen, Meriden	24.00	
				25.00	
4774	Bradley's Eclipse Phosphate	American Agricultural Chemical Co., New York	Phineas Platt, Milford	----	15.45
			H. A. Doyle, Burnside	**28.00**	
4775	Bradley's Niagara Phosphate	American Agricultural Chemical Co., New York	Phineas Platt, Milford	----	12.98
			A. A. Cashen, Meriden	**25.00**	
4861	General Crop Fish Guano	Ohio Farmers' Fertilizer Co., Columbus, Ohio	R. B. Witter, Brooklyn, Conn.	25.00	12.42
			D. G. Arnold, Putnam	**24.00**	
4950	Sanderson's Superphosphate with Potash	Sanderson Fertilizer & Chemical Co., New Haven	T. H. Eldridge, Norwich	28.00	12.05
			Johnson Bros., Jewett City	25.00	
				26.00	

ANALYSES AND VALUATIONS—*Continued.*

Station No.	Percentage difference between cost and valuation.	Nitrogen					Phosphoric Acid.							Potash.		
		Nitrogen as Nitrates.	Nitrogen as Ammonia.	Nitrogen Organic.	Total Nitrogen. Found.	Total Nitrogen. Guaranteed.	Soluble.	Reverted.	Insoluble.	Total. Found.	Total. Guaranteed.	Available. Found.	Available. Guaranteed.	Found. As Muriate.	Found. Total.	Guaranteed.
4764	68.8	0.08	---	1.27	1.35	**0.8**	5.02	2.85	2.86	10.73	**10.0**	7.87	**8.0**	1.16	3.01	**2.0**
4969	69.5	0.05	---	2.40	2.45	**2.5**	5.30	1.66	0.89	7.85	----	6.96	**6.0**	2.22	2.22	**2.0**
4763	69.8	0.32	0.11	1.24	1.67	**1.5**	4.93	4.18	3.11	12.22	**11.0**	9.11	**9.0**	2.05	2.05	**2.0**
4820	69.9	---	---	1.09	1.09	**0.8**	6.10	2.92	2.37	11.39	**10.0**	9.02	**9.0**	3.77	3.77	**4.0**
4984	72.8	---	---	1.26	1.26	**1.1**	5.09	3.37	2.41	10.87	**10.0**	8.46	**8.0**	2.13	2.13	**2.0**
5074	73.4	0.35	---	0.70	1.05	**0.8**	5.30	4.58	2.93	12.81	**10.0**	9.88	**8.0**	1.90	1.90	**2.0**
4832	74.8	---	---	1.17	1.17	**1.0**	2.13	4.80	5.11	12.04	**9.0**	6.93	----	2.29	2.29	**2.0**
4859	76.7	---	---	1.14	1.14	**0.8**	5.95	2.87	1.84	10.66	**10.0**	8.82	**8.0**	1.32	1.32	**1.0**
4774	81.2	---	---	1.24	1.24	**1.0**	5.63	3.30	1.98	10.91	**10.0**	8.93	**8.0**	2.32	2.32	**2.0**
4775	92.6	---	---	1.07	1.07	**0.8**	5.20	2.76	1.33	9.29	**8.0**	7.96	**7.0**	1.46	1.46	**1.0**
4861	93.2	0.05	---	1.03	1.08	**0.8**	3.02	4.81	1.52	9.35	**8.0**	7.83	**7.0**	1.07	1.07	**1.0**
4950	115.8	---	---	---	---	---	3.06	5.54	1.94	10.54	----	8.60	**9.0**	1.62	3.46	**5.0**

NITROGENOUS SUPERPHOSPHATES.

Station No.	Name of Brand.	Manufacturer or Dealer.	Sent by	Dealer's cash price per ton.	Valuation per ton.
	2. *Sampled by Purchasers.*				
4574	Lobos Peruvian Guano	Edmund Mortimer, New York	E. P. Brewer, Silver Lane	$30.00	$29.83
6117	Peruvian Guano		E. N. Austin, Suffield	30.00	29.83
4956	Mapes' Complete for Light Soils	Mapes' F. & P. G. Co., New York	Josiah Hawkins, Southport	36.00	31.68
5038	East India Brand, Special Fertilizer	American Agricultural Chemical Co., N. Y.	A. P. Wakeman, Fairfield	26.00	22.18
4958	Sanderson's Formula A	Sanderson Fertilizer & Chemical Co., New Haven	O. G. Beard, Shelton	35.00	26.54
4804	James' Bone Phosphate	Ernest L. James, Warrenville, Conn.	Manufacturer	30.00	21.77
4772	Sanderson's Bone, Fish and Potash	Sanderson Fertilizer & Chemical Co., New Haven	E. L. Crane, Groton	25.00	17.95
4992	Sanderson's Bone, Fish and Potash	Sanderson Fertilizer & Chemical Co., New Haven	Daniel Morgan, Poquonoc Bridge	23.75	17.04
4713	Superphosphate	G. W. Miles, Milford	J. A. Northrup, Woodmont	---*	17.25
4712	Superphosphate	G. W. Miles, Milford	J. A. Northrup, Woodmont	---*	13.94
6129	Special Mixture	Sanderson Fertilizer & Chemical Co., New Haven	E. B. Clark Co., Milford	---	20.94

* Bought at auction.

SPECIAL MANURES.

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

1. *Samples Drawn by Station Agent.*

In the table on pages 62 to 77 are given analyses of one hundred and five brands represented by samples drawn by the Station agents.

ANALYSES AND VALUATIONS—*Continued.*

Station No.	Percentage difference between cost and valuation.	Nitrogen					Phosphoric Acid.							Potash.		
		Nitrogen as Nitrates.	Nitrogen as Ammonia.	Nitrogen Organic.	Total Nitrogen. Found.	Total Nitrogen. Guaranteed.	Soluble.	Reverted.	Insoluble.	Total. Found.	Total. Guaranteed.	Available. Found.	Available. Guaranteed.	Found. As Muriate.	Found. Total.	Guaranteed.
4574	0.6	0.14	1.68	0.72	2.54	---	1.06	12.72	20.06	33.84	----	13.78	----	1.13	1.13	----
6117	0.6	0.17	1.67	0.65	2.49	---	1.04	13.16	19.76	33.96	----	14.20	----	1.05	1.05	----
4956	13.6	3.65	---	1.93	5.58	**4.9**	2.22	4.99	1.96	9.17	**8.0**	7.21	**6.0**	1.22	7.05	**6.0**
5038	17.2	---	1.01	1.59	2.60	**2.5**	5.28	3.01	1.28	9.57	**9.0**	8.29	**8.0**	6.00	6.00	**6.0**
4958	31.9	0.64	0.12	3.00	3.76	**3.3**	4.86	3.85	2.57	11.28	**10.0**	8.71	**6.0**	5.84	5.84	**6.0**
4804	37.8	---	---	2.59	2.59	---	3.31	7.76	2.58	13.65	----	11.07	----	2.24	2.24	----
4772	39.2	---	---	1.84	1.84	---	7.54	2.95	0.33	10.82	----	10.49	----	1.84	1.84	----
4992	39.4	---	0.35	1.90	2.25	**1.7**	1.63	3.51	2.36	7.50	**6.0**	5.14	**4.0**	4.58	4.58	**4.0**
4713	----	0.33	0.38	1.54	2.25	---	2.94	2.92	2.11	7.97	----	5.86	----	4.14	4.14	----
4712	----	0.21	0.58	1.61	2.40	---	1.41	2.91	3.36	7.68	----	4.32	----	2.65	3.14	----
6129	----	---	---	1.98	1.98	---	4.69	1.97	0.95	7.61	----	6.66	----	8.91	8.91	----

GUARANTEES.

Of the samples represented in the following tables, ten failed to come up to the maker's guarantee in respect to the percentage of nitrogen, eight in respect to that of phosphoric acid, and twenty in respect to that of potash.

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

5075. Bowker's Tobacco Ash Elements. Potash found 14.45 per cent., guaranteed 15.0.

5027. Chittenden's High Grade Special Tobacco Manure. Nitrogen found 5.57, guaranteed 5.7.

5072. Bowker's Fairfield Onion Fertilizer. Available phosphoric acid found 7.81, guaranteed 8.0.

4749. Shay's Mystic Gilt Edge Potato Manure. Potash found 4.38, guaranteed 5.0.

5051. Olds & Whipple's complete Tobacco Fertilizer. Potash found 4.27, guaranteed 5.5.

5059. American Agricultural Chemical Co.'s High grade Tobacco Manure. Nitrogen found 5.53, guaranteed 5.8. Potash found 9.75, guaranteed 10.0.

4862. Hubbard's Soluble Tobacco Manure. Potash found 9.29, guaranteed 10.0.

4751. Stockbridge Potato and Vegetable Manure. Potash found 8.93, guaranteed 10.0.

4987. Baker's Complete Potato Manure. Nitrogen found 3.14, guaranteed 3.3.

4803. American Farmer's Complete Potato Manure. Potash found 5.50, guaranteed 6.0.

6128. Chittenden's Complete Tobacco Fertilizer. Nitrogen found 3.18, guaranteed 3.3. Six other samples of the same brand, 6123, 6124, 5026, 6126, 6125, and 6127 did not meet the manufacturer's guarantee of potash.

5023. Shoemaker's Swift-Sure Superphosphate for Potatoes.* Nitrogen found 2.62, guaranteed 2.9. Potash found 6.85, guaranteed 7.0.

4953. Sanderson's Top Dressing Fertilizer. Total Phosphoric acid found 7.29, guaranteed 8.0. Available phosphoric acid found 4.53, guaranteed 6.0.

4974. American Agricultural Chemical Co.'s Tobacco Starter and Grower. Potash found 3.57, guaranteed 4.0.

5061. Coe's Special Potato Fertilizer. Potash found 3.57, guaranteed 4.0.

4975. Armour's High Grade Potato Manure. Nitrogen found 1.45, guaranteed 1.6.

5050. Olds & Whipple's Potato Manure. Available phosphoric acid found 4.60, guaranteed 5.0. Potash found 6.81, guaranteed 7.0.

5081. Sanderson's Old Reliable Superphosphate. Nitrogen found 2.29, guaranteed 2.5. Available phosphoric acid found 5.93, guaranteed 7.0.

4711.* Mapes' Top Dresser. Improved, half strength. Nitrogen found 4.61, guaranteed 4.9. Phosphoric acid found 3.57, guaranteed 4.0.

5083. Mapes' Top Dresser. Improved, half strength. Nitrogen found 4.46, guaranteed 4.9.

5057. American Agricultural Chemical Co.'s Grass and Lawn Top Dressing. Nitrogen found 3.74, guaranteed 3.9.

4968. Bowker's Corn Phosphate. Potash found 2.09, guaranteed 2.4.

5035. Packer's Wheat, Oats and Clover Fertilizer. Phosphoric acid found 11.78, guaranteed 12.0.

* See page 59.

5067. Coe's Columbian Corn Fertilizer. Nitrogen found 1.03, guaranteed 1.2. Potash found 1.86, guaranteed 2.5.

4762. Bowker's Potato and Vegetable Phosphate. Available phosphoric acid found 8.83, guaranteed 9.0.

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

Analyses requiring Special Notice.

Chittenden's Complete Tobacco Fertilizer, **5086, 6123, 6124, 6125, 6126, 6127, 6128, 5026.**

The analysis of **5086** was reported to the sender of the sample erroneously, all the potash being reported as muriate, whereas the larger part of it was in the form of sulphate.

The error was corrected as soon as it was called to the attention of the Station, and at request of the manufacturer our sampling agent drew samples of this brand from all places in the neighborhood where it could be found, and these samples were analyzed with the results which appear in the table.

M. L. Shoemaker & Co. objected that the analysis, **5023**, of their Swift-Sure Superphosphate for Potatoes ran nearly half a per cent. short in ammonia and nearly three-quarters of one per cent. short in potash. A retest of the sample confirmed our previous figures, and it was not possible for us to find other samples of this brand on sale after this protest of the manufacturer reached us.

The manufacturers claim that at least half of the potash in Mapes' Tobacco Manure, Wrapper Brand, **4777**, page 64, and in Mapes' Tobacco Ash Constituents, **4698**, page 72, is present as carbonate.

In the foregoing tables the valuations of these brands are made, reckoning the potash as sulphate. If half of it, in each case, is figured as carbonate, at 7¼ cents per pound, the valuation of the Wrapper Brand Tobacco Manure would be $37.79 per ton, and of the Tobacco Ash Constituent, $24.47.

Mapes' Top Dresser, Improved, half strength, No. **4711**, page 74, is stated by the manufacturer to be made of nitrate of potash, nitrate of soda, sulphate of ammonia, Peruvian guano and plaster. Of course, a valuation such as is employed here

does not represent, and is not intended to represent, the cost of plant food in chemicals which are exceptionally expensive or seldom used in commercial fertilizers. After receiving the above statement from the manufacturer a second sample of this brand was drawn, No. **5083**, the analysis of which is given on page 76.

The E. F. Coe Co. stated that the analysis of their Columbian Corn Manure, No. **5067**, should run much higher in percentages of plant food, and asked that other samples of this brand should be drawn and analyzed. An effort was made to do this but the goods could not be found at the time by our sampling agent.

Cost and Valuation.

The method of ascertaining the retail cash cost price of the special manures and of computing the valuation is the same as described on page 41.

The average cost per ton of the one hundred and ten special manures included in the tables was $33.35, the valuation, $24.05, and the percentage difference, 38.7.

In 1901 the corresponding figures were:—Average cost, $32.64; valuation, $23.80; and percentage difference, 37.1.

2. *Special Manures Sampled by Purchasers.*

In the tables, on pages 62 and 77, are also included three analyses of samples of special manures sent to the Station by purchasers.

Tobacco Manures claimed to contain Potash as Carbonate or Nitrate.

In the following table are analyses of a number of tobacco fertilizers which are claimed to contain potash, chiefly, or wholly, in form of nitrate or carbonate. Since potash in these forms costs considerably more than in sulphate and muriate, it should not be valued at the same rate as in mixed fertilizers. It is not possible in most cases to determine by analysis whether the manufacturer's claims are well-founded, but, *assuming potash to be present in form of nitrate or carbonate* and valued at 7¼ cents per pound, the valuations are as given in the table:

5075. Bowker's Tobacco Ash Elements, made by Bowker Fertilizer Co., Boston. Sampled from stock of Bowker Branch, Hartford.

5051 and **4840.** Olds & Whipple's Complete Tobacco Fertilizer, made by Olds & Whipple, Hartford. Sampled from stock of manufacturer.

5005. Pouleur's Pure Carbonate of Potash Tobacco Starter, made by Auguste Pouleur, Windsor. Sampled from stock of manufacturer.

4696. Mapes' Tobacco Starter, Improved,, made by the Mapes F. & P. G. Co., New York. Sampled from Mapes' Branch, Hartford, Spencer Bros., Suffield, and F. S. Bidwell, Windsor Locks.

Analyses of Brands Claimed to Contain Potash in Form of Carbonate or Nitrate.

Percentage amounts of	5075	5051	4840	5005	4696
Nitrogen as nitrates	----	----	----	2.08	1.52
" " ammonia	----	0.22	----	----	0.14
" organic	----	4.84	4.94	0.54	2.94
" total	----	5.06	4.94	2.62	4.60
" guaranteed	----	**4.5**	**4.5**	**2.5**	**4.1**
Phosphoric acid, soluble	0.14	----	----	----	2.32
" " reverted	7.23	3.55	3.76	4.69	4.51
" " insoluble	1.83	2.97	2.97	6.00	2.28
" " total	9.20	6.52	6.73	10.69	9.11
" " guaranteed	----	----	----	**7.0**	**8.0**
Available phos. acid found	7.37	3.55	3.76	4.69	6.83
" " " guaranteed	**6.0**	**3.0**	**3.0**	----	**6.0**
Potash as muriate	0.73	----	----	0.13	0.93
" total	14.45	4.27	5.85	14.30	1.75
" guaranteed	**15.0**	**5.5**	**5.5**	**13.0**	**1.0**
Cost per ton	$30.00	34.00	35.00	50.00	34.00
Valuation per ton*	$27.89	27.28	29.35	35.38	23.62

The average composition and cost of special manures for the last three years has been as follows:

Percentage Composition.

Year.	Nitrogen.	Available phosphoric acid.	Potash.	Cost per ton.
1902	3.03	8.17	6.08	$33.35
1901	2.87	8.88	6.44	32.64
1900	2.86	8.90	6.35	32.73

* Assuming all potash, other than muriate, to be in form of nitrate or carbonate, valued at 7¼ cents per pound.

Special Manures, Sampled by the Station.

Station No.	Name of Brand.	Manufacturer.	Dealer.	Dealer's cash price per ton.	Valuation per ton.
	Sampled by Station Agent				
4745	H. G. Grass and Grain Fertilizer	The Rogers Mfg. Co., Rockfall	Manufacturer	$37.00	$34.17
			Geo. Fanning, Ledyard	37.00	
5027	Chittenden's H. G. Special Tobacco Fertilizer	National Fertilizer Co., Bridgeport	J. N. Lasbury, Broad Brook	41.00	35.34
			John Clark, Simsbury	42.00	
4965	Darling's Tobacco Grower	American Agricultural Chemical Co., N. Y.	Joseph Warner, Glastonbury	39.00	32.05
			E. F. Miller, Ellington	37.00	
				38.00	
4782	Hubbard's Oats and Top Dressing	The Rogers & Hubbard Co., Middletown	John Bransfield, Portland	49.00	41.20
			J. M. Page & Co., Naugatuck	50.00	
			H. W. Andrews, Wallingford	48.00	
4746	H. G. Complete Corn and Onion Manure	The Rogers Mfg. Co., Rockfall	Manufacturer	34.00	27.24
			George Fanning, Ledyard	33.00	
5072	Bowker's Fairfield Onion Fertilizer	Bowker Fertilizer Co., Boston	Bowker's Branch, Southport	------	25.48
				31.00	
4833	Essex Special Tobacco Manure	Russia Cement Co., Gloucester, Mass.	Spencer Bros., Suffield	44.00	35.31
			J. & H. Woodford, Avon	43.00	
			Broad Brook Lumber Co., Broad Brook	44.00	
4796	H. G. Fertilizer for Oats and Top Dressing	The Rogers Mfg. Co., Rockfall	J. F. Blakesley, North Haven	44.00	36.10
			Rockville Milling Co., Rockville	------	
5046	Mapes' Seeding Down Manure	Mapes' F. & P. G. Co., N. Y.	Mapes' Branch, Hartford	37.00	30.34
4691	Essex Complete Manure for Potatoes, Roots and Vegetables	Russia Cement Co., Gloucester, Mass.	W. J. Cox, East Hartford	38.00	30.96
			Spencer Bros., Suffield	39.00	
4977	High Grade Soluble Tobacco and Potato Manure	The Rogers Mfg. Co., Rockfall	Wm. Orr, Southington	40.00	30.93
			Manufacturer	38.00	
5030	Bowker's Complete Alkaline Tobacco Grower	Bowker Fertilizer Co., Boston	Bowker's Branch, Hartford	34.00	26.78
			Newell St. John, Simsbury	33.00	
4978	H. G. Soluble Tobacco Manure	The Rogers Mfg. Co., Rockfall	Manufacturer	44.00	35.71
			W. E. Bostwick, New Milford	42.00	
4749	Mystic Gilt Edge Potato Manure	C. M. Shay, Groton	Manufacturer	30.00	24.33

Analyses and Valuation.

Station No.	Percentage difference between cost and valuation.	Nitrogen					Phosphoric Acid.						Potash.		
		Nitrogen as Nitrates.	Nitrogen as Ammonia.	Nitrogen Organic.	Total Nitrogen. Found.	Total Nitrogen. Guaranteed.	Soluble.	Reverted.	Insoluble.	Total. Found.	Total. Guaranteed.	Available. Found.	Available. Guaranteed.	Found. As Muriate.	Found. Total.	Guaranteed.
4745	08.3	trace	---	3.30	3.30	3.0	none	10.22	7.34	17.56	16.0	10.22	----	13.11	13.11	12.0
5027	16.0	0.16	0.93	4.48	5.57	5.7	4.29	1.97	0.66	6.92	7.0	6.26	5.0	0.86	10.82	10.0
4965	18.6	2.10	0.22	2.29	4.61	4.5	4.48	2.29	0.18	6.95	5.0	6.77	4.0	0.49	10.92	10.0
4782	18.9	7.63	--	1.27	8.90	8.8	none	5.61	2.09	7.70	7.8	5.61	3.9	9.68	9.68	8.3
4746	21.1	1.58	---	2.28	3.86	3.6	4.61	3.40	1.93	9.94	8.0	8.01	6.0	7.69	7.69	7.0
5072	21.7	1.19	0.12	1.99	3.30	3.0	5.38	2.43	1.82	9.63	9.0	7.81	8.0	7.81	7.81	6.0
4833	21.8	2.00	---	2.72	4.72	4.5	4.53	2.24	3.61	10.38	8.0	6.77	----	0.61	12.43	12.0
4796	21.9	4.51	0.11	2.04	6.66	6.3	1.44	6.86	1.45	9.75	9.0	8.30	7.0	8.57	8.57	7.5
5046	22.0	1.88	0.25	0.50	2.63	2.5	none	10.58	7.61	18.19	18.0	10.58	----	5.49	10.48	10.0
4691	22.7	0.60	---	3.11	3.71	3.7	5.60	2.59	5.06	13.25	9.0	8.19	----	0.61	9.04	8.5
4977	22.9	0.92	---	3.33	4.25	3.5	1.54	5.81	2.94	10.29	9.0	7.35	7.0	0.56	9.31	8.8
5030	23.2	1.50	---	2.74	4.24	4.0	trace	4.68	3.29	7.97	5.0	4.68	4.0	0.57	5.55	5.0
4978	23.2	1.47	0.10	3.85	5.42	5.0	1.74	5.29	2.12	9.15	8.0	7.03	6.0	0.43	10.97	11.0
4749	23.3	0.55	---	2.65	3.20	3.0	5.70	3.77	2.81	12.28	----	9.47	8.0	4.38	4.38	5.0

SPECIAL MANURES, SAMPLED BY THE STATION.

Station No.	Name of Brand.	Manufacturer.	Dealer.	Dealer's cash price per ton.	Valuation per ton.
	Sampled by Station Agent				
4784	Hubbard's Soluble Potato Manure	The Rogers & Hubbard Co., Middletown	G. W. Dennison, Saybrook	$40.00	$32.16
			J. M. Page & Co., Naugatuck	40.00	
5059	H. G. Tobacco Manure	American Agricultural Chemical Co., N. Y.	J. & H. Woodford, Avon	42.00	33.68
4783	Hubbard's Grass and Grain Fertilizer	The Rogers & Hubbard Co., Middletown	J. M. Page & Co., Naugatuck	41.00	32.01
			Schwarz Bros., Rockville	39.00	
				40.00	
4838	Wilcox Potato Manure	Wilcox Fertilizer Works, Mystic	Manufacturer	27.00	21.57
			J. M. Young, Norwich	27.00	
4750	Mapes' Economical Potato Manure	Mapes' F. & P. G. Co., N. Y.	Mapes' Branch, Hartford	34.00	26.18
			Southington Lumber Co., Southington	33.00	
4752	Bradley's Complete Manure for Potatoes and Vegetables	American Agricultural Chemical Co., N. Y.	Avery Bros., Norwich Town	35.00	26.91
			D. L. Clark, Milford	34.00	
4862	Hubbard's Soluble Tobacco Manure	The Rogers & Hubbard Co., Middletown	G. W. Dennison, Saybrook	45.00	34.58
			H. W. Andrews, Wallingford	44.00	
4951	Sanderson's Formula B., for Tobacco	Sanderson Fertilizer and Chemical Co., New Haven	Manufacturer	35.00	25.94
			J. H. Hackett, Wapping	33.00	
			C. Hendal, Hockanum	32.00	
			Spencer Bros., Suffield	46.00	35.34
4777	Mapes' Tobacco Manure (Wrapper Brand)*	Mapes' F. & P. G. Co., N. Y.	Mapes' Branch, Hartford	45.00	
4747	Wilcox Potato, Onion and Tobacco Manure	Wilcox Fertilizer Works, Mystic	Olds & Whipple, Hartford	37.00	27.31
			Manufacturer	35.00	
4751	Stockbridge Potato and Vegetable Manure	Bowker Fertilizer Co., Boston	Bowker's Branch, Hartford	37.00	28.71
			E. B. Clark Co., Milford	34.00	
4987	East India Complete Potato Manure	American Agricultural Chemical Co., N. Y.	Edward White, Rockville	36.00	27.84
4695	Mapes' Potato Manure	Mapes' F. & P. G. Co., N. Y.	F. S. Bidwell, Windsor Locks	38.00	28.52
			Mapes' Branch, Hartford	37.00	
			Birdsey & Raven, Meriden	38.00	
5053	Wilcox Grass Fertilizer	Wilcox Fertilizer Works, Mystic	Manufacturer	35.00	26.88

* See page 59.

ANALYSES AND VALUATIONS—*Continued.*

Station No.	Percentage difference between cost and valuation.	Nitrogen: Nitrogen as Nitrates.	Nitrogen: Nitrogen as Ammonia.	Nitrogen: Nitrogen Organic.	Nitrogen: Total Nitrogen. Found.	Nitrogen: Total Nitrogen. Guaranteed.	Phosphoric Acid: Soluble.	Phosphoric Acid: Reverted.	Phosphoric Acid: Insoluble.	Phosphoric Acid: Total. Found.	Phosphoric Acid: Total. Guaranteed.	Phosphoric Acid: Available. Found.	Phosphoric Acid: Available. Guaranteed.	Potash: Found. As Muriate.	Potash: Found. Total.	Potash: Guaranteed.
4784	24.4	3.25	0.15	2.34	5.74	**5.0**	0.72	7.19	4.32	12.23	**10.0**	7.91	**7.0**	0.87	5.41	**5.0**
5059	24.7	----	2.80	2.73	5.53	**5.8**	4.22	1.35	0.98	6.55	**6.0**	5.57	**5.0**	1.01	9.75	**10.0**
4783	25.0	----	0.39	2.54	2.93	**2.5**	none	9.90	6.81	16.71	**15.0**	9.90	**6.6**	12.60	12.60	**12.5**
4838	25.2	0.36	0.29	2.13	2.78	**2.1**	2.42	4.75	2.86	10.03	**7.0**	7.17	**6.0**	3.44	5.18	**4.5**
4750	26.1	1.81	0.14	1.65	3.60	**3.3**	2.02	3.95	1.45	7.42	**6.0**	5.97	**4.0**	1.08	8.85	**8.0**
4752	26.3	1.10	0.34	2.13	3.57	**2.3**	4.93	4.09	1.56	10.58	**9.0**	9.02	**8.0**	7.33	7.33	**7.0**
4862	27.2	2.43	0.20	2.42	5.05	**5.0**	0.77	7.58	4.66	13.01	**10.0**	8.35	**7.0**	0.69	9.29	**10.0**
4951	27.2	0.50	---	2.89	3.39	**3.3**	3.95	3.82	2.49	10.26	**10.0**	7.77	**6.0**	0.94	6.65	**6.0**
4777	27.3	3.18	0.23	3.06	6.47	**6.2**	none	3.62	2.34	5.96	**4.5**	3.62	----	0.81	10.86	**10.5**
4747	28.2	0.87	0.13	2.65	3.65	**3.3**	5.78	2.94	1.37	10.09	**8.0**	8.72	**7.0**	2.08	6.85	**6.0**
4751	28.9	1.10	---	2.39	3.49	**3.0**	3.65	4.22	2.07	9.94	**7.0**	7.87	**6.0**	8.93	8.93	**10.0**
4987	29.3	1.36	---	1.78	3.14	**3.3**	4.72	3.38	2.29	10.39	**7.0**	8.10	**6.0**	10.83	10.83	**10.0**
4695	29.7	1.86	0.14	1.98	3.98	**3.7**	3.89	4.54	1.93	10.36	**8.0**	8.43	**8.0**	1.52	7.43	**6.0**
5053	30.2	1.81	---	2.54	4.35	**4.1**	4.21	3.06	3.05	10.32	**7.0**	7.27	----	5.75	5.75	**5.0**

Special Manures, Sampled by the Station.

Station No.	Name of Brand.	Manufacturer.	Dealer.	Dealer's cash price per ton.	Valuation per ton.
	Sampled by Station Agent				
4943	Wheeler's Bermuda Onion Grower	American Agricultural Chemical Co., N. Y.	W. H. Baldwin, Cheshire	$26.00	$19.93
5022	Swift-Sure Guano for Onions	M. L. Shoemaker & Co., Phila., Pa.	C. O. Jelliff & Co.,* Southport	25.00	21.88
				29.00	
4705	Swift's Lowell Potato Phosphate	Lowell Fertilizer Co., Boston	Standard Feed Co., Bridgeport	33.00	24.12
			C. W. Lines, New Britain	32.00	
4854	Bradley's Complete Manure for Top Dressing grass and grain	American Agricultural Chemical Co., N. Y.	S. J. Stevens, Glastonbury	36.00	27.09
4708	Bowker's Early Potato Manure	Bowker Fertilizer Co., Boston	Bowker's Branch, Hartford	34.00	25.52
			Bowker's Branch, Southport	35.00	
5073	Stockbridge Grass Top Dressing	Bowker Fertilizer Co., Boston	Bowker's Branch, Hartford	37.00	27.76
4800	Lister's Potato Manure	Lister Agricultural Chemical Works, Newark, N. J.	A. N. Clark, Milford	37.00	26.22
			R. H. Hall, East Hampton	34.00	
				35.00	
5044	Swift's Lowell Tobacco Manure	Lowell Fertilizer Co., Boston	Loomis Bros., Granby	43.00	32.19
4945	Wheeler's Havana Tobacco Grower	American Agricultural Chemical Co., N. Y.	E. E. Pitney, Ellington	34.00	25.35
			Bruce Beach, New Milford	35.00	
4803	American Farmers' Complete Potato Fertilizer	American Farmers' Fertilizer Co., N. Y.	H. A. Bugbee, Willimantic	28.00	20.85
			F. H. Rolf, Guilford	28.00	
6123	Chittenden's Complete Tobacco Fertilizer†	National Fertilizer Co., Bridgeport	Mary Rutherford, Thompsonville	36.00	26.71
4795	Essex Complete Manure for Corn, Grain and Grass	Russia Cement Co., Gloucester, Mass.	E. N. Pierce & Co., Plainville	39.00	28.16
			C. K. & H. T. Hale, Gildersleeve	37.00	
				38.00	
4865	Hubbard's '02 Top Dress Phosphate	The Rogers & Hubbard Co., Middletown	J. H. Burrill, Liberty Hill	33.00	24.30
			H. W. Andrews, Wallingford	34.00	
6128	Chittenden's Complete Tobacco Fertilizer†	National Fertilizer Co., Bridgeport	Peter Sheriden, Suffield	------	26.51
				36.00	
5023	Swift-Sure Superphosphate† for Potatoes	M. L. Shoemaker & Co., Phila., Pa.	C. A. Meeker, Southport	30.00	25.75
			J. G. Schwink, Meriden	32.00	
				35.00	

* Purchaser, not a dealer. † See page 59.

Analyses and Valuations—*Continued.*

Station No.	Percentage difference between cost and valuation.	Nitrogen					Phosphoric Acid.							Potash.		
		Nitrogen as Nitrates.	Nitrogen as Ammonia.	Nitrogen Organic.	Total Nitrogen. Found.	Total Nitrogen. Guaranteed.	Soluble.	Reverted.	Insoluble.	Total. Found.	Total. Guaranteed.	Available. Found.	Available. Guaranteed.	Found. As Muriate.	Found. Total.	Guaranteed.
4943	30.4	----	---	0.98	0.98	0.8	8.00	2.10	1.22	11.32	10.0	10.10	9.0	7.43	7.43	7.0
5022	32.5	0.67	---	1.43	2.10	1.7	5.47	3.45	4.59	13.51	----	8.92	8.0	5.57	5.57	5.0
4705	32.7	0.13	---	2.56	2.69	2.5	7.18	1.54	0.64	9.36	9.0	8.72	8.0	0.35	6.50	6.0
4854	32.9	----	0.94	3.84	4.78	4.8	5.46	2.70	1.70	9.86	6.0	8.16	5.0	3.23	3.23	2.5
4708	33.2	1.17	0.16	2.05	3.38	3.0	5.39	2.78	1.85	10.02	8.0	8.17	7.0	7.16	7.16	7.0
5073	33.3	3.00	---	1.81	4.81	4.3	4.75	2.33	1.59	8.67	6.0	7.08	5.0	6.24	6.24	6.0
4800	33.5	----	1.23	1.84	3.07	3.0	7.70	1.51	1.13	10.34	9.0	9.21	8.0	7.74	7.74	7.0
5044	33.6	1.90	---	3.12	5.02	4.9	3.36	3.34	1.15	7.85	7.0	6.70	6.0	0.89	9.49	8.0
4945	34.1	0.60	0.48	1.60	2.68	2.0	4.94	2.43	2.81	10.18	7.0	7.37	6.0	9.93	9.93	10.0
4803	34.3	----	---	1.94	1.94	1.0	6.66	2.40	1.88	10.94	8.5	9.06	7.0	4.14	5.50	6.0
6123	34.8	----	0.47	3.24	3.71	3.3	7.35	2.17	1.15	10.67	10.0	9.52	8.0	0.80	4.83	5.4
4795	34.9	0.77	---	2.64	3.41	3.3	5.23	3.16	2.65	11.04	9.5	8.39	----	9.42	9.42	9.5
4865	35.8	3.77	---	1.06	4.83	4.5	2.35	2.89	1.12	6.36	6.0	5.24	4.5	4.81	4.81	4.5
6128	35.8	----	0.41	2.77	3.18	3.3	7.36	2.37	0.75	10.48	10.0	9.73	8.0	0.81	6.35	5.4
5023	35.9	0.88	---	1.74	2.62	2.9	6.45	3.79	4.23	14.47	----	10.24	8.0	6.85	6.85	7.0

Special Manures, Sampled by the Station.

Station No.	Name of Brand.	Manufacturer.	Dealer.	Dealer's cash price per ton.	Valuation per ton.
	Sampled by Station Agent				
6124	Chittenden's Complete Tobacco Fertilizer*..	National Fertilizer Co., Bridgeport	George McLeisch, Thompsonville.....	.....	26.17
				$36.00	
4744	Complete Potato and Vegetable Fertilizer.	The Rogers Mfg. Co., Rockfall	Manufacturer	32.00	23.19
			Geo. Fanning, Ledyard	30.00	
4818	Packer's Union Potato Manure	American Agricultural Chemical Co., N. Y.	Chester Clark, Durham.....	28.00	21.62
			T. E. Greene, Plainfield.....	32.00	
			T. A. Tillinghast, Brooklyn.....	30.00	
4692	Essex Tobacco Starter.	Russia Cement Co., Gloucester, Mass....	Spencer Bros., Suffield	34.00	23.77
			W. J. Cox, East Hartford.....	33.00	
5026	Chittenden's Complete Tobacco Fertilizer*.	National Fertilizer Co., Bridgeport	Thos. Cavanaugh, Gildersleeve.....	36.00	25.89
6126	Chittenden's Complete Tobacco Fertilizer*.	National Fertilizer Co., Bridgeport	E. E. Thompson, Thompsonville.....	36.00	25.88
6125	Chittenden's Complete Tobacco Fertilizer*.	National Fertilizer Co., Bridgeport	George Bostwick, Thompsonville.....	36.00	25.86
6127	Chittenden's Complete Tobacco Fertilizer*.	National Fertilizer Co., Bridgeport	Webster Burbank, Thompsonville.....	.....	25.82
				36.00	
4953	Sanderson's Top Dressing Fertilizer	Sanderson's Fertilizer and Chemical Co., New Haven.....	J. H. Hackett, Wapping.....	35.00	24.99
4973	American Farmers' Corn King	American Farmers' Fertilizer Co., N. Y.....	H. A. Bugbee, Willimantic	28.00	21.18
			Lewis Ford, Norwich.	32.00	
				30.00	
4974	Tobacco Starter and Grower.....	American Agricultural Chemical Co., N. Y.	S. J. Stevens, Glastonbury	34.00	23.97
			D. T. Dyer, Collinsville.....	34.00	
			C. M. Beach, New Milford.....	35.00	
4812	Read's Vegetable and Vine Fertilizer.....	American Agricultural Chemical Co., N. Y.	L. A. Fenton, Norwich Town	31.00	21.80
			Orrin Russ, Mt. Hope	31.00	
5061	E. Frank Coe's Celebrated Special Potatoe Fertilizer.....	E. Frank Coe Co., New York.....	C. O. Jelliff & Co., Southport	28.00	19.62
4693	Mapes' Corn Manure..	Mapes' F. & P. G. Co., New York.....	Birdsey & Raven, Meriden.....	34.00	23.12
			Mapes' Branch, Hartford.....	33.00	
			F. S. Bidwell, Windsor Locks	34.00	

* See page 59.

Analyses and Valuations—*Continued.*

Station No.	Percentage difference between cost and valuation.	Nitrogen					Phosphoric Acid.							Potash		
					Total Nitrogen.					Total.		Available.		Found.		
		Nitrogen as Nitrates.	Nitrogen as Ammonia.	Nitrogen Organic.	Found.	Guaranteed.	Soluble.	Reverted.	Insoluble.	Found.	Guaranteed.	Found.	Guaranteed.	As Muriate.	Total.	Guaranteed.
6124	37.6	....	0.53	3.07	3.60	**3.3**	7.18	2.46	1.17	10.81	**10.0**	9.64	**8.0**	0.79	4.55	**5.4**
4744	38.0	trace	...	2.74	2.74	**2.3**	5.22	3.85	2.78	11.85	**10.0**	9.07	**8.0**	5.12	5.12	**5.0**
4818	38.8	0.44	...	1.61	2.05	**2.1**	6.54	2.58	1.93	11.05	**10.0**	9.12	**8.0**	6.31	6.31	**6.0**
4692	38.8	1.57	...	1.07	2.64	**2.5**	6.16	3.95	3.72	13.83	**12.0**	10.11	....	0.33	4.38	**2.5**
5026	39.0	....	0.55	2.99	3.54	**3.3**	7.30	2.29	1.17	10.76	**10.0**	9.59	**8.0**	0.94	4.51	**5.4**
6126	39.1	....	0.52	3.06	3.58	**3.3**	7.04	2.28	1.17	10.49	**10.0**	9.32	**8.0**	0.80	4.62	**5.4**
6125	39.2	....	0.49	3.09	3.58	**3.3**	6.98	2.17	1.08	10.23	**10.0**	9.15	**8.0**	0.81	4.80	**5.4**
6127	39.4	....	0.51	2.97	3.48	**3.3**	7.18	2.01	1.08	10.27	**10.0**	9.19	**8.0**	0.71	5.03	**5.4**
4953	40.1	0.70	...	3.32	4.02	**4.0**	2.75	1.78	2.76	7.29	**8.0**	4.53	**6.0**	7.62	7.62	**6.0**
4973	41.6	trace	1.06	1.42	2.48	**2.4**	5.44	3.40	1.91	10.75	**9.5**	8.84	**8.0**	2.42	4.09	**4.0**
4974	41.8	....	0.42	2.94	3.36	**3.3**	5.44	3.61	1.85	10.90	**9.0**	9.05	**8.0**	0.82	3.57	**4.0**
4812	42.2	0.64	0.09	1.30	2.03	**2.1**	6.24	3.19	2.11	11.54	**10.0**	9.43	**8.0**	6.28	6.28	**6.0**
5061	42.7	....	...	1.93	1.93	**1.7**	6.86	2.50	1.73	11.09	**9.5**	9.36	**8.0**	0.82	3.57	**4.0**
4693	42.7	0.70	0.10	1.82	2.62	**2.5**	2.96	6.20	2.34	11.50	**10.0**	9.16	**8.0**	6.12	6.12	**6.0**

Special Manures, Sampled by the Station.

Station No.	Name of Brand.	Manufacturer.	Dealer.	Dealer's cash price per ton.	Valuation per ton.
	Sampled by Station Agent				
4821	Great Eastern Vegetable, Vine and Tobacco	American Agricultural Chemical Co., N. Y.	Frank Gates, East Hampton	$32.00	$21.68
			S. A. Post, Westbrook	32.00	
			T. E. Greene, Plainfield	30.00	
				31.00	
4975	Armour's H. G. Potato	Armour Fertilizer Co., Baltimore, Md.	Daniels Mill Co., Hartford	33.00	22.32
			E. A. Buck & Co., Willimantic	30.00	
			Meriden Grain & Feed Co., Meriden	38.00	
				32.00	
4710	Bowker's Potato and Vegetable Fertilizer	Bowker Fertilizer Co., Boston	Bowker's Branch, Hartford	**32.00**	22.20
			Bowker's Branch, Southport	------	
4707	Essex Market Garden and Potato Manure	Russia Cement Co., Gloucester, Mass.	W. J. Cox, East Hartford	**33.00**	22.82
			E. N. Pierce & Co., Plainville	35.00	
5033	Packers' Union Animal Corn Fertilizer	American Agricultural Chemical Co., N. Y.	Chester Clark, Durham	28.00	20.73
			Rockville Milling Co., Rockville	32.00	
				30.00	
4864	Hubbard's Potato Phosphate	The Rogers & Hubbard Co., Middletown	G. W. Dennison, Saybrook	32.00	21.37
			John Bransfield, Portland	30.00	
				31.00	
4773	Bradley's Potato Fertilizer	American Agricultural Chemical Co., N. Y.	D. L. Clark, Milford	**28.00**	19.22
			W. B. Martin, Rockville	29.00	
4816	Quinnipiac Potato Phosphate	American Agricultural Chemical Co., N. Y.	J. P. Lathrop, Plainfield	**28.00**	19.19
			C. A. Young & Co., Danielson	28.00	
			C. C. Pierce, Putnam	28.00	
5050	O. & W. Potato Fertilizer	Olds & Whipple, Hartford	Manufacturer	**32.00**	21.91
4759	Stockbridge Corn Manure	Bowker Fertilizer Co., Boston	Bowker's Branch, Hartford	**37.00**	24.96
			W. H. Scott & Co., Pequabuck	38.00	
4979	Potato and Tobacco Special	Ohio Farmer's Fertilizer Co., Columbus, Ohio	A. M. Paine, South Woodstock	**28.00**	18.89

Analyses and Valuations—*Continued.*

Station No.	Percentage difference between cost and valuation.	Nitrogen					Phosphoric Acid.							Potash.		
		Nitrogen as Nitrates.	Nitrogen as Ammonia.	Nitrogen Organic.	Total Nitrogen. Found.	Total Nitrogen. Guaranteed.	Soluble.	Reverted.	Insoluble.	Total. Found.	Total. Guaranteed.	Available. Found.	Available. Guaranteed.	Found. As Muriate.	Found. Total.	Guaranteed.
4821	43.0	0.24	0.13	1.69	2.06	**2.1**	6.58	2.67	2.14	11.39	**10.0**	9.25	**8.0**	6.01	6.01	**6.0**
4975	43.4	----	---	1.45	1.45	**1.6**	7.33	1.30	0.40	9.03	----	8.63	**8.0**	10.44	10.44	**10.0**
4710	44.1	0.77	0.12	1.77	2.66	**2.3**	4.94	4.00	3.44	12.38	**10.0**	8.94	**8.0**	4.39	4.39	**4.0**
4707	44.6	0.48	---	1.86	2.34	**2.0**	6.32	3.29	3.21	12.82	**10.0**	9.61	----	5.51	5.51	**5.0**
5033	44.7	0.73	---	1.74	2.47	**2.5**	8.37	2.06	1.54	11.97	**11.0**	10.43	**9.0**	2.30	2.30	**2.0**
4864	45.1	0.79	---	1.22	2.01	**2.0**	5.76	4.49	2.03	12.28	**10.0**	10.25	**9.0**	5.13	5.13	**5.0**
4773	45.7	0.33	0.14	1.74	2.21	**2.1**	5.55	3.13	2.00	10.68	**9.0**	8.68	**8.0**	3.36	3.36	**3.0**
4816	45.9	0.45	0.12	1.43	2.00	**2.1**	6.67	2.93	1.79	11.39	**10.0**	9.60	**8.0**	3.16	3.16	**3.0**
5050	46.1	1.58	---	1.66	3.24	**2.5**	trace	4.60	2.17	6.77	----	4.60	**5.0**	0.85	6.81	**7.0**
4759	48.2	1.11	---	2.12	3.23	**3.0**	4.88	2.96	1.99	9.83	**8.0**	7.84	**6.0**	7.40	7.40	**6.0**
4979	48.2	0.05	---	1.88	1.93	**1.6**	4.53	4.48	1.42	10.43	**10.0**	9.01	**8.0**	4.01	4.01	**4.0**

Special Manures, Sampled by the Station.

Station No.	Name of Brand.	Manufacturer.	Dealer.	Dealer's cash price per ton.	Valuation per ton.
	Sampled by Station Agent				
4761	Bowker's Tobacco Starter	Bowker Fertilizer Co., Boston	Bowker's Branch, Hartford	$33.00	$22.16
			O. H. Meeker, Danbury	33.00	
4822	Darling's Potato Manure	American Agricultural Chemical Co., N. Y.	M. D. Stanley, New Britain	32.00	21.26
			T. E. Greene, Plainfield	32.00	
4776	Quinnipiac Potato Manure	American Agricultural Chemical Co., N. Y.	G. M. Williams Co., New London	32.00	21.26
			Adams & Canfield, Norwalk	32.00	
4966	Crocker's Ammoniated Corn Phosphate	American Agricultural Chemical Co., N. Y.	W. L. Wellwood, So. Coventry	30.00	19.87
			F. M. Loomis, North Granby	29.00	
			H. A. Welton, Thomaston	32.00	
4863	Hubbard's Corn Phosphate	The Rogers & Hubbard Co., Middletown	J. H. Burrill, Liberty Hill	26.00	16.53
			H. W. Andrews, Wallingford	25.00	
4765	Berkshire Potato and Vegetable Phosphate	Berkshire Fertilizer Co., Bridgeport	Manufacturer	29.00	19.10
			J. W. Palmer, Stamford	32.00	
			J. J. Keilty, Watertown	32.00	
4698	Mapes' Tobacco Ash Constituents*	Mapes F. & P. G. Co., New York	Spencer Bros., Suffield	32.00	21.01
			F. S. Bidwell, Windsor Locks	32.00	
4999	Great Eastern Northern Corn Special	American Agricultural Chemical Co., N. Y.	S. A. Post, Westbrook	32.00	20.85
4778	Mapes' Fruit and Vine Manure	Mapes F. & P. G. Co., New York	P. J. Bolan, Waterbury	40.00	24.65
			Mapes' Branch, Hartford	38.00	
4967	Crocker's Potato, Hop and Tobacco Phosphate	American Agricultural Chemical Co., N. Y.	W. A. Thrall, Windsor	31.00	20.07
			M. L. Wellwood, So. Coventry	32.00	
			F. M. Loomis, North Granby	31.00	
4948	Williams & Clark's Americus Potato Manure	American Agricultural Chemical Co., N. Y.	H. A. Doyle & Co., Burnside	33.00	19.34
			W. H. Chappell, Chesterfield	28.00	
			J. A. Murphy, Warrenville	30.00	
4704	Swift's Lowell Potato Manure	Lowell Fertilizer Co., Boston	Standard Feed Co., Bridgeport	29.00	18.61
			J. C. Lincoln, Berlin	30.00	

* See page 59.

Analyses and Valuations—*Continued.*

Station No.	Percentage difference between cost and valuation.	Nitrogen					Phosphoric Acid.							Potash.		
		Nitrogen as Nitrates.	Nitrates as Ammonia.	Nitrogen Organic.	Total Nitrogen. Found.	Total Nitrogen. Guaranteed.	Soluble.	Reverted.	Insoluble.	Total. Found.	Total. Guaranteed.	Available. Found.	Available. Guaranteed.	Found. As Muriate.	Found. Total.	Guaranteed.
4761	48.9	0.65	---	1.89	2.54	**2.3**	3.98	5.24	2.51	11.73	**10.0**	9.22	**8.0**	0.36	4.32	**3.0**
4822	50.5	trace	0.20	2.58	2.78	**2.5**	4.69	2.07	0.28	7.04	**7.0**	6.76	**6.0**	1.30	5.63	**5.0**
4776	50.5	0.11	---	2.63	2.74	**2.5**	3.82	3.33	1.81	8.96	**7.0**	7.15	**6.0**	5.54	5.54	**5.0**
4966	51.0	0.22	---	1.99	2.21	**2.1**	7.22	3.20	2.12	12.54	**9.0**	10.42	**8.0**	1.99	1.99	**1.5**
4863	51.2	0.06	---	1.00	1.06	**1.0**	5.60	4.05	1.61	11.26	**10.0**	9.65	**8.0**	3.73	3.73	**3.5**
4765	51.8	----	---	2.22	2.22	**1.7**	4.26	2.02	1.73	8.01	**8.0**	6.28	**6.0**	1.51	5.23	**4.0**
4698	52.3	----	---	0.69	0.69	**0.5**	none	2.44	3.32	5.76	**5.7**	2.44	---	1.17	15.37	**15.0**
4999	53.5	0.91	---	1.74	2.65	**2.5**	6.83	3.16	1.47	11.46	**11.0**	9.99	**9.0**	2.51	2.51	**2.0**
4778	54.2	0.99	0.20	0.95	2.14	**1.7**	2.96	3.74	1.23	7.93	**7.0**	6.70	**5.0**	1.65	11.31	**10.0**
4967	54.5	0.22	---	1.90	2.12	**2.1**	7.10	2.87	1.76	11.73	**9.0**	9.97	**8.0**	3.25	3.25	**3.0**
4948	55.1	0.51	---	1.59	2.10	**2.1**	6.74	2.77	1.84	11.35	**10.0**	9.51	**8.0**	3.05	3.05	**3.0**
4704	55.8	----	---	2.04	2.04	**1.6**	5.54	1.88	0.69	8.11	**8.0**	7.42	**7.0**	0.21	4.40	**4.0**

Special Manures, Sampled by the Station.

Station No.	Name of Brand.	Manufacturer.	Dealer.	Dealer's cash price per ton.	Valuation per ton.
	Sampled by Station Agent				
4793	Sanderson's Potato Manure	Sanderson Fertilizer & Chemical Co., New Haven	E. B. Clark Co., Milford	$28.00	$18.52
			J. G. Schwink, Meriden	30.00	
			P. Sullivan, Portland	30.00	
				29.00	
5081	Sanderson's Old Reliable or Corn Superphosphate	Sanderson Fertilizer & Chemical Co., New Haven	N. W. Dayton, New London	30.00	17.71
				28.00	
4971	American Farmers' Grain Grower	American Farmers' Fertilizer Co., N. Y.	H. A. Bugbee, Willimantic	25.00	13.91
			J. E. Leonard & Son, Jewett City	**22.00**	
			J. P. Kingsley & Son, Plainfield	22.00	
4815	Quinnipiac Corn Manure	American Agricultural Chemical Co., N. Y.	Adams & Canfield, R. F. D., Norwalk	30.00	18.31
			J. P. Lathrop, Plainfield	28.00	
			C. A. Young & Co., Danielson	**29.00**	
4831	Essex Corn Fertilizer	Russia Cement Co., Gloucester, Mass.	C. S. Gillette, Cheshire	35.00	20.72
			J. B. Parker, Poquonock	**33.00**	
			F. T. Blish Hdw. Co., South Manchester	33.00	
4711	Mapes' Top Dresser, Improved,* one-half strength	Mapes F. & P. G. Co., New York	Mapes' Branch, Hartford	**31.00**	19.40
			Birdsey & Raven, Meriden	32.00	
4835	Wheeler's Potato Manure	American Agricultural Chemical Co., N. Y.	John Bransfield, Portland	30.00	19.39
			W. H. Baldwin, Cheshire	32.00	
				31.00	
5043	Armour's Grain Grower	Armour Fertilizer Works, Baltimore, Md.	E. A. Buck & Co., Willimantic	**25.00**	15.57
			Meriden Feed Co., Meriden	25.00	
4801	Lister's Corn and Potato Fertilizer	Lister Agricultural Chemical Works, Newark, N. J.	S. A. Billings, Meriden	31.00	17.99
			R. H. Hall, East Hampton	28.00	
				29.00	
4781	Chittenden's Potato Phosphate	National Fertilizer Co., Bridgeport	Mrs. E. R. Aiken, Silver Mine	35.00	22.29
			F. Hallock & Co., Derby	38.00	
				36.00	
5006	Williams & Clark's Potato Phosphate	American Agricultural Chemical Co., N. Y.	Phineas Platt, Milford	----	19.82
			D. B. Wilson, Waterbury	**32.00**	

* See page 59.

Analyses and Valuations—*Continued.*

Station No.	Percentage difference between cost and valuation.	Nitrogen					Phosphoric Acid.							Potash.		
		Nitrogen as Nitrates.	Nitrogen as Ammonia.	Nitrogen Organic.	Total Nitrogen. Found.	Total Nitrogen. Guaranteed.	Soluble.	Reverted.	Insoluble.	Total. Found.	Total. Guaranteed.	Available. Found.	Available. Guaranteed.	Found. As Muriate.	Found. Total.	Guaranteed.
4793	56.6	----	0.25	1.76	2.01	**1.8**	2.22	3.66	2.60	8.48	**8.0**	5.88	**5.0**	6.27	6.27	**6.0**
5081	58.1	----	---	2.29	2.29	**2.5**	2.11	3.82	4.78	10.71	**10.0**	5.93	**7.0**	3.16	3.16	**2.0**
4971	58.2	0.22	---	0.81	1.03	**0.8**	3.42	5.14	2.99	11.55	**9.5**	8.56	**8.0**	1.56	1.56	**1.0**
4815	58.4	0.31	0.13	1.78	2.22	**2.1**	6.40	2.83	1.72	10.95	**10.0**	9.23	**8.0**	1.70	1.70	**1.5**
4831	59.3	0.44	---	1.99	2.43	**2.0**	4.99	4.00	3.56	12.55	**11.0**	8.99	---	3.32	3.32	**3.0**
4711	59.8	3.71	0.11	0.79	4.61	**4.9**	0.69	2.00	0.88	3.57	**4.0**	2.69	---	0.23	2.49	**2.0**
4835	59.9	----	---	2.12	2.12	**2.1**	6.64	2.45	1.57	10.66	**9.0**	9.09	**8.0**	3.42	3.42	**3.0**
5043	60.6	0.03	---	1.65	1.68	**1.7**	6.82	1.38	0.56	8.76	----	8.20	**8.0**	2.07	2.07	**2.0**
4801	61.2	----	0.30	1.45	1.75	**1.7**	7.42	1.89	1.26	10.57	**9.0**	9.31	**8.0**	3.06	3.06	**2.0**
4781	61.5	----	---	2.11	2.11	**2.1**	7.07	2.66	1.16	10.89	**10.0**	9.73	**8.0**	6.37	6.37	**6.0**
5006	61.5	----	---	2.47	2.47	**2.5**	3.60	3.11	2.25	8.96	**7.0**	6.71	**6.0**	5.14	5.14	**5.0**

Special Manures, Sampled by the Station.

Station No.	Name of Brand.	Manufacturer.	Dealer.	Dealer's cash price per ton.	Valuation per ton.
	Sampled by Station Agent				
4697	Bradley's Potato Manure	American Agricultural Chemical Co., N. Y.	Spencer Bros., Suffield	$32.00	$19.76
			F. S. Bidwell, Windsor Locks	32.00	
5083	Mapes' Top Dresser Improved, one-half strength*	Mapes F. & P. G. Co., New York	J. P. Barstow & Co., Norwich	31.00	18.96
4949	Williams & Clark's Americus Corn Phosphate	American Agricultural Chemical Co., N. Y.	W. H. Chappell, Chesterfield	29.00	17.67
			Carlos Bradley, Ellington	30.00	
4946	Wheeler's Corn Fertilizer	American Agricultural Chemical Co., N. Y.	E. E. Pitney, Ellington	28.00	16.94
4998	Great Eastern Grass & Oats Fertilizer	American Agricultural Chemical Co., N. Y.	Frank Gates, East Hampton	20.00	13.19
			Thos. Richmond, New Milford	25.00	
				22.00	
5057	Grass and Lawn Top Dressing	American Agricultural Chemical Co., N. Y.	G. A. Root & Son, Forestville	36.00	21.48
4814	Read's Practical Potato Special	American Agricultural Chemical Co., N. Y.	P. McEnerney's Sons, Derby	30.00	17.12
			L. A. Fenton, Norwich Town	28.00	
				29.00	
4758	Bradley's Corn Phosphate	American Agricultural Chemical Co., N. Y.	F. S. Bidwell, Windsor Locks	30.00	17.70
			W. H. Scott & Co., Pequabuck	30.00	
5068	E. Frank Coe's Columbian Potato Fertilizer	E. Frank Coe Co., New York	Balch & Platt, Winsted	32.00	18.57
4968	Bowker's Corn Phosphate	Bowker Fertilizer Co., Boston	Lewis Ford, Norwich	30.00	16.85
			E. F. Miller, Ellington	29.00	
5035	Packers' Union Wheat, Oats and Clover Fertilizer	American Agricultural Chemical Co., N. Y.	Rockville Milling Co., Rockville	23.00	12.92
5067	E. Frank Coe's Columbian Corn Fertilizer‡	E. Frank Coe Co., New York	Balch & Platt, Winsted	32.00	17.51
4762	Bowker's Potato and Vegetable Phosphate	Bowker Fertilizer Co., Boston	Lightbourn & Pond Co., New Haven	33.00	17.39
			D. B. Wilson, Waterbury	32.00	
5008	Wheeler's Grass and Oats Fertilizer	American Agricultural Chemical Co., N. Y.	August Grulich, Meriden	28.00	13.33
5007	Essex Lawn Dressing	Russia Cement Co., Gloucester, Mass.	W. J. Cox, East Hartford	†	------
	Sampled by Purchasers.				
4961	Chittenden's Complete Tobacco Fertilizer*	National Fertilizer Co., Bridgeport	----------	36.00	27.26
5086	Chittenden's Complete Tobacco Fertilizer*	National Fertilizer Co., Bridgeport	Geo. McLeish, Thompsonville	36.00	26.95
4991	Potato Manure	Sanderson Fertilizer & Chemical Co., New Haven	Daniel Morgan, Poquonock Bridge	28.50	20.49

* See page 59. † Sold only in small packages. ‡ See page 60.

Analyses and Valuations—*Continued.*

Station No.	Percentage difference between cost and valuation.	Nitrogen: Nitrogen as Nitrates.	Nitrogen: Nitrogen as Ammonia.	Nitrogen: Nitrogen Organic.	Nitrogen: Total Nitrogen. Found.	Nitrogen: Total Nitrogen. Guaranteed.	Phosphoric Acid: Soluble.	Phosphoric Acid: Reverted.	Phosphoric Acid: Insoluble.	Phosphoric Acid: Total. Found.	Phosphoric Acid: Total. Guaranteed.	Phosphoric Acid: Available. Found.	Phosphoric Acid: Available. Guaranteed.	Potash. Found. As Muriate.	Potash. Found. Total.	Potash. Guaranteed.
4697	61.9	---	---	2.40	2.40	**2.5**	4.56	2.44	1.47	8.47	**7.0**	7.00	**6.0**	5.28	5.28	**5.0**
5083	63.5	3.97	---	0.49	4.46	**4.9**	1.23	2.01	1.40	4.64	**4.0**	3.24	----	0.60	1.92	**2.0**
4949	64.1	0.33	---	1.80	2.13	**2.1**	6.24	2.66	1.79	10.69	**10.0**	8.90	**8.0**	1.64	1.64	**1.5**
4946	65.3	----	---	1.64	1.64	**1.7**	5.95	3.11	2.43	11.49	**10.0**	9.06	**8.0**	2.13	2.13	**2.0**
4998	66.8	----	---	---	---	----	8.22	3.07	0.84	12.13	**12.0**	11.29	**11.0**	2.20	2.20	**2.0**
5057	67.6	----	---	3.74	3.74	**3.9**	3.46	3.07	2.72	9.25	**6.0**	6.53	**5.0**	2.15	2.15	**2.0**
4814	69.4	0.04	---	1.17	1.21	**0.8**	4.05	2.30	1.58	7.93	**5.0**	6.35	**4.0**	7.52	7.52	**8.0**
4758	69.5	----	---	2.07	2.07	**2.1**	5.92	2.95	1.70	10.57	**9.0**	8.87	**8.0**	1.90	1.90	**1.5**
5068	72.3	----	---	1.46	1.46	**1.0**	8.93	1.74	1.96	12.63	**11.0**	10.67	**8.0**	0.19	2.50	**2.5**
4968	78.0	0.24	0.23	1.32	1.79	**1.5**	5.84	2.91	1.92	10.67	**10.0**	8.75	**8.0**	2.09	2.09	**2.0**
5035	78.0	----	---	---	---	----	7.52	3.73	0.53	11.78	**12.0**	11.25	**11.0**	2.15	2.15	**2.0**
5067	82.8	----	---	1.03	1.03	**1.2**	9.17	2.62	1.92	13.71	**10.5**	11.79	**8.5**	0.33	1.86	**2.5**
4762	84.0	0.35	---	1.47	1.82	**1.5**	5.90	2.93	2.68	11.51	**10.0**	8.83	**9.0**	2.21	2.21	**2.0**
5008	110.1	----	---	---	---	----	7.65	3.58	1.04	12.27	**12.0**	11.23	**11.0**	2.40	2.40	**2.0**
5007	----	0.05	3.71	0.07	3.83	**3.7**	4.38	2.22	4.22	10.82	**8.0**	6.60	----	0.44	7.85	**7.0**
4961	32.1	----	0.64	3.15	3.79	----	7.55	2.45	1.00	11.00	----	10.00	----	0.73	4.70	----
5086	33.6	----	0.54	3.04	3.58	**3.3**	7.65	2.44	1.14	11.23	**10.0**	10.09	**8.0**	0.52	4.91	**5.4**
4991	39.1	----	0.21	2.29	2.50	**1.8**	3.39	4.75	2.30	10.44	----	8.14	----	4.29	4.29	**6.0**

An inspection of the tables of analyses shows that the number of pounds of nitrogen, phosphoric acid and potash purchasable for $30 in these special manures were as follows:

			Ton price.	Nitrogen.	Phosphoric acid.	Potash.
In the first	10	analyses in the table	$39.10	72	120	153
" next	14	" " "	37.00	69	118	130
" "	16	" " "	34.56	58	144	127
" "	13	" " "	34.15	57	154	93
" "	9	" " "	31.55	48	177	102
" "	13	" " "	30.54	42	150	105
" "	11	" " "	30.19	46	154	78
" "	14	" " "	30.14	42	164	68
" "	5	" " "	29.00	35	243	74

As a rule, the lower the ton price the more expensive to the purchaser is the plant food he buys.

HOME MIXTURES.

In a following table, pages 80 and 81, are given analyses of seven home-mixed fertilizers. The samples analyzed were, for the most part, drawn and sent by the persons who made the mixtures. With the analyses are given, wherever it is known, the formulas by which the fertilizers were made.

The average cost of these fertilizers per ton, calculated from the table, is $27.75, and the valuation $25.20. It is not known in all cases whether "cost" covers more than cost of the raw materials. Assuming that it does not, in any case, and allowing $3.00 per ton (an excessive amount) for the cost of mixing and bagging, the average cost of the goods mixed has been $30.75, and the percentage difference between cost and valuation 22.0 per cent., much lower than in the average of factory-mixed goods.

The mechanical condition of these mixtures is also, in most cases, all that could be desired. The statement made by interested parties, that a proper mixture of the ingredients in a fertilizer can only be made by the use of mixing machinery, is absurd.

MISCELLANEOUS FERTILIZERS AND MANURES.

TOBACCO STEMS.

These are the midribs of tobacco leaves, removed in preparing the leaf for manufacture, which are baled and sold as a fertilizer. The greatest difference between samples is found in the water content, some bales being quite dry and others very wet. The sample for analysis should be taken from a number of bales and should be carefully weighed *at once.* The fresh weight should be noted on the description which is sent to the Station. In this way only can the real water-content and the real value of the stems be determined. If the weight is not noted *at once,* and the stems dry out considerably during shipment to the Station, the analysis, being thus made on the partially dried stems, will not fairly represent the composition of the bales.

Four samples have been analyzed during the year, as follows:

5039. From stock of Olds & Whipple, Hartford. Sampled and sent by S. J. Stevens, Glastonbury.

5093, 5094 and **5095,** representing different car lots of unknown origin. Sampled and sent by W. H. Olcott, South Manchester.

ANALYSES OF TOBACCO STEMS.

Percentage amounts of	5039	5093	5094	5095
Moisture	17.00	13.03	12.16	12.32
Nitrogen	2.31	2.39	2.80	2.04
Phosphoric acid	0.43	0.46	0.42	0.38
Potash	7.24	8.28	6.14	4.72
Cost per ton	$14.00	12.00*	12.00*	12.00*

These samples show about the usual range of composition, No. **5095** containing less potash than is usual. Stems are regarded as an excellent fertilizer, readily available to crops. They contain as much nitrogen and a good deal more potash than the average mixed fertilizer, but scarcely any phosphoric acid.

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* In car lots.

HOME MIXTURES. FORMULAS,

Station No.	Made by	Formulas. Pounds per ton							
		Nitrate of Soda.	Sulphate of Ammonia.	Hen Manure.	Cotton Seed Meal.	Tankage.	Acid Phosphate.	Dissolved Bone Black.	High Grade Sulphate of Potash.
4651	S. D. Woodruff & Sons, Orange	99	99	----	----	691	593	197	----
4841	Conn. School for Boys, Meriden	500	----	----	----	500	400	----	----
4842	Conn. School for Boys, Meriden	100	----	----	----	750	750	----	----
4670	S. D. Woodruff & Sons, Orange	----	----	----	----	----	----	----	----
4843	Wm. H. Mansfield, West Hartford	100	----	----	----	750	----	750	200
4980	E. Manchester & Sons, Winsted	100	----	----	400	400	400	400	200
5070	P. K. Hoadley, Guilford	----	----	656	----	----	1049	----	----

VEGETABLE ASHES.

When a plant or any part of a plant is burned, practically all of the potash contained in it remains in its ashes. While the total weight of potash is the same in the ashes as in the plant, the *percentage* of potash in the ashes will always be very much greater than in the vegetable matter from which it came.

For example: in a test made at this Station, Report of 1883, page 68, 105¾ pounds of hickory cordwood, containing 2½ ounces of potash, yielded on burning 2⅛ pounds of ashes, containing still the 2½ ounces of potash. The hickory wood itself contained only 0.15 per cent. of potash, while the ashes which came from it contained 7.54 per cent. of potash.

Wood ashes have long been favorably known as a fertilizer rich in lime, and also containing from 5 to 8 per cent. of potash. But at present various other kinds of ashes, from cotton hulls, beet sugar factory refuse, tobacco stalks, tobacco stems, refuse from sheep dip manufacture, etc., most of them manufacturing by-products, are offered for sale. Some of them are valuable sources of potash in the form of carbonate. Those which have been examined at this Station during the past year are mentioned below.

WOOD ASHES.

In a following table are given twenty-nine analyses of articles called "wood ashes." It is quite clear, however, that samples

ANALYSES AND VALUATIONS.

Of Mixture.			Analyses.								Cost (Unmixed) and Valuation.		Percentage difference between Cost and Valuation.
Double sulphate Potash and Magnesia.	Muriate of Potash.	Kainit.	Nitrogen as Nitrates.	Organic Nitrogen.	Total Nitrogen.	Soluble Phosphoric Acid.	Reverted Phosphoric Acid.	Insoluble Phosphoric Acid.	Total Phosphoric Acid.	Potash.	Cost per ton.	Valuation per ton.	
----	321	----	0.78	2.97	4.85*	5.04	2.57	1.47	9.08	8.12	$26.00	$30.61	15.1†
----	250	350	3.49	1.34	4.83	2.30	2.74	1.42	6.46	9.09	28.50	27.96	1.9
200	200	----	0.71	1.90	2.61	4.08	4.03	2.71	10.82	7.87	25.00	24.03	4.0
----	----	----	1.44	1.77	3.28	4.24	3.37	1.37	8.98	7.71	26.00	24.76	5.0
----	200	----	0.73	2.82	3.55	4.94	4.20	3.09	12.23	7.63	30.00	28.06	6.9
----	100	----	0.84	2.41	3.25	5.36	2.25	1.09	8.70	7.25	31.00	25.12	23.8
----	295	----	0.04	0.60	0.64	4.88	2.43	0.38	7.69	7.71	----	15.87	----

* 1.10 per cent. of nitrogen as ammonia.
† Valuation exceeds cost.

4570, 4572, 4770, and **4827** are not unleached wood ashes. Two-fifths of sample **4770** is earth.

The analysis of **4847** showed much less potash than the manufacturer expected from the results of preliminary analyses made before the shipment from Canada. A portion of the sample was, therefore, sent by the Station, at request of the importer, to two chemists in New York, one of whom reported 5.90 per cent. and the other 5.47 per cent. of potash. At the same time the analysis was repeated in this laboratory on the identical sample which was sent to the other chemists, with the following results:

Potash soluble in acid	4.74 and 4.82
Potash soluble in water	3.99 and 4.01
Phosphoric acid	1.47

No explanation for this wide discrepancy appears. Very close agreement is not to be expected on material of this kind, but a difference of 1.2 per cent. in the determination of potash must be due to error in sampling or analysis.

Leaving out of account the four analyses named above, the percentage of water-soluble potash in the samples has ranged from 3.13 to 6.92, the phosphoric acid from 1.13 to 2.38 and the lime from 26.59 to 48.80. That is, some samples of "wood

ashes" may have only half as much potash, phosphoric acid or lime as others.

Excluding the four samples named, the other twenty-four have the following average composition:—

Potash soluble in acid	5.6
Potash soluble in water	4.8
Phosphoric acid	1.5
Lime	31.2

The percentages of potash and phosphoric acid are slightly larger than last year and of lime somewhat smaller.

The average price has been ten dollars. If the water-soluble potash is valued at 7¼ cents, as in carbonate, and the phosphoric acid at 4 cents, lime in ashes of average composition costs about 32 cents per 100 pounds.

Wood ashes are distinctively a lime fertilizer, containing this year on the average more than six times as much lime as potash. When pure and derived from hard wood, Canada ashes are well worth what is charged for them and yield excellent results, especially on meadows and orchards. The great trouble with them has always been the wide range of composition which they show and the occasional frauds in their sale.

The average percentage composition of Canada wood ashes as determined by analyses made at this Station for the last eight years has been as follows:

	1895	1896	1897	1898	1899	1900	1901	1902
No. of analyses	16	22	21	9	8	17	24	24
Potash soluble in water	4.3	5.5	5.5	5.5	4.6	4.3	4.6	4.8
Phosphoric acid	1.5	1.5	1.2	1.5	1.5	1.4	1.4	1.5
Lime	34.0	32.5	32.5	36.5	33.5	34.0	35.9	31.2
Sand and soil	12.3	11.0	10.5	5.0	----	----	----	----
Charcoal	2.0	2.5	2.0	1.3	----	----	----	----
Cost per ton	$10.75	10.36	10.30	9.82	9.40	8.75	9.00	10.00
Average cost of lime per 100 pounds,* in cts.	49 c.	18	20	9	23	20	17	32

* Allowing 7¼ cents per pound for potash (in form of carbonate) and 4 cents per pound for phosphoric acid.

LEACHED WOOD ASHES.

A sample of this material, No. **9742,** bought of Hartness, Detroit, Mich., by H. B. Curtis, Cheshire, for $6.00 per ton in the car lot, had the following percentage composition:

Water-soluble potash	0.23
Acid-soluble potash	0.65
Lime	21.82
Magnesia	2.27
Phosphoric acid	1.27
Sulphuric acid	trace
Chlorine	none
Sand	9.45
Charcoal	1.29

It also contained over 42 per cent. of water.

With all allowance for the potash and phosphoric acid contained in these leached ashes, the lime in them costs $1.07 per 100 pounds;—from three to seven or eight times as much as in unleached ashes.

It is hard to see how leached ashes can be purchased at a profit.

BOWKER'S TWENTY-FIVE PER CENT. ASH COMPOUND.

This article, made by the Bowker Fertilizer Co. of Boston, is guaranteed to contain 25 per cent. of potash in form of carbonate.

Two analyses have been made:

4660. Sent by I. B. Davis, Bloomfield.

5031. Sampled by the Station agent from stock of Bowker's Branch, Hartford.

ANALYSES OF BOWKER'S ASH COMPOUND.

Percentage amounts of	4660	5031
Phosphoric acid	1.66	----
Potash	25.30	
Of which soluble in water	24.78	26.16
Sulphuric acid	0.82	----
Chlorine	0.34	.37
Cost per ton	$40.00	40.00
Potash as carbonate costs per pound	**8.0**	**7.5**

Wood Ashes.

Station No.	Dealer or Purchaser.	Sampled or sent by
4570	E. N. Austin, Suffield	H. H. Austin, Suffield
4571	" " "	" " "
4572	" " "	" " "
4770	" " "	E. N. Austin, "
6118	" " "	" " "
4714	Bowker Fertilizer Co., Boston	A. J. Sherwood, R. F. D. No. 5, Bridgeport
	" " " Southport	Station Agent
4715	" " " Hartford	Bowker Fertilizer Co., Hartford
4771	" " "	Conn. Valley Orchard Co., Deep
4785		River
	" " "	S. T. Welden, Simsbury
4789	" " "	Bowker Fertilizer Co., Hartford
4847	" " " Hartford	P. P. Hickey, Burnside
4955	" " " "	Conn. Valley Orchard Co., Deep
5012		River
	" " "	Bowker Fertilizer Co., Hartford
7256	" " "	" " " "
7257		E. N. Austin, Suffield
4808	A. N. Graves, Suffield	Walter Fawthrop, Cromwel
4809	John Joynt, Lucknow, Ont., Can.	Earl Cooley, Berlin
4786	F. W. Miller, Ont., Canada	R. A. Moore, Kensington
4826	Geo. L. Munroe, Oswego, N. Y.	A. J. Pierpont, Waterbury
4736		" " "
4737		Station Agent
4844	Auguste Pouleur, Windsor	
4827	Prentiss, Brooks & Co., Holyoke, Mass.	C. D. Cannon, Windsor Locks
		Warner-Miller Co., New Haven
4740		John Gardiner, Cromwell
4993		F L. Staples, Bridgeport
6134	John Joynt, Lucknow, Ont., Can.	A. J. Sherwood, Bridgeport
7927		" " "
7928		
9748	Stroup, Son & Co , Boston, Mass.	Importers

ASHES OF TOBACCO STALKS.

Analyses made at this Station years ago showed that large amounts of plant food and particularly of potash are contained in the stalks of tobacco from which the leaves have been stripped. In the Report for 1892, pp. 31 to 34, it is shown, from results of actual field tests, that the barn-cured stalks from an acre of tobacco weigh about 3,500 pounds and contain about 32 pounds of nitrogen, 8 of phosphoric acid, 13 of lime and 49 of potash. That is, about one-third of the plant food taken up by a tobacco crop is contained, after curing, in the stalks.

Percentage Composition.

Potash soluble in Acid.	Potash soluble in Water.	Phosphoric Acid.	Lime, Calcium Oxide.	Magnesia.	Carbonic Acid.	Sand and Soil.	Charcoal.	Sulphuric Acid.	Cost per ton.
0.75	0.59	1.09	25.16	1.99	17.50	3.80	2.07	0.32	$ 6.00
4.46	3.47	1.41	34.56	4.33	15.36	11.32	2.86	0.60	10.00
2.06	0.89	0.99	23.44	4.15	11.50	11.69	4.00	0.24	8.00
1.68	1.02	0.97	19.34	3.89	----	40.21	9.52	0.87	8.00
6.19	4.51	2.01	----	----	----	----	----	----	12.00
5.68	4.87	1.15	31.15	2.80	----	6.93	1.90	0.50	10.00
7.81	6.92	1.34	28.58	3.78	----	12.45	2.13	2.05	10.00
4.60	4.03	1.48	----	----	----	----	----	----	----
6.68	5.85	1.36	30.46	5.02	----	11.07	1.63	0.96	10.00
4.41	3.70	1.56	30.26	3.55	----	14.28	1.27	0.56	9.25
4.55*	4.09	1.45	29.88	4.23	----	13.12	1.86	1.22	9.50
6.27	5.45	1.66	27.88	4.11	----	11.84	1.14	0.89	10.00
6.81	5.83	1.75	34.18	4.37	----	11.20	1.20	1.38	----
4.92	4.12	1.34	29.70	----	----	12.33	1.38	1.09	10.50
3.92	3.13	1.15	26.59	----	----	15.44	5.33	0.85	10.50
7.13	6.28	1.39	29.06	3.72	----	8.86	1.67	1.87	11.00
5.18	4.51	1.48	33.88	3.82	----	8.11	1.47	0.73	9.00
7.37	6.58	1.71	39.92	3.49	----	7.43	0.72	0.76	9.50
4.64	4.15	1.13	36.50	3.13	----	7.47	1.01	0.54	9.50
5.66	4.37	2.38	41.66	6.63	----	3.95	0.25	0.36	----
5.32	3.84	2.28	43.54	7.10	----	3.42	0.28	0.28	----
5.50	5.09	1.64	34.08	3.36	----	6.16	1.13	0.62	10.00
1.40	1.20	0.59	37.98	4.94	----	2.37	0.50	0.11	10.00
6.10	4.88	1.57	48.80	8.51	----	2.63	0.17	0.19	----
4.76	4.31	1.34	34.42	3.42	----	15.57	3.44	0.85	10.00
4.03	3.67	1.33	32.50	---	----	9.57	1.50	0.65	----
5.26	4.76	1.40	31.22	2.95	----	7.81	1.58	0.68	----
4.66	4.16	1.27	31.68	3.02	----	8.55	1.12	0.71	----
7.21	6.90	1.61	38.52	2.31	----	4.20	0.94	0.39	----

* See page 81.

A sample of "Ashes of burnt Tobacco Stalks," **4661**, sent by Willard E. Treat, Silver Lane, during the present year, was found to contain the following percentages:

Phosphoric acid, water-soluble	0.32
" " citrate-soluble	4.85
" " insoluble	0.14
" " total	5.31
Potash soluble in water	37.84
Sulphuric acid	3.64
Chlorine	3.03

The potash is chiefly in form of carbonate and the ashes would of course be very valuable as a fertilizer on tobacco land.

Tobacco Stem Ashes.

These are claimed to be the ashes of the "stems" or midribs of tobacco leaves which are removed in preparing the leaf for manufacture. The stems may also have been extracted to make sheep dips.

4653. Sold by Olds & Whipple, Hartford. Sampled and sent by F. B. Hatheway, Suffield.

5096. Sold by Olds & Whipple, Hartford. Sampled and sent by William J. Welch, Enfield.

Analyses of Tobacco Stem Ashes.

	4653	5096
Percentage amounts of		
Phosphoric acid, water-soluble	----	----
" " citrate-soluble	0.90	1.41
" " insoluble	1.47	0.61
Potash soluble in acid	27.46	25.73
Of which soluble in water	26.82	24.91
Chlorine	1.98	1.95
Sulphuric acid	3.16	3.33
Cost per ton	$40.00	40.00

The percentages of both sulphuric acid and chlorine are quite small, most of the potash being present as carbonate. If phosphoric acid and potash in form of sulphate and chloride are valued as in mixed fertilizers, the potash as carbonate in these samples costs 8.8 cents per pound, which is higher than potash in this form costs either as potassium carbonate, see page 28, or in other forms of ashes.

Vegetable Ash.

Under this name the firm of Olds & Whipple of Hartford puts on the market a mixture claiming to be chiefly or exclusively made of the ashes of various vegetable matters and to contain about 25 per cent. of potash chiefly in form of carbonate.

4990. Sampled from stock of J. J. O'Melia, Broad Brook.

5054. Sampled from stock of F. B. Griffin, Granby.

5049. Sampled by Station agent, and **5091,** sampled by the manufacturers, both from manufacturer's stock.

Analyses.

	4990	5054	5049	5091
Percentage amounts of				
Phosphoric acid, water-soluble	----	----	----	0,48
" " citrate-soluble	4.47	----	----	3.50
" " insoluble	1.36	----	----	1.32
Potash soluble in acid	25.06	----	----	22.56
Of which soluble in water	23.58	25.27	24.65	21.30
Chlorine	2.37	2.51	2.90	1.37
Sulphuric acid	10.70	5.29	4.54	3.58
Cost	$40.00	40.00	40.00	40.00
Potash costs per pound	**12.9**	**8.5**	**8.8**	**9.8**

The sample sent by Mr. O'Melia contains twice as much sulphuric acid as either of those drawn by the Station agent. If the phosphoric acid and the potash as muriate and sulphate are valued as in mixed fertilizers, the potash in form of carbonate, excluding **4990,** ranges from 8.5 to 9.8 cents per pound, a higher cost than in pure calcined carbonate.

Cotton Hull Ashes.

Of this material, only three samples have been sent to us for analysis during the present year.

4753. Bought of Olds & Whipple, Hartford. Sampled and sent by W. E. Treat, Silver Lane.

4989. Bought of the American Cotton Oil Co., by Spencer Brothers of Suffield.

6108. Bought of Olds & Whipple, Hartford, by W. E. Treat, Silver Lane.

Analyses of Cotton Hull Ashes.

	4753	4989	6108
Percentage amounts of			
Phosphoric acid, water-soluble	----	trace	1.30
" " citrate-soluble	----	4.64	9.65
" " insoluble	----	0.81	0.38
Potash, total	24.40	25.78	22.11
Of which soluble in water	22.30	23.06	19.22
Chlorine	----	none	0.18
Sulphuric acid	----	3.45	1.58
Cost per ton	$43.00	45.00	42.00
Potash costs cents per pound	----	**8.7**	**8.3**

Cotton hull ashes have been used for the last fifteen years in Connecticut in very large quantities as a tobacco fertilizer. Of

a sudden they have disappeared from our market and cannot be obtained anywhere.

Regarding the cause of this disappearance and the possibility of getting them next year, one who is well acquainted with the situation writes us as follows:

"We learn from all sources that cotton hulls have been growing in favor as a feed for cattle for several years and that in many sections they command a price of from $5 to $7 per ton for feeding purposes without burning; this made them impossible to use for fuel, as they were worth about $1.25 per ton to use as a fuel under the boilers. There are only a few places where the hulls are now being burned and these are interior points far away from shipping facilities and in sections where feed is exceedingly cheap.

All southern brokers and grain dealers now list cotton hulls as a food product the same as they do meal and corn, it being a regular staple article with them."

Cattle raising is likely to be more of an industry in the future than it is now at the South, and it is probable that Connecticut farmers will have to pay still higher prices for cotton seed meal, and will not be able to buy cotton hull ashes at all.

However, calcined carbonate of potash will be a good substitute, and has the advantage of very uniform composition.

STONE LIME.

The following analyses were made on samples sent at our request by the Warner-Miller Co. of New Haven and represent the quality of the three different grades of lime at present in market:

5088. Glen Falls Lime, made at Glen Falls, N. Y. A very hard lime with good keeping quality, slaking out very free from grit, used in this vicinity almost exclusively for whitewashing.

5089. Cheshire Lime, made in Cheshire, Mass. and used in this vicinity mostly for finishing lime; that is, it is reduced with water to the consistence of putty and mixed with white sand and plaster for finishing walls. It also makes good whitewash.

5090. New Milford Lime, made in this State and chiefly used for making mortar for laying up brick or stone work, or for plastering.

ANALYSES.

	Glen Falls. 5088	Cheshire. 5089	New Milford. 5090
Lime	92.42	90.52	55.58
Magnesia	1.06	4.27	38.55
Sand	0.98	1.45	2.90
Other matters	5.54	3.76	2.97
	100.00	100.00	100.00

At the retail (barrel) rates prevailing in August, 1902, which were exceptionally high, one hundred pounds of stone lime in form of

New Canaan Lime (300 pounds in barrel) cost 57 cents.
Cheshire Lime (320 pounds in barrel) cost 70 cents.
Glen Falls Lime (200 pounds in barrel) cost 88 cents.

The analyses show that more than one-third of the weight of the New Milford "Stone Lime" is magnesia, and that real lime (calcium oxide) costs more in the New Canaan stone lime than in either of the other grades. For agricultural purposes slaked lime which is nearly free from magnesia is, we believe, preferable. Apparently the cheapest source for this, at present, is slaked oyster shell lime.

All the lime companies in Connecticut and all but two in Massachusetts are now owned and operated by the New England Lime Co., which has its general offices at Canaan, Conn.

In case car lots of lime for agricultural purposes are wanted, parties should get quotations from this company. We believe Massachusetts or Vermont Lime, free from much magnesia, is to be preferred for agricultural purposes, and if bought in car lots in barrels would not cost a great deal more than the New Milford or Canaan lime, carrying from 30 to 45 per cent. of magnesia.

The Canaan lime weighs 300 pounds to the barrel, the Massachusetts lime 350 pounds. A car load of Canaan lime is about 135 barrels.

In bulk, in car lots, Connecticut lime costs at the works about a dollar per ton less than Massachusetts lime, while the freight rates from factories out of the State may be some 10 or 12 cents per 100 pounds.

Lime-kiln Ashes.

This material is the ashes from fuel used in roasting or "burning" limestone rock, unavoidably mixed with much burned lime. The small percentage of potash in them comes wholly from the ashes of the fuel.

4668. From kilns at Canaan. Sampled and sent by J. C. Jackson, Norwalk.

4681. Sampled from stock bought of E. N. Austin, Suffield, by J. Olmstead, Windsor Locks.

6131. From J. H. Putnam, Litchfield.

Analyses of Lime-kiln Ashes.

	4668	4681	6131
Percentage amounts of			
Potash	0.83	0.37	0.93
Of which soluble in water	0.44	0.24	0.18
Phosphoric acid	1.66	0.83	0.78
Lime	33.60	38.30	27.92
Magnesia	10.15	1.32	----
Sand and earth	2.40	2.65	----
Charcoal	0.79	1.92	----
Sulphuric acid	0.03	none	----
Cost per ton	$6.50*	13 cents per bush.†	

Valuing the phosphoric acid at 2 cents and the potash soluble in water at 7¼ cents (as carbonate), the lime in sample **4668** costs 78 cents per 100 pounds, and in sample **4681** 34 cents per 100 pounds.

Lime-kiln ashes may be bought at the kilns for about 12½ cents per bushel on cars by the car load. In less than car lots charge is made for the packages. The manufacturers state that the ashes weigh from 60 to 80 pounds per bushel.

Waste Lime from Gas Manufacture.

A sample, **6132**, received from J. H. Putnam, Litchfield, which may be lime from the decomposed carbide left after the evolution of acetylene gas, had the following percentage composition:

Moisture	52.62
Sand and insoluble matter	5.72
Lime	36.38
Magnesia	0.40
Sulphuric acid	0.08
Carbonic acid	4.80
	100.00

* In car lots. † A bushel of Canaan lime-kiln ashes weighs about 75 pounds. At this rate these ashes cost about $3.50 per ton.

The material consists of moist slaked lime with some carbonate of lime.

Mexican Potash.

A sample, **6130**, marked "Teguesquite, a Mexican Potash Salt" offered by a New York broker to a fertilizer manufacturer in this State, had the following percentage composition:

Sand and insoluble matter	3.06
Potash, soluble in water	2.82
Soda	37.61
Lime	0.66
Magnesia	0.60
Carbonic acid	25.44
Sulphuric acid	7.22
Phosphoric acid	0.24
Chlorine	7.93
Moisture, by difference	16.20
	101.78
Oxygen equivalent to chlorine	1.78
	100.00

The material is chiefly carbonate of soda (washing soda) with some sulphate of soda and salt and less than three per cent. of potash.

Garbage Tankage.

The samples referred to below represent material made of city garbage collected in Bridgeport and cooked and dried in a patented apparatus.

4588. Sent by Plumb & Winton, Bridgeport, in December, 1901.

7933. Sent by F. S. Staples, Bridgeport, in October, 1902.

Analyses of Garbage Tankage.

	4588	7933
Percentage amounts of		
Moisture	4.29	23.97
Nitrogen	2.72	1.99
Phosphoric acid	3.24	2.43

The composition of such material will of course vary greatly according to the extent to which the drying is carried. Fresh garbage also greatly varies in composition with the season of the year.

Sheep Manure.

This material, gathered in corrals in the grazing regions and unavoidably more or less leached by exposure to rain, is not an economical fertilizer for the farmer at the prices usually quoted. A sample, **4672**, sent by S. D. Woodruff & Sons, Orange, contained:

Nitrogen	2.34 per cent.
Phosphoric acid	1.47
Potash	1.80

The price quoted, $13.50 per ton, is, of course, prohibitive to the farmer.

Land Plaster.

4644. Bought of the G. W. Miles Co., Milford, by G. W. Clark & Son, Milford.

Analysis.

Moisture and combined water	21.21
Insoluble in acid	1.54
Carbonic acid	4.15
Sulphuric acid	39.12
Lime	33.19
Magnesia	0.38
Other matters, by difference	0.41
	100.00

According to this analysis the sample consists of:

Pure hydrated gypsum (plaster)	84.10
Carbonate of lime	9.43
Moisture	3.63
Other matters, by difference	2.86
	100.00

This is about the usual composition of Nova Scotia plaster.

"Fertilizer."

A "Fertilizer," No. **9741**, sent for analysis by James Horan, Bridgeport, contained:

Nitrogen	2.75
Phosphoric acid	1.50
Potash	1.97

Examination showed that the material consisted largely of weed seeds such as are found in wheat screenings, viz.: bind weed and the foxtails. It had apparently been heated to kill the seeds.

REVIEW OF THE FERTILIZER MARKET,

For the Year Ending October 31, 1902.

By E. H. Jenkins.

Nitrogen

Nitric Nitrogen.

The *wholesale* New York quotation of nitrogen in form of nitrate, which was 12.2 cents per pound in November, 1901, rose steadily to 17.1 cents in May, 1902, and then steadily declined to 12.1, which was the October quotation.

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

Year	1902	1901	1900	1899	1898	1897	1896	1895
Average quotation, cents per pound for nitrogen, *wholesale*	13.4	11.9	11.8	10.5	11.0	11.4	11.1	11.4

Nitrate nitrogen has been sold to farmers in this State during the past season for from 12.7 to 15.8 cents per pound, or from $40.00 to $50.00 per ton for nitrate of soda.

Ammonic Nitrogen.

The *wholesale* New York quotation of nitrogen in this form was 13.6 cents per pound in November, 1900. It began rising in February, 1902, and was quoted at 15.0 cents in June. The prices have been lower since that time, the October quotation being 14.3.

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

Year	1902	1901	1900	1899	1898	1897	1896	1895
Average quotation, cents per pound for nitrogen, *wholesale*	14.2	13.3	13.9	14.0	11.9	10.5	11.1	14.3

Scarcely any sulphate of ammonia is used by farmers for home mixing, as the present price is almost prohibitive for use as a fertilizer. It has been quoted at retail in Connecticut at $70 to $72 per ton, making the cost 17.1 to 17.4 cents per pound.

Organic Nitrogen.

The *wholesale* New York quotation of nitrogen in form of red blood, which was 13.7 cents per pound in November, 1901, fell off to 13.5 in February, 1902, then rose sharply to 14.9 in May, fell off to 14.2 in July and since then has advanced in price, the October quotation being 15.2. In general, the prices of blood have ruled higher in 1902 than in the preceding year, but the New York quotations of concentrated tankage have not shown the same rise.

Low grade tankage, bone, fish, and especially cotton seed meal, are the nitrogenous matters most popular with those who buy fertilizing materials for use directly or after mixing at home. Ground bone and bone meal ruled slightly higher in 1902 than in 1901, dry fish fell a dollar a ton last summer, but at this writing is quoted at $27.50, nearly $3.00 per ton higher than at the same time last year. The nitrogen of cotton seed meal also costs, *at retail,* a cent per pound more than last year.

Phosphatic Materials.

The *wholesale* New York quotations of bone meal show an advance of about $1.00 per ton and Charleston rock is quoted at $9.12½ per ton as against $7.25 a year ago.

The wholesale quotation of available phosphoric acid in form of acid phosphate has remained the same through the year at 62½ cents per unit or 3.12 cents per pound of available phosphoric acid.

The prices which have been generally paid for available phosphoric acid by farmers in this State are out of all proportion to the wholesale price of the article, and those who have to make purchases of this material will do well to get quotations from a number of manufacturers and brokers before placing their order.

Potash.

The *wholesale* quotations of potash salts, which are regulated within narrow limits by the German Kali Works, show little fluctuation.

Muriate of Potash.

Potash in this form was quoted *at wholesale* in New York at 3.66 cents per pound till July, and since then at 3.63 cents.

At retail in this State, potash in this form has cost from 3.8 to 4.6 cents per pound. See page 31.

Double Sulphate of Potash and Magnesia.

At *wholesale,* in New York, potash in this form was quoted at 4.27 cents per pound in November, 1901, and remained at that figure till June, 1902, since which time it has been quoted at 4.16 cents.

At retail in this State, it has cost between 4.9 and 5.5 cents per pound. See page 31.

High Grade Sulphate of Potash.

Potash in this form was quoted *at wholesale* in New York, in November, 1901, at 4.32 cents per pound. It fell in July, 1902, to 4.29, and has remained at that figure ever since.

Potash in this form has sold at retail in this State for about 5.0 cents per pound during the present season.

EXPLANATIONS OF MARKET QUOTATIONS.

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

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

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

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

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

To facilitate finding the actual cost of nitrogen per pound

from the cost per unit of ammonia in the market reports, the following table is given:

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

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

if quoted at	3.0	cents per	pound,	Nitrogen	costs	14.4 cents per lb.
"	2.9	"	"	"	13.9	"
"	2.8	"	"	"	13.4	"
"	2.7	"	"	"	12.9	"
"	2.6	"	"	"	12.5	"
"	2.5	"	"	"	12.0	"
"	2.4	"	"	"	11.5	"

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

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

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

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

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

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

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

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

The following table shows the fluctuations in the wholesale prices of a number of fertilizing materials in the New York market, since November, 1897. The price given for each month is the average of the four weekly quotations for that month. Sulphate of ammonia is assumed to contain 20.8 per cent. and nitrate of soda 15.7 per cent. of nitrogen; muriate of potash 50½ per cent., high grade sulphate 49.2 per cent., and double manure salt 26.5 per cent. of actual potash.

Wholesale Prices of Fertilizing Materials.

	Cost of Nitrogen at wholesale in					Cost of Potash at wholesale in			
	Dried Blood.								
	Red. Cents per pound.	Black or low grade. Cents per pound.	Concentrated Tankage. Cents per pound.	Nitrate of Soda. Cents per pound.	Sulphate of Ammonia. Cents per pound.	Muriate of Potash. Cents per pound.	Double Manure Salt. Cents per pound.	High Grade Sulphate of Potash. Cents per pound.	Available Phosphoric Acid in Dissolved South Carolina Rock. Cents per pound.
September	11.4	11.4	11.1	10.5	14.8	3.58	3.91	4.07	3.13
October	11.1	11.1	10.9	10.9	14.3	3.58	3.91	4.07	3.60
November	11.0	10.8	10.8	11.1	13.8	3.58	3.91	4.10	3.09
December	11.7	11.1	10.8	11.5	14.1	3.58	3.94	4.10	3.09
1900. January	13.4	11.5	---	11.9	14.3	3.58	3.94	4.10	3.05
February	15.2	---	---	12.6	14.0	3.59	3.94	4.00	3.05
Average of 6 months	*12.3*	*11.2*	*10.9*	*11.4*	*14.2*	*3.58*	*3.92*	*4.07*	*3.17*
March	14.9	---	---	13.6	15.0	3.66	4.04	4.21	3.17
April	15.0	---	---	13.3	14.5	3.66	4.04	4.21	3.17
May	13.9	---	---	11.5	14.0	3.66	4.04	4.21	3.17
June	12.8	---	---	10.8	13.8	3.66	4.04	4.21	3.15
July	12.6	---	---	11.1	13.5	3.66	4.04	4.21	3.20
August	13.6	13.7	---	11.3	13.7	3.66	4.04	4.21	3.30
Average of 6 months	*13.8*	*13.7*	-	*11.9*	*14.1*	*3.66*	*4.04*	*4.21*	*3.19*
September	13.6	13.3	---	11.4	13.4	3.66	4.04	4.21	3.30
October	14.0	13.6	---	11.5	13.4	3.66	4.04	4.21	3.30
November	14.4	13.8	---	11.6	13.4	3.66	4.04	4.21	3.26
December	14.2	13.7	---	11.6	13.5	3.66	4.04	4.21	3.12
1901. January	14.0	13.6	---	11.7	13.4	3.66	4.04	4.21	3.12
February	14.3	---	---	11.7	13.4	3.66	4.04	4.21	3.12
Average of 6 months	*14.1*	*13.6*	---	*11.6*	*13.4*	*3.66*	*4.04*	*4.21*	*3.20*
March	14.5	---	---	11.6	13.3	3.66	4.27	4.32	3.12
April	14.3	---	---	11.7	12.9	3.66	4.27	4.32	3.12
May	14.2	---	---	11.9	13.3	3.66	4.27	4.32	3.12
June	14.0	---	---	12.1	13.1	3.66	4.27	4.32	3.12
July	13.9	---	---	12.2	13.1	3.66	4.27	4.32	3.12
August	13.7	---	---	12.4	13.1	3.66	4.27	4.32	3.12
Average of 6 months	*14.1*	---	---	*11.9*	*13.1*	*3.66*	*4.27*	*4.32*	*3.12*
September	13.5	---	---	12.3	13.4	3.66	4.27	4.32	3.12
October	14.0	---	---	12.2	13.5	3.66	4.27	4.32	3.12
November	13.7	---	---	12.2	13.6	3.66	4.27	4.32	3.12
December	13.3	---	---	12.2	13.3	3.66	4.27	4.32	3.12
1902. January	13.6	---	---	12.7	13.6	3 66	4.27	4.32	3.12
February	13.5	---	---	14.2	14.1	3.66	4.27	4.32	3.12
Average of 6 months	*13.6*	---	---	*12.6*	*13.6*	*3.66*	*4.27*	*4.32*	*3.12*
March	14.0	---	---	14.9	14.1	3.66	4.27	4.32	3.12
April	14.5	---	---	15.5	14.5	3.66	4.27	4.32	3.12
May	14.9	---	---	17.1	14.8	3.66	4.27	4.32	3.12
June	14.5	---	---	13.6	15.0	3.66	4.22	4.30	3.12
July	14.2	---	---	12.9	14.5	3.63	4.16	4.29	3.12
August	14.3	---	---	12.1	14.1	3.63	4.16	4.29	3.12
Average of 6 months	*14.6*	---	---	*14.3*	*14.5*	*3.65*	*4.22*	*4.31*	*3.12*
September	14.6	---	---	12.0	14.5	3.63	4.16	4.29	3.12
October	15.2	---	---	12.1	14.3	3.63	4.16	4.29	3.12

SECOND REPORT

OF THE

STATE ENTOMOLOGIST OF CONNECTICUT

To the Board of Control of the Connecticut Agricultural Experiment Station:

I hereby transmit my second Report as State Entomologist under the act concerning Insect Pests. This Report is a record of entomological work during the calendar year of 1902, while the statement of receipts and expenditures is for the State fiscal year from October 1st, 1901, to September 30th, 1902.

Respectfully submitted,

W. E. Britton,

State Entomologist.

Report of the Receipts and Expenditures of the State Entomologist from October 1st, 1901, to September 30th, 1902.

Receipts.

From William H. Brewer, Treasurer		$ 522.00
E. H. Jenkins, Treasurer		2,800.00
N. D. Platt for oil		2.00
		$3,324.00

Expenditures.

Field, office and laboratory assistance	$ 497.97	
Printing and illustrations	1,011.60	
Postage	37.12	
Stationery	122.88	
Telephone and Telegraph	2.10	
Express, freight and cartage	25.92	
Library	305.86	
Laboratory apparatus and supplies	458.58	
Spraying apparatus and supplies	168.00	
Office supplies	93.66	
Traveling expenses of Entomologist and assistants, including nursery and orchard inspection and experimental work, meetings, etc.	600.31	
		$3,324.00

Memorandum—This account of the State Entomologist has been duly audited by the State Auditors of Public Accounts.

The Insect Pest Law.

Chapter 238, General Statutes of Connecticut.

Section 4386. State entomologist; appointment. Said board of control shall appoint a state entomologist to hold office during the pleasure of the board, who shall have an office at the experiment station, but shall receive no compensation other than his regular salary as a member of the station staff. He may appoint such number of deputies, not exceeding three, as he may deem necessary.

Sec. 4387. Duties. The state entomologist, either personally or through his deputies, shall visit any orchard, field, garden, nursery, or storehouse, on request of the owner, to advise treatment against pests. He may inspect any orchard, field, or garden, in public or private grounds, which he may know or have reason to suspect to be infested with San José scale or any serious pests; may issue such bulletins of said experiment station as in his judgment are needed to convey information about pests; may conduct experiments and investigations regarding injurious insects and the remedies for their attacks; diffuse such information by means of correspondence, lectures, and published matter; and may employ such assistants in his office, laboratory, or in the field, and purchase such apparatus and supplies as may be necessary. He shall keep a detailed account of expenses, and publish each year a report of such expenses, and of the work done.

Sec. 4388. Certificate of inspection of nursery stock. All nursery stock shipped into this state from any other state, country, or province, shall bear on each package a certificate that the contents of said package have been inspected by a state or government officer and that said contents appear free from all dangerous insects or disease. In case nursery stock is brought within the state without such a certificate, the consignee may return it to the consignor at the latter's expense, or may call the state entomologist to inspect the same and deduct the costs of such inspection from the consignor's bill for such stock. This section shall be deemed to be a part of every contract made in this state for the sale of nursery stock to be shipped into this state.

Sec. 4389. Inspection of nurseries. Penalty. All nurseries or place where nursery stock is grown, sold, or offered for sale, shall be inspected at least once each year by the state entomologist or one of his deputies, and if no serious pests are found, a certificate to that effect may be given. If such pests are found the owner shall take such measures to suppress the same as the state entomologist may prescribe. If such measures are not immediately taken by the owner of such nursery or place such certificate shall be withheld, and every nurseryman who does not hold such a certificate, after the first annual inspection, who shall sell or otherwise dispose of nursery stock, shall be fined not more than fifty dollars. The form of certificate and the season for inspecting nurseries may be determined by the state entomologist. The state entomologist or any of his deputies may at all times enter any public or private grounds in the performance of his duty.

Sec. 4390. Appropriation. The sum of three thousand dollars is appropriated to carry out the provisions of Sections 4386, 4387, 4388, and 4389, which sum is to be paid quarterly to the treasurer of said station, who shall hold the same subject to the order of the state entomologist.

Entomological Work.

The entomological work under the law has been prosecuted along the following lines during the year:

1. Increasing the collection of Connecticut insects.
2. Arranging exhibition sets showing the life-stages of injurious species.
3. Field experiments in destroying the San José scale-insect.
4. Publications.
5. Illustrated lectures.
6. Correspondence.
7. Inspection of nurseries.
8. Examination of orchards, gardens, etc., upon request.
9. Identification of insects for farmers and fruit growers.
10. A study of the white-fly.
11. Observations on the injurious and beneficial insects of the season.

Organization, Equipment, Etc.

Assistance.—Since March 1st the writer has been assisted in the office, field and laboratory by Benjamin H. Walden, B.Agr., a graduate of the Connecticut Agricultural College. Mr. Walden has also done much of the photographic work of the season. A student was employed for a few weeks to collect insects.

Equipment.—The laboratory equipment has been increased by the purchase of a specimen cabinet, breeding cages, collecting nets, a dissecting microscope, attachable mechanical stage for the compound microscope, a cabinet holding nearly 1,000 microscopic slides and a small enlarging camera. A considerable number of the Riker specimen tablets and small glass-covered wooden cases have been procured and are especially useful in exhibiting insects.

Two Gould "Kerowater" and one Deming "Peerless" barrel pumps, and several Deming "Success" bucket pumps were purchased for experimental work. These pumps were loaned to orchardists when not needed in our own experiments.

For fumigating trees a sheet tent, 24 feet square, was made of ten-ounce duck and filled with paraffine. A folding box tent for small growing trees and a box for fumigating small plants, cions, etc., were devised and constructed.

The general collection of insects has been increased nearly one-third by the season's accessions.

Library.—Important additions to the entomological library have been complete sets of the Transactions of the American Entomological Society; Psyche; Journal of the New York Entomological Society and Entomologica Americana. The accessions also include the Practical Entomologist, Miss Ormerod's English Reports, and a number of general and special works of one and two volumes each.

Exhibits.—A set of insecticides ready for use in sealed bottles, also some dry insecticide materials in exhibition jars, were shown at the meeting of the Connecticut Board of Agriculture at Norwich in December. At the same meeting were shown the life stages of several injurious species arranged in Riker specimen tablets, and in glass-covered wooden cases. Some of the insects were also exhibited at the various meetings of the Connecticut Pomological Society, and especially at the fruit-exhibit at Berlin, October 1st and 2d, and at the field meeting at the Experiment Station in November.

Field Experiments.—Field experiments to kill the San José scale by spraying were conducted at Westville, Bridgeport, and Terryville. These were not as extensive as had been planned, on account of unfavorable weather in late winter and early spring.

In November, 1902, a few large apple trees in Plainville were fumigated with hydrocyanic gas.

Publications.

The First Report of the State Entomologist (52 pages, 2 figs., XI plates) covering the period from July 1st, 1901, when the act concerning Insect Pests went into effect, until December 31st, 1901, was issued and distributed in May. This report also contains insect notes of the Station between November 1st, 1900, and January 1st, 1902. An edition of 10,750 copies was printed.

Postal Card Bulletin (not numbered with the regular series) giving brief instructions regarding immediate work against the Elm Leaf-Beetle was printed in an edition of 11,000 copies and mailed to residents of the State during July.

Bulletin 139, The Apple-Tree Tent-Caterpillar (12 pages, 3 figs., III plates) containing a general account of the insect and its prevalence in Connecticut, together with methods of combating it, was published in an edition of 11,000 copies and sent out in August.

Bulletin 140, The White-Fly or Plant-House Aleyrodes (17 pages, 5 figs., IV plates), being a somewhat detailed account of the injury, life history, and remedies, together with a technical description, was published in 10,500 copies and distributed in December.

Lectures.

During the calendar year the State Entomologist has given twelve lectures at farmers' and fruit growers' institutes, grange meetings, etc. Seven of these were illustrated with lantern slides.

Correspondence.

The correspondence of the Entomologist has increased gradually during the year. In addition to a number of packages and 75 circular letters sent out from this office, 679 letters have been written during the calendar year. A large portion of the correspondence is connected with the identification of insects and the method of treatment recommended.

Nursery Inspection and Certification.

In the Entomologist's report for last year, p. 232, is given a list of nursery firms to which certificates had been granted. A few firms which had not been known to the State Entomologist applied for inspections in the spring of the present year. The inspections were made and certificates granted until October 1st. These nurseries were again inspected in the fall.

Following are the names of nursery firms to which certificates have been granted. The number of the certificate and the date when the inspection was finished is also given. The list is believed to contain all nursery firms in the State with three exceptions—in one case a certificate was refused, and in two others the nurseries have not yet been put in condition to receive certificates. There are thirty-one names on the list and four of the nurseries were inspected twice, making a total of thirty-eight inspections for the year.

List of Nursery Firms Receiving Certificates in 1902.

Name of Firm.	Location.	Inspection Finished.	Certificate Number.
Allen, Chas. I. (2)	Terryville	Dec. 4	98
Atwater, C. W.	Collinsville	Oct. 7	71
Barnes Bros.	Yalesville	Oct. 16	78
Bishop, J. N. (2)	Plainville	Nov. 11	93
Bowditch, J. H.	Pomfret Center	Oct. 29	85
Burr & Co., C. R.	New Canaan	Oct. 8	73
Butler & Jewell Co., The	Cromwell	Dec. 30	95
Comstock & Lyon	Norwalk	Nov. 10	92
Conine, F. E.	Stratford	Oct. 10	75
Conn. Agricultural College (2)	Storrs	Nov. 13	94
Conn. Valley Orchard Co. (2)	Berlin	Dec. 31	99
Conway, W. B.	New Haven	Oct. 20	79
Dehn & Bertolf	Greenwich	Nov. 25	97
Elizabeth Park Nursery	Hartford	Oct. 15	77
Elm City Nursery Co.	New Haven	Oct. 30	86
Frey, Alois	Hartford	Nov. 3	88
Gardner, R. H.	Cromwell	Nov. 18	76
Gurney & Co., H. H.	New Canaan	Oct. 8	72
Hale, J. H.	So. Glastonbury	Oct. 25	82
Hoyt's Sons, Stephen	New Canaan	Oct. 9	74
Hunt & Co., W. W.	Hartford	Oct. 28	84
Jackson, B. A.	So. Norwalk	Nov. 5	91
Jackson, E. B.	Stamford	Oct. 26	83
Longden, C. E.	North Haven	Oct. 21	81
Norton, A. F.	New Britain	Dec. 31	100
Pierson, A. N.	Cromwell	Oct. 1	70
Platt Co., The Frank S.	New Haven	Oct. 20	80
Ryther, O. E.	Norwich	Nov. 5	90
Veitch Co., The Robert	New Haven	Nov. 1	87
Vidbourne & Co., J.	Hartford	Nov. 5	89
Wallace, W. E.	Hartford	Nov. 17	96

The form of certificate differs somewhat from that used last year to make it more nearly conform to the ideas expressed at the meeting of Official Horticultural Inspectors held at Washington, D. C., November 11, 1901, at which the writer was present. The changes consist in adding the date when the inspection was completed and in making it include all dangerously injurious insects and diseases without mentioning specifically any of them. The form used during 1902 is here given:—

No. ..... *Inspection completed* *190*

THE

Connecticut Agricultural Experiment Station.

OFFICE OF STATE ENTOMOLOGIST,
NEW HAVEN, CONN.

Certificate of Inspection.

THIS IS TO CERTIFY that the stock at the nursery and premises of ..... of ..... Conn., has been carefully examined in compliance with the provisions of Chapter 122 of the Acts of the General Assembly, January Session of 1901, and that it is apparently free from dangerously injurious insects and diseases.

This certificate is invalid after 190

..... *State Entomologist.*

Condition of Nurseries in 1902.

With a few exceptions the nurseries of the State were found to be in better condition as regards the scale than in 1901, when the law went into effect.

Two or three nurserymen were somewhat careless and did not take sufficiently radical measures to exterminate the pest when it had first been discovered. Consequently considerable stock had to be destroyed in 1902. In other cases, nurseries are located in the vicinity of scale-infested orchard trees to which no remedial treatment has been applied. Such nurseries will not remain uninfested. In such places much stock must annually be destroyed and the remainder fumigated or the owner must procure grounds in a better locality. But there is no

assurance that any locality will long be free from scale. Where a nursery becomes infested by proximity to infested orchards, there is no redress for the nurseryman under the present law, which makes no provision for compelling the orchardist to fumigate, spray, or destroy his infested trees.

In thirteen nurseries no trace of the scale was found, while nineteen were found to be infested. Nurserymen are usually prompt to destroy or fumigate stock when advised by the inspector to do so, and the writer here wishes to express his appreciation of their coöperation. It is only by such cordial coöperation that the pest can be controlled.

Acreage of Connecticut Nurseries.

There are at the present time about 422 acres of growing nursery stock in Connecticut. These figures are based upon data obtained from the nurserymen, and in a few cases the estimates of the inspector. Fruit stock and all kinds of hardy ornamental plants are included.

Examination of Orchards, Fields and Gardens.

Thirty-five inspections of orchards and gardens have been made during the year, most of them at the request of the owners, but in a few cases on request of some other interested person. Several times the entomologist has responded to calls to examine city shade trees for city officials and private citizens, but in most cases the inspection referred to fruit trees in orchards or gardens.

Infested Localities.

In the beginning of 1902 the San José scale-insect was known to exist in 99 localities (see Rept. for 1901, p. 234). During the year 66 new localities have been discovered, making in all 165, including nurseries.

Identification of Insects.

Considerable time has been taken in the determination of species of insects sent to the Station by fruit-growers, farmers, etc. Some of the insects were found injuring plants, while

others were sent from a desire to learn whether or not to expect injury from them. Beneficial insects like lady-beetles are frequently mistaken for injurious species by persons not familiar with insect life. The writer received specimens of the elm leaf-beetle, *Galerucella luteola* Müll., and the two-spotted lady-beetle, *Adalia bipunctata* Linn., from a person who had found both kinds hibernating in the house and thought them to be destroyers of carpets. While the elm leaf-beetle should be killed whenever found, it would be a mistake to destroy the two-spotted lady-beetle, which is very beneficial to agriculturists because in both the larval and adult stages it feeds upon plant lice and allied insects.

The reader will notice from the following tables that of the insects identified a large proportion are scale-insects. This naturally follows the agitation and discussion regarding the San José scale-insect, which must be considered the chief pest of the Connecticut orchard. Orchardists, therefore, are anxious to know if their trees are infested, and several have expressed to the writer their satisfaction on learning that the specimens which they had submitted proved to be some other and much less dangerous kind of scale-insect. To know about it had saved them considerable worry, and enabled them to apply a remedial treatment with intelligence.

The identification of specimens, then, is of considerable importance as is evidenced by the increasing number of specimens submitted. In case of any serious insect outbreak, or the introduction into the State of any dangerous species, if specimens are sent to this office, an investigation will be conducted at once and measures will be taken to suppress it.

Between January 1, 1902, and January 1, 1903, 171 samples of insects have been received; these are given in the following list:

INSECTS RECEIVED FOR IDENTIFICATION.

Date.	Name.	Host.	Locality.	Remarks.
1902				
Jan. 3	San José Scale, *Aspidiotus perniciosus* Comst.	Apple	Plantsville	Twigs thoroughly infested.
" 10	Scurfy Bark-Louse, *Chionaspis furfurus* Fitch	"	Newington	Females on twigs. Egg stage.
" 13	San José Scale, *Aspidiotus perniciosus* Comst.	"	Fairfield	Twig well coated.
" 21	Tulip Tree Scale, *Lecanium tulipiferæ* Cook	Tulip Tree	Bridgeport	Twig covered.
Feb. 1	Mealy Bug, *Dactylopius citri* Risso	Coleus	Southington	Plants had been killed by the insect.
" 1	San José Scale, *Aspidiotus perniciosus* Comst.	Apple and Japan Plum	Hartford	Mostly dead.
" 1	——— ?	*Ilex crenata*	New Haven	Cocoon on plants imported from Japan.
" 6	Scurfy Bark-Louse, *Chionaspis furfurus* Fitch	Apple	Cheshire	Egg stage.
" 6	——— ?	Elm	Bridgeport	Pupæ from bark.
" 6	Tulip Tree Scale, *Lecanium tulipiferæ* Cook	Tulip Tree	Hartford	Partially grown insects. Alive.
" 5	Bag Worm, *Thyridopteryx ephemeræformis* Haw.	Arbor vitæ	New Canaan	Bags containing eggs, on twigs.
" 5	Cecropia Moth, *Samia cecropia* Linn.	Maple	"	Cocoon fastened to branch.
" 5	Spider's eggs, sp.		"	In sacks.
	Cocoons, sp.	Maple	"	
" 8	Scurfy Bark-Louse, *Chionaspis furfurus* Fitch	Apple	Hartford	On twigs. Egg stage.
" 8	San José Scale, *Aspidiotus perniciosus* Comst.	"	"	On same twigs as preceding,
" 10	San José Scale, *Aspidiotus perniciosus* Comst.	"	Bridgeport	Insects mostly dead. Trees had been treated.
" 13	Oyster-shell Bark-Louse, *Mytilaspis pomorum* Bouché	Butternut	Seymour	Bark of twigs well covered. Egg stage.
" 13	San José Scale, *Aspidiotus perniciosus* Comst.	Japan Plum	Bridgeport	Insects attacked by a fungus (*Capnodium?*).
" 14	Cherry Scale, *Aspidiotus forbesi* Johns	Apple	Plainville	A few specimens on cions.
" 15	Scurfy Bark-Louse, *Chionaspis furfurus* Fitch	Pear	South Norwalk	Shells of both sexes on twigs. Egg stage.
" 15	Beetle, *Hylotrupes ligneus* Fabr.	Red Cedar	Westville	Emerged from tunnels in cedar bean poles.
" 20	Katydid, *Microcentrum retinervis* Say?	Apple	Yalesville	Eggs on cions purchased for grafting.
" 24	Purple Orange Scale, *Mytilaspis citricola* Pack.	Orange	Bozrahville	On fruit purchased in market.
" 27	Beetle, *Hylotrupes ligneus* Fabr.	Red Cedar	Westville	Additional material sent by request.
Mar. 4	Scurfy Bark-Louse, *Chionaspis furfurus* Fitch	Pear	Shelton	Egg stage.
" 13	" " "	"	New Haven	" "
" 15	——— *Aspidiotus* sp.?	"	New London	Immature females.
" 17	Oyster-shell Bark-Louse, *Mytilaspis pomorum* Bouché	Lilac	Bridgeport	Egg stage.
" 17	" " " "	"	Meriden	" "
" 17	San José Scale, *Aspidiotus perniciosus* Comst.	Apple, Pear, Plum	Bridgeport	Insects attacked by a fungus (*Capnodium?*).

INSECTS RECEIVED FOR IDENTIFICATION.

Date.	Name.	Host.	Locality.	Remarks.
Mar. 17	Scurfy Bark-Louse, *Chionaspis furfurus* Fitch	Apple	Leete's Island	Egg stage.
" 17	Mite, ——— sp.?	Spinach	Ansonia	Eggs and adults present.
" 19	San José Scale, *Aspidiotus perniciosus* Comst.	*Spiræa Sorbifolia*	Hartford	Sent to have effect of treatment ascertained.
" 19	——— *Calophya flaveola* Riley, MS.	Sumac (*R. glabra*)	"	Pupa stage on twigs.
" 22	White-marked Tussock Moth, *Notolophus leucostigma* S. & A.	Apple	Bridgeport	Egg-mass on leaf.
" 24	Elm Leaf-Beetle, *Gallerucella luteola* Müll.	———	Southbury	Found hibernating in a dwelling house.
" 24	Two-Spotted Lady-Beetle, *Adalia bipunctata* Linn.	———	"	" " " "
" 26	San José Scale, *Aspidiotus perniciosus* Comst.	Peach	Groton	Owner had 500 trees. 25 per cent. killed.
" 27	Scurfy Bark-Louse, *Chionaspis furfurus* Fitch	Apple	Bristol	On twigs. Egg stage.
" 27	" " "	Apple and Hawthorn	New Haven	" " " "
" 29	Oyster-shell Bark-Louse, *Mytilaspis pomorum* Bouché	Apple	Shaker Station	" " " "
Apr. 1	" " " "	"	Thompsonville	" " " "
" 1	Scurfy Bark-Louse, *Chionaspis furfurus* Fitch	"	"	" " " "
" 1	" " "	"	Scitico	" " " "
" 7	" " "	"	Franklin	" " " "
" 9	San José Scale, *Aspidiotus perniciosus* Comst.	Peach	Bridgeport	Twigs well covered. Mostly alive.
" 15	" " "	Apple	Unionville	Trees purchased in 1901.
" 15	Oyster-shell Bark-Louse, *Mytilaspis pomorum* Bouché	Willow	Somers	Egg stage.
" 17	Snowy Tree Cricket, *Œcanthus niveus* Harr.	Raspberry	Westville	Eggs laid in canes.
" 18	Scurfy Bark-Louse, *Chionapsis furfurus* Fitch	Currant	Highwood	Egg stage. Cane completely covered.
" 21	Promethea Moth, *Attacus promethea* Dru.	Japan Plum	Farmington	Cocoons on twigs.
" 22	San José Scale, *Aspidiotus perniciosus* Comst.	"	Meriden	Branch thickly coated.
" 23	" " "	Apple	Milford	Sprayed with kerosene. Not all dead.
" 24	Rose Scale, *Aulacaspis rosæ* Sand.	Rose	Clintonville	A few living insects on twigs.
" 24	Snowy Tree Cricket, *Œcanthus niveus* Harr.	Apple and Raspberry	Collinsville	Eggs deposited in the twigs.
" 24	San José Scale, *Aspidiotus perniciosus* Comst.	Plum	Highland, N. J.	A few dead specimens around buds.
" 26	Scurfy Bark-Louse, *Chionaspis furfurus* Fitch	Apple	Seymour	Egg stage.
May 1	San José Scale, *Aspidiotus perniciosus* Comst.	Pear & Apple	Highwood	Partially grown.
" 1	Spider's eggs	Horse Chestnut	Morris	Egg-mass under loose bark.

INSECTS RECEIVED FOR IDENTIFICATION.

Date.	Name.	Host.	Locality.	Remarks.
May 1	—— *Acronycta Americana* Harr.	Horse Chestnut	Morris	Pupa stage under the bark.
" 2	Bag Worm, *Thyridopteryx ephemeræformis* Haw.?	Cedar	New Haven	Larva on stock imported from Japan.
" 8	—— *Anomala binotata* Gyll.	Strawberry	"	Adults feeding on leaves.
" 9	San José Scale, *Aspidiotus perniciosus* Comst.	Hawthorn	"	Received from N. J. All dead.
" 12	Oyster-shell Bark-Louse, *Mytilaspis pomorum* Bouché	Lilac	West Suffield	Egg stage.
" 13	San José Scale, *Aspidiotus perniciosus* Comst.	Currant	Preston	Twig dead. Coated with scales.
" 14	Spruce Louse, *Lachnus abietis* Fitch?	Spruce	New Haven	Twig completely covered.
" 17	—— *Harpalus pennsylvanicus* DeG.		Scotland	Found around base of peach trees.
" 17	—— *Platynus placidus* Say		"	" " "
" 17	Well-marked Cut-Worm, *Noctua clandestina* Harr.		"	" " "
" 19	Scurfy Bark-Louse, *Chionaspis furfurus* Fitch	Apple	North Guilford	Eggs just hatching.
" 20	Oyster-shell Bark-Louse, *Mytilaspis pomorum* Bouché	Ash	Ansonia	Old shells only.
" 20	Beetle, *Corymbites cylindriformis* Hbst.		Warehouse Point	Found crawling upon fruit trees.
" 20	Aphis, sp.?	Plum	Newtown	On new growth.
" 20	Tortoise Beetle, *Coptocycla guttata* Oliv.	Apple and Plum	New Haven	Resting on leaves and branches.
" 20	" " " *aurichalcea* Fabr.	Apple and Plum	"	" " "
" 21	Raspberry Cane Maggot, *Phorbia rubivora* Coq.	Raspberry	Bristol	Larva tunneling in new shoots.
" 21	Abbot Sphinx, *Thyreus abbotii* Swains		Surry, N. H.	Adult.
" 22	White-marked Tussock Moth, *Notolophus leucostigma* S. & A.	Maple	Morris	Egg-masses on bark.
"		"	Cornwall Bridge	Larval stage, two-thirds grown.
" 27	Forest Tent-Caterpillar, *Clisiocampa disstria* Hbn	Pine	So. Manchester	Eggs just hatched.
" 27	Pine Scale, *Chionaspis pinifoliæ* Fitch	Lilac	" "	Old shells only.
" 27	Oyster-shell Bark-Louse, *Mytilaspis pomorum* Bouché	Fern	New Britain	Specimens immature.
" 31	Scale on fern, *Lecanium hemisphæricum* Targ.-Tozz?	Maple	Hartford	Larvæ three-fourths grown.
" 31	Forest Tent-Caterpillar, *Clisiocampa disstria* Hbn.	Currant	Ansonia	Mostly dead.
June 2	Putnam's Scale, *Aspidiotus ancylus* Putn.	Strawberry	East Wallingford	Larvæ, partially grown.
" 3	Strawberry Saw-fly, *Emphytus maculatus* Norton		New Haven	Adult moth.
" 3	Eight-spotted Forester, *Alypia octomaculata* Hbn.	Currant	Milford	Under side of leaves covered.
" 3	Currant Aphis, *Myzus ribis* Linn.			

INSECTS RECEIVED FOR IDENTIFICATION.

Date.	Name.	Host.	Locality.	Remarks.
June 3	Four-lined Leaf-bug, *Pœcilocapsus lineatus* Fabr.	Sage and *Œnothera*	Milford	Sucking sap from the leaves.
" 4	Twice-stabbed Lady Beetle, *Chilocorus bivulnerus* Muls.	San José Scale	Stratford	Abundant and devouring the scales.
" 5	Scale, *Lecanium juglandis* Bouché?	Plum	Watertown	Only one individual.
" 6	" " "	"	West Haven	Egg stage. Twig well infested.
" 6	Scarlet Spider, *Trombidium sericeum* Say		Rainbow	Found upon seedling pines.
" 9	Abbot Sphinx, *Thyreus abbotii* Swains		Hartford	Adult moth.
" 9	Oyster-shell Bark-Louse, *Mytilaspis pomorum* Bouché	Willow	New London	Newly hatched insects, crawling.
" 11	Quince Curculio, *Conotrachelus crataegi* Walsh	Quince	Woodbridge	Work of insect in young fruit.
" 16	Tulip Tree Scale, *Lecanium tulipiferæ* Cook	Tulip Tree	Brookfi'ld Center	Both sexes on twigs.
" 18	Eyed Elater, *Alaus oculatus* Linn.		Woodbridge	Adult beetle.
" 24	Moth, *Noctua lubricans* Gn.		Farmington	Adults found in buildings.
" 25	Lady Beetle, *Brachyacantha ursina* Fabr.		Hartford	Devouring plant lice on plum tree.
" 27	Strawberry Leaf-Roller, *Phoxopteris comptana* Frol.	Strawberry	Collinsville	Larvæ badly crushed.
" 28	Cherry Aphis, *Myzus cerasi* Fabr.	Cherry	Cannon	Causing leaves to curl.
" 28	Black Aphis, sp.?	Windsor Bean	New Haven	Leaves and stems covered.
" 28	Tortoise Beetle, *Coptocycla clavata* Fabr.	Tomato	Warren	Adults devouring leaves.
July 5	Ambrosia Beetle, *Xyleborus pyri* Peck	Peach	Long Hill, Middletown	Adults emerging from tunnels in trunk.
" 9	Scurfy Bark-Louse, *Chionaspis furfurus* Fitch	Apple	Westport	Both sexes present.
" 12	Fruit Bark Beetle, *Scolytus rugulosus* Ratz.	Plum	New Haven	Burrowing in trunk and branches.
" 14	Tulip Tree Scale, *Lecanium tulipiferæ* Cook	Magnolia	"	Both sexes present.
" 14	Mealy Bug, *Dactylopius citri* Risso	"	"	On twigs with *L. tulipiferæ*.
" 17	Saw-fly, *Selandria*, sp.?	Hawthorn	Southington	Larvæ eating green portion of leaves.
" 18	Broad-necked Prionus, *Prionus laticollis* Dru.		New Milford	Adult beetle.
" 18	Lesser Prionus, *Orthosoma brunneum* Forst.		"	" "
" 18	Brown Elaterid, sp.?		"	" "
" 18	White-fly, *Aleyrodes vaporariorum* Westw.	Strawberry	Milford	Both larvæ and adults present.
" 21	Cabbage Aphis, *Aphis brassicæ* Linn.	Turnip & Kale	"	On seed plants.
" 22	Caterpillar, sp.?	Gloxinia	Bristol	Eating flowers and leaves.
" 22	Maple Borer, *Plagionotus speciosus* Say	Maple	"	Found on trees.
" 23	Scurfy Bark-Louse, *Chionaspis furfurus* Fitch	Pear	Rockville	Both sexes present.
" 28	Cranberry Worm, *Rhopobota vacciniana* Pack.	Cranberry	"	Adult insects.

INSECTS RECEIVED FOR IDENTIFICATION.

Date.	Name.	Host.	Locality.	Remarks.
July 29	Apple Leaf-Miner, *Tischeria malifoliella* Clem.	Apple	Quaker Hill	Larvæ mining in apple leaves.
" 31	White-Fly, *Aleyrodes vaporariorum* Westw.	Strawberry	Saugatuck	Larvæ and adults present.
Aug. 1	Fruit Bark-Beetle, *Scolytus rugulosus* Ratz.	Peach	Stamford	Boring in trunk.
" 1	Ichneumon Fly, *Thalessa*, sp.?		New Haven	Issuing from dead tree.
" 11	Tulip Tree Scale, *Lecanium tulipiferæ* Cook	Tulip Tree	Danbury	Not fully mature.
" 14	" " "	"	Southington	" "
" 14	—— *Alaria florida* Gn.		New Haven	Found on flowers.
" 14	Strawberry Flea Beetle, *Haltica ignita* Ill.	Elm & Hickory	Chapinville	Small dark-blue beetles feeding on leaves.
" 16	Saw-fly, *Selandria*, sp.?	Cherry	Harwinton	Larvæ eating leaves.
" 18	Saddle-Back Caterpillar, *Empretia stimulea* Clem.	Pear	Mt. Carmel Center	" " "
" 18	Scurfy Bark-Louse, *Chionaspis furfurus* Fitch	Apple	Hartford	
" 19	Tomato Worm, *Protoparce Carolina* Linn.	Tomato	New Haven	Small larva parasitized.
" 20	Spider, *Lycosa scutellata*		Hartford	
" 20	Cecropia Caterpillar, *Samia cecropia* Linn.	Chestnut	New Haven	Larva devouring leaves.
" 21	Asparagus Beetle, *Crioceris asparagi* Linn.	Asparagus	Shelton	Devouring asparagus plants.
" 21	Orange-striped Oak Worm, *Anisota senatoria* S. & A.	Oak	New Haven	Larvæ stripping the trees.
" 23	Yellow-necked Caterpillar, *Datana ministra* Dru.	Apple	Burlington	
" 23	Raspberry Moth, *Synchlora glaucaria* Gn.		New Canaan	Adult insect.
" 23	White Pine Weevil, *Pissodes strobi* Peck	White Pine	New Haven	Pupæ and adults from the leader of a young pine.
" 23	Walking Stick, *Diapheromera femorata* Say		"	Found inside of a building.
Sept. 4	Dog-day Harvest Fly, *Cicada tibicen* Linn.		Hockanum	One adult and several pupa cases.
" 4	Red Humped Caterpillar, *Œdemasia concinna* S. & H.	Japan Plum	Forestville	Larvæ devouring foliage.
" 4	Slug Caterpillar, *Parasa chloris* H.-S.	"	"	" " "
" 5	" " *Lagoa crispata* Pack.	Quince	New Haven	" " "
" 8	Pine Saw-fly, *Lophyrus*, sp.?	Pine	Rainbow	Larvæ, yellow with black spots. Pupated in a few days.
" 13	Cecropia Caterpillar, *Samia cecropia* Linn.	Plum	New Haven	Parasitized larva eating leaves.
" 13	Luna Caterpillar, *Actias luna* Linn.	Chestnut	"	Larva eating leaves.
" 15	San José Scale, *Aspidiotus perniciosus* Comst.	Apple & Pear	"	Dead insects on dead wood. Many trees killed.
" 15	" " "	Peach	Southport	A few young scales around the buds.
" 19	Tomato Worm, *Protoparce Carolina* Linn.	Lilac	New Haven	Larva.
" 20	Slug Caterpillar, *Lagoa crispata* Pack.	Apple	"	Larva eating leaves.

INSECTS RECEIVED FOR IDENTIFICATION.

Date.	Name.	Host.	Locality.	Remarks.
Sept. 20	Saddle-Back Caterpillar, *Empretia stimulea* Clem.	Honeysuckle	New Haven	Larva eating leaves.
" 22	Cabbage Aphis, *Aphis brassicæ* Linn.	Cabbage	Milford	On leaves, sucking the sap.
" 29	San José Scale, *Aspidiotus perniciosus* Comst.	Peach and *Cornus*	New Haven	Mature females and young.
Oct. 14	Pigeon Tremex, *Tremex Columba* Linn.	Hickory	"	
" 24	—— *Sesia*, sp.?	"	Stockbridge, Mass.	Galls on twigs.
" 30	San José Scale, *Aspidiotus perniciosus* Comst.	Plum, Apple, Pear & Peach	Meriden	Twigs completely encrusted.
Nov. 10	Tulip Tree Scale, *Lecanium tulipiferæ* Cook	Tulip Tree	New Haven	Old shells and immature insects.
" 11	San José Scale, *Aspidiotus perniciosus* Comst.	Apple	Shaker Station	Twig badly infested. Young crawling.
" 14	White-Fly, *Aleyrodes vaporariorum* Westw.	Geranium	New Haven	Larvæ and adults on under surface of leaves.
" 15	Lady Beetle, *Pentilia misella* LeC.	San José Scale	Westville	Reported as being very abundant on infested plum tree.
" 17	San José Scale, *Aspidiotus perniciosus* Comst.	Apple	Baltimore, Md. Sent from New Canaan	All dead; had been fumigated.
" 21	Rose Scale, *Aulacaspis rosæ* Sand.	Rose	Danielson	Males and females. Egg stage not found.
" 24	Spider, sp.?		New Haven	Found in cellar.
" 24	San José Scale, *Aspidiotus perniciosus* Comst.	Plum	Geneva, N. Y. Sent from New Canaan	Dead; had been fumigated.
" 28	" " "	"	Cromwell	" " "
Dec. 2	" " "	"	Bridgeport	Mostly dead. Had been treated.
" 2	Scurfy Bark-Louse, *Chionaspis furfurus* Fitch	Apple	East Hartford	Egg stage.
" 4	San José Scale, *Aspidiotus perniciosus* Comst.	"	Pomfret Center	On trees purchased in 1901.
" 6	White-Fly, *Aleyrodes vaporariorum* Westw.	*Fuchsia* and *Eupatorium*	Levis, Quebec, Canada	Adults only.
" 16	Spider, *Agalena nævia*		Hartford	
" 26	Apple Aphis, probably, *Aphis pomi* DeG.	Apple	Collinsville	Eggs glued around the buds.
" 26	—— sp.?	"	"	A larva making sinuous burrows just beneath the outside layer of cells of the bark of twigs.

EXPERIMENTS IN SPRAYING TO KILL THE SAN JOSÉ SCALE-INSECT. SEASON OF 1902.

Spraying experiments to kill the San José scale-insect were conducted in three different places, Westville, Bridgeport and Terryville. On account of stormy and windy days through March the spraying was mostly delayed until the month of April. The leaves soon began to appear, so that the time for applying insecticides to dormant trees was comparatively short. The experiments, therefore, were much less extensive than had been planned.

In each of the experiments, as in those of 1901, twigs were examined just before spraying, and the percentages of living scales noted. About six weeks after spraying, twigs were again examined to ascertain the effect of the treatment. Thirty trees in Westville, 11 in Terryville, and over 200 in Bridgeport were treated in the experiment.

The insecticides used were: crude oil undiluted and in 25 per cent. mixture with water; kerosene, 25 per cent. mixture in water; Adler's soda soap, one pound in one gallon of water; "Naphcin," one-half pint in two gallons of water, and the lime, sulphur and salt mixture.

Three kinds of crude oil were used:

Standard Oil Co., testing 43° Beaumé; Derrick Oil Co., testing 45° Beaumé; a black oil, purchased near Terryville, 35.8° Beaumé.

The lime, sulphur and salt mixture was prepared after two formulas, as follows:

No. 1	50 lbs.	Fresh stone lime.
	50 "	Flowers of Sulphur.
	50 "	Common salt.
	150 gals.	Water.
No. 2	30 lbs.	Fresh stone lime.
	20 "	Flowers of Sulphur.
	15 "	Common salt.
	60 gals.	Water.

In each case the materials were weighed out, the lime slaked, the sulphur and salt added with enough water to cover and the whole boiled in a kettle for at least one hour. The water was then added and the mixture applied while fresh. Boiling for a longer time is said to improve the mixture and some recommend boiling it for three hours, but this was not done in these experiments.

Westville Experiments.

Sixteen young pear trees were sprayed, March 24th, with 25 per cent. crude oil (Standard Oil Co.) in water. These trees were badly infested and were cut back previous to spraying. On April 1st six trees (five pear and one plum) were sprayed: three pears with 25 per cent. kerosene in water; one pear with lime, sulphur and salt mixture, and a pear and a plum each were drenched with undiluted crude oil. Eight trees were sprayed April 15th. Undiluted crude oil (Standard Oil Co.) was applied to two apple, one cherry and one plum tree. One pear was treated with undiluted Derrick oil, and another with the same kind of oil used in 25 per cent. mixture with water. One pear tree was sprayed with Adler's soda soap, one pound in one gallon of water, and one tree with the lime, sulphur and salt mixture. The spraying was done in favorable weather and the trunk, branches and twigs were coated with the liquid as thoroughly as it was possible to coat them.

By consulting Table I, page 116, the reader will see that on a number of young pear trees sprayed with 25 per cent. crude oil and 25 per cent. kerosene, no living insects could be found on May 23d. These were all small trees where it was possible to reach all twigs with the bamboo extension from the ground.

The two apple trees sprayed April 15th (see Table II) were large trees and ladders were used in spraying. The fact that 13 per cent. of living insects were found indicates that these trees were not as thoroughly covered with the spray as some others. These trees were severely injured, presumably by the oil. Some injury was caused by both the Standard and Derrick oils where used undiluted, with very slight injury from each in 25 per cent. mixtures with water. No injury could be detected from the use of the lime, sulphur and salt mixture.

Experiments at Bridgeport.

Between April 10 and April 16 over 200 trees were sprayed in this experiment. Nearly all were Japan plum of medium

TABLE I.—WESTVILLE EXPERIMENTS. DORMANT TREES SPRAYED MARCH 24, 1902.

Number of trees treated.	Kind of trees.	Condition of trees before treatment.	Treatment and materials applied.	Per cent. of living insects at time of treatment.	Per cent. of living insects on May 23.	Per cent. probably killed by treatment.	Effect of treatment on trees.
10	Pear	Badly infested	25 per cent. crude oil in water	85.4	.09	85.3	Slight injury.
1	"	" "	" " " " "	75.5	0	75.5	" "
1	"	" "	" " " " "	63.	0	63.	" "
1	"	" "	" " " " "	53.4	0	53.4	" "
1	"	" "	" " " " "	52	0	52.	" "
1	"	" "	" " " " "	77	0	77.	" "
1	"	" "	" " " " "	41	†	--	

WESTVILLE EXPERIMENTS. DORMANT TREES SPRAYED APRIL 1, 1902.

1	Pear	Badly infested	25 per cent. kerosene in water	62	0	62	No injury.
1	"	" "	" " " "	75	0	75	" "
1	"	" "	" " " "	90	0	90	Buds slightly injured.
1	"	" "	Crude oil, drenched	84	0	84	Buds nearly all killed.
1	Europ. Plum	" "	" " "	72.2	0	72.2	" " " "
1	Pear	" "	Lime sulphur salt*	95	.05	94.9	No injury.

* Formula No. 1.

† This tree was removed by the owner before a record was taken.

TABLE II.—WESTVILLE EXPERIMENTS. DORMANT TREES SPRAYED APRIL 15, 1902.

Number of trees treated.	Kind of trees.	Condition of trees before treatment.	Treatment and materials applied.	Per cent. of living insects at time of treatment.	Per cent. of living insects on May 23.	Per cent. probably killed by treatment.	Effect of treatment on trees.
2	Apple	Badly infested	Crude oil (Standard)	46	13	33	Nearly all buds killed.
1	Cherry	Moderately infested	" " "	21.2	0	21.2	" " " "
1	Elm	" "	" " "	32	0	32	Buds nearly all killed.
1	Pear	Badly infested	Derrick oil	50.4	0	50.4	Buds considerably injured.
1	"	" "	Derrick oil, 25%	65.4	0	65.4	Very slight injury.
1	"	" "	Soda soap, 1 lb. 1 gal.	62.	18	44	No injury.
1	"	" "	Lime sulphur salt*	71	.03	70.07	" "

* Formula No. 1.

TABLE III.—BRIDGEPORT EXPERIMENTS. DORMANT TREES SPRAYED APRIL 10–16, 1902.

Number of trees treated.	Kind of trees.	Condition of trees before treatment.	Treatment and materials applied.	Per cent. of living insects at time of treatment.	Per cent. of living insects June 23.	Per cent. probably killed by treatment.	Effect of treatment on trees.
71	Japan Plum	Badly infested	25 per cent. crude oil in water	43	.08	42.92	No injury.
30	Japan Plum	" "	" " "	79	4.9	74.1	No injury.
30	Japan Plum	" "	" " "	83	9.5	73.5	No injury.
1	Cherry	Moderately infested	" " "	71.1	2.1	69.1	No injury.
1	Cherry	" "	Lime, sulphur, salt*	85.6	†	----	No injury.
1	Peach	" "	" " "	56	0	56.	No injury.

* Formula No. 1. † The record was accidentally destroyed so that an exact percentage cannot be given, but it was very small.

TABLE IV.—TERRYVILLE EXPERIMENTS. DORMANT TREES SPRAYED APRIL 18, 1902.

Number of trees treated.	Kind of trees.	Condition of trees before treatment.	Treatment and materials applied.	Per cent. of living insects at time of treatment.	Per cent. of living insects June 24.	Per cent. probably killed by treatment.	Effect of treatment on trees.
1	Plum	Moderately infested	Lime, sulphur and salt*	58	7.3	50.7	No injury.
1	"	" "	" " "	62	.89	61.11	No injury.
1	"	Badly "	" " "	42	5.5	36.5	No injury.
1	"	" "	" " "	60.2	4.5	55.7	No injury.
1	"	" "	" " "	74	0	74.	No injury.
1	"	" "	" " "	57	5.3	51.7	No injury.
1	Peach	Moderately "	" " "	98	.063	97.93	No injury.
1	Plum	Badly "	Naphcin, ½ pint to 2 gall.	69.5	37.8	31.7	No injury.
1	"	" "	" " "	66	38.	28.	No injury.
1	"	" "	25 per cent. crude oil in water	61	0	61.	Considerable injury.
1	"	" "	" " "	54	0	54.	Considerable injury.

* Formula No. 2.

size, planted close together and badly infested. Though only 134 trees are recorded in Table III, many more were treated from which no twigs were taken. The oil used was from the Standard Oil Co., and in 25 per cent. mixture with water, seemed to cause no injury to the trees. On the other hand, the percentage of living insects after the treatment was somewhat greater than the average in the Westville experiment, where similar methods were used.

Terryville Experiments.

On April 18th ten Japan plum and one peach tree were sprayed at Terryville. The lime, sulphur and salt was used on six plum and one peach tree and in no case did it appear to injure the tree. It was quite effective, moreover, in destroying the scales. The crude oil used here was a very heavy, black oil, testing 35.8° Beaumé, and purchased in the vicinity. It injured the trees to some extent. The "Naphcin," a commercial preparation much advertised, did not prove very deadly to the scales, as the figures of Table IV show.

Other Records.

The most extensive test of the lime, sulphur and salt was made at Yalesville by Barnes Bros., who sprayed 7,000 trees or nearly half their orchard with the mixture just before the buds started in spring. Formula 2, as given on page 114, was used in the Barnes orchard, but instead of diluting after boiling, the whole volume of water was boiled with the other ingredients for two hours instead of one hour, as was practiced in our experiments. The Messrs. Barnes employed a steam boiler of about five horse power capacity, and on two sides of the boiler were placed eight 120-gallon hogsheads to hold the mixture and into which the steam was forced through iron pipes connected with the boiler. The cooking apparatus shown on plate III was placed by a spring near one side of the orchard so that an abundance of water could be easily obtained. Many practical difficulties were encountered that hindered the work and increased the cost of it. It was found that leather packing in the pumps was soon destroyed as well as leather shoes and gloves worn by the workmen. The mixture corrodes the skin, making the face and hands sore after working in it for a few

days, so that some protection is necessary. The cost of the application was about eleven cents per tree including cost of boiler and apparatus, materials, labor, etc., but the boiler has not been injured and its cost should not be charged wholly to one season's account. Boiling the whole quantity of the mixture for so long a time also greatly increased the cost per tree.

In some laboratory tests made at the Station it was found that flowers of sulphur being in smaller particles dissolves up quicker than the sulphur flour or ground brimstone. In preparing the mixture after formula No. 2, all the flowers of sulphur dissolved on boiling for one hour, but where the sulphur flour was used some undissolved sulphur remained after boiling the same time. It will probably pay to screen the sulphur just before boiling to get rid of all lumps that do not dissolve readily in making the mixture.

The writer went through the orchard in July and again in August and observed the result of the work. Only a few living insects could be found, showing that the insecticide was effective, and the trees appeared clean and healthy. The owners are well satisfied with the results of the treatment and feel sure that the injury caused by peach scab and brown rot were somewhat lessened by it. The remaining portion of their orchard will be sprayed the coming season. It should be noted that the lime, sulphur, and salt mixture is probably an excellent fungicide as well as insecticide. Sulphide of potassium is often applied to combat fungus diseases and there is no reason why sulphide of lime, the effective agent in lime, sulphur, and salt, should not be equally effective and more lasting in its effects.

The use of a *more dilute* solution of sulphide of lime on trees in foliage for the destruction of fungi is well worth testing.

A grower near Bridgeport used the mixture quite extensively the past season and reports satisfactory results. An orchardist in Milford who sprayed many peach trees, using both crude oil and the lime, sulphur, and salt mixture, reports that the latter proved far more satisfactory.

Oil was also used by many orchardists and satisfactory results were obtained in most cases. Some applied it undiluted through a nozzle having a small aperture, and others used it in 25 per cent. mixture with water. Both kerosene and crude oil were employed.

The extensive spraying operations in Keney Park, Hartford, were under the direction of Mr. H. J. Koehler, who kindly furnishes the following notes:

"Our spraying for the San José scale-insect was done during the months of January, February, March and April. The materials used were as follows: whale oil soap, of three different brands, all supposed to be made of potash instead of soda, crude petroleum, kerosene, and the lime, sulphur, and salt wash made after the formula given by the Department of Agriculture. (See formula No. 2, page 114.)

The greater part of the whale oil soap was dissolved in hot water at the rate of two pounds of the former to one gallon of the latter, and the rest at the rate of one and one-half pounds to one gallon of water, the manufacturer of one brand recommending this proportion. The directions for use which accompany the soaps often state that they can be dissolved in cold water, but we found this impossible after several attempts. Possibly in the summer, with the water warmer than in winter, it might be done, although it is doubtful. One brand proved refractory even with boiling water, and a barrel full of the dissolved mixture left standing over night was so hard the next morning that it could almost be cut, and had to be heated over again before using. The other two brands when once dissolved could be used without difficulty even when ice cold. For heating purposes we used a sixty gallon iron kettle, set into an iron ring supported by five legs. This was set up out of doors, and sheet iron was used to confine the fire, an opening being left to secure draft. One man was kept constantly at the kettle, his time being occupied in weighing soap, getting water, splitting wood for the fire, etc.

The crude petroleum was ordered from the Providence Department of the Standard Oil Company, Providence, R. I. We tested it and found it to be of the required specific gravity, that is between 43° and 45° Beaumé. The cost of the petroleum was ten cents a gallon, including barrel, shipping charges extra. It was applied undiluted.

The refined kerosene was ordered from a local dealer, and the same as is used for illuminating purposes. The barrels were marked '150 Water White Oil.' It was applied in the form of a mechanical mixture with water, most of it with the pump set at twenty-five per cent. We found it impossible to maintain the percentage accurately. It was usually greater than that indicated. In testing it without a nozzle so that no pressure accumulated in the pump it worked quite accurately, but soon after attaching the nozzle pressure would accumulate and the accuracy would be impaired. Possibly the proportion of accumulated compressed air in the air pump was greater than that in the oil pump, and therefore not enough water was pumped per stroke. Attempts were made to get the desired percentage by setting the pump at a lower percentage than what was wanted. This scheme did not work on account of the varying pressure in the pump, so it is safe to say that we tried all percentages between ten and fifty, the average being probably about twenty-five.

On account of the amount of spraying we had to do, it was impossible to wait until the weather conditions were ideal for the use of kerosene and crude petroleum. It might be fine in the morning at the time of starting out, and then change. Unless it actually began to rain we usually kept right on, until quitting time, which was then 4.30 P. M.

We sprayed an old orchard, consisting mostly of apples and a few pears, with twenty-five per cent. kerosene, on a day when the sky was uniformly overcast and which during part of the time was foggy. Up to date (June 19th), no injury is apparent, in fact no injury to any thing has yet been noticed where the oil and water mixture was used. Considerable injury was done with the crude oil. A number of peach trees and *Cornus florida* were killed outright, and most, although not all, the plants sprayed with crude oil seemed to be retarded in their growth, so that they have not even yet caught up with plants sprayed with other materials. The peach trees were sprayed in the afternoon of a fairly bright still day which came in between two rainy days, with snow on the ground, so that there must have been considerable moisture in the air. The other plants were sprayed on an ideal day, that is, clear and windy. It may be said that all of the plants on which crude oil was used, were quite thoroughly drenched. To merely moisten the plants as prescribed was in our experience an impossibility with the pump. The only way we could do this was by making the application with a 'Cyclone Bug Exterminator,' a syringe made on the plan of an atomizer, and which gives the finest possible spray. Crude oil applied with this syringe was used on one peach tree about twelve feet high, and the tree given a thin film of oil all over. The difference in favor of this tree and those sprayed with the pump was quite marked, even where such trees showed no effect of the oil except a retardation of growth. In fact it seemed to me that this tree started out more vigorously than unsprayed ones. The application was made on a bright still day, about two o'clock in the afternoon. A friend of mine sprayed an elm in full leaf in June with pure kerosene with one of these syringes and no injury resulted.

The variety of plants sprayed was quite extensive. Some of those sprayed with kerosene and water were: *Aronia nigra, Rosa blanda, lucida, Carolina, multiflora* and *rugosa, Viburnum Opulus* and *dentatum, Cornus stolonifera, sericea, paniculata, florida,* and *alternifolia, Pyrus Aucuparia* and *baccata, Prunus maritima, serotina, Virginiana,* and *pumila, Crataegus Crus-Galli, coccinea, cordata,* and *Oxyacantha,* peaches, pears, apples, plums, cherries, and currants. Just to note the effect, *Pinus Strobus, Tsuga Canadensis, Picea excelsa,* and *Kalmia latifolia* were sprayed with oil and water with the pump set at twenty per cent. and some with whale oil soap. No injury resulted in either case. Some of the above mentioned conifers were sprayed with crude oil. All were considerably retarded, although none seem to have been killed.

When applying the lime, sulphur, and salt wash, care was taken to keep it well agitated. The application was followed by several dry days, and later pouring rains had no visible effect in washing it off. Even weeks

afterwards the plants looked as white as at the time they first became dry after the spraying, and the smell of sulphur was still noticeable.

Nevertheless, even if it proves a reliable insecticide, it is hardly to be recommended for extensive use on landscape plantings on account of the ugly whiteness which it imparts. It is the cheapest of all materials, and objections against its use on aesthetic grounds would have little weight on commercial places."

Discussion of Results.

From these experiments it appears that the undiluted crude oil is liable to cause injury to some trees even if applied under favorable conditions and with considerable care. Ought we then to advise it where unskilled workmen must necessarily apply it to the trees? In some other states, notably Ohio, very great damage has resulted from the extensive spraying of orchards with oils. In case of a badly infested tree it is rather difficult to decide whether the injury was caused by the application or whether the scale was largely responsible for it.

There is much less danger of injuring the trees where the oil is applied in a 25 per cent. mixture with water, but the pumps for mixing have not yet been perfected, and do not always give the proper proportions. The operators are also subjected to many annoyances from the clogging of the oil or water valves or some other disorder of the pump. Crude oil and kerosene, either undiluted or in 25 per cent. mixture, will kill the scale-insects if it comes in contact with them, and coat the surface reaching into the crevices of the bark much better than most liquids. This merit is of considerable importance. Hundreds of trees have been sprayed with oils without apparent injury. But occasionally serious injury has occurred with no apparent reason.

To reduce the danger to a minimum the oils should be applied on bright days in early spring just before the buds open. Growth then begins at once. If applied in late fall or early winter there is a long period of inactivity of the tree, during which the oil may penetrate and injure the cambium. The relatively short period of application at a time when the season brings a rush of work, and many windy days when spraying is impossible, is a disadvantage for the oil treatment.

In a single season's experiments the lime, sulphur, and salt mixture has destroyed the insect as effectively as the oil and no

trees have been injured. No record of injury has yet come to my notice where this mixture was used on dormant trees in Connecticut or any other state. It can be applied with any spraying pump, thus obviating the difficulties connected with the oil and water pumps. The mixture may be applied at any time during the winter months, making the spraying season much longer so that suitable days may be selected for spraying and allowing time to finish the work before the rush of the spring season comes. The materials are not costly, but the boiling of them is something of a nuisance, and is the greatest disadvantage of the lime, sulphur, and salt mixture. On a small scale the materials may be boiled in a kettle, but in a large orchard, the best method is to boil them in barrels with live steam from a boiler, as described on page 120, and shown on plate III.

Summary.

1. Spraying experiments were conducted in Westville, Bridgeport and Terryville during March and April, 1902, about 250 trees in all being treated. Most of the trees were badly infested.

2. Three kinds of crude oil, each used in 25 per cent. mixture with water, and two kinds used undiluted; kerosene, 25 per cent. mixed with water; Adler's soda soap, one pound in one gallon of water; "Naphcin," one-half pint in two gallons of water; and the lime, sulphur, and salt mixture made up after two formulas, were the insecticides used.

3. The crude oils, both undiluted and in 25 per cent. mixture, were effective in killing the scales, but damaged the trees in some cases. At Bridgeport almost no injury could be detected. Twenty-five per cent. kerosene in water was also fatal to the insects and caused only slight injury to the trees.

4. Adler's soda soap and "Naphcin," in the proportions used were not effective in killing the scales, though perhaps might be in more concentrated preparations. The trees were not injured.

5. Lime, sulphur and salt, in both of the formulas used, destroyed the scales satisfactorily without injuring the trees, and has been employed extensively in some of the large peach orchards with satisfactory results.

The admirable work done by Barnes Bros. shows that large bearing orchards can be sprayed effectively with this mixture at a cost of not more than eleven cents per tree.

FUMIGATION EXPERIMENTS.

During November, 1902, it was discovered that three large apple trees at Plainville were infested with the San José scale-insect.

The owner naturally wished to save the trees, as he had no others bearing the same varieties of apples, and was anxious to fumigate them, though was willing to destroy them if advised to do so.

A fumigating cloth or sheet tent was procured in the spring, made of ten-ounce duck and twenty-four feet square. This was made gas-tight by covering with paraffine dissolved in naphtha. The tent was shipped to Plainville, and on November 11 the trees were fumigated. The sheet was not large enough to cover the trees, so the trees were cut back enough to take the tent, the severed branches being burned. Plate II shows the appearance of the tree after cutting back and when covered by the tent. On January 20th a careful examination of the trees failed to reveal any living insects.

HOW TO TREAT AN INFESTED ORCHARD.

Suppose we have a badly-infested orchard of peach or apple trees, how shall we treat it? This is a problem confronting many commercial fruit-growers in Connecticut to-day, as well as a large number of persons who have small orchards for the home supply.

In the light of our present knowledge of what has been accomplished in Connecticut and elsewhere the following treatment seems to be the proper one to apply:

1. Remove all worthless trees. It will not pay to treat them.

2. Cut back severely, especially the branches that have lost a portion of their vitality because infested. This will enable the trees to make a stronger growth in the spring and reduce the area to be covered with the spray. The remaining portion being nearer the ground can be sprayed more economically than the ends of the twigs. Burn all branches cut off; fire is an effective scale destroyer.

3. Spray the pruned trees during the winter months with the lime, sulphur, and salt mixture, taking pains to coat thoroughly all portions of the trunk from the ground to the ends of the branches. This will not injure the trees and it is believed to be a good fungicide as well as an insecticide.

4. The trees may be sprayed with oil, but crude oil should be applied in 25 per cent. mixture just before the buds start, and some injury is to be expected.

5. If the orchard is a small one of young trees and isolated from other fruit trees, fumigating with hydrocyanic acid gas may be profitable, but is very expensive on large trees. Each tree must be covered with a gas-tight tent.

6. When growth begins, fertilize liberally and cultivate thoroughly to promote the vigor and health of the trees.

THREE NATURAL ENEMIES OF THE SAN JOSÉ SCALE–INSECT IN CONNECTICUT.

Chilocorus bivulnerus Muls.

On May 26 the writer visited the grounds of Mr. J. L. Raub on the outskirts of New London, the locality where the San José scale was first discovered in Connecticut in 1895. Mr. Raub experimented with various insecticides, but had to depend upon hired and unskilled workmen to apply them, and the results were rather unsatisfactory. He also employed "dendrolene" quite extensively when that substance was being recommended, and many trees were killed. With the number destroyed by the scale, his fruit plantation was thus considerably depleted. Becoming discouraged with the outlook, Mr. Raub abandoned his place in 1900 and moved into the city, where he has since resided, and for two years no measures had been taken to check the spread of the scale. Natural enemies of the insect had not been idle, however, for some of the trees had taken on new vigor and were not so badly infested as they had been previously. On one apple tree, which was especially noticeable, the adults of the twice-stabbed lady-beetle, *Chilocorus bivulnerus* Muls., were very abundant, traveling about over the infested branches. Many scale-insects were examined and but few living ones were found. The beetle was also present on other trees of the orchard and seemed to be fairly effective in destroying the scale.

The twice-stabbed lady-beetle was received from Stratford, June 4, where it was reported as being very abundant in the neighborhood and devouring the scale-insects on plum trees.

The writer has observed this lady-beetle in different parts of the State, where it has been distributed for many years, but in no place has he found it as abundant as at New London, and nowhere else has he considered it an important factor in keeping the scale in check. The twice-stabbed lady-beetle, which is shown in figure 1, is a small black beetle about one-eighth of an inch in length, with a red spot on each wing. It occurs nearly all over the United States, and in California is said to have effected the extermination of the San José scale in some of the orchards of Tulare county.* Dr. Howard states† that in the East, though common, this lady-beetle does not seem to be attracted to the scale.

Pentilia misella LeC.

Late in the fall (November 5), while looking over an infested orchard at Hartford, my attention was attracted to some very

FIG. 1.—The Twice-stabbed Lady-Beetle *Chilocorus bivulnerus* Muls. Twice natural size.

small black beetles crawling about on the sunny side of the trunk and branches of an apple tree. This proved to be the lady-beetle, *Pentilia misella* LeC., which is considered the most important predaceous enemy of the San José scale in Maryland and Virginia. Adults only were observed in the Hartford orchards and they were devouring the insects, reaching under the shells for the mature and partially grown individuals. Repeatedly did the writer observe the beetles examine young scales, and pass on without devouring them, apparently preferring a more mature morsel. This peculiarity in the feeding habit of the beetle has been mentioned by Dr. Howard,‡ who states that the larvæ feed more abundantly on the newly-hatched scales.

Pentilia misella has also been found in California, where it did efficient work in destroying the scale. It is a very small

*Insect Life, Vol. V, p. 53.

†Bulletin 3, New Series, Div. of Ent., U. S. Dept. of Agr., p. 53.

‡Idem, p. 52.

black beetle, scarcely one-sixteenth of an inch in length. It is shown in figure 2. This beetle was received from Westville, November 15, where it was reported as being very abundant on plum trees.

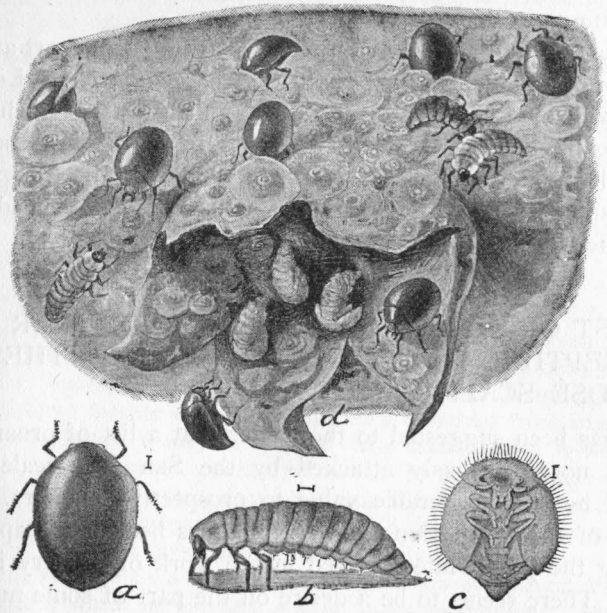

FIG. 2.—*Pentilia misella* LeC. *a*, beetle; *b*, larva; *c*, pupa; *d*, blossom end of scale-infested pear, showing beetles and their larvæ feeding upon the scales, all greatly enlarged. (After Howard & Marlatt, Bull. 3, N. S. Div. of Ent., U. S. Department of Agriculture.)

A Fungus Enemy.

Twigs were received from Bridgeport, February 13, which had been cut from a scale-infested Japan plum tree. On the twigs were small, hard, black knot-like formations which, upon examination, proved to be one stage of a fungus. Apparently the fungus usually grows upon the dead insects, as these were found to be filled with the mycelium. But few living specimens showed indications of having been attacked by the fungus, and the writer believes this to be generally the case. Specimens were sent to Dr. G. P. Clinton, Botanist of this Station, who was then at Harvard University. He reported that the fungus was not in condition to be determined with exactness, but that it

seemed to be allied to certain stages of *Capnodium,* species of which occur on leaves and twigs that have been infested with plant-lice. He considered it partially parasitic in this case, though generally occurring as a saprophyte—i. e. growing on dead matter. Dr. Clinton stated that he could find nothing about this fungus in literature.

Later the fungus was again received from Bridgeport and the writer observed it at Westville, Bridgeport, New London, Terryville and Hartford. It occurs chiefly on twigs that are well coated with scales, many of which, of course, are dead, but some living individuals on these twigs showed the presence of the fungus. It is doubtful if it will have any considerable influence in keeping the scale in check.

A LIST OF TREES AND SHRUBS AND THEIR SUSCEPTIBILITY TO THE ATTACKS OF THE SAN JOSÉ SCALE-INSECT.

It has been suggested to the writer that a list of ornamental plants not injuriously attacked by the San José scale-insect would be of considerable value to prospective planters. The value of the suggestion has several times been made apparent during the year while engaged in the work of nursery inspection. There seems to be a desire on the part of some nurserymen and landscape gardeners to recommend for planting such species and varieties of trees and shrubs as are most likely to escape injury. The insect is quite universally distributed and we cannot exterminate it. If, however, we can use in the ornamental planting of parks, private and public grounds, trees and shrubs which are exempt from its attack, not only will more satisfactory results be obtained but the cost of caring for the grounds in after years be materially lessened.

Many writers have published lists of food plants of the San José scale, but in 1901, Dr. E. P. Felt, State Entomologist of New York, published a list in three divisions according to observations made in the State of New York. The first division included plants which had not been found infested though growing near badly infested specimens. The second division included those plants on which the insect had been found, but in small quantities and not seriously injured by the infestation. The

third division contained the plants that are found to be badly infested.

This arrangement is of much more value to the public than the ordinary food-plant list, for it gives the planter a chance to learn something about the extent of infestation where it occurs, and it also names the uninfested plants. With the idea of arranging a list that could be safely followed throughout the United States, the following circular was issued to the entomologists and horticultural inspectors of the various states, together with a list of plants upon which observations had been made in Connecticut:—

CONNECTICUT AGRICULTURAL EXPERIMENT STATION.
OFFICE OF STATE ENTOMOLOGIST.

NEW HAVEN, CONN., December 1, 1902.

Dear sir:—Since the introduction of the San José scale-insect into the eastern States, many ornamental trees and shrubs have been attacked by it and destroyed, or at least rendered unsightly. It is apparent in every infested locality that certain species are exempt from attack, and this fact leads one to suppose that the insect cannot thrive as well upon them as upon the kinds commonly infested. If there are kinds of trees and shrubs which the scale does not attack, it is important that nurserymen, planters and landscape gardeners should know about them and urge their use in place of the species most commonly infested.

The writer appends a list of the more common ornamental trees and shrubs upon which he has been able to make observations. These are divided into three classes as follows:

1. Commonly infested.
2. Occasionally or rarely infested.
3. Not infested.

To be of value, such a list should cover not a single State, but the whole country.

Will you, therefore, kindly examine the accompanying list and make such changes as in your experience and observation are necessary to make it fit your locality, and return in the addressed and stamped envelope at your earliest convenience? In case the list is published, due credit will be given to each observer suggesting changes.

Yours very truly,

W. E. BRITTON, *State Entomologist.*

About 80 circulars were sent out and 45 replies have been received. From the replies and from observations made in Connecticut, the writer has prepared the following list. The fruit-trees are included, as they are sometimes planted for ornament, especially the flowering varieties.

The first list includes all plants which have been reported as badly or commonly infested in any locality. The second contains plants which have not been reported as being badly infested anywhere though the insect has been found upon them when near other infested plants. It is believed that in many cases the scale cannot breed upon the plants in this list and therefore they are safe from injury by its attacks.

The third list contains plants upon which the scale has not been reported though many of them probably will later need to be transferred to list number two.

Bailey's Cyclopedia of American Horticulture has been followed regarding the names of plants.

List of Hardy Trees, Shrubs and Vines.

Commonly or Badly Infested.

Acacia sp. Lintner, Felt, N. Y., Alwood, Va.
Akebia sp. Felt, N. Y.
Akebia quinata Decaisne. Alwood, Va.
Amelanchier Canadensis Medic., and other species. Shad-bush, Juneberry. Britton, Koehler, Conn., Alwood, Va.
Citrus trifoliata Linn. Scott, Ga., Alwood, Va., Gossard, Fla.
Cornus alba Linn. var, *Sibirica* Lodd. Britton, Conn.
Cornus Baileyi Coult & Evans. Gould (in N. Y.).
Cornus sanguinea Linn. Britton, Conn.
Cotoneaster sp? Britton, Conn., Lintner, Felt, N. Y., Card, R. I.
Cotoneaster vulgaris Lindl. Alwood, Va.
Crataegus sp. Hawthorn. Britton, Conn., Lintner, Felt, N. Y., Alwood, Va., Smith, N. J.
Crataegus cordata Soland. Koehler, Conn.
Crataegus Oxyacantha Linn., English Hawthorn. Britton, Koehler, Conn.
Crataegus coccinea Linn. Koehler, Conn.
Crataegus Crus-galli Linn. Koehler, Conn.
Cydonia vulgaris Pers. Common Quince. Britton, Conn., Lintner, N. Y., Alwood, Va.
Cydonia Japonica Pers. Japanese or Flowering Quince. Britton, Koehler, Conn., Lintner, N. Y., Alwood, Va., Johnson, Md.
Fagus sylvatica Linn. var *purpurea* Ait. European Purple-Leaved Beech. Smith, N. J.
Juglans Sieboldiana Maxim. Japanese Walnut. Britton, Conn., Alwood, Va., Sherman, N. C., Smith, N. J.
Ligustrum vulgare Linn. Common Privet. Alwood, Va.
Populus sp. Poplar. Britton, Conn., Smith, N. J., Sanderson, Del., Felt, N. Y.

Populus deltoides Marsh. Carolina Poplar. Britton, Conn., Rolfs & Quaintance, Fla., Alwood, Va.
Populus nigra Linn. var *Italica* DuRoi. Lombardy Poplar. Britton, Koehler, Conn., Rolfs & Quaintance, Fla., Alwood, Va.
Prunus amygdalus Stokes. Almond. Lintner, N. Y., Alwood, Va.
Prunus Armeniaca Linn. Apricot. Lintner, Felt, N. Y., Alwood, Va., Smith, N. J.
Prunus Avium Linn. Sweet Cherry. Britton, Conn., Lintner, Felt, N. Y., Alwood, Va., Smith, N. J., Cockerell, N. M.
Prunus pumila Linn. Koehler, Conn.
Prunus pumila var. *Besseyi* Waugh. Sand Cherry. Alwood, Va.
Prunus Cerasifera Ehrh., var. *atropurpurea* Dipp. (*P. pissardi.*) Purple-leaved Plum. Britton, Conn., Felt, N. Y.
Prunus domestica Linn. European Plum. Britton, Conn., Alwood, Va.
Prunus hortulana Bailey. Wild Goose Plum. Alwood, Va.
Prunus Japonica Thunb. Flowering Almond. Britton, Conn., Felt, N. Y.
Prunus maritima Wangh. Beach Plum. Koehler, Britton, Conn.
Prunus Persica Sieb & Zucc. Peach. Britton, Koehler, Conn., Lintner, Felt, N. Y., Alwood, Va., Cockerell, N. M.
Prunus triflora Roxbg. Japanese Plum. Britton, Koehler, Conn., Alwood, Va.
Prunus serotina Ehrh. Koehler, Conn.
Prunus Virginiana Linn. Choke Cherry. Koehler, Conn.
Ptelea trifoliata Linn. Hop Tree. Fernald, Mass.
Pyrus communis Linn. Pear. Britton, Koehler, Conn., Lintner, Felt, N. Y., Alwood, Va., Cockerell, N. M.
Pyrus sinensis Lindl. Sand Pear, including Kieffer, Alwood, Va.
Pyrus baccata Linn. Koehler, Conn.
Pyrus Malus Linn. Apple. Britton, Koehler, Conn., Lintner, Felt, N. Y., Alwood, Va., Doten, Nev., Cockerell, N. M.
Pyrus sp. Crabapple. Britton, Conn.
Ribes oxyacanthoides Linn. Gooseberry. Britton, Conn., Lintner, Felt, N. Y., Alwood, Va., Troop, Ind.
Ribes Aureum Pursh. Missouri or Flowering Currant. Lintner, N. Y.
Ribes rubrum Linn. Currant. Britton, Conn., Lintner, Felt, N. Y.
Ribes nigrum Linn. Black Currant. Alwood, Va.
Rosa sp. Britton, Conn., Lintner, N. Y., Alwood, Va., Cockerell, N. M., Burgess, Ohio, Troop, Ind., Gould, Md., Scott, Ga.
Rosa Carolina Linn. Koehler, Conn.
Rosa lucida Ehrh. Koehler, Conn.
Rosa Virginiana Mill. Koehler, Conn.
Rosa rugosa Thunb. Britton, Koehler, Conn.
Salix sp. Willow. Britton, Conn., Felt, N. Y., Sanderson, Del.
Salix lucida Muhl. Koehler, Conn.
Salix pentandra Linn. Laurel-leaved Willow. Lintner, N. Y., Alwood, Va.
Salix vitellina Linn. Koehler, Conn.
Salix Babylonica Linn. Weeping Willow. Lintner, N. Y., Alwood, Va.
Salix humilis Marsh. Koehler, Conn.
Salix incana Schrank. Koehler, Conn.

Sorbus sp. Mountain Ash. Felt, N. Y., Hunter, Kan.
Sorbus Americana Marsh. American Mountain Ash. Britton, Koehler, Conn., Alwood, Va.
Sorbus Aucuparia Linn. European Mountain Ash. Britton, Koehler, Conn.
Sorbus melanocarpa C. Koch. (*Aronia nigra* Koehne.) Black Chokeberry. Koehler, Conn.
Symphoricarpus racemosus Michx. Snowberry. Felt, N. Y., Smith, N. J.
Syringa vulgaris Linn. Common Lilac. Burgess, Ohio, Com. of Agr., N. Y., Troop, Ind., Alwood, Va.
Syringa Persica Linn. Persian Lilac. Britton, Conn.
Tilia sp. Basswood, Linden. Britton, Conn., Lintner, Com. of Agr., N. Y.
Tilia Americana Linn. American Linden or Basswood. Britton, Conn., Alwood, Va.
Toxylon pomiferum Raf. Osage Osage. Britton, Conn., Lintner, Felt, N. Y., Alwood, Va.
Ulmus sp. Elm. Lintner, N. Y., Webster, Ohio, Troop, Ind.
Ulmus Americana Linn. American Elm. Britton, Koehler, Conn., Alwood, Va.
Ulmus campestris Smith. English or European Elm. Britton, Conn., Felt, N. Y., Smith, N. J.

Occasionally or Rarely Infested.

Acer sp. Maple. Webster, Burgess, Ohio, Fernald, Mass., Butz, Penn., Com. of Agr., N. Y.
Acer saccharinum Linn. Silver Maple. Gould, Md., Alwood, Va., Hunter, Kan., Felt, N. Y.
Acer saccharinum. Weir's Cut-Leaved. Felt, N. Y.
Acer platanoides Linn. Norway Maple. Gould, Md.
Actinidia arguta Mig. (*A. polygama.*) Alwood, Va.
Æsculus Hippocastaneum Linn. Horse-Chestnut. Felt, Com. of Agr., N. Y., Burgess, Parrott, Green, Ohio.
Alnus sp. Alder. Felt, N. Y., Alwood, Va.
Ampelopsis quinquefolia Michx. Virginia Creeper. Alwood, Va.
Betula sp. Birch. Felt, N. Y.
Betula alba Linn. Cut-Leaved White Birch. Britton, Conn., Rolfs & Quaintance, Fla.
Buxus sp. Box. Britton, Conn.
Castanea Americana Raf. Chestnut. Rolfs & Quaintance, Fla., Alwood, Va., Felt, N. Y.
Catalpa sp. Rolfs & Quaintance, Fla.
Catalpa bignonioides Walt. Common Catalpa. Alwood, Va.
Ceanothus Americana Linn. Koehler, Conn.
Celtis occidentalis Linn. Koehler, Conn.
Cercidiphyllum Japonicum Sieb & Zucc. Britton, Conn.
Citrus Aurantium Linn. Gossard, Fla.
Cornus alternifolia Linn. Koehler, Conn.

Cornus stolonifera Michx. Koehler, Conn.
Cornus circinata L'Herit. Koehler, Conn.
Cornus Amomum Mill. Koehler, Conn.
Cornus candidissima Marsh. Koehler, Conn.
Cornus florida Linn. Com. of Agr., Felt, N. Y., Britton, Conn.
Cornus florida. Red flowering. Alwood, Va.
Deutzia sp. Fernald, Mass.
Diospyros Virginiana Linn. Persimmon. Lintner, N. Y.
Elæagnus sp. Felt, N. Y.
Elæagnus longipes Gray. Silver Thorn. Com. of Agr., N. Y., Scott, Ga.
Eucalyptus sp. Felt, N. Y.
Euonymus sp. Lintner, N. Y., Alwood, Va.
Ficus Carica Linn. Fig. Felt, N. Y.
Forsythia sp. Com. of Agr., N. Y.
Fraxinus sp. Ash. Felt, N. Y., Butz, Penn.
Fraxinus Americana Linn. White Ash. Hunter, Kan.
Gleditschia tricanthos Linn. Honey Locust. Britton, Conn., Sanderson, Del., Com. of Agr., N. Y., Johnson, Md.
Hibiscus Syriacus Linn. Shrubby Althea. Smith, N. J.
Hicoria Pecan Britt. Pecan Nut. Lintner, N. Y., Alwood, Va., Scott, Ga.
Juglans nigra Linn. Black Walnut. Alwood, Va., Rolfs & Quaintance, Fla.
Juglans regia Linn. Persian or English Walnut. Alwood, Va., Lintner, Felt, N. Y., Sanderson, Md.
Kalmia latifolia Linn. Mountain Laurel. Felt, N. Y.
Kerria Japonica DC. Globe Flower. Japanese Rose. Felt, N. Y.
Ligustrum ovalifolium Hassk. California Privet. Britton, Koehler, Conn.
Lonicera sp. Honeysuckle. Felt, N. Y.
Morus sp. Mulberry. Alwood, Va., Burgess, Ohio, Johnson, Md., Scott, Ga.
Morus sp. Tea's Weeping Mulberry. Taft, Mich.
Physocarpus opulifolius Maxim. Koehler, Conn.
Picea alba Link. White Spruce. Fernald, Mass.
Prunus Cerasus Linn. Sour Cherry. Felt, N. Y., Alwood, Va., Burgess, Ohio.
Photinia villosa DC. Koehler, Conn.
Rhodotypos kerrioides Sieb & Zucc. Koehler, Conn.
Rhus sp. Sumac. Rolfs & Quaintance, Fla., Alwood, Va., Felt, N. Y.
Rhus cotinus Linn. Smoke Bush. Com. of Agr., N. Y.
Robinia sp. Locust. Sanderson, Del., Burgess, Webster, Ohio, Johnson, Md.
Rubus strigosus Michx. Red Raspberry. Alwood, Va., Lintner, Felt, N. Y., Johnson, Md.
Rubus nigrobaccus Bailey. (*R. villosus.*) Common Blackberry. Lintner, Felt, N. Y., Johnson, Md.
Rubus villosus Ait (*R. Canadensis*). Dewberry. Felt, N. Y.
Sambucus sp. Elder. Com. of Agr., N. Y., Fernald, Mass., Webster, Ohio.

Sassafras officinale Nees. Sassafras. Sanderson, Del.
Sorbaria sorbifolia A. Braun. (*Spiræa sorbifolia* L.) Britton, Conn.
Spiræa sp. Britton, Conn., Lintner, Felt, N. Y., Alwood, Va.
Thuya occidentalis Linn. Arborvitæ. Fernald, Mass.
Viburnum sp. Britton, Conn., Alwood, Va.
Viburnum cassinoides Linn. Britton, Koehler, Conn.
Viburnum Opulus Linn. Koehler, Conn.
Vitis sp. Grapes. Britton, Conn., Felt, N. Y., Alwood, Va., Butz, Penn., Rolfs & Quaintance, Fla., Johnson, Md.

NOT INFESTED.

Ailanthus glandulosa Desf. Tree of Heaven.
Amorpha fruticosa Linn.
Andromeda sp.
Aralia spinosa Linn. Hercules' Club.
Aristolochia macrophylla Lam. Dutchman's Pipe.
Asimina triloba Dun. Papaw.
Baccharis halimifolia Linn. Groundsel Tree.
Benzoin odoriferum Nees. (*Lindera Benzoin* Blume.) Spice Bush.
Berberis (All species). Barberry, including *Mahonia.*
Bignonia sp. Trumpet Vine.
Calycanthus floridus Linn. Carolina Allspice, Sweet-scented Shrub.
Carpinus sp. Hornbeam.
Cedrus sp. Cedar.
Celastrus scandens Linn. Bitter Sweet.
Cephalanthus occidentalis Linn. Button Bush.
Cercis Canadensis Linn. Judas Tree, Red Bud.
Chamaedaphne calyculata Moench. (*Cassandra.*) Leather Leaf.
Chionanthus Virginica Linn. Fringe Tree.
Cladrastis tinctoria Raf. Yellow Wood.
Clethra alnifolia Linn. Sweet Pepperbush.
Corylus sp. Filbert. Hazelnut.
Daphne Mezereum. Linn.
Diervilla sp. Weigela.
Dirca palustris Linn. Leatherwood, Moosewood.
Exochorda grandiflora Lindl. Pearl Bush.
Gaylussacia sp. Huckleberry.
Genista tinctoria Linn. Dyer's Greenweed.
Ginkgo biloba Linn. Maidenhair Tree.
Gymnocladus Canadensis Lam. Kentucky Coffee Tree.
Halesia tetraptera Linn. Silver Bell, Snowdrop Tree.
Hamamelis Virginiana Linn. Witch Hazel.
Hedera Helix Linn. English Ivy.
Hicoria sp. (Excepting *H. Pecan* Britt.) Hickory.
Hydrangea (All species).
Hypericum Moserianum Andre. Gold Flower.
Ilex sp.

Itea Virginica Linn. Virginian Willow.
Jasminum nudiflorum Lindl. Yellow Jasmine.
Juglans cinerea Linn. Butternut.
Juniperus sp. Juniper.
Koelreuteria paniculata Laxm. Varnish Tree.
Laburnum vulgare Griseb. Golden Chain.
Larix sp. Larch.
Liquidambar styraciflua Linn. Sweet Gum.
Liriodendron Tulipifera Linn. Tulip Tree.
Lycium halimifolium Mill. Matrimony Vine.
Magnolia (All species).
Myrica cerifera Linn. Wax Myrtle.
Nyssa sylvatica Marsh. Tupelo, Pepperidge, Black Gum, Sour Gum.
Ostrya Virginica Willd. Horn Beam, Iron Wood.
Paulownia imperialis Sieb. & Zucc.
Phellodendron sp.
Philadelphus coronarius Linn. Mock Orange, Syringa.
Pinus sp. Pine.
Platanus occidentalis Linn. American Plane. Buttonwood.
Potentilla fruticosa Linn.
Quercus (All species). Oak.
Retinispora (All species). Japan Cypress.
Rhamnus sp. Buckthorn.
Rhododendron sp.
Sciadopitys verticillata Sieb. & Zucc. Umbrella Pine.
Shepherdia sp.
Smilax sp.
Sophora Japonica Linn. Japan Pagoda Tree.
Staphylea sp. Bladder Nut.
Stephanandra flexuosa Sieb. & Zucc.
Styrax Japonica Sieb. & Zucc.
Tamarix sp.
Taxodium distichum Rich. Bald Cypress.
Taxus sp. Yew.
Tecoma radicans Juss. Trumpet Creeper.
Tsuga Canadensis Carr. Common Hemlock.
Vaccinium sp.
Wistaria sp.
Xanthoceras sorbifolia Bunge.
Xanthoxylum Americanum Mill. Prickly Ash.

Certain species have been reported as seriously infested in one part of the country and as exempt in other localities. Such plants have been placed in list No. 1. Quince is reported as being rarely infested, by Felt, of New York, and by Smith, of New Jersey. Sanderson writes that willows and poplars are not

commonly infested in Maryland and Delaware, but in Connecticut willow hedges have been seriously infested and young willow and poplar trees in nurseries have been thoroughly encrusted by the scales. Cockerell reports that osage orange is not infested in New Mexico though much grown, and that *Catalpa* elm and walnut have not been found infested. Apricot, quince and poplar are also reported as not being infested in New Mexico. Alwood of Virginia, Burgess of Ohio, and Felt of New York place the sour cherry (*P. cerasus*) in list No. 2, though I have never found it infested in Connecticut. Burgess suggests that Kieffer pear be placed in the same list, but it is reported by Alwood as being badly infested in Virginia. Linden was placed in list No. 1 by the Commissioner of Agriculture of New York, while the hop-tree (*Ptelea trifoliata*) was placed in the same list by Fernald of Massachusetts. Elm was placed in list No. 1 by Webster in Ohio and Troop of Indiana. Smith of New Jersey finds European elm, purple-leaved beech, and Japanese walnut badly infested, while the common quince, cherry (except on Japanese stock), apricot, and poplar are not commonly infested. He has not seen the scale on birch, linden, persimmon, *Catalpa, Acacia* or *Buxus.* Alwood of Virginia puts the common privet (*L. vulgare*) in list No. 1, while Koehler, in Connecticut, mentions it as one of the plants upon which he has not found the scale though growing near infested plants. Gossard of Florida, Scott and Fiske of Georgia, report *Citrus trifoliata* as being badly infested, while Alwood of Virginia places this plant in list No. 2. *C. Aurantium,* the common orange, is rarely infested, according to Gossard.

In Connecticut the most commonly infested plants are apple, pear, peach, Japan plum, and currant among the fruits, though sweet cherry, European plum, quince and gooseberry are sometimes seriously injured.

The most commonly infested ornamentals are purple-leaved plum, *Crataegus,* Japanese quince, mountain ash, red-twigged dogwood and *Rosa rugosa.* Poplar, willow, Persian lilac, *Cotoneaster,* elm (both American and European), and osage orange have been found thoroughly encrusted by the insects, especially when growing near infested trees.

THE APPLE-TREE TENT-CATERPILLAR.*

Clisiocampa americana, Harris.

One of the chief leaf-eating enemies of the apple orchard is the tent-caterpillar. Though not as injurious as some other pests, it is, perhaps, the most obvious one, for by it the trees are stripped of their foliage early in the season. As it forms conspicuous nests on the wild cherry and apple trees, its presence is evident to all, and as it may be easily destroyed there is really no excuse for allowing it to attack and seriously injure orchards. This insect is distinguished from others that feed upon the leaves by the nests or tents which it makes on the branches early in May. The caterpillars remain inside the nest through the night and during cloudy weather, coming out to feed for a short time each pleasant day.

Fruit growers are apt to confuse the tent-caterpillar with the fall web-worm, an insect which makes nests on the ends of the branches of fruit and forest trees during August and September. The two species are quite different and can easily be distinguished if we remember that the former occurs only in spring, and that the caterpillars stay inside the tent in bad weather, but go out of it to feed. The fall web-worm appears in late summer, and the feeding is done wholly within the nest. A few leaves are enclosed in the web, and after these have been eaten, the web is enlarged to include fresh leaves, which in turn are devoured. Sometimes an entire branch is thus enclosed by the nest of the fall web-worm.

The tent-caterpillar is sometimes wrongly called the "bag-worm." The bag-worm is a very different insect. Bag-worms do not live together in large nests like tent-caterpillars, but each larva forms a small bag or case from one to two inches long in which the body is enclosed. The entire larval period and the pupa stage are passed in this case and the female lays eggs in it for the following generation.

The apple-tree tent-caterpillar also differs from, though closely allied to, the forest tent-caterpillar, which has caused much injury to fruit, shade and forest trees in Vermont, New

*This matter was printed as Bulletin 139 and distributed in July, in an edition of 11,000 copies. It is reproduced here with slight emendations.

Hampshire and northern New York during the past few years. Notwithstanding its name, the forest tent-caterpillar forms no tent.

The apple-tree tent-caterpillar is a native of North America and probably occurs throughout the United States and Canada, but is most abundant in the Eastern States. Though damage by this insect was recorded as early as 1646, the species was first named and described by Dr. T. W. Harris only fifty years ago.

Abundance in Connecticut in 1902.

Though the nests are seen every spring in Connecticut, the insect has not usually been as destructive here as in northern New England.

The wild cherry furnishes the common food supply, and often the injury does not extend to apple orchards.

The present season, however, the tent-caterpillar has been abundant everywhere and has attacked not only cherry and apple trees, but several other kinds. One grower reports this as the most troublesome pest on his peach trees. The black cherry trees and choke cherry bushes along roadsides and hedge rows were stripped of leaves. According to our observations, the outbreak was not a local one, but occurred over the whole State. It was somewhat more severe in the northern portion. The three agents employed by the Station to gather fruit statistics, who have covered the entire State in their travels, have reported defoliated trees in nearly every town. The writer has made similar observations in those portions of the State in which he has occasion to travel.

Moreover, of all orchard insects the tent-caterpillar is the most commonly reported by the fruit growers.

Mr. T. S. Gold believes that the insect has not been so abundant for sixty-six years or since the terrible ice storm of 1836.

Food Plants.

The black and choke cherry are the favorite and probably the natural food-plants of the species. The apple is the next choice, and in seasons when the caterpillars are numerous

orchards are attacked and sometimes entirely defoliated. Lowe mentions* cherry, apple, plum, peach, rose, witch hazel, beech, barberry, oak, willow and poplar as food plants. Weed found the caterpillars feeding upon birch,† and the writer has occasionally found them eating the leaves of various species of oak.

Habits and Life History.

The eggs are laid in cylindrical masses encircling small twigs of the apple and cherry, during the last days of June or first of July. Specimens in breeding cages in the laboratory laid eggs soon after the middle of June, but this is somewhat earlier than they are laid upon the trees out of doors. After depositing a ring of eggs averaging over two hundred in number, the parent moth covers the eggs with a viscid fluid which hardens, giving them a varnished appearance. The eggs are probably greatly protected by this coating from the weather and from predaceous insects. See Fig. 3.

The eggs do not hatch until the following April, thus remaining upon the twigs for about nine months. The tiny caterpillars first feed upon the frothy mass surrounding the eggs, and next attack the new leaves which are then unfolding. After a few days they spin many silken threads to form their nest, usually in a fork of the branches.

This nest or colony contains the caterpillars from a single mass of eggs. Except when feeding they remain in the nest, but when nearly full-grown, the caterpillars may often be found at rest on the outside of the tent. (See Plate VI.) They spin threads wherever they crawl along the branches from the nest to their feeding places.

The egg-masses do not all hatch at the same time, and it is not uncommon to find half-grown and newly-hatched caterpillars in the same vicinity. Mr. J. M. Whittlesey, of Morris, Conn., states in a letter to the writer, that during the spring of 1902 the hatching period extended over nearly twenty-one days.

The average feeding period is about six weeks, during which time the caterpillars have molted or cast their skins several

* Bulletin 152, N. Y. Agr. Exp. Station, p. 281.
† Bulletin 38, N. H. Agr. Exp. Station, p. 53.

times. As they increase in size they become more voracious and devour the leaves rapidly. At each molting period they stop feeding for a few hours, then begin again with renewed vigor.

When fully grown the caterpillars cease eating and wander about restlessly for a day or two, then spin white silken cocoons in the grass under the trees, in the crevices of the rough bark, or about buildings, boxes, etc., that may be near the infested trees.

There is only a single brood each year.

A colony of tent-caterpillars was brought into the laboratory on May 1st. The nest had been formed, though the caterpillars were small, measuring about three-sixteenths of an inch in length. They had probably been hatched about a week and are shown on Plate V. On May 26th, they had become full-grown and three or four were pupating. In a week all had made their cocoons and by the 16th of June the adults began to emerge. This continued for nearly a week, until all had come forth. Meantime several egg-masses had been formed in the breeding cage by the females.

Description.

Egg. The eggs are grey in color and very small, being about one-eighteenth of an inch long, and slightly more than half as thick. The upper end is circular, and is slightly larger than the lower end. They are placed on end, close together, and covered one-sixteenth of an inch deep with a brown substance resembling glue. The whole mass usually encircles the twig, but is sometimes deposited on one side only. An egg-mass is shown in Fig. 3.

Larva. When first hatched, the caterpillar is very small and nearly black with a few grey hairs.

It molts five or six times as it increases in size, and after each molt the markings show more distinctly. When full-grown the caterpillar is from two to two and one-half inches in length and is thinly covered with long light-brown hairs.

The color is black with a white stripe along the back, and many short irregular brownish stripes or markings along the side of each segment. The sides are of a bluish color and each segment bears an oval blue spot nearly surrounded with black.

The under side of the body, head, and legs are black. A full-grown larva, natural size, is shown on Plate IV.

Pupa. The pupa stage is passed in a white, oval cocoon, which is about one inch in length and half an inch in thickness. It is made of silken threads spun by the caterpillar and loosely woven. It is usually attached by one side to some object in a more or less protected place. Plate VII shows a few of the cocoons.

Fig. 3.—Egg-mass on Apple Twig; natural size.

Adult. The adult is a four-winged moth of light reddish-brown color with two whitish stripes, extending obliquely across each fore wing. The female has a wing expanse of about one and one-half, and the male about one and one-eighth inches. The males are inclined to be somewhat darker in color than the females, though there is much variation in the intensity of the ground color and of the markings in both sexes.

The rear wings are the same color as the fore wings, but are not marked with white stripes. Both sexes are shown on Plate VII.

Natural Enemies.

The tent-caterpillar is usually held in check to a considerable extent by its natural enemies; in fact, but for them it would be much more abundant and destructive each season. Its abundance the present season is due to a comparative scarcity of natural enemies, thus allowing the species to multiply unchecked.

An ichneumon fly, *Pimpla inquisitor* Say., is a common parasite of the tent-caterpillar, and there is a bacterial disease which in some seasons destroys the larvæ in large numbers. If the latter is prevalent, large numbers of dead caterpillars are found about the trees and nests.

Birds are important factors in the control of this pest, the cuckoos playing an important part. The crow, chickadee, oriole, chipping sparrow, yellow warbler, and red-eyed vireo are other birds that feed upon the caterpillars.

This season we have not observed the presence of the bacterial disease, or unusual abundance of the ichneumon parasites,—while the trees now have a great number of egg-masses, indicating that the insect will be abundant next season. Farmers and fruit growers should therefore be ready to combat it.

Remedies.

Destroying the Eggs.

Much can be done through the winter months in destroying the egg-masses. When the trees are bare these can be seen near the ends of the twigs, and may easily be clipped off by means of a tree pruner having a long handle, which enables the operator to reach and cut off the egg-masses while standing upon the ground. These should then be gathered and burned.

Professor Weed recommends that children be given a small bounty for gathering egg-masses and cites a case in Newfields, N. H., where they were offered ten cents per hundred clusters, by the village improvement society. 8,250 egg-masses were collected, and if each cluster contained 150 eggs, which is a small average, 1,237,500 eggs were destroyed at a cost of $8.25.*

* Bulletin 17, New Series, Division of Entomology U. S. Department of Agriculture, p. 77.

Many writers advise the destruction of the wild cherry and seedling apple trees, which harbor the tent-caterpillar along the hedge-rows and roadsides.

If not destroyed, the owner should certainly care for these trees to the extent of keeping them free from insects, and not allow them to be a menace to his neighbor or the orchards of the vicinity.

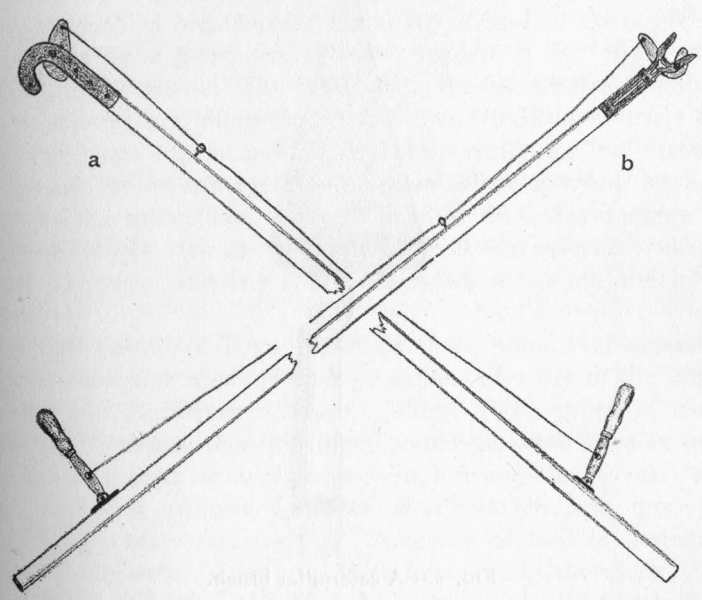

Fig. 4.—*a*, Waters' Tree Pruner; *b*, Henry's Tree Pruner.

Brushing off the Nests.

Twenty years ago the writer used to be sent through the orchards with a brush mounted on the end of a pole to remove the nests from the trees in the early morning or on a cloudy day when the caterpillars were in them.

The brush was made of stiff bristles twisted in heavy wire and trimmed to the shape of a cone about six inches long. It was made for the purpose, and worked admirably.

The operator stands upon the ground, inserts the point of the brush in the nest and gives it a few turns, and the entire nest with contents is wound upon the brush. The caterpillars may then be easily destroyed by crushing upon the ground.

During recent years I have not been able to find this brush on the market, but the M. Leiner Company of 1250 Brook avenue, New York, has been making some samples after my specifications and will be prepared to manufacture it in the future if there is a demand for it. The cost will be less than fifty cents at wholesale or even in dozen lots. Local dealers

FIG. 5.—A caterpillar brush.

and seedsmen should procure a supply and be ready to sell them to fruit growers next spring. The appearance of the brush is shown in Figure 5.

Burning.

Some fruit growers practice burning the nests on the trees and for this purpose an asbestos torch has been designed and manufactured. The torch is filled or covered with kerosene, lighted, and held under the nest when the caterpillars are inside. We do not recommend burning, because there is danger of severe injury to the tree. Where the nests are near the ends of the branches the damage may be very slight, but as the tent-caterpillars often make their tent at the fork of comparatively

large branches, it cannot be burned without danger of killing these branches. Brushing off the nests with a caterpillar brush is just as expeditious as burning and there is no danger of injuring the trees.

Spraying.

Where the orchardist practices early spraying no other remedy need be considered. Arsenate of lead or Paris green, with or without Bordeaux mixture, applied to the foliage will kill the caterpillars. The chief difficulty lies in the fact that some of the caterpillars hatch and begin feeding as early as the first leaves appear and before there is really any leaf-surface to poison; some damage may be done before spraying begins. But, as the caterpillars eat very little at first, this damage is not liable to be serious. These early colonies may be brushed from the trees, and the spray depended on to kill the later ones.

A half pound of Paris green or three pounds of arsenate of lead should be used for each 50 gallons of water or the same quantity of Bordeaux mixture. Where Paris green is used without Bordeaux mixture, three pounds of fresh lime to one of poison should be used to prevent burning the leaves. As the Bordeaux mixture contains plenty of lime, no more is needed in connection with it. Arsenate of lead is perfectly insoluble in water, does not injure foliage, and therefore does not need the addition of lime. Paris green contains a little free acid which is soluble in water, and which unless neutralized may burn the foliage.

SUMMARY.

1. The apple-tree tent-caterpillar, a native insect and one of the chief leaf-eating enemies of the orchard, has been very abundant throughout Connecticut the present season and has injured fruit trees by defoliating them in May. Wild cherry is probably the natural food of the species, but when abundant it attacks apple and other fruit trees.

2. Eggs are laid on the twigs of the food plant in summer and hatch the following April. After a few days the young caterpillars form on the branches a nest in which they live, going out from it to feed. They are always within the nest

at night and in cloudy weather. They become full-grown in about six weeks and spin white silken cocoons from which the adults emerge two weeks later.

3. The small grey eggs are deposited in masses of 200 or more encircling the twigs, and are covered with a brownish substance. The full-grown caterpillar is over two inches long, black above and below, and blue on the sides, with a white stripe along the back. It is thinly covered with light brown hairs. The white cocoon is about one inch in length and half an inch in thickness. The adult is a reddish-brown moth with two whitish stripes extending obliquely across each fore wing.

4. The species is usually held in check by its natural enemies, which consist of several kinds of birds, parasitic insects and a bacterial disease.

5. The remedies are: to gather and destroy the egg-masses during the winter months; spray when the leaves appear, using three pounds of arsenate of lead or one-half pound of Paris green to 50 gallons of water or Bordeaux mixture; if impracticable to spray, brush off the nests as soon as they can be found, choosing the early morning or cloudy weather, when the caterpillars are inside the nest; burning the nests on the trees is not to be recommended.

THE WHITE-FLY OR PLANT-HOUSE ALEYRODES.*

Aleyrodes vaporariorum Westw.?

For eight years the most serious insect pest affecting forcing-house tomatoes at the Station has been the "white-fly," "mealy-wing," or plant-house Aleyrodes. Were it impossible to hold the insect in check, the crop each winter would be nearly a total failure. Seemingly the species grows more and more abundant each succeeding year; at least the remedies need to be applied with greater persistence than formerly, and in spite of all the spraying and fumigating a goodly number of individuals survive.

The attacks of the white-fly are by no means confined to

* This paper was published as Bulletin 140, in an edition of 10,500 copies, and sent out in December. It is here reproduced with appropriate emendations.

the tomato plant, but other forcing-house crops, especially cucumbers and lettuce, are sometimes seriously injured. There is a large number of florists' plants upon which the insect is known to live, and several of them are each year much damaged by its attacks. Nor are the depredations of this insect limited to plants under glass; on the contrary, it lives and multiplies on the out-door plants of the garden through the summer, frequently causing more or less injury. The white-fly has already been reported as injuring strawberry plants in Kentucky* and New York,† and we may expect similar accounts of it from other localities.

In 1901 the white-fly was sent to the Station from Bridgeport, where it was damaging aster and chrysanthemum plants. In July, 1902, specimens were received from Milford and Saugatuck on strawberry leaves, and in November on geranium leaves from New Haven. Just before this report was printed, specimens were received from Pomfret on tomato. In December adults were sent to the writer from Levis, Quebec, Can., where *Fuchsia* and *Eupatorium* were infested. In all probability this is the same species, though without the pupa cases or larvæ identification is impossible. Prof. Fletcher informs me that the white-fly has been present in the greenhouses of the Central Experimental Farm, at Ottawa, Can.

While on a vacation in August the writer observed that aster plants growing in a garden in Surry, N. H., were infested with this insect.

The original home of this Aleyrodes is unknown. Westwood states that it is supposed to have been carried into England on plants from Mexico. It may have been brought here either from England or from Mexico. Quaintance states‡ that it has been received by the Entomologist at Washington from New Haven and Storrs, Connecticut; West Grove, Pa., and Goshen, Ind.

It also occurs in such widely separated regions as Michigan, Illinois, Kentucky, New York, Massachusetts, New Hampshire, Ohio and the District of Columbia, which indicates that it is

* Report of Kentucky Experiment Station for 1890, p. 37.
† Bulletin 190, Cornell Experiment Station, p. 155.
‡ Bull. 8, Tech. Series, Division of Entomology, U. S. Department of Agriculture, p. 39.

now thoroughly distributed throughout the northeastern portion of the United States.

Relationship to Other Insects.

The *Aleyrodidæ*, to which the white-fly belongs, are closely related to the *Coccidæ*, or scale-insects, being perhaps intermediate between them and the plant-lice, *Aphididæ*. They differ from the former in that both sexes are winged and motile, and from the latter in being fastened to the plant in the nymph stage. The larvæ or nymphs hatch from eggs deposited by the females on the under surface of leaves, and closely resemble several species of scale-insects.

Aleyrodid insects are not considered to be of very great economic importance. They are much more abundant in the tropics than in temperate regions. Many species occur on cultivated and wild plants, but are seldom abundant enough to be a serious menace to them. Signoret's monograph of the *Aleyrodidæ*, published in 1868, contains twenty-three species found in Europe.* Quaintance lists forty-two species† in America, but *A. citri* Riley & Howard, which is a serious pest of the orange and lemon groves of the Southern States, and this plant-house aleyrodes are without doubt the two most important species from the standpoint of the horticulturist.

How it Injures Plants.

The female lays eggs on the under sides of the leaves. Soon after the eggs hatch the young larvæ or nymphs attach themselves to the leaf and injure it by sucking out the sap for their nourishment throughout the period of larval growth. As each female deposits several eggs, and as only a short time is required for the complete cycle of development, successive generations finally cover the entire under surface of the leaf. The tissues collapse from the effects of this continuous pumping out of the life-juices of the plant, and the leaf shrivels and falls. As new leaves are formed at the top of the plant these in turn become infested, and later wither and die. If no efforts are made to

* Annales de la Societé Entomologique de France, 1868, p. 387.

† Bull. 8, Tech. Series, Division of Entomology, U. S. Dept. of Agriculture.

destroy the pest, the entire plant may be dead before the end of the season, or if it be a vigorous grower like the tomato, may have a few green leaves at the top, with a bare stem from which the leaves have withered and dropped. In the greenhouses the insects usually become very abundant towards the end of the season, and the warm days of spring seem to favor their multiplication: this occurs in our tomato house nearly every year in spite of a weekly spraying which kills all adults with which the material comes in contact. As the season advances the plants in the garden become infested and the species keeps multiplying out of doors until cold weather approaches, when it again appears in the greenhouse, there to pass the following winter.

Though most of the feeding is done in the nymph stage, the adult is provided with mouthparts well fitted for sucking and probably injures plants to some extent. I have often seen adults resting on the lower surfaces of leaves with their beaks piercing the tissues. When disturbed they fly upward, and if abundant they literally fill the upper portion of the greenhouse. A sweet sticky substance called honeydew is exuded by the larvæ, and this covers the fruits and lower leaves of the plants during the latter part of the winter. A black fungus grows in the honeydew, giving the plants the appearance of having been covered with soot.

Food Plants.

Although in forcing-houses the white-fly has been most troublesome on tomato, cucumber and melon plants, and the florists must fight it persistently on *Ageratum, Lantana* and heliotrope, I believe that it is able to live upon and may attack almost any kind of plant if the preferred ones are not at hand. Solanaceous plants (those belonging to the potato family) are favorites, and tobacco growing at the Station in 1901 was badly infested. Should this insect become established in the tobacco fields of Connecticut, it would doubtless prove a very troublesome pest.

The following list contains only those plants upon which I have observed the insect in its nymph stages: the adults have been found resting upon the leaves of a great many other kinds of plants.

Abutilon sp.
Ageratum mexicana.
Aster.
Bean.
Berberis Thunbergi.
Calla lily.
Campanula sp.?
Catalpa.
Chrysanthemum.
Cigar plant (*Cuphea*).
Coleus.
Columbine.
Coreopsis lanceolata.
Cucumber.
Currant.
Erigeron philadelphicum.
Eupatorium.
Fuchsia.
Geranium.
Golden Glow (*Rudbeckia laciniata*).
Grevillea robusta.
Heliotrope.
Hibiscus moscheutos.
Hibiscus rosa-sinensis.
Hickory.
Japan plum.
Lantana.
Lavendula dentata.
Lettuce.
Lilium superbum.
Lonicera.
Maurandya.
Melon.
Monarda.
Morning Glory.
Nasturtium (*Tropæolum*).
Nutmeg (*Schinus molle*).
Oxalis.
Parrot's Feather (*Myriophyllum proserpinacoides*).
Pelargonium.
Phlox.
Phytolacca decandra.
Platycodon.
Potato.
Primula obconica.
Rhodotypos kerrioides.
Rose.
Salvia.
Smilax.
Snapdragon.
Solidago canadensis.
Spice bush.
Spiræa.
Squash.
Strawberry.
Tecoma radicans.
Tobacco.
Tomato.
Verbena.
Zinnia.

Westwood found it on *Tecoma velutina, Gonolobus, Solanum,* and plants belonging to the *Bignoniæ* and *Aphelandræ.*

Habits and Life History.

The plant-house Aleyrodes in all its stages is found on the under sides of the leaves and seldom anywhere else unless disturbed. The eggs are laid on the leaves, perhaps, when the plant is small, and as the new leaves are formed these become the ovipositing places. Thus the lower leaves of large and badly infested plants are usually completely covered on their under surfaces with the empty skins from which the adults have emerged. These leaves are the first to wither and drop. Those

next higher up on the plant will show nymphs and pupæ; still higher we shall find younger and newly hatched nymphs, while on the upper leaves the adults will be mating and the females laying eggs. The process of ovipositing is an interesting one and was observed by the writer a few years ago in two cases on lettuce plants. The female first thrust her beak into the leaf, and depositing an egg, swung about with her beak still inserted and serving as a pivot, continuing to deposit eggs in a circle of about one millimeter in diameter. One of these circles contained six, while another had nine eggs. This peculiar egg-laying habit was observed many years ago by Réaumur in *Aleyrodes chelidonii* as cited by Westwood in the Gardener's Chronicle (1856, p. 852). But our species does not always lay eggs in this manner, for I have often found eggs deposited singly and scattered over the surface of the leaf. Davis has observed that on hairy plants like the *Ageratum* the eggs are deposited singly.

The eggs were light green or nearly white at first but soon changed to a dark color, and hatched in eleven days. The newly-hatched larva moves about for a short time, then becomes stationary and resembles a scale-insect. In increases in size for a time and when fully grown changes to a yellowish color. Still more important changes are taking place inside. This is called the pupa stage. Finally the skin cracks open along the median line of the back, and transversely through the caret-shaped line, and the fully developed insect appears. It is pure white, much resembling a tiny moth, and it is entirely covered with particles of wax. The old pupa skins remain attached to the leaf for a long time. The adults fly about, mate and the female soon begins to lay eggs. It is not known how long the insects live after reaching this stage. From the laying of the egg to the time that the adult comes forth requires a period of about five weeks. Plate VIII shows nymphs and adults on a leaf.

It is not known whether the species can survive the winter out of doors in this climate, but in the cases coming under the writer's observation it has been carried through the cold weather on plants in greenhouses or dwellings.

Description.

Egg.—Length, 200μ to 250μ (.2 to .25 millimeter). Thickness, 90μ to 100μ (.09 to .1 millimeter) in thickest portion. Elongated ovate in shape. White or light green when first laid but soon (three days according to Davis) changing to a dark bluish-black. The large end is attached to the under surface of the leaf by means of a very short and slender thread-like stalk which is difficult to make out. Smooth and shiny or covered with minute granules of white wax. See fig. 6, and Plate X. Eggs observed by the writer hatched in eleven days.

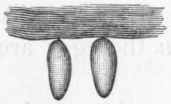

Fig. 6.—Eggs: × 36.

Fig. 7.—Newly-hatched nymph, ventral view: × 55.

Newly-hatched Nymph.—Length, about 252μ (.25 millimeter), width, about 101μ (.1 millimeter). Body thin, showing eyes, vasiform orifice, and caudal setæ, which are probably tactile. Ventral surface shows six poorly developed legs: eyes and antennæ are situated near anterior end of body. Mouth-parts are in form of a sucking tube having its origin just in front of the forelegs. The segmentation is apparent in the abdominal region. See fig. 7.

Full-grown Nymph.—Length, about .75 millimeter. Width, about .5 millimeter though varying considerably in size. Thickness, about .28 millimeter. Greenish-white in color, dorsum mildly convex with several cross sutures indicative of segmentation. One of these has the form of a broad and shallow caret (∧) not far from the middle of the body. A median line from the point of this extends to the anterior end of the body, and it is along this line and across through the caret-shaped mark that the skin opens for the adults to emerge. There is a submarginal row of short, white, wax filaments or rods. Under the margin and extending perpendicularly from the horizontal plane of the body to the leaf is a wall of wax made up of

narrow filaments side by side and adjoining each other. This wax fastens the insect to the leaf, and often breaks off in flakes when the nymph is removed and mounted in glycerine. Even when broken off this wall shows the parallel lines or striæ, and it is along these that it separates most readily.

In the fully matured nymph and pupa, long curved waxen rods occur on the dorsum as follows—a pair close to anterior margin and a second pair a short distance back of the first. A third pair on the thoracic region. The fourth and fifth pairs are close together on the abdominal region just back of the caret-shaped cross-mark. The sixth pair is situated near the vasiform orifice and a seventh pair occurs near the posterior margin.

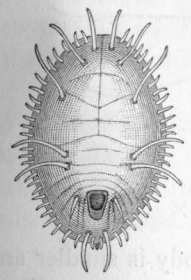

Fig. 8.—Mature nymph or pupa, dorsal view: × 36.

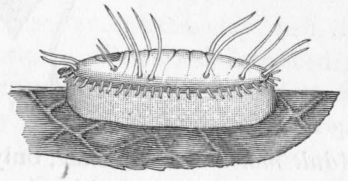

Fig. 9.—Lateral view of mature nymph: × 36.

These rods arise from distinct pores and vary greatly in length. Hairs occur; one on each side of the vasiform orifice, and a pair at the caudal extremity of the body. The mature nymph is shown in figs. 8 and 9.

Adult female.—Length, about 1.5 millimeters from head to ends of folded wings. Wing expanse of about 2.5 millimeters. Body plump and yellow in color, terminating in an ovipositor of three pieces. Four pure white wings extending beyond end of abdomen, each with a single median vein which in the fore wings is branched at the base; a row of papillæ or tubercles resembling beads extends around the margin, and each papilla bears minute hairs. These are shown on Plate XI. Eyes brown, in two pairs, the upper ones slightly smaller than the lower, but with a larger number of facets. Antennæ seven-jointed, the first joint very short, the second thick, the third long, the others about equal in length and all but the first and second with many

ring-like markings. Proboscis of three pieces arising from under the back side of the head and containing a groove in which are four bristle-like lancets. The lancets have a different origin from the proboscis, and arise from the front of the head. Each leg has two tarsal joints, the distal one being furnished with a pair of claws and a spine or bristle-like appendage. Wings, body and legs covered with a powdery white wax. See fig. 10.

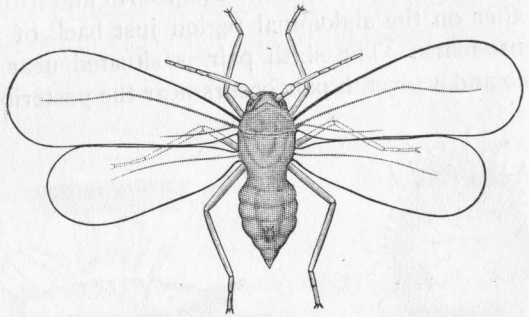

FIG. 10.—Adult female: × 36.

Adult male.—Like female, only the body is smaller and more pointed, terminating with the genital organs. Shown on Plate IX.

IDENTITY AND NAME OF THE INSECT.

The insect was first noticed at the Station during the winter of 1894–95, on tomato plants under glass. During 1895, the writer sent specimens to Prof. M. V. Slingerland of Cornell University, and later to Dr. L. O. Howard of Washington, both of whom reported it to be *Aleyrodes*, but that it was impossible to determine the species, for up to this time the *Aleyrodidæ* had received but little study in this country and few American species had been described. Prof. Garman, to whom specimens were sent, pronounced the Connecticut species identical with that which he had reported as attacking strawberry in Kentucky.

During the past year the writer has made several requests for authoritatively determined specimens from England, in order to settle once for all the identity of the insect. Prof. David Sharp of Cambridge very kindly sent some adults from the botanical garden at Cambridge, which presumably were

A. vaporariorum Westw., but as Dr. Sharp makes no claim to a special knowledge of the group, the matter is still unsettled. Moreover the pupa case is needed to determine the species with certainty. The adults from England could not be distinguished from specimens taken in the Station greenhouses.

Garman and Packard, in the works of these authors mentioned on pages 159-160, write of this insect under the name of *A. vaporarium*. Davis uses the name *vaporarium* in 1894 (Insect Life, Vol. VII, p. 174), but in 1896 (Special Bull. 2 Mich. Exp. Station) adopts Westwood's spelling. The difference in the spelling of the specific name is doubtless due to an oversight.

For the generic name some writers use the Greek spelling *Aleurodes*, meaning flour-like, which describes the waxy or mealy appearance of the insects. The present writer has preferred the original spelling as given by Latreille many years ago.

As Westwood's description fits our species very well, it is probable that the two are identical. Westwood described and figured the species in the Gardener's Chronicle for 1856, p. 852. As this is inaccessible to many, the description is here reproduced.

WESTWOOD'S DESCRIPTION OF *A. vaporariorum*.

The New Aleyrodes of the Greenhouse.—During the past 12 months the greenhouses, both in the public gardens at Kew and in the gardens of the Horticultural Society at Chiswick, have been infested with a new pest, under the appearance of a very minute white four-winged insect, like a miniature moth, to which my attention was first directed by Sir William Hooker, and subsequently by Dr. Lindley. It especially attacks the leaves of Mexican species of *Gonolobus, Tecoma velutina, Bignoniæ, Aphelandræ, Solanums,* and other similar soft-leaved plants, and is supposed to have been imported with living plants or in the packings of *Orchidaceæ* from Mexico, in all cases attaching itself to the under side of the leaf. Here it sits tranquilly with the tip of its short naked sucker or rostrum thrust into the leaf, but on passing the hand over the plants, quite a little white cloud of the insects is raised. They soon, however, settle again to renew their attacks, which are shortly followed by a discoloration and blackening, and subsequent drooping and falling

of the leaves. The ordinary fumigations have been tried, and the winged insects, which are very delicate little creatures, are easily killed, but in a day or two a fresh brood of the perfect insects makes its appearance in as great numbers as before, and this continues to be the case after repeated fumigations. Nor is the placing of the plants out in the open air more successful in getting rid of the enemy, as Mr. Gordon pointed out to me a cluster of plants which had been in the open air for more than a fortnight, and which were swarming with the insects as thickly as those within doors.

The insect when seated with its four wings closed over its back is not larger than the head of a good-sized pin, and were it not for its beautiful clear white colour it would be seen with difficulty. A microscopical examination proves it to belong to the genus *Aleyrodes* (one of those aberrant groups allied to *Aphis* and *Coccus*), of which we possess in this country several native species, one (*A. Chelidonii*) found upon *Chelidonium majus*, and also on the common cabbage; another, first determined by Mr. Haliday, infests the common *Phillyrea*.

The body is soft and rather fleshy, the head distinct, with a pair of antennæ consisting of only six joints, the first large, the second long, and the four following short and slender; the eyes are four in number, each being small and round, the two on each side placed near each other; the rostrum short, fleshy, apparently two-jointed, emitting from its apex a fine-pointed (certainly compound) black seta, which is the real instrument by which the plants are wounded. The whole body, legs, and wings of the insect are covered with a white powdery secretion, analogous to the white floccose matter of the Apple-blight *Aphis*, the white mass in which the eggs of various species of *Coccus* are enveloped, and which is developed in many other Homopterous insects; the wings are of moderate size, rounded at the tips, with a single central strong rib; when at rest they are placed over the back roof-wise, and the legs are rather short and simple.

On examining some of the infested leaves I found them covered with great numbers of flat bodies of extremely delicate texture, fringed with long, straight, slender hairs (having a good deal of the appearance of some small species of mites); their number was greatest on the lower leaves of the plants,

and I counted not fewer than 250 upon a single leaf of moderate size. They are of an oval, flattened form, the margin being very thin; the fore half of the body is occupied by two portions, which shut close by a straight slit along the middle of the back, but are generally seen more or less opened like the doors of a cupboard. These bodies are the envelopes of the pupæ of the Aleyrodes, which have already made their escape in the winged state, but with them were mixed many much smaller specimens of the insect destitute of the fine hairs and very transparent, of a very flat, oval figure, the middle and hinder half of the body exhibiting traces of the abdominal segments, with the anal apparatus placed at some distance from the hinder extremity of the body; the rostrum, very minute and conical, is seen at some distance from the anterior extremity, and around are seen several pairs of tubercles, which seem to represent the eyes, antennæ, and legs, and which are seen much more clearly in Professor Burmeister's figures of the young of *Aleyrodes Chelidonii*.

The present species, although very closely resembling *A. Chelidonii*, differs from it in its smaller size, in having only 6-jointed antennæ, in the want of the dusky spot on each wing, in the more suddenly angled rib in the middle of the fore-wings, and especially in the long straight rigid hairs with which the body of the pupa case is defended, and within which the insect lies concealed for several days, unaffected by external agents (except heat and cold), which circumstance explains the cause of the sudden reappearance of the insect so soon after fumigation. In consequence of its being only hitherto known in greenhouses it may be specifically named *Aleyrodes vaporariorum*. . . . . .

J. O. WESTWOOD.

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1894. Davis. Insect Life, Vol. VII., p. 174. Brief description. Troublesome in greenhouses in Michigan.

1895. Britton. Conn. Exp. Sta. Rep., p. 203. Brief description and illustrations.

1896. Davis. Mich. Exp. Sta., Miscellaneous Bull.,* p. 22. Description and illustrations.

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1900. Quaintance. U. S. Div. of Ent., Tech. series No. 8, pp. 16 and 39. Distribution and key to the species.

1901. Slingerland. Cornell Exp. Sta., Bull. 190, p. 155. Attacking strawberries in New York. Illustrations from Davis.

1902. Britton. Conn. Exp. Sta. Bull. 140. Full account with description and illustrations.

Remedies.

Fumigating.—Fumigating with tobacco is the remedy that has been oftenest recommended for this insect, but the fumes from the burning of ordinary stems or dust do not kill any considerable number of the insects. Many are stupefied by the fumes and fall from the plants, but revive later and soon become as active as ever. During the past two or three years tobacco used in this way seems to have been less effective in destroying the adults than when the writer first employed it eight years

* This was issued as Special Bull. 2, and bears the date of November, 1896. Later it was found that the bulletin numbers had been duplicated and this was changed to Miscellaneous Bulletin.

ago. Where the adults are stupefied and fall to the ground, a copious watering of the surface of the soil will kill them in great numbers. At the Illinois Experiment Station tobacco fumigation has not been satisfactory.*

Fumigating with hydrocyanic acid gas to kill the white-fly was here first given a trial in 1900 and an account of the experiment was published in the Report of this Station for 1900, page 311. Three ounces of potassium cyanide for each one thousand cubic feet of space were used, and the house closed for thirty minutes. All insects were killed, but the tomato plants were more or less injured. Our experiments as well as those of others indicate that the tomato is more susceptible to the effects of the gas than most plants, and care must therefore be taken in fumigating tomato houses. Several trials were then made with two and one-half ounces for each thousand cubic feet of space and the results were similar. Some of the tomato plants were injured, but the insects were killed in all cases. One house which was old and not very tight allowed some of the fumes to escape, so that the plants were uninjured though the insects were all killed.

Dr. J. Fisher used one ounce of cyanide for each one thousand cubic feet of space and killed all the insects without injury to the tomato plants.†

Spraying.—In 1895, the writer used whale-oil soap solution (1 lb. of soap to 5 gallons of water) in the form of a spray on the under surface of the leaves to kill the nymphs. The result was successful, but on account of the disagreeable odor of whale-oil soap, it was discarded. Fir-tree oil (one-half pint in two gallons of water) gave excellent results when the plants were thoroughly sprayed with the solution. The adults and nymphs which were moistened by the spray were killed. The cost of the material, however, makes the treatment an expensive one and precludes its use on a large scale. Fir-tree oil has a pleasant odor and is not objectionable to use in a greenhouse of ornamental plants or even in a dwelling.

A fine spray of kerosene and water (15 per cent. kerosene) was then applied to the tomato plants on sunny days, by means of a "kerowater" pump, with good results in killing the insects.

* Bull. 81, Illinois Agr. Exp. Station, p. 512.

† Johnson, Fumigation Methods, p. 136.

But kerosene, like whale-oil soap, has an unpleasant odor, and occasionally causes a slight injury to the foliage. Even when not at first apparent, the leaves in some instances took on later a brown or reddish color not indicative of health, and some of these finally dropped.

Early in 1901, we began spraying the tomato plants with common soap and water, dissolving one pound of soap in eight gallons of water. This seemed to be the best, all things considered, of any of the sprays. Not only was it effectual in killing all adults and nymphs with which it came in contact, but it was both inexpensive and inodorous, and at first did not appear to cause the slightest injury to the plants. The soap was cut in thin slices, then dissolved in hot water, and cold water added to make the right proportions. The plants received one application each week for about three months, when some of the leaves finally exhibited signs of injury.

As the plants had never been sprinkled with water from the hose, and had received frequent applications of soap, the leaves finally became coated over with soap to such an extent as to seriously interfere with the normal processes of respiration. The lower leaves in some cases shriveled and dropped. A few sprayings cause no injury, and probably none would be done in any case if the plants are sprinkled freely with water to remove the excess of soap.

The chief difficulty with sprays of any kind is that it is impossible to reach all places where the insects are located. Many leaves are curled so that the spray cannot reach the under side, and there are always portions of plants which do not, on account of location perhaps, receive a thorough treatment; this permits the escape of a sufficient number of adults, or of nymphs which soon change to adults, to keep the house infected.

Summary.

1. The white-fly has been the worst insect pest of tomatoes and cucumbers under glass at the Station during the past eight years. Many florists' plants are also injured, and the insect has attacked strawberry and many other plants out of doors in summer. It has been received from several growers in Connecticut, and is widely distributed over the northeastern United States. Its original home is unknown.

2. The white-fly is closely related to the scale-insects, and to the plant lice. It resembles the former in its immature stages, but differs from it in that both sexes are winged when reaching the adult stage.

3. It injures plants by sucking the sap, from the under sides of the leaves. The lower leaves are the first to shrivel and drop. Most of the injury is caused by the nymphs or immature insects.

4. The nymphs of the white-fly have been found upon sixty different kinds of plants in Connecticut.

5. About five weeks are required for the white-fly to pass through its life-stages, all of which are found on the under sides of the leaves. Eggs hatch in eleven days, and the young nymphs crawl for a short time, when they become stationary and secrete wax in long filaments. When the adults emerge, the pupa skins remain attached to the leaves. It is not yet known whether the species can survive the winter unprotected in this climate, but it is carried over on plants in greenhouses and dwellings.

6. It is thought to be identical with the European species *A. vaporariorum* of Westwood, but this has not yet been fully determined.

7. Fumigating with tobacco is not an effective remedy. Hydrocyanic acid gas (using two and one-half ounces of potassium cyanide for each one thousand cubic feet) killed the insects but injured tomato plants. Dr. Fisher used one ounce of cyanide and did not injure his plants, but killed all of the insects.

8. Spraying the under surfaces of the leaves with common laundry soap and water (one pound dissolved in eight gallons) proved to be a cheap and effective remedy. If applied frequently, however, the soap should be occasionally washed from the leaves by spraying them with clear water.

INJURY TO TREES BY SQUIRRELS.

During 1901, and again in 1902 certain elm trees in New Haven were pruned of their twigs, which fell to the ground. It was thought to be the work of some insect—perhaps climbing cut-worms.

In May, 1902, it was observed to be the work of grey squirrels. The following note appeared in "Science" of June 13th, page 950, and is self-explanatory:

The Grey Squirrel as a Twig-Pruner.

"Last year my attention was called to some Elm street trees in New Haven, which had been injured by having the twigs eaten off early in June. The twigs were cut off through the hard wood formed the previous season, just below the new growth. Under certain trees the ground was fairly covered with the detached twigs. No borers were found in the severed portions as is the case when infested by the oak pruner, *Elaphidion villosum* Fabr., which attacks several kinds of shade tree. Still, it was supposed that some insect caused the damage, as climbing cut-worms sometimes eat off the new growth—but usually through the soft tissue.

The present season, similar injury has been reported from Farmington and New Haven.

On May 23, while cycling through the streets of New Haven, I noticed a small elm tree under which the ground was covered with freshly severed twigs. The same tree was attacked last year. Four grey squirrels were seen in the top busily engaged in devouring the nearly ripe seeds. As the seeds of the American elm are near the extremity of last season's growth where the twigs are very slender, the squirrels were obliged to perform many noteworthy acrobatic feats in order to obtain the seeds. Some were hanging by the hind feet from slender branches to reach twigs beneath them, and all were munching away at the seeds as if half starved. In some cases they were not able to reach the clusters of seeds, and would bite off the twigs, which dropped to the ground where they could find their food later. Several twigs were dropped in this way in a period of about two minutes, while the writer was watching them. In some cases the squirrels cut off twigs from which they had already eaten the seeds. Trees bearing no seeds are not pruned in this manner, and none of the trees will probably be injured very seriously. This habit of squirrels may have been recorded by other observers, but I do not remember seeing it in print.

The best remedy seems to be to provide the squirrels with plenty of other food at this season of the year when their natural food supply has been nearly exhausted.

W. E. Britton.
Conn. Agr. Experiment Station.

The gentleman who had reported a similar injury to trees in Farmington was informed of this discovery by the writer, and began to watch his own trees. Later he wrote that his trees too had "squirrels," but that they were red instead of grey squirrels. Some of the severed twigs are shown on Plate XII.

THE BROWN-TAIL MOTH.

Euproctis chrysorrhœa Linn.

Erroneously Reported from Hartford.

One of the leading daily papers of the State reported in its issue of May 16th:

"Specimens of the brown-tailed tussock moth were brought into the office yesterday, having been found in the northern section of the city. The moths have just hatched from the cocoon and, although very small, have already begun to weave their web, which resembles somewhat that of the tent caterpillar and nearly fills the glass jar in which they were received. They do not look to be dangerous, but are likely to grow into pests of substantial character. The specialty of the worm is tree foliage and it strips the leaves clean and is thus dreaded. In addition to its devastating qualities, it is said to be poisonous to human beings by reason of the white fluff of hairs which flies in the atmosphere and finds lodgement on the skin, producing an irritation resembling eczema. It is said that a great deal of money has been used in the vicinity of Boston during this season to destroy the cocoons and thus kill the little caterpillars before they had a chance to get into the world at all."

The writer immediately visited the office and examined the specimens referred to, which were not at all the brown-tail moth, but another species, the white-marked Tussock Moth, *Notolophus leucostigma* S. & A., which is fairly common throughout the State and which has been very destructive to shade trees in Boston, Brooklyn and other cities during the past few years. The newly hatched caterpillars were brought to the office accompanied by the statement that it was the brown-tail moth. The writer called attention to the error and the editor promised to correct it. Later several notes appeared in the same paper saying that specimens of the adult moths had been seen in Hartford by persons who were familiar with the insect in Massachusetts.

The brown-tail moth is not believed to be present in Connecticut, or at least its existence here has not been proved. But as it may be brought into the State at any time, from Massachusetts, everyone should be on the watch for it. Its identity should, however, be thoroughly established before announcing its presence. If specimens are sent to the State Entomologist, he will inform the sender whether or not it is the brown-tail moth and if it is will take prompt action to exterminate it.

In order that the reader may be more familiar with the appearance of this insect a brief account is given below.

The brown-tail moth is found in Southern and Central Europe, in Northern Africa and in Western Asia. It seems to have been brought from Europe to Massachusetts, where it was first noticed about ten years ago in the vicinity of Somerville. It was not known to be the brown-tail moth, however, until 1897,

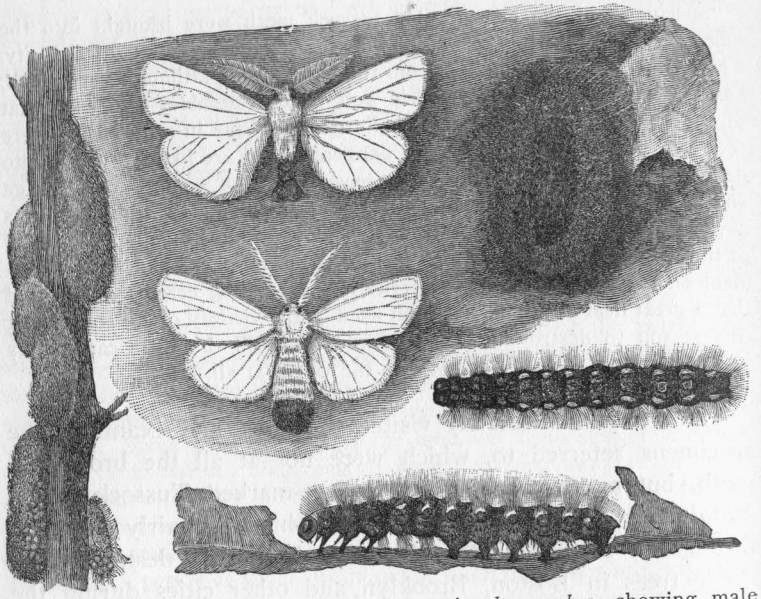


FIG. 11. The brown-tail moth *Emproctis chrysorrhea*, showing male moth above, female below, egg-masses at left, cocoon at right and caterpillars. (After Howard, Yearbook of U. S. Department of Agriculture for 1897.)

when the attention of the gypsy moth commission was called to the matter. It was made the subject of a bulletin* published in 1897 by the Massachusetts Agricultural Experiment Station at Amherst. Mr. A. H. Kirkland informs me that the brown-tail moth has now spread over an area of about 1,500 square miles, including portions of New Hampshire and Maine, as well as Eastern Massachusetts. Pear seems to be the chief food plant, but a list of thirty-six plants upon which the caterpillars were found feeding in Massachusetts, including our common fruit

* Special Bulletin, July, 1897.

and forest trees, is contained in the above-mentioned bulletin, from which was obtained most of the information about the insect herein given.

A good idea of the brown-tail moth in its different stages may be obtained from fig. 11. The eggs are laid on the under side of leaves in masses of 200 to 300, during the month of July. The young caterpillars begin feeding on the leaves, skeletonizing them, and soon form nests at the ends of the branches by drawing together leaves and fastening them with silken threads. In these nests the partially grown caterpillars pass the winter, coming out in the spring to feed upon the opening buds. A photograph of the winter nests is shown on Plate XIII.

When fully grown the caterpillars are about one and one-half inches in length, of a brown color with scattered reddish brown hairs. The body is marked with small grey spots. Along each side of the body there are long, white branched hairs that form elongated white spots arranged in a row.

When through feeding the caterpillars change to the pupa stage among the leaves. The pupa is three-fourths of an inch long and of a dark-brown color.

The hairs of the caterpillars cause an extreme irritation to the skin when brought in contact with it. The caterpillars frequently crawl about on houses and buildings in search of food and persons often brush against them.

The adult females are pure white, with a tuft of brown hairs on the end of the abdomen, and a wing expanse of about one and three-fourths inches. The males are smaller than the females, having a wing-expanse of about one and one-fourth inches, and there are small black dots on the fore wings. With the exception of these dots the male resembles the female, both of which are shown in figure 11.

THE RASPBERRY CANE MAGGOT.

Phorbia rubivora Coquillett.

During May injured raspberry canes were received from Bristol. Investigation showed the injury to have been caused by the cane maggot, a two-winged fly belonging to the genus *Phorbia*, and closely related to the onion maggot and cabbage maggot.

The insect has been reported from New York, Pennsylvania, West Virginia, Michigan and Canada. The females lay eggs on the young shoots in April when the latter are only a few inches high. The eggs soon hatch and the young maggot begins to tunnel downward in the pith, going about half the length of the shoot, then works its way out to the bark and cuts a tunnel around the stem, sometimes completely girdling it just under the bark. By this time the tip of the shoot begins to wilt, and a blackened area shows on the outside around the point of injury. The tip usually shrinks, droops over, and finally dries up and dies. The maggot eats a small hole through the bark from the girdle, though it does not emerge, but keeps on feeding in the pith until the shoot is nearly severed. The tunnel is shown in fig 12.

FIG. 12. Tunnel of cane maggot in raspberry shoot. Natural size.

The raspberry cane maggot has been studied in New York by Prof. Slingerland, and Bulletin 126 of the Cornell Agricultural Experiment Station contains an account of it.

At the time the bulletin was prepared the name of the insect had not been determined. Later it was found to be a new species and was described and named *Phorbia rubivora* by Mr. D. W. Coquillett of Washington, D. C. The technical description was published in Canadian Entomologist, Vol. XXIX, p. 162, July, 1897.

The maggots observed by Prof. Slingerland pupated about July 1st, but the adults did not emerge until the following April. The pupa stage is passed inside the tunnel near the base of the shoot, and the insect does not emerge from it until it comes forth as an adult fly.

The insect may do considerable damage in raspberry plantations, attacking both the red and black raspberries.

The only remedy is to cut out and burn the infested canes during May. Plate XIV shows the egg, adult fly and injured raspberry shoots.

CONTINUED DESTRUCTION OF HICKORY TREES BY THE HICKORY BARK BORER.

In my report of last year, page 267, was an account of serious injury to hickory trees in New Haven by the hickory bark borer *Scolytus quadrispinosus* Say:

The beetle has kept up the destruction through the season of 1902, and many more dead hickories have been removed. The attack has not been confined to the Hillhouse place, but trees to the north have been attacked, and hickories east of Whitney avenue have also been injured. During July Mr. Chas. E. Atwater of 321 Whitney avenue, after asking my advice, decided to spray the two hickory trees in his yard, and employed a local nursery firm fitted for spraying work to apply the poison. The nursery firm requested me to superintend the work, and on July 28th the spraying was done.

About nine pounds of arsenate of lead was prepared by dissolving arsenate of soda and acetate of lead and putting the two solutions together in a barrel holding between forty and fifty gallons, and filling up the barrel with water. The trees were thoroughly coated with this poisonous mixture from the ground to the twigs and foliage of the highest branches. It was thought that this might prevent the further eating of the twigs and also keep the beetles from breeding in the trunks if they had not already begun to do so. Twigs continued to fall, however, after applying the poison, though Mr. Atwater thinks that these were less numerous than before spraying. Possibly these twigs were nearly severed at the time of spraying and were broken off later.

Miss Hillhouse informs me that the dead trees that were cut out numbered about the same as last year. Probably not far from 250 hickory trees have been killed on the Hillhouse place by this beetle during the seasons of 1901 and 1902. (A few trees on this place were also sprayed, but I do not know what was used or the results.)

It is doubtful if spraying will prove a satisfactory remedy, and appearances now indicate that many more hickory trees in the vicinity may be killed unless the species should be held in check by its natural enemies.

THE COMMON CURRANT WORM.

Pteronus ribesii Scop. (*Nematus ventricosus* Klug.)

The chief enemy of the currant in Connecticut is the currant worm, usually called the imported currant worm because the species was introduced into America from Europe about 1858. It is now common all over the United States, while the native currant worm (*Pristiphora grossulariæ* Walsh) now seldom does much damage to cultivated berry plants in Connecticut.

The adults emerge from the ground and lay eggs on the under sides of the leaves during the latter part of April and in May.

FIG. 13. Eggs of the currant worm. Twice natural size.

This insect also attacks the gooseberry and the first eggs deposited are generally on gooseberry leaves because they unfold earlier than the currant leaves. The eggs are placed end to end in rows along the veins, as shown in fig. 13, on a gooseberry leaf. They are about one-twenty-fifth of an inch in length and slightly less than one-fifth of an inch in thickness.

They hatch within a week or ten days and the first larvæ were found feeding on May 8th at the Station last season. The newly hatched larvæ are whitish at first, but soon become green with black spots and a black head. Some partially grown specimens are shown in fig 14. Fig. 15 shows the appearance of the fully grown currant worm. The first and eleventh segments are tinged with yellow. During growth, which may require two or three weeks, the larva molts several times and finally reaches

a size of about three-fourths of an inch in length. It then descends to the ground and spins tough, smooth, brown cocoons in the soil near the surface and usually under the leaves and rubbish around the food-plants, which are often entirely de-

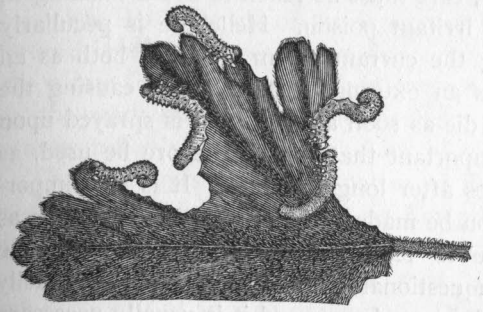


FIG. 14. The currant worm. Partially grown larvæ, twice natural size.

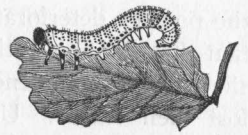


FIG. 15. Fully grown currant worm, natural size.

foliated. About the last of June or first of July the adults emerge, mate and the females lay eggs for the second brood. Cocoons are shown in fig. 16, and the adult female in fig. 17.

The adult is a four-winged fly and there is considerable difference between the sexes. The female is from one-fourth to

FIG. 16. Cocoons of currant worm. Natural size.

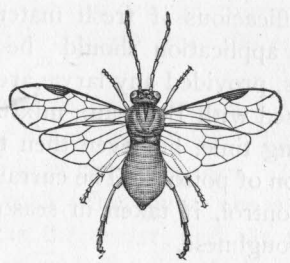


FIG. 17. Adult of the currant worm. Female, about twice natural size.

three-eighths of an inch in length, and has a yellow abdomen with head and thorax nearly black. The male is about one-fourth of an inch long and the general color of the body is black.

The second brood is usually small and produces cocoons that carry the species through the following winter.

The simplest remedial treatment is to apply hellebore to the leaves as soon as the young begin to feed. This may be dusted upon the plants in the form of a dry powder or may be mixed with water in the proportions of one ounce to two gallons of water. If applied as a powder, care must be taken to avoid inhaling it, as it is a very active irritant poison. Hellebore is peculiarly effective in destroying the currant worm and acts both as an internal poison and as an external irritant, often causing the worms to curl up and die as soon as the liquid is sprayed upon them. It is highly important that fresh hellebore be used, as the powder deteriorates after long standing. It is also important that the application be made early in the season as soon as the worms commence to feed and before the bushes have lost their leaves. Unquestionably the young are more easily destroyed than the full-grown larvæ, and it is usually necessary to go over the bushes a week or two after the first application, because the eggs do not all hatch at the same time, and as the plants are making a rapid leaf-growth at this season there are new leaves which have not been poisoned by the first treatment. If the first brood is kept well in check there will be little damage from the second. Many commercial growers use Paris green instead of hellebore, but in the home garden hellebore is preferable because it is not as dangerous a poison and is just as efficacious if fresh material is used and properly applied. The application should be repeated if washed off by heavy rains, provided any larvæ are eating the leaves. If Paris green is used with Bordeaux mixture it will stick upon the leaves for a long time, but even then the new leaves may need an application of poison. The currant worm is one of the easiest insects to control, if taken in season and the applications made with thoroughness.

THE ASPARAGUS BEETLE.

Crioceris asparagi Linn.

Asparagus plantations throughout the State are infested each season by the asparagus beetle. The adults appear in May and feed upon the new shoots. The eggs, laid about this time, hatch

in about eight days and the young larvæ or grubs feed upon the green tissue of the asparagus plants, especially upon the leaves and small stems. In about twelve days, or when fully grown, the grubs go into the ground and transform, the pupa stage lasting about ten days. Thus about thirty days are required to complete the life cycle of the asparagus beetle, and as there are several broods each season we find eggs, grubs and adults upon the plants from May until late in autumn. The winter is passed in the adult stage, the beetles seeking protected places under stones, rubbish and the rough bark of trees.

The asparagus beetle is a native of Europe and first became a serious pest in this country on Long Island in 1859, though probably introduced several years previously.

The eggs are brown in color, oval in shape and are nearly one-sixteenth of an inch in length. They are deposited in rows longitudinally on the shoot and each egg is set on end in a hole which has been eaten in the stem by the beetle. Occasionally an egg is placed on the end of another egg previously deposited.

The grubs or larvæ are a dull grey color with black head. The body is considerably thickened toward the posterior extremity. When fully grown they are nearly one-fourth of an inch in length. They then enter the ground or conceal themselves beneath dead leaves or rubbish and transform to pupæ in very simple cocoons. Ten days later the beetles emerge, thirty days having been required to complete the changes from the egg to the adult beetle.

The beetle is less than one-fourth of an inch in length. Head, legs and wing-covers are of a bright bluish black color. Thorax and margins of wing covers are of a light reddish brown. There are three cream-colored spots on each wing-cover, one at the base, the second just in front, near the center, and the third about half-way between the second and the tip of the wing cover. The first and second spots may be confluent, forming right-angled or L-shaped spots at the base of the wing covers.

The eggs, larva and beetle are shown on Plate XV.

Various remedies have been recommended against the asparagus beetle. After the cutting season is over the plants may be sprayed with Paris green or arsenate of lead. Air-slaked lime dusted on the plants when moist is frequently recommended.

In some fields it is the practice to allow trap shoots to grow and when well covered with eggs these are destroyed. During the past season we have had very good results at the Station in spraying young plants with hellebore—one ounce in two gallons of water.

MISCELLANEOUS INSECT NOTES.

Spinach Leaf-Miner.

Several fields of spinach plants in Greens Farms were found to be attacked by the spinach leaf-miner *Pegomyia vicina* Lintn. The growers in the vicinity were not familiar with the pest, though for several seasons it has been destructive on Long Island. It was also noticed in New Haven. The life history of the insect was worked out by Sirrine in 1895, and it was shown to have several (probably six) broods each season and to live in the wild goosefoot or lambs quarters (*Chenopodium*) and the foliage of beet. It becomes a serious pest, however, when it attacks spinach, as all the plants have to be examined and the infested leaves thrown out before the crop can be sent to market. The larvæ make at first a slender thread-like mine inside the leaf, but finally broaden the tunnel, which appears as a blotch upon the leaf, the green tissue having been devoured. The eggs are deposited on the lower surface of the leaf, and at no time in its life history is this insect amenable to the application of insecticides. Gathering and destroying infested leaves; crushing the maggots inside the leaf; fall plowing and keeping the fields free from weeds, especially lambs quarters, are recommended by Mr. Sirrine.*

The Twelve-spotted Asparagus Beetle in Connecticut.

This is an introduced species that has been gradually working northward. It has been present in New Jersey for several years. The writer has been on the watch for it in asparagus plantations in Connecticut, but has never found it. A single specimen was captured on asparagus in New Haven, June 16th, by a student who was collecting insects for the Station. We may fairly expect this species to continue northward, and to

* Bull. 99, N. S., N. Y. Agr. Exp. Station.

become established here as a pest of asparagus, injuring the plants in the same manner as the common asparagus beetle. The name of this new-comer is *Crioceris 12-punctata* Linn.

Orange-striped Oak-Worm and Spiny Oak-Worm.

During August many of the small oak trees about New Haven were stripped of their foliage by dark-brown spiny caterpillars with longitudinal orange stripes and a pair of fleshy black horn-like protuberances near the head. These caterpillars usually

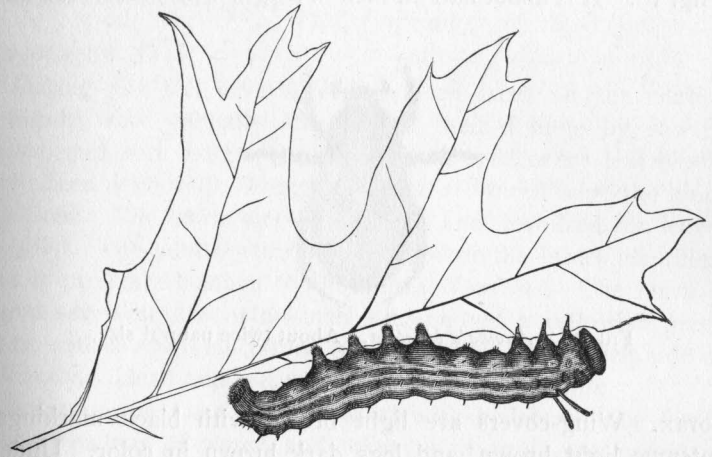


FIG. 18. The orange-striped oak-worm. *Anisota senatoria.* Larva natural size.

feed in clusters, and if abundant, soon defoliate small trees. Smith states that he has seen acres of forest almost entirely defoliated by these caterpillars.* Doubtless the insect attacks the various species of oak, but here the black oak seemed to suffer more than other kinds. The orange-striped oak-worm, shown in fig. 18, is the larva of a yellowish brown moth called the Senator moth and bearing the scientific name of *Anisota senatoria* S. & A. Frequently we find associated with these striped caterpillars, another kind causing similar injury, but light yellowish brown in color, with black spines along the back and sides and the long black horn-like appendages near

* Economic Entomology, page 278.

the head. This is a closely related species, *Anisota stigma* Fabr., and is more abundant in the southern states.

Anomala binotata Gyll.

On May 8th some beetles were brought to the Station with the report that they had been feeding on strawberry leaves in a garden in New Haven. The leaves were considerably eaten, and over a hundred of the beetles were gathered and destroyed. The species proved to be *Anomala binotata* Gyll., and is shown in fig. 19. It is about half an inch in length with black head and

FIG. 19. *Anomala binotata.* About twice natural size.

thorax. Wing-covers are light brown with black markings. Antennæ light brown, and legs dark brown in color. Under side of thorax covered with light brown hairs. This beetle has been recorded as attacking the blossoms, but nowhere have I found any mention of injury to the leaves by it.

Some partially eaten leaves are shown on Plate XII.

Orange Dog Caterpillar—Papilio cresphontes Cram.

This insect was even more abundant in 1902 than during the preceding year. The caterpillars could be gathered by the hundred in some of the nurseries, where they were feeding upon the leaves of the "hop tree" *Ptelea trifoliata.*

Cedar Bark borers. Hylotrupes ligneus Fabr. *Callidium antennatum* Newm.

Specimens of *Hylotrupes ligneus* Fabr. were received in February from a correspondent in New Haven, who reported that the beetles emerged from cedar bean poles which had

been brought into a warm building. This beetle is about one-third of an inch long with light-brown wing-covers marked with black; a large spot occurring near the center of each wing-cover and the distal third black. This beetle is a serious enemy of the cedar tree in some localities.

The second species is of nearly the same size and shape as *Hylotrupes,* but is of a metallic blue or green in color with no markings. A great many of these beetles emerged from a dozen cedar bean poles in the writer's garden in May, and nearly a hundred were captured.

Saw-fly on Birch.

During the fall several young birch trees on the Station grounds were partially stripped of their foliage by saw-fly larvæ, and had these trees not been sprayed every leaf would have been devoured. Paper birch and red birch were the kinds attacked. The larvæ were gregarious and devoured the leaves rapidly. The adults were not obtained or the insect identified, but it probably belongs to the genus *Nematus.* The larva is about seven-eighths of an inch long and of a yellowish green color with a row of black or brown patches along each side of the body. Head and feet are black and prolegs white.

Some of the trees were sprayed with hellebore—one ounce in two gallons of water, and others with soap—one pound in eight gallons of water. Both remedies were effective in destroying the insects.

Lagoa crispata Pack.

The caterpillar of the Crinkled Flannel Moth *Lagoa crispata* Pack. was unusually abundant during August and September, and was found feeding upon the leaves of apple, quince, chestnut and hickory. It is a curious slug-like larva, covered with brown hairs, shown on Plate XV. The adult is a beautiful light yellow moth with brown wavy markings, from which the common name is taken. It will probably never be sufficiently abundant to be much of a pest.

The Cherry-Scale in Connecticut.

The cherry-scale *Aspidiotus forbesi* John. during February was found on apple cions taken from a tree in Bristol. The

locality has not yet been examined, but the species has probably become established in the State. The same treatment recommended for San José scale-insect should be employed to destroy the cherry-scale.

ILLUSTRATIONS.

The illustrations in this report are from the following sources:

Plate XIV is herein reproduced from Bulletin 126 of the Cornell Agr. Exp. Station, by courtesy of Prof. M. V. Slingerland, Entomologist.

Plates VIII to XI and XV, a, b, and c, are from photographs made for the author by the late Mr. H. A. Doty.

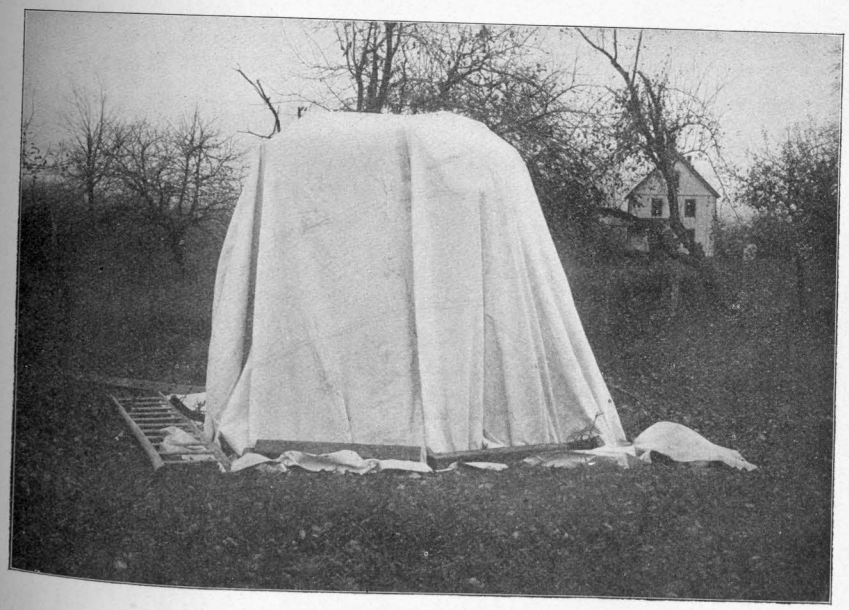
Plates II to VII, XII, XIII and XV, d, are from photographs made by Mr. B. H. Walden, under the author's direction.

Plate I is from a photograph by the author.

Figures 2 and 11 are from publications of the Division of Entomology, U. S. Department of Agriculture, by courtesy of Dr. L. O. Howard, Entomologist. Figures 3, 13, 14, and 16 were made and engraved on wood from photographs and specimens, by Mr. R. M. Sherman, who also made figures 15, 17 and 18 from drawings by Mr. Walden, and figures 2, 6 to 10, 12 and 19 from drawings by the author. Figures 4 and 5 were etched on zinc from sketches by the author.

Trees killed by San José Scale and "Yellows." View in a Connecticut Peach Orchard.

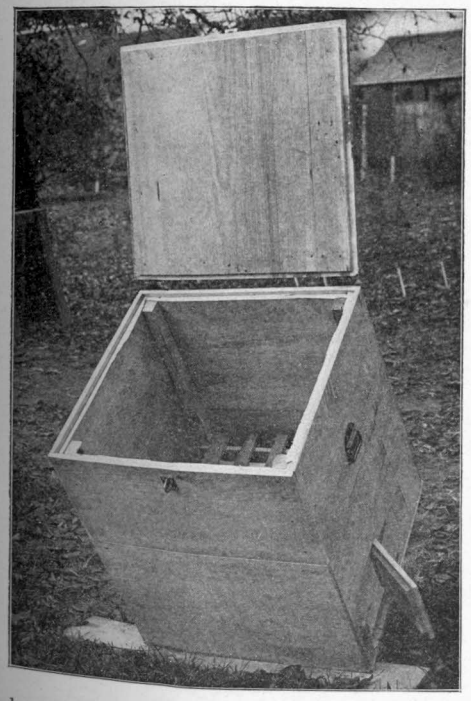
a. Tree cut back ready for treatment.



b. Tree covered by tent.

FUMIGATING LARGE TREES.

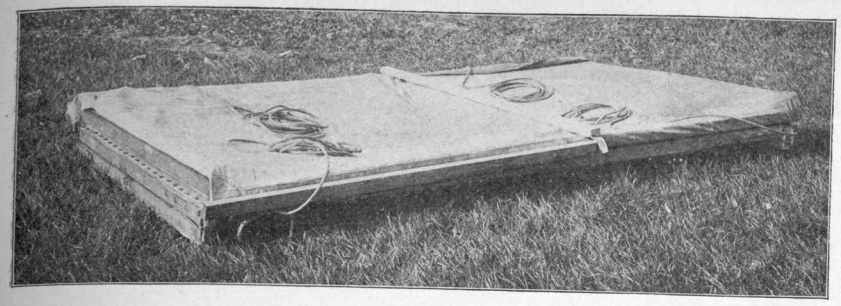
a. Barnes Bros. plant for boiling the lime, sulphur and salt mixture.



b. Fumigating box for small plants, cions, buds, etc.

c. A fungus attacking the San José scale forms black spots on the twigs. Natural size.

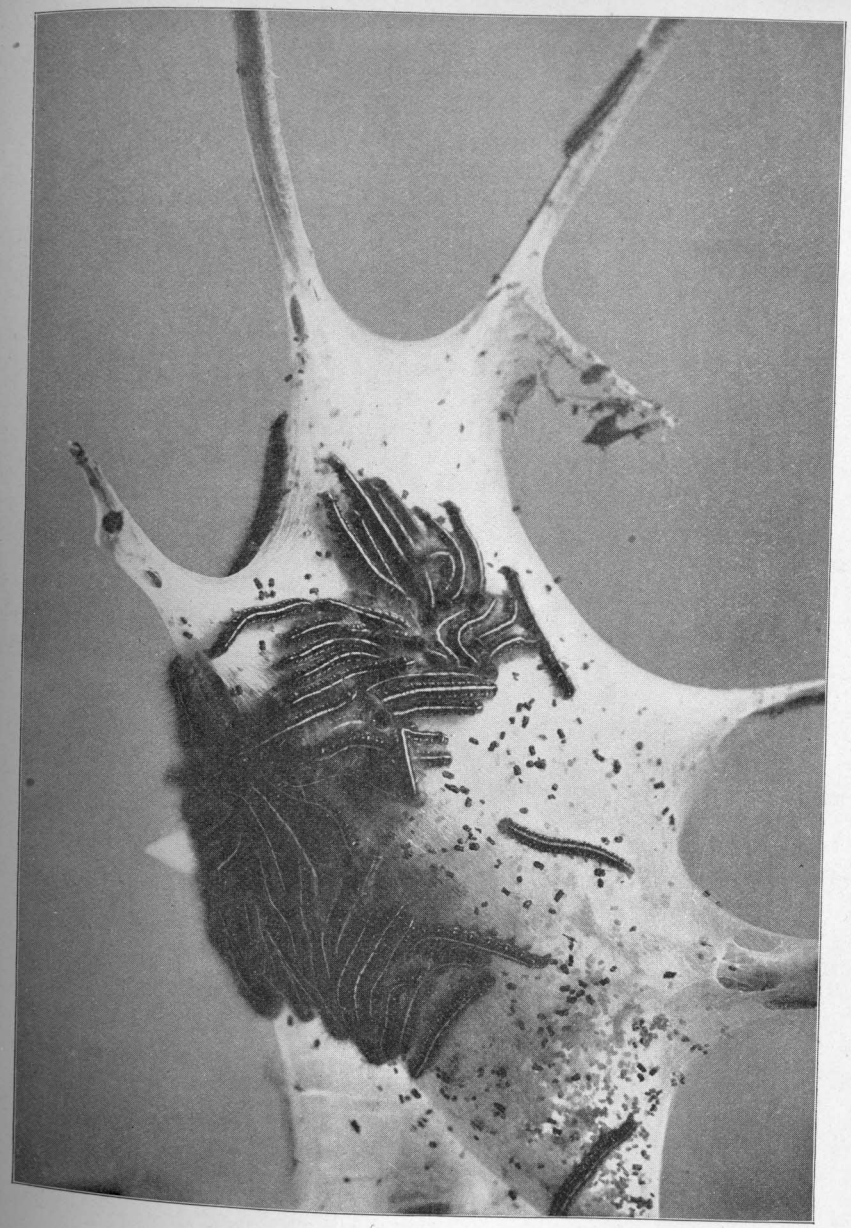
FUNGUS: FUMIGATING BOX: STEAM PLANT FOR COOKING THE LIME, SULPHUR AND SALT MIXTURE.



a. The tent folded.

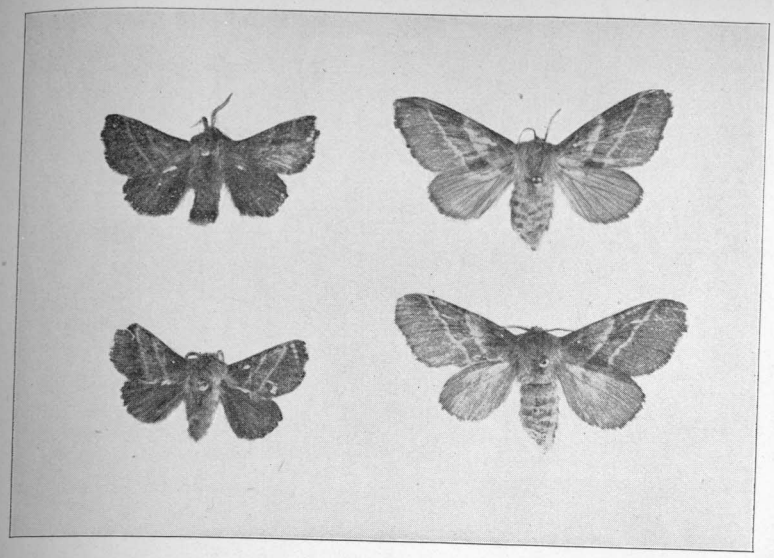
b. The tent over a tree.

FOLDING TENT FOR FUMIGATING TREES.

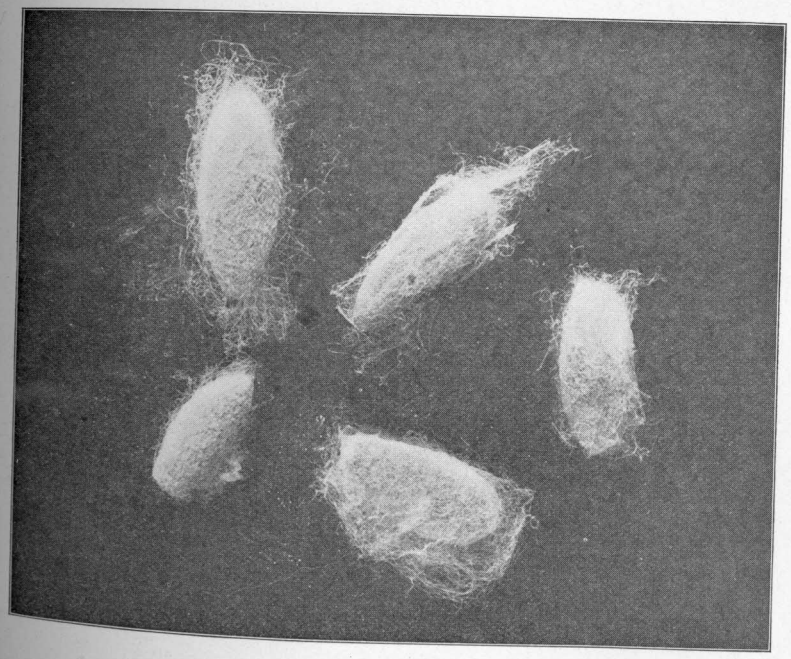


Caterpillars resting on the outside of the nest.

THE TENT-CATERPILLAR.

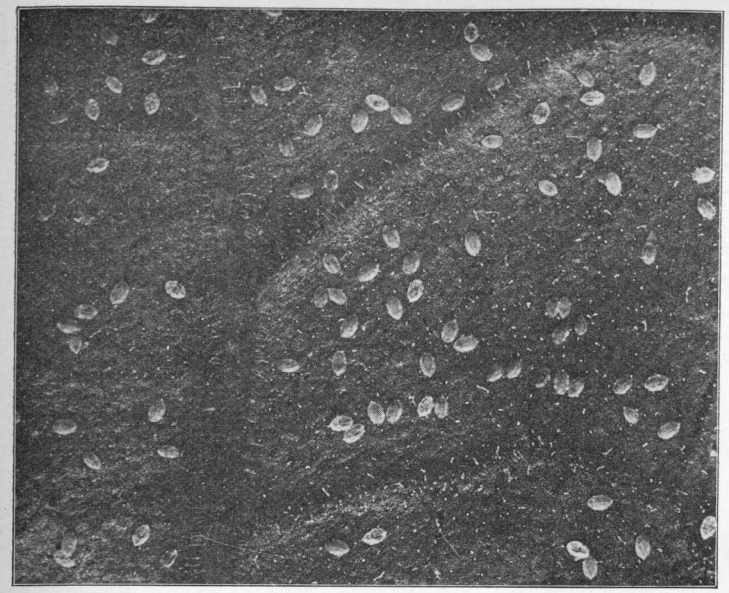


a. Male and female moths. Natural size.

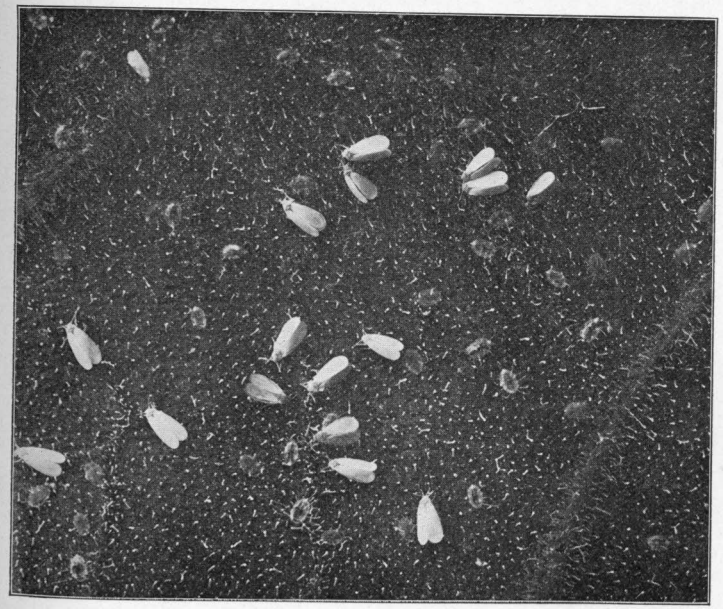


b. Cocoons of the Tent-Caterpillar. Natural size.

THE TENT-CATERPILLAR.

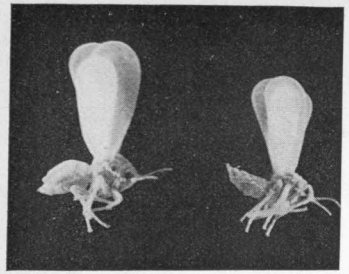


a. Nymphs: Enlarged about four times.

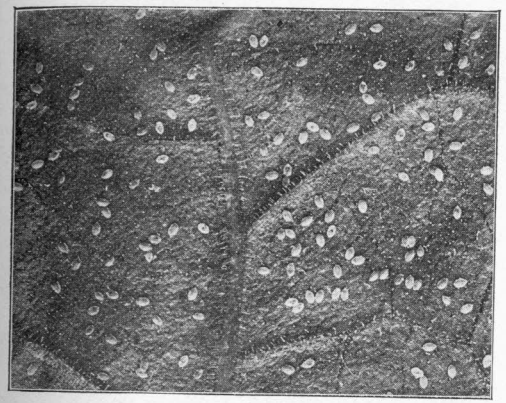


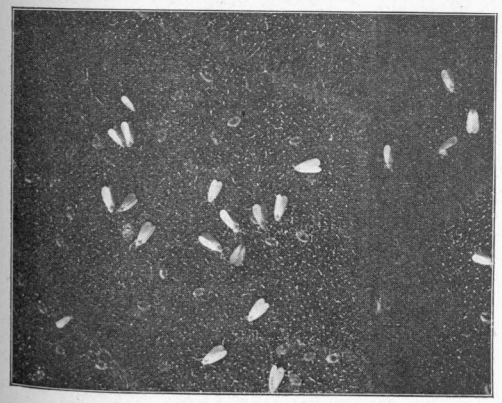
b. Adults and pupa skins. Enlarged four times.

THE WHITE-FLY ON TOBACCO LEAF.

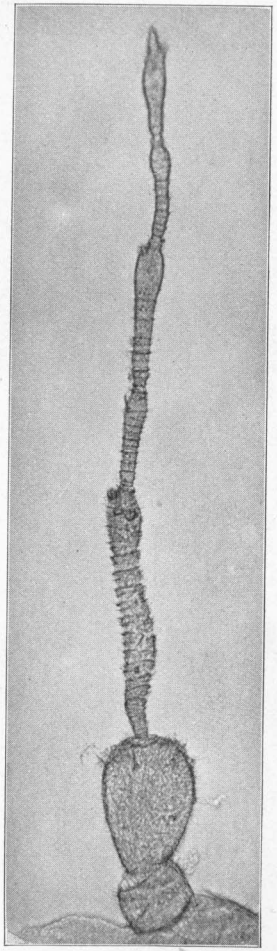


a. Female and male : much enlarged.



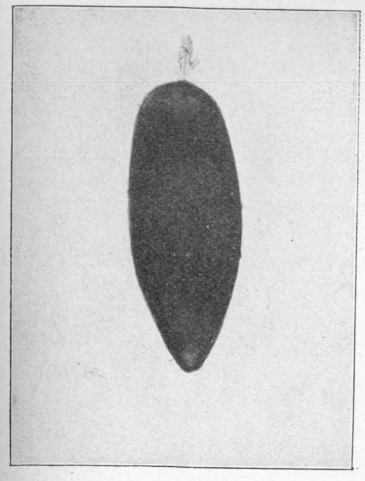


b. Nymphs and adults ; twice natural size.

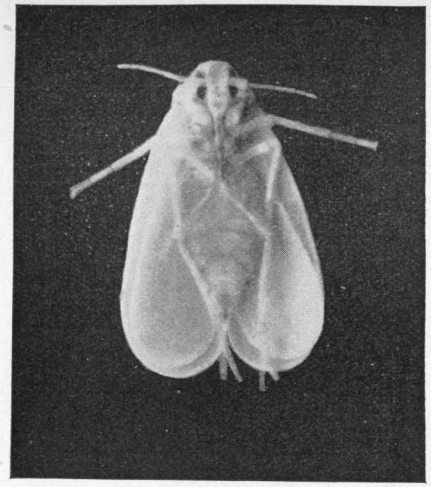


c. Antenna, showing ring-like markings : much enlarged.

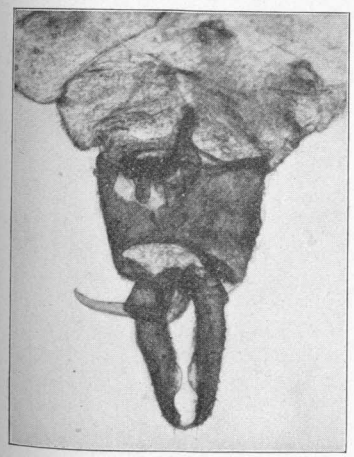
THE WHITE-FLY.



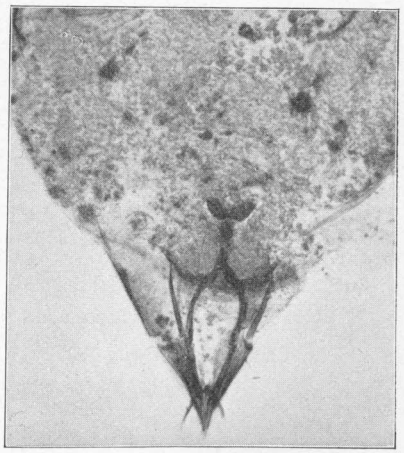
a. Egg, showing stalk : much enlarged.



b. Adult female, ventral view, showing proboscis : much enlarged.

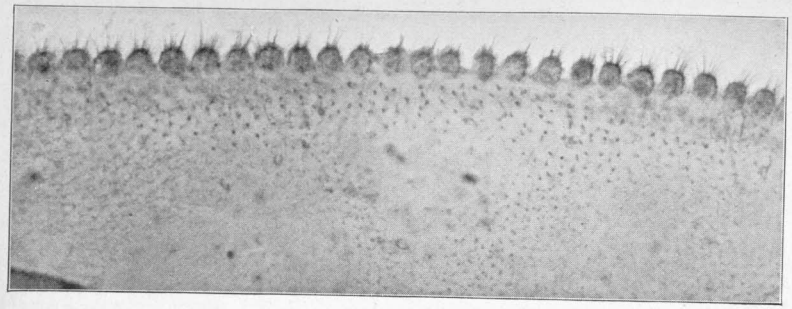


c. Genital organs of male : much enlarged.

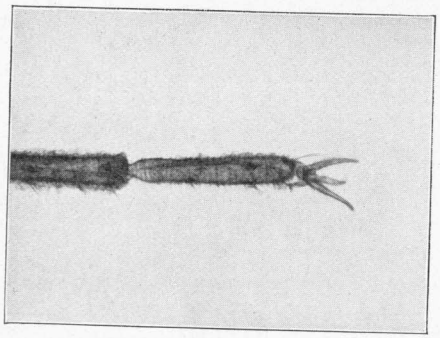


d. Ovipositor of female : much enlarged.

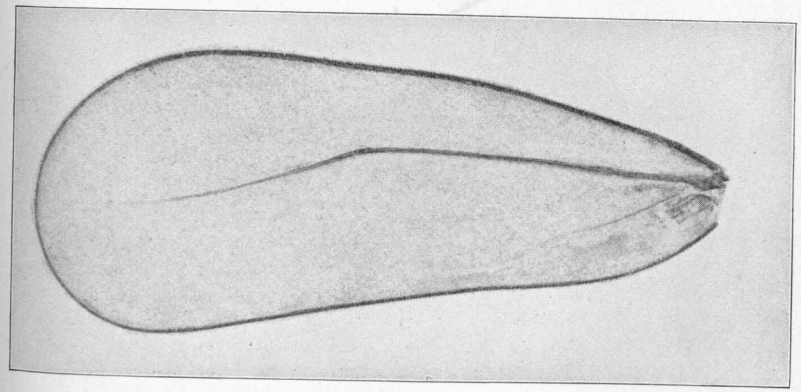
THE WHITE-FLY.



a. Edge of wing: much enlarged.

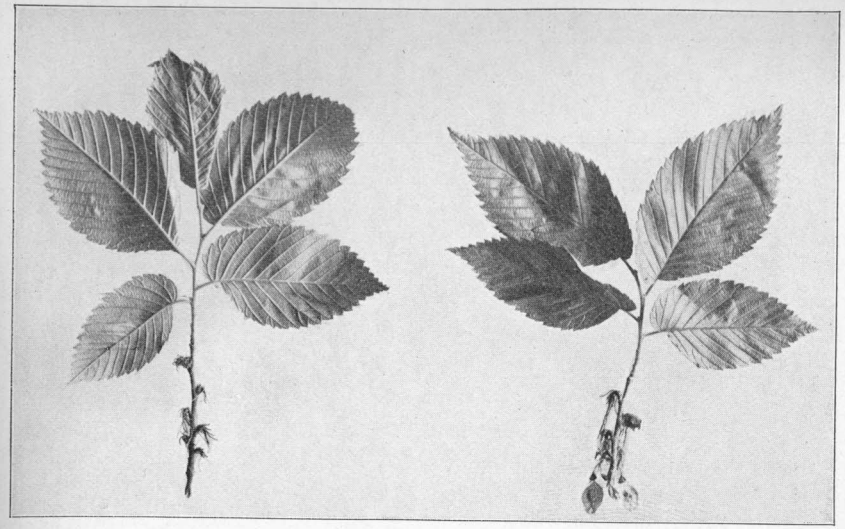


c. Foot: greatly enlarged.

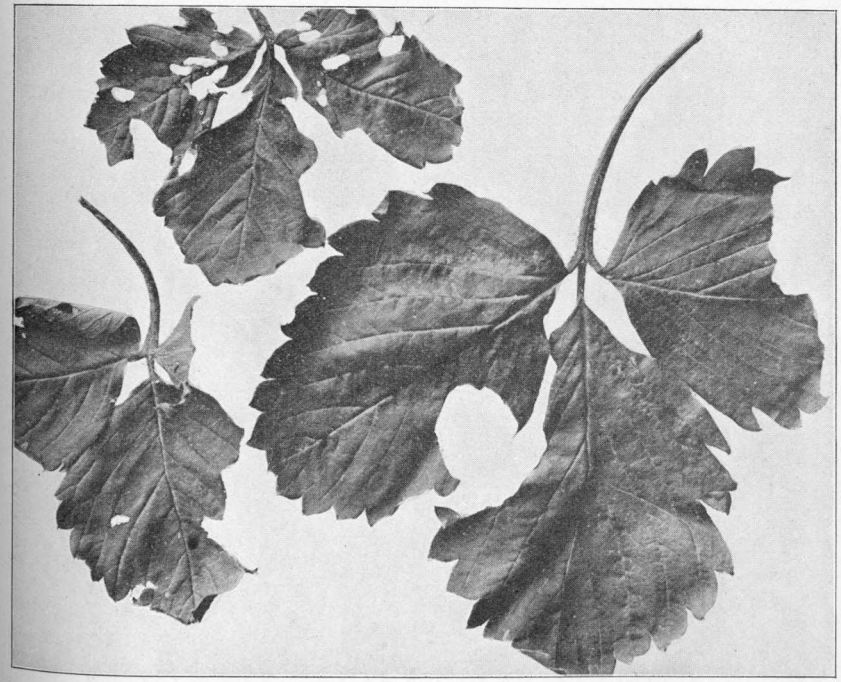


b. Fore wing: greatly enlarged.

THE WHITE-FLY.

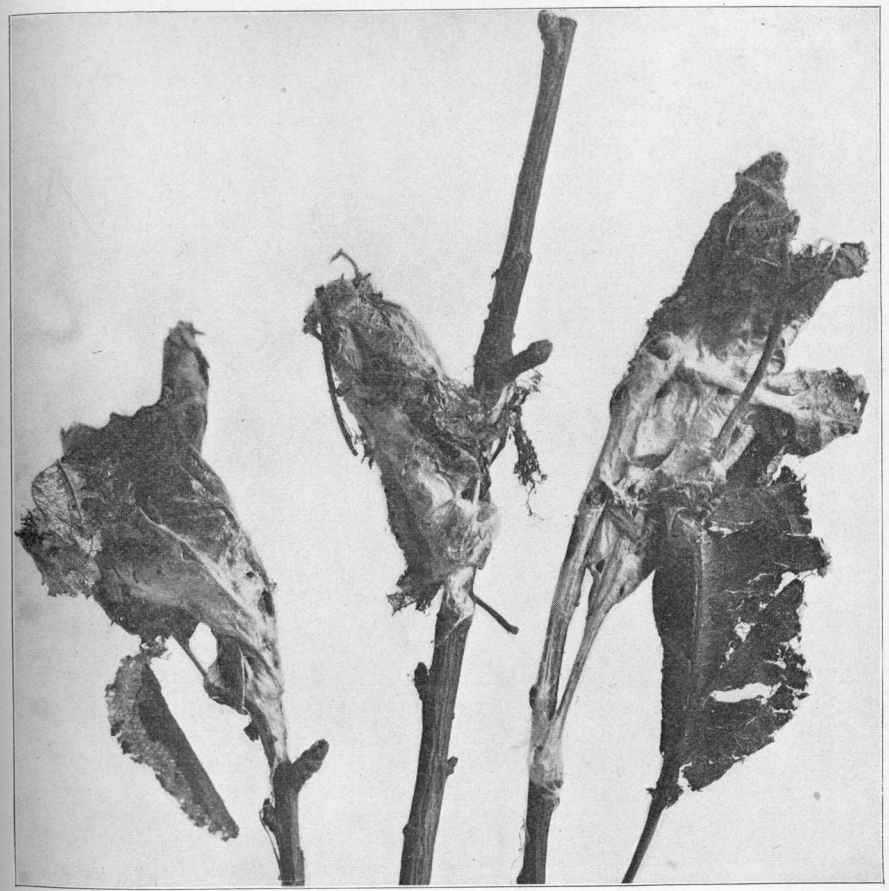


a. Elm twigs cut off by Grey Squirrels.



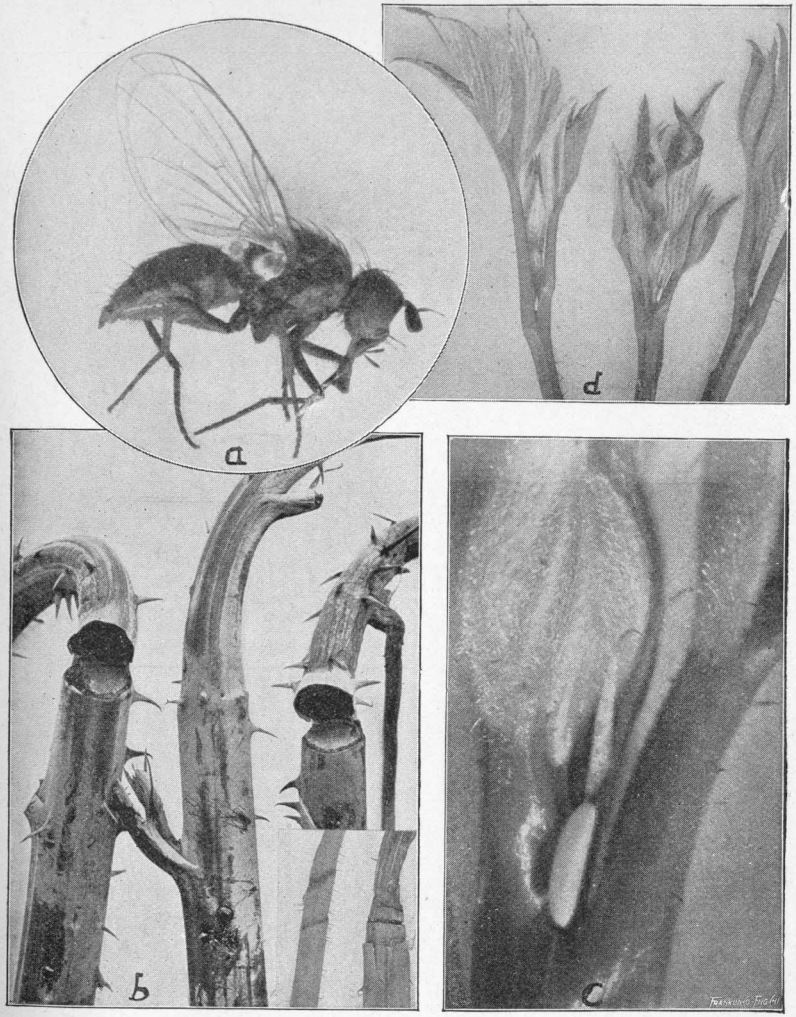
b. Strawberry leaves eaten by *Anomala binotata* Gyll.

ELM TWIGS AND STRAWBERRY LEAVES.



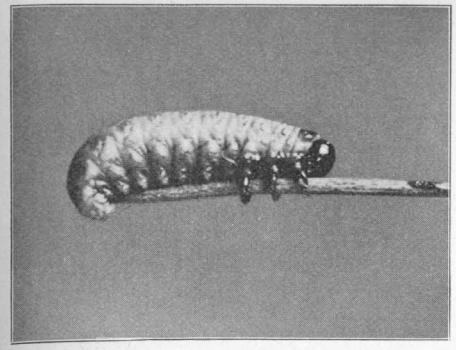
Winter nests of the Brown-Tail Moth. Natural size.

BROWN-TAIL MOTH.

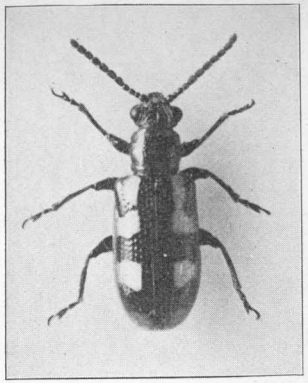


a. Adult female fly, much enlarged ; b. Raspberry shoots injured by the maggot, natural size ; c. Egg, much enlarged ; d. Tips of shoots, each bearing an egg, natural size (after Slingerland, Cornell University Experiment Station, Bulletin 126).

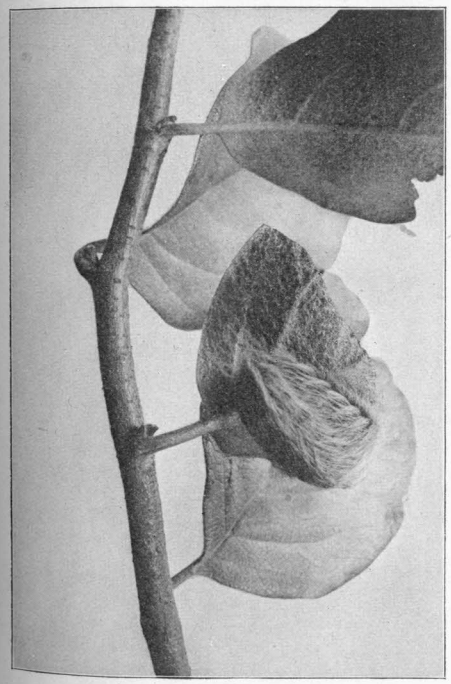
THE RASPBERRY CANE MAGGOT.



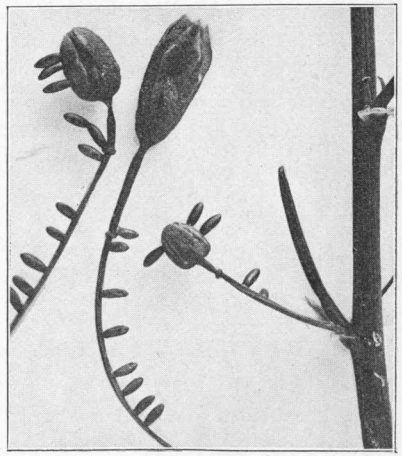
b. Larva of asparagus beetle. Much enlarged.



c. Asparagus beetle. Much enlarged.



d. Larva of the crinkled Flannel moth *Lagoa crispata*. Natural size.



a. Eggs of asparagus beetle. Much enlarged.

LAGOA CRISPATA AND THE ASPARAGUS BEETLE.

SEVENTH

REPORT ON FOOD PRODUCTS.

To His Excellency, Abiram Chamberlain, Governor of Connecticut:

As required by law, I herewith submit to you the Seventh Report of the Connecticut Agricultural Experiment Station on Food Products, for the year ending July 31st, 1902.

I regret that the pressure of other Station work during the fall and winter has made it necessary to postpone the preparation of this Report.

Very respectfully,

E. H. JENKINS, *Director.*

LAW REGULATING THE MANUFACTURE AND SALE OF FOOD PRODUCTS.

There are on the Statute book nine distinct laws regarding the manufacture and sale of adulterated food products. Only one, however, imposes duties on this Station. This is found in Sections 2573 to 2578, inclusive, of the General Statutes of Connecticut, revision of 1902, and is as follows:

SEC. 2573. *Food misbranded or adulterated.* No person or corporation shall manufacture for sale, sell, offer or expose for sale, or have in his possession to sell, any article of food which is adulterated or misbranded. The term food, in this section, shall include every article used for food or drink by man, horses, or cattle. Misbranded food shall include every article of food and every article which enters into the composition of food, the package or label of which shall bear any statement purporting to name any ingredient or substance as not being contained in such article, which statement shall be untrue in any particular; or any statement purporting to name the substance or substances of which such article is made, which statement shall not give fully the names of all substances contained in such article in any measurable quantity.

SEC. 2574. *Adulterated food; term defined.* In the following cases an article shall be deemed adulterated: (1), if any substance or substances be mixed or packed with it so as to reduce, lower, or injuriously affect its quality or strength; (2), if any inferior substance or substances be substituted wholly or in part for the article; (3), if any valuable constituent of the article has been wholly or in part abstracted; (4), if it be an imitation of or sold under the name of another article; (5), if it is so colored, coated, polished, or powdered that damage is concealed, or if it is made to appear better or of greater value than it is; (6), if it contain poisonous ingredients which may render such article injurious to the health of a party consuming it, or if it contain any antiseptic or preservative not evident and not known to the purchaser or consumer; (7), if it consists, in whole or in part, of a diseased, filthy, decomposed, or putrid substance, either animal or vegetable, unfit for food, whether manufactured or not, or if it is in any part the product of a diseased animal, or of any animal that has died otherwise than by slaughter; *provided,* that an article of food product shall not be deemed adulterated or misbranded in the following cases: (a), in the case of mixtures or compounds which may be now or from time to time hereafter known as articles of food under their own distinctive names, and not included in definition fourth of this section; (b), in the case of articles labeled, branded, or tagged, so as to plainly and correctly show that they are mixtures, compounds, combinations or blends; (c), when any matter or ingredient is added to a food because the same is required for the protection or preparation thereof as an article of commerce in a fit state for carriage or consumption, and not fraudulently to increase the bulk, weight, or measure of the food or to conceal the inferior quality thereof; (d), when a food is unavoidably mixed with some extraneous matter in the process of collection or preparation.

SEC. 2575. *Analysis of food to be made.* The Connecticut agricultural experiment station shall make analyses of food products on sale in this state, or kept in this state for export, suspected of being adulterated. Samples of food products for analysis shall be taken by the agents of the station, or by the dairy commissioner or his deputy, at such times and places and to such an extent as in the judgment of the officers of said experiment station, or of the dairy commissioner, shall seem expedient. The dairy commissioner or his deputy shall have access at all reasonable hours to any place wherein it is suspected that there is kept for sale or export any article of food adulterated with deleterious or foreign ingredients, and said dairy commissioner or his deputy, upon tendering the market price for such article, may take from any person, firm, or corporation, samples of the same. Said experiment station may fix standards of purity, quality or strength, when such standards are not specified by law. Whenever said experiment station shall find by analysis that adulterated food products have been on sale in this state, or kept in this state for export, it shall forthwith transmit the facts so found to the dairy commissioner, who shall make complaint to the proper prosecuting officer, to the end that violators of the law relating to the adulteration of food products shall be prosecuted.

SEC. 2576. *Report on adulterated food products.* Said station shall make an annual report to the governor upon adulterated food products, which shall not exceed one hundred and fifty pages.

SEC. 2577. *Appropriation.* To carry out the provisions of sections 2575 and 2576, the sum of twenty-five hundred dollars is annually appropriated to said Connecticut agricultural experiment station, which shall be paid in equal quarterly installments to the treasurer of the board of control of said station, upon the order of the comptroller, who shall draw his order for the same.

SEC. 2578. *Action not maintainable.* Every person who, by himself, his agent, or attorney, with intent that the same may be sold as unadulterated, adulterates any food product for man, horses, or cattle, or knowing that the same has been adulterated, offers for sale or sells the same as undulterated or without disclosing or informing the purchaser that the same has been adulterated, shall be fined not more than five hundred dollars, or imprisoned not more than one year. No action shall be maintained on account of any sale or other contract made in violation of section 2573.

DUTIES OF THE STATION UNDER THE FOOD LAW.

The foregoing act requires the Station:

First. To make analyses of food products suspected of adulteration.

Second. Whenever it shall find by its analyses that adulterated food products have been on sale, to forthwith transmit the facts so found to the Dairy Commissioner.

Third. To make an annual report to the Governor.

SAMPLES EXAMINED BY THE STATION.

During the year ending July 31, 1902, authorized agents of the Station have visited twenty-five of the cities and larger towns of the State and have purchased in them samples of food products for examination at the Station.

In all there were bought by the Station 1,034 food products. A considerable number in addition have been examined which were submitted by grocers or purchasers.

The total number of food examinations made in our laboratory, within the twelve months covered by this report, is 1,867, classified as follows:

Milk	422
Cream	10
Syrups from Soda Fountains	113
Bottled Syrups and Fruit Juices	38
Bottled Carbonated Beverages	74
Sweet Pickles	18
Lard and Compound Lard	171
Cheese	21
Maraschino Cherries	6
Black Pepper	58
White Pepper	28
Cayenne Pepper	28
Cinnamon	42
Cloves	43
Allspice	34
Mace	1
Coffee	33
Cocoa	45
Alcoholic Liquors	4
Extract Vanilla	3
Extract Lemon	1
One sample each of Cream Tartar, Sage, Sugar, Butter, Dried Curd, Canned Beets, Gluten Bread, Tea, Vinegar, Baking Powder	10
Food preservatives	2
Total	1,205

For the Dairy Commissioner:

Butter	41	
Molasses	384	
Honey	3	
Vinegar	234	
		662
		1,867

The State Dairy Commissioner is charged by special statutes with the enforcement of laws regulating the sale of butter, vinegar, molasses and concentrated commercial feeds.

Since 1886, when the office of Dairy Commissioner was established, to the present, this Station has done at its own cost all the chemical work desired by the Commissioner and has given all needed expert evidence in court.

In the following pages the results of the work of this year are presented by members of the Station staff.

MILK.

By A. L. Winton, M. Silverman and E. Monroe Bailey.

Milk bought of Milkmen by the Station Agents.

During the summer of 1902, 292 samples were collected and examined, the plan of the investigation being essentially the same as was followed in 1900 and 1901.

Collection of Samples.

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

The cans are of tin, 2¼ inches square and 3¼ inches high, not including the screw cap. Filled to the brim, they have a capacity of 280 cc., or a little more than half a pint. The screw cap is 1½ inches in diameter, thus allowing easy access to the interior for washing, and is lined with a disk of thick paraffined paper, insuring a water-tight joint. They were made to order by S. A. Ilsley & Co., Brooklyn, but cans like these, except that the caps are of smaller diameter, are kept in stock by the manufacturers. The general appearance of the bicycle and its attachment, as well as the arrangement of the sampling cans, is shown by a photo-engraving in the Report for 1900.

The sampling agent, between the hours of four and seven A. M., rode from street to street and bought a pint of milk of each milkman whom he met, without making known the object of his errand. He also noted the name of the milkman or his dairy given on the wagon, or if not thus given he asked the driver for the name of the man who carried on the business. The agent thoroughly mixed the sample of milk and filled one of the tin cans with it. He also filled out a numbered blank describing the sample and attached a duplicate number to the can.

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

Examination of Samples.

Determinations of specific gravity, fat and total solids, and tests for preservatives and colors were made in each sample immediately after its arrival. A summary of the results obtained will be found in Table I; the names of the dealers and the analyses in Table II. The name which was on the milk cart was copied, but where no name appeared, it was obtained from the driver. All names obtained in this way are marked with an asterisk. The table also gives the specific gravity of the milk at 60° F., the first two figures, which are the same in all cases, being omitted. Thus 25.3 signifies a specific gravity of 1.0253. Next follow the percentages of fat and total solids. Percentages of solids below 12.0 and of fat below 3.0 are given in full-faced type.* Lastly the table shows which of the samples were preserved with borax or formaldehyde, and which were colored with annatto or a coal-tar dye.

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

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

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

* Several states have adopted 12 per cent. of solids and 3 per cent. of fat as the minimum percentages in pure milk. Connecticut has adopted no standard for milk.

Whole milk generally has a specific gravity at 60° F. between 1.029 and 1.033. Exceptionally rich milk with a high percentage of fat may, however, have a specific gravity lower than 1.029, and by that test alone would be unjustly condemned. Addition of water to milk lowers and skimming raises the specific gravity. Low percentages of fat and solids and low specific gravity indicate that the milk has been watered, but when a deficiency of fat and solids is associated with a high specific gravity, the milk has probably been skimmed. Samples which have been both skimmed and watered and which are very deficient in fat and solids may have a normal specific gravity, as the two operations have opposite effects on this physical property of milk.

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

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

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

TABLE I.—SUMMARY OF ANALYSES OF MILK BOUGHT OF MILKMEN, 1902.

Place.	Total number of samples.	Below three per cent. of fat.	Below twelve per cent. of solids.	Both solids and fat below the percentages named.	Preserved with boric acid (borax).	Preserved with formaldehyde.	Colored with annatto.	Colored with coal-tar dye.
Ansonia	5	0	2	0	0	0	0	0
Bridgeport	30	2	12	2	0	0	0	0
Bristol	11	0	0	0	0	0	0	0
Danbury	11	0	6	0	0	0	0	0
Derby	10	0	2	0	0	0	0	0
Hartford	29	1	8	1	1	0	0	0
Meriden	16	0	3	0	0	0	0	0
Middletown	18	1	3	1	0	0	0	0
New Britain	12	1	3	1	0	0	0	0
New Haven	33	2	17	2	0	2	4	3
New London	18	1	6	1	0	0	0	0
Norwalk	5	0	3	0	0	0	0	0
Norwich	10	0	0	0	0	0	0	0
Putnam	6	0	1	0	0	0	0	0
Rockville	6	0	1	0	0	0	0	0
South Norwalk	7	0	2	0	0	0	0	0
Stamford	14	0	1	0	0	1	0	0
Torrington	3	0	1	0	0	0	0	0
Wallingford	11	0	0	0	0	0	0	0
Waterbury	20	0	7	0	0	0	0	0
Willimantic	17	0	2	0	0	0	0	0
Total for 1902	**292**	**8**	**80**	**8**	**1**	**3**	**4**	**3**
Total for 1901	**375**	**23**	**109**	**23**	**2**	**7**	--	--
Total for 1900	**246**	**11**	**54**	**17**	**7**	**14**	--	--

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

The General Quality of the Milk Supply in August, 1902.

Excluding analyses of samples which had certainly been watered or skimmed, the average percentage of total solids in the analyses given in Table II is 12.63 and the average percentage of fat, 4.13.

The corresponding averages for the same time of year were 12.50 and 4.0 in 1901, and 12.53 and 3.99 in 1900.

Of the samples examined in 1902, thirty-two or 10.9 per cent. of the whole number were adulterated, in four cases by preservatives, in seven cases by dyes and in twenty-four cases by watering or skimming.

TABLE II.—MILK BOUGHT OF MILKMEN.

Station No.	Sampled, September.	Dealer.	Specific gravity at 60° F.	Fat.	Total solids.	Preservative.	Color.
		Ansonia.					
5952	15	John Conley*	26.8	3.8	**11.83**	None	Natural.
5953	"	J. F. P.	25.3	5.5	12.99	"	"
5954	"	P. B. Sperry*	31.5	4.5	13.48	"	"
5955	"	G. R. Wheeler	30.9	4.3	13.05	"	"
5951	"	J. F. W.	27.8	3.3	**10.93**	"	"
		Bridgeport.					
5807	3	J. Bannay, Imperial Dairy	28.8	3.9	12.08	"	"
5784	"	Beach & Trumbull*	30.1	3.6	12.42	"	"
5781	"	Jacob Blisey*	28.1	4.1	12.27	"	"
5782	"	John Blousis, Mill Plain*	28.4	3.6	**11.68**	"	"
5802	"	E. R. Burr*	27.6	4.6	13.17	"	"
5805	"	Henry R. Burr, Greenfield Hill*	29.8	4.3	13.04	"	"
5776	"	E. C. Burroughs	29.8	4.4	13.18	"	"
5783	"	D. B. Curtis & Son	30.8	4.5	13.59	"	"
5808	"	Oscar Frausen, Long Hill	29.3	3.4	**11.67**	"	"
5789	"	A. O. Gregory	26.3	3.5	**11.32**	"	"
5811	"	E. L. Hoyt, Long Hill*	30.0	4.1	13.17	"	"
5806	"	H. E. Hull	30.0	**2.9**	**11.39**	"	"
5812	"	F. C. Jennings*	26.2	3.0	**10.17**	"	"
5814	"	Chas. Kitscher*	28.4	3.7	**11.98**	"	"
5787	"	Albert Laufer*	28.3	3.9	12.47	"	"
5803	"	John C. Lobdell*	29.4	3.7	12.55	"	"
5785	"	Geo. L. McClellan	30.5	3.9	12.51	"	"
5786	"	William McClellan	29.8	3.8	12.52	"	"
5779	"	John McDonnell*	27.3	3.6	**11.71**	"	"
5809	"	I. G. Miller, Pleasant View Farm, Stratfield	29.1	3.2	**11.46**	"	"
5810	"	G. A. Moll*	27.5	3.7	12.00	"	"
5778	"	John Oldstein*	30.1	4.6	13.39	"	"
5801	"	Patchen*	29.5	3.6	12.63	"	"
5815	"	George Randall*	28.4	3.6	**11.94**	"	"
5804	"	The Roger Farm Dairy	30.0	4.2	12.91	"	"
5777	"	E. E. Sherman, Long Hill*	26.6	3.3	**10.97**	"	"
5780	"	George Sherman*	28.9	4.7	13.77	"	"
5788	"	Albert Vogt*	27.8	3.3	**11.81**	"	"
5790	"	William Wheeler*	29.7	4.0	12.52	"	"
5813	"	Julian Wilson*	26.3	**2.8**	**10.46**	"	"
		Bristol.					
5968	16	A. B. Brewer, Hillside Farm	28.7	4.2	12.40	"	"
5961	"	George B. Evans	29.9	4.5	13.26	"	"
5962	"	T. Holt, Maple View Farm	28.2	4.9	13.21	"	"
5969	"	Manchester Bros., Fern Hill Dairy	30.2	5.0	13.95	"	"
5967	"	Manchester Bros., Fern Hill Dairy	30.8	4.9	13.59	"	"
5966	"	S. D. Newell	30.4	4.5	13.27	"	"
5965	"	N. J. Potter*	27.8	4.8	13.33	"	"
5971	"	O. Roberts, Maple Lawn Farm	29.2	4.5	13.06	"	"
5963	"	G. A. Root & Son	26.5	4.2	12.19	"	"
5970	"	G. A. Root & Son	29.2	4.8	13.45	"	"
5964	"	James L. Willcox, Clover Hill Stock Farm	30.8	4.1	12.99	"	"

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

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

Station No.	Sampled, Aug.-Sept.	Dealer.	Specific gravity at 60° F.	Fat.	Total solids.	Preservative.	Color.
	Aug.	*Danbury.*					
5730	27	Bailey's Pure Milk	28.9	3.8	12.34	None	Natural.
5731	"	Danbury Milk Co.	28.9	4.2	12.33	"	"
5727	"	E. B. Field*	30.7	4.2	12.87	"	"
5728	"	Albert Fuller*	26.4	3.7	**11.24**	"	"
5737	"	J. F. Hall	28.9	3.4	**11.66**	"	"
5735	"	Frank Haviland*	28.3	3.9	**11.53**	"	"
5729	"	Nabold Jacob*	26.4	4.3	**11.88**	"	"
5736	"	Andrew Mishico*	30.9	3.9	12.90		"
5733	"	Robinson Bros., Pembroke Dairy	25.2	3.4	**10.78**	"	"
5734	"	C. H. White*	29.1	4.4	12.34	"	"
5732	"	Worden, Great Plains*	25.9	3.3	**10.79**	"	"
	Sept.	*Derby.*					
5948	13	George Birdsey, No. 12*	30.6	4.0	12.39	"	"
5960	15	George Birdsey*	26.8	4.0	**11.78**	"	"
5957	"	D. H. C.	29.4	4.4	12.91	"	"
5947	13	Charles Diamond*	30.9	4.0	12.49	"	"
5959	15	H. C. Hubbell, No. 22	27.9	4.2	12.19	"	"
5956	"	M. W. Johnson*	30.9	3.7	12.29	"	"
5958	"	Daniel Nichols*	29.4	4.3	13.11	"	"
5950	13	Wilbur Osborn*	29.9	3.9	12.52	"	"
5946	"	C. R. Quick	31.4	4.4	13.45	"	"
5949	"	E. W. Thompson, No. 42*	29.0	3.6	**11.71**		
		Hartford.					
5794	4	T. Arcari	27.4	3.8	**11.84**	"	"
5854	"	L. H. Barnard, No. 71	29.0	4.6	13.77	"	"
5797	"	A. G. Brewer, No. 93	27.6	4.4	12.99		
5820	"	A. W. Butler, No. 2, West Hartford	30.3	3.5	12.13	"	"
5818	"	J. J. Carroll, No. 224, West Hartford	29.1	4.4	13.29	Borax	"
5800	"	C. J. Christensen, No. 109	29.1	3.6	12.09	None	"
5795	"	A. Cohen, No. 149	25.9	3.3	**10.89**	"	"
5827	"	A. Cohen, No. 149	28.8	3.6	**10.94**	"	"
5793	"	H. I. Epstein	30.9	3.2	12.09	"	"
5851	"	W. P. Francis	28.9	4.4	13.14	"	"
5823	"	H. J. Gilbert, No. 33, Elmwood	30.3	3.8	12.69	"	"
5791	"	P. Goldberg	29.7	5.5	14.51	"	"
5855	"	E. S. Goodale, Newington	29.0	4.6	13.06	"	"
5796	"	H. W. Holcomb, No. 26	30.0	**2.6**	**11.02**		
5853	"	W. C. Hubbard, No. 154, Blue Hills ave.	30.0	4.8	13.99	"	"
5825	"	G. F. Humphrey, Bloomfield	29.8	4.0	12.54	"	"
5822	"	J. M. Johnson, No. 191	28.3	4.0	12.41	"	"
5824	"	J. W. Merrill, No. 58	25.0	4.2	**11.53**	"	"
5817	"	B. E. Moody, No. 56	29.9	4.3	13.10	"	"
5816	"	C. Neilson, Kellogg Farm Dairy	29.6	3.4	**11.93**	"	"

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

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

Station No.	Sampled, September.	Dealer.	Specific gravity at 60° F.	Fat.	Total solids.	Preservative.	Color.
		Hartford.					
5856	4	N. A. Nissen	28.6	3.7	13.59	None	Natural.
5798	"	C. Peterson, No. 28	30.0	4.5	13.80	"	"
5857	"	B. D. Phelps, Windsorville	26.6	4.8	**11.47**	"	"
5792	"	Romano Rocco	29.9	4.0	12.49	"	"
5826	"	Spring Brook Farm, No. 217, South Wethersfield	31.3	4.2	13.25	"	"
5821	"	N. Swenson, Elmwood	26.1	4.2	12.07	"	"
5799	"	L. A. St. John	29.8	3.6	12.09	"	"
5819	"	J. T. Tilden, No. 40	26.1	3.0	**10.32**	"	"
5852	"	E. W. Walker, West Hartford	28.1	4.4	12.74	"	"
		Meriden.					
5842	5	J. D. Bartholomew	27.0	3.8	**11.56**	"	"
5838	"	John W. Britney, Beaver Lake Farm	27.6	3.4	**11.33**	"	"
5837	"	G. E. Butler*	26.5	4.8	12.77	"	"
5835	"	Chalafew*	28.5	4.1	13.08	"	"
5840	"	G. W. Delaney*	29.6	4.0	12.63	"	"
5830	"	Dickerman Bros.	27.2	4.6	13.00	"	"
5834	"	Henry Hallmann*	26.0	3.3	**11.08**	"	"
5828	"	D. Higgins, 17 Butler st.	29.3	4.2	12.78	"	"
5829	"	D. Higgins, 17 Butler st.	29.6	3.7	12.39	"	"
5836	"	Gus. Linch*	29.8	3.6	12.15	"	"
5831	"	A. McRae	29.2	3.6	12.12	"	"
5841	"	Gustav Schlag*	29.0	4.0	12.34	"	"
5839	"	W. G. Schwink	30.2	4.5	13.31	"	"
5832	"	Harry Scovel*	30.1	5.0	13.99	"	"
5833	"	H. A. Sibley*	30.2	4.0	13.24	"	"
5843	"	J. W. Yale	29.4	4.5	13.20	"	"
		Middletown.					
5937	12	F. B. Ashton	30.4	3.7	12.27	"	"
5934	"	Daniels Bros., Millbrook Farm	28.7	5.1	13.50	"	"
5941	"	James Dripps	28.3	4.4	12.66	"	"
5935	"	T. Coleman	31.8	**2.5**	**11.20**	"	"
5944	"	T. Coleman	28.2	5.3	13.46	"	"
5930	"	F. A. Crook	26.7	3.0	**10.46**	"	"
5943	"	W. C. Fowler*	30.9	4.7	13.32	"	"
5938	"	T. J. Harris*	25.6	3.0	**10.18**	"	"
5931	"	F. O. Jackson, Walnut Grove Dairy	27.3	4.6	12.69	"	"
5933	"	H. C. Johnson & Son	27.8	4.2	12.19	"	"
5932	"	W. G. Johnson & Sons	29.7	3.9	12.21	"	"
5942	"	Lee Bros.	28.8	4.4	12.59	"	"
5945	"	D. Mott	30.4	3.6	12.01	"	"
5929	"	F. Newman*	30.9	4.2	12.74	"	"
5939	"	C. C. Plum	28.8	4.3	12.57	"	"
5940	"	E. H. Plum, Westfield*	28.3	4.5	13.10	"	"
5936	"	E. J. Roberts, Maple Shade Dairy	30.2	4.4	13.01	"	"
5928	"	F. S. Scovill	29.9	4.9	13.54	"	"

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

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

Station No.	Sampled, September.	Dealer.	Specific gravity at 60° F.	Fat.	Total solids.	Preservative.	Color.
		New Britain.					
5867	5	Cedar Hill Farm	31.5	5.0	14.04	None	Natural.
5869	"	Elmhurst Milk	30.2	4.2	13.01	"	"
5864	"	J. Flood & Sons	29.4	3.6	12.12	"	"
5866	"	Hooker's Brookside Farm	30.4	4.0	12.66	"	"
5861	"	Edward Lindell	30.1	4.2	12.71	"	"
5863	"	William Miller*	30.0	**2.8**	**11.31**	"	"
5858	"	J. Monsees	22.5	3.0	**9.42**	"	"
5859	"	J. J. Newton, West Hartford	30.0	3.6	**11.93**	"	"
5862	"	Springdale Dairy	27.4	5.9	14.01	"	"
5860	"	August Spurtzolder*	29.1	5.4	13.81	"	"
5865	"	G. A. Wall, Maple Grove Farm	28.6	5.1	13.41	"	"
5870	"	Levi Wells*	28.4	6.4	14.92	"	"
		New Haven.					
5884	6	T. S. Allen	31.4	3.5	12.37	"	"
5881	"	F. J. Buck	26.7	3.4	**11.02**	"	Annatto.
5888	"	E. N. P., Clover Dairy	28.8	3.6	**11.69**	"	Coal-tar dye.
5767	2	E. N. P., Clover Dairy	29.1	3.6	12.04	"	"
5885	6	H. W. Coe, East Haven	26.7	4.4	12.20	"	Natural.
5879	"	W. L. Crawford	27.7	3.4	**10.91**	"	"
5872	"	C. C. Dudley	29.1	3.9	**11.97**	"	Annatto.
5762	2	J. F. Dunn	26.3	3.3	**10.80**	"	Natural.
5765	"	H. J. Fabrique	27.7	3.8	**11.85**	"	"
5770	"	Granniss Corner Dairy	29.1	3.6	12.03	"	"
5775	"	W. R. Hoggett	29.1	3.4	**11.56**	"	"
5769	"	B. N. Hosley	30.3	3.6	12.31	"	"
5874	6	M. B. & F. S. Hubbell	30.3	4.2	12.79	"	"
5774	2	M. B. & F. S. Hubbell	31.2	4.0	12.90	"	"
5878	6	A. Husinsky	28.2	3.3	**11.33**	"	Annatto.
5875	"	G. B. Jerome	30.8	3.7	12.28	"	Coal-tar dye.
5882	"	J. W. Johnson	29.3	3 6	**11.90**	"	Natural.
5877	"	S. Langel	28.2	3.8	**11.92**	"	"
5768	"	S. C. Mead	31.9	3.9	12.97	"	"
5873	"	Robert B. Miller	30.3	3.3	**11.76**	"	"
5883	"	New England Dairy	30.3	3.8	12.38	"	"
5764	"	New England Dairy	30.4	3.6	12.45	"	"
5871	"	L. C. Palmer	29.8	4.8	13.27	"	"
5910	10	S. H. Rice	32.4	**2.4**	**10.93**	Formaldehyde	"
5771	2	S. H. Rice	30.3	3.7	12.44	"	"
5880	6	E. G. Schlachter & Son, Orange	31.3	3.8	12.43	None	Annatto.
5772	2	J. H. Story, Cedar Hill Dairy	30.5	3.1	**11.79**	"	Natural.
5761	"	C. E. Thatcher	30.3	3.5	12.18	"	"
5766	"	W. F. Thompson	29.4	3.2	**11.46**	"	"
5763	"	F. A. V., No. 175	27.9	3.7	**11.82**	"	"
5887	6	H. A. Warner, Highwood	28.9	3.2	**11.14**	"	"
5773	2	Byron Webler, No. 78*	30.3	3.8	12.26	"	"
5876	6	H. Weinstein	26.2	**2.5**	**9.65**	"	"

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

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

Station No.	Sampled, Aug.-Sept.	Dealer.	Specific gravity at 60° F.	Fat.	Total solids.	Preservative.	Color.
	Sept.	*New London.*					
5849	9	A. T. Avery, Waterford	31.2	3.4	12.12	None	Natural.
5902	"	Charles Beckwith*	26.4	4.0	**11.74**	"	"
5900	"	H. G. Champion	31.2	3.7	12.60	"	"
5904	"	F. A. Comstock*	30.1	4.7	13.81	"	"
5847	"	F. L. Dimmock*	29.3	4.0	12.64	"	"
5905	"	W. S. Fitch*	31.1	4.1	12.57	"	"
5846	"	Leon St. German, Cohanzie st.	30.1	3.9	12.58	"	"
5848	"	T. H. Hanney, Waterford	30.2	3.2	**11.60**	"	"
5903	"	E. J. Hempstead & Son	29.6	4.5	13.33	"	"
5901	"	Hill Crest Farm	32.7	**2.6**	**11.73**	"	"
5908	"	Barney Ketz, Cohanzie st.*	30.3	4.5	13.35	"	"
5906	"	Ernest Lewis*	29.9	5.2	13.87	"	"
5844	"	C. G. Newbury*	28.1	4.9	13.69	"	"
5907	"	N. A. Richards, Quaker Hill	30.6	3.4	**11.75**	"	"
5845	"	H. S. Smith	30.2	3.4	**11.90**	"	"
5899	"	G. Snelitzki, Cohanzie st.*	32.1	3.3	12.16	"	"
5850	"	H. T. Squire, 61 Ocean ave.	29.1	5.0	13.98	"	"
5909	"	N. Stenger, Oak Race Course Farm	26.1	3.9	**11.31**	"	"
	Aug.	*Norwalk.*					
5724	26	Finch Bros., Chestnut Hill*	26.0	3.8	**11.05**	"	"
5721	"	Joseph T. Guyer	23.3	4.3	**11.07**	"	"
5722	"	David Jenks	26.0	4.4	**11.91**	"	"
5725	"	R. Loudon	31.5	4.3	13.37	"	"
5723	"	F. R. Waters	33.2	3.8	13.16	"	"
		Norwich.					
5893	8	Mrs. H. F. Davis	29.5	4.3	12.86	"	"
5895	"	George DeWolf*	28.3	4.7	13.74	"	"
5889	"	W. S. DeWolf.*	31.6	4.5	13.76	"	"
5892	"	Fred Gardner*	30.1	4.2	13.00	"	"
5897	"	Goldberg, Fox Hill*	30.8	5.4	14.30	"	"
5891	"	F. K. Kingsley	30.9	4.0	12.83	"	"
5890	"	J. G. Lyman*	31.1	3.6	12.18	"	"
5894	"	John Rogers*	30.9	4.8	13.80	"	"
5896	"	William Smith*	28.3	4.9	13.32	"	"
5898	"	C. H. Wheeler*	30.8	3.8	12.75	"	"
		Putnam.					
5993	25	John Hanley*	32.0	3.6	12.58	"	"
5996	"	H. E. Hurlbutt	30.1	4.5	13.00	"	"
5995	"	Peter River*	29.5	4.3	12.55	"	"
5994	"	E. E. Sanderson*	31.5	4.7	13.63	"	"
5997	"	Wilson Togood*	29.5	3.1	**11.25**	"	"
5998	"	Arthur Williams*	31.5	3.5	12.62	"	"

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

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

Station No.	Sampled, Aug.-Sept.	Dealer.	Specific gravity at 60° F.	Fat.	Total solids.	Preservative.	Color.
	Sept.	*Rockville.*					
5987	18	Philip Doyle*	31.0	4.4	13.19	None	Natural.
5984	"	Fred Guenther, Park Dairy	25.4	4.0	**11.30**	"	"
5999	"	William H. Prescott*	28.5	5.5	14.52	"	"
5988	"	C. T. Slater, Spring Brook Dairy	28.0	5.1	13.96	"	"
5986	"	L. R. Sparrow*	30.5	4.4	12.79	"	"
5985	"	William C. Vinton, Hillside Dairy	27.0	4.8	12.52	"	"
	Aug.	*South Norwalk.*					
5719	26	William E. Barnes	31.4	4.4	13.28	"	"
5717	"	Birge's Dairy, Westport	30.8	3.9	12.55	"	"
5726	"	Joseph Carey*	29.9	3.6	12.06	"	"
5716	"	Charles H. Hawxhurst	31.7	3.7	12.56	"	"
5715	"	Charles E. Hoyt	28.2	3.3	**11.26**	"	"
5720	"	John G. Johnson	31.3	4.2	13.13	"	"
5718	"	W. D. Keeler	29.0	3.6	**11.74**		
		Stamford.					
5712	25	Bedell & Tompkins, Long Ridge Dairy	30.3	4.7	13.39	"	"
5711	"	Bouton's Noroton Dairy	30.6	3.8	12.63	"	"
5703	"	G. C. Chard, Riverbank Dairy	27.0	4.4	12.66	"	"
5708	"	H. P. Howard	31.3	4.1	13.03	"	"
5713	"	P. Larkin	29.0	4.3	12.77	"	"
5710	"	McClean's Summer St. Dairy	22.7	3.4	**9.89**	Formaldehyde	"
5702	"	Mt. Pleasant Dairy	31.2	4.2	13.07	None	"
5709	"	Rock Hill Dairy	29.9	4.2	12.95	"	"
5706	"	Rock Spring Dairy	31.3	3.9	12.69	"	"
5704	"	Sarr's Milk Wagon	29.9	3.7	12.12	"	"
5714	"	G. Swenson	29.5	4.2	12.63	"	"
5707	"	W. F. Waterbury	31.7	3.7	12.46	"	"
5701	"	West Over Dairy	31.2	3.6	12.06	"	"
5705	"	White Clover Dairy	30 0	4.8	13.50		
		Torrington.					
5992	24	Charles Converse*	30.2	4.6	13.38	"	"
5990	"	Weigold & Co.	24.6	4.3	**11.70**	"	"
5991	"	Weigold Milk Co.	26.6	4.5	12.30		
		Wallingford.					
5983	17	Harvey Beaumont*	29.2	4.8	13.25	"	"
5982	"	A. A. B.	28.7	4.3	12.50	"	"
5978	"	H. Giguere, Elm Farm	30.4	3.5	12.12	"	"
5974	"	W. H. Harrison	29.9	4.1	12.94	"	"
5981	"	O. P. Merriman*	29.2	5.2	14.00	"	"
5980	"	B. R. Tyler*	29.3	4.1	12.80	"	"
5973	"	E. R. Warner	29.7	4.2	12.83	"	"
5975	"	C. L. Williams	30.4	4.5	13.06	"	"
5976	"	George Williams*	30.1	4.1	12.66	"	"
5979	"	H. S. Williams	29.3	4.3	12.68	"	"
5972	"	J. D. Williams*	30.7	4.4	13.29	"	"

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

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

Station No.	Sampled, Aug.-Sept.	Dealer.	Specific gravity at 60° F.	Fat.	Total solids.	Preservative.	Color.
	Aug.	*Waterbury.*					
5757	29	F. Allen	28.4	4.6	12.73	None	Natural.
5754	"	I. B. Calhoun	30.1	4.5	13.45	"	"
5743	"	F. P. Clough	30.6	4.1	13.21	"	"
5749	"	Joe Cohen*	29.9	3.2	**11.26**	"	"
5738	"	T. B. Eggleston	26.6	3.5	**11.17**	"	"
5756	"	Jake Kasoski*	30.4	3.7	12.58	"	"
5751	"	C. A. Kernathan	29.9	4.3	13.05	"	"
5752	"	Lockwood Bros.	30.9	3.7	12.50	"	"
5755	"	J. W. Loughlin, Oakville	31.0	4.1	12.84	"	"
5748	"	J. F. Manthey	26.0	3.1	**10.48**	"	"
5740	"	Frank McDonnell	29.9	3.8	12.55	"	"
5741	"	W. J. Munson, Watertown	30.3	3.9	12.80	"	"
5742	"	E. H. Oviatt, Watertown	30.2	3.7	12.24	"	"
5739	"	Hans Rasmussen	29.0	3.4	**11.91**	"	"
5753	"	J. N. Rose	28.8	3.7	**11.84**	"	"
5747	"	L. A. Rose	29.8	3.4	**11.85**	"	"
5745	"	H. B. Russell	29.4	4.1	12.57	"	"
5744	"	W. S. Strong	27.5	3.3	**11.19**	"	"
5746	"	George Tracy*	29.4	4.6	13.31	"	"
5750	"	G. S. Vanatta	30.8	3.7	12.64	"	"
	Sept.	*Willimantic.*					
5925	11	A. M. Anthony	30.1	4.6	13.22	"	"
5915	"	S. P. Brown, Homestead Farm	30.8	4.0	12.71	"	"
5919	"	Crane, Wolf Rock Dairy	29.6	4.6	12.90	"	"
5913	"	J. M. Daggett & Son	32.4	4.1	13.39	"	"
5921	"	E. W. Ellison, Rock Maple Farm	30.1	5.6	14.08	"	"
5927	"	J. H. Griggs, Pleasant Valley Farm	29.5	5.7	14.33	"	"
5923	"	C. A. & H. C. Hawkins*	29.6	4.5	13.15	"	"
5924	"	C. M. Holbrook*	24.0	3.6	**10.50**	"	"
5914	"	C. H. Hoxie	27.8	4.1	12.00	"	"
5917	"	G. A. Jacobs, Mansfield City Dairy	29.9	5.3	13.90	"	"
5920	"	Nason & Goldsborough, Hillside Farm	30.7	4.1	12.81	"	"
5922	"	C. B. Pomeroy, Jr.	29.5	4.5	12.93	"	"
5911	"	A. Potter*	31.9	4.2	13.42	"	"
5912	"	G. W. Rappelyea*	30.4	4.1	12.71	"	"
5926	"	F. Rosebrooks	30.4	4.0	12.64	"	"
5916	"	J. H. Stearns, Mountain Milk Farm	29.9	3.8	12.11	"	"
5918	"	Joel Warren*	28.7	3.5	**11.94**	"	"

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

In 1901, 8.5 per cent. of the samples were certainly adulterated and in 1900, 11.4 per cent.

Milk from a Producer Sampled by the Station.

Late in August, the manager of a milk company complained to the Station that one of his patrons in an adjoining town was supplying him with milk which, according to tests made by his chemist, was adulterated.

A few days later a representative of the Station, in the presence of the manager of the company and the alleged producer, drew samples of each can of the suspected milk (three in number) as they were being loaded on the wagon for delivery. Tests of these samples were made at the Station with the following results:

Station No.	Specific Gravity at 60° F.	Fat.	Total Solids.	Solids not Fat.
5758	25.6	2.70	9.69	6.99
5759	22.3	2.80	9.04	6.24
5760	24.7	2.90	9.70	6.80

On the strength of these analyses the samples were reported as unquestionably adulterated by watering, and the manager of the milk company at once brought suit for damages in the city where the company was located.

In the trial the evidence showed that the accused was not technically the milk producer, as the business was carried on in the name of his wife; furthermore, that the case was not within the jurisdiction of that court, and the judge dismissed the case.

Milk and Cream Sampled by Health Officers, Producers, Dealers and Consumers.

During the past year 125 samples of milk, 2 of skim milk and 10 of cream, not sampled by the Station, have been examined. Only the following cases are of public interest.

Colored Milk. A sample submitted by C. E. Thatcher, New Haven, although containing a good percentage of solids and fat was colored with a coal-tar dye.

Watered Milk. Mrs. Mary E. Johnston, Whitneyville, sent a sample which, containing but 2.4 per cent. of fat and having a specific gravity of but 1.0201, was unquestionably watered.

Preserved Cream. A sample of cream from C. H. Borden, Health Officer, Stamford, contained formaldehyde and another from S. S. Walker, Long Hill, contained boric acid.

Casein, Albumin and Total Protein in Milk of Single Cows.

In sixteen samples of milk from single cows sent by the Storrs Agricultural Station, casein and albumin were determined by precipitation and determination of nitrogen in the precipitates, and total protein by determination of nitrogen directly in the milk, the conventional factor 6.25 being employed in all three cases.

The maximum, minimum and average percentages were as follows:

	Maximum.	Minimum.	Average.
Casein	3.41	2.04	2.77
Albumin	0.89	0.51	0.66
Total protein	4.20	2.84	3.57

Methods of Analysis.

Determinations of *Specific Gravity, Total Solids* and *Fat,* and tests for *Boric acid (Borax)* and *Formaldehyde* are made by the methods employed in 1901 and 1902.*

Tests for *Annatto, Coal-tar colors and Caramel* are made by Leach's method.†

CARBONATED NON-ALCOHOLIC BEVERAGES AND FRUIT FLAVORS.

By A. L. Winton, A. W. Ogden, M. Silverman and E. Monroe Bailey.

Samples collected by the Station Agents.

Water, variously flavored and charged with carbonic acid, commonly called "soda water,"‡ may be said to be the national summer drink of the United States. Although statistical proof is not obtainable, it is doubtless true that the consumption of the various carbonated non-alcoholic beverages (not including mineral waters) within our border is greater both *per capita* and *in toto* than in any other country.

* Reports of this Station for 1900, p. 126; 1901, p. 105.

† Jour. Am. Chem. Soc., 1900, **22**, 207, U. S. Dept. Agr. Bur. Chem., Bul. **65**, 36.

‡ Also known as "Soda" and more appropriately as "Carbonated Water."

In Connecticut nearly all of the five hundred apothecaries have soda fountains, and in some cases soda water, during the summer months, is a more important source of revenue than drugs. Soda fountains are also maintained by many confectioners and some of the department stores.

Bottled soda water, ginger ale and similar beverages are sold in large quantities for family use and for consumption in saloons, restaurants, fruit-stands and refreshment-stands.

Soda Water, Sold from Fountains.

Apparatus for Dispensing Soda Water. In stores where soda water is drawn for consumption from faucets, the "fountains," which are the metal cylinders in which it is stored, are kept in the cellar, and from these pipes lead to and through a box packed with ice at the dispensing counter. This box, which is commonly, but erroneously, known as the "fountain," also contains reservoirs for the various flavoring syrups and is usually cased in polished marble, with nickel faucets and trimmings.

The pressure of the carbonic acid gas in the cylinder forces the carbonated water through the pipes to the faucets, which are so arranged that a large or a fine stream can be drawn, the latter being used to mix and froth the drink.

Besides the flavoring and sweetening matters added in form of syrups, "Cream" is added to chocolate, coffee, vanilla and some other flavors, and frothed eggs, "acid phosphate" and various other materials are used in the preparation of special drinks.

Preparation of Carbonated Water. Formerly each fountain was charged by connecting with apparatus in which carbonic acid gas was set free by the action of sulphuric acid on marble dust or other carbonate, but now carbonic acid, either made from acid and carbonates or derived from mineral springs, is liquified by pressure and supplied in small steel cylinders.

Some retailers make their own carbonated water, but this work is usually done by local manufacturers, who deliver the fountains ready charged. The operation of charging is, however, a simple one and can be easily carried out by any one provided with the necessary apparatus. The "fountain" is nearly filled with cold water and placed on its side in a cradle.

The cock at its end is connected by means of a stout rubber hose with the cylinder of liquid carbonic acid and the gas that freely escapes from the latter is allowed to enter the fountain, where its absorption by the water is aided by constant agitation. This is continued until the water is saturated at about 170 pounds pressure,* as shown by a gauge.

Soda Water Syrups. The syrups used in soda water consist of sugar syrup (12 to 15 pounds of granulated sugar in 1 gallon of water) mixed with fruit juices, or other flavoring materials, and frequently with gum arabic, soap bark, senegal, or some other substance, to produce foam. The most popular syrups are vanilla, lemon, orange, strawberry, raspberry, chocolate, coffee, ginger, sarsaparilla and pineapple, but there are many others which have a more or less extensive sale. A pamphlet issued by a well-known house gives a list of 333 different syrups, which can be made from the materials they supply.

The syrups dispensed at soda fountains are made on the premises, or bought ready for use.

For the convenience of those who wish to make their own syrups, but do not care to handle the fruit, many kinds of genuine fruit juices and crushed fruits are now on the market in sealed bottles, jugs and jars. These preparations are sent out sterilized, or otherwise treated to prevent spoiling, and will generally keep until opened. For use they are mixed with sugar syrup and a little citric or tartaric acid, to bring out the flavor.

Adulteration of Soda Water Syrups. The adulterants most commonly found in fruit syrups as well as in bottled soda water are artificial flavoring substances, artificial coloring matter, chemical preservatives, and sweetening substances other than cane sugar.

Among the flavoring materials prepared by chemical processes in imitation of genuine extracts or fruit juices are artificial oil of wintergreen, artificial vanillin, and various chemicals, chiefly ethers, which are the ingredients of the so-called extracts of strawberry, raspberry, pineapple, banana, peach and some other fruits. Although artificial oil of wintergreen is chemically the same as the oil from the wintergreen berry or birch bark, and vanillin is identical with the chief flavoring principle

* Mineral waters and root beer are charged at a lower pressure.

of the vanilla bean, extracts made from them lack the delicate flavor of those made from the natural products and command a lower price in the market. Both, however, are unobjectionable from the sanitary standpoint.

But the artificial extracts made to imitate strawberry, raspberry and some other fruit juices or flavors are quite unlike the flavoring matters of the true fruits in chemical composition, as well as in flavor, and when taken in ice cream, confectionery or soda water are apt to produce unpleasant consequences; indigestion and diarrhoea. Often within a half hour after taking them, their artificial nature becomes very evident to the senses of taste and smell.

Among the chemicals used in their preparation are ethyl acetate, ethyl butyrate, amyl acetate, amyl butyrate and other ethers as well as amyl alcohol and a number of organic acids.

Various dyes chiefly of coal-tar origin ("aniline dyes") are extensively used to color artificial fruit syrups and also to give real fruit syrups a more brilliant color. Their use is objectionable, as some of them are believed to be injurious to health and all of them serve to deceive the purchaser.*

The addition of chemical preservatives, notably salicylic acid, benzoic acid and boric acid (borax), is practiced by most of the leading manufacturers of fruit syrups in place of sterilization by heating and other processes which injure the flavor of the product. These chemicals serve not merely to keep the products during transportation and storage, but also after they have been transferred to the fountain or punch bowl of the retailer, and are of great value to the manufacturers in their efforts to meet the demand for products that will keep until used even in the hottest weather.† Because of their probable injurious properties they are not fit ingredients of food products.

The sale of fruit syrups or soda water containing any of these preservatives except with a suitable label is illegal in this State.

Glucose and saccharine (the coal-tar product with 500 times the sweetening power of cane sugar) are used to a limited extent in fruit syrups.

* For a further discussion of the use of coal-tar dyes in food see Report of this Station for 1901, p. 179.

† See Report of this Station for 1899, p. 139 and other reports.

Bottled Carbonated Beverages.

These, like "soda water" which is only sold by the glass, are water charged with carbonic acid and variously colored, flavored and sweetened.

Of this class of "temperance drinks," "ginger ale," put up usually in two-third pint round-bottomed bottles, is perhaps the most popular. In addition to ginger extract and sugar it may contain a little lemon juice or citric acid and lemon oil. Sometimes capsicum is used in place of a part or all of the ginger extract.

Other kinds of bottled effervescent beverages are "sarsaparilla," birch beer; also lemon, orange, raspberry and vanilla ("cream") soda water, which differ only in the flavors and coloring matters which they contain.

The above list is only a partial one, but includes those which are most in demand.

The cheap grades are commonly of local manufacture and are sold either in quart or half pint bottles, with corks or patent stoppers. The bottling of soda water is done by a machine, which adds a measured quantity of syrup and carbonated water to each bottle and inserts the stopper.

At the present time much of the bottled orange and vanilla ("cream") soda water and birch beer is colored with coal-tar dyes, and practically all the bottled strawberry and raspberry soda water on our market is both artificially colored and flavored.

Examination of Samples.

The detailed analyses of 211 samples of syrups, fruit juices and carbonated beverages collected during the past year are given in Tables III to VIII. A summary of these analyses and of the analyses of 210 samples examined in 1899 follows:

The adulterants found in 1899 were artificial flavoring substances, coal-tar and other artificial colors, chemical preservatives (salicylic acid, benzoic acid and boric acid), and glucose. In 1902 the same adulterants, excepting boric acid, were detected.

Of the 113 syrups from soda water fountains examined in 1902, 16 contained artificial flavors, 44 coal-tar dyes, 6 cochineal, 1 an unidentified color, 31 salicylic acid, 11 benzoic acid,

SUMMARY OF ANALYSES OF SYRUPS, FRUIT JUICES AND CARBONATED BEVERAGES MADE IN 1899 AND 1902.

	1899.			1902.		
	Not found adulterat'd.	Adulterated.	Total.	Not found adulterat'd.	Adulterated.	Total.
Syrups from Soda Water Fountains	36	56	92	37	76	113
Bottled Syrups and Fruit Juices	8	20	28	7	20	27
Bottled Carbonated Beverages	57	33	90	28	43	71
Total	101	109	210	72	139	211

and 4 glucose; of the 27 bottled syrups and juices 7 contained coal-tar dyes, 3 unidentified dyes, 9 salicylic acid, 5 benzoic acid, and 1 glucose; of the 71 bottled carbonated beverages, 8 contained artificial flavors, 34 coal-tar dyes, 2 unidentified dyes, and 10 salicylic acid.

It will be noted that 85 out of the total of 211 samples examined contained coal-tar dyes. As was the case in 1897, the quantity in a glass of soda water (250 cc.), or in the syrup sufficient for a glass of soda water, was in many cases sufficient to dye a six-inch square of white woolen cloth (Nun's veiling) a most brilliant color, — scarlet, magenta, crimson, orange, or green, according to the dye.

Identification of the individual dyes is difficult and often impossible, owing to the large number on the market (in 1897 over 500 were listed), the constant introduction of new ones, and the lack in many cases of decisive tests, especially when two or more dyes are present.

In the tables either the individual dye or the group to which it belongs is given. Magenta and acid magenta are names of individual dyes; tropeolin, ponceau, eosin and Bordeaux are names of groups, the individual colors of which are designated in the trade by letters (tropeolin OO, eosin A, etc.), or special names. The tropeolins are orange or orange-red colors; the ponceaus are scarlets; the eosins are fluorescent reds and the Bordeaux colors are wine reds. In the last group are here included not only Bordeaux B, Bordeaux S, etc., but azorubin S and other azo-dyes, the colors of which, after being fixed on wools, are changed to blue or purple by sulphuric acid, but are restored by dilution.

The green dyes were for the most part mixtures of blue-green dyes (malachite green, etc.) and yellow dyes, the resultant color being a grass green.

Salicylic acid is still the most popular preservative for soda water and syrups, being present in 50 samples examined, but benzoic acid, which has largely replaced salicylic acid in catsups, jams, etc., is coming into more extensive use. In 1897 only 3 samples contained benzoic acid, but in 1902 there were 16 samples.

TABLE III.—SYRUPS FROM SODA WATER FOUNTAINS NOT FOUND ADULTERATED.

Station No.	Sold for	Dealer.
5302	Golf Mist	*Willimantic.*—C. DeViller, 873 Main street.
5126	Nickeltone	*New Haven.*—M. L. Shorer, 787 Grand avenue.
5199	Orange Celery	*Derby.*—A. Fellini, 10 Olivia street.
5188	Orange	*Norwalk.*—36 West avenue.
5205	Raspberry	*Danbury.*—Barnum Pharmacy, Main and White sts.
5203	"	Wessells & Co., Bakery, 266 Main street.
5263	"	*Hartford.*—Hartford Candy Kitchen, 224 Asylum st.
5308	"	*Middletown.*—Hartford Candy Kitchen, 374 Main st.
5245	"	*Meriden.*—West End Pharmacy, West Main & North sts.
5187	"	*Norwalk.*—W. & H. Keleher, 57 Main street.
5189	"	Frank R. Starr, 64 West avenue.
5294	"	*Norwich.*—Maneatty Bros., 231 Main street.
5297	"	Willow & Franklin.
5239	"	*New Britain.*—Bancroft's Pharmacy, 255 Main street.
5235	"	Curren Bros., Druggists, 415 Main st.
5237	"	McEnroe & Eger, 217 Main street.
5139	"	*New Haven.*—Candy Kitchen, 435 State street.
5114	"	H. Ginzberg, 11 Humphrey Sq., or 307 Hamilton street.
5123	"	J. T. Hillhouse, Druggist, Grand ave. and East Pearl street.
5227	"	*Waterbury.*—Charles Dondero, 150 South Main st.
5143	"	*West Haven.*—When Dairy Lunch, Savin Rock.
5171	Sarsaferine	*Stamford.*—The Olympia, 111 Atlantic Square.
5230	Strawberry	*Bristol.*—Fogg's Bakery, North Main street.
5200	"	*Derby.*—G. H. Harding, Druggist, 211 Main street.
5309	"	*Middletown.*—Greek American Co., 276 Main street.
5238	"	*New Britain.*—C. E. McEnroe, 51 Church street.
5271	"	*New Haven.*—Howe & Stetson, ... Chapel street.
5125	"	A. Schultz, Grand ave. & Jefferson st.
5278	"	*New London.*—Sayles Pharmacy, 201 Bank street.
5285	"	Taylor Ice Cream, 13 Broad street.
5286	"	Charles M. Taylor, 239 State street.
5291	"	*Norwich.*—147 Franklin street.
5184	"	*South Norwalk.*—Schmede's Confectionery, 42 South Main street.
5170	"	*Stamford.*—The St. Johns, 452 Main street.
5255	"	*Wallingford.*—O. D. Foote, 136 Center street.
5220	"	*Waterbury.*—High Grade Bakery, 24 East Main street.
5142	"	*West Haven.*—Pagoda No. 19, Savin Rock Grove.

TABLE IV.—ADULTERATED SYRUPS FROM SODA WATER FOUNTAINS.

Station No.	Sold for	Dealer.
5225	Ambrosia punch	*Waterbury.*—A. C. Walker, Druggist, 756 Bank st.
5198	Blood orange	*Derby.*—M. S. Cuneo, 222 Main st.
5146	Brady's mint	*Bridgeport.*—H. A. Dupee, 81 Fairfield ave.
5130	Cherry	*New Haven.*—52 Broad & 60 Oak st.
5229	Middleby's Shamrock	*Bristol.*—Candy Kitchen, North Main & Laurel sts.
5283	Miner's iced mint	*New London.*—Anthony Traggis, 186 State st.
5219	Miner's iced mint	*Waterbury.*—The Star Confectionery Co., 9 Center sq.
5296	Orange	*Norwich.*—West Side Fruit and Confectionery Store, 145 West Main st
5140	"	*New Haven.*—37 Oak st.
5124	Daggett's orangeade	E. Buckman, 345 Grand ave.
5147	Pan American orangeade	*Bridgeport.*—Lane's 1040 Main st.
5206	Raspberry	*Bethel.*—Erdman & Elwell, 81 Main st.
5150	"	*Bridgeport.*—Chas. Pullen, 612 East Main st.
5145	"	18 Fairfield ave.
5231	"	*Bristol.*—Madden's Pharmacy, 21 Prospect st.
5267	"	*Hartford.*—H. Block, 70 Temple st.
5269	"	O. Coledezky, 68 Morgan st.
5268	"	Morris Later, 198 Front st.
5265	"	L. Howard Tracy, 308 Main st.
5311	"	*Middletown.*—Kandy Kitchen, 200 Main st.
5232	"	*New Britain.*—Ice Cream and Confectionery, 271 Main st.
5131	"	*New Haven.*—New York Confectionery, 56 Oak st.
5128	"	Fred Ross, 145 Congress ave.
5281	"	*New London.*—Crystal Candy Kitchen, 82 State st.
5280	"	Pequot Candy Kitchen, 415 Bank st.
5282	"	A. H. Wilkinson, 127 State st.
5293	"	*Norwich.*—Sevin, Druggist, 122 Main st.
5169	"	*Stamford.*—Meda Bros., 481 Main st.
5256	"	*Wallingford.*—J. E. Cassin, 38 Center st.
5254	"	Demetrio, Confectionery, 338 Center st.
5223	"	*Waterbury.*—Brass City Drug Co., East Main and Welton sts.
5224	"	G. T. Geddes, Druggist, 826 Bank st.
5221	"	Lillian's Confectionery, 151 E. Main st
5301	"	*Willimantic.*—Macfarlane, 749 Main st.
5144	"	*West Haven.*—Putnam's Restaurant, Savin Rock
5149	Strawberry	*Bridgeport.*—Ferando Bros., 785 E. Main st.
5148	"	1264 Main st.
5202	"	*Danbury.*—Baldwin & McDonald, Druggists, 256 Main st.
5208	"	S. Cresci, 3 White st.
5207	"	Reed & Co., Druggists, 143 Main st.
5204	"	105 White st.
5259	"	*Hartford.*—Boston Candy Store, 184 Asylum st.
5261	"	C. W. Brown, 1403 Main st.
5262	"	Donato Diorio, 300 Winter st.
5258	"	James Lemenzo, 48 Union place

Station No.	Flavoring Matter.	Coloring Matter.	Preservative.	Sugar.
5225		Coal-tar dye	Salicylic acid	Cane sugar.†
5198		Bordeaux*	"	"
5146		Green coal-tar dye		"
5130	Artificial	Ponceau*		"
5229		Green coal-tar dye		Cane sugar.†
5283		" " "		"
5219		" " "		"
5296		Tropeolin*		Cane sugar.†
5140		"		"
5124		Tropeolin*		Cane sugar.†
5147		Tropeolin*		Cane sugar.†
5206			Benzoic acid	"
5150			"	"
5145			Salicylic acid	Glucose.
5231			"	Cane sugar.†
5267	Artificial	Bordeaux*		"
5269		Magenta*		"
5268		Acid magenta*		"
5265		Cochineal		"
5311			Salicylic acid	"
5232			Salicylic acid	Cane sugar.†
5131		Bordeaux*	Benzoic acid	"
5128		Cochineal		Glucose.
5281			Benzoic acid	"
5280		Bordeaux*		Cane sugar.†
5282			Benzoic acid	"
5293			"	"
5169		Magenta*	Salicylic acid	"
5256			"	"
5254		Artificial	"	"
5223			Salicylic acid	Cane sugar.†
5224			"	"
5221	Artificial	Bordeaux*		"
5301			Salicylic acid	"
5144			"	"
5149	Artificial	Bordeaux*		"
5148			Salicylic acid	"
5202		Ponceau*	Salicylic acid	Cane sugar.†
5208	Artificial	Bordeaux*		"
5207		Magenta*	Salicylic acid	"
5204		Eosine*		"
5259			Salicylic acid	"
5261			Benzoic acid	"
5262	Artificial	Acid magenta*	Salicylic acid	"
5258	"	Bordeaux*		"

* A coal-tar dye. See page 200. † Partially inverted.

TABLE IV.—ADULTERATED SYRUPS

Station No.	Sold for	Dealer.
5270	Strawberry	*Hartford.*—Rapelye & Palmer, Asylum & High sts.
5260	"	J. Rosenbaum, 1057 Main st.
5264	"	Paul Werder, 737 Main st.
5266	"	68 Front st.
5247	"	*Meriden.*—Diamond Candy Store, 46 E. Main st.
5246	"	Julius Katt, 46 West Main st.
5248	"	W. W. Mosher, 13 Colony st.
5307	"	*Middletown.*—J. W. Stueck, 382 Main st.
5310	"	172 Main st.
5234	"	*New Britain.*—S. Bland, 410 Main st.
5236	"	G. E. Bunny, Main & W. Main st.
5233	"	Ice Cream and Confectionery, 271 Main st.
5136	"	*New Haven.*—T. S. Adams, 125 Dixwell ave.
5113	"	Mrs. C. P. Holmes, 916 State st.
5272	"	Fred Ross, 145 Congress ave.
5115	"	G. Smernoff, Grand ave. & Wallace st.
5132	"	78 Oak st.
5138	"	209 Wallace st.
5284	"	*New London.*—R. Blaskin, 16 Bradley st.
5279	"	S. J. Downey, 509 Bank st.
5292	"	*Norwich.*—Anthony & Straggis, Main st.
5295	"	Candy Store, 157 West Main st.
5186	"	*South Norwalk.*—E. R. DeForest, 6 South Main st.
5168	"	*Stamford.*—F. Ohler, Bakery, 552 Atlantic st.
5172	"	H. Wahlers, 50 Atlantic st.
5222	"	*Waterbury.*—J. B. Ebbs, Pharmacy, East Main and Cherry sts.
5226	"	Joslin & Allen, 169 Bank st.
5228	"	Palace Confectionery Co., 131 South Main st.
5300	"	*Willimantic.*—Thread City Candy Kitchen, Main st.
5303	"	C. DeViller, 873 Main st.
5129	Violetene	*New Haven.*—10 Oak st.

SAMPLES SENT BY DEALERS AND CONSUMERS.

7265. Bowker's Concentrated Orangeade, H. L. Bowker & Co., Boston. Sent by Mendel & Freedman, New Haven. Preserved with benzoic acid, and colored with tropeolin.

7266. Bowker's Concentrated Lemonade, H. L. Bowker & Co., Boston. Sent by Mendel & Freedman, New Haven. Preserved with benzoic acid.

7929. Strawberry Syrup. Sent by J. W. Stueck, Middletown. Colored with coal-tar dyes.

FROM SODA WATER FOUNTAINS—*Continued.*

Station No.	Flavoring Matter.	Coloring Matter.	Preservative.	Sugar.
5270		Ponceau*	Salicylic acid	Cane sugar.†
5260	Artificial	Bordeaux*		"
5264			Salicylic acid	"
5266	Artificial	Ponceau*		"
5247		Cochineal		"
5246			Salicylic acid	"
5248		Ponceau*	Benzoic acid	"
5307		"	"	"
5310	Artificial	Bordeaux*		"
5234	"	"		"
5236		Cochineal	Salicylic acid	"
5233		Bordeaux*		Cane sugar.†
5136		"		"
5113	Artificial	"	Salicylic acid	"
5272				Glucose.
5115		Bordeaux*	Salicylic acid	Cane sugar.†
5132	Artificial	"		"
5138	"	Cochineal		"
5284	"	Acid magenta*	Salicylic acid	"
5279		Bordeaux*		"
5292			Benzoic acid	"
5295	Artificial	Acid magenta*		"
5186		Coal-tar dye	Salicylic acid	"
5168			"	"
5172		Cochineal	"	"
5222		Ponceau*	Benzoic acid	Cane sugar.†
5226			Salicylic acid	"
5228			Salicylic acid	Cane sugar.†
5300		Eosine*		"
5303			Salicylic acid	"
5129		Coal-tar dye		"

* A coal-tar dye. See page 200. † Partially inverted.

7930. Strawberry Syrup. Sent by J. W. Stueck, Middletown. Preserved with benzoic acid.

7931. Strawberry Syrup. Sent by J. W. Stueck, Middletown. Preserved with benzoic acid, and colored with coal-tar dyes.

9736. Raspberry Syrup. Simpson Spring Co., So. Easton, Mass. Sent by manufacturers. Not found adulterated.

9737. Orange Syrup. Simpson Spring Co., So. Easton, Mass. Sent by manufacturers. Colored with tropeolin.

TABLE V.—BOTTLED SYRUPS AND FRUIT JUICES NOT FOUND ADULTERATED.

Station No.	Brand.	Dealer.	Price per bottle, cents.	Quantity in bottle, ounces.
	Blood Orange Phosphate.			
5217	Thompson, New York, N. Y.	*Waterbury*—Hewitt Grocery Co., 20 No. Main St.	25	16
	Grape Juice.			
5213	Ruby, Health Food Co., N. Y.	*Danbury*—A. C. Benedict, 193 Main St.	25	16
5249	Vinos, United Nine Co., Vineland, N. J.	*Meriden*—H. E. Bushnell, 79–85 W. Main St.	25	16
5241	Concord, Steele Bros., New Britain, Ct.	*New Britain*—Wm. Foulds, Bigelow and Park Sts.	25	16
5196	Chautauqua, Fruit & Grape Juice Co., Westfield, N. Y.	*South Norwalk*—C. E. Seymour, 33 Washington St.	25	16
5218	Golden Arbor, F. H. Leggett, N. Y.	*Waterbury*—Hewitt Grocery Co., 20 No. Main St.	25	16
	Lime Juice.			
5305	Porto Rico	*Hartford*—C. H. Talcott & Co., 273 Asylum St.	15	16

9738. Strawberry Syrup. Simpson Spring Co., So. Easton, Mass. Sent by manufacturers. Colored with Bordeaux.

9739. Sarsaparilla. Simpson Spring Co., So. Easton, Mass. Sent by manufacturers. Not found adulterated.

9735. Strawberry Pulp Juice. Sent by The Palisade Mfg. Co., West Hoboken, N. J. Preserved with benzoic acid.

9734. Raspberry Pulp Juice. Sent by The Palisade Mfg. Co., West Hoboken, N. J. Preserved with benzoic acid.

7264. Raspberry Syrup. Sent by The Brass City Drug Co., Waterbury. Preserved with benzoic acid, and colored with eosine.

9772. Lutton's Birch Beer. Sent by Joseph R. Tatham, Rockville. Not found adulterated.

9773. Lutton's Ginger Ale. Sent by Joseph R. Tatham, Rockville. Not found adulterated.

VANILLA EXTRACT.

In the Report for 1901, p. 156, was given the analysis of a sample of Vanilla Extract made by McMonagle & Rogers of Middletown, N. Y., containing 0.05 per cent. of commarin, a flavoring principle not found in vanilla beans. This sample was bought in the Connecticut market, bearing the manufacturer's name as above. Messrs. McMonagle & Rogers, as soon as their attention was called to the matter, wrote the Station, denying that Tonka beans, artificial vanillin, commarin or artificial coloring matter were used in their premium vanilla or that the formula had been changed in years, except to increase slightly the percentage of vanilla beans. They also called attention to the fact that the same preparation sold in bulk by them to a wholesale grocer and bottled and sold by the latter under his own name, was examined by the Station and not found adulterated.

It was impossible for the Station to trace further the history of the particular sample examined by us in which commarin was detected. But immediately on receiving this protest our sampling agent drew other samples of this brand, McMonagle & Rogers' Premium Vanilla, as follows:

No. 5473. Dealer, Finney & Benedict, 41 Wall St., Norwalk.

No. 5634. Dealer, O. T. Otis, 261 Main St., Norwich.

No. 5611. Dealer, Hills & Co., 372 Asylum St., Hartford.

These three samples were analyzed and not found adulterated. Neither of them contained any trace of commarin.

LEMON EXTRACT.

No. 5474. McMonagle & Rogers' Premium Lemon Extract. Bought by Station agent of Finney & Benedict, 41 Wall St., Norwalk. This sample was not found adulterated. It contained 6.10 per cent. of lemon oil and the index of refraction of precipitated oil was 1.4688.

TABLE VI.—ADULTERATED BOTTLED

Station No.	Brand.	Dealer.
	Grape Juice.	
5306	Concord, Lehn & Fink, New York	*Hartford.*—G. A. McCorkle, 1189 Main St.
5242	Hygienic, W. W. Walker Co., Hartford and New Britain	*New Britain.*—W. W. Walker Co., 238–240 Main St.
5321	Randall's, The Chautaqua Fruit Co., Ripley, N. Y.	*New Haven.*—Howe & Stetson, Chapel St.
	Lime Juice.	
5243	Bee Brand, Jamaica, Geo. W. Bentley Co., Boston	*New Britain.*—W. W. Walker Co., 238–240 Main St.
5287	Montego	*New London.*—Keefe, Davis & Co., 125 Bank St.
	Orangeade.	
5119	Curtis & Moore, Boston	*New Haven.*—Johnson & Bro., State and Court Sts.
5179	Pan American, J. Hungerford Smith, Rochester	*Stamford.*—J. K. Lawrence, 55 Atlantic St.
	Pineapple Syrup.	
5327	C. & M. Fruit Syrup, Curtis & Moore, Boston	*Middletown.*—D. J. Hartman, 530 Main St.
5298	Superior Flavored, Eagle Mfg. Co., N. Y.	*Norwich.*—Gus. Thumm, 71 Franklin St.
	Raspberry Syrup.	
5322	Pure Fruit Syrups, Simpson Spring Co., So. Easton, Mass.	*Middletown.*—Thomas Walsh, 486 Main St.
5160	E. E. Hall & Son, New Haven	*New Haven.*—E. E. Hall & Son, State St.
5159	Superior Flavored, Eagle Mfg. Co., N. Y.	Mendel & Freedman, 772 Chapel St.
5134	Fruit Syrup Raspberry Shrub, Curtis & Moore, Boston	Mohican Co., 18 and 22 Church St.
5195	Tournade's Pure New Jersey Fruit Syrup, Palisade Mfg. Co., W. Hoboken, N. J.	*So. Norwalk.*—C. E. Seymour, 33 Washington St.
5182	True Fruit Raspberry Shrub, J. Hungerford Smith Co., Rochester, N. Y.	*Stamford.*—Theo. Leeds, Atlantic and Main Sts.
	Strawberry Syrup.	
5116	E. E. Hall & Son., New Haven.	*New Haven.*—E. E. Hall & Son, State St.
5127	Extra Quality, Philip J. Ritter Conserve Co., Philadelphia	D. M. Welch & Son, 8 Grand Ave.
5133	C. & M. Fruit Syrup, Curtis & Moore, Boston	D. M. Welch & Son, 28 Congress Ave.
5180	Palisade Fruit Syrup, Palisade Mfg. Co., W. Hoboken, N. J.	*Stamford.*—G. A. Ferris, 446 Main St.
5178	Tournade's Pure New Jersey Fruit Syrup, Palisade Mfg. Co., W. Hoboken, N. J.	J. M. Wassing, 568 Atlantic St.

FRUIT SYRUPS AND FRUIT JUICES.

Station No.	Price per bottle, cents.	Quantity in bottle, ounces.	Coloring Matter.	Preservative.	Sugar.
5306	30	16		Salicylic acid	Cane sugar.†
5242	20	16½		Salicylic acid	Cane sugar.†
5321	25	16	Acid magenta*	Benzoic acid	Cane sugar.†
5243	10	16		Salicylic acid	Cane sugar.†
5287	10	16		Salicylic acid	Cane sugar.†
5119	25	12	Tropeolin*	Benzoic acid	Cane sugar.†
5179	25	16	Tropeolin*		Cane sugar.†
5327	25	12		Salicylic acid	Cane sugar.†
5298	10	9			Glucose.
5322	15	9	Bordeaux*		Cane sugar.†
5160	25	12		Salicylic acid	
5159	10	9	Bordeaux*		Glucose.
5134	25	12		Benzoic acid	Cane sugar.†
5195	25	15	Artificial		Cane sugar.†
5182	25	16	Artificial	Salicylic acid	Cane sugar.†
5116	25	12		Salicylic acid	Cane sugar.†
5127	10	16	Ponceau*	Benzoic acid	Cane sugar.†
5133	25	12	Coal-tar dye	Benzoic acid	Cane sugar.†
5180	15	7½	Artificial		Cane sugar.†
5178	25	15		Salicylic acid	Cane sugar.†

* A coal-tar dye. See page 200. † Partially inverted.

TABLE VII.—SODA WATER AND OTHER CARBONATED BEVERAGES NOT FOUND ADULTERATED.

Station No.	Brand.
	Ginger Ale.
5317	The Greater N. Y. Bottling Co., Bridgeport
5197	Gray & Light, Bridgeport
5318	Mullins Bros., Bridgeport
5312	F. D. Morehouse, Bridgeport
5314	Walter Stapleton, Bridgeport
5214	Arethusa Spring Water Co., Seymour
5212	Bartley & Clancey, Danbury
5328	Pullan Bros., Aurora Spring Bottling Works, Meriden
5332	T. F. Lyons, Meriden
5330	Bowe's Crystal Spring Bottling Works, Meriden
5323	Gold Label, Simpson Spring Co., South Easton, Mass.
5326	Aromatic Royal Scepter, Vartray Water Co., Buffalo, N. Y.
5244	Clicquot Club Bottling Co., Millis, Mass.
5320	Thomas Bohan, New Haven (*Statement of Dealer*)
5273	J. C. Scovill, New Haven
5117	Vartray Water Co., Buffalo, N. Y.
5118	Gosman's, Baltimore, Md.
5277	Star Bottling Works, New Haven
5120	John Clancy, New Haven
5290	Aromatic, M. A. Kane Co., New London
5190	H. J. & G. S. Grumman, Norwalk
5181	Delatour, Ackley G. Schuyler, New York
5175	Lee's Specialties, Stamford Bottling Works, Stamford
5174	Gray Bros., New Canaan
5176	G. B. Seeley's Son, New York
5183	Eagle Bottling Works, Glenbrook
5135	*Phenix*—Phenix Nerve Beverage Co., Boston
5288	*Phosa*—Rumford Chemical Works, Providence, R. I.
5154	*Ron Bre*—J. C. Scovill, New Haven

Station No.	Dealer.	Price per bottle, cents.	Quantity in bottle, ounces.
5317	*Bridgeport.*—John Brownstein, 1316 Main street	10	29
5197	Avillo & Dellico, 290 State st.	10	29
5318	Fruit and Confectionery, 1264 Main st.	10	24
5312	Ice Cream and Soda, 6 Fairfield ave.	10	29
5314	Walter Stapleton, 173 Middle st.	10	29
5214	*Danbury.*—A. C. Benedict, Main st.	10	12
5212	L. Marasco, 301 Main st.	5	9
5328	*Meriden.*—G. Boggianio, 50 East Main st.	10	28
5332	H. E. Bushnell, 79 West Main st.	10	27
5330	Kapitzke & Quinlan, 80 East Main st.	10	29
5323	*Middletown.*—G. E. Burr, 136 Main st.	10	15
5326	R. A. Pease & Son, 236 Main st.	10	13
5244	*New Britain.*—Sovereign Trading Co., 282 Main st.	10	15
5320	*New Haven.*—Thomas Bonelle, 82 State st.	10	29
5273	D. DeBella, 44 Union st.	10	28
5117	E. E. Hall & Son, State st.	10	12
5118	Mohican Co., 18–22 Church st.	10	12
5277	Star Bottling Works, 24 Dow st.	10	27
5120	219 Congress ave.	10	28
5290	*New London.*—Frank Caracacausa, 51 State st.	12	28
5190	*South Norwalk.*—55 Washington st.	10	28
5181	*Stamford.*—Theo. Leeds, Atlantic and Main sts.	10	12
5175	M. Palermo, 56 State st.	10	29
5174	M. Palo, 199 Main st.	10	24
5176	J. M. Wassing, 568 Atlantic st.	10	29
5183	A. G. Weed, Atlantic square	10	26
5135	*New Haven.*—Treffrey Pharmacy, Edwards and State sts.	25	32
5288	*New London.*—Labriso Candy, 105 Bank st.	--	--
5154	*New Haven.*—Celentano Bros. 41 Broadway	10	28

TABLE VIII.—ADULTERATED SODA WATER

Station No.	Brand.	Dealer
	Birch Beer.	
5210	No label	*Danbury.*—Casassa, 187 Main st.
5211	No label	S. Cresci, 3 White st.
	Blood Orange.	
5153	Clicquot Club Ext. Co., Millis, Mass.	*New Haven.*—A A. Eisele, 289 Dixwell ave.
5162	"Pureoxia," Palatable Water Still Co., Boston	D. F. Richardson, 1329 State st.
5289	No label	*New London.*—E. Miner, 261 Bank street
	Cherry Cider.	
5209	Los Angeles Fruit Cider Co., Los Angeles, Cal.	*Derby.*—J. N. Wise, 254 Main st.
	Cream Soda.	
5319	Mullins Bros., Bridgeport	*Bridgeport.*—Fruit and Confectionery, 1264 Main st.
5313	F. D. Morehouse, Bridgeport	Ice Cream & Soda, 6 Fairfield ave.
5253	Pullan Bros., Aurora Spring Bottling Works, Meriden	*Meriden.*—C. Boggiano, 45 East Main st.
5329	Bowe's Cream Soda, Crystal Spring Bottling Works, Meriden	Kapitzke & Quinlan, 80 East Main st.
5192	H. J. & G. S. Grumman, Norwalk	*Norwalk.*—"Felix" Fruit and Confectionery, 51 Main st.
5177	Thos. Halloran, Stamford	*Stamford.*—Marti Stora, Garden & Pacific sts.
5173	Eagle Bottling Works, Glenbrook	Samuel Price, 300 Main st.
	Cyc-Kola.	
5157	The Clicquot Club Co., Millis, Mass.	*New Haven.*—Johnson & Brother, State and Court sts.
	Fruitina.	
5315	The Greater N. Y. Bottling Co., Bridgeport	*Bridgeport.*—John Brownstein, 1316 Main st.
	Ginger Ale.	
5137	"Pureoxia," Palatable Water Still Co., Boston	*New Haven.*—M. F. Hope, 357 Grand ave.
5163	U. S. Club Ginger Ale, Phenix Nerve Beverage Co., Boston	R. E. Kirst, 1320 State st.
5161	Naugatuck Diamond Bottling Co., Waterbury	R. H. Nesbit Co., 47-49 Elm st.
5257	Hires, Chas. E. Hires Co., Phila., Pa.	*Wallingford.*—O. D. Foote, 136 Centre st.
5325	"*Kolox*" Nerve Tonic, The Granite Rock Spring, Higganum	*Middletown.*—D. I. Chapman, 146 Main st.
	Lemon Sour.	
5324	Undina Brand, The Granite Rock Spring, Higganum	A. M. Bidwell, 344 Main st.

AND OTHER CARBONATED BEVERAGES.

Station No.	Price per bottle, cents.	Quantity in bottle, ounces.	Flavoring Matter.	Coloring Matter.	Preservative.	Sugar.
5210	5	9		Bordeaux*		Cane sugar.†
5211	5	9		"		"
5153	10	15		Bordeaux*		Cane sugar.†
5162	10	14		"	Salicylic acid	"
5289	5	9		Acid magenta*		"
5209	25	26		Bordeaux*	Salicylic acid	"
5319	10	27	Vanilla	Coal-tar dye		Cane sugar.†
5313	10	29	"	Bordeaux*		"
5253	10	29	"	"		"
5329	10	27	"	"		"
5192	10	26	"	"		"
5177	10	29	"	"		"
5173	10	29	"	Artificial		"
5157	25	32			Salicylic acid	Cane sugar.†
5315	10	27		Bordeaux*		"
5137	10	15			Salicylic acid	Cane sugar.†
5163	10	15			"	"
5161	10	12			"	"
5257	10	15			"	"
5325	10	15			"	"
5324	10	15		Artificial		Cane sugar.†

* A coal-tar dye. See p. 200. † Partially inverted.

TABLE VIII.—ADULTERATED SODA WATER

Station No.	Brand.	Dealer.
	Ora-Ade.	
5216	U. S. Club, Phenix Nerve Beverage Co., Boston	*Waterbury.*—Penn. Merchandise Co., 118 E. Main st.
	Orange Cider.	
5122	Undina Brand, The Granite Rock Spring, Higganum	*New Haven.*—Greek and American Confectionery, Temple st. and Congress ave.
5156	California Orange Cider Co., Ocean Grove, N. J.	E. E. Nichols, 318 State st.
	Orange Phosphate.	
5252	Pullan Bros., Aurora Spring Bottling Works, Meriden	*Meriden.*—C. Boggiano, 45 East Main st.
5331	T. F. Lyons, Meriden	H. E. Bushnell, 79 W. Main st.
5250	Bowe's Crystal Spring Soda Works, Meriden	I. Dondero, 306 East Main st.
5167	Thos. J. Bohen, New Haven	*New Haven.*—J. D. Pickus, 66 Washington st.
	Orange Soda.	
5191	Gray Bros., New Canaan	*Norwalk.*—26 West ave.
	Raspberry Soda.	
5316	The Greater N. Y. Bottling Co., Bridgeport	*Bridgeport.*—John Brownstein, 1316 Main st.
5275	Gilhuly's Bottling Works, New Haven	*New Haven.*—245 George st.
5194	Saml. S. Baker, South Norwalk	*Norwalk.*—Boggiano Confectionery, 21 Main st.
	Sparkling Kolafra.	
5152	The Kolafra Co., Jersey City, N. J.	*New Haven.*—241 Dixwell ave.
	Strawberry Soda.	
5251	T. F. Lyons, Meriden	*Meriden.*—H. E. Bushnell, 79–85 West Main st.
5240	No label	*New Britain.*—B. Arata, 327 Main street.
5121	Thomas J. Bohen, New Haven	*New Haven.*—B. Casari & Bro., 123 Congress ave.
5155	J. C. Scovill, New Haven	Celentano Bro., 41 Broadway
5166	John Clancy, New Haven	Onito, 146 George st.
5276	Star Bottling Works, New Haven	Star Bottling Works 24 Dow st.
5274	Gilhuly's Bottling Works	245 George st.
5193	Saml. S. Baker, South Norwalk	*Norwalk.*—Boggiano's Confectionery, 21 Main st.
5299	C. E. Wright, Norwich (*Statement of dealer*)	*Norwich.*—M. B. Schwartz, 27 Main st.
5215	No label	*Waterbury.*—Banby Bros., 8 Center square

AND OTHER CARBONATED BEVERAGES—*Continued.*

Station No.	Price per bottle, cents.	Quantity in bottle, ounces.	Flavoring Matter.	Coloring Matter.	Preservative.	Sugar.
5216	10	15		Ponceau*	Salicylic acid	Cane sugar.†
5122	10	15		Coal-tar dye		Cane sugar.†
5156	20	25		Tropeolin*		"
5252	10	29		Tropeolin*		Cane sugar.†
5331	10	27		"		"
5250	10	27		"		"
5167	10	29		Ponceau*		"
5191	10	27		Bordeaux*		"
5316	10	29		Bordeaux*	Salicylic acid	Cane sugar.†
5275	10	27		"		"
5194	10	28	Artificial	Acid magenta*		"
5152	5	9			Salicylic acid	"
5251	10	27	Vanilla	Acid magenta*		Cane sugar.†
5240	5	9	"	"		"
5121	10	27	Artificial	Ponceau*		"
5155	10	--	"	Acid magenta*		"
5166	10	27	"	"		"
5276	10	27	"	Ponceau*		"
5274	10	27	"	Bordeaux*		"
5193	10	29	"	Acid magenta*		"
5299	5	9	Lemon	"		"
5215	5	9	Artificial	"		"

* A coal-tar dye. See p. 200. † Partially inverted.

SWEET PICKLES.

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

Home-made Sweet Pickles are prepared by cooking fruits or vegetables in a mixture of vinegar, sugar syrup and spices. It is also a common practice to add a little alum to make the pickles brittle. In order to prevent spoiling it is essential that the vinegar, sugar syrup and spices are of suitable strength, that the cooking is thoroughly performed and that the pickles are stored in a suitable place. Among the fruits commonly preserved in this manner are peaches, pears, cherries, currants and gooseberries, and among the vegetables are cucumbers, green tomatoes, cauliflower, onions and melon rind.

Commercial Sweet Pickles attractively put up in glass bottles have been on the market for some years.

The liquor in which they are preserved often differs markedly from that of home-made pickles in that it is not so sour, not so spicy and, although intensely sweet, is not of a thick syrupy consistence. Although they are kept in warm rooms and through the hot summer months there is seldom loss from spoiling. All these characters point to the presence of artificial sweetening material, on the one hand, and of chemical preservatives on the other—suspicions which are confirmed by the analyses herewith reported.

Examination of Samples.

Analyses of eighteen brands of sweet pickled cucumbers and other vegetables found on sale in Connecticut are given in table.

Only one of these samples, No. 5407, put up by an English house, contained neither glucose, nor saccharin, nor chemical preservatives.

The sweetening material in ten of the brands was entirely sugar (cane sugar) partially or entirely converted into invert sugar by the cooking with vinegar, in two was glucose, in three was entirely saccharin or a similar artificial sweetening material, and in two was a mixture of sugar and saccharin.

All but three of the samples contained chemical preservatives, which in twelve samples was benzoic acid and in three was salicylic acid.

Nearly all the pickles contained small quantities of alumina and sulphuric acid, derived possibly from alum.

The acidity in the liquor, calculated as acetic acid, varied from 0.82 to 3.05 per cent.

One of the samples was colored with copper.

Glucose Sirup, as was noted in the report for 1901, being composed chiefly of sugars and dextrines similar to cane sugar in nutritive value, is, when pure, a wholesome product, although inferior to cane sugar in sweetening power. Much of the glucose sirup on the market contains, however, in addition to the substances named, sulphurous acid, which is added in the form of bisulphite of soda during the process of manufacture, as a bleaching agent. Oftentimes, the amount present is sufficient to give the sirup a disagreeable taste. Since sulphites, bisulphites and sulphurous acid are all powerful antiseptics and preservatives, the sale of food products containing them is, in this State, subject to the same regulations as those containing other preservatives.

It is a significant fact that all the samples of fruit products found during the year 1901 to contain glucose, also contained, without any exception, a considerable amount of sulphurous acid, whereas none sweetened entirely with cane sugar gave any test for this substance.

Saccharin is a general term for a number of closely related chemicals with sweetening power from 400 to 500 times greater than ordinary sugar, but with no value whatever as a food. Although it is frequently prescribed by physicians to satisfy the cravings of diabetic patients for sugar, still its surreptitious use as a substitute for sugar is strongly denounced, and in some countries is declared illegal. Saccharin is also a preservative and for this reason, if for no other, its indiscriminate use is highly objectionable.

Benzoic Acid, as has been frequently noted in the recent reports of this Station, has come into extensive use as a preservative for jellies, jams, fruit, syrups, catsups, and has largely replaced *salicylic acid*, which several years ago was used for this purpose. The use of these and all other chemical preservatives in food products without a declaration is illegal in Connecticut.

TABLE IX.—ANALYSES OF SWEET PICKLES.

Station No.	Brand.	Dealer.
	Cucumber Sweet Pickles.	
5406	Varick Brand, Varick Pickle Co., New York	*Bridgeport.*—C. K. Bishop, E. Main St.
5404	O. K. Extra Spiced, Alart & McGuire, New York	H. Isenburg & Co., 109 State St.
5402	Sweet Pickles, F. C. Gould, East Hartford, Conn.	A. Mertens, 263 State St.
5700	Sweet Midget Gherkins, H. J. Heinz Co., Pittsburg	R. T. Whiting, 901 Main St.
5414	Gherkins, A. C. Blenner & Co., New Haven	*New Haven.*—H. Buchter, State St.
5413	Tourist Brand, The Avery Pres. Co., Detroit	Pohlman & Scanlan, 142 Dixwell Ave
5409	Acme Extra Spiced, The J. Weller Co., Cincinnati	*Norwalk.*—Grand Central Groc. Co., 19 Main St.
5408	Republic Brand, Austin, Nichols & Co., New York	F. D. Lawton, 47 Main St.
5410	New Eng. Spiced Midgets, The E. G. Dailey Co., Detroit	*South Norwalk.*—L'Hommedieu Bros., 203 E. Washington St.
7286	Our Best, W. A. Leggett & Co., New York	*Stamford.*—E. M. Purdy, West End, Park Grocery
	Mixed Sweet Pickles (Cucumbers, Cauliflower, Onions, etc.).	
5401	English Spiced, The Williams Bros. Co., Detroit	*Bridgeport.*—C. K. Bishop, E. Main St.
5405	Heinz Preserved, H. J. Heinz Co., Pittsburg	Cream Hill Dairy, 193 Fairfield Ave.
5403	Old Virginia Home-made, Johnson Bros. & Co., Richmond	Dundon Bros., East Main St.
7292	Thistle Brand, J. P. Bradenoch & Sons, Henrico Co., Va.	*New Haven.*—Mohican Co., 22 Church St.
5412	Warfield Brand, Seeman Bros., New York	*South Norwalk.*—C. Becker, 141 East Washington Ave.
5411	Sweet Mixed Pickles, Lutz & Schramm Co., Allegheny	Chas. E. Seymour, 33 Washington St.
7287	Majestic Brand, James G. Powers & Co., New York	*Stamford.*—Empire State Tea Co., 303 Main St.
5407	Mixed Pickles, Clark & Burton, London	Empire Market, 512 Main St.

TABLE IX.—ANALYSES OF SWEET PICKLES.

Station No.	Price per bottle, cents.	Capacity of bottle, fluid ounces.	Sweetening material.	Chemical preservative.	Oxide of alumina in the pickles.	In the syrup.				
						Cane sugar.	Invert sugar.	Total sugar.	Total solids.	Acidity calculated as acetic acid.
					%	%	%	%	%	%
5406	18	15.4	Glucose		0.008				12.77†	1.55
5404	10	9.0	Saccharin‡	Benzoic acid	0.030	0.0	0.0	0.0	4.11	2.51
5402	10	7.5	Sugar*	Benzoic acid	0.000	1.1	10.5	11.6	12.12	3.05
5700	35	11.4	Sugar*	Benzoic acid	0.013	2.0	26.3	28.3	30.27	1.86
5414	10	19.4	Saccharin‡		0.030				1.57	2.57
5413	15	14.4	Sugar*	Benzoic acid		0.3	8.0	8.3	10.70	
5409	13	11.0	Sugar*	Benzoic acid	0.035	0.0	11.2	11.2	14.31	1.30
5408	18	16.0		Salicylic acid	0.016				9.59	0.82
5410	12	8.0	Sugar*	Benzoic acid	0.030	0.0	4.5	4.5	7.09	2.28
7286	12	11.0	Saccharin‡	Benzoic acid	0.014	0.0	0.0	0.0	4.78	0.96
5401	10	10.0	Sugar*	Benzoic acid	0.035	0.0	10.2	10.2	12.54	2.40
5405	22	14.4	Sugar*	Benzoic acid	0.022	1.1	24.6	25.7	27.87	2.45
5403	10	9.4	Sugar*	Benzoic acid	0.005	0.6	18.8	19.4	26.12	2.08
7292	10	11.0	Sugar* Saccharin‡	Salicylic acid	0.003	1.5	4.6	6.1	11.20	1.89
5412	10	10.7	Saccharin‡ Sugar*	Benzoic acid	0.046	0.0	1.3	1.3	3.86	2.73
5411	15	7.4	Sugar*	Benzoic acid	0.024	0.3	13.9	14.2	16.34	1.48
7287	10	11.0	Glucose	Salicylic acid	0.000				13.87†	2.40
5407	15	10.0	Sugar*			6.3	13.8	20.1	22.99	

* Consists chiefly of invert sugar formed from ordinary (cane) sugar during the process of pickling.

† Largely glucose.

‡ Here used to designate various related coal-tar products with sweetening power 400–500 times greater than ordinary sugar.

Copper Salts serve to give pickles a deep green color.

It was formerly a common practice in the household to make pickles in a brass or copper kettle, thus dissolving from the kettle sufficient copper to color the product a bright green. The same end is attained in preserving factories by the addition of a small amount of copper sulphate.

As copper salts are decidedly poisonous, and are not readily eliminated from the system, their use even in small quantities is highly pernicious.

Methods of Analysis.

Saccharin. Shake a portion of the syrup with an equal quantity of ether, separate the clear ether layer and evaporate at a gentle heat. If saccharin is present the extract will have an intensely sweet taste.*

This test is not reliable when a considerable amount of cinnamon or cassia is present, as the volatile oils from these spices have a decidedly sweet taste. For example, the extracts from Nos. 5402 and 5408 contained so much cassia oil that it was found impossible to decide whether the sweet taste was entirely due to this oil or in part to saccharin.

In the absence of salicylic acid and benzoic acid, saccharin may be detected by fusing the extract with caustic potash and testing the mass for salicylic acid. If the pickles contained salicylic acid, this must be previously removed by dissolving the extract in dilute hydrochloric acid, treatment with excess of bromine water and filtering from the insoluble bromine compound.

But benzoic acid is now more often present in pickles than salicylic acid, and interferes with the foregoing test owing to the formation of small quantities of salicylic acid, along with other decomposition products, by fusion with caustic potash. We have found no convenient means of removing this acid.

Determination of sulphur in the ether extract is also of little value, as mustard seed and onions, two common ingredients of pickles, contain sulphur compounds (the former allyl sulphocyanide, the latter allyl sulphide), which are extracted to some extent by the liquor in which pickles are preserved and are readily dissolved by ether.

Spica's tests† were likewise found unsatisfactory for detecting saccharin in these products.

Salicylic Acid and Benzoic Acid. See Report for 1899, p. 32, or for 1899, p. 132.

Alumina. Char 5 grams of the material in a platinum dish at a heat below redness. Boil the carbonaceous mass with dilute hydrochloric acid, filter, and wash with hot water. Return the residue, together with

* U. S. Dept. Agr., Bur. Chem., Bul. **65**, 51.

† Gaz. chim. Ital., 1901, 31, II, 41; Ztschr. f. Unters. d. Nahr. u. Genussmittel, 1902, **5**, 620.

the paper, to the platinum dish and burn to a white ash. Boil again with hydrochloric acid, filter, wash and add to the first filtrate.

Separate silica if necessary. Mix the solution with sodium phosphate solution in excess of what is required to form normal aluminum phosphate. Add ammonia until a precipitate remains on stirring, then hydrochloric acid drop by drop until the precipitate dissolves. Heat the solution to about 50° C., mix with considerable excess of 50 per cent. ammonium acetate solution and 4 cc. of 80 per cent. acetic acid.

As soon as the precipitate of aluminum phosphate, mixed with a little iron phosphate, has settled, collect on a filter, wash with hot water, ignite and weigh.

Fuse the mixed phosphates with ten parts of sodium carbonate, dissolve in dilute sulphuric acid, reduce with hydrogen sulphide and determine the iron by the permanganate method. In the same solution determine the phosphoric acid. To obtain the weight of Al_2O_3, subtract the sum of the weights of Fe_2O_3 and P_2O_5 from the weight of the mixed phosphates.

LARD.

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

Compound lard is a mixture of cotton seed oil with enough stearin to give it the requisite degree of solidity and a small amount of real lard. Lard stearin, the residue left after expressing lard oil, cotton seed stearin, obtained by a similar process in the manufacture of "Winter" cotton seed oil, or, rarely, paraffine, may be used in place of beef stearin.

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

The sale of compound lard for lard is a fraud akin to the sale of oleomargarine for butter. Even if the product is designed merely as a substitute for lard and is sold at wholesale under its true name, when retailed as lard it is, under the law, an adulterated food product.

Examination of Samples.

One hundred and seventy-one samples were bought in Connecticut, of which 166 were sold as lard, the remainder as compound lard.

Of the samples sold as lard, 55 on examination were found

to be compound lard, consisting largely of a mixture of cotton seed oil and beef stearin.

A summary of the results obtained in the examination of samples sold as lard during the years 1896, 1900, and 1902, together with the average price per pound, follows:

	1896.	1900.	1902.
Number of samples not found adulterated	75	150	111
" " adulterated	43	10	55
Total	118	160	166
Per cent. of samples adulterated	**36.5**	**6.2**	**33.1**
Average price per pound of samples not found adulterated (cents)	11.2	10.0	14.2
Average price per pound of samples found adulterated (cents)	9.4	8.4	11.5

From these figures it appears that the smallest percentage of adulterated samples (6.2 per cent.) was found in 1900 when the price of lard was cheapest, being but 10.0 cents per pound for the pure and 8.4 cents for the adulterated samples. During the past year the price has been unusually high (14.2 cents for the pure, and 11.5 cents for adulterated samples) and the percentage of adulterated samples (33.1 per cent.) correspondingly high. This percentage, however, is not as high as in 1896, when the average price per pound was over two cents lower than in 1902.

A description of the samples sold as compound lard follows:

7346. Stated to be Swift's Lard Compound. Bought of Ehle's Cash Grocery, 5 West St., Danbury. Price 6 cents per ½ pound.

6022. Stated to be Lard Compound. Bought of Spencer & Pierpont, 352 E. Main St., Waterbury. Price 5 cents per ½ pound.

7339. Stated to be Swift's Jewell Lard Compound. Bought of People's Cash Market, 89 White St., Danbury. Price 35 cents per 3 pound pail.

6062. Stated to be Lard Compound. Bought of F. P. Cassidy, Willimantic. Price 6 cents per ½ pound.

7349. Labelled: White Cloud Lard Compound. Armour & Co. Bought of New York State Butter House, 192 South Main St., Waterbury. Price 32 cents per 3 pound pail.

TABLE X.—LARD NOT FOUND ADULTERATED.

Station No.	Brand.	Dealer.	Price per half pound, cents.
		Ansonia:	
7357	Sold in bulk	D. M. Welch & Son, 186 Main St.	7
		Bridgeport:	
6075	Sold in bulk	Cash Grocery, 1042 E. Main St.	6
6088	" " "	City Market Co., 282 State St.	6
6086	" " "	National Grocery Co., 52 Cannon St.	7
6085	Palatine, Plumb & Winton Co., Bridgeport	N. Y. Grocery, 857 Kossuth St.	45*
		Osborne Bros., 629 Noble Ave.	8
6076	Sold in bulk	George Reinecke, 652 E. Main St.	45*
6084	Silver Leaf, Swift & Co.	Richards & Schmidt, 2065 Main St.	7
6077	Sold in bulk	J. A Ronan, 369 E. Main St.	7
6082	" " "	E. A. Sherwood. 679 Main St,	7
6078	" " "	Village Store Co., 746 E. Main St.	6
6083	" " "	E. E. Wheeler, 1131 Main St.	7
6089			
		Danbury:	
7340	Sold in bulk	W. D. Baldwin, 93 White St.	7
7347	" " "	Danbury Cash Grocery, Main St.	6
7344	" " "	D. E. Ketcham & Co., 35 Elm St.	7
		Derby:	
7363	Sold in bulk	G. W. Coggswell, 32 Elizabeth St.	7
7360	" " "	Geo. E. May & Son, 260 Main St.	7
7362	" " "	People's Cash Grocery, 47 Elizabeth St.	7
		Hartford:	
7368	Squire's Eastern Packing Co., Boston	Boston Branch Grocery, 747 Main St.	45*
6074	Sold in bulk	Cady & Lombard, Albany Ave.	7
6069	" " "	Cowles & Howard, 156 Windsor Ave.	7
7396	" " "	J. D. Dillon, 244 Pearl St.	7
6034	" " "	H. Griswold, 547 Main St.	7
6070	" " "	L. C. Hart, 113 Albany Ave.	7
6071	" " "	George Patterson, 1397 Main St.	7
7394	" " "	Pearl St. Grocery, 119 Pearl St.	7
6032	" " "	Public Market Co., 611 Main St.	7
7392	" " "	S. Satriano, 44 Park St.	7
7389	Pure Leaf, North Star Brand, North Packing & Provision Co.	A. Squires & Sons Co., 32-43 Market St.	50*
7395	Sold in bulk	W. J. Tolhurst, 55 Maple Ave.	8
		Meriden:	
6011	Sold in bulk	H. E. Bushnell & Co., 75 W. Main St.	8
6012	" " "	P. Carter & Co., 250 W. Main St.	7
7375	Indiana Brand, Kingan & Co., Indianapolis, Ind.	City Meat Market, 21 E. Main St,	45*
7373	Sold in bulk	N. England Butter Store, 24 E. Main St.	6
		Middletown:	
6066	Sold in bulk	D. I. Chapman, 148 Main St.	7
6068	Pure Leaf Rex, Cudahy Packing Co., U. S. A.	I. L. Coe's Sons, 150 Main St.	42*
6067	Sold in bulk	W. K. Spencer, 98 Main St.	7
6063	" " "	O. Thompson & Co., 592 Main St.	7

* Per 3 pound pail.

TABLE X.—LARD NOT FOUND ADULTERATED—*Continued.*

Station No.	Brand.	Dealer.	Price per half pound, cents.
		New Britain:	
7376	Pure Leaf, J. P. Squire & Co., Boston	H. A. Hall, 212 Main St.	50*
7387	Sold in bulk	Holcomb & Frick, 183 Park St.	7
7377	Shield Brand, Pure Leaf, Armour & Co.	Public Market & Grocery, 375 Main St.	45*
7382	Sold in bulk	P. J. Reilly, 279 E. Main St.	8
7381	" " "	Sovereigns' Trading Co., 282 Main St.	7
7383	" " "	Union Trading Co., 61 Arch St.	8
7386	" " "	W. W. Walker, 218 Main St.	7
7384	" " "	J. T. Ward, 75 Arch St.	8
		New Haven:	
7364	Sold in bulk	Paul Baer, 181 Dixwell Ave.	7
7327	" " "	Wm. Costello, 242 Hamilton St.	7
7323	" " "	A. Duhan, 1134 State St.	6
7322	" " "	Franklin St. Cash Store, 239 Franklin St.	7
7370	" " "	N. A. Fullerton, 1231 Chapel St.	6
7372	Pure Leaf, Sperry & Barnes, New Haven	S. L. Hughes, 65 South St.	80†
7371	Sold in bulk	Paul Jente, 131 Broadway	7
7325	" " "	F. J. Markle, State & Olive Sts.	7
7328	" " "	Wm. Tansey, 29 William St.	8
7368	" " "	H. M. Tower, 383 Congress Ave.	7
7321	" " "	A. H. Waterbury, 250 Grand Ave.	6
7365	" " "	D. M. Welch & Son, 28 Congress Ave.	7
7326	Springfield Provision Co., Brightwood, Mass.	D. M. Welch & Son, 8 Grand Ave.	45*
		New London:	
6041	Sold in bulk	Blinman & Trueman Sts.	7
6038	" " "	Daboll & Freeman, 148 State St.	7
6039	" " "	Wm. A. Holt, 50 Main St.	7
6043	" " "	Edward Keefe, 495 Bank St.	7
6040	" " "	Keefe & Davis, 125 Bank St.	7
6044	" " "	W. H. Morris, Jr., Hempsted & Manwaring Sts.	7
6045	" " "	W. H. Slocum, 21 Broad St.	7
		Norwalk:	
6096	Sold in bulk	Wm. M. Betts, 15 Main St.	8
6095	" " "	C. L. Glover, 35 Wall St.	8
6097	" " "	F. D. Lawton, 47 Main St.	7
		Norwich:	
6055	Sold in bulk	J. R. Allyn Corp., 3 Thames St.	7
6052	" " "	W. H. Cardwell, 3 & 9 Market St.	7
6049	" " "	J. D. Cranston, 170 W. Main St.	8
6046	" " "	Mohican Co., Main St.	7
6051	" " "	A. T. Otis & Son, 261 Main St.	8
6050	" " "	H. D. Rallion, 45 Broadway	8
6048	" " "	R. F. Smith, 47 Shetucket St.	7
6047	" " "	Welcome Smith, 137 Main St.	7

* Per 3 pound pail.

† Per 5 pound pail.

TABLE X.—LARD NOT FOUND ADULTERATED—*Continued.*

Station No.	Brand.	Dealer.	Price per half pound, cents.
		Putnam:	
6035	Sold in bulk	Edward Mullen, Main St.	7
6036	" " "	A. C. Stetson	7
		South Norwalk:	
7338	White Star, G. H. Hammond Co., Hammond, Ind.	Central Food Co., Washington & R. R. Aves.	45*
6090	Sold in bulk	Louis Joseloff, 72 N. Main St.	7
6091	" " "	L'Hommedieu Bros., 204 E. Washington Ave.	8
		Stamford:	
7334	Sold in bulk	Fitch A. Hoyt, 133 Atlantic Square	8
7337	" " "	Judd Market & Provision Co., 44 Atlantic Sq.	7
7335	" " "	West End Park Grocery	7
7332	" " "	J. W. Wassing, 568 Atlantic St.	7
7331	" " "	W. W. Waterbury, 499 Main St.	7
		Torrington:	
6027	Sold in bulk	G. W. Main, 71 Main St.	8
6030	" " "	Mrs. M. McGuire, 176 S. Main St.	7
6031	" " "	Torrington Cash Grocery, Water St.	7
6029	" " "	C. H. Volkman, 121 Albert St.	7
6028	" " "	G. S. Weeks, 184 Main St.	8
		Waterbury:	
7348	Pure Lard, Merwin Provision Co., New Haven	Brownell's Boston Butter House, 147 S. Main.	40*
6024	Sold in bulk	Brownell's Boston Butter House, 147 S. Main.	7
6014	" " "	Healy's Cash Grocery, 622 S. Main St.	8
6025	" " "	Hewitt Grocery Co., 20 N. Main St.	8
6018	" " "	T. P. Kelley, Washington Ave.	7
6020	" " "	D. J. McGrath, 777 Bank St.	7
6021	" " "	White Simmon Co., 163 Bank St.	8
		Willimantic:	
6061	Sold in bulk	Frank Larrabee, Church St.	8
6056	" " "	F. M. Lincoln, 725 Main St.	7
6057	" " "	Mullen & St. Onge, Union St.	7
6058	" " "	Reade Bros., 717 Main St.	7
6060	" " "	G. A. Tripp, 798 Main St.	7
6059	" " "	A. A. Trudeau, 943 Main St.	7
		Winsted:	
7355	Sold in bulk	E. W. King, 524 Main St.	7
7350	" " "	Larkin & Sparks, 110 Main St.	7
7351	" " "	N. Y. Grocery Co., 404 Main St.	7
7354	" " "	H. C. Price, 701 Main St.	8
7353	" " "	Public Market, 397 Main St.	7
7352	" " "	H. Tasler, 222 Main St.	7

* Per 3 pound pail.

TABLE XI.—ADULTERATED LARD.

Station No.	Brand.	Dealer.	Price per half pound, cents.
		Ansonia:	
7358	Sold in bulk	W. H. Bronson, 234 Main St.	7
7356	" " "	Fogarty Cash Grocer. 13 High St.	6
		Bridgeport:	
6080	Sold in bulk	L. Brown, 721 Pembroke St.	6
6087	" " "	H. Isenberg & Co., 109 State St.	6
6081	" " "	W. B. Meyer, 521 E. Main St.	7
6079	" " "	Stapleton Bros., 232 N. Washington Ave.	6
		Danbury:	
7345	Sold in bulk	H. K. Church, 147 Main St.	6
7342	" " "	M. McPhelemy, 44 White St.	5
7341	" " "	N. Y. Cash Grocery, 307 Main St.	5
7343	" " "	J. W. Smith, 62 Elm St.	6
		Derby:	
7359	Sold in bulk	N. Y. Grocery, 217 Main St.	6
7361	" " "	D. M. Welch & Son, 312 Main St.	6
		Hartford:	
7393	Sold in bulk	199 State St.	6
7391	" " "	H. Bacharach, 22 Park St.	6
6033	" " "	Dow & Hatch, 2 Church St.	5
6073	" " "	P. S. Kennedy, 1036 Main St.	5
6072	" " "	Union Grocery Co., 1026 Main St.	5
7390	" " "	S. Vogel, 361 Main St.	7
		Meriden:	
6013	Sold in bulk	M. W. Booth, 41 E. Main St.	6
6010	" " "	M. Keegan, 288 W. Main St.	7
7374	" " "	Meriden Tea & Coffee Co., 77 E. Main St.	5
		Middletown:	
6064	Sold in bulk	D. J. Hartman, 530 Main St.	6
6065	" " "	Middletown Cash Grocery, 354 Main St.	5
		New Britain:	
7380	Sold in bulk	East End Cash Market, Hartford Ave. & Spring St.	7
7385	" " "	Wm. Foulds, 236 Park St.	6
7379	" " "	J. E. Murphy, 500 Main St.	6
7378	" " "	Public Market & Grocery, 375 Main St.	5
		New Haven:	
7398	Sold in bulk	S. S. Adams, Court & State St.	5
7320	" " "	S. S. Adams, 745 Grand Ave.	5
7367	" " "	Booth Meat Co., 80 Congress Ave.	5
7324	" " "	R. F. Copeland, 1208 State St.	5
7366	" " "	M. C. Dingwall, 66 Congress Ave.	5
7399	" " "	Mohican Co., 22 Church St.	6
7369	" " "	Mohican Co., 22 Church St.	5
7397	" " "	W. E. Waterbury, 770 State St.	5

TABLE XI.—ADULTERATED LARD—*Continued.*

Station No.	Brand.	Dealer.	Price per half pound, cents
		New London:	
6042	Sold in bulk	Mohican Co., State St.	5
		Norwalk:	
6099	Sold in bulk	Grand Central Grocery, 19 Main St.	5
6098	" " "	N. Y. Grocery, 35 Main St.	5
		Norwich:	
6053	Sold in bulk	Aldrich & McNickle, 36 Franklin St.	7
6054	" " "	Thos. Wilson, 78 Franklin St.	7
		Putnam:	
6037	Sold in bulk	J. E. Sullivan, Main St.	6
		South Norwalk:	
6094	Sold in bulk	Central Food Co., W. Washington Ave.	7
6092	" " "	Lorenza Dibble, 13 N. Main St.	5
6093	" " "	N. Y. Grocery, 132 E. Washington Ave.	6
		Stamford:	
7330	Sold in bulk	C. Anderson & Co., 490 Main St.	5
7336	" " "	Empire State Tea Co., 303 Main St.	5
7333	" " "	C. W. Slater, 282 Main St.	8
7329	" " "	R. T. Woodbury, 107 Pacific St.	5
		Waterbury:	
6015	Sold in bulk	Dabrouge & Abolan, 336 S. Main St.	6
6017	" " "	T. J. Doran, 451 E. Main St.	6
6026	" " "	Foote's Cash Grocery, 480 W. Main St.	5
6019	" " "	Lithuanian Meat Market, 905 Bank St.	5
6016	" " "	N. Y. Cash Grocery Co., 130 E. Main St.	7
6023	" " "	Whalen Cash Grocery, Junction Broadway	5

*Methods of Examination.** Refractive index was determined at 40° C. in the Zeiss Butyro-refractometer and specific gravity at 98° C. by a Westphal balance. Cotton seed oil was detected by the Halphen test,† and the Bechi test as modified by Dudley.‡ Tests for beef stearin were made by the Gladding-Belfield test,§ and for paraffine by the usual saponification method.

Range in Composition. In the samples examined the physical constants varied as follows:

	Refractometer reading at 40°.	Refractive index at 40°.	Specific Gravity at 98° C. (Water at 15.5° = 1).
Lard not found adulterated	50–52.5	1.4593–1.4609	0.8594–0.8630
Adulterated Lard	52–57.0	1.4606–1.4639	0.8607–0.8665
Compound Lard	56–56.5	1.4633–1.4636	0.8645–0.8654

* For a detailed description of these methods see Report for 1900, 138, also U. S. Dept. Agr., Bur. Chem., Bul. **65**, 20.

† Jour. Pharm. Chim., 1897, **6**, 390.

‡ Jour. Am. Chem. Soc., 1895, **17**, 724.

§ *Ibid.*, 1896, **18**, 189.

CHEESE.

By A. L. Winton and E. Monroe Bailey.

Our attention has been called to the fact that the various kinds of soft cheeses sold in jars, tin-foil packages, etc., differ greatly in keeping qualities, some keeping for an indefinite period in good condition, others quickly deteriorating by moulding. Tests for preservatives were made in brands found on sale in the State, with the results given in Tables XII and XIII. Of the twenty-one samples examined, seven, representing six brands, contained borax.

Table XII.—Cheese not Found Adulterated.

Station No.	Brand.	Dealer.	Price per package.
		Bridgeport.	
5453	American Cream Cheese, Special Quality	Geo. Engelhardt, 587 E. Main st.	.10
			.10
5454	Clover Leaf Cream Cheese	R. T. Whiting, 961 Main st.	
5455	Eagle Brand Cream Cheese, Purity Guaranteed	R. Wundrack, 1277 Main st.	.10
		Hartford.	
5614	American Club House Cheese, Chandler & Rudd Co., Cleveland, Ohio	Hills & Co., 372 Asylum st.	.30
		Meriden.	
5610	Clover Leaf Brand Cream Cheese	C. N. Dutton & Co., 17 Colony st.	.10
		New Haven.	
5492	Eagle Brand Cream Cheese, Purity Guaranteed	C. E. Minor, 182 Temple st.	.12
5493	Fromage de Brie, Eagle Brand	S. J. Hugo, 120 Crown st.	.20
5605	Surchoix Camembert	S. J. Hugo, 320 Crown st.	.30
		So. Norwalk.	
5471	Neufchatel, Cow Brand Cream Cheese, Extra Quality	Gustave E. Fredrich, 13 Railroad ave.	.05
5470	Neufchatel, Cow Brand Cream Cheese, Extra Quality	Chas. E. Seymour, 33 Washington st.	.05
5469	Eagle Brand Cream Cheese	Central Food Co., Railroad ave.	.10
		Norwalk.	
5468	Neufchatel, Orange Brand Cream Cheese, Extra Quality	Delicatessen Store, 9 Main st.	.05
		Stamford.	
5461	Eagle Brand Cream Cheese	S. L. Price, 298 Main st.	.10
		Waterbury.	
5477	Neufchatel, Cow Brand Cream Cheese	John Herman, 184 So. Main st.	.05
5476	Amer. Club House Cheese, The Chandler & Rudd Co., Cleveland, Ohio	Hewitt Grocery Co., 14 No. Main st.	.15

Table XIII.—Cheese containing Borax.

Station No.	Brand.	Dealer.	Price per package.
		Bridgeport.	
5456	Royal Luncheon Cheese, The Gourlay Thompson Co., Detroit, Mich.	National Grocery Co., 50 Cannon st.	.10
		New Haven.	
5491	MacLaren's Roquefort, A. F. MacLaren Cheese Co., Detroit, Mich.	Mohican Co., 18–20 Church st.	.15
5645	MacLaren's Imperial Cheese, A. F. MacLaren, Detroit, Mich.	S. J. Hugo, 120 Crown st.	.25
5604	MacLaren's Imperial Cheese, A. F. MacLaren, Detroit, Mich.	Johnson & Bro., Court and State st.	.25
5602	Royal Roquefort Cheese, Gourlay Thompson Co., Detroit, Mich.	M. C. Dingwall, 66 Congress ave.	.15
5478	Manhattan Club Cheese, Manhattan Dairy Co., Boston, Mass.	*Waterbury.* Woodruffs, 40 No. Main st.	.10
5479	Neufchatel, Excelsior, Philadelphia Brand	Woodruffs, 40 No. Main st.	.05

MARASCHINO CHERRIES.

By A. L. Winton and E. Monroe Bailey.

Six brands of cherries preserved in cordial were found to be colored with coal-tar dyes as shown in Table XIV. In five of these the color was an eosine, a dye much used in red ink; in one it was ponceau.

TABLE XIV.—MARASCHINO CHERRIES COLORED WITH COAL-TAR DYES.

Station No.	Brand.	Dealer.	Price per bottle, cents.	Capacity of bottle, fluid ounces.	Dye.
		Hartford.			
5620	Bigarreaux au Marasquin, Gabriel Triat & Co., Bordeaux, France	H. Griswold, 547 Main st.	25	7	Eosine.
5612	Bigarreax Roses au Marasquin, H. F. Laurent & Co., Bordeaux, France	Newton Robertson, 338 Asylum st.	25	4	Ponceau.
5613	Bigarreaux au Marasquin, Vve Savarin, Bordeaux, France	Smith & Clapp, 193 Asylum st.	25	7	Eosine.
		New Haven.			
5488	Bigarreaux au Marasquin, Dandicolle & Gaudin, Bordeaux, France	F. G. Gilbert, 918 Chapel st.	25	7	Eosine.
5489	Cerises au Marasquin, Geo. Dalidet & Co., Bordeaux, France	S. W. Hurlburt, 1074 Chapel st.	30	7	Eosine.
		Norwich.			
5640	Bigarreaux au Marasquin, Jourde, Bordeaux, France	H. D. Rallion, 45 Broadway	25	6	Eosine.

GROUND SPICES.

By A. L. WINTON and E. MONROE BAILEY.

During the year 233 samples of spices have been examined, of which 40 were found adulterated. The detail results are given in Tables XV and XVI, a summary in the following statement:

EXAMINATION OF SPICES.

	Samples not found adulterated.	Samples adulterated or below standard.	Total.
Black Pepper	32	26	58
White Pepper	27	1	28
Cayenne Pepper	25	3	28
Cinnamon	39	3	42
Cloves	37	6	43
Allspice	33	1	34
	193	40	233

Black Pepper. Five of the samples were adulterated with ground wheat screenings, consisting of broken and shrunken wheat mixed with the seeds of black bindweed (*Polygonum Convolvulus*), green foxtail (*Setaria viridis*), yellow foxtail (*S. glauca*), wild mustard and other weeds. In some of the large cities ordinary screenings, such as are sent out from the flour mills, are separated into two products, one containing the larger part of the broken and shrunken wheat, the other consisting chiefly of weed seed. Probably it is this latter product that is ground as a pepper adulterant. Further particulars with regard to wheat screenings are given on pages 339 to 358 of this report.

Seven samples contained ground cocoanut shells, or other nut shells, charred or roasted to give them the desired black color. A full account of the use of this adulterant, together with methods of detection, appeared in the Report for 1901, pages 208 to 225.

Black pepper is the immature unshelled berry of the pepper plant; white pepper is the ripe berry deprived of its outer coats. The waste material obtained in preparing white pepper, known as "pepper shells," is extensively employed as an adulterant of black pepper. This material is detected by its large percentage of fiber and ash as well as by the predominance of woody tissues. Thirteen samples contained more than 7.00 per cent. of ash, and either were adulterated with pepper shells or were of such poor quality as to be unfit for consumption.

Ground biscuit was the chief adulterant of two samples and maize meal of one. The pungency of a number of the fraudulent mixtures was reinforced by Cayenne pepper.

White Pepper. A single sample was found to be adulterated with maize meal.

Cayenne Pepper. Of the three adulterated samples, one contained a large amount of dirt, another contained maize meal, and still another consisted chiefly of ground nut shells colored with a coal-tar dye.

Cinnamon. Three samples were found adulterated. One of these contained a maize product and cocoanut shells, the second, ground biscuit and nut shells, and the third, ground biscuit with possibly other admixture.

Cloves. Clove stems were present in large amount in three samples, cocoanut shells, in one sample, a mixture of ground

biscuit and nut shells, in one sample, and ground roasted peas in one sample.

Allspice. One sample was grossly adulterated with ground cocoanut shells.

Mace. A sample of mace, from Messrs. Van Loan, Maguire & Gaffney, New York City, submitted for examination by Messrs. Charles G. Lincoln & Co., wholesale grocers, Hartford, was found to contain a large admixture of Bombay mace, which although a product of a tree belonging to the same genus as that yielding true mace has no aromatic taste, and is classed by food analysts as an adulterant.

Five samples of pure mace, ground at this Station in 1898, contained from 20.96 to 23.72 per cent. of fixed oil and resin (non-volatile ether extract), and a single sample of Bombay mace contained 59.81 per cent.

As the sample in question contained 42.18 per cent of this ingredient, it is probable that about half of the material was Bombay mace.

The grinders admitted that the sample contained Bombay mace (25 pounds of this product with 75 pounds of Batavia mace, the next cheapest whole mace that comes into our market), but contended that it was not adulterated.

"If it were all Bombay mace," they wrote, "it would be pure mace." It should be added that if the sample were all Bombay mace, it would be absolutely worthless as a spice.

TABLE XV.—SPICES NOT FOUND ADULTERATED.

Station No.	Brand.	Dealer.	Price per ¼ lb., cents.	Ash.	Sand.
	Black Pepper.				
		Bridgeport.			
5351	Seaside Mills, David Trubee & Co., Bridgeport	J. B. Sullivan, 588 E. Main st.	9	5.81	
5355	Union Pacific Tea Co. Pure Sovereign Spices	Union Pacific Tea Co., 1058 Main st.	10	6.63	1.44
5359	E. R. Durkee & Co., New York	Centennial Tea Co., 1688 Main st.	10	6.62	1.79
5363	Sold in bulk	R. T. Whiting, 961 Main st.	10	5.69	
		Danbury.			
5515	Sold in bulk	M. McPhelemy, 40 White st.	8	6.50	1.25
5521	" "	N. Y. Cash Groc'y, 307 Main st.	5	6.65	0.96
		Hartford.			
5424	Sold in bulk	S. Satriano, 41 Park st.	10	6.85	1.21
5431	Bugbee & Brownell, Providence	A. H. Tillinghast, 341 Main st.	10	4.83	
5429	D. & L. Slade Co., Boston, Epicurean Pepper	H. Griswold, 547 Main st.	10	4.48	
		Meriden.			
5449	Sold in bulk	C. N. Dutton, 17 Colony st.	10	5.17	
5446	" "	Grant's Tea Store, 22 E. Main st.	10	4.14	
		Middletown.			
5652	Sold in bulk	New York Grocery, 96 Main st.	8	6.11	
5418	Sold in bulk	O. Thompson & Co., 592 Main st.	10	5.49	
		New Britain.			
5550	Minor, Read & Garrette, New Haven	J. T. Ward, 75 Arch st.	10	6.48	1.36
		New Haven.			
5588	Sold in bulk	S. S. Adams, 745 Grand ave.	8	6.91	1.45
5590	" "	R. I. Blakeslee, 40 Grand ave.	10	6.03	
5575	" "	Henry Voelker, 120 Shelton ave.	10	5.37	
		New London.			
5689	E. P. Hornick, New York	W. M. Lucy, 193 Bank st.	10	4.64	
5697	Sold in bulk	Wm. R. Murray, 733 Bank st.	8	4.85	
		Norwich.			
5673	Fraser Bros. Co., Providence	H. I. Palmer, 29 Franklin st.	10	5.63	
5684	Sold in bulk	J. S. Spicer, 116 Water st.	8	5.84	
		Putnam.			
5664	Sold in bulk	J. E. Sullivan, Main st.	10	4.26	
5670	W. H. Mansfield & Co., Monogram Brand	W. H. Mansfield & Co., Main st.	10	5.48	

TABLE XV.—SPICES NOT FOUND ADULTERATED—*Continued.*

Station No.	Brand.	Dealer.	Price per ¼ lb., cents.	Ash.	Sand.
	Black Pepper.	*South Norwalk.*			
5503	Sold in bulk	F. D. Lawton, 22 So. Main st.	10	6.50	1.30
		Stamford.			
5378	Sold in bulk	C. M. Slater, 280 Main st.	9	4.67	
5380	" "	O. S. Brown, 52 Atlantic sq.	7	4.61	
		Waterbury.			
5528	Grand Union Tea Co.	Grand Union Tea Co., 79 Bank st.	10	4.44	
5524	John P. Augur, New Haven, Crescent Mills	Foote's Grocery, 440 W. Main st.	10	5.59	
5525	Stickney & Poor, Boston	T. P. Kelley, Washington sq.	10	5.57	
5540	Sold in bulk	Blanchett's, 258 So. Main st.	10	6.84	0.98
		Willimantic.			
5659	Sold in bulk	A. A. Trudeau, 949 Main st.	10	4.59	
	White Pepper.	*Bridgeport.*			
5370	Howard & Co., New York, Empress	C. K. Bishop, East Main st.	15	1.56	
5362	Sold in bulk	Village Store Co., 244 State st.	6	2.92	0.05
		Danbury.			
5512	F. H. Leggett & Co., New York, Golden Horn	W. D. Baldwin, 93 White st.	12	1.22	
5516	Sold in bulk	Ehle's Cash Grocery, 7 West st.	12	2.69	
		Hartford.			
5427	Sold in bulk	H. Griswold, 547 Main st.	10	2.19	
5435	" "	Cowles & Howard, 156 Windsor ave.	10	6.38	1.39
		Meriden.			
5443	Sold in bulk	H. F. Rudolph & Co., 38 E. Main st.	10	1.56	
5442	Sold in bulk	M. Keegan, 288 W. Main st.	10	3.52	0.46
		Middletown.			
5420	Sold in bulk	D. I. Chapman, 146 Main st.	10	2.02	
		New Britain.			
5557	Sold in bulk	W. W. Walker, 238 Main st.	10	1.39	
5554	The Williams & Carleton Co., Hartford	Public Market, 375 Main st.	10	4.02	0.45
		New Haven.			
5586	Sold in bulk	J. W. Persse, 426 State st.	8	4.35	0.34
5595	" "	Thomas, 16 Congress ave.	10	2.41	
5578	Howard & Co., New York, Empress	S. S. Adams, 412 State st.	15	2.17	

TABLE XV.—SPICES NOT FOUND ADULTERATED—*Continued.*

Station No.	Brand.	Dealer.	Price per ¼ lb., cents.	Ash.	Sand.
	White Pepper.	*New Haven.*			
5573	Sold in bulk	Boston Grocery, 926 Chapel st.	10	2.10	
5568	F. J. Markle, Finest Quality	F. J. Markle, 105 Broadway	12	1.63	
5571	J. P. Augur, New Haven, Crescent Mills	Wm. Beck, 322 Elm st.	10	1.30	
		Norwich.			
5671	Swain, Earle & Co., Boston	Appley & Jordon, 88 W. Main st.	10	1.48	
5675	Welcome A. Smith, Norwich	Welcome Smith, 137 Main st.	15	1.28	
5685	Sold in bulk	H. D. Rallion, 45 Broadway	15	1.97	
		Putnam.			
5665	Sold in bulk	Edward Mullen, 25 Main st.	10	2.72	
		South Norwalk.			
5506	Sold in bulk	L'Hommedieu Bros., 203 E. Washington st.	12	2.77	
		Stamford.			
5373	S. Wilde's Sons, New York	A. G. Weed, 10 Atlantic sq.	15	1.47	
5384	Sold in bulk	C. Anderson & Co., 492 Main st.	9	2.25	
		Waterbury.			
5533	Lincoln, Seyms & Co., Hartford, Capitol Mills	Spencer & Pierpont Co., 352 E. Main st.	10	4.35	
5538	Sold in bulk	Hewitt Grocery Co., 14 No. Main st.	15	3.36	0.17
		Willimantic.			
5661	D. & L. Slade Co., Boston	C. R. Hibberd, 22 North st.	10	1.40	
	Cayenne Pepper.	*Bridgeport.*			
5352	Stickney & Poor, Boston	W. L. Wolfram, 1007 E. Main st.	10	6.82	0.43
5360	E. R. Durkee, New York	C. G. Stewart, 198 Fairfield ave.	10	6.85	0.87
		Danbury.			
5520	Sold in bulk	J. Wm. Smith, 62 Elm st.	12	6.00	
5514	Lewis DeGroff & Son, New York, Health Brand	M. McPhelemy, 40 White st.	10	6.34	
5510	Bennett, Simpson & Co., London, Genuine African	Village Store Co., 238 Main st.	10	7.57	0.57
		Hartford.			
5439	Sold in bulk	P. S. Kennedy, 1046 Main st.	10	6.13	
5425	" "	A. H. Tillinghast, 341 Main st.	10	6.96	0.86

TABLE XV.—SPICES NOT FOUND ADULTERATED—*Continued.*

Station No.	Brand.	Dealer.	Price per ¼ lb., cents.	Ash.	Sand.
	Cayenne Pepper.	*Meriden.*			
5544	Sold in bulk	L. C. Brown, 4 W. Main st.	13	8.44	0.95
5440	Sold in bulk	Meriden Tea & Coffee Co., 77 E. Main st.	10	6.57	
		Middletown.			
5653	Sold in bulk	New England Tea Co., Main st.	10	7.80	1.31
		New Britain.			
5563	Sold in bulk	Union Trading Co,, 61 Arch st.	10	5.78	
5558	Sold in bulk	Sidney Oldershaw, 250 Park st.	10	6.42	
5546	The Williams & Carleton Co., Hartford	J. E. Murphy, 500 Main st.	10	5.85	
		New Haven.			
5566	J. P. Augur, New Haven	Pohlman & Scanlon, 142 Dixwell ave.	10	5.41	
5570	F. J. Markle	F. J. Markle, 101 Dixwell ave.	10	6.61	
5580	W. G. Dean & Son, New York, Ardent Brand	D. M. Welch & Son., 8 Grand ave.	9	6.11	
5592	Sold in bulk	A. Basserman, Ferry st. and Grand ave.	10	5.71	
5596	Sold in bulk	M. C. Dingwall, 66 Congress ave.	8	6.30	
		New London.			
5590	Lincoln, Seyms & Co., Hartford	The Mohican Co., State st.	9	6.47	
		Norwich.			
5676	Tiger Mills, New York	R. F. Smith, 47 Shetucket st.	15	6.43	
		South Norwalk.			
5505	Sold in bulk	N. Y. Grocery Co., 132 E. Washington st.	9	5.59	
		Stamford.			
5376	Sold in bulk	H. S. Daskam, 198 Atlantic st.	18	7.92	0.75
5385	Sold in bulk	A. G. Weed, 10 Atlantic sq.	13	7.85	0.86
		Waterbury.			
5545	Sold in bulk	Woodruff's, 40 No. Main st.	10	7.08	0.88
		Willimantic.			
5656	Sold in bulk	G. R. Tripp, 798 Main st.	10	6.64	

TABLE XV.—SPICES NOT FOUND ADULTERATED—*Continued.*

Station No.	Brand.	Dealer.	Price per ¼ lb., cents.	Ash.	Sand.
	Cinnamon.	*Bridgeport.*			
5364	Sold in bulk	China & Japan Tea Co., 1634 Main st.	10	4.75	
5369	Sold in bulk	Dundon Bros., E. Main st.	10	5.99	
5371	Columbia Tea Co., New York City	Columbia Tea Co., Main st.	10	8.06	
		Danbury.			
5522	Sold in bulk	Danbury Grocery Co., Main st.	8	6.08	
5519	Sold in bulk	N. T. Hoyt, 9 West st.	10	5.84	
5513	D. & L. Slade Co., Boston	M. McPhelemy, 40 White st.	10	3.20	
		Hartford.			
5423	Sold in bulk	Allen Bros., 466 Main st.	12	3.97	
5432	The Wm. Boardman & Sons Co., Hartford, Gold Star	N. Y. Butter House, 709 Main st.	7	6.17	
5437	Sold in bulk	Drake & Phillips Grocery Co., 342 Windsor ave.	12	4.29	
		Middletown.			
5416	F. H. Leggett & Co., New York, Golden Horn	R. A. Pease, 236 Main st.	15	4.29	
5419	Sold in bulk	G. E. Burr, 136 Main st.	12	4.29	
5600	E. R. Durkee & Co., New York	Burr & Young, 220 Main st.	10	3.59	
		Meriden.			
5450	Sold in bulk	F. H. Lewis, 98 W. Main st.	10	5.30	
		New Britain.			
5549	Bennett, Sloan & Co., New York	American Tea Co., 95 Arch st.	10	3.99	
5552	Miner, Read & Garrette, New Haven	J. T. Ward, 75 Arch st.	10	6.03	
5561	Sold in bulk	Holcomb & Frick, 189 Park st.	10	3.99	
5553	The E. S. Kibbe Co., Hartford	Public Market, 375 Main st.	10	2.76	
5547	W. H. Montanye & Co., New York, Half Saigon	Union Tea Co., 317 Main st.	10	7.96	4.31
		New Haven.			
5599	Sold in bulk	H. M. Tower, 379 Congress ave.	8	4.21	
5597	Sold in bulk	W. E. Waterbury, 770 State st.	5	5.43	
5594	J. & W. Cahill & Co.	J. & W. Cahill & Co., George and Church sts.	10	3.69	
5574	Sold in bulk	S. S. Adams, Dixwell ave.	9	5.64	
		New London.			
5687	Wm. A. Murray, New London	Wm. A. Murray, 793 Broad st.	10	3.90	
5693	Howard & Co., New York	Keefe & Davis, 125 Bank st.	10	6.77	
5695	Sold in bulk	Daboll & Freeman, 150 State st.	15	3.92	

TABLE XV.—SPICES NOT FOUND ADULTERATED—*Continued.*

Station No.	Brand.	Dealer.	Price per ¼ lb., cents.	Ash.	Sand.
	Cinnamon.	*Norwalk.*			
5397	Sold in bulk	Lorenzo Dibble, 13 N. Main st.	15	2.85	
5400	Sold in bulk	N. Y. Grocery Co., 37 Main st.	8	2.38	
		Norwich.			
5681	Sold in bulk	A. T. Otis, 261 Main st.	15	5.75	
5686	" "	R. F. Smith, 47 Shetucket st.	10	4.46	
		Putnam.			
5668	W. H. Mansfield, Monogram Brand	W. H. Mansfield & Co., Main st.	10	6.47	
		South Norwalk.			
5504	Sold in bulk	Gustav E. Fredrich, 13 Railroad ave.	10	3.40	
5508	Stout, Spencer & Co., New York, Imperial	Edwin Wilcox, 70 East Washington st.	10	5.44	
		Stamford.			
5381	Sold in bulk	R. T. Woodbury, 107 Pacific st.	6	6.58	
5386	John Ovens, New York	C. Andersen & Co., 492 Main st.	12	3.16	
		Waterbury.			
5544	Sold in bulk	Foote's Grocery, 440 West Main st.	15	3.73	
5543	Sold in bulk	A. W. Brumaghim, 844 Bank st.	10	5.73	
5530	Sultana Spice Mills, New York	Atlantic and Pacific Tea Co., 29 East Main st.	12	5.06	
		Willimantic.			
5654	Sold in bulk	Frank Larrabee, Church st.	10	4.15	
5662	J. F. Hennessy, Willimantic	New York Cash Grocery, 48 Church st.	10	3.43	
	Cloves.	*Bridgeport.*			
5366	Sold in bulk	Coe & White, 1256 Main st.	15	6.71	
5357	James G. Powers & Co., New York, Red Shield	National Grocery and Provision Co., 50 Cannon st.	10	6.95	
5356	Union Pacific Tea Co., New York, Sovereign	Union Pacific Tea Co., 854 East Main st.	10	8.42	1.24
5353	Dwinell Wright Co., Boston, Royal First Quality	J. A. Ronan, 365 E. Main st.	10	7.05	
		Danbury.			
5517	Sold in bulk	Doran's Cash Grocery, 150 Main st.	10	7.98	

TABLE XV.—SPICES NOT FOUND ADULTERATED—*Continued.*

Station No.	Brand.	Dealer.	Price per ¼ lb., cents.	Ash.	Sand.
	Cloves.	*Hartford.*			
5438	Sold in bulk	Smith & Clapp Grocery Co., 193 Asylum st.	10	8.35	0.88
5430	Grand Union Tea Co., New York	Grand Union Tea Co., 74 Asylum st.	10	6.18	
5426	Sold in bulk	C. H. Strong, 131 Main st.	10	7.36	
		Meriden.			
5448	Sold in bulk	H. E. Bushnell, 75 West Main st.	10	7.18	
5441	Sold in bulk	N. P. Lamontague, 29 State st.	10	7.18	
5447	" "	J. J. Pagnam, 33 W. Main st.	10	5.82	
		Middletown.			
5417	Sold in bulk	Thos. Walsh, 486 Main st.	10	6.94	
5415	F. C. Bushnell Co., New Haven	W. F. Ackley, 510 Main st.	8	6.84	
		New Britain.			
5560	Sold in bulk	Sovereign Trading Co., 282 Main st.	15	8.42	0.86
5559	Sold in bulk	H. A. Hall, 208 Main st.	8	5.74	
		New Haven.			
5587	Sold in bulk	Goodwin's Tea Store, 344 State st.	10	6.69	
5585	Sold in bulk	A. H. Waterbury, 250 Grand ave.	5	8.86	1.73
5584	Sold in bulk	M. Gans & Son, 722 Grand ave.	8	6.71	
5577	" "	A. A. Eisele, 287 Dixwell ave.	10	6.26	
5572	" "	Wm. Loveday, 11 Shelton ave.	10	6.70	
		New London.			
5691	E. P. Hornick, New York	A. M. Stacey, 123 State st.	15	6.32	
		Norwalk.			
5399	Sold in bulk	Finney & Benedict, 41 Wall st.	15	6.94	
5398	" "	F. D. Lawton, 47 N. Main st.	8	6.19	
5394	" "	Lewis Joseloff, 72 N. Main st.	10	7.18	
		Norwich.			
5682	Sold in bulk	Stanton & Tyler, 58 Main st.	15	7.33	
5674	Welcome A. Smith, Norwich, Pure Penang	Welcome Smith, 137 Main st.	20	7.49	
5678	The Chandler & Rudd Co., Cleveland, Ohio, Pure Zanzibar	Thomas Wilson, 76 Franklin st.	10	7.92	
		Putnam.			
5669	W. H. Mansfield, Monogram Brand	W. H. Mansfield & Co., Main st.	10	7.02	

TABLE XV.—SPICES NOT FOUND ADULTERATED—*Continued.*

Station No.	Brand.	Dealer.	Price per ¼ lb., cents.	Ash.	Sand.
	Cloves.				
5667	Bennett, Sloan & Co., New York	*Putnam.* W. I. Bartlett, 77 Main st.	10	7.48	
5666	Haskell, Adams & Co., Boston, Rival Brand	Edward Mullen, 25 Main st.	10	7.16	
		South Norwalk.			
5507	D. & L. Slade Co., Boston	Conrad Becker, 141 E. Washington st.	10	7.41	
		Stamford.			
5379	Sold in bulk	Fitch A. Hoyt, 133 Atlantic square	10	8.00	0.63
		Waterbury.			
5536	John P. Augur, New Haven, Crescent Mills	J. B. Archambault, 294 South Main st.	10	6.88	
5532	Lincoln, Seyms & Co., Hartford, Capitol Mills	Spencer & Pierpont, 352 East Main st.	10	6.44	
5531	The Wm. Boardman's Sons Co., Hartford	D. J. McGrath, 777 Bank st.	10	7.18	
5529	Stickney & Poor, Boston	G. W. McGregor, 313 South Main st.	10	6.78	
		Willimantic.			
5655	Sold in bulk	Read Bros., 717 Main st.	12	7.68	
	Allspice.				
5372	Columbia Tea Co., New York City	*Bridgeport.* Columbia Tea Co., Main st.	10	5.98	0.48
5368	Grand Union Tea Co., Brooklyn, N. Y.	Grand Union Tea Co., 1112 Main st.	10	5.76	
5361	Sold in bulk	H. Isenburg & Co., 109 State st.	7	6.96	0.61
5354	E. R. Durkee & Co., New	John Brownstein, 1314 Main			
5523	York	st.	10	6.00	0.57
		Danbury.			
5511	Sold in bulk	H. K. Church, 147 Main st.	10	5.72	
5422	Union Pacific Tea Co., New York, Sovereign	Union Pacific Tea Co., 253 Main st.	10	7.00	1.01
		Hartford.			
5421	Sold in bulk	Boston Grocery, 743 Main st.	5	7.00	0.95
	" "	Centennial Tea Co., 575 Main st.	10	6.44	0.46
		Meriden.			
5445	Sold in bulk	M. W. Booth, 41 E. Main st.	10	6.17	
		Middletown.			
5651	Sold in bulk	D. J. Hartman, 530 Main st.	10	5.94	

TABLE XV.—SPICES NOT FOUND ADULTERATED—*Continued.*

Station No.	Brand.	Dealer.	Price per ¼ lb., cents.	Ash.	Sand.
	Allspice.	*New Britain.*			
5548	Bennett, Sloan & Co., New York	American Tea Co., 95 Arch st.	10	4.82	
5564	Sold in bulk	A. Bonander, 22 Park st.	10	5.10	
5551	Miner, Read & Garrette, New Haven	J. T. Ward, 75 Arch st.	10	5.60	
		New Haven.			
5567	J. P. Augur, New Haven, Crescent Mills	Pohlman & Scanlan, 142 Dixwell ave.	10	5.08	
5576	Sold in bulk	Paul Jente, 127 Broadway	8	4.54	
5581	W. G. Dean & Son, New York, Ardent Brand	D. M. Welch & Son, 8 Grand ave.	8	5.94	
5591	Sold in bulk	W. G. Graves, 341 Grand ave.	10	5.43	
5598	" "	Arthur Tennant, 751 State st.	8	5.52	
		New London.			
5688	E. P. Hornick, 269 Pearl st.	W. H. Slocum, 21 Broad st.	10	5.17	
5694	Howard & Co., New York	Keefe & Davis, 125 Bank st.	10	5.42	
		Norwich.			
5672	Howard & Co., Empress	A. Francis & Son, Thames st.	10	5.95	0.32
5683	Sold in bulk	J. D. Cranston, 172 West Main st.	10	5.68	
5677	The Chandler & Rudd Co., Cleveland, Ohio, Pure Jamaica	Thomas Wilson, 76 Franklin st.	10	4.99	
		Putnam.			
5663	Sold in bulk	A. C. Stetson, Railroad ave.	10	4.37	
		South Norwalk.			
5502	Sold in bulk	Chas. E. Seymour, 33 Washington st.	10	4.80	
		Stamford.			
5390	Robert Hill, New York	Empire State Tea Co., 303 Main st.	10	6.75	0.38
5383	Sold in bulk	W. W. Waterbury, 501 Main st.	7	5.04	
5382	" "	Theo. Leeds, Atlantic & Main sts.	7	4.62	
		Waterbury.			
5542	Sold in bulk	Penn. Merchandise Co., 120 East Main st.	10	4.66	
5541	Sold in bulk	White-Simmons Co., 163 Bank st.	10	5.82	
5535	J. B. Archambault	J. B. Archambault, 294 South Main st.	10	5.91	
		Willimantic.			
5657	Sold in bulk	D. F. Blish, 66 Church st.	10	4.81	
5660	Lincoln, Seyms & Co., Hartford, Union Club	F. P. Casey, Jackson st.	10	4.80	

TABLE XVI.—SPICES, ADULTERATED OR BELOW STANDARD.

Station No.	Brand.	Dealer.	Price per ¼ lb., cents.	Ash.	Sand.	Adulterants.
	Black Pepper.	*Bridgeport.*				
5358	Sparhawk, Poole & Co., London	Empress Tea & Coffee Co., 1044 Main st.	8	7.10	1.45	Pepper shells or dirt.
5367	F. R. Farrington & Co., New York and Boston	Coe & White, 1256 Main st.	10	8.66	1.71	Pepper shells or dirt.
		Danbury.				
5518	Sold in bulk	Atlantic & Pacific Tea Co., 163 Main st.	7	13.08	4.57	Pepper shells or dirt.
		Hartford.				
5428	Sold in bulk	Buckley & Reardon, 577 Main st.	8	11.66	1.89	Pepper shells or dirt.
5434	" "	Hills & Co., 372 Asylum st.	10	10.74	4.13	Pepper shells or dirt.
5436	" "	Working Men's Grocery, 4 Church st.	5	4.11	-----	Wheat screenings.
		New Britain.				
5556	Sold in bulk	Wm. Foulds, 236 Park st.	8	8.46	2.88	Starchy matter.
5555	" "	Thos. McCabe, 591 Main st.	10	7.20	1.60	Pepper shells or dirt.
5562	" "	W. H. Pierce & Co., 72 W. Main st.	10	3.87	------	Wheat screenings, charred nut shells, cayenne.
		New Haven.				
5579	W. G. Dean & Son, New York, Ardent Brand	D. M. Welch & Son, 8 Grand ave.	7	9.41	3.70	Pepper shells or dirt.
5565	Fullerton's	Boston Grocery, 926 Chapel st.	10	6.63	1.30	Ground biscuit.

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

Station No.	Brand.	Dealer.	Price per ¼ lb., cents.	Ash.	Sand.	Adulterants.
	Black Pepper.	*New Haven.*				
5583	Sold in Bulk	Gilson Tea Co., 417 State st.	7	6.02	------	Ground biscuit.
5593	J. & W. Cahill & Co.	J. & W. Cahill & Co., George st.	10	5.98	0.88	Maize product, nut shells.
5569	F. J. Markle	F. J. Markle, 105 Broadway	10	11.24	5.92	Pepper shells or dirt.
5582	John T. Doyle Co., New Haven	D. Dore, 579 Grand ave.	10	12.85	5.64	Pepper shells or dirt.
		New London.				
5692	Howard & Co., New York	Keefe & Davis, 125 Bank st.	10	14.73	8.19	Pepper shells or dirt.
		Norwalk.				
5396	Sold in bulk	Grand Central Grocery Co., 19 Main st.	10	7.07	1.38	Pepper shells or dirt.
		Norwich.				
5680	Sold in bulk	Manhattan Tea Store, 6 Main st.	8	8.37	3.28	Wheat screenings, cayenne.
		South Norwalk.				
5509	Wm. A. Leggett & Co., New York, Rajah Brand	Central Food Co., Railroad ave.	10	7.67	2.02	Pepper shells or dirt.
		Stamford.				
5377	Sold in bulk	J. M. Wassing, 570 Atlantic st.	8	10.62	3.75	Corn product, dirt.
5393	Wood's American Spice Mills, New York	Stamford Tea Co., 72 Pacific st.	13	3.68	------	Wheat screenings, nut shells.
5374	Columbia Tea Co., New York	Columbia Tea Co., 196 Main st.	13	11.68	3.96	Pepper shells or dirt.

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

Station No.	Brand.	Dealer.	Price per ¼ lb., cents.	Ash.	Sand.	Adulterants.
	Black Pepper.	*Waterbury.*				
5526	Empire Mills, New York	F. Fabricant, 171 So. Main st.	10	4.09	------	Wheat screenings, nut shells, cayenne.
5527	Fischer Mills, New York	New York & China Tea Co., 181 So. Main st.	10	5.94	------	Ground biscuit.
5537	Sold in bulk	J. J. Fruin, 447 W. Main st.	10	4.07	------	Wheat screenings, cocoanut shells, buckwheat product, cayenne.
5534	Archibald & Lewis, New York	Hewitt Grocery Co., 14 No. Main st.	10	7.89	2.09	Pepper shells or dirt.
		Willimantic.				
5658	Sold in bulk	H. C. Hall, 35 Union st.	10	8.32	1.95	Pepper shells or dirt.
	White Pepper.	*Hartford.*				
5433	Challenge Mills, New York	City Hall Grocery, 42 State st.	15	2.24	------	Corn meal.
	Cayenne Pepper.	*Bridgeport.*				
5365	Sold in bulk	Atlantic & Pacific Tea Co., 707 E. Main st.	9	11.62	2.87	Excess of ash.
		Norwich.				
5679	Sold in bulk	Thos. Wilson, 76 Franklin st.	12	10.64	0.58	Corn meal.
		Norwalk.				
5395	Sold in bulk	D. S. Davenport, 20 No. Main st.	10	3.27	------	Nut shells, red coal-tar dye.

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

Station No.	Brand.	Dealer.	Price per ¼ lb., cents.	Ash.	Sand.	Adulterants.
	Cinnamon.	*New Haven.*				
5589	Sold in bulk	Fair Haven Butter House, 391 Grand ave.	10	9.18	5.60	Corn product, cocoanut shells.
		Stamford.				
5391	Wood's American Spice Mills, New York	Stamford Tea Co., 72 Pacific st.	13	12.70	1.70	Ground biscuit, nut shells.
5388	Robert Hill, New York	Empire State Tea Co., 303 Main st.	10	6.42	------	Ground biscuit.
	Cloves.	*New London.*				
5696	Sold in bulk	J. R. Avery, 19 Broad st.	10	4.28	------	Cocoanut shells, allspice.
		Stamford.				
5375	Columbia Tea Co., New York	Columbia Tea Co., 196 Main st.	13	10.17	2.03	Clove stems.
5389	Robert Hill, New York	Empire State Tea Co., 303 Main st.	10	10.12	1.99	Clove stems.
5387	John Ovens, New York	C. Andersen & Co., 492 Main st.	12	9.41	1.62	Clove stems.
5392	Wood's American Spice Mills, New York	Stamford Tea Co., 72 Pacific st.	13	10.42	0.85	Ground biscuit, nut shells.
		Waterbury,				
5539	Sold in bulk	J. F. Phelan, 42 E. Main st.	9	5.80	------	Roasted peas.
	Allspice.	*Norwalk.*				
5501	Sold in bulk	Atlantic & Pacific Tea Co., 41 Main st.	7	3.90	------	Cocoanut shells.

COFFEE.

By A. L. Winton.

Thirty-three samples of coffee have been examined during the year, of which only three samples were found adulterated. The names of the brands, the names and addresses of the dealers and the prices per pound of the samples not found adulterated, are given in Table XVII. Descriptions of the adulterated samples follow:

5457. Anchor Brand Coffee. Walker & Boell, 32 Water st., New York. Bought of Peoples Dairy, 1366 Main st., Bridgeport. Price 18 cents per pound box. *Contained a large amount of chicory.*

5633. Silver Edge Java Coffee. L. A. Gallup & Co., Water st., Norwich. Bought of A. Francis & Sons, Thames st., Norwich. Price 25 cents per pound can. *Contained a large amount of ground peas.*

5475. Sold in bulk. Bought of J. F. Phelan, 41 East Main st., Waterbury. Dealer stated that this coffee contained chicory. Price 25 cents per pound. *Contained pellets made of pea hulls and other materials and chicory.*

The decrease in adulteration of coffee during the past seven years is clearly shown in the following summary:

Statement Showing the Gradual Decrease in the Adulteration of Ground Coffee in the past Seven Years.

Year.	Number of samples examined.	Number of adulterated samples.	Percentage of adulterated samples in whole number examined.
1896	65	58	89.2
1897	45	39	86.6
1898	22	9	40.9
1899	80	14	17.5
1900	55	7	12.7
1901	50	5	10.0
1902	33	3	9.1

Table XVII.—Coffee not Found Adulterated.

Station No.	Brand.	Dealer.	Price per pound, cents.
		Bridgeport:	
7271	Uncle Sam Java, S. E. Vincent.	City Market Co., 282 State st.	25
5458	National, John H. Turnbull Co., New York	Dundon Bros., East Main and Nichols st.	25
5460	The Celebrated Empress Brand.	Empress Tea Co., 1044 Main st.	18
5459	Niagara Java and Mocha, J. B. Sullivan	J. B. Sullivan, 588 East Main st.	25
		Hartford:	
5616	Williams Casino, The Williams & Carleton Co.	Cady & Lombard, 161 Albany ave.	35
5615	Our Own Java and Mocha, Cowles & Howard	Cowles & Howard, Windsor ave.	25
5618	Moody's Morning Glory, Charles E. Moody & Co., Boston	Drake & Phillips Grocery, 342 Windsor ave.	25
5617	Golden Crown, Mocha and Java, N. Y. Tea Store, Hartford	P. S. Kennedy, 1046 Main st.	25
5648	Superior Brand, Fancy Blend, Mocha & Java, G. F. Patterson.	G. E. Patterson, 1397 Main st.	25
5625	Old Glory, Union Grocery Co.	Union Grocery Co., 1026–1036 Main st.	25
		Meriden:	
5609	Superior Brand, Mocha and Java, M. J. Goffee	M. J. Goffee, 176 West Main st.	25
		Middletown:	
5647	White House, Mocha and Java, Dwinell-Wright Co., Boston	O. Thompson & Co., 592 Main st.	35
		New Britain:	
5480	Crescent Mills, Java and Mocha, John P. Augur, New Haven	City Market, 318 Main st.	30
5481	Java & Mocha, Holcombe & Frick	Holcombe & Frick, 189 Park st.	25
5483	Coronation High Grade Blend Coffee, Edwin J. Gillies & Co., N. Y.	Public Market, 375 Main st.	35
5482	Rex Java and Mocha, Lincoln, Seyms & Co., Hartford	Union Trading Co., 61 Arch st.	35
		New Haven:	
5601	Crescent Mills, Java and Mocha, John P. Augur, New Haven	H. Buchter, Olive and State sts.	25
5495	Peerless Blend, W. H. Montanye & Co., New York	D. Dore, 579 Grand ave.	25
7285	Aromatic Semper-Idem, Loudon & Johnson, New York	L. C. Pfaff & Son, 7–9 Church st.	25
5500	Java and Mocha, H. M. Tower.	H. M. Tower, 379 Congress ave.	25
7280	Country Club, John F. Nickerson Co., Boston	D. M. Welch, 8 Grand ave.	25
		New London:	
6000	Wizard Oriental Blend, The Williams & Carleton Co., Hartford	Blinman & Trueman	25
5999	Hermitage, Stoddard, Gilbert & Co., New Haven	Daboll & Freeman, 148 State st.	25

TABLE XVII.—COFFEE NOT FOUND ADULTERATED—*Continued.*

Station No.	Brand.	Dealer.	Price per pound, cents.
		Stamford:	
5464	Vantines Mo-Ri	G. R. Raymond, 77 Atlantic st.	--
5467	Sold in bulk	Stamford Tea Co., 72 Pacific st.	25
5466	Town Talk, Tucker & Goodwin, Hartford	J. W. Wassing, 570 Atlantic st.	30
5465	Silver Quarter, Swain, Earle & Co., Boston	W. W. Waterbury, 501 Main st.	25
		Willimantic:	
5627	Boston Blend, Cobb, Bates & Yerxa Co.	D. F. Blish, 66 Church st.	25
5628	Gold Coin, Java and Mocha, C. R. Hibberd	C. R. Hibberd, 22 North st.	25
5626	Princess Java and Mocha, G. R. Tripp	G. R. Tripp, 798 Main st.	25

COCOA.

BY A. L. WINTON, M. SILVERMAN AND E. MUNROE BAILEY.

Chocolate and Cocoa are made from the "beans" or seeds of several small trees, natives of tropical America, of which *Theobroma cacao* L. is by far the most important. Cocoa beans were highly esteemed by the aborigines, especially the Aztecs of Mexico and Peru, who prepared from them beverages and foods. They were brought to the notice of Europeans by Cortez and other explorers, but were not extensively imported into Europe until the seventeenth century, about the time tea and coffee were introduced from the East. At present the world's supply comes chiefly from Venezuela, Guiana, Ecuador, Brazil, Trinidad, Cuba, Mexico, and other regions bordering on the Gulf of Mexico, being gathered in these regions from trees both wild and cultivated, and also to some extent from Java, Ceylon, Africa and other parts of the Old World, where the tree has been successfully cultivated.

The yellow or brown cocoa fruit is from 4 to 6 inches long, from 2 to 3 inches wide, and has 10 ridges passing from the base to the apex giving the surface a melon-like appearance. It

contains from 35 to 75 seeds in 5 rows, embedded in a mucilaginous substance.

The seeds after being removed from the fruit and freed from the adhering pulp are dried at once in some localities, but the better grades are first subjected to a fermentation process, which destroys certain bitter and acrid constituents.

Cocoa beans as they come into the market are reddish brown in color, and somewhat resemble Lima beans in shape and size, but are not so strongly flattened nor are they kidney shaped. Like Lima beans they consist of two thickened cotyledons or seed leaves, connected with a small rootlet and enclosed within a hull or shell. The dark brown cotyledons are irregularly folded and readily break into angular pieces.

Process of Manufacture. The first stages in the manufacture of both chocolate and cocoa are the same.

After removing stones, chips and other impurities, the beans are roasted, thus developing a desirable flavor and facilitating the processes of separation from the shells and grinding. The beans are then crushed by machinery and separated from the shells. In some factories the "germs" (rootlets) are also removed.

The broken cotyledons, free of shells, known as "cocoa nibs," are next ground in the chocolate mill. The heat of grinding melts the fat which makes up about half the weight of the nibs, and the ground product runs out of the mill as a thin paste. This paste, after cooling in moulds, is unsweetened chocolate. Sweet chocolate is prepared by mixing pulverized sugar and vanilla, or other flavor, with the warm chocolate paste before moulding.

Cocoa is prepared by removing a portion of the fat from the warm mass by pressure and reducing the residue to a powder, with or without addition of vanilla flavor.

"Dutch Process" Cocoa is cocoa treated with an alkali, usually soda or ammonia, to hinder the fat from collecting on the surface of the beverage prepared from it. This is sometimes called "soluble cocoa."

Cocoa butter is the expressed fat obtained as a by-product in the manufacture of cocoa.

Cocoa shells are used to some extent for the preparation of a beverage, but are usually regarded as a waste product and are often ground with cocoa products, spices, etc., as an adulterant.

Constituents of Cocoa Beans and Cocoa Products. The following table shows the average composition of cocoa nibs, pure cocoa, and cocoa shells, as determined by the writers:

	Cocoa nibs (hand shelled). Average of 17 analyses.	Pure Commercial cocoa. Average of 26 analyses.	Cocoa shells (hand shelled). Average of 17 analyses.
Water	2.72	6.23	4.87
Ash	3.32	5.49	10.43
Theobromin	1.04	1.15	0.49
Caffein	0.40	0.16	0.16
Other nitrogenous substances (protein)	12.12	18.34	14.46
Crude fiber	2.64	4.48	16.55
Pure starch	8.07	11.14	4.13
Other nitrogen-free substances	19.57	26.32	46.15
Fat	50.12	26.69	2.76
	100.00	100.00	100.00

Unsweetened chocolate consists merely of ground coca nibs and has practically the same composition as given above, although the process of separation from the shells as carried on commercially is seldom as complete as when the shelling is done by hand. The quantity of sugar in sweet chocolate ranges from 50 to 70 per cent. and the quantities of other ingredients are consequently somewhat less than half as much as in unsweetened chocolate.

From the analyses it is clear that beverages made from chocolate and cocoa are valuable not merely for their stimulating properties, but also for their food ingredients, thus differing markedly from tea and coffee, which are of little value as foods.

The solid matter of both products consists largely of fat, starch and protein, which if not the most digestible forms of these elements, as some manufacturers would have the public believe, are at least equal to the forms present in many other articles of diet.

Cocoa products owe their stimulating properties to two closely related alkaloids, theobromin and caffein, the former being the more abundant. Caffein is the chief alkaloid of both tea and coffee. It is a remarkable fact that the three most important non-alcoholic beverages, tea, coffee and cocoa, all contain stimulating principles, although their popularity is usually attributed largely to their agreeable flavors. The flavor of each is distinct and characteristic, but caffein is present in all of them and

theobromin, although present in considerable amount only in cocoa, is similar to caffein both in chemical composition and physiological action.

Adulteration of Cocoa. The removal of a portion of the fat as practiced in the manufacture of cocoa is not an adulteration, as the term cocoa has come to mean chocolate that has been thus treated and the product thus obtained is regarded as better suited for the preparation of the beverage than chocolate.

Whether the grinding of cocoa beans with the shells constitutes an adulteration is a matter yet to be decided. Certainly the product thus obtained is inferior and should not be allowed to come into competition with cocoa made from the shelled beans. The addition of extra shells, like the addition of pepper shells to pepper, is clearly an adulteration. There is also no excuse for the addition of starch, flour and sugar, the diluents usually employed, except in cocoas labeled as compounds or in some other truthful manner.

Sugar, it should be remembered, costs but from one-eighth to one-tenth as much per pound as cocoa, so that the presence of any considerable amount of this material reduces materially the value of the product.

Venetian red, coal-tar dyes and other artificial colors are used in various cocoa products to hide other more bulky adulterants.

Examination of Samples.

The samples of commercial cocoa examined represent 45 brands and in all cases were sold in labeled packages.

They are classified as follows:

Cocoa not found adulterated	26 brands
Adulterated cocoa	12 "
Compound cocoa	7 "
Total	45 "

Cocoa not found adulterated. In Tables XVIII and XXI, pp. 254, 255, 258 and 259, are grouped those brands in which no foreign substance was detected. The amount of fat ranged from 15.79 to 37.22 per cent., being on the average 26.69 per cent. In other words, some manufacturers remove only about one-quarter of the fat, while others remove over two-thirds. The percentage of crude fiber ranged from 3.22 to 7.81.

Some of the brands with high percentages of fiber may have been manufactured from unshelled beans or may have been mixed with ground cocoa shells, although considerable allowance must be made for the variation in composition of the different grades of beans, the process of shelling employed, and the amount of fat removed.

A comparison of the water- and fat-free analyses of commercial cocoas with those of cocoa nibs (Table XXV, pages 282, 283), brings out most strikingly those which are abnormal in composition, particularly as regards fiber and ash.

Only one brand (Van Houten's) appeared to have been made by the Dutch process. This brand contained a high percentage of total ash and ash soluble in water, and the ash had a high alkalinity.

Adulterated Cocoa (Tables XIX and XXII, pp. 257 and 260). Of the twelve adulterated brands, six contained wheat flour, one, wheat flour and sugar; three, maize starch or flour; one, Bermuda arrowroot starch; and one, sugar.

Sterry's shell cocoa (No. 5348) was made from cocoa shells with the addition of sugar. It is classed as adulterated, because the presence of sugar was not stated on the label.

Hooton Cocoa and Chocolate Co. protested against the analysis of No. 5341 (Table XIX, p. 257), stating as follows: "The package was not sealed when bought and the contents when examined were radically different in color and grain from the goods we are packing and have been packing for years. We therefore claim that the analysis (No. 5341) is not an analysis of our product and ask permission to submit further samples direct from factory for your inspection, and also give you below the names of at least two retailers who have recently had our goods." The samples sent by the manufacturers as well as other samples purchased later by our agent, bore a slightly different label from the first sample purchased and were not found adulterated.

It should be stated in this connection, that when a manufacturer puts up goods in a labeled but unsealed package, the Station feels justified in publishing the name of the manufacturer with the analysis of the contents of that can, although it does not hold him responsible for goods purchased in a can

once securely sealed but with the seal obviously broken at the time of purchase.

Rockwood & Co. stated in regard to analysis No. 5338, as follows: "In the early part of last year, we are under the impression that considerable cocoa was packed under the Golden Lion Brand that contained 10 per cent. of wheat flour, and it is our impression that some of this got into the State of Connecticut. We draw this conclusion because on your report you use the words 'Pure Cocoa Golden Lion Brand,' and the label used the early part of last year so read.

On the new label, which we commenced to use last summer the word 'Pure' was left out so as to make the label useful for shipments, both domestic and export. We are sending you two of these labels to illustrate what we have written, and as it has been our intention, and as we are sure we are now shipping pure cocoa into your State, we shall deem it a favor of you to pick up another sample of recent purchase so as to prove what we say is correct."

Another sample of the brand named and also of Rockwood & Co.'s Breakfast Cocoa, purchased in compliance with the above request, were both not found adulterated.

William P. Baker wrote, with regard to analysis of No. 7293: "I beg to say that the goods in question were bought in bulk from a reputable manufacturer as pure, and guaranteed by that manufacturer to be such. I simply pack it in tin and label it as stated above."

Compound Cocoa. The brands described in Tables XX and XXIII, pp. 257, 262 and 263, were labeled so as to show that ingredients other than cocoa were present. In three of the brands, the only admixture detected was sugar; in two, sugar and Bermuda arrowroot starch; and in one, wheat flour. The high percentage of protein (other nitrogenous substances) calculated to the water-, fat- and sugar-free material in Croft's Swiss Milk Cocoa is quite probably due to the casein of milk. This brand also contained 26.96 per cent. of sugar, calculated as cane sugar.

Methods of Examination.

Detailed description of the methods of analysis employed are given on pages 273 to 278 of this Report.

TABLE XVIII.—COCOA NOT FOUND ADULTERATED.

Station No.	Brand.	Dealer.	Price per half pound, cents.
5350	W. H. Baker, Winchester, Va. Best Cocoa	*Hartford.*—New York Butter House, 709 Main st.	20
5641	Walter Baker & Co., Dorchester, Mass. Breakfast Cocoa	*New London.*—G. H. Thomas, 437 Bank st.	25
5347	Bedford Cocoa, 87-93 Bedford ave., Brooklyn	*So. Norwalk.*—L. Hommedieu Bros., 205 E. Washington ave.	20
5630	Bensdorp & Co., Amsterdam. Bensdorp's Royal Dutch Cocoa	*Willimantic.*—H. C. Hall, 35 Union st.	35
5336	Brewster Cocoa Mfg. Co., Newark. Brewster's Caracas Breakfast Cocoa	*Meriden.*—M. Keegan, 288 W. Main st.	23
5631	H. B. Buttel, Newark. Buttel's Cocoa	*Willimantic.*—Frank M. Lincoln, 725 Main st.	20
5635	Crown Chocolate Co., Chelsea, Mass. Crown Breakfast Cocoa	*Norwich.*—J. R. Allyn, 3 Thames st.	20
5337	Hawley & Hoops, New York. Pure Breakfast Cocoa	*Meriden.*—C. N. Dutton & Co., 17 Colony st.	23
5342	Hills & Co., Hartford. Gold Seal	*Hartford.*—Hills & Co., 372 Asylum st.	25
5343	Howard & Co., New York. Cabinet Breakfast Cocoa	Smith, Clapp Grocery Co., 193 Asylum st.	20
5646	Huyler's Caracas Cocoa, New York	*New London.*—Wm. A Holt, 50 Main st.	25
5344	W. Huyler Co., New York. Caracas Breakfast Cocoa	*Hartford.*—Buckley & Reardon, 575 Main st.	22
5638	The Walter M. Lowney Co., Boston. Lowney's B'kfast Cocoa.	*Norwich.*—E. F. Burlingame, W. Main and Thames sts.	20
7275	Manhattan Cocoa Mills, New York. American Breakfast Cocoa	*So. Norwalk.*—Louis Joseloff, 72 No. Main st.	20
7281	F. J. Markle, New Haven. Gold Medal Breakfast Cocoa	*New Haven.*—F. J. Markle, State and Olive sts.	20
5622	Geo. Miller & Son Co., Philadelphia, Pa. Miller's Breakfast Cocoa	*Middletown.*—D. J. Hartman, 530 Main st.	20
5637	The Mohican Co., Norwich. Breakfast Cocoa	*Norwich.*—The Mohican Co., 264 Main st.	20
7288	Puritan Food Co., New York. Puritan Pure Foods, Cocoa	*Stamford.*—R. T. Woodbury, 107 Pacific st.	24
5639	Rallion. Breakfast Cocoa	*Norwich.*—H. D. Rallion, 45 Broadway	25
5629	Runkel Bros., New York. Breakfast Cocoa	*Willimantic.*—Frank Larrabee, Church st.	25
7278	Seeman Bros. White Rose Breakfast Cocoa	*Norwalk.*—C. L. Glover, 35 Wall st.	25
5345	H. F. Sparrow Co., Cambridge, Mass. New England Breakfast Cocoa	*Hartford.*—S. Satriano, 41 Park st.	20
5632	C. J. Van Houten & Zoon, West Holland. Van Houten's Pure Soluble Cocoa	*Putnam.*—W. H. Mansfield & Co., Main st.	50

TABLE XVIII.—COCOA NOT FOUND ADULTERATED—*Continued.*

Station No.	Brand.	Dealer.	Price per half pound, cents.
5349	Walker's. Sherman Park, N. Y.	*Hartford.*—Boston Grocery, 743 Main st.	20
5339	Josiah Webb & Co., Milton, Mass. Webb's Pure Cocoa Powder	*Meriden.*—J. J. Pagnam, 33 W. Main st.	20
5340	H. O. Wilbur & Sons, Phila Wilbur's Pure Breakfast Cocoa	*Hartford.*—Cowles & Howard, 156 Windsor ave.	20
10000	Hooton's Soluble Breakfast Cocoa.* Screw Cap package	Hooten Cocoa & Chocolate Co., Newark, N. J.	--
10001	Hooton's Soluble Breakfast Cocoa.* Plain tin package, sealed	Hooten Cocoa & Chocolate Co., Newark, N. J.	--
7797	Hooton's Soluble Breakfast Cocoa.* Screw Cap package	*Norwich.*—J. M. Young	25
7800	Rockwood & Co.'s Golden Lion Brand Cocoa*	*Hartford.*—Newton, Robertson & Co., 338 Asylum st.	20
7799	Rockwood & Co.'s Breakfast Cocoa*	Newton, Robertson & Co., 388 Asylum st.	20

* See remarks on pages 252 and 253.

MISCELLANEOUS SAMPLES.

4663 to **4666** inclusive. Liquors sent by W. J. D. Fowler, Westbrook, by order of S. S. Webb, Deputy Sheriff, Chester.

4663.	Gin	Alcohol, by weight, 33.02 per cent.
4664.	Whiskey	" " " 31.73 "
4665.	"	" " " 32.76 "
4666.	Malt Extract	" " " 4.83 "

9786. Cream of Tartar. Sent by W. L. L. Ellis, Ansonia. Not found adulterated.

9787. Sage. Sent by W. L. L. Ellis, Ansonia. Not found adulterated.

9758. Granulated Sugar. Sent by Mrs. C. S. Griswold, Groton, Mass. Not found adulterated.

9812. Brookfield Extra Creamery Butter. Sent by The L. C. Bates Co., New Haven. Not found adulterated.

4563. Curd. Sent by Pomperaug Valley Creamery, South Britain, Conn. Contained 68.81 per cent. of protein.

9792. Canned Beets. Sent by Commissioner J. B. Noble, Hartford. Can badly corroded. Contents contained a small amount of heavy metals.

9880. Gluten Bread. Sent by Carlos French, Seymour. Stated to have been made in France. Purchased of Purcell Mfg. Co., New York.

ANALYSIS.

Water	7.26
Ash	1.12
Protein	57.88
Fiber	0.39
Nitrogen-free extract	32.57
Fat	0.78
	100.00

9784. Green Tea. Sent by J. A. Scutt, Southford, who stated that tea made from this sample had caused sickness in his family. Contained Paris green.

7932. "Liquid Preservo," Magnus & Lauer, New York. Sent by manufacturer. Consists of a solution of benzoic and boric acids partly or entirely combined with soda.

9783. Preservative for Yeast. Sent by Atlantic Starch Works, Westport.

ANALYSIS.

Water	7.70
Ash	0.27
Matter insoluble in water (chiefly potato starch)	75.26
Other matters (sugar, dextrine, etc.)	16.77
	100.00

5644. Sweetheart One Spoon Baking Powder. Manufactured only by Southern Soda Works Co., Nashville, Tennessee. Bought by Station agent of Fair Haven Butter Store, 391 Grand Ave., New Haven. Adulterated with 24.57 per cent. of ground rock (mixture of talc and tremolite). Attention was first called to this grossly adulterated baking powder in the report of this Station for 1900, pages 165, 170 and 171.

4613. Vinegar. Sent by J. T. Doyle Co., New Haven. Acidity, 4.15, solids, 2.00.

TABLE XIX.—ADULTERATED COCOA.

Station No.	Brand.	Dealer.	Price per half pound, cents.	Adulterants.
7293	Wm. P. Baker, N. Y.* Choicest Powdered Cocoa	*New Haven.*—Paul Baer, 181 Dixwell ave.	24	Wheat flour.
5624	Bennett, Sloan & Co., Princess Cocoa	*Middletown.*—Thos. Walsh, 486 Main st.	25	Wheat flour.
5643	Brewster Cocoa Mfg. Co., Jersey City. Acme Lunch Cocoa	*New Haven.*—A. H. Waterbury, 250 Grand ave.	14	Wheat flour, sugar.
7276	Lewis De Groff & Son, New York. Health Brand Breakfast Cocoa	*So. Norwalk.*—Central Food Co., Railroad ave.	25	Wheat flour.
7294	M. C. Dingwall, New Haven. Pure Breakfast Cocoa	*New Haven.*—M. C. Dingwall, 66 Congress ave.	15	Maize starch or flour.
5341	Hooton Cocoa & Choc. Co., Newark. Hooton Sol. Breakfast Cocoa†	*Hartford.*—P. S. Kennedy, 1046 Main st.	25	Maize starch or flour.
7268	H. Isenburg & Co., Bridgeport. White Lily Brand	*Bridgeport.*—H. Isenburg & Co., 109 State st.	23	Maize starch or flour.
7297	John Ovens, N. Y. Excelsior Brand Breakfast Cocoa	*Norwalk.*—Grand Central Grocery, 19 Main st.	18	Wheat flour.
5636	Jas. G. Powers & Co., New York. Red Shield Breakfast Cocoa	*Norwich.*—Appley & Jordan, 88 W. Main st.	20	Wheat flour.
5338	Rockwood & Co., N. Y. Pure Golden Lion Brand Cocoa†	*Meriden.*—H. E. Bushnell & Co., 75 W. Main st.	20	Wheat flour.
5348	Sterry & Sterry, N. Y. Sterry's Pure Shell Cocoa	*Hartford.*—Public Market, 611 Main st.	10	Sugar.
5623	Wallace & Co., N. Y. Caracas Breakfast Cocoa	*Middletown.*—D. I. Chapman, 146 Main st.	20	Arrowroot starch.

* See remarks on page 253. † See remarks on page 252. ‡ See remarks on page 253.

TABLE XX.—COMPOUND COCOA.

Station No.	Brand.	Dealer.	Price per half pound, cents.	Constituents other than cocoa.
7298	Stephen L. Bartlett, Boston. Ralston Health Club Cocoa	*New Haven.*—S. S. Adams, Court and State sts.	25	Sugar.
7269	Croft & Allen Co., Philadelphia. Croft's Swiss Milk Cocoa	*Bridgeport.*—Richards & Schmidt, 2065 Main st.	25	Sugar, milk product.
5346	J. S. Fry & Sons, Bristol and London. Fry's Homeopathic Cocoa	*Hartford.*—A. H. Tillinghast, 341 Main st.	20	Sugar,) arrowroot
7299	James Epps & Co., London, Eng. Prepared Cocoa	*New Haven.*—Boston Grocery, 926 Chapel st.	25	Sugar,) starch.
7290	Hub Cocoa Works, Boston. Admiral Cocoa	*Danbury.*—Danbury Cash Grocery, Main st.	15	Sugar.
5619	Chas. H. Phillips Chem. Co., N. Y. Phillips' Digestible Cocoa	*Hartford.*—H. Griswold, 547 Main st.	40	Sugar.
7296	Sparrow & Co., Cambridgeport, Mass. London Breakfast Cocoa	*Putnam.*—Edward Mullan, Main st.	20	Wheat flour.

TABLE XXI.—COCOA NOT FOUND ADULTERATED.

Station No.	Brand.	In the air-dry material.														
		Water.	Ash.				Theobromin.	Caffein.	Other nitrogenous substances.	Crude fiber.	Crude starch.	Pure starch.	Other nitrogen-free substances.	Fat.	Total nitrogen.	Polarization at 20° C.*	
			Total.	Soluble in water.	Insoluble in acid (sand).	Alkalinity.										Direct.	After inversion.
		%	%	%	%		%	%	%	%	%	%	%	%	%		
5350	W. H. Baker's	5.43	3.84	1.95	0.06	2.05	1.29	0.10	15.81	3.71	14.02	10.62	21.98	37.22	2.96	0	0
5641	Walter Baker & Co.'s	6.16	5.07	2.02	0.16	2.40	1.12	0.27	19.19	3.80	15.87	11.29	26.88	26.22	3.50	0	0
5347	Bedford	7.80	5.56	3.07	0.35	2.70	1.10	0.08	18.69	7.81	14.75	8.69	33.37	16.90	3.35	0	0
5630	Bensdorp's Royal	6.25	6.25	4.62	0.15	2.39	1.11	0.17	17.81	3.72	13.86	9.16	24.76	30.77	3.24	+1.8	0
5336	Brewster's Caracas	6.06	4.72	1.99	0.18	2.16	1.25	0.14	17.25	3.71	15.79	11.45	23.91	31.51	3.19	+1.2	0
5631	Buttel's	6.06	5.32	3.26	0.14	2.69	1.28	0.16	19.31	3.22	17.30	13.29	26.98	24.38	3.53	0	0
5635	Crown	7.53	4.72	2.31	0.36	2.41	0.85	0.04	15.81	6.72	16.50	11.52	24.72	28.09	2.81	+1.6	0
5337	Hawley & Hoop's	6.27	4.66	1.89	0.18	2.18	1.14	0.24	18.62	4.00	15.87	11.40	26.30	27.37	3.40	+0.8	0
5342	Hills & Co.'s	7.53	6.73	4.11	0.13	2.80	1.23	0.15	17.62	3.79	14.21	9.50	22.82	30.63	3.25	+2.0	0
5343	Howard Co.'s Cabinet	6.06	5.06	1.95	0.23	2.42	1.20	0.10	18.37	4.95	16.83	11.88	27.16	25.22	3.33	+3.6	0
5646	Huyler's Caracas	6.21	4.65	1.81	0.17	2.20	0.99	0.22	17.37	3.77	13.93	9.16	23.12	34.51	3.15	0	0
5344	W. Huyler Co.'s Caracas	5.52	5.52	3.34	0.19	2.75	1.18	0.08	18.12	6.06	14.73	9.77	29.24	24 51	3.29	0	0
5638	Lowney's	6.11	4.52	1.76	0.15	2.14	1.11	0.14	18.37	3.66	14.80	10.79	25.75	29.55	3.32	0	0
7275	Manhattan, American	5.88	5.28	2.94	0.13	2.67	1.10	0.16	18.25	4.21	15.77	11.09	28.28	25.75	3.31	+4.0	0
7281	Markle's Gold Medal	5.64	4.44	2.97	0.01	1.96	1.32	0.08	17.50	3.69	16.11	12.33	23.75	31.25	3.23	0	0
5622	Miller's	6.93	5.19	2.06	0.54	2.33	0.95	0.08	17.50	4.84	14.73	10.00	26.44	28.07	3.12	+1.2	0
5637	The Mohican Co.'s	6.18	5.60	3.27	0.15	2.63	1.11	0.08	19.37	4.43	16.82	11.07	27.74	24.42	3.47	+0.8	0
7288	Puritan	4.63	5.50	2.08	0.10	2.25	1.03	0.16	21.44	4.16	18.04	12.72	28.14	22.22	3.80	0	0
5639	Rallion's	5.25	5 94	3.78	0.19	3.25	1.20	0.25	19.00	4.36	17.25	12.08	27.33	24.59	3.49	0	0
5629	Runkel's	6.35	4.79	2.46	0.10	2.59	1.11	0.33	18.44	4.57	18.16	13.20	25.10	26.11	3.39	0	0
7278	Seeman Bros.' White Rose	6.28	5.85	3.69	0.08	2.93	1.03	0.25	19.19	4.28	17.95	13.46	26.27	23.39	3.46	0	0
5345	H. F. Sparrow Co.'s N. E.	7.04	7.43	2.60	0.40	2.05	1.13	0.13	19.00	4.65	16.07	11.52	26.46	22.64	3.43	+2.0	0
5632	Van Houten's	5.95	7.98	6.46	0.19	5.00	0.94	0.09	18.81	4.39	13.71	9.35	23.50	28.99	3.33	+3.0	0
5349	Walker's	5.41	5.03	2.01	0.24	2.29	1.57	0.10	18.81	4.52	16.20	11.74	27.97	24.85	3.53	0	0
5339	Webb's	7.33	8.48	2.92	1.38	2.71	1.39	0.13	19.31	5.37	15.26	10.00	32.20	15.79	3.56	0	0
5340	Wilbur's	6.01	4.67	1.95	0.18	2.38	1.21	0.11	17.87	4.26	16.57	12.40	24.33	29.14	3.27	0	0
	Maximum	7.80	8.48	6.46	1.38	5.00	1.57	0.33	21.44	7.81	18.04	13.46	33.37	37.22	3.80	+4.0	0
	Minimum	5.25	3.84	1.76	0.01	1.96	0.85	0.04	15.81	3.22	13.71	8.69	21.98	15.79	2.81	0	0
	Average	6.23	5.49	2.82	0.24	2.55	1.15	0.16	18.34	4.48	15.81	11.14	26.32	26 69	3.33	+0.8	0

* Corrected for volume of insoluble matter.

TABLE XXI.—COCOA NOT FOUND ADULTERATED.

Station No.	Brand.	In the water- and fat-free material.											
		Ash.				Theobromin.	Caffein.	Other nitrogenous substances.	Crude fiber.	Crude starch.	Pure starch.	Other nitrogen-free substances.	Total Nitrogen.
		Total.	Soluble in water.	Insoluble in acid (sand).	Alkalinity.								
		%	%	%		%	%	%	%	%	%	%	%
5350	W. H. Baker's	6.70	3.40	0.10	3.58	2.25	0.18	27.57	6.47	24.45	18.52	38.31	5.16
5641	Walter Baker & Co.'s	7.50	2.99	0.24	3.55	1.66	0.40	28.38	5.62	23.46	16.70	39.74	5.17
5347	Bedford	7.38	4.08	0.47	3.59	1.46	0.10	24.82	10.37	19.59	11.55	44.32	4.45
5630	Bensdorp's Royal	9.92	7.34	0.24	3.79	1.76	0.27	28.29	5.91	22.01	14.54	39.31	5.14
5336	Brewster's Caracas	7.56	3.19	0.29	3.46	2.00	0.22	27.63	5.94	25.29	18.34	38.31	5.11
5631	Buttel's	7.65	4.68	0.20	3.87	1.84	0.23	27.76	4.63	24.88	19.10	38.79	5.07
5635	Crown	7.33	3.58	0.56	3.74	1.32	0.06	24.56	10.44	25.62	17.89	38.40	4.36
5337	Hawley & Hoop's	7.02	2.84	0.27	3.29	1.72	0.36	28.05	6.03	23.91	17.18	39.64	5.12
5342	Hills & Co.'s	10.88	6.65	0.21	4.53	1.99	0.24	28.49	6.13	22.96	15.36	36.90	5.25
5343	Howard & Co.'s Cabinet	7.36	2.84	0.34	3.52	1.75	0.15	26.73	7.20	24.49	17.29	39.52	4.84
5646	Huyler's Caracas	7.84	3.05	0.29	3.71	1.67	0.37	29.30	6.36	23.50	15.45	39.01	5.31
5344	W. Huyler Co.'s Caracas	7.89	4.77	0.27	3.93	1.69	0.11	25.90	8.66	21.05	13.96	41.79	4.70
5638	Lowney's	7.02	2.73	0.23	3.33	1.73	0.22	28.55	5.69	23.00	16.77	40.02	5.16
7275	Manhattan, American	7.72	4.30	0.19	3.91	1.61	0.23	26.69	6.16	23.06	16.22	41.37	4.84
7281	Markle's Gold Medal	7.03	4.70	0.01	3.10	2 09	0.13	27.73	5.85	25.53	19.53	37.64	5.12
5622	Miller's	7.98	3.17	0.83	3.58	1.46	0.12	26.92	7.45	22.66	15.39	40.68	4.80
5637	The Mohican Co.'s	8.06	4.71	0.21	3.79	1.60	0.12	27.89	6.38	24.24	15.95	39.99	5.00
7288	Puritan	7.52	2.84	0.13	3.07	1.41	0.22	29.30	5.69	24.66	17.39	38.47	5.19
5639	Rallion's	8.46	5.39	0.27	4.63	1.71	0.36	27.08	6.21	24.58	17.22	38.94	4.97
5629	Runkel's	7.09	3.64	0.14	3.84	1.64	0.49	27.30	6.77	26.89	19.54	37.17	5.01
7278	Seeman Bros.' White Rose	8.32	5.24	0.11	4.17	1.46	0.36	27.28	6.09	25.52	19.14	37.35	4.91
5345	H. F. Sparrow Co.'s N. E.	10.57	3.69	0.56	2.91	1.61	0.19	27.02	6.61	22.85	16.38	37.62	4.87
5632	Van Houten's	12.27	9.93	0.29	7.68	1.44	0.14	28.91	6.75	21.07	14.37	36.12	5.11
5349	Walker's	7.21	2.88	0.34	3.28	2.25	0.14	26.97	6.48	23.22	16.83	40.12	5.06
5339	Webb's	11.02	3.79	1.79	3.52	1.81	0.17	25.12	6.98	19.85	13.01	41.89	4.63
5340	Wilbur's	7.21	3.00	0.28	3.67	1.81	0.17	27.58	6.57	25.55	19.12	37.54	5.04
	Maximum	12.27	9.93	1.79	7.68	2.25	0.49	29.30	10.44	27.24	19.54	44.32	5.31
	Minimum	6.70	2.73	0.01	2.91	1.41	0.06	24.82	4.63	19.59	11.55	36.12	4.36
	Average	8.17	4.21	0.34	3.81	1.72	0.22	27.38	6.68	23.58	16.64	39.19	4.97

TABLE XXII.—ADULTERATED COCOA.

Station No.	Brand.	IN THE AIR-DRY MATERIAL.															Polarization at 20° C.*	
		Water.	Ash. Total.	Ash. Soluble in water.	Ash. Insoluble in acid (sand).	Ash. Alkalinity.	Theobromin.	Caffein.	Other nitrogenous substances.	Crude fiber.	Crude starch.	Pure starch.	Sugar.	Other nitrogen-free substances.	Fat.	Total nitrogen.	Direct.	After inversion.
		%	%	%	%		%	%	%	%	%	%	%	%	%	%		
7293	William P. Baker's	7.08	3.69	1.51	0.08	1.93	1.04	0.10	16.12	3.06	21.02	17.33	0	18.83	32.75	2.93	0	
5624	Bennett, Sloan & Co.'s Princess	6.94	3.32	1.15	0.12	1.75	0.82	0.08	15.81	2.69	28.82	24.50	0	18.18	27.66	2.81	0	
5643	Brewster's Acme	4.41	2.37	0.83	0.04	1.10	0.50	0.05	8.37	1.38	13.23	11.57	46.90	11.35	13.10	1.51	+47.5	−15.3
7276	Lewis De Groff & Son's	6.24	3.59	1.47	0.29	2.00	0.96	0.13	15.81	3.14	20.27	16.46	0	19.68	33.99	2.87		
7294	M. C. Dingwall's	7.40	6.28	2.84	0,51	2.60	0.95	0.11	13.87	7.01	25.85	21.01	0	28.38	14.99	2.55		
5341	Hooton's	6.52	5.71	3.51	0.11	3.15	1.04	0.21	18.19	4.33	18.79	14.57	0	23.17	26.26	3.29	0	
7268	Isenburg & Co.'s White Lily	6.80	4.76	2.77	0.04	2.40	1.45	0.11	18.31	3.64	18.34	13.90	0	25.15	25.88	3.41		
7297	Oven's Excelsior	6.74	6.36	2.95	0.30	2.43	0.88	0.13	16.94	7.25	20.34	15.59	0	29.98	16.13	3.02		
5636	James G. Powers & Co.'s Red Shield	6.72	3.19	1.21	0.18	1.75	0.87	0.11	15.44	2.28	28.83	25.43	0	18.29	27.67	2.77	0	
5338	Rockwood & Co.'s Pure Golden Lion	7.22	4.83	2.35	0.25	2.36	1.14	0.12	17.19	4.91	17.73	15.79	0	27.15	21.65	3.14	0	
5348	Sterry's Shell Cocoa	7.81	6.84	3.32	1.32	3.13	0.61	0.04	12.00	10.15	8.12	3.81	19.05	32.87	6.82	2.12	+22.3	− 3.2
5623	Wallace & Co.'s Caracas	6.24	4.47	1.70	0.24	2.32	1.06	0.16	17.31	3.83	17.32	12.22	0	22.78	31.93	3.15	0	

* Corrected for volume of insoluble matter.

TABLE XXII.—ADULTERATED COCOA.

Station No.	Brand.	IN THE WATER-, FAT- AND SUGAR-FREE MATERIAL.											
		Ash. Total.	Ash. Soluble in water.	Ash. Insoluble in acid (sand).	Ash. Alkalinity.	Theobromin.	Caffein.	Other nitrogenous substances.	Crude fiber.	Crude starch.	Pure starch.	Other nitrogen-free substances.	Total nitrogen.
		%	%	%		%	%	%	%	%	%	%	%
7293	William P. Baker's	6.13	2.51	0.13	3.21	1.73	0.17	26.79	5.08	34.93	28.81	31.29	4.87
5624	Bennett, Sloan & Co.'s Princess	5.08	1.76	0.18	2.67	1.25	0.13	24.17	4.11	44.07	37.46	28.80	4.29
5643	Brewster's Acme	6.66	2.33	0.11	3.09	1.41	0.14	23.52	3.88	37.17	32.51	31.88	4.24
7276	Lewis De Groff & Son's	6.01	2.46	0.49	3.35	1.61	0.22	26.46	5.25	33.91	27.54	32.92	4.81
7294	M. C. Dingwall's	8.10	3.66	0.65	3.35	1.22	0.14	17.87	9.03	33.30	27.07	36.57	3.29
5341	Hooton's	8.50	5.22	0.16	4.68	1.55	0.31	27.06	6.44	27.95	21.67	34.47	4.89
7268	Isenburg & Co.'s White Lily	7.07	4.12	0.06	3.56	2.15	0.16	27.20	5.41	27.24	20.65	37.36	5.06
7297	Oven's Excelsior	8.24	3.82	0.39	3.15	1.14	0.17	21.96	9.40	26.37	20.21	38.88	3.91
5636	James G. Powers & Co.'s Red Shield	4.86	1.84	0.27	2.66	1.32	0.17	23.54	3.47	43.94	38.76	27.88	4.22
5338	Rockwood & Co.'s Pure Golden Lion	6.79	3.30	0.34	3.32	1.60	0.17	24.16	6.90	24.92	22.20	38.18	4.41
5348	Sterry's Shell Cocoa	10.32	5.01	1.99	4.72	0.92	0.06	18.09	15.30	12.24	5.74	49.57	3.19
5623	Wallace & Co.'s Caracas	7.23	2.75	0.39	3.75	1.71	0.26	28.00	6.19	28.01	19.76	36.85	5.09

TABLE XXIII.—COMPOUND COCOA.

Station No.	Brand.	IN THE AIR-DRY MATERIAL.																
			Ash.														Polarization at 20° C.*	
		Water.	Total.	Soluble in water.	Insoluble in acid (sand).	Alkalinity.	Theobromin.	Caffein.	Other nitrogenous substances.	Crude fiber.	Crude starch.	Pure starch.	Sugar.	Other nitrogen-free substances.	Fat.	Total nitrogen.	Direct.	After inversion.
		%	%	%	%		%	%	%	%	%	%	%	%	%	%		
7298	Bartlett's Ralston Health Club	3.77	2.83	1.95	0.08	2.16	0.50	0.10	8.69	1.95	6.51	5.11	53.96	10.44	12.65	1.57	+54.9	−17.4
7269	Croft's Swiss Milk	3.12	2.67	1.55	0.17	2.16	0.50	0.07	14.75	3.43	10.60	6.65	26.96	18.78	22.07	2.54	+29.9	− 6.2
5346	Fry's Homeopathic	6.15	1.96	0.77	0.05	1.45	0.42	0.02	8.56	1.90	28.24	26.60	26.33	9.77	18.29	1.51	+25.1	−10.2
7299	Epp's Prepared	6.02	1.58	0.70	0.08	1.27	0.32	0.02	6.50	1.45	25.85	24.67	24.80	8.35	26.29	1.14	+24.2	− 9.0
7290	Hub Cocoa Works, Admiral	3.98	3.07	1.79	0.39	2.42	0.27	0.08	7.31	3.76	4.81	3.45	57.86	14.91	5.31	1.28	+58.9	−18.6
5619	Phillip's Digestible	3.33	2.71	1.07	0.08	1.45	0.65	0.08	9.25	1.92	7.67	6.06	34.60	11.76	29.64	1.70	+36.3	−10.1
7296	Sparrow & Co.'s London Breakfast	7.97	6.73	2.13	0.37	1.55	0.85	0.05	18.50	4.49	29.26	24.58	0	22.81	14.02	3.24	+ 4.1	0

* Corrected for volume of insoluble matter.

TABLE XXIII.—COMPOUND COCOA.

Station No.	Brand.	IN THE WATER-, FAT- AND SUGAR-FREE MATERIAL.											
		Ash.											
		Total.	Soluble in water.	Insoluble in acid (sand).	Alkalinity.	Theobromin.	Caffein.	Other nitrogenous substances.	Crude fiber.	Crude starch.	Pure starch.	Other nitrogen-free substances.	Total nitrogen.
		%	%	%		%	%	%	%	%	%	%	%
7298	Bartlett's Ralston Health Club	9.55	6.59	0.27	7.29	1.69	0.34	29.34	6.58	21.98	17.25	35.25	5.30
7269	Croft's Swiss Milk	7.67	3.24	0.36	4.51	1.05	0.15	30.82	7.17	22.15	13.90	39.24	5.31
5346	Fry's Homeopathic	3.98	1.56	0.10	2.95	0.85	0.04	17.39	3.86	57.38	54.04	19.84	3.07
7299	Epp's Prepared	3.68	1.63	0.19	2.96	0.75	0.04	15.15	3.38	60.27	57.54	19.46	2.66
7290	Hub Cocoa Works, Admiral	9.34	5.44	1.19	7.37	0.82	0.24	22.25	11.45	14.64	10.50	45.40	3.90
5619	Phillip's Digestible	8.36	3.30	0.25	4.47	2.00	0.25	28.52	5.92	23.65	18.68	36.27	5.24
7296	Sparrow & Co.'s London Breakfast	8.62	2.73	0.47	1.98	1.09	0.06	23.71	5.76	37.50	31.51	29.25	4.15

FOOD PRODUCTS EXAMINED FOR THE DAIRY COMMISSIONER IN THE TWELVE MONTHS ENDING JULY 31, 1902.

Suspected Butter.

Forty-one samples were examined, of which twenty-seven were genuine butter free from any considerable admixture of olemargarine. Fourteen samples were oleomargarine.

Methods of Examination.

The samples were examined with a refractometer, and their specific gravity and volatile fatty acids were determined by the methods described in previous reports.

Molasses.

Three hundred and eighty-four samples of molasses have been examined, of which sixty-six contained more or less glucose syrup. The methods of examination have been described in previous reports.

Honey.

Three samples have been examined, and found to be genuine.

Vinegar.

Two hundred and thirty-four samples of vinegar were examined so far as to determine acidity and total solids. Of this number forty-two contained less than 4 per cent. of acidity, the minimum established by the State, and forty-one had less than 2 per cent. of solids.

SUMMARY.

In the following table are given the kind and number of Food Products examined by the Station during the preceding twelve months, exclusive of those tested for the Dairy Commissioner, the number of each kind not found adulterated, the number found adulterated by addition of a chemical preservative, or by other adulterants, and also the numbers which were marked "compound."

From this it appears that of the 1,209 samples examined, 848 were not found adulterated, 12 were compounds, 56 contained preservatives and 291 were variously adulterated.

Table XXIV.—Summary of the Results of Examination of Food Products in 1902.

	Not found adulterated.	With preservative only.	Other adulterants, or below standard.	"Compounds."	Total number examined.
Milk	372	4	46	--	422
Cream	8	2	--	--	10
Syrups from soda fountains	37	21	55	--	113
Bottled syrups and fruit juices	9	13	16	--	38
Bottled carbonated beverages	30	6	38	--	74
Sweet pickles	1	3	17	--	21
Lard and compound lard	111	--	55	5	171
Cheese	14	7	0	--	21
Maraschino cherries	0	0	6	--	6
Black pepper	32	0	26	--	58
White pepper	27	0	1	--	28
Cayenne pepper	25	0	3	--	28
Cinnamon	39	0	3	--	42
Cloves	37	0	6	--	43
Allspice	33	0	1	--	34
Mace	0	0	1	--	1
Coffee	30	0	3	--	33
Cocoa	26	0	12	7	45
Alcoholic liquors	4	--	--	--	4
Extract vanilla	3	0	0	--	3
Extract lemon	1	0	0	--	1
One sample each of cream tartar, sage, sugar, butter, dried curd, canned beets, gluten bread, tea, vinegar, baking powder	9	0	2	--	11
Food preservatives	--	--	--	--	2
	848	56	291	12	1209

THE EFFECTS OF ROASTING ON THE CHEMICAL COMPOSITION OF COCOA BEANS.

By A. L. Winton, M. Silverman and E. Monroe Bailey.

Cocoa beans are invariably roasted before being shelled for the manufacture of chocolate or cocoa.

The following observations were made to determine whether this roasting, as is commonly assumed, really changes the chemical composition of the beans, and if so whether the nature or extent of this change depends on the temperature of roasting.

Literature. Weigmann's[1] analyses of seven kinds of unshelled cocoa beans, before and after roasting, showed that,

[1] König. Chemie der menschl. Nahrungs- und Genussmittel, Berlin, 1889, 3 Aufl., I Band. 1019, 1020.

at the temperature employed, there was no appreciable change in the percentage of nitrogen, theobromin, fat, nitrogen-free extract or crude fiber, calculated to the water-free basis. Although the nibs and shells were not analyzed separately, it is reasonable to assume that the conclusions would not have been altered had such a separation been made, an assumption which, however, would not have been justified had his analyses indicated that roasting changed the composition. It is to be regretted that although Weigmann made careful determinations of starch in a number of samples, he omitted comparative determinations on the samples in question, and consequently his work does not show whether starch is changed to dextrine or otherwise altered.

Zipperer's[1] determinations of water, theobromin, starch and ash, in seven samples of shelled beans (nibs) before and after roasting, lead to the remarkable conclusion that starch is formed by the roasting process. Zipperer determined starch by treating the material from which the fat had been extracted, for three to four hours in a Soxlet autoclave with water at 133° to 144° C., digesting with acid and titrating the sugar thus obtained with Fehling solution—a method which is open to criticism.[2] Koenig[3] notes that Zipperer's figures for theobromin are low.

Neither Weigmann's nor Zipperer's experiments show the effects of roasting on the chemical and physical constants of the fat.

A comparison of the average results of both authors follow:

	Number of analyses averaged.	Water.	Nitrogen x 6¼.	Theobromin.	Fat.	Starch.	Nitrogen-free extract.	Crude fiber.	Pure ash.	Sand.
Weigmann's Results.										
Raw Whole Beans	7	7.93	14.19	1.49	45.57	....	22.92	4.78	3.99	0.62
Roasted Whole Beans.	7	6.79	14.13	1.58	46.19	....	24.10	4.63	3.87	0.29
Zipperer's Results.										
Raw Shelled Beans ...	7	7.11	....	0.45	51.78	8.33	....	...	3.60	...
Roasted Shelled Beans	7	6.71	....	0.43	49.24	10.43	....	...	3.92	...

[1] The manufacture of Chocolate and Other Cacao Preparations, 2d ed., Berlin, 1902, 33, 34.

[2] See Maercker, Handbuch der Spiritusfabrikation, Berlin, 7 Aufl. 108; also Winton, Report of this Station, 1886, 136-140, Jour. Anal. Chem., 1888, 2, 158-162.

[3] *Loc. cit.*, 1020.

Description of Samples. In our experiments a sample of Caracas beans was divided into four equal portions. The first portion was not roasted, the second roasted at a lower heat than is customary, the third in the usual manner, and the fourth at an abnormally high heat. These operations were conducted in a chocolate factory by skilled workmen, following the customary methods, in the presence of a representative of the Station. The samples were then brought to the laboratory, shelled by hand, and the weights of the nibs and shells determined separately. After grinding so as to pass a sieve with round holes 1 mm. in diameter, both the nibs and the shells were analyzed by the methods described on pages 273 to 278.

Results of Analyses. The analyses show that so far as the ingredients determined are concerned, the nibs are altered little, if at all, by roasting. There is no evidence that starch is converted into dextrine or other soluble carbohydrates, that the amount or constants of the fat are changed, or that the theobromin, caffein or other nitrogenous substances are altered. It is quite possible that the fat, by enclosing starch and other constituents, protects them from change. The slight increase in the percentage of fiber in the roasted samples is probably due to finely divided charcoal from the shells which was unavoidably introduced in the shelling.

These results do not by any means prove that only the mechanical condition of the nibs is affected by roasting and no chemical change whatever takes place during the process. As a matter of fact, the flavor of roasted beans is materially different from that of the raw beans, and this must be due to some difference in chemical constitution, but this difference would appear to be slight and justifies the adoption of standards of composition based on analyses of beans roasted at a medium heat such as was employed in the preparation of the samples described in the subsequent paper.

The changes in the composition of the shells due to roasting are an increase in the percentage of fiber (owing to the charring of the outer portion) and of optically active substances and a slight decrease in the fat and starch.

TABLE XXV.—ANALYSES OF COCOA NIBS* AND SHELLS SHOWING THE EFFECTS OF ROASTING.

Station No.		Per cent. of nibs or shells in the whole beans.	In the air-dry material.																
				Ash.													Polarization at 20° C.	
			Water.	Total.	Soluble in water.	Insoluble in acid.	Alkalinity.	Theobromin.	Caffein.	Other nitrogenous substances.	Crude fiber.	Crude starch.	Pure starch.	Other nitrogen-free substances.	Fat.	Total nitrogen.	Direct.	After inversion.
	Nibs.	%	%	%	%	%		%	%	%	%	%	%	%	%	%		
7724	Raw	85.85	5.13	3.05	1.39	0.02	2.35	1.03	0.42	11.38	1.90	10.14	6.93	18.71	51.45	2.26	0	0
7726	Under roasted	87.16	4.43	3.14	1.38	0.01	2.35	0.94	0.41	11.81	2.06	10.21	7.61	17.92	51.69	2.30	0	0
7728	Medium roasted	87.96	3.71	3.14	1.45	0.00	2.50	1.02	0.41	11.56	2.71	10.00	7.41	18.39	51.65	2.29	0	0
7730	Over roasted	87.69	3.11	3.23	1.42	0.02	2.40	0.95	0.37	11.87	2.84	10.51	7.54	18.59	51.50	2.31	0	0
	Shells from above.																	
7725	Raw	14.15	8.69	11.40	3.63	4.59	5.32	0.33	0.20	12.50	13.41	11.35	4.59	44.61	4.27	2.16	+4.0	+4.0
7727	Under roasted	12.84	6.94	12.03	3.50	4.63	5.40	0.39	0.24	12.50	14.35	10.45	4.44	46.19	2.92	2.20	+5.2	+5.6
7729	Medium roasted	12.04	6.01	12.04	4.24	4.55	5.35	0.48	0.21	12.69	15.55	10.37	4.35	45.99	2.68	2.24	+5.0	+4.8
7731	Over roasted	12.31	5.16	12.43	4.23	4.82	5.35	0.56	0.24	12.44	15.70	11.30	4.44	46.05	2.98	2.23	+5.8	+6.0

* Shelled Cocoa Beans.

TABLE XXV.—ANALYSES OF COCOA NIBS AND SHELLS SHOWING THE EFFECTS OF ROASTING.

Station No.		In the water-free material.														Constants of fat, ether extract.			
		Ash.				Theobromin.	Caffein.	Other nitrogenous substances.	Crude fiber.	Crude starch.	Pure starch.	Other nitrogen-free substances.	Fat.	Total nitrogen.	Polarization at 20° C.				
		Total.	Soluble in water.	Insoluble in acid.	Alkalinity.										Direct.	After inversion.	Melting point, degrees C.	Zeiss Refractometer reading at 40° C.	Refractive index at 40° C.	Iodine number.
	Nibs.	%	%	%		%	%	%	%	%	%	%	%	%						
7724	Raw	3.21	1.46	0.02	2.48	1.09	0.44	11.99	2.01	10.68	7.31	19.73	54.22	2.38	0	0	33.0	47.5	1.4576	36.33
7726	Under roasted	3.29	1.44	0.01	2.46	0.98	0.43	12.36	2.16	10.68	7.96	18.74	54.08	2.41	0	0	32.5	47.5	1.4576	35.69
7728	Medium roasted	3.26	1.51	0.00	2.60	1.06	0.43	12.01	2.82	10.39	7.70	19.09	53.63	2.38	0	0	32.7	47.5	1.4576	35.61
7730	Over roasted	3.33	1.47	0.02	2.48	0.98	0.38	12.26	2.93	10.84	7.78	19.19	53.15	2.38	0	0	32.5	47.5	1.4576	35.66
	Shells from above.																			
7725	Raw	12.48	3.97	5.03	5.83	0.36	0.22	13.69	14.69	12.43	5.03	48.85	4.68	2.37	+4.3	+4.3	----	----	----	----
7727	Under roasted	12 93	3.76	4.97	5.80	0.42	0.26	13.43	15.42	11.24	4.77	49.63	3.14	2.37	+5.6	+6.0	----	----	----	----
7729	Medium roasted	12.81	4.51	4.84	5.69	0.51	0.22	13.50	16.54	11.03	4.63	48.94	2.85	2.38	+5.3	+5.1	----	----	----	----
7731	Over roasted	13.11	4.47	5.09	5.64	0.59	0.25	13.12	16.56	11.92	4.68	48.55	3.14	2.35	+6.1	+6.3	----	----	----	----

ANALYSES OF AUTHENTICATED SAMPLES OF COCOA BEANS.

By A. L. Winton, M. Silverman and E. Monroe Bailey.

This work was undertaken in connection with the examination of the brands of cocoa and chocolate found on sale in Connecticut, and at the suggestion of the Committee on Food Standards appointed by the Association of Official Agricultural Chemists. This committee found the data regarding the range of composition of cocoa beans from which the various cocoa products on the American market are made were not sufficient to furnish a safe basis for fixing standards of composition.

The adoption of standards of composition for products of the cocoa bean presents special difficulties, because they are not made from ground whole beans, but from beans which have been roasted and shelled—so-called "cocoa nibs." Furthermore, in the case of cocoa a variable portion of the fat has been removed and in the case of sweet chocolate variable amounts of sugar and flavoring materials have been added. The nibs of roasted beans, however, should nearly agree in composition with the chocolate made from these beans since chocolate is the cocoa nibs ground directly or after the removal of the germs, which make but a small portion by weight of the whole. From the composition of the water- and fat-free nibs may also be derived standards for commercial cocoa and sweet chocolate based on their analyses calculated to the water-, fat- and sugar-free basis.

Analyses of the shells are of value in detecting their admixture in commercial samples as well as in calculating the analysis of the whole cocoa bean.

Foreign Analyses. A considerable number of analyses, more or less complete, have been made of both whole and shelled cocoa beans and also of cocoa shells, by Tuchen,[1] Payen,[2] Boussingault,[3] Lampadius,[4] Laube and Aldendorff,[5] Heisch,[6] Weigmann,[1] Zipperer,[2] Wolfram,[3] Seyler,[4] Bell,[5] Benseman,[6] Bechurts,[7] Filsinger,[8] and other European analysts. These results, even the earlier ones, give a fairly correct idea of the range in the percentages of water, fat, fiber and ash and the chemical and physical constants of the fat. But the percentages of theobromin and starch are in many instances obviously erroneous, due, as a rule, to faulty methods of analysis.

Most of the authors determined starch by direct inversion or by the use of the Soxlet autoclave; both of which methods, especially the former, give too high results. Weigmann, however, determined starch in a few samples by the diastase method, and his results in these cases are apparently accurate.

Of the published results on theobromin (theobromin and caffein), those by Weigmann are believed to be accurate (although Kunze criticises his method as wrong in principle), as are also those by Kunze,[9] Hilger and Eminger,[10] and Decker,[11]

Detailed results of the analyses made prior to 1899 with description of the methods are given in Koenig's compilation and very full abstracts of the papers published prior to 1892 on the manufacture, adulteration and analysis of cocoa products are given by Ewell.[12]

American Analyses. Ewell made no analyses of cocoa beans, but confined his attention to numerous samples of commercial cocoas and chocolates, and the same may be said of Leach,[13] Doolittle,[14] McGill,[15] Eaton,[16] Yaple[17] and other American analysts.

[1] Ueber die organ. Bestandtheile des Cacao. Dissertation. Göttingen, 1857.
[2] Grouven: Vorträge über Agric. Chem., 1872, **1**, 451.
[3] *Ibid.* Also Ann. Chim. et Phys., 1883, 433.
[4] Der Cacao und die Chocolade. Berlin, 1859.
[5] König: Chemie der menschl. Nahrungs- und Genussmittel. Berlin, 1889, I Band, 1019-1022.
[6] Analyst, 1877, 1, 142.

[1] König: Chemie der menschl. Nahrungs- und Genussmittel. Berlin, 1889, I Band, 1019-1022.
[2] The manufacture of Chocolate and Other Cacao Preparations, 2d ed., Berlin, 1902, 33, 34.
[3] Jahresbericht d. k. chem. Centralstelle f. öffentl. Gesundheitspflege in Dresden, 1878, 76.
[4] *Ibid.*, 1888, 86.
[5] The Chemistry of Foods. London, 1881, Part I, 76, 80.
[6] Repertorium f. analyt. Chemie, 1884, 213; also 1885, 178.
[7] Arch. Pharm., 1893, **231**, 687. Vjschr. Chem. Nahr., 1894, **9**, 207.
[8] Ztschr. f. öffentl. Chem., 1900, **6**, 223, 471.
[9] Ztschr. f. anal. Chem., 1894, **33**, 1.
[10] Forschungsberichte ü. Lebensmittel, 1894, **1**, 292.
[11] Schweiz. Wchschr. Pharm., 1902, **40**, 527-530, 541-45, 553-57.
[12] U. S. Dept. Ag. Div. Chem. Bul., **13**, Part 7.
[13] Reports of the Mass. Board of Health.
[14] Reports of the Mich. Dairy and Food Dept.
[15] Laboratory of The Inland Revenue Dept., Ottawa, Can., Bul. **72**, 1900.
[16] Report of the Ills. State Food Commissioner, 1901.
[17] Amer. Jour. Pharm., 1895, **67**, 318.

Ridenour[1] reports analyses of twelve samples of cocoa beans, two of which were roasted. He does not state whether or not the beans were shelled, but the results indicate that they were not. The following are his maximum, minimum and average percentages:

	Fat.	Theobromin.	Albuminoids.	Dextrose.	Sucrose.	Starch.	Lignin.	Cellulose.	Extractive matters.	Moisture.	Ash.
Maximum	50.95	1.16	12.69	2.76	2.72	7.53	9.05	19.64	13.53	6.63	5.03
Minimum	36.81	0.75	7.50	0.42	0.32	1.35	3.28	11.32	5.84	1.55	2.71
Average	42.99	0.97	10.51	1.40	1.29	4.27	5.95	14.44	9 30	5.18	3.70

It is difficult to explain the wide range of Ridenour's percentages of fat, starch and some other ingredients or the high percentages of lignin and cellulose. Although starch was determined by direct inversion, the results are on the average much lower than we find by the diastase method.

The seventeen grades of cocoa beans which we have analyzed, representing in each case a large consignment, were carefully sampled from original packages of New York importers.

Seven of the samples were different grades of Venezuelan or Caracas beans, the commercial designations and quoted prices per pound being as follows: Chuao (33 cents), Selected Venezuelan (32 cents), San Felipe (22 cents), Ovello (21 cents), Santa Rosa (19 cents), and Aqua Clara (17 cents). The name and price per pound of sample No. 7736 was not stated.

Other South American cocoas represented were Maracaibo, from the regions in the northeastern part of Columbia bordering on Venezuela (22 cents), Ariba Guayaquil from Ecuador (16¾ cents), and Bahia, the best known Brazilian grade (13 cents). Of the West Indian cocoas analyzed, the Trinidad (15 cents) is by far the best, Cuban (13 cents), St. Domingo (12½ cents), Jamaica (11 cents), and Haiti (10 cents), being all inferior grades. One sample of African cocoa known in the trade as San Thomé (13½ cents), and one from Ceylon (19 to 21 cents) complete the list.

A few stones were picked out from the samples, as is customary in all chocolate factories to avoid damage to the machinery

[1] *Ibid.*, 207.

as well as to insure a better product, after which the beans were roasted at a moderate heat by an experienced man. The shelling was done by hand and the weights of both nibs and shells recorded. It was found impracticable to grind the samples finer than 1 mm. owing to the large fat-content, but in the determination of starch and fiber, as is noted under "Methods of Analsis," the material was further reduced during the process of analysis. The results on the air-dry nibs and shells (Tables XXVI and XXVII) were obtained by actual analysis, but those on the unshelled beans (Table XXVIII) were calculated from the data in the two preceding tables. Each table consists of two parts; one, on the left hand page, giving the analyses of the air-dry material, the other, on the right hand page, giving the same analyses calculated to the water- and fat-free basis.

Methods of Analysis.

Water. Dry 2 grams of the material to constant weight at 100° in a current of dry hydrogen.

The following results show that drying in hydrogen gives higher results than drying in the air:

	Nibs.				Shells.			
	7724	7726	7728	7730	7725	7727	7729	7731
Dried in air.								
4 hours	3.84	3.23	2.56	1.99	7.01	5.31	4.26	3.62
8 hours	4.19	3.55	2.83	2.22	7.69	5.86	4.67	3.95
Dried in hydrogen.								
4 hours	5.02	4.31	3.61	3.00	8.39	6.76	5.88	5,02
8 hours	5.13	4.43	3.71	3.01	8.69	6.94	6.01	5.16

Total Ash. Burn 2 grams in a muffle furnace at a heat below redness.

Ash Soluble in Water. Boil the ash prepared as above with 50 cc. of water. Collect the insoluble portion in a Gooch crucible, wash with hot water, dry, ignite and weigh. Subtract the percentage of insoluble ash thus determined from the percentage of total ash, thus obtaining the percentage of water-soluble ash.

Ash Insoluble in Acid (Sand).[1] Incinerate 2 grams of the material as above directed, boil with 25 cc. of 10 per cent. hydrochloric acid (sp. gr. 1,050) for five minutes, collect the insoluble matter in a Gooch crucible, wash with hot water, ignite and weigh.

[1] Report of this Station for 1898, 186. U. S. Dept. Agr., Bur. Chem., Bul. 65, 55.

Alkalinity of the Ash (Ewell's Method).[1] Reduce 2 grams to an ash, as described above. Add 100 cc. of water, an excess of standard decinormal sulphuric acid and boil until the carbonic acid is removed. Titrate the excess of acid with standard decinormal potassium hydrate solution. Calculate the number of cc. of decinormal acid required to neutralize the ash from one gram of the original material.

Theobromin and Caffein (Decker-Kunze Method).[2] Boil 10 grams of the powdered material and 5 grams of calcined magnesia for 30 minutes with 300 cc. of water. Filter by the aid of suction on a Buchner funnel, using a round disk of filter paper. Transfer the material and paper to the same flask used for the first boiling, add 150 cc. of water and boil 15 minutes. Filter as before and repeat the operation of boiling with 150 cc. of water and filtering. Wash once or twice with hot water. Evaporate the united filtrates (with quartz sand if sugar be present), to complete dryness in a thin glass dish of about 300 cc. capacity.[3]

Grind to a coarse powder in a mortar provided with a suitable cover to prevent loss by flying. Transfer to the inner tube of a Tollens, Johnson, or Wiley fat extractor, and dry thoroughly in a water oven. Extract with chloroform for 3 hours, or until the theobromin and caffein are completely removed, into a weighed flask. It is important that the material be thoroughly dry, that an extractor be used that permits of a hot extraction, and that a considerable volume of chloroform passes through the material. Distil off the chloroform, and dry at 100° C. to constant weight.

If the material be shelled cocoa beans, pure chocolate or cocoa, the extract thus obtained is practically pure theobromin and caffein, but if the material is cocoa shells or a cocoa product mixed with a large amount of shells, the extract may be brown in color, due to the presence of considerable amounts of impurities.

In either case, separate the caffein by treating the extract in the flask at the room temperature for some hours with 50 cc. of pure benzol. Filter through a small paper into a tared dish, evaporate to dryness and dry to constant weight at 100° C., thus obtaining the amount of caffein.

Determine theobromin by Kunze's[4] method, as follows:

Add to the residue and paper 150 cc. of water, enough ammonia water to make the liquid slightly alkaline and an excess of decinormal silver nitrate solution. Boil to half the original volume, add 75 cc. of water and repeat the boiling. The solution should be perfectly neutral. If it contains the slightest amount of free ammonia, add water and boil until it is completely removed.

[1] U. S. Dept. Agr., Div. Chem., Bul. **13**, Part 7, 956.

[2] Schweiz. Wchschr. Phar., 1902, **40**, 527-530, 541-545, 553-557; Abstract Chem. Centr., 1903, **74**, 62.

[3] A "Hoffmeister Schälchen" may be used, or dishes may be made from broken flasks by making a scratch with a diamond and leading a crack from this scratch about the flask by means of a glowing spring-coal.

[4] Ztschr. f. anal. Chem., 1894, **33**, 1.

Filter from the insoluble silver theobromin compound and wash with hot water. In the filtrate determine the excess of silver nitrate by Volhard's[1] method as follows:

Add 5 cc. of cold saturated solution of ferric ammonium sulphate (ferric-ammonium alum) and enough boiled nitric acid to bleach the liquid. Titrate with decinormal ammonium sulphocyanide solution until a permanent red color appears.

1 cc. of decinormal $AgNO_3$ solution is equivalent to 0.01802 grams of theobromin. If the mixed alkaloids were colorless, the theobromin obtained by subtracting the weight of caffein from the weight of the mixed alkaloids will usually agree closely with that obtained by silver titration.

Other Nitrogenous Substances. Add the percentages of nitrogen present as theobromin and caffein,[2] subtract the sum from the total nitrogen found and multiply the remainder by 6.25.

Crude Fiber. The method is that adopted by the Association of Official Agricultural Chemists for the analysis of cattle foods, except that the fiber is filtered and weighed on a paper rather than on a Gooch crucible, since the latter is liable to clog, rendering filtration impossible.

Place the residue from the determination of ether extract in a 500-cc. Erlenmeyer flask, and add 200 cc. of boiling 1.25 per cent. sulphuric acid. Loosely cover the flask, heat at once to gentle boiling, and continue the boiling thirty minutes. Filter on a paper, wash with hot water, and rinse back into the same flask with 200 cc. of boiling 1.25 per cent. sodium hydroxide solution, nearly free from carbonate. After boiling, as before, for thirty minutes, collect the fiber on a weighed paper, thoroughly wash with hot water, and finally with a little alcohol and ether. Dry to constant weight at 100° C., and weigh. Deduct the amount of ash in the fiber, as determined by incineration, from the total weight.

Determine the loss in weight sustained by the paper on treatment with sodium-hydroxide solution, alcohol and ether, and introduce the necessary correction, if any.

In the analysis of commercial cocoa and other finely ground pulverized cocoa products, the residue after fat extraction may be used directly for fiber determination. If, however, the material is at all granular, as were the samples of cocoa nibs ground to pass a 1 mm. sieve, it must be reduced to an impalpable powder, otherwise the results will be much too high. The pulverization may be conveniently and thoroughly performed by grinding with ether, as described under "pure starch," removing the extracted residue from the paper with the hot 1.25 per cent. sulphuric acid solution.

Crude Starch (Copper-Reducing Matters by Direct Inversion Calculated as Starch). Weigh 4 grams into a small Wedgewood mortar.

[1] Ztschr. f. anal. Chem., 1874, **13**, 171.

[2] Percentage of theobromin multiplied by 0.311, and percentage of caffein multiplied by 0.289, give percentage of nitrogen.

Add 25 cc. of ether and grind with a pestle. After the coarser material has settled out decant off the ether with the fine suspended matter on a 11 cm. filter paper. Repeat this treatment several times until no more coarse material remains. After the ether has evaporated from the filter, transfer the fat-free residue to the mortar by means of a jet of cold water and rub to an even paste. Filter the liquid on the paper previously employed. Repeat the process of transferring from the filter to the mortar, grinding and filtering, until all sugar is removed. Proceeding in this manner, all starch and sugar are removed and any error due to caking of the material is obviated. In the case of cocoa sweetened with sugar, the filtrate should measure at least 500 cc.

Transfer the residue to a flask of 500 cc. capacity with 200 cc. of water, convert the starch into dextrose by the Sachsse method,[1] as follows:

Add 20 cc. of 25 per cent. hydrochloric acid (sp. gr. 1.125) and heat for three hours in a boiling water-bath. Care should be taken that the flask is surrounded by boiling water to the height of the liquid within or otherwise treated so that the solution is heated within a degree or two of 100° C. Cool the solution, nearly neutralize with sodium hydroxide solution, add 5 cc. of basic acetate solution,[2] make up to 250 cc. in a graduated flask, and filter through a dry paper. To 100 cc. of the filtrate, add 1 cc. of 60 per cent. sulphuric acid measured from a pipette.

Shake thoroughly and, as soon as the lead sulphate has settled, filter through a dry paper. Determine reducing matters by the Allihn method,[3] as follows: Mix 30 cc. of a solution containing 173 grams of Rochelle salts and 125 grams of caustic potash in 500 cc. of water, 30 cc. of a solution of 34.69 grams of pure crystallized copper sulphate in 500 cc. of water, and 60 cc. of water, in a beaker of 300 cc. capacity, and heat to boiling. To the boiling liquid, without delay, add 25 cc. of the solution to be examined, heat to boiling, and boil 3 minutes. After the reduced copper suboxide has settled, collect on a Gooch crucible.

To prepare asbestos pulp for use in the Gooch crucible, cut woolly asbestos (best quality) into small pieces, boil with hydrochloric acid, and wash free from acid and fine particles on a sieve with 1 mm. meshes. Woolly asbestos of suitable quality, when packed in the crucibles with the aid of a blunt glass rod, retains completely the finely divided copper suboxide, which is not true of the variety usually employed in filtering coarser precipitates.

The copper may be weighed either as Cu_2O, after washing successively with alcohol and ether, and drying at 100° C., or as CuO, after heating from 2 to 5 minutes at dull redness in the oxidizing flame.[4]

[1] Chem. Centralbl., 1877, **8**, 732.
[2] Prepared by boiling for 30 minutes, 430 grams of normal lead acetate and 130 grams of litharge with 1,000 cc. of water and diluting the filtrate to 1.25 sp. gr.
[3] Jour. prakt. Chem., 1880, N. F., **22**, 52.
[4] Maine Agr. Exp. Sta., 1888, 207.

Owing to the high percentage of fat, the caking during washing with water, and the presence of cocoa red and other constituents, the determination of starch in cocoa products, whether by direct inversion or the much more exact diastase method, presents greater difficulties than are encountered in the analysis of most starchy materials.

The above described process, if strictly followed, gives results which, although not representing accurately the percentage of starch, are concordant and of considerable value in detecting starchy adulterants.

Pure Starch (Diastase Method). Treat four grams with ether and water, as described in the preceding section. Especial care should be exercised that the material is ground to a fine powder with ether.

Carefully wash the wet residue from the paper into a beaker with 100 cc. of water, heat on an asbestos plate to boiling with constant stirring, and continue the boiling and stirring thirty minutes. Replace the water lost by evaporation, and immerse the beaker in a water-bath kept at from 55° to 60°. When the liquid has cooled to the temperature of the bath, add 10 cc. of fresh extract of malt (prepared by digesting for two or three hours 100 grams of powdered fresh malt with 1,000 cc. of water and filtering), and digest the mixture for two hours with occasional stirring.[1] Boil a second time for thirty minutes, cool, and digest as before with another 10-cc. portion of malt extract. Heat to boiling the third time, cool, and transfer to a 250-cc. graduated flask. Add 3 cc. of alumina cream to insure a clear filtrate, make up to the mark, filter through a dry paper, and remove 200 cc. of the filtrate to a 500-cc. flask. Conduct the inversion, and determine the reducing power of the solution, as already described under "Copper-reducing matter by direct inversion," except that the treatment with basic acetate of lead and its removal with sulphuric acid is omitted. Make a correction for the dextrose due to the added malt extract, as determined by blank analyses. The residue after the malt digestion, when examined microscopically, must be entirely free from starch.

Owing to the high percentage of fat, it was found impracticable to reduce cocoa nibs to powder finer than 1 mm., which is altogether too coarse for extracting the starch by the diastase method as well as for the determination of crude fiber. It was therefore necessary either to extract the fat from a weighed portion of the sample, dry the residue, weigh, grind to a fine powder and make the analyses on weighed portions of this fine fat-free material, or else grind weighed portions of the coarse material during the process of analysis as above described. The latter course was found the more convenient of the two.

As cocoa starch is said to be more resistant to boiling water than other starches, thorough boiling with water and a prolonged digestion with malt extract is advisable. Treatment with basic acetate of lead is not necessary.

[1] Handbuch der Spiritusfabrikation, 7th ed., 1898, 109; see also Wiley, Principles and Practice of Agricultural Analysis, 1897, vol. iii, 198.

Other Nitrogen-free Substances. These figures are obtained by subtracting from 100 the sum of the percentages of water, total ash, theobromin, caffein, other nitrogenous substances, crude fiber, pure starch and fat.

Fat. Weigh 3 grams of material into the inner tube of a Tollens, Johnson, or Wiley fat extractor. Keep in a sulphuric acid desiccator three days, or until the water is practically removed. Extract with anhydrous ether until no more fat is removed. Grind and repeat the extraction. Dry the extract at 100° C.

It is essential that the material be dried before extraction, but this drying cannot be performed to advantage by heat owing to the melting of the fat and consequent caking of the residue. The following results indicate that a slight error is introduced if the air-dry material is extracted.

	Nibs.				Shells.			
	7724	7726	7728	7730	7725	7727	7729	7731
Direct extraction---	51.57	51.70	51.93	51.49	4.78	3.34	3.03	3.33
Extraction after drying in desiccator -	51.45	51.69	51.65	51.50	4.27	2.92	2.68	2.98

Total Nitrogen is determined by the Kjeldahl method.

Polarization (Sugar). Extract 13.024 grams of the material (half the normal quantity) on a filter paper with absolute ether, keeping the funnel covered with a watch glass to avoid absorption of water. Allow the residue to dry at the room temperature, and transfer, together with the paper, to a graduated 200-cc. flask. Add 60 cc. of water, shake and allow to stand with occasional shaking for three hours. Clarify with 10 cc. basic lead acetate, 2 cc. of a saturated solution of alum and 2 cc. of alumina cream. Make up to the mark, shake and filter through a dry paper. Polarize the solution in a 200 mm. tube before inversion and in a 220 mm. tube after inversion. Multiply the readings by four.

In the case of sweetened cocoa or chocolate, calculate the percentage of cane sugar by Clerget's formula, introducing a correction for the volume occupied by the insoluble matter determined as follows: After sufficient solution has been obtained for polarization, collect on the filter all the insoluble matter (undissolved substance, filter paper, lead and alumina precipitates, etc.) and wash several times with cold water. Wash into a dish with a jet of water, evaporate on a water bath to dryness and dry thoroughly at 120° C. Transfer the dry residue to a graduated 50 cc. flask and add water from a burette. Cork, and allow to stand some hours, agitating gently from time to time to liberate bubbles.

Finally, fill to the mark with water. The total number of cc. of water added is the corrected volume of the solution polarized.

Constants of the Fat. The melting point is determined on the ether extract by Wiley's method,[1] refractive index by the Zeiss refractometer,[2] and iodine number by the Hübl process.[3]

[1] U. S. Dept. Agr., Bur. Chem., Bul. 65, 23.
[2] *Ibid.*, p. 23.
[3] *Ibid.*, p. 24.

Discussion of the Analyses.

The analyses of the air-dry nibs show the range in composition which may be expected in pure unsweetened chocolate, allowing for the slightly greater amount of ash, sand and crude fiber unavoidably present in the machine-shelled product.

The same analyses reduced to the water- and fat-free basis and with the same allowance for accidental impurity serve for comparison with analyses of commercial cocoa[1] and sweet chocolate, calculated not only free of water and fat but also free of sugar if this ingredient is present.

Determinations of ash, sand and crude fiber are of especial value in detecting cocoa shells, while the percentages of crude starch (reducing matters by direct inversion calculated as starch) and pure starch (determined by the diastase method) serve to detect considerable amounts of wheat flour, arrowroot starch and other starchy adulterants. Both shells and starchy matter are, however, detected more conveniently and in smaller amounts by microscopic examination, the chemical analysis being chiefly useful in determining the extent of adulteration.

Since low percentages of fat in either chocolate or cocoa may be due either to removal of part of this ingredient or to addition of a diluent, this determination should always be supplemented by further analyses and microscopic examination.

Cocoa shells are much less uniform in composition than the nibs, since they are contaminated with variable amounts of adhering dirt and are changed to a greater or less extent by the roasting, while the nibs are protected by the shells from contamination and change.

Water. The analyses show that the shells of roasted cocoa beans contain a greater and more variable amount of water than the nibs. The nibs are not only protected by the shells from contact with the air but, owing to the large percentage of fat, when once dry, they do not absorb moisture as readily as the more hygroscopic shells.

Ash. Owing to adhering dirt the percentages of total ash and sand in the shells are in all cases much greater than in the nibs and show much wider variations.

[1] See tables, pages 258, 259.

The percentages of ash soluble in water and the figures for alkalinity are also higher in the shells, but these higher results are due largely to true constituents of the shell. The alkalinity of the ash of the shells, although on the average twice as much as in the nibs, does not vary so greatly in the different samples.

It should be noted that the addition of shells to cocoa products increases the total ash soluble in water and the alkalinity of the ash and renders these determinations alone of little value in determining whether or not a sample has been made by the Dutch process.

Alkaloids (Diureides). The analyses not only show wide range in the percentages of theobromin and caffein present in the different varieties, but also in the relative amounts of the two alkaloids. For example, in Maracaibo nibs No. 7744, Table XXVI, the theobromin was 0.84 and the caffein 0.73 per cent., but in Haiti nibs No. 7762 the theobromin was 1.06 and the caffein 0.14 per cent. and in the average of all samples of nibs the percentages were 1.04 and 0.40 respectively. In the samples of Venezuelan nibs, including the roasted and unroasted samples of Table XXV and Nos. 7746, 7740, 7742, 7748, 7732, 7752 and 7736 of Table XXVI, the percentages are, however, quite uniform.

Hilger[1] was the first to show that the fresh cocoa bean contains a glucoside part of which, during drying and fermentation, is decomposed by the action of an enzyme into theobromin, caffein, dextrose and cacao-red. Schweitzer[2] regards the glucoside as an ester ($C_{60}H_{86}O_{15}N_4$) containing one part of theobromin, one part of cacao-red, and six parts of glucose. The latter author found that the theobromin resulting from the decomposition of this glucoside contained 0.3 per cent. of caffein.

Schweitzer's conclusions do not, however, account for the widely different proportion of the two diureides in our samples.

Other Nitrogenous Substances. Total Nitrogen. The total nitrogen is about the same in both nibs and shells, but as the nibs contain greater amounts of joint alkaloids they consequently contain smaller amounts of other nitrogenous substances. The percentage of total nitrogen in the water- and fat-free nibs is much greater than in the shells or in any of the common adulterants.

[1] Apoth. Zeit., 1892, 469.
[2] Pharm. Ztg., 1898, **43**, 380.

Crude Fiber. As has been stated, crude fiber determinations are of great value in detecting adulterations with shells or other woody material. Calculated to the water- and fat-free basis the minimum percentage in the shells is 13.71, and the maximum percentage in the nibs is 6.56, from which it appears that the addition of each fifteen per cent. of shells increases the amount of fiber by at least one per cent.

Starch. Determinations of "crude starch" (reducing matters by direct inversion calculated as starch) and "pure starch" (determined by the diastase process) are of use both in detecting starchy adulterants such as flour and starch, and non-starchy adulterants including cocoa shells, the greatest differentiation being obtained by the diastase method whichever kind of adulterant is present.

Other Nitrogen-free Substances. These figures are of some scientific interest, but can be obtained only by a more complete analysis than is usually called for in practical work.

Polarization. In many of the samples of nibs direct polarization gave a zero reading, but in others small amounts of optically active substances were present equivalent in one case to 1.6 per cent. of cane sugar. After inversion in all cases the reading was zero. All of the shells contained decided amounts of active substances equivalent to from 3 to 7 per cent. of cane sugar. The readings both before and after inversion were in all cases practically the same.

Constants of the Fat. The ether extract was used for these determinations, as the object was to secure data for use in the detection of foreign fats in cocoa and chocolate and not in the examination of commercial cocoa butter. The latter product is obtained either by pressure or partial extraction with a petroleum product, and therefore may be different from the extract obtained by complete exhaustion with ether.

Our results obtained on ether extract agree, however, quite closely with the published results on cocoa butter.

TABLE XXVI.—ANALYSES OF ROASTED COCOA NIBS.*

Station No.		Per cent. of nibs in the whole beans.	IN THE AIR-DRY MATERIAL.															
			Water.	Ash.				Theobromin.	Caffein.	Other nitrogenous substances.	Crude fiber.	Crude starch.	Pure starch.	Other nitrogen-free substances.	Fat.	Total nitrogen.	Polarization at 20° C.	
				Total.	Soluble in water.	Insoluble in acid (sand).	Alkalinity.										Direct.	After inversion.
		%	%	%	%	%		%	%	%	%	%	%	%	%	%		
7746	Chuao	86.12	2.70	3.41	1.14	0.07	2.85	0.95	0.68	11.56	2.67	10.96	7.81	19.22	51.00	2.34	0	0
7740	Selected Venezuelan	86.16	3.01	3.46	1.27	0.02	2.70	0.98	0.44	12.56	3.20	12.37	8.82	19.33	48.20	2.44	0	0
7742	San Felipe	88.65	2.48	3.56	1.28	0.06	2.68	0.92	0.45	12.62	3.12	11.84	8.65	19.92	48.28	2.43	0	0
7748	Ovello	88.65	2.37	3.51	1.10	0.04	2.66	0.82	0.48	12.75	2.57	11.82	8.76	20.63	48.11	2.43	0	0
7732	Santa Rosa	87.15	2.80	3.33	1.24	0.03	2.80	0.87	0.38	12.56	2.47	11.82	8.99	20.31	48.29	2.39	0	0
7752	Aqua Clara	88.26	2.65	3.21	1.12	0.00	2.65	1.06	0.56	11.75	2.61	11.46	8.09	19.14	50.93	2.37	0	0
7736	Caracas	86.68	2.72	3.48	1.20	0.02	2.80	0.99	0.55	12.06	2.30	11.73	8.79	20.34	48.77	2.40	0	0
7744	Maracaibo	89.56	2.86	4.15	1.86	0.00	3.35	0.84	0.73	11.00	2.70	12.09	8.76	18.89	50.07	2.23	+1.6	0
7734	Ariba	88.76	2.64	3.62	1.17	0.05	1.85	1.18	0.28	13.06	2.21	9.30	6.49	20.13	50.39	2.54	+1.0	0
7738	Bahia	88.16	2.77	2.76	0.73	0.02	1.50	1.16	0.18	11.19	2.23	11.59	8.00	20.12	51.59	2.20	+1.0	0
7754	Trinidad	88.02	3.09	3.12	1.39	0.01	2.65	0.91	0.41	12.37	2.70	12.25	8.89	20.23	48.28	2.38	0	0
7758	Cuban	89.32	3.18	3.11	1.09	0.00	2.17	1.10	0.29	11.81	2.43	10.01	7.19	18.64	52.25	2.32	0	0
7756	St. Domingo	88.12	2.73	3.21	0.97	0.05	2.20	1.27	0.26	12.37	2.51	10.89	8.14	21.07	48.44	2.45	+0.9	0
7764	Jamaica	91.17	2.29	3.16	1.11	0.01	2.25	1.16	0.22	12.12	2.80	9.46	6.74	19.70	51.81	2.36	+1.0	0
7762	Haiti	87.21	2.64	3.13	0.91	0.04	2.95	1.06	0.14	12.81	2.85	10.32	7.08	18.60	51.69	2.42	0	0
7750	African	88.96	2.48	2.61	0.90	0.01	1.75	1.32	0.23	11.19	2.81	11.41	8.40	18.72	52.24	2.27	+0.6	0
7760	Ceylon	92.90	2.77	3.67	1.23	0.01	2.80	1.03	0.62	12.19	2.79	10.37	7.64	17.69	51.60	2.45	+1.0	0
	Maximum	92.90	3.18	4.15	1.86	0.07	3.35	1.32	0.73	13.06	3.20	12.37	8.99	21.07	52.25	2.54	+1.6	0
	Minimum	86.12	2.29	2.61	0.73	0.00	1.50	0.82	0.14	11.00	2.21	9.30	6.49	17.69	48.11	2.20	0	0
	Average	88.46	2.72	3.32	1.16	0.02	2.51	1.04	0.40	12.12	2.64	11.16	8.07	19.57	50.12	2.38	+0.4	0

* Shelled Cocoa Beans.

TABLE XXVI.—ANALYSES OF ROASTED COCOA NIBS.*

Station No.		IN THE WATER- AND FAT-FREE MATERIAL.												CONSTANTS OF FAT (ether extract).			
		Ash.				Theobromin.	Caffein.	Other nitrogenous substances.	Crude fiber.	Crude starch.	Pure starch.	Other nitrogen-free substances.	Total nitrogen.	Polarization at 20° C.		Melting point, degrees C.	Zeiss refracto-meter reading at 40° C.	Refractive index at 40° C.	Iodine Number.
		Total.	Soluble in water.	Insoluble in acid (sand).	Alkalinity.									Direct.	After inversion.				
		%	%	%		%	%	%	%	%	%	%	%						
7746	Chuao	7.36	2.46	0.14	6.16	2.05	1.47	24.97	5.77	23.67	16.87	41.51	5.05	0	0	33.0	47.00	1.4572	33.90
7740	Selected Venezuela	7.09	2.60	0.04	5.53	2.01	0.90	25.74	6.56	25.35	18.07	39.63	5.00	0	0	34.0	47.5	1.4576	34.21
7742	San Felipe	7.23	2.60	0.12	5.44	1.87	0.91	25.64	6.33	24.04	17.57	40.45	4.93	0	0	32.5	47.5	1.4576	34.68
7748	Ovello	7.09	2.22	0.08	5.37	1.66	0.97	25.75	5.19	23.87	17.69	41.65	4.91	0	0	33.5	47.00	1.4572	34.84
7732	Santa Rosa	6.81	2.53	0.06	5.72	1.78	0.78	25.67	5.05	24.16	18.38	41.53	4.88	0	0	33.5	47.5	1.4576	33.74
7752	Aqua Clara	6.92	2.26	0.00	5.71	2.28	1.21	25.31	5.62	24.68	17.43	41.23	5.11	0	0	33.5	47.00	1.4572	34.51
7736	Caracas	7.17	2.47	0.04	5.77	2.04	1.13	24.86	4.74	24.18	18.12	41.94	4.95	0	0	33.8	47.25	1.4574	34.07
7744	Maracaibo	8.81	3.96	0.00	7.12	1.79	1.55	23.37	5.74	25.68	18.61	40.13	4.74	+3.4	0	32.3	47.5	1.4576	35.38
7734	Ariba	7.71	2.49	0.11	3.94	2.51	0.60	27.80	4.70	19.80	13.82	42.85	5.41	+2.1	0	34.5	47.25	1.4574	34.50
7738	Bahia	6.05	1.60	0.04	3.29	2.54	0.39	24.52	4.89	25.40	17.53	44.08	4.82	+2.2	0	33.6	48.00	1.4579	36.37
7754	Trinidad	6.42	2.86	0.02	5.45	1.87	0.84	25.43	5.55	25.19	18.28	41.61	4.89	0	0	33.5	47.00	1.4572	34.19
7758	Cuban	6.98	2.45	0.00	4.87	2.47	0.65	26.50	5.45	22.44	16.13	41.82	5.21	0	0	33.5	47.5	1.4576	35.70
7756	St. Domingo	6.58	1.99	0.10	4.51	2.60	0.53	25.33	5.14	22.30	16.67	43.15	5.02	+1.9	0	32.7	47.00	1.4072	33.92
7764	Jamaica	6.88	2.42	0.02	4.90	2.53	0.48	26.40	6.10	20.61	14.68	42.93	5.14	+2.2	0	32.3	47.00	1.4572	36.17
7762	Haiti	6.85	1.99	0.08	6.46	2.32	0.31	28.05	6.24	22.60	15.50	40.73	5.30	0	0	35.0	46.00	1.4565	35.43
7750	African	5.76	1.98	0.02	3.86	2.92	0.51	24.71	6.21	25.20	18.55	41.34	5.01	+1.1	0	33.0	47.5	1.4576	57.89
7760	Ceylon	8.04	2.70	0.02	6.14	2.26	1.36	26.71	6.11	22.72	16.74	38.78	5.37	+2.2	0	32.7	47.5	1.4576	35.07
	Maximum	8.81	3.96	0.14	7.12	2.92	1.55	28.05	6.56	25.68	18.61	44.08	5.41	+3.4	0	35.0	48.00	1.4579	37.89
	Minimum	5.76	1.60	0.00	3.29	1.66	0.31	23.37	4.70	19.80	13.82	38.78	4.74	0	0	32.3	46.00	1.4565	33.74
	Average	7.04	2.46	0.05	5.32	2.21	0.86	25.69	5.61	23.66	17.10	41.49	5.05	+0.9	0	33.3	47.23	1.4573	34.97

* Shelled Cocoa Beans.

TABLE XXVII.—ANALYSES OF ROASTED COCOA SHELLS.

Station No.		Per cent. of shells in the whole bean.	IN THE AIR-DRY MATERIAL.																
				Ash.													Polarization at 20° C.	
			Water.	Total.	Soluble in water.	Insoluble in acid (sand).	Alkalinity.	Theobromin.	Caffein.	Other nitrogenous substances.	Crude fiber.	Crude starch.	Pure starch.	Other nitrogen-free substances.	Fat.	Total nitrogen.	Direct.	After inversion.
		%	%	%	%	%		%	%	%	%	%	%	%	%	%		
7747	Chuao	13.88	3.71	20.72	2.52	11.18	5.02	0.39	0.15	10.69	12.93	9.87	3.69	45.72	2.00	1.87	+4.9	----
7741	Selected Venezuelan	13.84	6.57	8.24	4.89	0.34	5.92	0.46	0.24	17.31	16.94	13.23	4.44	48.83	1.97	2.98	+6.8	+6.4
7743	San Felipe	11.35	3.81	15.30	2.02	5.89	5.60	0.61	0.21	12.25	14.95	11.69	4.17	46.13	2.57	2.21	+4.0	+3.2
7749	Ovello	11.35	4.14	16.66	2.82	7.02	5.05	0.48	0.17	12.44	15.37	10.23	3.42	45.08	2.24	2.19	+6.1	----
7733	Santa Rosa	12.85	4.86	8.54	4.70	0.84	5.85	0.39	0.16	14.94	17.31	11.19	4.65	46.20	2.95	2.55	+4.0	+4.0
7753	Aqua Clara	11.74	4.75	10.60	3.85	3.29	5.37	0.42	0.20	13.12	15.73	12.05	4.65	47.21	3.32	2.29	+6.8	+6.4
7737	Caracas	13.32	4.52	11.60	3.94	3.74	5.32	0.37	0.15	13.06	15.03	11.07	4.14	48.10	3.03	2.25	+4.0	+4.0
7745	Maracaibo	10.44	5.28	7.23	3.98	0.35	5.73	0.46	0.28	16.00	15.80	11.94	3.36	48.03	3.56	2.78	+6.1	+5.6
7735	Ariba	11.24	4.47	8.20	5.67	0.47	5.80	0.20	0.10	13.31	14.73	10.89	4.47	51.86	2.66	2.22	+7.0	+6.4
7739	Bahia	11.84	4.67	7.46	4.48	0.05	5.62	0.56	0.08	18.06	16.90	10.78	3.90	46.15	2.22	3.09	+3.1	+2.8
7755	Trinidad	11.98	5.72	7.88	4.45	0.20	5.77	0.60	0.19	15.31	18.35	13.07	5.16	44.81	1.98	2.69	+5.2	+5.2
7759	Cuban	10.68	5.33	7.65	3.44	0.88	----	----	----	----	16.96	11.91	----	----	2.67	2.05	----	----
7757	St. Domingo	11.88	4.48	7.14	3.18	0 99	----	----	----	----	18.47	10.78	----	----	1.66	1.76	----	----
7765	Jamaica	8.83	4.82	11.36	3.08	4.30	----	----	----	----	19.21	12.46	----	----	2.48	1.91	----	----
7763	Haiti	12.79	5.24	16.34	2.32	2.49	----	----	----	----	17.46	10.80	----	----	5.23	2.20	----	----
7751	African	11.04	5.03	8.22	4.68	0.23	5.22	0.90	0.04	18.00	18.47	11.66	3.60	43.71	2.03	3.17	----	----
7761	Ceylon	7.10	5.37	5.07	2.37	0.38	---	----	----	----	18.14	13.89	----	----	4.57	1.74	----	----
	Maximum	13.88	6.57	20.72	5.67	11.18	5.92	0.90	0.28	18.06	19.21	13.89	5.16	51.86	5.23	3.17	+7.0	+6.4
	Minimum	8.83	3.71	7.14	2.02	0.05	5.02	0.20	0.04	10.69	12.93	9.87	3.36	43.71	1.66	1.74	+3.0	+2.8
	Average	11.54	4.87	10.48	3.67	2.51	5.52	0.49	0.16	14.54	16.63	11.62	4.14	46.40	2.77	2.34	+5.2	+4.9

TABLE XXVII.—ANALYSES OF ROASTED COCOA SHELLS.

Station No.		IN THE WATER- AND FAT-FREE MATERIAL.													
		Ash.												Polarization at 20° C.	
		Total.	Soluble in water.	Insoluble in acid (sand).	Alkalinity.	Theobromin.	Caffein.	Other nitrogenous substances.	Crude fiber.	Crude starch.	Pure starch.	Other nitrogen-free substances.	Total nitrogen.	Direct.	After inversion.
		%	%	%		%	%	%	%	%	%	%	%		
7747	Chuao	21.97	2.67	11.86	5.32	0.41	0.16	11.34	13.71	10.47	3.91	48.50	1.98	+5.2	----
7741	Selected Venezuelan	9.01	5.35	0.37	6.47	0.50	0.26	18.93	18.52	14.47	4.86	47.92	3.26	+7.4	+7.0
7743	San Felipe	16.34	2.16	6.29	5.98	0.65	0.22	13.08	15.96	12.49	4.45	49.30	2.36	+4.3	+3.4
7749	Ovello	17.79	3.01	7.50	5.39	0.51	0.18	13.29	16.42	10.94	3.65	48.16	2.34	+6.5	----
7733	Santa Rosa	9.27	5.10	0.91	6.35	0.42	0.17	16.21	18.77	12.14	5.04	50.12	2.77	+4.3	+4.3
7753	Aqua Clara	11.53	4.19	3.58	5.84	0.46	0.22	14.27	17.11	13.11	5.06	51.35	2.49	+7.4	+7.0
7737	Caracas	12.55	4.26	4.05	5.75	0.40	0.16	14.13	16.26	11.97	4.48	52.02	2.43	+4.3	+4.3
7745	Maracaibo	7.93	4.37	0.38	6.29	0.50	0.31	17.54	17.33	13.10	3.69	52.70	3.05	+6.7	+6.1
7735	Ariba	8.83	6.11	0.51	6.25	0.22	0.11	14.33	15.86	11.73	4.81	55.84	2.39	+7.5	+6.9
7739	Bahia	8.01	4.81	0.05	6.04	0.60	0.09	19.40	18.15	11.58	4.19	49.58	3.32	+3.3	+3.0
7755	Trinidad	8.54	4.82	0.22	6.25	0.65	0.21	16.59	19.88	14.16	5.59	48.54	2.91	+5.6	+5.6
7759	Cuban	8.32	3.74	0.96	----	----	----	----	18.43	12.94	----	----	2.23	----	----
7757	St. Domingo	7.61	3.39	1.05	----	----	----	----	19.68	11.48	----	----	1.87	----	----
7765	Jamaica	12.26	3.32	4.64	----	----	----	----	20.72	13.44	----	----	2.06	----	----
7763	Haiti	18.25	2.59	2.78	----	----	----	----	19.50	12.06	----	----	2.46	----	----
7751	African	8.84	5.04	0.25	5.62	0.97	0.04	19.37	19.87	12.55	3.87	47.04	3.41	----	----
7761	Ceylon	5.63	2.63	0.42	---	----	----	----	20.15	15.42	----	----	1.93	----	----
	Maximum	21.97	6.11	11.86	6.47	0.97	0.31	19.40	20.72	15.42	5.59	55.84	3.41	+7.4	+7.0
	Minimum	5.63	2.16	0.05	5.32	0.22	0.04	11.34	13.71	10.47	3.65	47.04	1.87	+3.3	+3.0
	Average	11.33	3.97	2.70	5.97	0.52	0.17	15.70	18.01	12.59	4.47	50.08	2.54	+5.7	+5.3

TABLE XXVIII.—ANALYSES OF ROASTED UNSHELLED COCOA BEANS. (CALCULATED FROM DATA IN TABLES XXVI AND XXVII.)

	In the air-dry material.															
		Ash.													Polarization at 20° C.	
	Water.	Total.	Soluble in water.	Insoluble in acid (sand).	Alkalinity.	Theobromin.	Caffein.	Other nitrogenous substances.	Crude fiber.	Crude starch.	Pure starch.	Other nitrogen-free substances.	Fat.	Total nitrogen.	Direct.	After inversion.
	%	%	%	%		%	%	%	%	%	%	%	%	%		
Chuao	2.85	5.82	1.33	1.61	3.16	0.87	0.61	11.44	4.09	10.80	7.24	22.87	44.21	2.27	+0.7	....
Selected Venezuelan	3.50	4.12	1.84	0.07	3.15	0.90	0.41	13.21	5.11	12.49	8.22	22.72	41.81	2.51	+0.9	+0.9
San Felipe	2.63	4.90	1.36	0.72	3.02	0.89	0.42	12.58	4.47	11.82	8.14	22.89	43.08	2.40	+0.5	+0.4
Ovello	2.57	5.00	1.30	0.84	2.92	0.78	0.45	12.71	4.02	11.64	8.16	23.42	42.89	2.40	+0.7	....
Santa Rosa	3.06	4.00	1.68	0.14	3.19	0.81	0.36	12.87	4.37	11.74	8.43	23.64	42.46	2.41	+0.5	+0.5
Aqua Clara	2.90	4.07	1.44	0.39	2.97	0.99	0.51	11.91	4.15	11.52	7.69	22.43	45.35	2.36	+0.8	+0.7
Caracas	2.96	4.56	1.57	0.52	3.14	0.91	0.50	12.19	4.01	11.64	8.18	24.03	42.66	2.38	+0.5	+0.5
Maracaibo	3.11	4.48	2.17	0.04	3.60	0.80	0.68	11.52	4.07	12.07	8.19	21.93	45.22	2.29	+2.0	+0.6
Ariba	2.84	4.13	1.68	0.10	2.29	1.07	0.26	13.09	3.62	9.47	6.26	23.70	45.03	2.50	+1.7	+0.7
Bahia	2.99	3.31	1.17	0.03	1.99	1.09	0.17	12.01	3.97	11.50	7.51	23.21	45.74	2.31	+1.3	+0.3
Trinidad	3.41	3.69	1.76	0.03	3.02	0.87	0.38	12.72	4.58	12.35	8.44	23.17	42.74	2.42	+0.6	+0.6
Cuban	3.41	3.60	1.34	0.09	....	....	....	....	3.98	10.21	....	....	46.95	2.29	....	....
St. Domingo	2.94	3.68	1.23	0.17	....	....	....	....	4.40	10.88	....	....	42.88	2.37	....	....
Jamaica	2.52	3.88	1.28	0.39	....	....	....	....	4.25	9.72	....	....	47.45	2.32	....	....
Haiti	2.97	4.82	1.09	0.36	....	....	....	....	4.72	10.38	....	....	45.75	2.39	....	....
African	2.77	3.23	1.32	0.04	2.13	1.28	0.22	11.92	4.54	11.45	7.88	21.47	46.69	2.37	....	....
Ceylon	2.95	3.77	1.31	0.04	....	....	....	....	3.88	10.62	....	....	48.25	2.40	....	....
Maximum	3.50	5.82	2.17	1.61	3.60	1.28	0.68	13.21	5.11	12.49	8.44	24.03	48.25	2.51	+2.0	+0.9
Minimum	2.52	3.23	1.09	0.03	1.99	0.78	0.17	11.44	3.62	9.47	6.26	21.47	41.81	2.27	+0.5	+0.3
Average	2.96	4.18	1.46	0.33	2.89	0.94	0.41	12.35	4.25	11.13	7.86	22.96	44.66	2.37	+0.9	+0.6

TABLE XXVIII.—ANALYSES OF ROASTED UNSHELLED COCOA BEANS.

	In the water- and fat-free material.													
	Ash.												Polarization at 20° C.	
	Total.	Soluble in water.	Insoluble in acid (sand).	Alkalinity.	Theobromin.	Caffein.	Other nitrogenous substances.	Crude fiber.	Crude starch.	Pure starch.	Other nitrogen-free substances.	Total nitrogen.	Direct.	After inversion.
	%	%	%		%	%	%	%	%	%	%	%		
Chuao	10.99	2.51	3.04	5.97	1.64	1.15	21.60	7.72	20.40	13.67	43.23	4.29	+1.3	....
Selected Venezuelan	7.53	3.36	0.13	5.76	1.65	0.75	24.16	9.34	22.84	15.03	41.54	4.59	+1.7	+1.7
San Filipe	9.03	2.50	1.33	5.56	1.64	0.77	23.17	8.23	21.77	14.99	42.17	4.42	+1.0	+0.9
Ovello	9.17	2.38	1.54	5.35	1.43	0.82	23.30	7.37	21.34	14.96	42.95	4.40	+1.4	....
Santa Rosa	7.21	3.09	0.28	5.87	1.49	0.66	23.65	8.04	21.59	15.50	43.45	4.43	+0.9	+0.9
Aqua Clara	7.86	2.78	0.75	5.74	1.91	0.99	23.01	8.02	22.26	14.86	43.35	4.56	+1.5	+1.3
Caracas	8.39	2.89	0.96	5.77	1.67	0.92	22.41	7.37	21.40	15.04	44.20	4.38	+0.9	+0.9
Maracaibo	8.67	4.20	0.08	6.97	1.55	1.32	22.30	7.88	23.36	15.85	42.43	4.43	+3.8	+1.1
Ariba	7.92	3.22	0.19	3.39	2.05	0.50	25.11	6.94	18.17	12.01	45.47	4.80	+3.3	+1.3
Bahia	6.46	2.28	0.06	3.88	2.13	0.33	23.42	7.74	22.43	14.65	45.27	4.51	+2.5	+0.6
Trinidad	6.85	3.27	0.06	5.61	1.62	0.71	23.62	8.51	22.93	15.67	43.02	4.49	+1.1	+1.1
Cuban	7.25	2.70	0.18	....	....	....	....	8.02	20.56	....	....	4.61	....	....
St. Domingo	6.79	2.27	0.31	....	....	....	....	8.12	20.08	....	....	4.37	....	....
Jamaica	7.75	2.56	0.78	....	....	....	....	8.49	19.42	....	....	4.64	....	....
Haiti	9.40	2.12	0.70	....	....	....	....	9.20	20.24	....	....	4.66	....	....
African	6.39	2.61	0.08	4.21	2.53	0.44	23.58	8.98	22.65	15.59	42.49	4.69	....	....
Ceylon	7.73	2.68	0.08	....	....	....	....	7.95	21.76	....	....	4.92	....	....
Maximum	10.99	4.20	3.04	6.97	2.53	1.32	25.11	9.34	23.36	15.85	45.47	4.92	+3.8	+1.7
Minimum	6.39	2.12	0.06	3.39	1.43	0.33	21.60	6.94	18.17	12.01	41.54	4.29	+0.9	+0.6
Average	7.96	2.79	0.62	5.34	1.77	0.78	23.28	8.11	21.36	14.82	43.30	4.54	+1.8	+1.1

THE ANATOMY OF EDIBLE BERRIES.[1]

By A. L. Winton.

For the purpose of facilitating the microscopic examination of preserves, jams, etc., during the year 1901 and the early part of 1902, I made a study of the microscopic structure of a number of fruits grown in the United States, some of which are descendants of European species, others of species indigenous to America, and during the spring of 1902, while at the University of Graz, Austria, at the suggestion of Prof. Moeller I extended the investigation so as to embrace the allied fruits grown only in Europe.

Twelve were investigated in America, as follows:

The cultivated strawberry (*Fragaria Chiloensis* Ehrh.).
The American field strawberry (*F. Virginiana* Duchesne).
The American red raspberry (*Rubus strigosus* Michx.).
The black raspberry (*R. occidentalis* L.).
The blackberry (*R. nigrobaccus* var. *sativus* Bailey).
The dewberry (*R. villosus* Ait.).
The red currant (*Ribes rubrum* L.).
The black currant (*R. nigrum* L.).
The American gooseberry (*R. oxyacanthoides* L.).
The European gooseberry (*R. Grossularia* L.).
The American cranberry (*Vaccinium macrocarpon* Ait.).
The huckleberry (*Gaylussacia resinosa* Torr. and Gray).

Three were studied in Austria, as follows:

The forest strawberry (*Fragaria vesca* L.).
The European raspberry (*Rubus Idaeus* L.).
The mountain cranberry (*Vaccinium Vitis Idaea* L.).

Although the primary object of this work was to secure data for use in the detection of inferior fruits, foreign seeds and other adulterants in fruit products, other points of scientific interest have not been overlooked.

[1] This paper was printed in the German language in Ztschr. f. Unters. d. Nahr. u. Genussm., 1902, 5, 785-814.

The writer desires to express his gratitude to Prof. Dr. Josef Moeller, Director of the Pharmacological Institute, Graz University, for kindly advice and criticism; also to Mr. W. E. Britton for aid in tracing the origin of American fruits. The cuts were reproduced from the author's drawings by F. X. Matolony of Vienna.

The Strawberry.

The varieties of strawberry cultivated in Europe are chiefly improved forms of *F. Chiloensis* Ehrh., but some are said to be hybrids of this species with *F. vesca* L. or *F. Virginiana* Duchesne. In many parts of Europe, however, the small but delicious wood strawberry (*F. vesca* L.) is consumed in larger quantities, both fresh and preserved, than the cultivated sorts.

Bailey[1] classifies the strawberries of North America in three groups: first, the Virginian group, including *F. Virginiana,* the common field and meadow strawberry of the eastern states, with its varieties; second, the vesca group, including the Old World strawberry and the American form, called by Porter *F. Americana;* third, the Chilian group, to which belongs the Chilian species with all its cultivated varieties, and the North American species, native of the Pacific coast, with its varieties.

In colonial times the wild, or Virginian strawberry, with its several varieties, was cultivated in American gardens, but of late years has been supplanted almost entirely by the numerous derivatives of the Chilian species, although wild strawberries are still gathered in considerable quantities in the meadows. *F. vesca* grows in the northern part of the United States, but is not so common as the Virginian species.

Macroscopic Structure.

The cultivated strawberries (*F. Chiloensis*) are usually of large size (often 3 to 5 cm. in diameter), and bear the achenes in deep depressions.

Berries of the wood species (*F. vesca*) are of small size (seldom over 1 cm. in diameter) and bear the achenes in shallow depressions.

Berries of the Virginian species are of about the same size as the wood strawberries, but like the cultivated berries, the achenes are deeply sunken in the receptacle.

[1] The Evolution of our Native Fruits. London, 1898, pp. 428-432.

The receptacle, the edible part of the strawberry, consists of a somewhat fleshy pith, a still more fleshy cortex, and between the two a narrow zone of fibrovascular bundles, from which branches shoot off through the cortex to the achenes. (Fig. 1, I.)

On the surface, the receptacle has a tufted appearance, due to the somewhat regularly arranged depressions occupied by the achenes. The epidermis is sparingly pubescent.

The achenes are ovate, pointed, about 1 mm. long (Fig. 1, II and III). Each is attached to the receptacle a little above its base, and contains a single anatropous seed, which is described as "exalbuminous," since the endosperm is not evi-

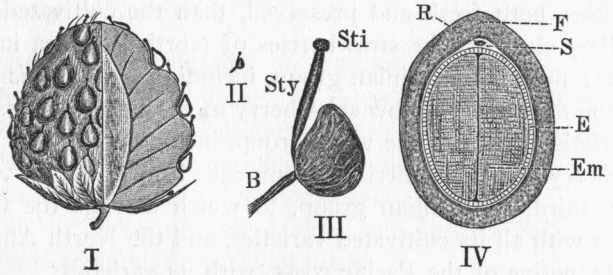


FIG. 1.—Strawberry. I Compound fruit, × 2. II Achene, × 1. III Achene, × 8. Sty, style; Sti, stigma; B, connecting bundle. IV Achene in transverse section, × 32. F, pericarp; S, testa; R, raphe; E, endosperm; Em, embryo.

dent under the simple lens. The style (about 2 mm. long) arises from the ventral side a little above the point of attachment.

The pericarp is hard and comparatively thick; the testa soft and thin; the embryo minute (Fig. 1, IV). When the fruit reaches maturity the calyx is still green and leaf-like, and the stamens are also well preserved. The calyx, the stamens, and a portion of the pith are removed in preparing the fruit for the table.

Histology.

Kraus,[1] in 1866, noted the general microscopic structure of the pericarp, and Tschierske,[2] in 1886, made an exhaustive

[1] Ueber den Bau trockner Pericarpien. Pringsheim Jahrbücher, **5**, 83-126.

[2] Beiträge zur vegleichenden Anatomie und Entwicklungsgeschichte einiger Dryadeenfrüchte. Ztschr. f. Naturwissenchaft, **59**, 594-600.

study of the structure and development of the pericarp, endosperm, receptacle and style. Neither author describes the structure of the testa. Blyth[1] gives the shape and dimensions of the achenes and refers briefly to the histology of some of the tissues found in jam, but does not mention the styles and hairs which are the elements of chief importance in diagnosis. Marpmann[2] describes some of the seed tissues and gives a cut illustrating their appearance in surface view.

In microscopic structure the cultivated, the wood and the Virginian strawberries are identical.

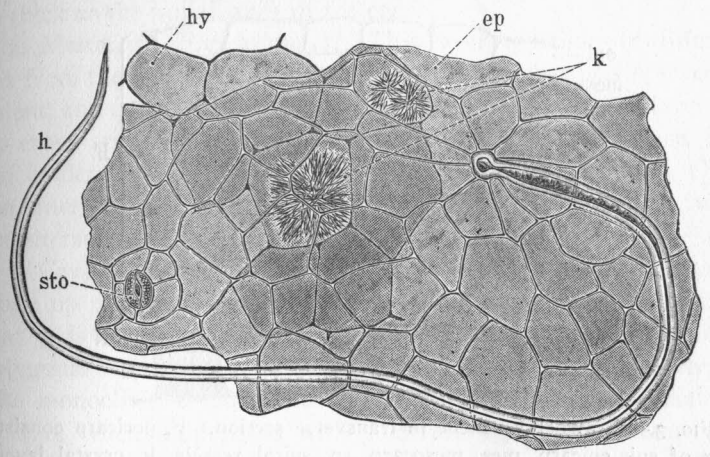


FIG. 2.—Strawberry receptacle in surface view. Ep, epidermis with h, hair and sto, stoma; hy, hypoderm; k, glucoside (?) crystals. × 160.

Receptacle. 1. The Epidermal Cells (Fig. 2, ep) for the most part are polygonal and isodiametric, but those radiating from the base of each hair are usually irregularly diamond shape, and often are strongly elongated. The hairs are not numerous, but are often over a millimeter long, tapering gradually from the widest part near the base to the point (Fig. 2, h). In the basal portion the lumen is several times the thickness of the walls, but narrows somewhat abruptly further on, and for fully three-fourths of the total length of the hair is but a narrow channel hardly one-quarter as wide as the walls. The walls, on the other hand, are narrowest at the basal end. Tschierske states that

[1] Foods: Their Composition and Analysis, London, 1896, 161.

[2] Ztschr. f. angew. Mikroskopie, 1896, **2**, 97.

stomata are entirely wanting, but the writer has found them in all the specimens of *F. Chiloensis* and *F. Virginiana* which he has examined.

2. Hypoderm or Sarkogen Layer (Fig. 2, hy). Tschierske has shown that the fleshy receptacle of the strawberry owes its origin to a hypodermal layer of meristematic cells, which are mostly tangentially elongated, and are always without intercellular spaces. These cells, to which he gives the name "sarkogen layer," resemble the phellogen or cork-forming cells of other plants, but differ in that the new cells are formed centripetally

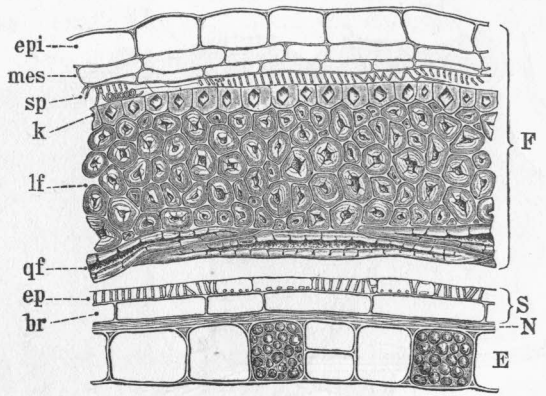


FIG. 3.—Strawberry achene in transverse section. F, pericarp consisting of epi, epicarp, mes, mesocarp, sp, spiral vessels, k, crystal layer, lf, outer endocarp with longitudinally extended fibers, and qf, inner endocarp with transversely extended fibers; S, testa consisting of ep, epidermis with reticulated cells, br, elongated brown cells; N, hyaline layer (nucellus); E, endosperm consisting of a single layer of aleurone cells. × 300.

and remain active during the whole period of growth, whereas the cork cells are formed centrifugally and die soon after formation. The cells increase in size in radial directions, and divide by tangential partitions. After they have performed their mission they continue to increase in size, but hold to their original shape.

3. Cortical Tissue. The daughter cells formed by the division of the cells of the sarkogen layer increase rapidly in size, become round in shape, and form intercellular spaces. This tissue forms the bulk of the ripe fruit. Each cell is rich in contents, which, on cooking or treatment with alcohol, yields a shriveled, opaque mass.

4. Bundles. Spiral and annular vessels from 0.005 to 0.010 mm. in diameter, and thin walled, elongated cells, are the conspicuous elements of the bundles.

5. Pith. Large berries often contain large intercellular spaces or cavities in the pith, formed by the tearing asunder of the cells during the rapid growth.

Pericarp. 1. Epicarp (Fig. 3, epi). Seen in surface view, the cells are polygonal, 0.015 to 0.05 mm. in diameter, with thin walls; but in transverse or longitudinal section they are rectangular and about 0.02 mm. thick. The cuticle is several times as thick as the radial walls of the cells.

2. Mesocarp (Fig. 3, mes.). This layer is strikingly different from the mesocarp of most edible fruits in that it is not succulent, and consists of only one, or in some parts two, cell layers. In cross section the cells have much the same appearance as the epidermis cells, but usually have smaller dimensions. On the inner side are numerous bundles, the branches of which run transversely about the achene.

3. Crystal Layer (Fig. 3, k). Kraus described this layer as made up of two cell layers; Tschierske, however, pointed out that it is in most cases made up of but one. The cells are polygonal isodiametric, from 0.008 to 0.020 mm. in diameter. The monoclinic crystals are always simple and are especially striking when illuminated with polarized light. The diameter of each crystal is about half that of the cell in which it is contained.

4. Outer Endocarp (Fig. 3, lf). This layer, forming the larger part of the pericarp, is made up of five or more thicknesses of sclerenchymatous fibers longitudinally arranged. As seen in cross section, the cell walls are about as thick as the diameter of the lumen. The pores are clearly evident in longitudinal section.

5. The Inner Endocarp (Fig. 3, qf) consists of the same elements as the outer endocarp, but is only one or two cell layers thick, and the cells are arranged transversely. On the dorsal side some of the fibers of this layer extend radially through the outer endocarp, thus facilitating the rupture of the pericarp during sprouting.

Testa. 1. The Epidermis (Figs. 3 and 4, ep) is made up of thin-walled cells, which in surface view are polygonal, in sec-

Examination of Strawberry Preserves.

The styles and achenes may be readily picked out with forceps and examined as to their size and shape, under a simple lens. The former, transparent in the fresh fruit, and rendered still more transparent by the boiling with sugar, may be studied under the compound microscope without further treatment. Their size (2 mm. long), narrow base and large transparent epidermal cells, are especially characteristic; but the spiral vessels accompanied by crystal clusters, and the stigma, often bristling with fungous threads, further aid in the identification. Crystals are clearly differentiated by the aid of polarizing apparatus.

For the study of the pericarp and seed, cross sections should be prepared, holding the achene between pieces of soft wood or in a hand-vice during the cutting. Especially striking are the two endocarp layers made up of sclerenchymatized fibers, running longitudinally in the outer, transversely in the inner layer, the endosperm made up of a single cell layer and the relatively large embryo. The testa with adhering endosperm may be isolated after cutting open the pericarp and studied in surface view under a compound microscope. The reticulated cells of the outer layer are highly characteristic.

In mounts prepared by placing on a slide a portion of the jam freed from seeds, and pressing it into a thin film with a cover glass, may be seen the tissues of the receptacle, of which the long, pointed thick-walled hairs and the long strands of vascular elements are of diagnostic value. Debris resulting from the disintegration of the cortical parenchyma cells with their shrivelled contents forms a considerable part of the jam, but has little use in identification.

The Red Raspberry.

Rubus Idaeus L. occurs native in various parts of the old world and is the parent of the raspberries cultivated in European gardens.

Bailey[1] states that the red raspberries cultivated in America are offspring of the native *R. strigosus* Michx., which, however, is closely related to the European raspberry *R. Idaeus* L. The

[1] *Loc. cit.*, p. 287.

yellow varieties are but albino forms of these species. A red variety of *R. Idaeus* grown in England, several red and yellow garden varieties of *R. strigosus* grown in New Haven, were studied by the writer and were all found to be practically identical both in macroscopic and microscopic structure.

Macroscopic Structure.

The raspberry, blackberry and other bramble fruits (*Rubus*) are intermediate in both macroscopic and microscopic structure between the strawberry (*Fragaria*) and the stone fruits (*Prunus*). They resemble the strawberry in that they are compound fruits with numerous individual fruitlets on a common

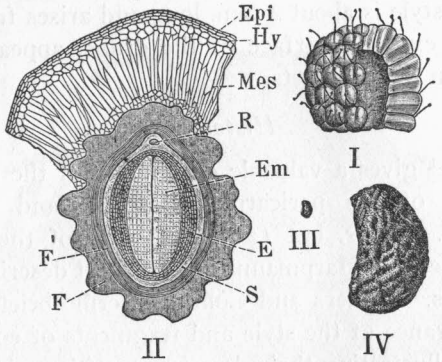


Fig. 7.—Red Raspberry. I Compound fruit, × 1. II Transverse section of a drupelet, × 32. Epi, epicarp; Hy, hypoderm; Mes, mesocarp; F, outer endocarp; F′, inner endocarp; S, testa; R, raphe; E, endosperm; Em, embryo. III Stone, × 1. IV Stone, × 8.

receptacle (although unlike the strawberry, the cortex of the receptacle is not fleshy and bears the fruitlets on elevations, not in depressions); and they resemble the stone fruits in the structure of the pericarp and seed, each individual fruitlet being in fact a miniature drupe. The resemblance between the raspberry drupelet and the peach is especially striking. In both the epicarp is pubescent, the mesocarp is fleshy, the endocarp (Fig. 7, III and IV) is a hard stone with wrinkles on the surface and the united testa and endosperm form a thin coat for the relatively large embryo. They are also very similar in histological structure, as is noted further on.

The drupelets are crowded together on the top and sides of the receptacle, each having a convex top or exposed

surface and four to seven facets on the sides formed by the pressure of the adjoining drupelets (Fig. 7, I). These facets are usually slightly convex or concave. Owing to their crowded arrangement the thickness of the flesh in the sides of the drupelets is much less than in the outer part. The exposed surface and the angles between the facets are pubescent, the facets themselves glabrous. In picking a raspberry the drupelets separate from the receptacle, clinging together in the form of a cup. Tschierske states that the individuals cling together, first because of the closely fitting adjoining facets, the slightly convex surface of one fitting into a corresponding concave surface of another, and second because of the interlocking of the crooked hairs. The style is about 4 mm. long and arises from the upper edge of the exposed surface of the drupe, appearing to come from between the drupelets.

Histology.

Tschierske[1] gives a valuable description of the structure and development of the pericarp, endosperm and style of the European *R. Idaeus,* but (as in the case of the strawberry) neglects the testa. Marpmann[2] gives a short description of some of the tissues. Villiers and Collin[3] describe briefly the microscopic appearance of the style and fragments of epicarp as seen in the jelly, illustrating their description with an inaccurate cut.

Receptacle. 1. The Epidermis resembles somewhat the epicarp of the fruit, but the hairs are less numerous and usually thicker walled.

2. Cortex. As no sarkogen layer is developed in the raspberry the cortex layer is thin, the bulk of the receptacle being the pith.

3. Bundles. It follows from what has been stated that the main bundles run near the surface of the receptacle. They are shorter and more strongly developed than in the strawberry, with larger and more numerous vessels.

4. The Pith consists of round parenchyma cells, devoid of cell contents, with intercellular spaces.

[1] *Loc. cit.,* pp. 612-628.
[2] *Loc. cit.,* 102.
[3] Traité des Altérations et Falsifications des Substances Alimentaires, Paris, 1900, 829.

Pericarp. 1. The Epicarp or Epidermis (Fig. 7, Epi, Fig. 8) on the facets of the drupelets consists entirely of polygonal cells, but on the exposed surfaces consists of polygonal cells and hairs, the hairs often being so numerous that they occur at two to four of the angles of the polygonal cells. Five or six cells frequently meet at the base of the hair, forming a rosette about it. The hairs vary greatly in length, up to 0.7 mm. Most of them have thin walls (0.0005 to 0.0015 mm.) of nearly uniform thickness from the base to the blunt apex and show a broad lumen (h); but some of the longer forms have thick walls and a narrow lumen resembling the strawberry hair (h'). The thin-walled hairs are commonly sinuous.

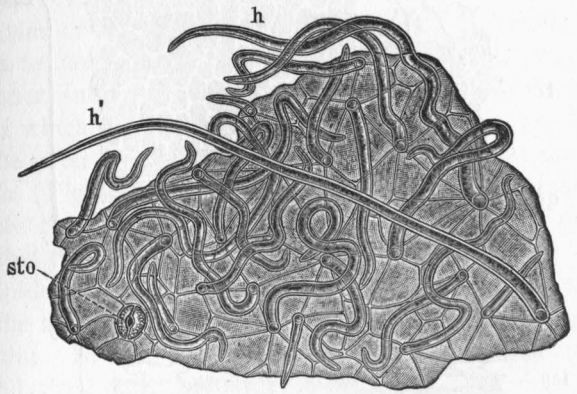


FIG. 8.—Red Raspberry epicarp with h', straight hair, h, sinuous hairs and sto, stoma. × 160.

2. Hypoderm (Fig. 7, Hy). Two or more cell layers of collenchyma form the hypoderm (a water tissue), serving to retard the evaporation of the fruit juice.

3. Mesocarp (Fig. 7, Mes). The outer two or three layers of the mesocarp consist of isodiametric cells with intercellular spaces, interspersed with crystal cells; but further inward, at least in the thicker portion of the fruit, the cells are enormously elongated in radial directions and are without intercellular spaces. Tschierske points out that the succulent nature of the fruit results from the radial growth of cells, not as in the strawberry from the formation of numerous isodiametric cells by a meristematic layer.

As in all the species of *Rubus,* cells with crystal clusters are common, particularly near the base of the style. Reticulated cells occur in the inner layers adjoining the endocarp.

4. Outer Endocarp (Fig. 7, F, Fig. 9, lf). Owing to the deep wrinkles the thickness of this coat is exceedingly variable. As

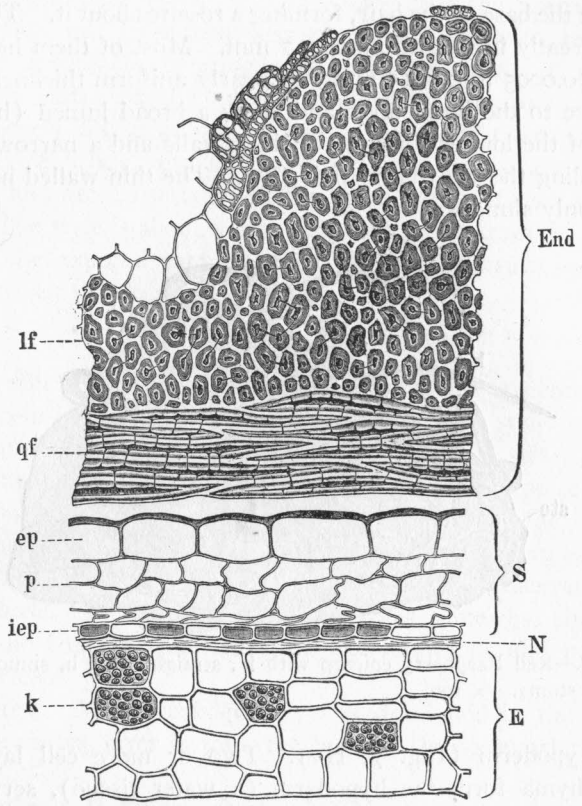


FIG. 9.—Red Raspberry. Endocarp and seed in transverse section. End, endocarp consisting of lf, longitudinally extended fibers and qf, transversely extended fibers; S, testa consisting of ep, epidermis, p, parenchyma (nutritive layer) and iep, inner epidermis; N, hyaline layer (nucellus); E, endosperm with k, aleurone grains. × 300.

in the strawberry, the sclerenchyma fibers are longitudinally arranged and cross those of the inner endocarp at right angles. The fibers are a little narrower than in the latter fruit and in cross sections are usually elliptical-polygonal, with the longer diameters in radial directions.

The writer finds that the walls of these fibres are made up of two thickened layers, an outer or secondary membrane and an inner or tertiary membrane, the two differing greatly from each other in their refractive power and their deportment toward reagents. As the middle lamella is inconspicuous, the double outer membranes in transverse sections form a net-work like that of ordinary thick-walled polygonal cells. The thickness of this double outer membrane is about the same as the thickness of the inner membrane and the diameter of the cell lumen. Zinc chloride iodine stains the outer membrane yellow, the inner blue; and safranin also serves to differentiate the two layers. In longitudinal section numerous pores passing through both membranes are evident. This interesting structure of the raspberry fibers, similar to that of the bast fibers of various plants,[1] appears to have escaped the attention of investigators.

5. Inner Endocarp (Fig. 7, F[1], Fig. 9, qf). The fibers of this coat, of which there are four or more thicknesses, are the same as in the outer endocarp, but run transversely about the fruit.

Testa (Fig. 9, S). The seed coats of the bramble fruits resemble closely those of the stone fruits, the chief difference being that the epidermal stone cells are wanting.

1. Epidermis (Fig. 9, ep). The cells are polygonal in surface view, the average diameter being 0.035 mm. and the maximum 0.070 mm. In transverse sections they are cushion-shaped, with a cuticularized outer wall.

2. Nutritive Layer (Fig. 9, p). The cells in this layer, having fulfilled their mission, are empty and are often more or less collapsed.

3. Brown Layer (Fig. 9, iep). The inner layer of the testa consists of cells of the same kind as in the outer epidermis, but only about half as large, the maximum diameter in surface view being 0.030 mm. and the average 0.020 mm. These cells are readily distinguished from those of the neighboring layer by their thicker walls and yellow brown color.

Nucellar Layer (Fig. 9, N). As in the strawberry, all that remains of the nucellar tissue is the layer of obliterated cells, which in section appears as the thickened outer wall of the endosperm.

[1] See Tschirch. Angewandte Pflanzenanatomie 1889, pp. 189, 190.

Endosperm (Fig. 9, E). A transverse section shows that the endosperm is made up of aleurone-cells with remnants of other cells adjoining the embryo. On the two broader sides of the elliptical section there are five or six cell layers, but the number diminishes toward both the ventral and dorsal sides, where there are only two or three.

The cells are polygonal in surface view, but in section are for the most part quadrilateral, arranged in radial rows. The aleurone grains are the same as in the strawberry.

Embryo (Fig. 7, Em). The structure of the embryo is practically the same as in the strawberry.

Style (Figs. 10 and 11). 1. The Epidermal Cells (Fig. 11, ep) are much smaller than in the strawberry, and owing to numerous wrinkles on the surfaces are not so transparent. These wrinkles may be brought out clearly either by treating specimens with iodine as recommended by Tschierske, or better, in the writer's experience, by bleaching with sodium hypochlorite and staining with safranin. On the broadened basal portion of the style are scattering hairs like those of the epicarp.

2. Bundles. After heating the style with dilute potash solution, the vessels (sp) and accompanying isodiametric crystal cells (k), are clearly evident.

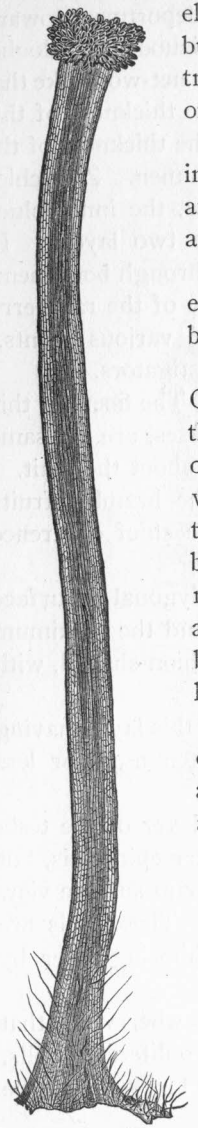


FIG. 10.—Raspberry style and stigma. × 32.

Examination of Raspberry Preserves.

Styles and stones (seeds with enclosing endocarp) are evident to the naked eye. The former may be examined directly under the microscope as in the case of the strawberry and are identified by their length (4 mm.), broadened base with hairs and small wrinkled epidermal cells. Vessels and crystal cells are also striking elements.

The stones are distinguished from seeds of other genera by their characteristic wrinkled surface and from blackberry stones by their smaller size. Cross sections show the two layers of endocarp, the testa with cells of the outer epidermis twice the diameter of those of the inner epidermis and with a middle parenchymatous layer, the endosperm of several cell layers and the embryo.

The epidermis with hairs for the most part blunt, thin-walled and sinuous and the crystal cells of the underlying mesocarp may be readily found in mounts prepared from the gelatinous portion of the product. Vascular elements are almost entirely wanting, as the receptacle is not picked with the fruit.

THE BLACK RASPBERRY (*Rubus occidentalis,* L.).

This species, a native of the northern United States, is the parent of the black varieties. It differs from the red raspberry

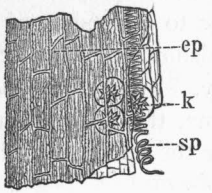


FIG. 11.—Raspberry style in surface view. ep, epidermis; sp, spiral vessels; k, crystal cells. × 300.

chiefly in smaller size of the drupelet and their deep purple-black color, due to the dark claret-red cell juice. The pits of both are about the same size and shape. The black raspberry has practically the same microscopic structure as the red species.

Black raspberry jam or preserve is of a deep claret-red color and the seeds are stained the same color.

THE BLACKBERRY.

Most of the works on systematic botany describe the dewberry, or running blackberry, as *Rubus Canadensis* L., the tall American blackberry as *Rubus villosus* Aiton; but Bailey,[1] who has examined the original specimens in European herbaria, has

[1] *Loc. cit.*, pp. 366, 379.

found that Linnaeus' species is the thornless blackberry (*R. Millspaughii* Britton) and Aiton's species is the dewberry. These names have been restored by Bailey to the plants to which they were originally assigned, and the tall blackberry, which would otherwise be without a name, has been called by him *R. nigrobaccus*. The type of this latter species is the common native bush blackberry, with long fruits and is the parent of the long cluster cultivated varieties, such as the Taylor and the Ancient Briton.

R. nigrobaccus var. *sativus* Bailey, the short cluster blackberry, is a less common native berry, but is the parent of the larger part of the garden varieties, the fruit of one of which, the Snyder, was studied by the writer. *R. fruticosus,* the European wild blackberry, does not occur either wild or cultivated in America.

The dewberry or running blackberry (*Rubus villosus* Aiton) grows wild in all parts of the United States except the extreme west and has given rise to a number of garden varieties. The berry is hardly distinguishable in macroscopic structure from the short cluster blackberry. In microscopic structure the two are also practically the same, the only difference which the writer has detected being that the epicarp of the dewberry sometimes bears a few hairs.

Macroscopic Structure.

The blackberry agrees with the raspberry in general structure, but differs in the following details: (1) Both the drupelets and the receptacle are glabrous throughout. (2) The drupelets are firmly attached to the receptacle by broad bases and do not separate from the latter on picking the fruit. There is really no epidermis of the receptacle, as the surface is almost completely covered by the bases of the drupelets, the epicarp of one being continuous with that of the adjoining drupelet. (3) As may be seen from Fig. 13, the pits resemble those of the raspberry in shape and markings, but are much larger. (4) The styles (Fig. 14) are but 2 mm. long and commonly arise from a marked depression in the drupelet. They are free from hairs and do not broaden at the base.

Histology.

Godfrin[1] notes the structure of the testa of *R. fruticosus* L., a European species, and gives a figure of a transverse section. Further than this the writer has found no literature on the histology of the blackberry.

Receptacle. The structure of the receptacle differs in no essential detail from that of the raspberry.

Pericarp. 1. Epicarp (Fig. 12, epi). The cells are for the most part elongated, the longer diameters extending in latitudinal directions on the sides of the drupelets, and in concentric

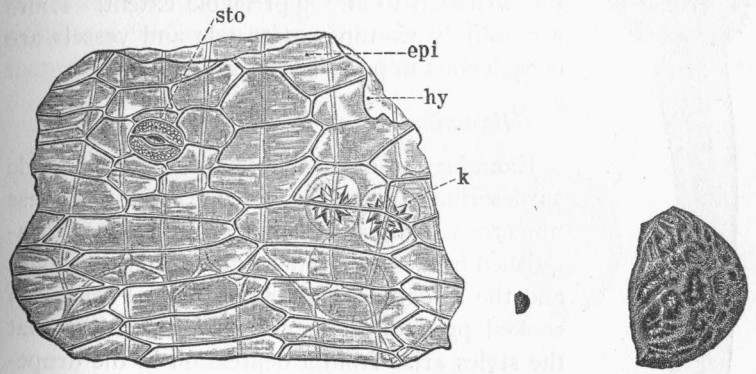


FIG. 12.—Blackberry. Outer layers of pericarp in surface view. epi, epicarp with sto, stoma; hy, hypoderm; k, crystal cells. × 160.

FIG. 13.—Blackberry stone. × 1 and × 32.

circles about the styles. Stomata are always present, hairs never in *R. nigrobaccus*, seldom in *R. villosus*.

2. Hypoderm (Fig. 12, hy). As in the epicarp, the cells are commonly elongated but are much larger and extend in longitudinal directions.

3. Mesocarp. This layer is much the same as in the raspberry. Crystal clusters (k) are numerous, especially near the surface.

4. Endocarp. As in the raspberry, the sclerenchymatized fibers of the endocarp have secondary and tertiary membranes and run longitudinally in the outer and latitudinally in the inner layer. Both coats, however, are thicker than in the raspberry, the inner consisting of six to ten cell layers.

[1] Étude histologique sur les Téguments Séminaux des Angiospermes. Soc. des Sciences de Nancy, 1880, p. 153.

Testa. It has been noted that the outer epidermis of the raspberry testa is made up of polygonal cells with about twice the diameter of those in the inner epidermis. The reverse is true in the case of the blackberry, the testa being much the same as a raspberry testa turned inside out. The average diameter of the outer epidermal cells is about 0.025 mm., the maximum 0.040 mm., whereas the average diameter of the inner epidermal cells is 0.040 mm. and the maximum 0.060 mm.

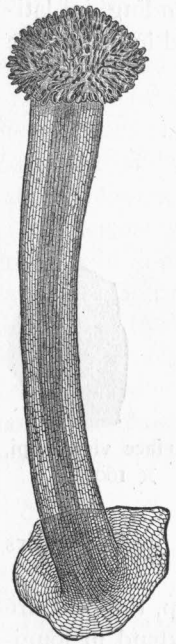


FIG. 14.—Blackberry style and stigma. × 32.

Style (Fig. 14). The epidermal cells are about the same size as in the raspberry, but are not wrinkled to any appreciable extent. Hairs are entirely wanting. Crystals and vessels are conspicuous in potash preparations.

Examination of Blackberry Preserves.

Examination of blackberry preserves is made as described under raspberry. Styles are less numerous than in the latter and are distinguished by their shorter length, absence of hairs and the smoothness of the epidermal cells. In cooked products it is not usually evident that the styles arise from a depression in the drupelet. The seeds are larger than in the raspberries, but in histological structure are very similar. They are, however, distinguished from the latter by the thicker inner endocarp and by the fact that the cells of the outer epidermis of the spermoderm are about half the diameter of those of the inner epidermis; whereas, in the raspberry the reverse is true. In blackberry preserves, unlike that made from raspberries, hairs are few or entirely absent; but tissues of the receptacle, notably the vascular elements, are present.

Compared with the strawberry, the bundles are shorter but more strongly developed with larger and more numerous vessels. Elongated epidermal cells and crystal clusters are also distinguishable.

THE RED CURRANT (*Ribes rubrum* L.).

Both the red and white garden varieties of currant are derived from the European species, *R. rubrum*. Three varieties, grown in the Experiment Station garden, have been examined by the writer; Fay's Prolific, a red variety with berries often 1.25 cm. in diameter, Versaillaise, a smaller berried red variety, and the white grape. All of these have the same microscopic structure.

Macroscopic Structure.

The calyx tube of the currant is united with the ovary, and the fruit (a true berry) bears on the summit the shriveled remains of the floral parts (Fig. 15, I). The deeply five-cleft bell-shaped calyx tube bears in its throat five petals much smaller

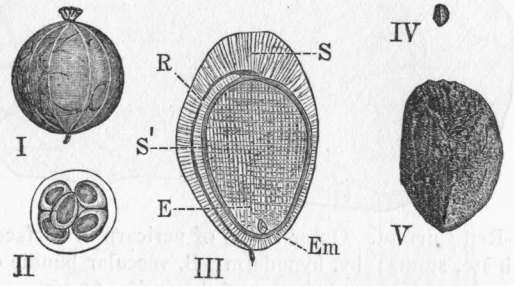


FIG. 15.—Red Currant. I Fruit, × 1. II Transverse section of fruit with seeds, × 1. III Longitudinal section of seed, × 8. S, gelatinous epidermis of testa; S', inner testa; R, raphe; E, endosperm; Em, embryo. IV Seed deprived of gelatinous coat, × 1. V Same as IV, × 8.

than the calyx lobes, and alternating with them, and five stamens opposite the lobes. The short style, about half the length of the calyx, is deeply two-cleft. The midribs of each of the floral envelopes, ten in number, are continued in the fruit in the form of longitudinal veins and are clearly seen through the transparent epicarp. The anatropous seeds, one to eight in number, are borne on two parietal placentæ (Fig. 15, II). As a result of the crowded arrangement they are usually flattened on one or more sides. The outer testa (Fig. 15, III S) is gelatinous and transparent and through it may be seen the delicate thread-like raphe and the brown hard inner testa. The minute embryo (Fig. 15, III Em) is imbedded in the base of the endosperm.

Divested of the gelatinous coat the seeds are from 4 to 5 mm. long and from 3 to 4 mm. broad (Fig. 15, IV and V).

Histology.

Lampe[1] has studied the development of the pericarp of *R. setosum* L. and Blyth,[2] and Villiers and Collin,[3] describe briefly some of the pericarp tissues of the red currant. The writer has studied the pericarp, seed and floral parts of the latter species.

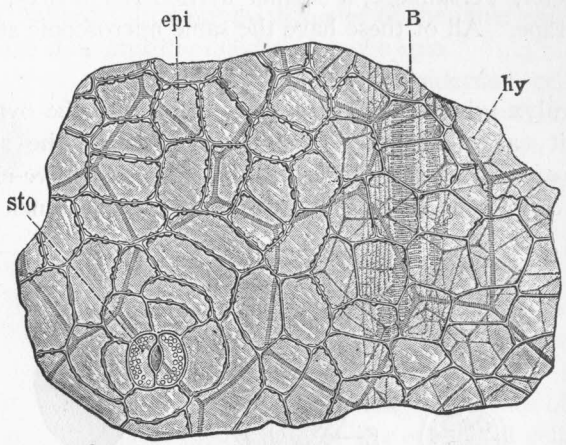


FIG. 16.—Red Currant. Outer layers of pericarp in surface view. epi, epicarp with sto, stoma; hy, hypoderm; B, vascular bundle or vein seen through the transparent outer layers of the fruit. × 160.

Pericarp. 1. Epicarp (Fig. 16, epi). As may be seen in surface view, the walls of the epicarp are irregularly beaded. In parts the walls are almost entirely thickened, with narrow pores; in other parts the walls are not thickened at all or only here and there. Frequently strongly beaded cells are divided by thin partitions into two daughter cells. Stomata are numerous. Cross sections show that the cells are considerably broader than thick.

2. Hypoderm (Fig. 16, hy). Two or three cell layers of collenchymatous cells underlie the epidermis. In surface view they are polygonal with diameters twice or more those of the epidermal cells. Their collenchymatous character is seen in a cross section.

[1] Ztschr. für Naturwissenschaft, 69, 295.
[2] Foods: Their Composition and Analysis. London, 1896, p. 162.
[3] Traité des Altérations et Falsifications des Substances Alimentaires, Paris, 1900, p. 828.

3. Mesocarp. Lampe found that this tissue results from the growth of cells formed during the early stages of development and not by cell division. In cross section the cells are isodiametric (from 0.1 to 0.3 mm. in diameter), with thin walls and numerous intercellular spaces. Radiating from the bundles (the veins seen through the epicarp) are elongated cells. Crystal clusters abound in the inner layer.

4. Endocarp (Fig. 17). Unlike the gooseberry, the currant has a sclerenchymatous endocarp. This remarkable tissue, best

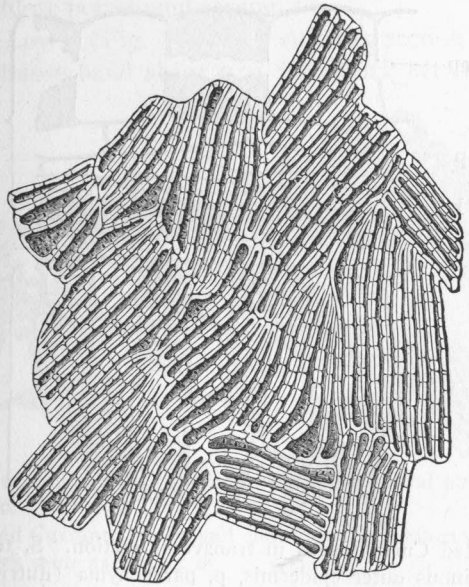


FIG. 17.—Red Currant endocarp in surface view. × 160.

studied in surface preparations, is exceedingly characteristic. The long cells are arranged in groups, each group consisting of five to fifteen cells side by side. The cells of adjoining groups may extend either in the same or different directions. Often the end walls of one group adjoin the side wall of the outer cell of another group. Curious crinoid-like forms result from the junction of several groups. As a rule the lumen is much narrower than the walls and oftentimes is reduced to a mere line. Numerous pores connect adjoining cells and some pierce the walls separating these cells from the mesocarp. The cells range in length up to 0.5 mm.; the thickness of the double walls is from 0.005 to 0.02 mm.

Testa (Fig. 18, S). 1. Mucilage Cells (Fig. 18, aep). The outer layer of the testa consists of large but thin-walled cells filled with gelatinous matter. These cells are about 0.09 mm. in tangential diameter but often have a radial diameter of over 0.5 mm. On the outer surface they are usually convex. Owing to the great size of the cells, this coat, although but a single cell-layer thick, forms a considerable part of the bulk of the seed.

2. Parenchyma (Fig. 18, p). Beneath the mucilage cells are

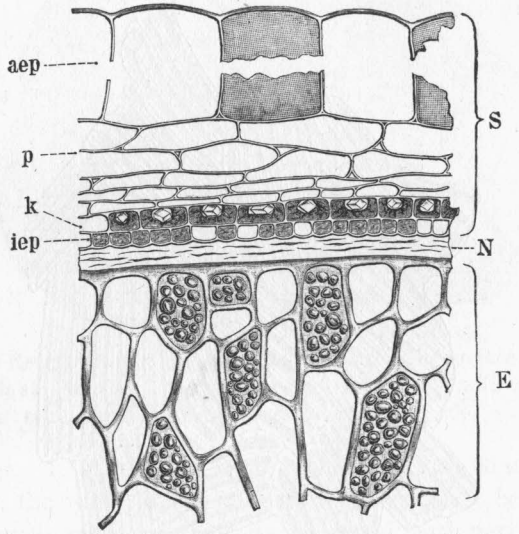


FIG. 18.—Red Currant seed in transverse section. S, testa consisting of aep, gelatinous outer epidermis, p, parenchyma (nutritive layer), k, crystal layer, iep, brown layer (inner epidermis); N, hyaline layer (nucellus); E, endosperm. × 300.

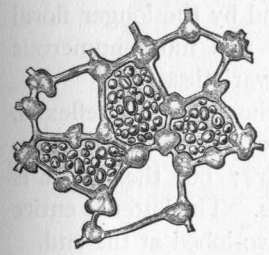
several layers of more or less flattened parenchymatous cells with intercellular spaces. The inner layers are smaller than the outer and more strongly flattened.

3. Crystal Layer (Figs. 18 and 20, k). In surface view the deep brown thick-walled cells of this layer are sharply polygonal with diameters from 0.008 to 0.020 mm. The middle lamella is colorless, the thick membrane, brown. Each cell contains a single monoclinic crystal, which nearly or completely fills the cell cavity.

With crossed Nicol prisms these crystals appear as luminous spots in the black background, disappearing on addition of a drop of hydrochloric acid. In section it may be seen that only the radial and inner walls are thickened and that as a consequence each crystal lies close to the thin outer wall.

4. Inner Epidermis (Figs. 18 and 20, iep). Like the crystal layer, the inner epidermis is of a deep brown color, but this color is due to cell contents, not to thickened cell walls. The cells are longitudinally elongated, varying in length up to 0.15 mm. and in width from 0.004 to 0.009. Both this layer and the crystal layer are readily separated from the endosperm by soaking in dilute potash and scraping.

Nucellar Layer (Fig. 18, N). A cross section of the seed shows a cellulose band about 0.01 mm. thick between the testa



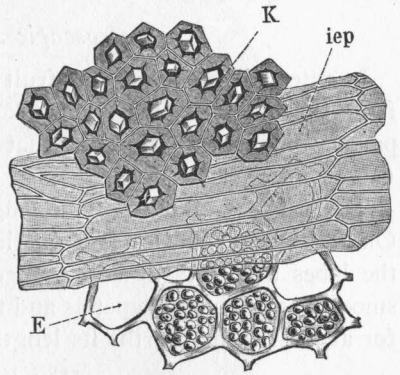


FIG. 19.—Red Currant. Transverse section of central portion of endosperm. × 300.

FIG. 20.—Red Currant. Testa and endosperm in surface view. Signification of letters same as in Fig. 18. × 300.

and the endosperm, consisting of the obliterated cells of the nucellus.

The Endosperm (Figs. 18 and 20, E) fills the larger part of the seed cavity. The cells are mostly elongated in the outer layers, but isodiametric in the inner portion and contain aleurone grains and fat. In the outer cells the walls are of even thickness (about 0.002 mm.), but in the center of the seed they frequently have knotty thickenings (Fig. 19).

Microscopic Examination of Red Currant Preserves.

Cells of the endocarp are the most conspicuous and characteristic elements of currant preserves. Fragments of the epidermis and floral parts are also evident but are of less value in identifi-

cation. The outer gelatinous coat of the seed is destroyed by cooking, but the crystal layer and the inner epidermis retain their original form and may be identified in surface mounts prepared by warming the seed in dilute potash solution and scraping with a scalpel. Sections of the seed are sometimes useful, but as a rule an examination of the testa in surface view is sufficient.

The Black Currant (*Ribes nigrum* L.).

This species does not occur native in America, the cultivated varieties of both Europe and America being derived entirely from European stock.

Macroscopic Structure.

In external appearance the fruit of this species is distinguished from the red currant by its black color and by the longer floral parts. The seeds are somewhat smaller and more numerous (about 15 in each berry) than in the red varieties.

The calyx is about 7 mm. long, and the lobes are reflexed. On the outer surfaces and on the ends of the inner surfaces, the lobes are clothed with numerous hairs; but the throat is smooth, as are also the petals and the styles. The latter is entire for at least three-fourths its length, but two-lobed at the end.

Histology.

Meyen[1] noted the glands on the black currant leaf in 1837. Lampe[2] studied the pericarp but did not describe the glands.

The cells of the *Epicarp* (Fig. 21, epi) are beaded and of about the same size as in the red currant. Here and there may be seen the bright yellow disc-shaped glands which are often 0.17 mm. or more in diameter (d). They occur in still greater numbers on the leaves, as was noted by Meyen, who found that they agreed in structure with the glands of the hop. These glands consist of a single layer of cells in the form of a disk, joined in the middle to the epicarp by means of a short several-celled stalk. The yellow oily secretion to which the plant owes its characteristic odor and flavor is contained in the reservoir formed by the separation of the outer cuticle from the cells.

[1] Secretionsorgane d. Pflanzen. Berlin, 1837.
[2] *Loc. cit.*, p. 295.

The *Mesocarp, Endocarp,* and *Seed* have the same general structure as the same parts of the red currant.

Under the microscope the *Calyx Hairs* have the same appearance as those on the epicarp of the raspberry. They are crooked, blunt-pointed, thin-walled, and vary in length up to 0.6 mm.

Microscopic Examination of Black Currant Preserves.

Black currant preserves, jams, etc., have a red-black color, and the characteristic spicy flavor of the fresh fruit. They are further distinguished from similar products made from red

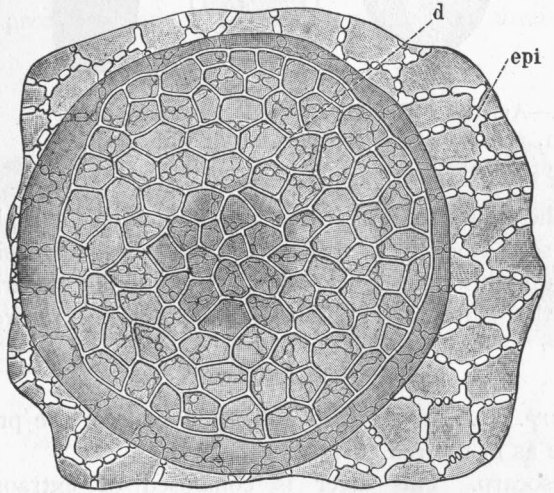


Fig. 21.—Black Currant. epi, epicarp with d, gland, in surface view. × 160.

currants by the glands on the epidermis, the longer floral parts, the hairs on the outer surface of the calyx and the smaller seeds.

The mesocarp, endocarp and seed tissues of the red and black currant are the same in structure.

The American Gooseberry (*Ribes oxyacanthoides* L.).

American cultivated gooseberries are largely derived from the native species *R. oxyacanthoides* L. The Downing, the variety studied by the writer, is believed by Bailey[1] to be a descendant of this species.

[1] *Loc. cit.*, p. 393.

Macroscopic Structure.

The gooseberry has much the same general structure as the currant, but the fruit is larger (1 to 2 cm. in diameter), the calyx and style are longer (6 mm. in length), and are pubescent, and the smooth pericarp is thicker (Fig. 22). The gelatinous

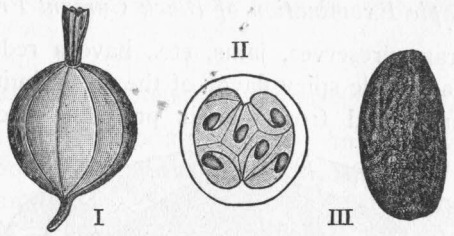


FIG. 22.—American Gooseberry (*Ribes oxyacanthoides*). I Whole fruit, × 1. II Transverse section of fruit with seeds, × 1. III Seeds deprived of gelatinous coat, × 8.

coat of the seed is thicker (often 2 mm. thick on the raphe side), but the seed freed from this coat is about the same size as in the currant, although somewhat narrower and more nearly terete. Unlike the European gooseberry, the surface is free from prickles.

Histology.

Pericarp. 1. The Epicarp and 2. Hypoderm are practically the same as in the red currant.

3. Mesocarp. This layer is composed of extraordinarily large cells (often 0.5 mm. in diameter), which are evident to the naked eye and are separated from each other by a network of cells hardly 0.05 mm. in diameter. In the inner layers the small cells are less numerous or entirely lacking. Crystal clusters are abundant, particularly in the inner layers.

4. Endocarp. The most striking histological distinction between the currant and gooseberry is in the structure of the endocarp, which in the currant is a dense sclerenchymatous tissue, in the gooseberry a layer of parenchyma cells with walls so thin that they are studied with difficulty. This remarkable difference in structure of two fruits of the same genus led the writer to examine the fruit of *R. aureum,* the only other species of this genus available for study. In this fruit, which resembles more the black currant than the gooseberry, the endocarp cells, although apparently parenchymatous, had thicker walls than

those of the latter, and the cells were arranged in a manner similar to those of the sclerenchymatized endocarp of the currant. A study of this coat in other species, and in all stages of development, would doubtless disclose other intermediate forms.

Testa, Endosperm, and *Embryo.* The microscopic structure of the seed is practically the same as that of the currant seed.

Floral Parts (Fig. 23). The remains of the floral parts are usually deep brown, and can be studied to advantage only after bleaching, preferably with sodium hypochlorite, and staining. A prominent mid-vein runs from the base almost to the

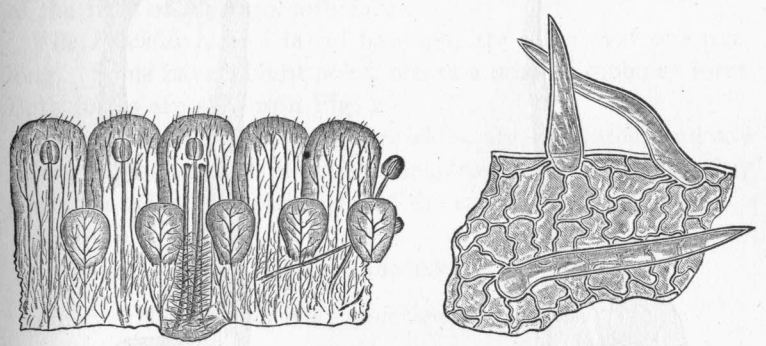


FIG. 23.—Gooseberry. Floral parts. × 5.

FIG. 24.—Gooseberry. Epidermis from margin of calyx, with hairs. × 160.

summit of each of the calyx and corolla lobes. About four secondary veins branching near the base, partly from the calyx midrib, partly from the corolla midrib, also run through nearly the length of the calyx lobes. Lateral branches from the midrib are numerous in the corolla, less so in the calyx.

The epidermal cells of the calyx are for the most part slightly elongated, and are arranged end to end in longitudinal rows. Near the ends of the lobes they have wavy outlines. The outer surface of the calyx and the upper part of the inner surface bear only a few scattering hairs. The calyx throat, however, is densely pubescent. These hairs are all thin-walled, and vary in length up to 1 mm. or more, the longest being in the calyx throat (Figs. 24 and 25).

The deeply parted styles are covered with epidermal cells, for the most part quadrilateral, and arranged end to end in rows, and on the lower half bear numerous thin-walled hairs 1 mm. or more in length.

Microscopic Examination of Gooseberry Preserves.

The epidermis, mesocarp and seed have the same structure as the corresponding parts of the currant, but the endocarp is not sclerenchymatized as in the latter fruit and is not evident in

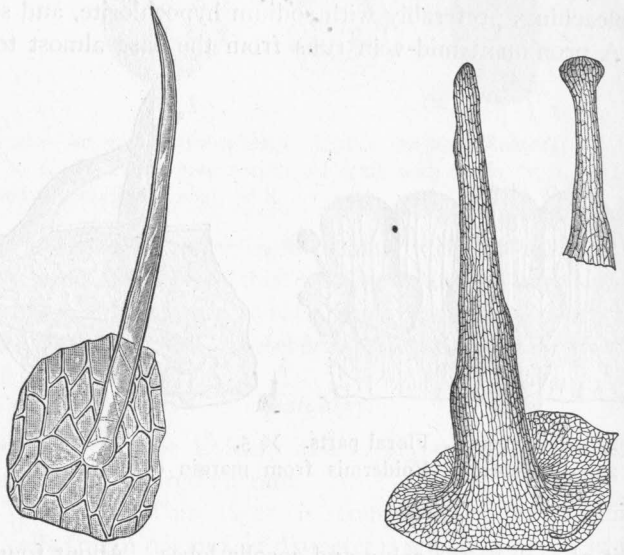


FIG. 25.—Gooseberry. Epidermis from throat of calyx, with hair. × 160.

FIG. 26.—European Gooseberry (*R. Grossularia*). Prickles with and without globular head. × 32.

preserves. The floral parts are of about the same length as in the black currant (6 mm.) but the calyx throat and the styles bear numerous long hairs, whereas these parts in the black currant are smooth, or only sparingly pubescent.

THE EUROPEAN GOOSEBERRY (*Ribes Grossularia* L.).

The European or prickly gooseberry, owing to the mildew to which it is subject, is not so successfully grown in America as the smooth-berried varieties derived from native species.

Some of our popular varieties, however, have a few prickles on the fruit, and have doubtless European ancestors.

Garcin[1] describes the microscopic structure of the pericarp of *R. Uva-Crispa* (*R. Grossularia*). Blyth[2] devotes but a single sentence to the gooseberry, evidently the common European species.

A study was made by the writer of the berries of "Carmen," a prickly variety grow in the Station garden; and also of an unknown variety, unquestionably *R. Grossularia,* grown in Scotland.

Except for the prickles, the structure of both is the same as of the fruit of *R. oxyacanthoides.*

The Prickles have a broad base and are often over one mm. long. Some have a blunt point, others a head of globular form. Both forms are shown in Fig. 26.

The Epidermal Cells of the prickles are elongated, and are arranged end to end in longitudinal rows. At the base they pass into the isodiametric cells of the epicarp.

THE CRANBERRY.

Bailey writes of this fruit as follows:[3]

"The cranberry (*Vaccinium macrocarpon* Ait.), the most unique of American horticultural products, was first cultivated, or rescued from mere wild bogs, about 1810. Its cultivation began to attract attention about 1840, although the difficulties connected with the growing of the new crop did not begin to clear away until about 1850. Cape Cod was the first cranberry-growing region, which was soon followed by New Jersey, and later by Wisconsin and other regions. The varieties now known are over a hundred, all having been picked up in bogs, and the annual product from tame bogs in the United States is more than eight hundred thousand bushels. . . .

This cultivated cranberry is *Vaccinium macrocarpon* Ait. There are other edible species, but they are not cultivated. The cowberry, or mountain cranberry, *Vaccinium Vitis-Idaea* L., is

[1] Recherches sur l'histogénèse des péricarpes charnus. Ann. sc. nat. Botanique, 7e series, 1890, 12, p. 175.
[2] *Loc. cit.*, p. 162.
[3] *Loc. cit.*, pp. 414, 424.

gathered in great quantities in Canada, where it is used for sauces. It is also native to Europe, where it is also much prized as a culinary fruit."

Macroscopic Structure.

Different varieties of the cultivated cranberry vary in shape (spherical, oval, pear-shaped), in color (pink, red, maroon, mottled), and in size (diameter up to 15 mm.).

The epicarp is smooth, and bears on the summit four short tooth-like calyx lobes, which are usually bent inward. Between the calyx lobes is a circular spot with a dot in the center, formed by the dropping of the floral parts.

The berry is four-celled, each cell containing on a central

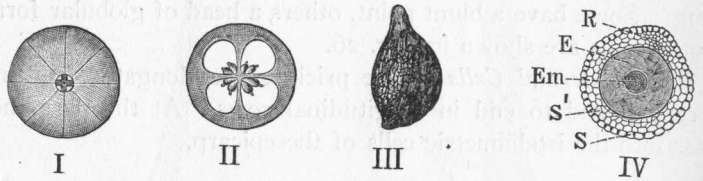


FIG. 27.—Cultivated Cranberry (*Vaccinium macrocarpum*). I Berry seen from above, × 1. II Transverse section of berry, × 1. III Seed, × 8. IV Transverse section of seed, × 15. S, epidermis of testa; S', inner testa; R, raphe; E, endosperm; Em, embryo.

placenta a number of seeds which fill only a small part of the otherwise empty cavity (Fig. 27).

In the nearly ripe fruit only the epicarp is colored, the other parts being white; but in the fully ripe fruit all the tissues are usually red.

The yellow short-beaked seeds have a thick testa and a bulky endosperm, with an elongated embryo of moderate size, consisting chiefly of the radicle, in the axis.

The mountain cranberry has practically the same macroscopic structure as the cultivated species, but is much smaller.

Histology.

The following description applies to both the cultivated and the mountain cranberry, the two being nearly, if not quite, identical in microscopic structure.

Pericarp. 1. The Epicarp (Fig. 28) is very simple in structure, with cells as seen in surface view from 0.02 to 0.05 mm.

in diameter, and cell walls about 0.003 mm. thick. Cross sections show that this layer is about 0.025 mm. thick and that the cuticle is strongly thickened.

2. The Hypoderm (Fig. 28) is for the most part only one cell-layer thick, and the cells are more or less isodiametric in

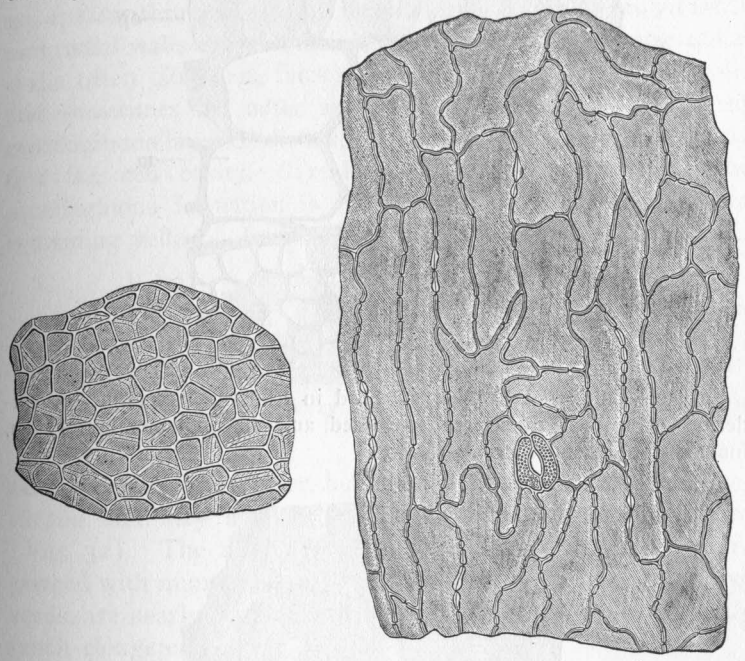


FIG. 28.—Cranberry. Epicarp and hypoderm. × 160.
FIG. 29.—Cranberry. Endocarp with stoma. × 160.

cross section. Evaporation is largely prevented by the thick cuticle, rendering a more strongly developed hypoderm unnecessary.

3. The Mesocarp cells are mostly isodiametric, and range up to 0.20 mm. in diameter, but in the partitions of the fruit cavities they are somewhat smaller.

4. The Endocarp (Fig. 29) is from 0.02 to 0.05 mm. thick and is made up of a single layer of cells. As is seen in surface preparations, the cells are for the most part longitudinally extended and are more or less curved or wavy in outline. The indistinctly porous cell walls are somewhat thicker than those of the mesocarp, but unlike those in some *Vaccinium* species are

not conspicuously sclerenchymatized. Although stomata are entirely lacking in the epicarp, it is a remarkable fact that they occur in considerable numbers in the endocarp.

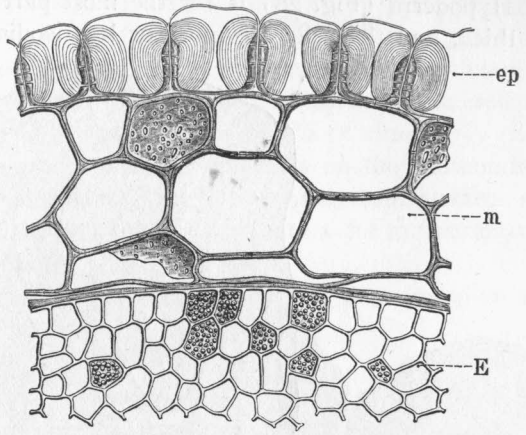


FIG. 30.—Cultivated Cranberry. Seed in transverse section. ep, epidermis of testa with sclerenchymatized and mucilaginous layers; m, inner testa; E, endosperm. × 160.

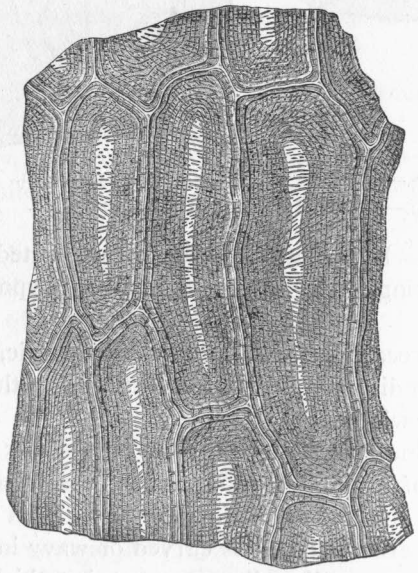


FIG. 31.—Cultivated Cranberry. Epidermis of testa in surface view. × 160.

Testa. 1. Epidermis (Fig. 30, ep, Fig. 31). Of all the tissues of the cranberry, this layer is the most characteristic and remarkable. The cells in the mature seed range in width up to 0.1 mm. and in length up to 0.4 mm., but in abortive seeds are much smaller. As is seen in cross section, the outer walls (Fig. 30, ep) are thin and convex, but the deep yellow or brown inner and radial walls are sclerenchymatously thickened (double radial walls often 0.02 mm. thick), and in addition the radial walls and sometimes the outer and inner walls have a transparent mucilaginous layer of distinctly stratified structure which nearly fills the cell cavity. Treated with zinc-chloride-iodine the mucilaginous formation is stained blue, the cell walls proper remaining yellow. In *V. Vitis-Idaea* the outer and inner walls

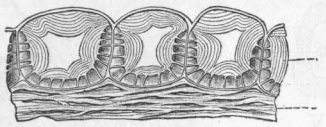


FIG. 32.—Mountain Cranberry (*Vaccinium Vitis-Idaea*). Transverse section of testa. × 160.

often have a swollen layer, but this may also occur in *V. macrocarpon* and may not be characteristic of the former species (Fig. 32). The sclerenchymatous radial and inner walls are pierced with numerous pores which, in the immature or abortive seeds, are nearly circular, but in the fully ripe seeds are usually much elongated.

2. Inner Testa. The remainder of the testa consists of two or three layers of large thick-walled porous cells, the innermost layers being more or less collapsed. In dried or cooked specimens, all of these cells are collapsed (Fig. 30, m).

Endosperm (Fig. 30, E). The average diameter of the cells is 0.035 mm. Protein grains are present throughout; starch is entirely absent.

The Embryo is not interesting in its microscopic structure.

Microscopic Examination of Cranberry Preserves.

Fragments of the epicarp and endocarp (the latter with stomata), bundles from the mesocarp, and seeds, may be found in preserves. The large porous epidermal cells of the testa with sclerenchymatous and mucilaginous layers are especially charac-

teristic and may be studied in surface preparations. In unripe or abortive seeds these cells are smaller, thinner-walled, and have pores more nearly round than in the mature seeds. Isolated stone cells detached by cooking from the testa of imma-

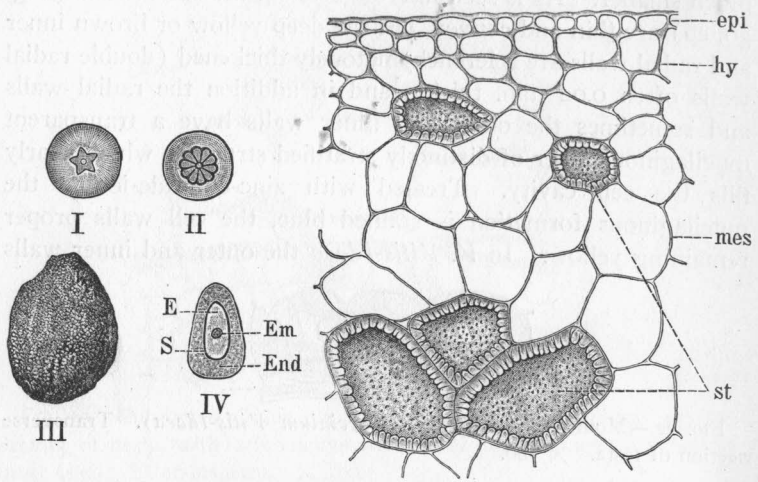


FIG. 33.—Huckleberry (*Gaylussacia resinosa*). I Fruit seen from above, × 1. II Transverse section of fruit, × 1. III Stone, × 8. IV Transverse section of stone, × 8. End, endocarp; S, testa; E, endosperm; Em, embryo.

FIG. 34.—Huckleberry. Transverse section of outer portion of the pericarp. epi, epicarp; hy, hypoderm; mes, mesocarp; st, stone cells. × 160.

ture seeds, sometimes occur in the gelatinous portion of the preserve.

THE HUCKLEBERRY (*Gaylussacia resinosa* Torr. and Gray).

This berry is abundant in the northern United States, and furnishes large quantities of fruit for the market. So far as the writer can learn, it is not cultivated; but some of the blueberries (*Vaccinium*), which are closely allied botantically and are similar in appearance and flavor, are now being improved by Munson[1] at the Maine Agricultural Experiment Station.

[1] Maine Ag. Ex. Sta. Rep. 1898, 164-172. Bul. 76, Aug., 1901. Am. Gard. 20, 1899, 852.

Macroscopic Structure.

The huckleberry is globular in form, blue-black in color, and one cm. or less in diameter (Fig. 33, I and II).

It is not a true berry, but a ten-celled drupe, the hard coverings of the so-called seeds being the inner walls of the pericarp cells.

The epicarp is smooth and the fruit is crowned with five pointed calyx lobes much like those of the cranberry. In the center, between these lobes, is a small depression, the scar of the style.

The pits are closely crowded about the axis and as a consequence are wedge-shaped (Fig. 33, III and IV). Under the hand lens they have a rough granular appearance.

Within the thick endocarp is the seed with a thin testa and a bulky endosperm; in the axis of the endosperm is an elongated embryo.

Histology.

Pericarp. 1. Epidermis (Fig. 35, epi). Surface mounts show the cells of this layer to be much the same in form and size as those of the cranberry epicarp; cross sections, however, show that the cuticle is much thinner.

2. The Hypodermal Coat (Fig. 34, hy) is several cell-layers thick, and thus furnishes a protection against evaporation, which is not necessary in the case of the cranberry owing to its thick cuticle.

3. Mesocarp (Fig. 34, mes). Owing to the presence of numerous stone cells (st) this layer is strikingly different from the mesocarp of the other small fruits investigated, but resembles that of the quince and pear, although the stone cells are thinner walled and the parenchyma cells about them are not strongly elongated, and are not arranged in a marked radiating pattern. These stone cells are angular or elliptical and vary in diameter up to 0.2 mm. The walls (0.02 mm. or less thick) are pierced with numerous small pores. They occur either singly or in groups throughout the mesocarp, and may be readily separated from the soft tissues by pressure.

4. Endocarp (Fig. 35, end). Most of the elements of this hard coat are stone cells, about the same size and shape as those of the mesocarp (although usually thicker-walled), but in the

wall adjoining the mesocarp there is a group of narrow sclerenchymatous fibers running parallel with the axis of the fruit and similar fibers form the inner layer of the coat.

The pits of the huckleberry crush more readily between the teeth than those of the bramble fruits, owing to the larger size of the stone cells and the relatively larger cell cavities.

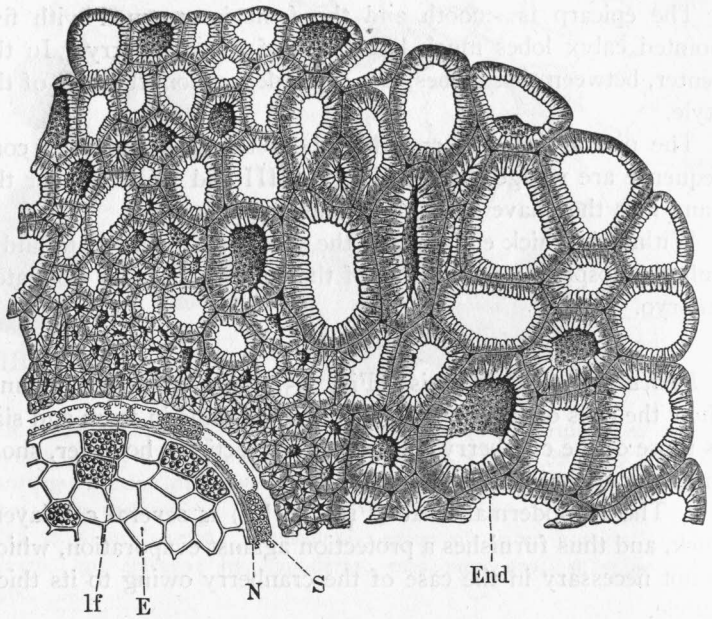


FIG. 35.—Huckleberry. Transverse section of endocarp and seed. end, endocarp with large isodiametric stone cells and lf, narrow longitudinally extended fibers; S, testa; N, hyaline layer (nucellus); E, endosperm. × 160.

Testa (Fig. 35, S). There is but one layer of cells in this coat, which may be removed after cutting off the endocarp and studied in surface view (Fig. 36). Most of the cells are of fantastic form with wavy outline, and often reach a length of 0.2 mm. The walls are beautifully reticulated, the nearly circular pores being 0.004 mm. in diameter. This coat is highly characteristic. The raphe is not conspicuous.

The Endosperm (Fig. 35, E) *and Embryo* are much the same in structure and form as in the cranberry.

Microscopic Examination of Huckleberry Preserves.

The characteristic elements of the huckleberry which may be found in preserves are the large stone cells of the mesocarp and

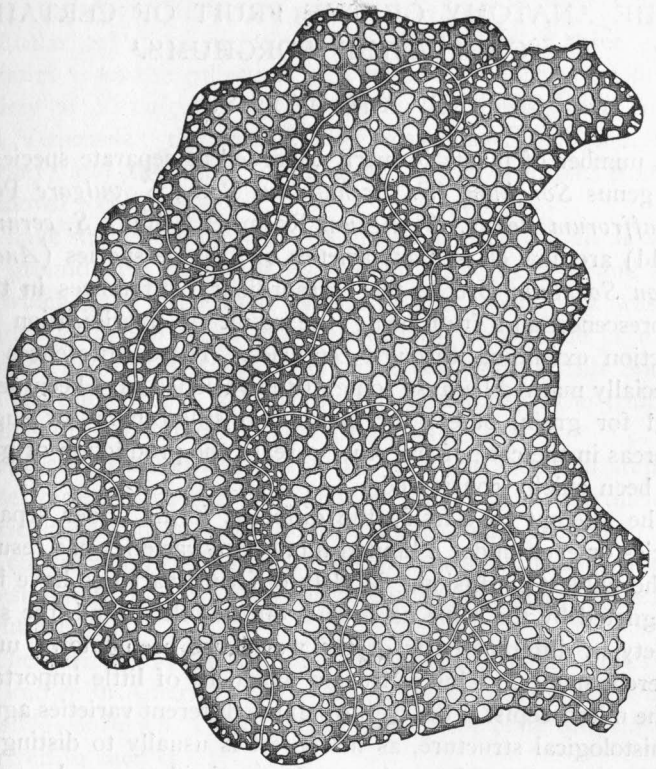


FIG. 36.—Huckleberry testa in surface view. × 300.

endocarp, and the reticulated cells of the testa. Stone cells of the mesocarp are distributed throughout the preserve, but those of the endocarp should be examined in transverse section. The testa is best seen in surface preparations.

THE ANATOMY OF THE FRUIT OF CERTAIN CULTIVATED SORGHUMS.[1]

By A. L. Winton.

A number of plants formerly regarded as separate species of the genus *Sorghum* (*S. saccharatum* Pers., *S. vulgare* Pers., *S. caffrorum* Beauv., *S. nigrum* Roem. et Schult., *S. cernuum* Willd) are now classed as varieties of a single species (*Andropogon Sorghum* Brot.), the extraordinary differences in their inflorescence and fruit being the result of hybridization and selection extending through centuries. These differences are especially marked because some of the varieties have been developed for grain, others for brush and still others for sugar; whereas in the case of the other cereals, the production of grain has been chiefly considered.

The attempt to classify the different forms under separate species or even under a limited number of varieties has resulted in the wildest confusion. Widely differing varieties have been designated by the same name and, on the other hand, the same variety in different parts of the world has been known under different names. This confusion would be of little importance to the microscopist if the fruit of all the different varieties agreed in histological structure, as his object is usually to distinguish sorghum products from the products of other cereals, not to identify the particular varieties. Owing, however, to the variations in microscopic as well as macroscopic structure, the problem presents some difficulties.

The purpose of this article is chiefly to point out the histological elements of the fruit and glumes which may be of service in diagnosis, whether they are common to all the varieties or peculiar to certain varieties. This is of particular importance in America, owing to the number of varieties which are or may be ground both for cattle foods and adulterants.

[1] A translation of this paper was printed in Ztschr. f. Unters. d. Nahr. u. Genussm. 1903, **6**, 337, as a contribution from Graz University.

Literature. Harz[1] figures cross sections of the fruit of several varieties of sorghum, but gives little attention to the elements in surface view. Hassack[2] studied four so-called species (*S. halepense, S. vulgare, S. cernuum, S. saccharatum*), both in cross section and in surface preparations.

Mittlacher[3] gives an exhaustive description of three exotic varieties from the collection at Vienna University: the first, a variety of *S. vulgare,* represented by specimens from Turkey and Venezuela; the second, also classed as *S. vulgare,* from Turkey, and the third, designated *S. saccharatum,* from an unknown locality.

I have studied twelve varieties grown in America, all of which are ground to a greater or less extent for cattle food and some of which have been used as adulterants. Not only was the mature grain examined but observations were made as to the habit of growth of plants raised from this grain at this Station, and the microscopic and macroscopic structure of the fruit and glumes during different stages of growth.

The classification adopted is the result of a careful study of these varieties by Ball and Day at the U. S. Department of Agriculture and is believed to be substantially in accord with the classification of Koernicke and of Hackel, although further investigations now in progress at the Department may lead to slight changes.

The varieties are designated by the names under which they are known in America and by the scientific names; but to avoid possible confusion, a short description of the plant and the fruit is given in each case.

It is again my privilege to acknowledge the valuable aid of my honored instructor, Prof. J. Moeller of Graz University, Austria, in whose laboratory I carried on the microscopic work and executed the drawings. I also take pleasure in thanking Prof. C. E. Ball and Prof. J. B. Davy of the Bureau of Plant Industry, U. S. Department of Agriculture, for their coöperation. The chemical analyses were executed by Mr. M. Silverman of this Station.

[2] Landw. Samenkunde, Bd. II, 1249.
[1] Mitth. aus dem Labor. f. Waarenkunde an der Wiener Handels-Akademie, 15 Jahr., 1887, 113-140; Ref. Bot. Centralbl. 1888, 17-19.
[2] Ztschr. des Allgem. österr. Apotheker-Vereines, 1901, 813, 831, 856, 875, 899 und 928.

BROOM-CORN (*Andropogon Sorghum* var. *technicus* Koern.).

Broom-corn is grown in large quantities in Illinois, Kansas, Nebraska and some other states of the United States, and to a much lesser extent in Spain, Italy and other parts of Europe. Although the grain is not fully ripe when the brush is in its best condition, still it is utilized to some extent as food for cattle and poultry, and sometimes is mixed with wheat bran as an adulterant.

I have studied four varieties as follows: Long Bush Evergreen, Early Japan, California Golden and Improved Dwarf. The mature plants of the first three varieties are from three to four meters in height, of the last variety from two to three meters, but the fruit and floral envelopes of the four varieties are practically the same, both in general appearance and in structure.

A study of the glumes and the palet of the broom-corn is important, since they closely envelop the grain and are not, with the exception of the flowering glume, removed by threshing.

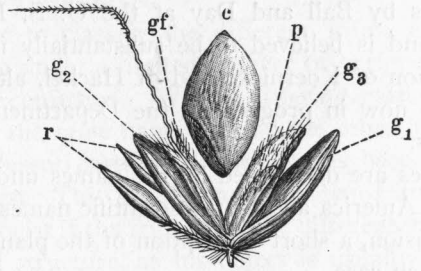


FIG. 37.—Broom-Corn. Fruit with chaff. r, two staminate spikelets; g^1, lower empty glume; g^2, upper empty glume; g^3, glume of rudimentary flower; gf, flowering glume with awn; p, palet; c, caryopsis. × 4.

Empty Glumes. Both glumes (Fig. 37, g^1 and g^2) are from 4 to 6 mm. long, equalling and closely enveloping the fruit. They vary in color from yellow-brown to red-brown. The soft hairs, which nearly cover the outer surface, are loosely attached and most of them are removed during the threshing and cleaning of the seed, leaving the glumes smooth and shining.

1. The Outer Epidermis (Figs. 38 and 39, aep) consists of strongly sclerenchymatized cells several times as long as they are broad, with wavy contour, interspersed here and there with

isodiametric hair-scars, each accompanied by a crescent-shaped cell with granular contents. The hairs, which are almost invariably detached in preparing the mount, if not in cleaning the seed, are often 1.0 mm. long and 0.012 mm. broad in the middle but taper towards both ends. Invariably the lumen is much broader than the walls.

2. The Hypoderm Fibers (Figs. 38 and 39, f), of which there are several layers, have thick walls and narrow cavities. They vary in length up to 0.5 mm. or more.

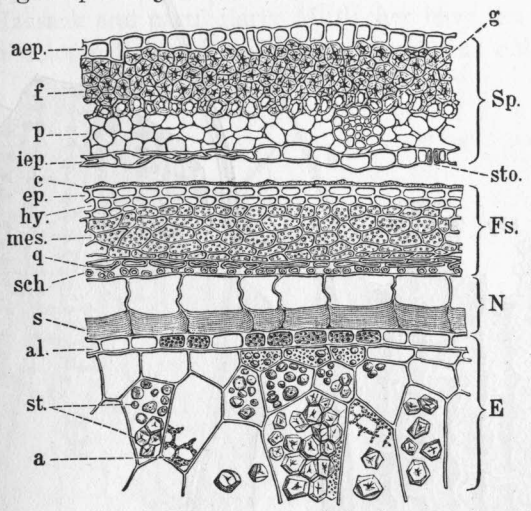


FIG. 38.—Broom-Corn. Transverse section of caryopsis and an empty glume. Sp, empty glume, consisting of the outer epidermis aep, the fiber layer f, the spongy parenchyma p, and the inner epidermis iep; g, bundel; sto, stoma; Fs, pericarp, consisting of the epidermis ep with the cuticle c, the hypoderm hy, the starchy mesocarp mes, the cross-cells q, and the tube-cells sch; N, nucellar or hyaline layer with swollen inner walls s; E, endosperm, consisting of the aleurone-layer al and the starch-cells with starch granules st and proteid network a. × 160.

3. Spongy Parenchyma (Figs. 38 and 40, p). As seen in surface view, the cells of this layer are more or less rectangular with circular intercellular spaces and resemble those of rice and barley glumes.

4. Inner Epidermis (Figs. 38 and 40, iep). In cross section this layer is not readily studied since the radial walls are usually collapsed; but in surface preparations, the large elongated cells, often 0.15 mm. long and 0.05 mm. wide, interspersed with stomata and hairs, are clearly displayed.

Thin Glume (Fig. 37, g^3). Within the lower or first glume and nearly equalling it in length, is the third or thin glume, the remnant of an abortive flower. This glume is exceedingly thin and membraneous and bears numerous hairs, particularly on the margin.

1. Outer Epidermis (Fig. 41, aep). In general form the cells are similar to those of the outer epidermis of the thick glumes, but are narrower and much thinner-walled. The marginal hairs

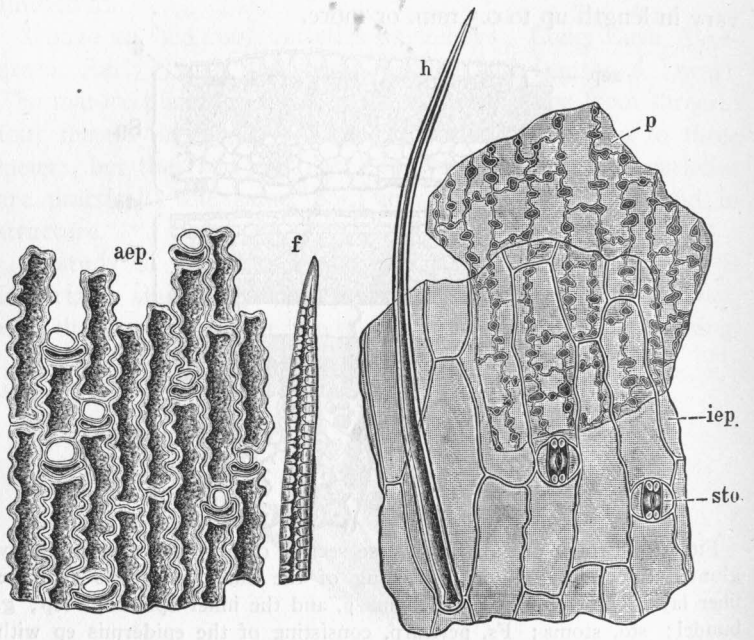


FIG. 39.—Broom-Corn. aep, outer epidermis and f, fiber of an empty glume in surface view. × 300.

FIG. 40.—Broom-Corn. p, spongy parenchyma and iep, inner epidermis of an empty glume in surface view; sto, stoma; h, hair. × 300.

(h) are long (often 0.5 mm.), single celled and pointed; but on the surface shorter hairs (h), with two or three joints and blunt ends, also occur. Both of these forms have exceedingly thin walls.

2. The Inner Epidermis (Fig. 5, iep) is distinguished from the outer by the straight walls and almost entire absence of hairs.

Flowering Glume (Fig. 37, gf). The fourth or flowering glume, situated between the upper or second glume and the

grain, is also membraneous and bears an upwardly barbed awn 5 to 7 mm. long. This awn, with the larger part of the flowering glume being readily detached by threshing, is seldom found in the grain on the market.

Palet (Fig. 37, p). This is membraneous and hairy like the third or thin glume, but is much smaller.

Pericarp. The grain or caryopsis is about 5 mm. long and from 2 to 3 mm. wide, tapering to a blunt point at both ends. It varies in color from yellow-brown to red-brown.

Harz, Hassack and particularly Mittlacher have described so fully the histological elements of the caryopsis, that only a brief

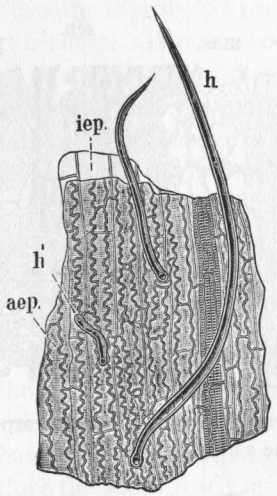


FIG. 41.—Broom-Corn. Glume of rudimentary flower (Fig. 1, g^3) in surface view. aep, outer epidermis with h, one-celled hair and h^1, two-celled hair; iep, inner epidermis. × 300.

description, essential for a clear understanding, need here be given.

1. Epidermis (Figs. 38 and 42, ep). The cells are longitudinally extended and have thick wavy side walls, with more or less distinct pores. Hassack has noted that the cuticle (c) is of uneven thickness, due to minute granules or crystals, which may be seen either in section or surface view.

2. The Hypoderm (Figs. 38 and 42, hy) consists of from one to three layers of cells, with walls somewhat thinner than those of the epidermis.

3. Starchy Mesocarp (Figs. 38 and 42, mes). Several layers of thin-walled parenchyma cells, filled usually with small round or rounded polygonal starch granules seldom over 0.006 mm. in diameter, make up this coat. In all the varieties here described the starch appears during the early stages of growth and persists until the fruit nearly or quite reaches full maturity. As the caryopsis, even when nearly mature, is intensely green owing to chlorophyl grains in the outermost layers of the mesocarp, it may be inferred that this starch is a direct product of assimilation in the pericarp. So far as I have observed, the presence or absence of a starchy mesocarp in the grain at the time of

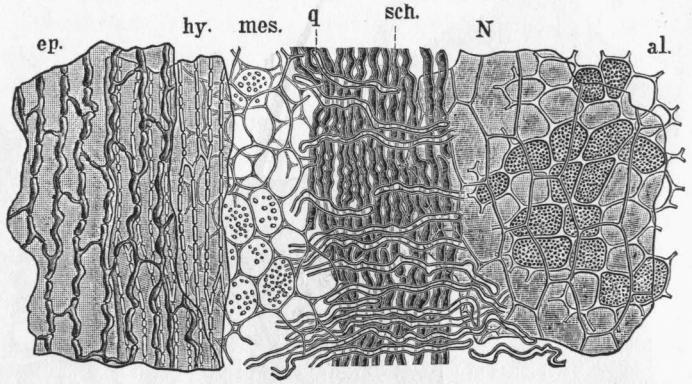


FIG. 42.—Broom-Corn. Layers of the pericarp in surface view. Significance of letters same as in Fig. 38. × 160.

harvest is not a definite varietal peculiarity, but is dependent on the ripeness of the fruit or other conditions. Some kernels of the same variety may possess it, while others show only empty, obliterated cells. Whether or not the starch is present in a given seed may often be determined by careful scraping and observation with the naked eye.

4. Cross-Cells (Figs. 38 and 42, q). These cells are usually long and narrow, being distinguished from the tube-cells only by their transverse arrangement. Near the extremities of the seed they are, however, shorter and of more irregular shape.

5. Tube-Cells (Figs. 38 and 42, sch). The cells of this layer lie at right angles to the cross-cells. They are about 0.005 mm. wide and often reach a length of 0.20 mm.

Nucellar or Hyaline Layer (Figs. 38 and 42, N). This layer is frequently 0.05 mm. thick. The outer radial walls are thin, but the inner wall (s) is greatly swollen. In surface view the large cells are conspicuous, not only because of their size, but because of their yellow or brown color.

Endosperm. 1. Aleurone Layer (Figs. 38 and 42, al). The individual cells of this layer are characterized by their great variation in size (0.01 to 0.04 mm. in diameter) and form.

2. Starch-Cells (Fig. 38, st). In the outer layers the starch granules, if present, are much smaller than in the interior of the seed, where they sometimes reach a diameter of 0.03 mm. They are usually sharply polygonal, with a distinct hilum and radiating fissures. The starch is surrounded by small protein granules, forming a net work (Fig. 38, a) which is especially evident after removing the starch by reagents. In some specimens, one or more of the outer cell layers are filled with these protein granules to the complete exclusion of the starch.

SUGAR SORGHUM (*Andropogon Sorghum* var. *saccharatus* Koern.).

Sugar sorghum has been cultivated for many years in China and Africa and for the past half century in America. Twenty years ago it gave promise of being the chief sugar plant of the United States, but has largely given place to the sugar beet. It is cut for sugar before the seeds reach maturity, but the latter still have some value as food for stock. When grown to maturity the seed are said to be equal or superior to durrha.

I have examined two of the most important varieties: Early Amber and Early Orange. In habit of growth, these varieties resemble closely the broom corns, but the panicles are shorter and less spreading. In both varieties the two black, shining, empty glumes are of about the same length as those of broom-corn, but are somewhat broader and, since they do not so closely envelop the caryopsis, are sometimes, though not usually, removed in threshing.

Numerous loosely attached hairs cover the surface of these empty glumes, but they, as well as the awned flowering glumes, drop off in the preparation of the grain for the market.

Under the microscope the two varieties examined can not be distinguished from the broom-corns except by the material in the epidermal cells of the empty glumes to which they owe their black color.

Kaffir Corn (*Andropogon Sorghum* (L.) Brot.).

Kaffir corn is the chief bread cereal and cattle food of the natives in parts of South Africa.

I have studied the so-called White and Red Kaffir Corn, two varieties grown extensively in parts of America. Both varieties reach the height of from 2 to 3 meters and produce their fruit in a dense head which does not bend over at maturity.

The empty glumes are somewhat shorter than the fruit and the flowering glume is not awned. The caryopsis is nearly globular, about 4 mm. in diameter and usually separates from the glumes in threshing.

In microscopic structure the two varieties are the same, differing from the broom-corns and sugar sorghums chiefly in that *the nucellar layer is not evident* either in cross section or in surface preparation, and in that *the hypoderm is more strongly developed,* often consisting of three layers of thick-walled cells.

The epidermis, starchy mesocarp, cross-cells, tube-cells, aleurone cells and starchy endosperm are practically the same as described under broom-corn.

White Milo Maize (*Andropogon Sorghum* (L.) Brot.).

This variety, known also as White Branching Sorghum and White African Millet, closely resembles white Kaffir corn in habit as well as in the macroscopic and microscopic structure of the caryopsis; but the occasional tendency of the rachis to bend over indicates possible relationship with the variety *durra.*

Durrha (*Andropogon Sorghum* var. *durra* (Forskal) Hackel).

Two varieties have been examined, the first known as Brown Durrha, the second as White Durrha or Jerusalem Corn. These two varieties are grown to some extent in America for the grain, which is used as food for both cattle and poultry. Both varieties are practically the same in habit of growth and also in the

macroscopic structure of the fruit envelopes and caryopsis. The plants reach the height of 2 to 3 meters, but as the dense heads approach maturity, the rachis below them bends over, forming a goose neck. As the names indicate, the color of the ripe caryopsis is brown in one variety and white in the other.

Both of the empty glumes are obtuse, densely hairy and about half the length of the large, flattened, more or less lenticular caryopsis, which is 5 to 6 mm. long and of about the same breadth. The flowering glume of white durrha is awned, but that of red durrha is awnless.

As found in the market, the grain is usually free from all envelopes.

Although to the naked eye the caryopses of the two varieties are much alike except in color, under the microscope they show one marked difference. *In brown durrha the nucellar or hyaline layer is always strongly developed, whereas in the white variety this layer is not evident.*

The other parts are much the same as described under broom-corn, but the outer layers of the endosperm normally contain only aleurone grains.

Yellow Milo Maize (*Andropogon Sorghum* var. *durra* (Forskal) Hackel).

Yellow Milo Maize has many points in common with Jerusalem Corn and according to Ball and Davy probably belongs under the variety *durra.*

The pubescent empty glumes and the awnless flowering glumes are somewhat shorter than the yellow caryopsis, which is about the same size as that of brown durrha, but is more nearly globular.

Microscopic examination shows that the caryopsis of this variety and of brown durrha are much alike in structure.

No traces of the nucellar layer are evident, but all of the other coats are strongly developed, the hypoderm and the starchy mesocarp being several cell-layers thick. Commonly only aleurone grains are found in the outer two or three cell-layers of the endosperm.

Microscopic Identification of Ground Sorghum.

The starch granules of sorghum are practically the same, both in form and size, as those of maize, although radically different from those of all other cereals. Meyer observed that the granules of some varieties of sorghum take on a reddish color, not a blue, with iodine solution, but Mittlacher found that this reaction takes place only after first soaking the grain in water. As a means of distinguishing sorghum starch from maize starch,

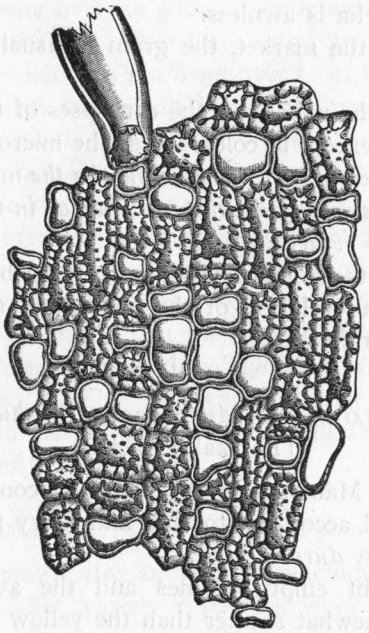


Fig. 43.—Maize. Epidermis of the upper empty glume in surface view. × 300.

this test is of little value, and it is necessary to depend on the differences in structure of other histological elements.

The epidermis of the glumes and the nucellar layer of both broom-corn and sugar sorghum are radically unlike any tissues found in maize. Especially characteristic are the cells of the nucellar layer, which may be readily found without treatment with reagents, whereas in other cereals they can seldom be seen except under the most favorable conditions.

After treatment with potash, the outer epidermis (Fig. 39, aep) of the empty glumes may be readily distinguished from the corresponding tissues of maize (Fig. 43) by the longer cells, their zigzag contour and the crescent-shaped cells which almost invariably accompany the hair-scars. The thin glume (Fig. 41) resembles those of maize (Fig. 44), but the cells are longer, narrower and less irregular in form.

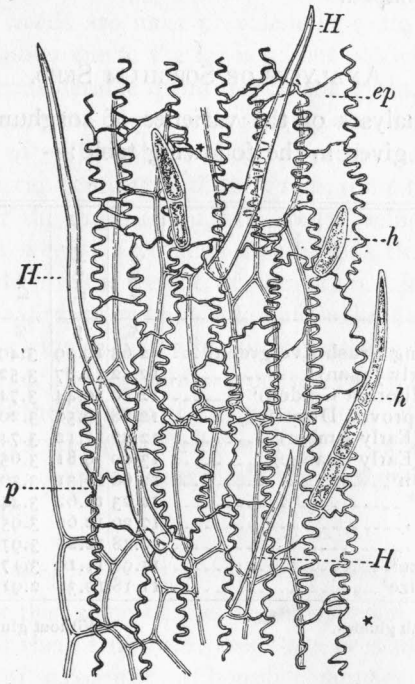


Fig. 44.—Maize. Membranaceous glume in surface view. ep, outer epidermis with the long one-celled hair H, and the short, blunt 1 to 3 celled hair h; *, hair scar; p, ground tissue. × 160. (Moeller.)

In the case of varieties that are not ground with the glumes or do not have a nucellar layer, reliance must be placed chiefly on the epidermis of the caryopsis, which, however, is not always characteristic, and on the starchy mesocarp, which is difficult to find in the ground product. The tube-cells of the two cereals are much the same and the cross-cells of sorghum are often not distinguishable from the spongy parenchyma cells of maize.

The elongated cells of the outer epidermis of the thick glumes in sorghum and barley are much alike, but the short conical hairs, often unaccompanied by crescent-shaped cells, are characteristic of barley. Sorghum and oat glumes are not so readily distinguished by the epidermal tissues; but in sorghum the cells of the spongy parenchyma are, like those of barley, irregularly rectangular with round intercellular spaces, whereas in oats they are star-shaped.

Analyses of Sorghum Seed.

Chemical analyses of the varieties of sorghum described in this paper are given in the following table:—

	Water.	Protein.	Fat.	Nitrogen-free extract.	Crude fiber.	Ash.
	%	%	%	%	%	%
Broom Corn (Long Brush Evergreen)[1]	12.63	10.19	3.49	67.90	2.83	2.46
" (Early Japan)[1]	12.32	11.87	3.52	65.56	3.84	2.89
" (California Golden)[1]	12.86	10.44	3.74	65.54	3.84	3.28
" (Improved Dwarf)[1]	12.88	9.56	3.20	64.93	6.19	3.24
Sugar Sorghum (Early Amber)[1]	12.37	11.12	3.74	67.43	3.08	2.26
" (Early Orange)[1]	13.00	9.81	3.65	69.80	1.99	1.75
White Kaffir Corn[2]	12.66	10.31	3.30	71.01	1.44	1.28
Red Kaffir Corn[2]	12.23	10.62	3.44	71.42	1.10	1.19
White Durrha[2]	12.20	12.62	3.95	67.63	1.53	2.07
Brown Durrha[2]	12.48	12.25	3.97	68.45	1.19	1.66
White Milo Maize[2]	11.98	11.19	3.17	70.92	1.37	1.37
Yellow Milo Maize[2]	11.18	10.31	2.91	72.08	1.75	1.77

[1] With glumes. [2] Without glumes.

AMERICAN WHEAT SCREENINGS.[1]

By A. L. Winton.

A number of the Experiment Stations in the United States have prepared lists of weeds occurring in their own section, with statements as to the crops infested. From these lists may be learned what weeds are most prevalent in grain fields, that is, those most troublesome to the farmer; but not what weed seeds are found in considerable quantities in the grain, or screenings from the grain, points of particular importance to the miller and the purchaser of mill products. Some weeds are so low growing that they escape cutting with the grain, some ripen their seed before or after the grain is cut, and some, including a number of the rankest weeds, have such small seeds that they do not appreciably add to the weight of the grain. It is, therefore, evident that a satisfactory knowledge of the kind and amount of weed seeds occurring in the grain can be gained only by a study of the grain itself, or the screenings from the grain, and not merely from a study of the herbage of the grain fields. Botanical analyses of screenings are particularly interesting, as a small amount of the material contains nearly all the impurities of a large amount of grain.

Screenings from European Wheat.

Vogl[2] states that some of the weeds of grain fields are cosmopolitan, and their fruits and seeds are present in practically every sample of screenings, although a number of them, such as cockle and legumes, occur in such large amounts that the others are relatively of small importance. According to the same author, fruits and seeds of the following weeds are present in considerable amount in screenings: *Vaccaria parviflora* Moench (cow herb); Species of *Galium* (bed straws); *Bifora radians* M. B.; *Bromus secalinus* L. (chess); *Lolium temulentum* L. (darnel); *Avena fatua* L. (wild oats); *Centaurea*

[1] A German translation of this paper appeared in Ztschr. f. Unters. d. Nahr. u. Genussm. 1903, **6**, 433, as a contribution from this Station.

[2] Die wichtigsten vegetabilischen Nahrungs- und Genussmittel (1899), p. 21.

Cyanus L. (corn flower); *Papaver Rhoeas* L. (corn poppy); *Lithospermum arvense* L.; Species of *Atriplex; Convolvulus arvensis* L. (small bindweed); Species of *Polygonum,* especially *P. Convolvulus* L. (black bindweed); *Melampyrum arvense* L. (cow wheat); *Alectorolophus hirsutus* Allion; *Delphinium Consolida* L. (larkspur); *Ranunculus arvensis* L. (buttercup); etc. Fruits of species *Setaria* (foxtail) and some umbelliferous plants, seeds of cruciferous plants, etc., are mentioned as occurring only in small amounts.

In a sample of wheat screenings from one of the largest steam mills near Vienna, Vogl found: broken wheat 41.7 per cent., cockle, 42.7 per cent., legumes, 6.4 per cent., bed straws, 3.3 per cent., *Atriplex,* 3.1 per cent., *Polygonum* species, 1.1 per cent., miscellaneous, 0.6 per cent.; while in another sample he found broken wheat, etc., 42.1 per cent., cockle, 29.7 per cent., legumes, 11.1 per cent., *Bifora radians,* 4.9 per cent., bed straws, 3.5 per cent., *Polygonum* species, 2.0 per cent., cow wheat, 2.5 per cent., cruciferous species 1.4 per cent., miscellaneous 2.3 per cent.

The sample of so-called "tares" consisted chiefly of legumes with small amounts of broken wheat, cockle, etc. One known as "chicken or small wheat" consisted largely of small wheat kernels mixed with chess (4.3 per cent.) and other fruits and seeds, including three kernels of foxtail.

The foreign matter in a sample of uncleaned wheat was chess, cockle and small amounts of other impurities, including two fruits of black bindweed.

Screenings from American Wheat.

For our purpose, the chief wheat-growing regions of America may be divided into three sections: First, the spring wheat section of the middle west, including Kansas, Ohio, Indiana, Missouri, Illinois, southern Nebraska, southern Michigan, and the adjoining states to the south; second, the winter wheat section of the middle northwest, including the states of Minnesota, North Dakota, South Dakota, Iowa, Wisconsin, northern Nebraska, and Canada; third, the Pacific section, including the States of California, Oregon and Washington.

Botanical Analyses of screenings from the first two of these sections are given in Table XXIX.

Table XXIX.—Botanical Analyses of Wheat Screenings.

Name of Seed, Fruit or Impurity.	Spring Wheat Screenings.			Winter Wheat Screenings.	Wheat Screenings Bought in Connecticut. Further particulars unknown.					
	From mill in New York City.	From mill in Milwaukee.	Average of five largest mills in Minneapolis.	From mill in Detroit.	From mill in Alton, Ill.*					
	7887	7889	7890	7886	7888	5109	5110	5111	5112	5158	5164
	%	%	%	%	%	%	%	%	%	%	%
Broken and shrivelled Wheat	48.2	67.5	19.8	69.6	38.8	49.3	41.4	44.9	40.0	69.5	42.0
Straw and Chaff	11.4	3.2	24.2	4.2	10.0	5.2	13.0	10.0	6.5	3.7	5.5
Dust (material finer than 1 mm.)	3.8	0.2	17.4	1.0	0.6	2.0	4.2	3.8	3.7	1.3	5.8
Black Bindweed (*Polygonum Convolvulus* L.)	18.0	15.8	12.8	9.4	0.1	17.8	27.0	24.5	23.6	8.9	23.1
Green Foxtail (*Setaria viridis* Beauv.)	2.2	1.2	7.4	0.8	0.0	11.6	3.0	4.2	10.9	5.9	10.0
Yellow Foxtail (*Setaria glauca* Beauv.)	5.6	8.1	5.4	0.8	0.0	1.8	0.7	1.0	3.0	1.9	2.9
Chess (*Bromus secalinus* L.)	0.0	0.0	0.0	6.6	49.3	2.8	trace	trace	0.0	2.2	trace
Flax (*Linum usitatissimum* L.)	3.4	0.4	2.0	3.1	0.0	3.8	3.7	4.9	4.9	0.7	4.0
Oats (*Avena sativa* L.)	3.6	2.0	3.2	2.1	trace	1.9	3.9	3.7	3.9	2.7	3.6
Ragweed (*Ambrosia artemisiæfolia* L.)	0.6	0.0	0.0	0.6	0.0	0.4	1.2	1.0	1.2	0.3	0.8
Wild Mustard (*Brassica* species)	0.0	1.2	2.8	0.2	0.0	0.6	0.3	0.5	0.5	1.1	0.6
Cockle (*Agrostemma Githago* L.)	0.0	0.0	0.0	0.4	0.0	0.5	0.0	0.0	0.0	0.5	0.0
Pigweed, etc. (*Amaranthus* and *Chenopodium* species)	0.0	0.0	2.0	trace	0.0	1.0	0.6	0.6	0.9	0.3	0.8
Miscellaneous Seeds	3.2	0.4	3.0	1.2	1.2	1.3	1.0	0.9	0.9	1.0	0.9
	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

* This sample represents only the coarser materials separated from the grain and does not include the dust, smaller seeds, etc.

Five of these samples, three from spring wheat and two from winter wheat, were obtained direct from the mills, each representing the product from a large quantity of wheat grown in the section named. The remaining six samples, purchased in Connecticut from the retail dealers, could not be traced with certainty, either to the mill where the wheat was cleaned, or the region where it was produced.

Cockle. The analyses indicate that cockle is, at the present time, a comparatively unimportant constituent of American screenings. Eight of the samples analyzed contained not a seed, the remaining three only from 0.4 to 0.5 per cent. by weight. It should be noted, however, that this weed occurs in all the wheat-growing states and in some districts, it is said, the seeds seriously injure the quality of the grain. As they are more nearly the size of wheat kernels than most of the other weed seeds, they are not completely separated by screening, but are in part ground with the grain. That this is true, is shown by the presence of small amounts of cockle hulls in wheat bran from many of the mills; but the entire absence of cockle in screenings, or the presence of very small amounts, indicates that the grain could not have been seriously contaminated.

Since many unobserving people in America apply the term "cockle" to all black seeds, including the fruit of black bindweed, it is not surprising that an exaggerated idea of the abundance of this seed has gained credence.

Black Bindweed. By far the most abundant weed seed in all the screenings examined, except No. 7888, which, as it did not contain the small seeds of the grain, need not be considered, was the seed (or more correctly, the fruit) of black bindweed, the amount present varying from 8.9 to 27.0 per cent. This weed is prevalent throughout the spring and winter wheat sections. Bolley and Waldron[1] state that it is one of the most detrimental weeds in the wheat fields of North Dakota, the heart of the spring wheat section. Hitchcock and Norton[2] mention it as a troublesome weed in Kansas, the most important of the winter wheat states, and Selby[3] notes its abundant occurrence in Ohio. The aggregate production of this weed grain in the entire country must be enormous.

[1] North Dakota Agricultural Experiment Station, Bulletin 46 (1900), p. 654.
[2] Kansas Agricultural Experiment Station, Bulletin 57 (1896), p. 29.
[3] Ohio Agricultural Experiment Station, Bulletin 83 (1897), p. 278.

Foxtail. Seeds (fruits) of Green Foxtail and Yellow Foxtail rank next to black bindweed in abundance, 1.2 to 11.6 per cent. of the former and 2.2 to 6.6 per cent. of the latter being present in the samples analyzed. Hay[1] of Minnesota writes of these two plants collectively: "The one weed which, in the aggregate, does more to sap our soils of the moisture and plant food needed by our crops is foxtail"; and Bolley and Waldron state that these two species reduce the yield of grain in North Dakota more than all other weeds combined. Hitchcock and Norton note its frequent occurrence in the grain fields of Kansas, and Selby speaks of it as a troublesome weed in Ohio.

Chess was present in six of the samples of screenings, but in only three was the amount appreciable (2.2 to 6.6 per cent.). The weed appears to be most troublesome in the winter wheat section, being mentioned as a serious pest by Hitchcock and Norton, Selby, Beal, and others of that section, but not by Bolley and Waldron or Hay of the spring wheat section. The tradition that wheat degenerates into chess is still believed by some farmers.

Flaxseed and *Oats* (0.4 to 4.9 per cent. of the former and a trace to 1.9 per cent. of the latter) were found in all the samples analyzed. These crops are frequently rotated with wheat and the self-seeded plants may occur in some quantities in the wheat fields.

Fruits of *Ragweed* and seeds of *Pigweed, Mustard* and other weeds were contained in small but variable amounts in the samples.

It thus appears that the screenings of the old and new world are quite different at the present time. Of the two chief constituents of European screenings, cockle occurs in small amount and leguminous seeds not at all in the American product, while the three leading seeds of American screenings (black bindweed, green foxtail, and yellow foxtail), although introduced from Europe, are of minor importance in their native land. Chess is often met with in considerable amount on both continents.

What has been said applies only to the districts east of the Rocky Mountains. No opportunity was presented for the

[1] Minnesota Agricultural Experiment Station Report 1895, p. 373.

TABLE XXX.—CHEMICAL ANALYSES OF WHEAT SCREENINGS AND WEED SEED FROM SCREENINGS.

	Spring Wheat Screenings.			Winter Wheat Screenings.		Wheat Screenings Bought in Connecticut. Further particulars unknown.								
Station No.	7887	7889	7890	7886	7888	5109	5110	5111	5112	5158	5164	7401	7405	7403	7404	
	From mill in New York City.	From mill in Milwaukee.	Average of five largest mills in Minneapolis.	From mill in Detroit.	From mill in Alton, Ill.*							Broken and shrunken wheat from No. 5164.	Black bindweed seeds from No. 5164.	Green foxtail seed from No. 5164.	Yellow foxtail seed from No. 5164.	Average of 310 analyses of American wheat.
Water	10.14	11.70	10.06	10.95	11.34	12.14	12.11	12.07	12.27	12.35	11.65	12.25	12.23	11.76	10.49	10.5
Ash	3.17	3.04	5.69	2.84	4.09	3.59	3.70	3.50	3.55	3.24	3.50	2.62	2.02	5.50	8.23	1.8
Protein	13.87	15.06	14.00	14.69	13.31	14.75	13.87	14.44	14.25	14.50	15.25	17.12	9.12	14.50	11.50	11.9
Fiber	8.83	6.31	13.21	5.09	7.61	6.64	8.69	8.64	8.06	4.80	6.85	3.02	8.46	11.24	23.02	1.8
Nitrogen-free Extract	59.01	60.32	50.90	62.36	60.85	58.06	57.09	56.44	56.58	61.33	57.64	62.34	65.96	51.44	40.73	71.9
Fat	4.98	3.57	6.14	4.07	2.80	4.82	4.54	4.91	5.29	3.78	5.11	2.65	2.21	5.56	6.03	2.1
	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00			100.00	100.00	100.00	100.00	100.0

* See note page 341.

examination of screenings from the Pacific coast, but it is well known that the product differs markedly in constitution from that of the East.

Hilgard[1] in 1890 stated that in California all of the species of Polygonum excepting *P. aviculare* were almost unknown, and chess, although found here and there, had failed to gain a foothold as a weed.

Darnel (*Lolium temulentum* L.) and wild oats (*Avena fatua* L.) were named, however, as serious pests in the California wheat fields.

Chemical Analyses. In Table XXX are given chemical analyses of the eleven samples of wheat screenings, also of the four principal constituents of American screenings—namely broken and shrunken wheat, black bindweed seed, green foxtail seed, and yellow foxtail seed—separated from one of the samples of screenings. The analyses were executed by Messrs. Ogden, Silverman and Bailey.

Each of the samples of screenings contained considerably more protein, fat, ash, and fiber, but less nitrogen-free extract than the average of American wheat. Of the constituents of the screenings, the broken and shrunken wheat was richest in protein, owing to the presence of immature kernels, whereas black bindweed seed was poorest in protein. Green foxtail seed with nearly 15 per cent. of fiber contained considerably more protein than sound wheat, and yellow foxtail with over 23 per cent. of fiber nearly as much. Seeds of both species of foxtail are about three times as rich in fat as wheat. Black bindweed and buckwheat are not only closely related botanically, but their seeds have practically the same chemical composition.

THE ANATOMY OF WEED SEEDS.

Since the separation of weed seeds from grain is never absolutely complete, the ground seeds are contained in flour, bran, and other mill products, where they may be detected by microscopic examination. A knowledge of the microscopic structure of weed seeds is also essential for the diagnosis of certain cattle foods, consisting of ground screenings, and also in the examination of ground black pepper for adulteration.

[1] California Agricultural Experiment Station Report 1890, p. 238.

Five samples of cattle foods sold under such names as "Gee's Germ Middlings," "Seed Meal," etc., examined by the writer during the past year, were found to be ground screenings, containing the same seeds as the samples described in Table XXIX and six samples of black pepper noted on page 231 of this report were adulterated with the same material.

The weed seeds occurring in largest amount in European screenings have been fully described by Vogl,[1] Moeller,[2] Schimper,[3] Mace,[4] Koenig,[5] Tschiercke and Oesterle,[6] Villiers and Collin,[7] Senft,[8] and other writers; but the fruit of black bindweed, the chief weed seed of American screenings, has only been partially described, and the two foxtails, which rank next in importance, have not, to my knowledge, been studied at all.

Kraus[9] merely notes the presence of warts on the pericarp of black bindweed, Villiers and Collin give a figure showing the calyx and epicarp in surface view, but no description, and Koenig figures some of the tissues, but gives only a short description.

To fill these gaps I have made the studies described in the following pages.

Black Bindweed (*Polygonum Convolvulus* L.).

Two common names for this troublesome plant are current, one, "black bindweed," referring to the climbing habit of the plant and the color of the achene; the other, "wild buckwheat," calling to mind the resemblance of the leaves and achenes to those of buckwheat. The jet black lusterless triangular achenes are 3 mm. long and the faces are 2 mm. broad (Fig. 45, II). Since the achenes at maturity are closely invested by the calyx (Fig. 45, I), both are harvested together; but during threshing, screening and transportation, the dry calyx, as a rule, is

[1] Die gegenwärtig am häufigsten vorkommenden Verunreinigung u. Verfälschungen der Mehl. u. deren Nachweisung. Wein., 1880. Die wichtigsten vegetabilischen Nahrungs- u. Genussmittel. Wien, 1899.
[2] Mikroskopie der Nahrungs- u. Genussmittel. Berlin, 1886.
[3] Anleitung zur mikroskopischen Untersuchung. Jena, 1886.
[4] Les Substances Alimentaires. Paris, 1891.
[5] Die menschlichen Nahrungsmittel. 2 Aufl. Berlin, 1893.
[6] Anatomischer Atlas, Leipzig, 1893-8.
[7] Traité des Altérations et Falsifications. Paris, 1900.
[8] Pharmaceutische Praxis, 1902. Heft 3 u. 4.
[9] Jahrb. f. wissenschaftl. Botanik (Pringsheim), 1866, 5, 83.

removed from the achenes, and the pericarp, splitting at the angles, is often separated from the seed.

The seed consists of a thin colorless testa, a starchy endosperm and a minute embryo situated in a longitudinal groove of the endosperm at one of the angles (Fig. 46).

Calyx (Figs. 46 and 47, C). The three outer lobes of the five- to six-lobed calyx are broader than the others and are slightly keeled at the angles.

1. Outer Epidermis (Fig. 47, aep). Distributed over the outer surface are numerous characteristic blunt-conical or nipple-

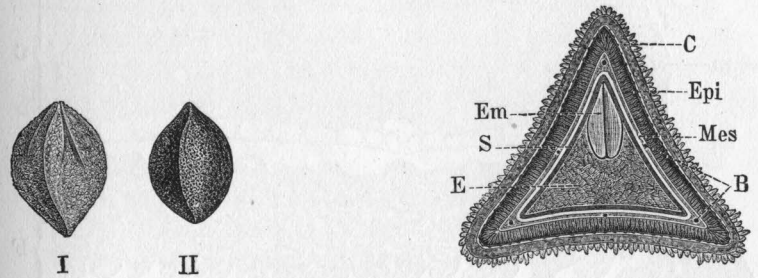


Fig. 45.—Black Bindweed. I Fruit with calyx. II Fruit without calyx. × 5.

Fig. 46.—Black Bindweed. Transverse section of the fruit. C, calyx; Epi, epicarp; Mes, mesocarp; B, fibro-vascular bundle; S, testa; E, endosperm; Em, embryo. × 16.

shaped papillae from 0.06 to 0.03 mm. in diameter at the base, each of which is marked with longitudinal striations. These papillae, as may be seen in tranverse section, are the outer portions of the epidermal cells, the inner portions forming a continuous cell layer.

2. Mesophyl (m). Between the outer and inner epidermis are several layers of chlorophyl-containing parenchyma with intercellular spaces.

3. Inner Epidermis (iep). Elongated cells with more or less wavy outline and varying in length up to 0.20 mm. and in breadth from 0.015 to 0.045 mm., interspersed here and there with stomata, make up the inner coat of the calyx.

Pericarp (Figs. 46 and 47, F, Figs. 48, 49 and 50). The black hulls or shells of the grain should be studied in cross section and in surface preparations, the latter being freed from the black coloring matter by warming on the slide with caustic

alkali, or better by boiling for half an hour with 1.25 per cent. sodium hydrate solution as in the determination of crude fiber.[1]

1. Epicarp (Figs. 46, 47 and 50, epi, Figs. 48 and 49). Cross sections show that the cells are about 0.10 mm. in radial diameter on the sides of the achenes and are still longer at the angles. The inner wall is thin, but the outer wall and the outer portions

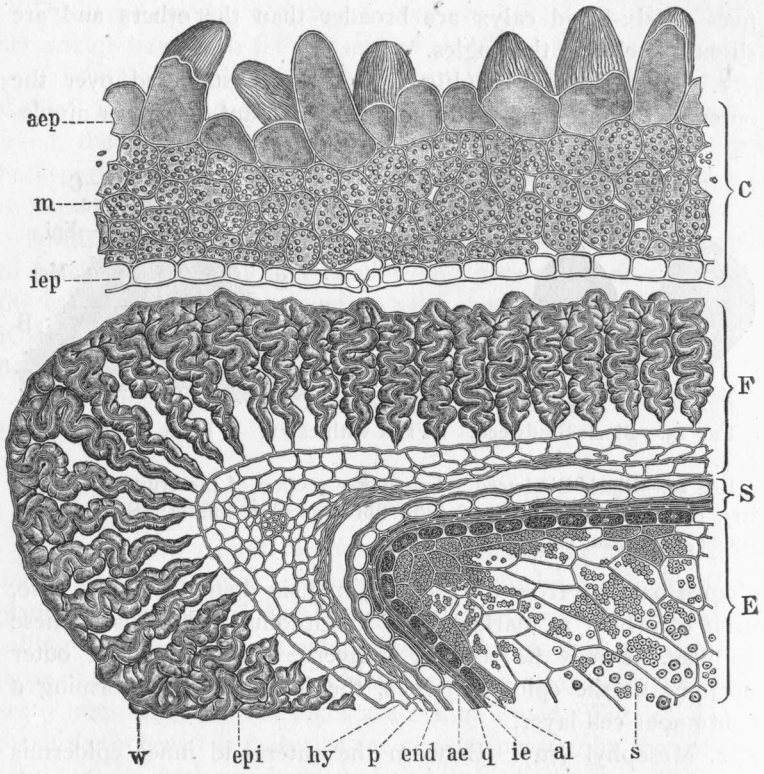


FIG. 47.—Black Bindweed. Transverse section of the fruit. C, calyx consisting of the outer epidermis aep, the mesophyll m and the inner epidermis iep; F, pericarp consisting of the epicarp epi with cuticular warts w, the mesocarp p and the endocarp end; S, testa consisting of the outer epidermis ae, the cross-cells q and the inner epidermis ie; E, endosperm consisting of the aleurone-cells al and the starch-cells s. × 160.

[1] In several papers I have called attention to the crude fiber process as a means of obtaining various ground materials in a suitable form for microscopic examination. As the material is boiled successively with dilute acid and alkali, all cell contents are removed and the cell tissues are rendered beautifully distinct. (See Conn. Agr. Expt. Station Rep., 1896, 34, U. S. Dept. Agr., Bureau Chem., Bul. **65**, 61.)

of the curiously wrinkled radial walls are strongly thickened. Proceeding from the inner wall outward, the radial walls increase in thickness until the much-branched cell cavity is

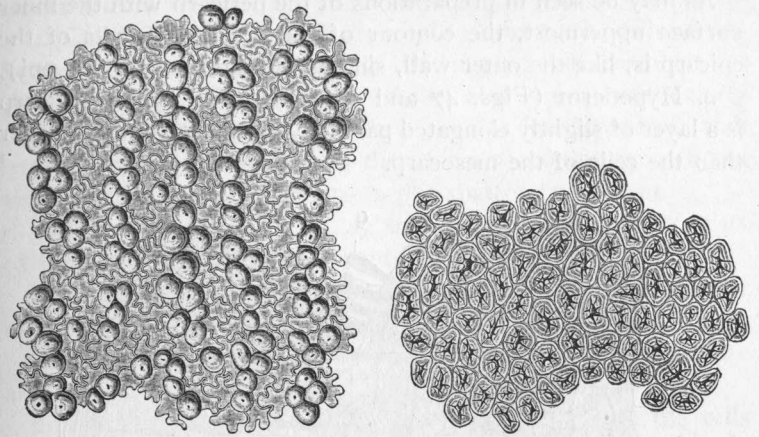


FIG. 48.—Black Bindweed. Epicarp in surface view. × 160.
FIG. 49.—Black Bindweed. Tangential section of the epicarp. × 160.

almost obliterated. On the surface are numerous warts from 0.015 to 0.03 mm. in diameter, into each of which a narrow branch of the cell cavity passes (Figs. 46 and 47, epi).

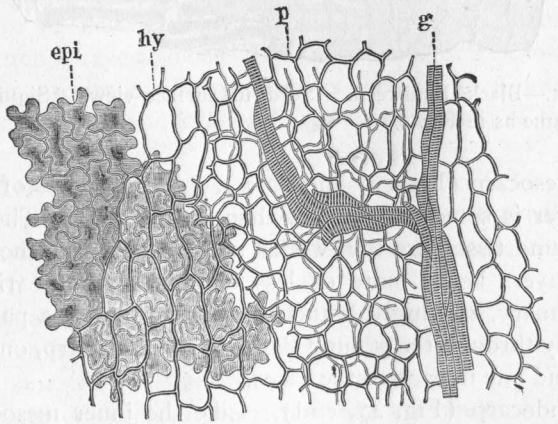


FIG. 50.—Black Bindweed. Surface view of the pericarp from below. × 160. Significance of letters same as in Fig. 47.

Surface preparations of the pericarp with the outer surface uppermost clearly show that the warts are arranged in irregular

longitudinal rows, also that the epicarp cells at the surface are sinuous in outline (Fig. 48), but gradually approach a circular form further inward (Fig. 49).

As may be seen in preparations of the pericarp with the inner surface uppermost, the contour of the inner cell walls of the epicarp is, like the outer wall, sinuous in outline (Fig. 50, epi).

2. Hypoderm (Figs. 47 and 50, hy). Beneath the epicarp is a layer of slightly elongated parenchyma cells somewhat larger than the cells of the mesocarp.

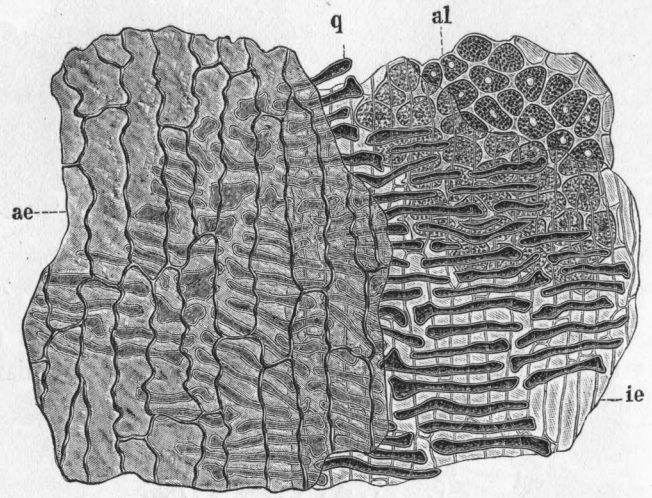


FIG. 51.—Black Bindweed. Seed in surface view. Significance of letters same as in Fig. 47.

3. Mesocarp (Figs. 47 and 50, p). At the angles of the fruit this layer is somewhat thicker than on the sides. The cells of the ground tissue are thin-walled and isodiametric, those of the inner layers being more or less obliterated in the ripe fruit. Six primary, sparingly branched vascular bundles pass longitudinally through the ground tissue of the mesocarp, one in each angle and one in each of the faces.

4. Endocarp (Fig. 47, end). Like the inner mesocarp, the cells are usually obliterated in the mature seed and are seldom evident either in cross section or in surface view.

Testa (Fig. 47, S, Fig. 51). Three coats, analogous to those of buckwheat, but differing in form, make up the testa.

1. Epidermis (Figs. 47 and 51, ae). As in buckwheat, the epidermal cells are wavy in outline; but in bindweed they are strongly elongated, whereas in buckwheat they are nearly isodiametric.

2. Cross Cells (Figs. 47 and 51, q). Most of the cells of this layer are elongated, resembling the tube-cells of cereals; but short cells of more irregular shape also occur, particularly near the base and apex. They are more or less separated from each other, but in no part do they form a spongy parenchyma with circular intercellular spaces like that of buckwheat.

3. Inner Epidermis (Figs. 47 and 51, ie). This coat consists of thin-walled, elongated elements.

Endosperm (Figs. 46 and 47, E). None of the elements are distinguishable from those of buckwheat, either in form or size.

1. Aleurone-Cells (Figs. 47 and 51, al) are of variable size and irregular shape.

2. Starch-Cells (Fig. 47, s). In the outer layers the cells are tangentially elongated; further inward, they are radially elongated and of large size. The polygonal or rounded granules vary in diameter from 0.003 to 0.012 mm.

Vogl has noted that after treating the starch aggregates of buckwheat with caustic potash, there remains a network corresponding to the outline of the starch granules, the threads of which are of homogenous structure without granules. This phenomenon I have also observed in the fruits of *P. Convolvulus* and other species of Polygonum as well as in a number of species of Rumex, and it is probably characteristic of the entire family.

The Embryo, consisting of an elongated radicle and two oblong cotyledons, may be conveniently isolated by soaking the seed in 1.25 per cent. caustic soda solution for some hours until the starch is removed.

Detection in Powder Form. Characteristic of this fruit are the papillae on the outer epidermis of the calyx and the epicarp with sinuous cell walls and rows of warts.

The outer epidermal cells of the testa are sinuous in outline, like those of buckwheat, but, unlike the latter, are commonly elongated.

Although the cross cells are morphologically the same as the spongy parenchyma of buckwheat, they resemble more nearly in structure the tube-cells of the cereals.

The starch granules are not characteristic and the network obtained after treatment with caustic alkali serves merely as an indication that the seed belongs to a Polygonaceous plant.

GREEN FOXTAIL (*Setaria viridis* Beauv., *Chaetochloa viridis* (L.) Scribn.).

Each spikelet consists of two empty glumes and two flowers, one perfect with coriaceous glume and palet, the other staminate

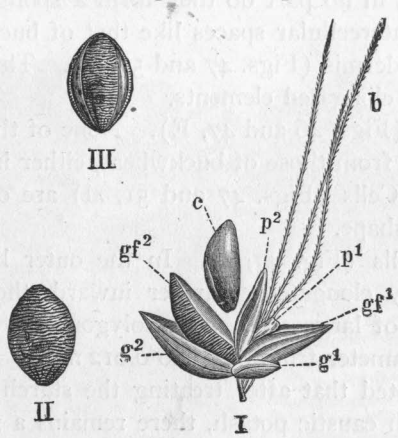


FIG. 52.—Green Foxtail. I Spikelet with ripe fruit. g^1, lower empty glume; g^2, upper empty glume; gf^1, glume, and p^1, palet of the staminate flower; gf^2, glume, and p^2, palet of fertile flower; c, caryopsis; b, bristles. II and III caryopsis enclosed by flowering glume and palet. × 8.

with membraneous envelopes (Fig. 52); at the base of the spikelet are from two to four upwardly barbed bristles varying in length up to 8 mm.

Empty Glumes and Glume of Sterile Flower (Fig. 52, g^1, g^2 and gf^1). The lower empty glume is three-nerved and less than 1 mm. long; the upper empty glume and the glume of the staminate flower are five-nerved and 2 mm. long. In microscopic structure the three are practically identical.

1. Outer Epidermis (Fig. 53). Characteristic of this layer are the elongated cells with sinuous side walls and longitudinal rows of pits so arranged that one pit occurs in each concave bend of the wall. On the middle portion of the mature glume each of these pits is so large that it fills completely the bend of

the wall and in addition has a thickened border, half of which coincides with the cell wall, thus giving the tissue a lace-like appearance. This structure is optically delusive, the pit borders often appearing to be the cell walls, but is resolved by careful focusing and comparison with the tissue in earlier stages of growth.

In addition to these elongated cells, pairs of short cells, one isodiametric, probably a hair-scar, the other more or less crescent-shaped, occur here and there, and less frequently stomata and thin-walled one to three-jointed hairs.

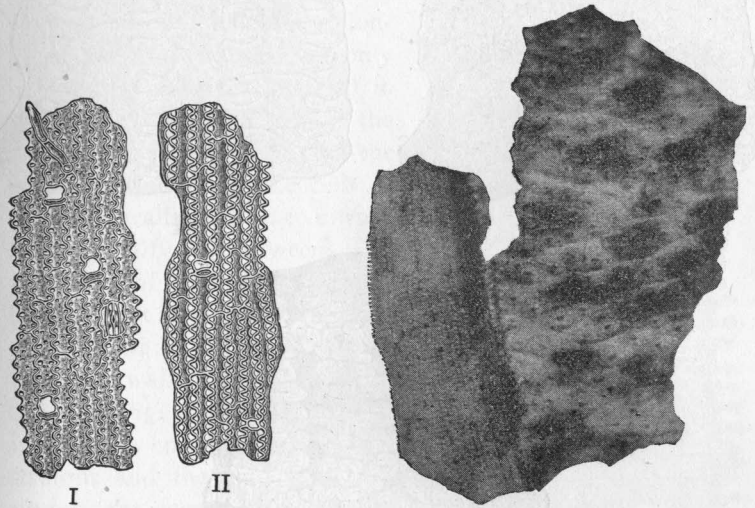


FIG. 53.—Green Foxtail. Outer epidermis of the staminate flower. I at the edge; II in the middle. × 300.

FIG. 54.—Green Foxtail. Outer epidermis of the glume of the fertile flower, showing the wrinkled central portion and the smooth edge.

2. Mesophyl. Only about the nerves and the basal portions of the glumes is this coat evident. It has no diagnostic importance.

3. The Inner Epidermis is composed of elongated cells with straight walls.

Palet of Staminate Flower (Fig. 52, p^1). Within the glume of the staminate flower is the palet, a hyaline scale only 1 mm. or less long with a notch at the end. In general structure, it is much the same as the other thin envelopes, but the cell walls are thinner.

1. Outer Epidermis. The narrow, elongated cells are wavy in outline, but pits are lacking or are indistinct. Isodiametric cells and thin-walled jointed hairs also occur.

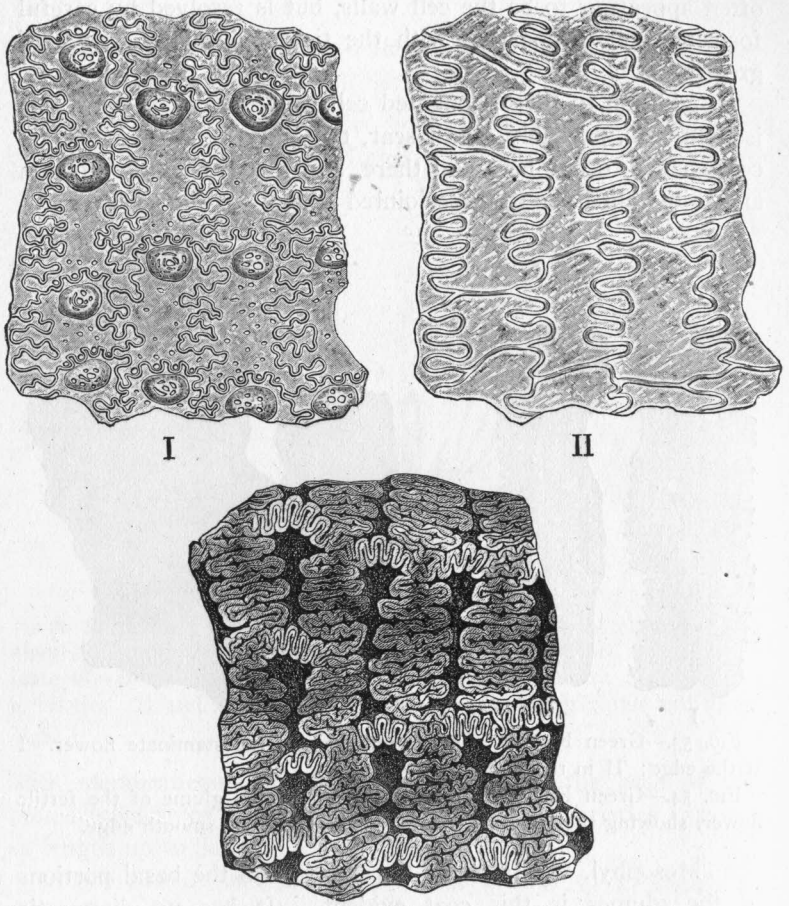


FIG. 55.—Green Foxtail. Outer epidermis from the middle of the glume of the fertile flower. I Outer surface, and II inner surface soon after blooming. III Outer surface when in fruit. × 300.

2. Inner Epidermis. Except at the base, where traces of mesophyl are sometimes evident, the inner epidermis immediately underlies the outer epidermis.

Glume and Palet of Perfect Flower (Fig. 52, gf^2, p^2). Both the glume and the palet of the fertile flower closely envelop the grain at maturity, the former being strongly convex, the latter flat except on the edges, which clasp about the caryopsis. At the time of flowering these envelopes are thin and of a green color, but at maturity they are coriaceous, silicified and of a brown or mottled color. Under a lens, numerous transverse wrinkles are evident on the glume and on the middle or flat portion of the palet, the lateral portions of the latter which clasp the caryopsis being smooth and shining.

1. Outer Epidermis (Figs. 54, 55 and 56). Throughout the glume and on the middle portion of the palet, the cells are isodiametric or moderately elongated and are arranged not only in longitudinal rows but also in irregular transverse rows, the wrinkles being formed by the outward bending of the cells at the end walls and the inward bending half way between. At the time of flowering, it may be seen that at the outer surface the end walls are sinuous and the side walls are compoundly sinuous (Fig. 55, I), but further inward the end walls are nearly straight and the side walls are simply, not compoundly sinuous (Fig. 55, II). At the end of each cell nearest the apex of the envelope, a cuticular wart bearing a group of pits is usually evident, particularly on the palet (Fig. 55, I). About these warts the adjoining end walls are more or less curved and the side walls are not so deeply sinuous. At maturity the cell cavity beneath the wart is conspicuous (on the palet nearly circular), but at the other end of the cell is narrow or not evident at all owing to the encroachment of the strongly thickened walls (Figs. 54 and 55, III).

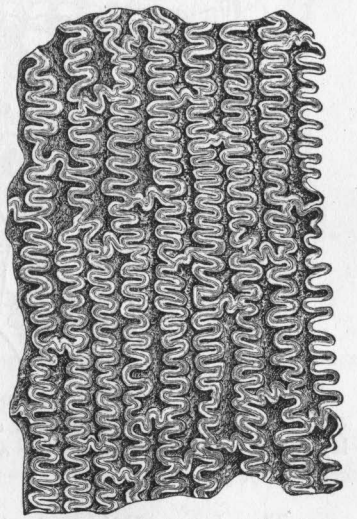


FIG. 56.—Green Foxtail. Outer epidermis from the edge of the glume of the fertile flower. ×300.

The cell contents during the early stages of development are colorless, but later on usually become dark brown.

The epidermal cells on the lateral or smooth portions of the

palet which clasp about the caryopsis are longer, narrower, and less complex than those already described (Fig. 56).

At maturity the wrinkles are usually from 0.03 to 0.06 mm. apart.

2. The Hypodermal Fibers may be readily isolated by treatment on the slide with caustic alkali. They vary in length up to 0.6 mm. and are often toothed at the margin.

3. Mesophyl. Rectangular parenchyma cells without intercellular spaces make up this layer. Numerous chlorophyl granules are present at the time of flowering.

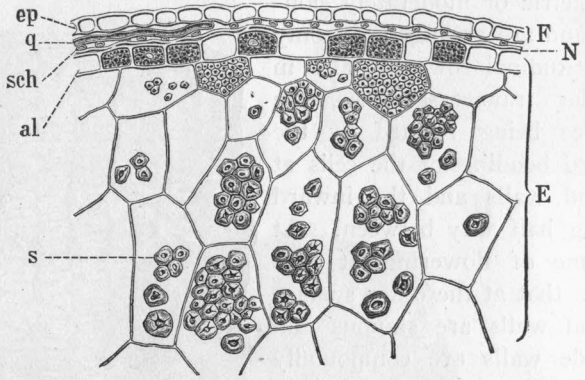


FIG. 57.—Green Foxtail. Transverse section of caryopsis. F, pericarp consisting of the epidermis ep and the tube-cells sch; N, nucellar layer; E, endosperm consisting of the aleurone-cells al and the starch-cells s. × 300.

4. The Inner Epidermis is composed of rectangular cells resembling those of the mesophyl. Both of these layers become more or less obliterated at maturity and are of no diagnostic importance.

Pericarp (Figs. 57 and 58). The ventral side is flat and has a darker colored spot, the remains of the hilum, near the base. Extending half way from the base to the apex on the dorsal side is a groove, which marks the position of the embryo.

Vogl describes minutely the histology of the caryopsis of common millet (*Panicum miliaccum* L.) and states that German millet (*Setaria panis* Jessen) has practically the same structure. I find that his description applies also to the caryopsis of both green and yellow foxtail.

1. Epidermis (Figs. 57 and 58, ep). As in the outer epidermal layers of the floral envelopes the cells are elongated

and wavy in outline. On the dark colored spot already referred to, the epidermal cells are more or less rectangular.

2. The Cross-Cells (Figs. 57 and 58, q) are similar to the tube-cells in form but are usually shorter, broader, and more irregular in shape.

3. Tube-Cells (Figs. 57 and 58, sch). These are 0.002 to 0.004 mm. wide and often reach the length of 0.3 mm.

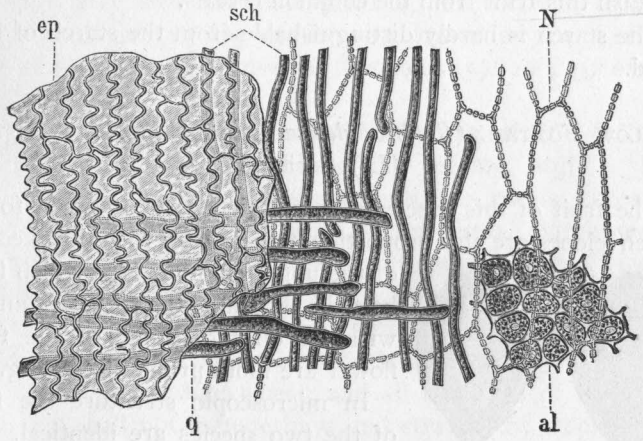


FIG. 58.—Green Foxtail. Caryopsis in surface view. Significance of letters same as in Fig. 57.

Nucellar or Hyaline Layer (Figs. 57 and 58, N). After treatment with alkali, this layer is clearly seen in surface view. The cells are of large size and have beaded walls.

Endosperm. 1. Aleurone Layer (Figs. 57 and 58, al). The cells vary in diameter from 0.01 to 0.02 mm.

2. Starch-Cells (Fig. 57, s). Polygonal starch granules with conspicuous hilums fill the parenchyma cells of the endosperm. In the outer layers they are from 0.004 to 0.008 mm. in diameter but further inward they reach the maximum diameter of 0.018 mm.

After dissolving the starch with potash, there remains a network of threads containing conspicuous granules. In this respect, however, this fruit can not be distinguished from the fruits of *S. glauca* Beauv., *S. panis* Jessen, *Panicum miliaceum* L. (see Vogl) and all the other species of *Panicum* which I have examined.

Detection in Powder Form. The membranous glumes with pores in the bends of the walls and the coriaceous, transversely

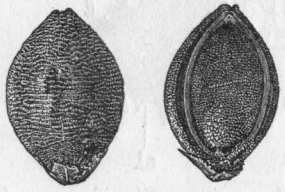
wrinkled, more or less spotted, envelopes of the fertile flower with compoundly sinuous, thickened cell walls are highly characteristic of both green and yellow foxtail. These tissues are usually present in all stages of development.

The fruit elements are like those of common millet and German millet. Treatment with caustic alkali brings out the structure of the fruit coats and nucellar layer, and serves to distinguish this fruit from the common cereals.

The starch is hardly distinguishable from the starch of bindweed.

YELLOW FOXTAIL (*Setaria glauca* Beauv., *Chaetochloa glauca* (L.) Scribn.).

The fruit of this species is larger than that of green foxtail, the envelopes are also proportionately larger (with the exception of the upper empty glume which is but half the length of the spikelet) and the wrinkles on the glume of the fertile flower are more pronounced (Fig. 59).



I II

FIG. 59.—Yellow Foxtail. Caryopsis inclosed in flowering glume and palet. I showing glume; II showing palet and edge of glume. ×8.

In microscopic structure the fruits of the two species are identical. The floral envelopes are also much alike, the only distinction being in the distance apart of the wrinkles on the mature flowering glumes. In green foxtail this distance is usually from 0.03 to 0.06 mm., but in yellow foxtail it is often from 0.08 to 0.12 mm. Since this distinction does not apply to the immature glumes and since the wrinkles on the palets of the two species are practically the same, it is often difficult to identify the species in ground mixtures. Fortunately, identification of the genus is all that is usually required.

In conclusion, I desire to thank my honored instructor, Prof. Dr. J. Moeller, Director of the Pharmacological Institute, Graz University, who has kindly criticized the drawings and the text. Acknowledgment is also due Mr. W. E. Britton and Mr. J. F. Malone, for the execution of photomicrographs (Figs. 59 and 54), and Dr. C. E. Preston for the preparation of sections. The cuts, excepting the two mentioned, were reproduced from my drawings by Mr. F. X. Matolony, Vienna.

COMMERCIAL FEEDING STUFFS.*

Feeding stuffs are included under the provisions of the law regulating the sale of foods, which defines the word food used in the act, so as to include every article used for food or drink by man, horses or cattle. See page 179 of this report.

But a special law, further regulating the trade in concentrated commercial feeding stuffs, was passed by the General Assembly in 1899 and is given in Sections 4591 to 4597 of the Revised Statutes, as follows:—

§ 4591. "Concentrated commercial feeding stuff" defined. The term "concentrated commercial feeding stuff" shall include linseed meals, cotton-seed meals, pea meals, cocoanut meals, gluten meals, gluten feeds, maize feeds, starch feeds, sugar feeds, dried brewers' grains, malt sprouts, hominy feeds, cerealine feeds, rice meals, oat feeds, corn and oat chop, corn and oat feeds, ground beef, or fish scraps, mixed feeds, provenders, bran, middlings, and mixed feeds made wholly or in part from wheat, rye, or buckwheat, and all materials of a similar nature, but shall not include hays and straws, the whole seeds nor the unmixed meals made directly from the seed of wheat, rye, barley, oats, Indian corn, buckwheat, or broom corn, nor feed ground from whole grain and sold directly from manufacturer to consumer.

§ 4592. Certificate of weight and quality. Every lot or parcel of concentrated commercial feeding stuff, sold, offered or exposed for sale 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, both constituents to be determined by the methods adopted at the time by

* The microscopic work in connection with the analyses reported in this paper was wholly done by Mr. Winton; the chemical analyses were made by Messrs. Ogden, Silverman and Bailey; the results were prepared for publication by the director.

*

tain are known and comparison is made on perfectly dry or water-free substance.

Ash is what is left when the combustible part of a feeding stuff is burned away by heating to faint redness in a current of air and besides a little charcoal and sand, which are accidental impurities, consists chiefly of lime, magnesia, potash and soda, combined with chlorine and carbonic, sulphuric and phosphoric acids.

Protein is a general term which includes all those nitrogenous materials of a concentrated feeding stuff which bear a general resemblance in composition and properties to egg albumin (white of egg), flesh fibrin (lean meat), and milk casein (curd). These nitrogenous materials are the most costly ingredients of feeds.

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

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

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

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

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

Protein may easily be made over by the animal into its own substance, i. e., into muscles, tendons and the various working tissues and membranes, because these necessary parts of the animal machine are themselves made up of the same kind of materials, or, chemically speaking, have the same composition as the protein bodies.

Fiber and the nitrogen-free extract, on the other hand, probably cannot serve at all for building up the muscles and other parts of the growing animal and cannot restore the waste and wear of those parts of mature animals, because they are of a very different nature. They contain no nitrogen, an element

which enters into all the animal tissues (proteins) to the extent of some sixteen per cent. of their dry matter.

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

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

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

The Uses of Analyses of Feeding Stuffs.

These uses are several. First, by an analysis compared with the average of others, any buyer of a feed can see whether it is of the usual quality. Thus on page 389, the analysis of cotton seed meal, No. 7660, compared with the average of eight analyses given on the same page, shows that its quality is below average as regards protein, the most valuable ingredient.

Secondly, by an analysis compared with the manufacturer's guaranty any buyer can see whether in composition the feed meets what is claimed for it. Thus on page 419 the analysis of sample No. 7569 shows that the feed contained about 3 per cent. less of protein than it was stated by the manufacturer to contain.

Thirdly, an analysis often shows clearly whether or not the feed is adulterated and may indicate also the form of adulteration. This use is fully illustrated by the discussion of adulterated wheat feeds on pages 370 to 372 of this report.

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

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

THE COMPOSITION OF THE COMMERCIAL FEEDING STUFFS AT PRESENT SOLD IN CONNECTICUT.

During the month of October, 1902, Mr. Churchill, sampling agent of this Station, collected three hundred and five samples of commercial feeding stuffs, mostly in the hands of dealers, in forty-nine towns and villages of this State.

The analyses of these feeds and of a few others sent by purchasers appear in Table IV, pages 388-419.

This table shows:

1. The chemical analysis of each sample, determined, as required by statute, by the methods adopted by the American Association of Official Agricultural Chemists.

2. The average composition of each feed as determined by the analyses.

3. The percentages of digestible nutrients in the feeds. These are calculated by the digestion coefficients, compiled by Dr. Jordan, and printed in Bulletin 77 of the Office of Experiment Stations. The coefficients, so far as they apply to the feeds discussed in this report, are given in Table I, page 382.

On following pages the analyses are discussed in the order of their place in Table IV.

Cotton Seed Meal.

Analyses on pages 388–389.

The percentages of protein in the eight samples which were completely analyzed ranged from 39.87 to 45.37, the average being 42.96. Two samples having less protein than the others, Nos. 7605 and 7660, contained larger percentages of fiber, indicating a less satisfactory separation of hulls.

The cotton seed oil producers prescribe that either "choice" or "prime" cotton seed meal shall contain not less than eight per cent. of ammonia, which is equivalent to 41.12 per cent. of protein. The two samples above mentioned are, therefore, on this basis, neither "choice" nor "prime" meal.

The average percentages of protein and fat, as determined at this Station, and the average prices, at the time the samples were drawn, have been as follows for the last four years:

	1899	1900	1901	1902
No. of Samples	10	4	6	8
Percentage of Protein	46.4	43.9	44.4	43.0*
" " Fat	10.4	8.6	9.8	10.3
Average price	$24.00	27.00	28.80	29.70

The price of cotton seed meal has steadily risen in the last four years, and the average percentage of protein has on the whole declined.

Guaranties.

Three of the samples were reported without the guaranty required by law: Nos. 7665, 9749 and 4604. 7605 was guaranteed to contain "7½ per cent. of ammonia," which is equivalent to 38.6 per cent. of protein. The sample contained 40.5 per cent. All the other samples had a guaranty of 43 per cent. of protein and 9 of fat. The only sample which failed to substantially meet this guaranty was 7660, which contained 3 per cent. less of protein and somewhat less of fat.

Linseed Meal.

Analyses on pages 388–389.

"Linseed Meal," "Oil Meal," and "Flax Seed Meal" are trade names for ground flax seed from which more or less of the oil has been removed. By the "old process" the oil is partly removed by pressure, leaving, however, from 5 to 10 per cent. of oil, "fat," in the meal. By the "new process" the oil is so far extracted with benzine as to leave less than two and a half per cent. in the meal. New process meal is more uniform in composition and contains more protein than old process meal. All the samples of each kind analyzed this year have been of good quality and unadulterated. The average percentages of protein and fat found in linseed meal for the last four years, as determined at this Station, with the average prices at the time the samples were drawn, are as follows:

* 43.7 including 4 other partial analyses.

	New Process.				Old Process.			
	1899	1900	1901	1902	1899	1900	1901	1902
No. of Samples	4	2	3	4	8	3	4	6
Percentage of Protein	37.7	38.4	39.0	39.8	33.8	31.3	34.4	32.8
" " Fat	2.4	2.4	1.8	2.1	7.7	6.7	7.7	7.8
Average price	$28.10	32.50	30.00	31.00	29.00	31.00	30.50	32.00

Guaranties.

Thirty-eight per cent. of protein and 3 per cent. of fat is the guaranty on all the samples of new process linseed meal, whose analyses are given in Table IV, and all meet this guaranty as respects protein. None of them have 3 per cent. of fat determined by the method prescribed by the Association of Official Chemists.

Of the old process meals, Nos. 7651, 7606, and 7562, meet the guaranty of 32 per cent. protein and 5 of fat. 7613 has a guaranty of 34 per cent. protein and 6.30 of fat. The protein found is 2½ per cent. below guaranty. 7471 has a guaranty of 37.8 per cent. protein and 7.5 of fat. The protein found is 2.8 per cent. less than the guaranty. No guaranty was given with No. 7693.

Wheat Products.

These are by-products in the manufacture of wheat flour. Several different processes of milling are in common use, yielding by-products which are not entirely alike in composition. The products made from winter wheat also differ in composition from those from spring wheat.

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

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

Red Dog Flour is the poorest grade of flour; off color and often sold as a cattle food.

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

With a single exception the samples of wheat feed were not accompanied, as is required by law, with any statements of composition.

In Table IV the wheat products from the mills named below are classed as winter wheat.

Acme Milling Co., Indianapolis, Ind.
American Cereal Co., Chicago.
Blish Milling Co., Seymour, Ind.
Camp Spring Mill Co., St. Louis, Mo.
Cole, H. C., Milling Co., Chester, Ill.
Dow & King, Pittsfield, Ill.
Eldred Mill Co., Jackson, Mich.
Evans, Geo. F., Hoosier Mills, Indianapolis, Ind.
Hannibal Milling Co., Hannibal, Mo.
Harter, Isaac, & Co., Galena, O.
Hecker-Jones-Jewell Milling Co., N. Y.
Holly Milling Co.
Hunter Bros., St. Louis.
J. E. M. Mill Co., Frankfort, Ky.
Jenks, J., & Co., Sand Beach, Mich.
Kane Mill Co., Atchison, Kansas.
Kehlor Bros., St. Louis, Mo.
Lawrenceburg Roller Mills Co., "Snowflake," Lawrenceburg, Ind.
Lexington Roller Mill Co., Lexington, Ky.
Maumee Valley Milling Co., Defiance, Ohio.
McDaniel & Pitman Co., Franklin, Ind.
Meyer, J. T., & Co., Clinton, Mo.
Miles & Son, Frankfort, Ky.
Model Roller Mills, Nashville, Tenn.
Moore, R. P., Milling Co., Princeton, Ind.
Rex Milling Co., Kansas City, Mo.
Saginaw Milling Co., Saginaw, Mich.
Saint Jacob Enterprise Mill Co., St. Louis.
Scott's Flour Mills, Detroit, Mich.
Sparks Milling Co., Alton, Ill.
Stock, F. W., Hillsdale, Mich.
Taylor Bros. Milling Co., Quincy, Ill.
Valiers & Spier Mill Co., Marine, Ill.
Valley City Milling Co., Grand Rapids, Mich.
Voigt Milling Co., Grand Rapids, Mich.
Wabash Mills, Terre Haute, Ind.
Walsh De Roo Milling Co., Holland, Mich.
Washington Flour Mill Co., Washington, Mo.

The wheat products from the following mills are classed as from spring wheat.

Anchor Milling Co., Superior, Wis.
Andrews & Co., Minneapolis.
Banner Milling Co., Buffalo, N. Y.
Bay State Milling Co., Winona, Wis.
Berger, Anderson Co., Milwaukee.
Brayton Milling Co., Minneapolis.
Cataract City Mill Co., Niagara Falls, N. Y.
Central Valley Milling Co., Buffalo, N. Y.
Daisy Roller Mill Co., Milwaukee, Wis.
Davis Co., J. G.
Duluth Imperial Mill Co., Duluth.
Freemen Milling Co., Superior, Wis.
Gardner Mill, Hastings, Minn.
Grafton Roller Mills, Grafton, N. D.
Imperial Mill Co., Duluth, Minn.
H. H. King & Co., Minneapolis.
Lake Superior Mills, Superior, Wis.
Listman, Wm., Milling Co., Superior, Wis., and Lacrosse, Wis.
Miner-Hillard Milling Co., Wilkes Barre, Penn.
Minkota Milling Co., Superior, Wis.
Moseley & Motley Milling Co., Rochester, N. Y.
New Prague Milling Co., New Prague, Minn.
New York City Mill Co.
North Dakota Milling Association, No. Dakota.
North Western Consolidated Milling Co., Minneapolis.
Pillsbury-Washburn Co., Minneapolis.
Red Lake Falls Milling Co., Red Lake, Minn.
Russell & Miller Milling Co., Superior, Wis., and Valley City, No. Dakota.
Sheffield Milling Co., Faribault, Minn.
Star & Crescent Milling Co., Chicago.
Thornton & Chase, Buffalo, N. Y.
Urban Roller Milling Co., Buffalo, N. Y.
Washburn-Crosby Co., Minneapolis.
Whitney & Wilson, Rochester, N. Y.
Woodworth & Co., E. S., Minneapolis.

Bran from Winter Wheat.

Analyses on pages 390–391.

The eleven samples whose analyses appear in the table were of good quality and not found in any instance adulterated. The percentages of protein ranged from 15.94 to 18.19.

Bran from Spring Wheat.

Analyses on pages 390–393.

The nineteen samples examined were of good quality and none of them were found adulterated. The percentage of protein ranged from 14.87 to 18.06, the average being a little lower than in winter wheat bran.

Middlings.

Analyses on pages 392–395.

The samples, with a single exception, were of the usual composition and not found adulterated. Middlings from spring wheat contained on the average a per cent. more of protein than winter wheat middlings.

Sample 7466 is marked "Colonial Middlings," and stated to be made by the Miner, Hillard Milling Co., Wilkesbarre, Penn. It is not wheat middlings, but a mixture of a wheat product and of corn meal, and contains about 1.8 per cent. more of fat and 6 per cent. less of protein than spring wheat middlings. It is sold with a guaranty of 13.5 per cent. of protein, 6.8 of fat and 62.5 of extract. The protein found is half a per cent. less, and the extract nearly 2½ per cent. less than the guaranty.

Mixed Feed.

Analyses on pages 396–401.

In the tables are analyses of 34 samples of mixed feed from winter wheat, 17 from spring wheat and 3 which are unclassified. All of these feeds are of good quality. The winter and spring wheat mixed feeds have substantially the same percentage of protein. The only one with a guaranty of composition is the Buckeye Wheat Feed, made by the American Cereal Co. 17.75 per cent. of protein and 4.70 per cent. of fat are guaranteed. Two samples were found to contain 16.87 and 17.75 per cent. of protein and 4.54 and 4.57 per cent. of fat respectively.

Adulterated Mixed Feed.

Seven samples sold as mixed feed are found to contain either corn bran or ground corn-cobs in quantity sufficient to seriously reduce their feeding value. Under the food law of this State such mixtures are adulterated and their sale is illegal. "Mixed Feed" is a trade name in common use, meaning a pure wheat-feed made up of mixed by-products separated in the flour milling process. Such mixed feed, as our analyses show, has a tolerably uniform composition, the protein ranging this year from 16.31 to 19.00 per cent., and the average cost being $22.10 per ton.

The mixture of wheat products with corn-cob or corn bran, above referred to, is a fraud, when sold under the name of another article, which it closely resembles in appearance, but to which it is quite inferior as a feed, the protein ranging from 9.31 to 14.75 per cent., while the price charged is practically the same as that of the mixed feed which it imitates.

Mixed Feed Adulterated with Corn Bran.

Nos. 7667 and 9761 were sold as "mixed feed" by Johnson & Morrison, Bethel, who state that the feed was bought of Hollister, Chase & Co., 90 Broad St., New York.

Messrs. Hollister, Chase & Co. state that the car was bought by them of Bernet, Craft & Kauffman, St. Louis, Mo.

Both samples, as appears from the microscopic and chemical examinations, are adulterated with enough corn bran to seriously reduce their feeding value.

Mixed Feed Adulterated with Corn Cobs.

7518. "Jersey Mixed Feed." Sampled from stock of Young Bros. Co., bought by them from Hollister, Chase & Co. of 90 Broad St., New York City. The bags containing the feed were marked, Kentucky Milling Co., Henderson, Ky., and Hollister, Chase & Co. state that it was bought of this firm.

7589. "Dairy Winter Mixed Feed." Sampled from stock of G. W. Eaton, Bristol, sold by Henry Jennings, 407 Chamber of Commerce, Boston, Mass., who states that it was bought

of a Portland firm, and as there are several mills in Henderson, Ky., the goods are invoiced without the name of the shippers.

7596. "Winter Mixed Feed." From stock of W. O. Goodsell, Bristol, bought of The Strong Lefferts Co., New York City. We are unable by correspondence with this firm to trace the goods any further.

7690. "Winter Mixed Feed." From stock of Balch & Platt, Winsted, bought of the J. S. Wolf Co., Pittsfield, Mass., which firm has not replied to inquiries concerning it.

4594. "Eclipse Mixed Feed." Sent by Miss M. A. Neale, Southington, from stock bought of Geo. W. Eaton, Plainville.

All the above feeds are adulterated with ground corn-cobs. Their analyses follow:

ANALYSES OF ADULTERATED MIXED FEEDS.

	Bernet, Craft & Kauffman St. Louis.		Kentucky Milling Co. Henderson, Ky.	Henry Jennings. From Henderson, Ky.	Strong Lefferts Co.	J. S. Wolf Co.	G. W. Eaton.	Mixed Feed. Genuine.*
	7667	9761	7518	7589	7596	7690	4594	
Water	10.46	11.50	10.84	10.31	10.32	10.46	----	11.29
Ash	5.94	5.46	4.80	4.38	4.25	4.23	----	5.36
Protein	14.37	13.62	12.81	14.75	13.12	14.12	9.31	17.69
Fiber	7.70	9.47	15.01	12.17	15.90	14.89	----	7.66
Extract	56.04	53.61	52.89	54.30	53.24	53.01	----	53.28
Fat	5.49	6.34	3.65	4.09	3.17	3.29	----	4.72
	100.00	100.00	100.00	100.00	100.00	100.00	----	100.00
Cost per ton	$20.00	21.00	21.00	23.00	22.00	23.00	23.00	22.10

These analyses show the deficiency in protein, and the excess of woody fiber which characterize these spurious "mixed feeds."

It seems quite impossible to learn anything by correspondence, regarding the manufacturers of them.

Last year the "Eclipse Mixed Feed" was traced to the W. R. Mumford Co. of Chicago, who did not notice letters of inquiry regarding the manufacturer of this brand.

It is quite possible that the retail dealers did not know the spurious nature of these adulterated feeds.

* Average of the 51 analyses made in 1902.

Wholesalers also may sometimes be deceived, but their opportunities for learning the character of the feed they sell are much better, for the mills which produce this stuff are well known in the trade.

The law regarding feeds requires that wheat feeds shall be sold with a statement giving name and address of the manufacturer and the guaranteed composition. The law is disregarded by dealers and the excuse is made that the enforcement of the law would cause great annoyance in the trade, and is unnecessary because wheat feeds are always pure and uniform in composition.

The fact is that for the two years past wheat feeds have been almost the only adulterated feeds in our market. Naturally wheat feed itself is brought into some disrepute and dealers who sell adulterated articles, whether innocently or not, come to be regarded with suspicion.

Average Composition of the Various Pure Wheat Products.

The average composition of the various pure wheat feeds sold in Connecticut in the last three years, with their prices, are given in the following table:

AVERAGE COMPOSITION AND PRICE OF WHEAT FEEDS IN CONNECTICUT IN 1899, 1900, 1901 AND 1902.

	Bran.		Middlings.		Mixed Feed.	
1899	Winter.	Spring.	Winter.	Spring.	Winter.	Spring.
Protein	15.9	15.6	15.8	15.6	16.8	16.8
Fat	4.3	4.7	4.4	4.7	4.5	5.1
Ton price	$19.80	19.14	19.00	19.25	19.44	19.25
1900						
Protein	16.1	16.5	17.7	19.1	18.1	17.6
Fat	4.6	5.0	4.7	5.5	4.7	5.3
Ton price	$21.09	20.00	21.00	21.50	21.00	20.80
1901						
Protein	16.3	17.3	18.0	19.7	17.5	18.5
Fat	4.5	4.7	5.0	5.5	4.7	5.1
Ton price	$21.80	21.06	22.75	22.10	22.20	22.20
1902						
Protein	17.1	16.7	18.1	19.2	17.7	17.7
Fat	4.6	4.9	4.4	5.4	4.6	5.1
Ton price	$23.37	20.90	23.85	23.44	22.00	22.35

This table indicates that:

1. The spring wheat products, as a rule, have somewhat higher percentages, both of protein and fat, than the winter wheat products.
2. This difference is rather more pronounced and constant in the case of middlings than in that of either bran or mixed feed.
3. The percentages of protein and of fat in bran are rather lower than in either middlings or mixed feed.
4. On the average the winter wheat products sell at a slightly higher price than the spring wheat products.

MAIZE MEAL.

Analyses on pages 400–403.

In Table IV are analyses of forty-eight samples drawn by our agent in all parts of the State.

All of these samples, judging from their water-content, are ground from old corn, not of the crop of 1902. The percentages of protein range from 9.19 to 11, averaging 9.89, and there is no evidence of adulteration in any of them, the range of composition being no greater than is usual in pure maize meal. The only sample calling for special notice is 7307, made by the American Cereal Co. and branded "Buckeye Pure Gold."

This has lower percentages of protein, fiber and fat than any other sample. Possibly it represents corn from which the germ has been removed. Apparently no foreign matter is mixed with it.

Guaranties.

None of the samples had any guaranty of composition.

GLUTEN MEAL.

Analyses on pages 402–405.

Five brands of gluten meal have been found on the market and their analyses appear in Table IV. The names of these brands, their guaranties and also their average composition, as appears from our analyses, are as follows:

No. of Analyses.		Protein.	Fat.
1	Pope's Cream Gluten, guaranteed	34.12	3.20
	found	43.00	1.48
2	Atlas Gluten, guaranteed	36.00	14.00
	found	36.28	15.51
3	Chicago Gluten, guaranteed	38.00	3.00
	found	35.46	2.82
1	King Gluten, guaranteed	35.5	3.7
	found	33.75	2.04
2	Atlantic Gluten, guaranteed	39.00	2.0
	found	46.22	2.44

The single sample of "Pope's Gluten" contained 9 per cent. more of protein and 1.75 per cent. less of fat than is guaranteed, differences so great as to suggest that the meal was in a package wrongly tagged. This brand was found last year to contain about 34.5 per cent. of protein and 1.34 of fat.

"Atlas gluten" is here included because of its trade name. It is, however, totally different in appearance and quality from the gluten meals obtained from corn meal in the glucose manufacture. It appears to contain dried brewery or distillery products. The composition fully meets the guaranty. It contains about the same percentage of protein as the gluten meals with four or five times as much fat.

The guaranty of Chicago gluten is stated to refer to the *water-free meal. On this basis* the samples analyzed contain an average of 39.6 per cent. of protein and 3.1 per cent. of fat, which meets the guaranty, although the meal with the usual water content contains only 35.46 per cent. of protein and 3.1 per cent. of fat. To the feeder it is of no great importance to know what the feed would contain if there were no moisture in it, but it is of great importance to know what it contains as he finds it in market. There is no good reason why this information should not be given in the guaranty. A guaranty which does not give it is of no practical use to the purchaser.

The analysis of the single sample of King gluten is slightly below the guaranty as respects protein and fat.

One sample of Atlantic gluten, "extra strong," made at Westport, Conn., contains 68.88 per cent. of protein, the highest percentage of protein which we have ever met with in the feed market. This brand is not very uniform in composition, the percentages of protein in three other samples analyzed being 43.6, 48.9 and 52.9. It fully meets the manufacturer's guaranty. In all the samples examined this year small amounts of rice hulls have been found. Atlantic gluten is made from wheat.

Gluten Feed.

Analyses on pages 404–407.

Fifteen analyses of this material are given in Table IV, representing five distinct brands.

Their guaranties compared with their composition are as follows:—

No. of Analyses.		Protein.	Fat.
7	Buffalo Gluten Feed, guaranteed	27.5	3.3
	found	27.2	3.2
3	Globe Gluten Feed, guaranteed	27.5	3.3
	found	26.5	3.5
2	Pekin Gluten Feed, guaranteed	27.5	3.3
	found	26.9	3.4
2	Queen Gluten Feed, guaranteed	27.1	3.2
	found	24.5	2.1
1	Waukegan Gluten Feed, guaranteed	27.3	3.3
	found	25.1	3.5

The analyses of Queen gluten and Waukegan gluten do not meet the manufacturers' guaranties in respect to protein. The analyses of the other brands are in substantial agreement.

Hominy Chops, Hominy Meal, Hominy Feed.

Analyses on pages 406–409.

Of the 28 samples represented in Table IV, two are inferior; 7515, Keystone Fancy, sold by Fish & Co., N. Y., and No. 7462, sold by Narragansett Milling Co., E. Providence, R. I. They are deficient in protein and fat and contain twice as much fiber as the others. Apparently these deficiencies are due to an undue proportion of hulls. There is no indication of admixture with foreign matters. With these two exceptions the samples are all of good quality, the percentage of protein ranging from 10.87 to 12.50 and averaging 11.57 per cent.

Guaranties.

Few of the lots of hominy meal examined by our sampling agent had any guaranty, as required by the law concerning feeds.

Those made by Hunter Bros. of St. Louis, Mo., and by Suffern, Hunt & Co., Decatur, Ill., had a guaranty of 11 per cent. protein and 7.7 of fat. The Buffalo Cereal Co. guarantee 11 of protein and 8.5 of fat. Chapin & Co., of St. Louis, guarantee 11.0 of protein and 8.0 of fat, and C. W. Campbell & Co., Westerly, R. I., 9.0 per cent. of protein and 6.0 per cent. of fat. The goods made by the firms named were fully up to these guaranties.

Rye Bran and Rye Feed.

Analyses on pages 408–409.

The six samples analyzed had the usual composition, the average percentage of protein being 15.43, ranging from 14.94 to 16.19.

None of the samples were accompanied by a manufacturers' guaranty as is required by law.

Barley Products.

Malt Sprouts.

Analyses on pages 408–409.

The two samples examined have about the usual composition, 27.7 per cent. of protein and 1.3 of fat. No. 7308 had a guaranty of 22 per cent. of protein. Both samples contained considerable black bind weed, one of them, 7308, cockle, and the other wild mustard and linseed; all being weeds likely to be found in barley.

Dried Brewers Grains.

Analyses on pages 410–411.

This feed, comparatively new in this State, contained,—the average of two analyses,—29.7 per cent. of protein and 6.9 per cent. of fat. As a source of digestible protein it ranks with the gluten feeds.

Oat Products.

Ground Oats.

Analyses on pages 410–411.

Four samples of ground oats had the average composition, 12.95 per cent. of protein and 4.54 of fat.

Royal Oat Feed.

Analyses on pages 410–411.

A single sample, 7671, made by the Great Western Cereal Co., consists largely of oat hulls, as is shown both by microscopic examination and by chemical analysis. Eight and one fourth per cent. of protein is guaranteed and only 6.87 per cent. is found in it. The guaranty of fat is 4.14 per cent. and 1.95 per cent. is found.

Buckwheat Products.

Analyses on pages 410–411.

The middlings, made by the Quinnebaug Mill of Danielson, have the usual composition, containing over 28 per cent. of protein. The hulls, as the analysis shows, are of little or no feeding value.

Miscellaneous By-Products.

Analyses on pages 410–411.

Here are included several kinds of manufacturing refuse, some of them having value as feeds, others quite worthless; a sort of dairymen's "bargain counter."

One sample of Peanut Bran contains 10.50 per cent. of protein along with 43 per cent. of fiber and 10.00 per cent. of mineral matter, of which 6.2 per cent. is sand.

One sample of Broken Peanuts contains 22.94 per cent. of protein; more, that is, than the wheat feeds, with 32.37 per cent. of oil. Its richness in protein suggests its value as a feed. What effect the oil in such large proportion would have on dairy products is a question which cannot be answered except by experiment.

Dried Distiller's Grains containing 34.50 per cent. of protein have a high value as dairy feed. The cost is also high, $34.10 per ton in car lots, delivered in New Haven.

"Cornaline" consists of coffee hulls, of no value as a feed and used as an adulterant of feeding stuffs.

Gee's Germ Middlings, made by G. E. Gee Grain Co., Minneapolis, Minn., is a mixture of ground weed seeds such as are common in screenings; black bind weed, yellow and green foxtail grass, a little linseed, etc. The chemical composition of

these middlings is approximately like that of wheat middlings, but it is extremely doubtful if it has anything like the same feeding value.

"Seed Meal" is a poultry food prepared from wheat screenings by grinding. It contains more protein than Gee's middlings just noticed, but belongs in the same class.

"Ready Bits" (damaged) is one of the cereal breakfast foods.

The "Corn Feed" sent by Vine Hill Farm Co. is made up of corn bran, chaff from cobs, immature corn kernels, oats, etc.

"White Meal" is hominy meal or some similar product mixed with salt, of which the sample contains 1.85 per cent.

Miscellaneous Mixed Feeds.

Provender and Other Corn and Oat Feeds.

Analyses on pages 412–415.

All of the 17 samples of Provender are of good quality, the percentage of protein ranging from 10.00 to 11.19 and averaging 10.47 per cent. None of the samples was accompanied by a guaranty of composition.

With the composition of this standard mixture, which should contain equal parts of corn and oats, are compared in the following table the average composition of various other corn and oat feeds on the Connecticut market.

	Protein.	Fiber.	Nitrogen-free Extract.	Fat.	Ton price.
Provender	10.47	3.95	67.10	4.13	$30.30
Victor Corn and Oat Feed	9.21	11.38	61.33	4.09	24.00
Vim Oat Feed	8.25	23.27	51.17	3.10	18.00
Boss Corn and Oat Feed	8.01	14.12	59.51	2.75	24.00
Excelsior " "	9.37	12.40	58.62	4.53	20.00
De-Fi " "	9.25	15.30	58.77	3.19	22.00
Diamond Mills Corn and Oat Feed	8.81	10.43	62.05	5.54	26.00

Each brand of these corn and oat feeds has a guaranty of composition which corresponds with the composition of the articles as determined by our analysis except in the following cases: The Boss Corn and Oat Feed does not meet the guaranty in respect of fat—4.2 guaranteed, 2.75 found—and the Diamond Mills brand, in which 9.44 per cent. of protein and 4.78 of fat are guaranteed, does not meet this guaranty.

As far as known to us, a single digestion experiment has been made with Victor Corn and Oat Feed. The digestible nutrients of provender and all the other corn and oat feeds have been calculated in Table IV by the digestion coefficients which were determined in the single test made on one brand. This, of course, involves the assumption that all are about equally digestible, and the figures therefore represent their average digestibility only in the most general and uncertain way.

Corn, Oats and Barley.

Analyses on pages 414–415.

In the table are analyses of five samples of "Schumacher's Stock Feed," also called Schumacher's Corn, Oats and Barley. The material is a mixture of the grains named and shows in these analyses a uniform composition. The guaranty is 13 per cent. of protein and 5 of fat. The average of the five samples shows 12.66 of protein and 5.13 per cent. of fat.

Horse Feeds.

Two brands appear in the tables, pages 414 and 415, the one made by the H. O. Co., the other by the Buffalo Cereal Co, both of Buffalo, N. Y. Both feeds are made of corn, oat, and wheat products, have about the same composition, sell at the same price, and meet the manufacturers' guaranty.

Poultry Feeds.

Analyses on pages 414–417.

The H. O. Poultry Feed contains a wheat product, corn meal and oats without hulls; the H. O. Scratching Feed consists of cracked corn, whole wheat, whole oats, with some cockle, chess and bind weed seed; the Success Poultry Feed consists of wheat, corn meal, oats and linseed; and the American Poultry Feed, made by the American Cereal Co., contains corn and a wheat product.

In chemical composition these feeds substantially meet the manufacturers' guaranties. They cost from $30.00 to $38.00 per ton.

Bone and Meat Meal.

Of this material, chiefly used as poultry food, six brands were found and analyzed, as appears on pages 416 and 417. The

composition depends wholly on the amount of bone present, and most of the "ash" in the analyses consists of bone phosphate.

The composition of several of these brands does not at all correspond with the manufacturers' guaranty, and this is hardly to be expected with material so coarse and heterogeneous as this.

Proprietary Dairy and Stock Feeds.

Analyses on pages 416–419.

The Quaker Dairy Feed is a mixture of oat, wheat and corn products and fully meets the manufacturer's guaranty.

The H. O. Dairy Feed is a mixture of oat, wheat and corn products with some cotton seed meal, and in composition meets substantially the guaranty.

The Great Western Dairy Feed consists chiefly of an oat product containing much hulls, as shown by the percentage of fiber, 20.83 per cent. One sample contains a little corn gluten. The percentage of protein in one of the two samples—9.37—was much less than the guaranteed percentage, 12.2.

The Daisy Dairy Feed is a mixture of an oat product, containing much hull and gluten meal. The single sample analyzed contains much less protein and fat than is guaranteed.

The Lenox Stock Food, a mixture of cracked corn and oat and wheat products, contains the guaranteed percentages of both protein and fat.

The Chester Stock Feed, a mixture of corn and oat products with some rye, contains 3.8 per cent. more protein than is guaranteed.

Empire State Corn Feed is a mixture of wheat and oat products with leaves and stalks of unidentified plants and 3.77 per cent. of sand. It scarcely meets the manufacturer's guaranty as respects protein.

The Creamery Feed of the Buffalo Cereal Co. contains corn gluten, oat and wheat products and cotton seed meal.

The Dairy Feed made by the same company is a mixture of oat and corn products. The two last named feeds have no guaranty.

Blatchford's Calf Meal contains linseed, beans, cotton seed, carob beans and fenugreek. The percentages of protein and fat found in the meal are a little less than the guaranteed percentages.

THE DIGESTIBILITY OF FEEDING STUFFS.

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

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

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

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

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

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

(Jordan's Compilation, Office of Experiment Stations, Bulletin 77.)

	Protein.	Fiber.	Nitrogen-free Extract.	Fat.
Cotton Seed Meal	88	56	61	93
Linseed Meal, new process	85	80	86	97
Linseed Meal, old process	89	57	78	89
Corn Meal	68	--	95	92
Gluten Meal	88	--	90	94
Gluten Feed	86	78	89	84
Wheat Bran	78	29	69	68
Wheat Middlings	80	33	81	86
Wheat Mixed Feed	80	25	78	78
Oats*	78	20	76	83
Rye Meal	84	--	92	64
Malt Sprouts	80	33	68	100
Dried Brewers' Grains	79	52	58	91
H. O. Dairy Feed	78	41	70	86
H. O. Horse Feed	74	35	79	84
Quaker Oat Feed	81	43	67	89
Quaker Dairy Feed†	78	41	70	86
Victor Corn and Oat Feed‡	71	48	83	87

REGARDING THE PURCHASE OF COMMERCIAL FEEDING-STUFFS.

It needs to be constantly borne in mind that feeding-stuffs are bought to supply a deficiency of protein in those which are usually raised on the farm.

Hay, corn fodder, ensilage and stover form the basis and make up the bulk of the cattle food and should supply all the coarse feed, as well as most of the starch, sugar and fat which are needed.

They are, however, deficient in protein. The feeder's aim then is, or should be, to buy *digestible protein* at as low a price as he can, in forms relished by his stock. He is not in the market to buy mixtures of cattle medicine and food, nor starchy foods, nor woody fiber, nor the many wastes of factories, where so-called "breakfast goods" for human use are made.

It will very rarely pay him to buy anything which contains as little protein as corn meal. Corn meal he can generally raise

* Mentzel and Lengerke. † Assumed same as H. O. Dairy Feed.
‡ Assumed for all other corn and oat feeds.

much more cheaply than he can buy it—and corn meal fed with hay or ensilage needs the addition of some feed richer in protein, in order to avoid waste of starchy matter in feeding.

Table II is a list of the commercial feeding-stuffs mentioned in this Bulletin with the percentages of protein and fat in them, and their average prices, arranged according to the per cent. of protein, the ingredient which the buyer is chiefly concerned with.

Study of the table shows that we have six distinct groups of feeding-stuffs:

1. Cotton seed meal and Atlantic and Cream glutens with over 40 per cent. of protein and costing between $28 and $30 per ton.
2. The linseed and gluten meals containing between 30 and 40 per cent. of protein, the prices ranging from $24.10 to $32.00 per ton.
3. The gluten feeds, brewers' grains, malt sprouts and buckwheat middlings, containing from 25 to 30 per cent. of protein, prices ranging from $18.50 to $28.00 per ton.
4. The wheat feeds, H. O. Dairy Feed, Buffalo Cereal Co.'s Creamery Feed and rye feed, having between 15 and 20 per cent. of protein and costing from $20.10 to $30.00 per ton.
5. Lower grade feeds, containing from 14.5 to 10 per cent. of protein, which the feeder of dairy stock need not consider at all in buying protein to balance a ration made up of home-grown fodder, if he has home-grown shelled corn at his disposal.
6. Mixtures of corn and oat refuse, having less protein even than corn meal.

TABLE II.—COMMERCIAL FEEDS ARRANGED ACCORDING TO THE PERCENTAGES OF PROTEIN IN THEM.

With more than 40 per cent. Protein.	Protein. Per cent.	Fat. Per cent.	Cost. Per ton.
Atlantic Gluten Meal	48.44	2.44	$28.00
Cream Gluten Meal	43.00	1.48	30.00
Cotton Seed Meal	42.96	10.28	29.70

TABLE II *(Continued)*.—COMMERCIAL FEEDS ARRANGED ACCORDING TO THE PERCENTAGES OF PROTEIN IN THEM.

With 30 to 40 per cent. Protein.	Protein. Per cent.	Fat. Per cent.	Cost. Per ton.
Linseed Meal, New Process	39.79	2.13	31.00
Atlas Gluten Meal	36.28	15.51	24.10
Chicago Gluten Meal	35.46	2.82	31.30
King Gluten Meal	33.75	2.04	30.00
Linseed Meal, Old Process	32.82	7.81	32.00
With 25 to 30 per cent. Protein.			
Dried Brewers' Grains	29.72	6.91	
Buckwheat Middlings	28.56	7.74	20.00
Malt Sprouts	27.75	1.34	18.50
Buffalo Gluten Feed	27.24	3.16	25.60
Pekin Gluten Feed	26.91	3.39	28.00
Globe Gluten Feed	26.54	3.54	27.00
Waukegan Gluten Feed	25.12	3.51	26.00
Queen Gluten Feed	24.46	2.12	26.00
With 15 to 20 per cent. Protein.			
Buffalo Cereal Co.'s Creamery Feed	20.37	4.43	26.00
Spring Wheat Middlings	19.15	5.42	23.44
Winter Wheat Middlings	18.14	4.41	23.85
Winter Wheat Mixed Feed	17.72	4.58	22.00
H. O. Dairy Feed	17.72	4.64	30.00
Spring Wheat Mixed Feed	17.66	5.06	22.35
Winter Wheat Bran	17.10	4.56	23.37
Spring Wheat Bran	16.72	4.94	20.90
Rye Feed	15.43	3.10	26.00
With 10 to 15 per cent. Protein.			
Quaker Dairy Feed	14.50	3.57	
Buffalo Cereal Co.'s Dairy Feed	14.31	4.40	
Empire State Stock Feed	14.25	3.68	20.00
Ground Oats	12.95	4.54	34.75
Chester Stock Feed	12.87	4.19	
H. O. Horse Feed	12.77	4.80	29.25
Buffalo Cereal Co.'s Feed	12.75	4.78	29.00
Schumacher's Stock Feed	12.66	5.13	
Hominy Meal	11.57	8.91	28.25
Great Western Dairy Feed	10.59	2.71	22.00
Provender	10.47	4.13	30.30
Lenox Stock Feed	10.25	4.67	25.50
Corn Meal	9.89	3.90	28.75

TABLE II *(Continued)*.—COMMERCIAL FEEDS ARRANGED ACCORDING TO THE PERCENTAGES OF PROTEIN IN THEM.

With less Protein than Corn Meal.	Protein. Per cent.	Fat. Per cent.	Cost. Per ton.
Excelsior Corn and Oat Feed	9.37	4.53	20.00
De-Fi " "	9.25	3.19	22.00
Victor " "	9.21	4.09	23.75
Vim Oat Feed	8.25	3.10	18.00
Boss "	8.01	2.75	
Royal "	6.87	1.95	18.00

It will also be noticed that the percentages of fat in these feeds are not very unlike, ranging between 1.5 and 5.4 per cent., with the exception of cotton seed meal, old process linseed meal, Atlas gluten meal, brewers' grains, hominy chops and buckwheat middlings, so that a rough comparison of the feeds can be made, *taking account of protein alone,* as that is the ingredient which the feeder is chiefly concerned in getting.

Such a comparison would show the following:

If 20 pounds of Protein in Atlantic Gluten cost		$0.58
Then 20 pounds of Protein in Malt Sprouts and in Atlas Gluten	cost about	.66
" "	Cream Gluten and Cotton Seed Meal cost about	.68
" "	Buckwheat Middlings cost about	.70
" "	New Process Linseed Meal cost about	.77
" "	Chicago Gluten and King Gluten Meal cost about	.88
" "	Buffalo Gluten Feed and Old Process Linseed Meal cost about	.98
" "	Other Gluten Feeds "	1.05
" "	Wheat Feeds, Buffalo Cereal Co.'s Creamery Feed cost about	1.20–1.40
" "	Empire Stock Feed "	1.40
" "	Rye Feed "	1.70
" "	Other Feeds, chiefly Corn and Oat cost about	2.07–2.90

The above is not intended to do more than make a rough but practically just statement of the *comparative* cost of protein in the several classes of feeding-stuffs. Of course all feeds contain other valuable food ingredients besides protein and fat, but they are not ingredients which the feeder commonly needs to buy.

As a general rule, he cannot afford to buy anything belonging in classes 5 and 6. Home-grown corn meal makes anything in these groups superfluous.

It is the part of economy to raise all the corn meal which is needed at home, not to buy anything to balance the cattle ration containing less protein than wheat feeds, and to let all condimental and medicinal cattle foods alone.

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 West Winsted.

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

BY H. G. MANCHESTER, WEST WINSTED.

	Pounds.
Cotton Seed Meal	1.5
Linseed Meal, old process	1.1
Gluten Meal	1.7
Gluten Feed	1.2
Wheat Bran, coarse	0.5
Wheat Middlings, coarse	0.8
Wheat Middlings, fine	1.1
Mixed Wheat Feed	0.6
Corn Meal	1.5
Oats	1.2
Rye Bran	0.6
H. O. Dairy Feed	0.7
Victor Corn and Oat Feed	0.7

SUMMARY.

1. Cotton seed meal, linseed meal, the gluten meals and feeds, the factory mixed feeds of the American Cereal Co., the Great Western Cereal Co. and the H. O. Company, and the mixed corn and oat feeds, excepting provender, are, as a rule, sold with a guaranteed percentage of protein and fat as is required by the state law. On the other hand, the wheat feeds, as well as some miscellaneous feeds of minor importance, are, as a rule, sold without guaranties, which is contrary to law.

2. The composition of most of the feeds which have guaranties is in substantial agreement with these guaranties.

3. The only evidence of deliberate fraud in the feed market which is shown by the analyses is the mixing of finely ground corn-cob or corn bran with mixed wheat feed, and selling this mixture in packages which do not bear the name of the manufacturers nor any statement giving the composition of the mixture.

Purchasers are warned against an article branded Eclipse Mixed Feed, which is a fraud of this kind, and the brands "Jersey Mixed Feed," "Winter Dairy Mixed Feed" and "Winter Mixed Feed" have all been found adulterated.

4. The prices charged at present for commercial feeding stuffs often bear no relation to their chemical composition or feeding value. It therefore requires special care and intelligence to select feeds which shall be economical for the dairyman or feeder of other stock. The standard feeds sold by reputable dealers, are, as a rule, much "cheaper" and more satisfactory than the low-priced factory wastes.

TABLE IV. ANALYSES OF COMMERCIAL FEEDS.

Station No.	Name of Feed.	Manufacturer or Jobber.	Retail Dealer.
	Cotton Seed Meal.		
7574	Cotton Seed Meal, Canary	R. W. Briggs & Co., Memphis, Tenn.	Berlin, J. C. Lincoln
7591	Cotton Seed Meal, Green Diamond	Chapin & Co., St. Louis, Mo.	Bristol, G. W. Eaton
7605	Cotton Seed Meal	Excelsior Mfg. Co.	Hartford, Daniels Mill Co.
7608	Cotton Seed Meal	American Cotton Oil Co., N. Y.	Hartford, Smith, Northam & Co.
7570	Cotton Seed Meal, Star Brand	Sledge & Wells, Memphis, Tenn.	Middletown, Coles Co.
7665	Cotton Seed Meal	Milledgeville, Ga.	New Canaan, C. H. Fairty
7660	Cotton Seed Meal, Magnolia Brand	Chas. M. Cox Co., Boston, Mass.	South Norwalk, M. T. Hatch
7490	Cotton Seed Meal, Canary	R. W. Briggs, Memphis, Tenn.	Yantic, A. R. Manning & Co.
9749	Cotton Seed Meal		New Canaan, D. A. St. John
4590	Cotton Seed Meal, Dixie	Humphreys, Godwin & Co., Memphis, Tenn.	New Milford, Ackley, Hatch & Marsh
4604	Cotton Seed Meal	Strong, Lafferts & Co., N. Y.	New Milford, Ackley, Hatch & Marsh
4608	Cotton Seed Meal, Green Diamond	Chapin & Co., St. Louis, Mo.	New Milford, Ackley, Hatch & Marsh
			Average of 8 analyses
			Average digestible
	Linseed Meal, New Process		
7313	Linseed Oil Meal	American Linseed Co., Chicago	New Haven, R. G. Davis
7478	" "	American Linseed Co., Chicago	New London, Arnold Rudd
7552	" "	American Linseed Co., Chicago	Stafford, E. C. Dennis
7488	" "	American Linseed Co., Chicago	Yantic, A. R. Manning & Co.
	Linseed Meal, Old Process.		
7651		American Linseed Co., New York	Bridgeport, Wm. H. Terry & Co.
7606		American Linseed Co., New York	Hartford, Daniels Mill Co.
7613		Hunter Bros., St. Louis	Hartford, Smith, Northam & Co.
7471		Hauenstein & Co., Buffalo, N. Y.	New London, E. H. Caulkins
7562		Metzger Seed & Oil Co., Toledo, Ohio	Willimantic, H. A. Bugbee
7693		Payne Bros. Co., Minneapolis, Minn.	Winsted, Balch & Platt
			Average of the above 4 analyses of New Process Linseed Meal
			Average digestible
			Average of the above 6 analyses of Old Process Linseed Meal
			Average digestible

SAMPLED IN 1902.

Station No.	Analyses. Water.	Ash.	Protein.	Fiber.	Nitrogen-free Extract. (Starch, gum, etc.)	Ether Extract.	Price per ton.
7574	9.28	5.80	42.19	6.44	24.53	11.76	$28.50
7591	8.02	6.27	45.12	5.16	24.77	10.66	30.00
7605	8.26	6.02	40.50	9.41	26.95	8.86	30.00
7608	7.09	6.04	45.37	6.26	26.20	9.04	30.00
7570	7.60	6.00	42.62	6.85	25.04	11.89	29.00
7665	8.50	6.05	43.37	6.31	25.68	10.09	30.00
7660	8.80	5.86	39.87	9.16	27.53	8.78	30.00
7490	8.55	6.65	44.62	5.46	23.26	11.16	30.00
9749	----	----	43.00	----	----	----	----
4590	----	----	47.81	----	----	----	----
4604	----	----	44.62	----	----	----	----
4608	----	----	45.25	----	----	----	----
	8.30	**6.08**	**42.96**	**6.88**	**25.50**	**10.28**	29.70
			37.80	**3.85**	**15.55**	**9.56**	
7313	11.73	5.40	40.63	7.84	32.10	2.30	29.00
7478	11.23	5.55	38.44	7.73	34.68	2.37	31.00
7552	10.45	5.34	40.12	8.36	33.76	1.97	32.00
7488	9.97	5.37	40.00	7.77	35.00	1.89	32.00
7651	10.02	4.90	35.00	7.58	35.67	6.83	30.00
7606	11.01	4.95	34.25	8.55	34.36	6.88	32.00
7613	10.20	5.20	31.56	9.61	34.76	8.67	32.00
7471	10.66	5.72	35.06	8.48	32.15	7.93	31.00
7562	10.49	6.82	31.56	8.89	34.16	8.08	32.00
7693	11.14	5.09	29.50	9.02	36.80	8.45	35.00
	10.84	**5.41**	**39.79**	**7.92**	**33.91**	**2.13**	31.30
			33.82	**6.34**	**29.16**	**2.06**	
	10.59	**5.44**	**32.82**	**8.68**	**34.66**	**7.81**	32.00
			29.20	**4.94**	**27.03**	**6.95**	

TABLE IV.—*Continued.* ANALYSES OF COMMERCIAL FEEDS.

Station No.	Name of Feed.	Manufacturer or Jobber.	Retail Dealer.
	WHEAT PRODUCTS.		
	Bran from Winter Wheat.		
7684	Bran, Fancy A. B. C.	American Cereal Co.,	Canaan, Ives & Pierce
7459	"	" " "	Saybrook, J. H. Day, Jr.
7316	"	L. C. Breed, St. Louis, Mo.	Guilford, F. H. Rolf
7416	"	L. C. Breed, St. Louis, Mo.	New Haven, J. T. Benham Est.
7450	"	L. C. Breed, St. Louis, Mo.	Plantsville, Atwater Mills
7519	" St. Louis	Chapin & Co., Boston, Mass.	Danielson, The Young Bros. Co.
7418	" Canada White	Chas. M. Cox Co., Boston, Mass.	New Haven, The J. T. Benham Est.
7422	"	The Isaac Harter Co., Toledo, Ohio.	Guilford, G. F. Walter
7493	"	Hunter Bros., St. Louis, Mo.	Norwich, Norwich Grain Co.
7510	"	St. Jacob Enterprise Mill Co., St. Jacob, Ill.	Danielson, Waldo Bros.
7571	" Willard Kidder	Wabash Mills, Terre Haute, Ind.	Middletown, Coles & Co.
			Average of above 11 analyses
			Average digestible
	Bran from Spring Wheat.		
7639	Bran, Tiger	American Cereal Co.	Thompsonville, H. K. Brainard
7498	"	Bay State Milling Co., Winona, Minn.	Norwich, A. A. Beckwith
7564	"	N. L. Berry, Prov., R. I.	Willimantic, H. A. Bugbee
7646	"	A. H. Brown & Bros., Boston, Mass.	Ansonia, Ansonia Flour and Grain Co.
7426	" Canada	Cataract City Milling Co., Niagara Falls, N. Y.	Hamden, Ira W. Beers
7704	" Niagara	Cataract City Milling Co., Niagara Falls, N. Y.	Waterbury, Spencer & Pierpont Co.
7657	" Jersey	Geo. C. Christian, Minneapolis, Minn.	Bridgeport, Berkshire Mills Co.
7662	"	Hecker-Jones-Jewell Co., New York	Stamford, E. E. Scofield
7501	"	Hollister, Chase & Co., New York	Plainfield, J. P. Kingsley & Son
7505	" Elmco	Listman Milling Co., Lacrosse, Wis.	Jewett City, J. E. Leonard & Son
7302	" L	Chas. R. Lull	New Haven, Abner Hendee
7649	" Independence	New York City Milling Co.	Bridgeport, Wm. H. Terry & Co.
7445	" "	New York City Milling Co.	Southington, South. Lumber & Grain Co.
7546	"	Northwestern Con. Milling Co. Minn.	East Hampton, R. H. Hall
7457	"	Pillsbury, Minneapolis	Centerbrook, W. J. Prann

SAMPLED IN 1902.

Station No.	Analyses. Water.	Ash.	Protein.	Fiber.	Nitrogen-free Extract. (Starch, gum, etc.)	Fiber Extract.	Price per ton.
7684	11.17	5.85	17.37	7.80	52.99	4.82	$21.00
7459	11.18	6.30	17.50	11.34	48.90	4.78	20.00
7316	11.95	4.91	17.62	6.92	54.00	4.60	20.00
7416	11.75	5.92	17.37	8.50	51.81	4.65	21.00
7450	10.94	5.63	17.87	7.39	53.47	4.70	22.00
7519	10.95	5.92	18.19	8.20	52.72	4.02	20.00
7418	12.99	5.84	15.81	9.57	50.81	4.98	21.00
7422	12.47	6.21	16.12	8.39	52.73	4.08	24.00
7493	11.21	7.19	15.94	9.40	51.64	4.62	21.00
7510	11.17	5.56	17.87	6.98	53.79	4.63	25.00
7571	9.69	6.28	16.50	8.31	54.93	4.29	22.00
	11.41	**5.96**	**17.10**	**8.44**	**52.53**	**4.56**	23.37
			13.34	**2.45**	**36.25**	**3.10**	
7639	10.57	6.73	17.19	11.16	49.32	5.03	19.00
7498	11.30	6.70	16.37	11.98	48.92	4.73	24.00
7564	10.32	6.17	17.50	8.28	53.38	4.35	20.00
7646	11.39	5.66	16.75	9.26	52.43	4.51	21.00
7426	12.84	6.39	17.12	10.69	47.64	5.32	19.00
7704	10.96	6.41	16.62	9.74	50.98	5.29	22.00
7657	10.74	6.89	17.06	10.79	49.40	5.12	20.00
7662	11.78	5.80	14.87	9.74	52.99	4.82	21.00
7501	11.07	6.94	16.75	11.32	48.85	5.07	20.00
7505	10.90	6.46	17.31	9.20	50.84	5.29	20.00
7302	11.13	5.94	16.87	8.19	53.50	4.37	20.00
7649	10.67	6.75	16.56	10.18	50.99	4.85	20.00
7445	11.28	6.68	17.00	10.57	49.76	4.71	20.00
7546	10.80	7.07	15.12	12.25	49.76	5.00	23.00
7457	11.57	6.40	16.50	11.46	49.09	4.98	24.00

TABLE IV.—*Continued.* ANALYSES OF COMMERCIAL FEEDS.

Station No.	Name of Feed.	Manufacturer or Jobber.	Retail Dealer.
7465	Bran	Pillsbury, Minneapolis	Stonington, S. H. Chesebro
7441	"	Russell & Miller Milling Co., Valley City, N. D.	Meriden, Meriden Grain & Feed Co.
7549	"	Washburn-Crosby Co., Minneapolis, Minn.	Stafford, E. C. Dennis
7533	Snow's Flaky	E. S. Woodworth & Co., Minneapolis, Minn.	Colchester, E. F. Strong
			Average of the above 19 analyses
	Middlings, Winter Wheat		Average digestible
7318	Middlings	L. C. Breed, St. Louis, Mo.	Guilford, F. H. Rolf
7429	"		Hamden, Ira W. Beers
7477	"	Dow & King, Pittsfield, Ill.	New London, Arnold Rudd
7556	"	W. S. Hills & Co., Boston, Mass.	Willimantic, W. D. Grant
7495	"	Hunter Bros., St. Louis, Mo.	Norwich, Norwich Grain Co.
7550	"	Hunter Bros., St. Louis, Mo.	Stafford, E. C. Dennis
7633	"	Kehlor Bros., St. Louis, Mo.	Suffield, Arthur Sikes
7508	"	J. F. Lennon, Providence, R. I.	Jewett City, J. E. Leonard & Son
7417	" Ballard Ship Stuff	J. E. Soper & Co., Boston, Mass.	New Haven, J. T. Benham Est.
7531	"	Valiers & Spier Mill Co., Marine, Ill.	Putnam, Bosworth Bros.
			Average of above 10 analyses
			Average digestible
	Middlings, Spring Wheat.		
7640	Middlings, Tiger	American Cereal Co.	Thompsonville, H. K. Brainard
7638	" " Red Dog	" "	" " "
7437	"	Bay State Milling Co., Winona, Wis.	Meriden, A. H. Cashen
7502	"	Brayton Milling Co., Minneapolis	Plainfield, J. P. Kingsley & Son
7428	"	Cataract City Milling Co., Niagara Falls	Hamden, Ira W. Beers
7511	" Bridal Veil	Central Milling Co., Buffalo, N. Y.	Danielson, Waldo Bros.
7611	" Daisy	Daisy Roller Mills, Milwaukee	Hartford, Smith, Northam & Co.
7480	" "	Daisy Roller Mills, Milwaukee	New London, Beebe & Bragaw
7692	" Snowball	Gardner Mill, Hastings, Minn.	Winsted, Balch & Platt
7301	" H	Hecker-Jones-Jewell Co., New York	New Haven, Abner Hendee
7452	" H	Hecker-Jones-Jewell Co., New York	Plantsville, Atwater Mills

SAMPLED IN 1902.

Station No.	Analyses. Water.	Ash.	Protein.	Fiber.	Nitrogen-free Extract. (Starch, gum, etc.)	Ether Extract.	Price per ton.
7465	10.75	5.37	16.50	11.50	50.91	4.97	$22.00
7441	11.95	7.01	18.06	10.69	47.18	5.11	22.00
7549	10.80	6.23	17.56	10.84	49.48	5.09	20.00
7533	12.08	4.96	15.94	11.00	50.89	5.13	21.00
	11.20	**6.34**	**16.72**	**10.47**	**50.33**	**4.94**	20.90
			13.04	**3.04**	**34.73**	**3.36**	
7318	11.76	3.46	17.94	4.23	58.29	4.32	23.00
7429	11.89	3.85	19.62	5.06	54.76	4.82	24.00
7477	12.51	3.63	17.31	5.15	56.76	4.64	25.00
7556	11.67	3.43	19.94	4.17	56.37	4.42	19.00
7495	11.90	3.26	17.75	3.15	59.15	4.79	25.00
7550	10.35	4.03	15.50	5.47	60.28	4.37	25.00
7633	10.85	2.23	20.50	1.83	60.94	3.65	28.00
7508	12.33	4.16	17.25	4.73	56.72	4.81	23.00
7417	12.04	4.76	19.06	6.93	52.35	4.86	22.50
7531	11.92	2.32	16.56	1.86	63.89	3.45	24.00
	11.72	**3.51**	**18.14**	**4.26**	**57.96**	**4.41**	23.85
			14.51	**1.41**	**46.95**	**3.79**	
7640	10.60	5.05	21.00	6.87	50.27	6.21	20.00
7638	10.93	2.69	20.87	1.71	59.50	4.30	25.00
7437	11.95	5.23	21.62	7.65	47.12	6.43	26.00
7502	12.02	4.26	17.12	8.78	52.92	4.90	21.00
7428	13.39	3.86	18.25	6.51	52.71	5.28	24.00
7511	12.01	4.98	17.75	8.92	50.50	5.84	22.00
7611	11.03	3.83	18.25	6.28	55.48	5.13	22.00
7480	11.76	4.87	19.50	7.05	51.56	5.26	24.00
7692	10.81	4.73	19.12	7.23	52.66	5.45	26.00
7301	11.53	5.11	19.25	8.64	50.17	5.30	21.00
7452	11.53	4.82	18.75	8.70	50.56	5.64	23.00

TABLE IV.—*Continued.* ANALYSES OF COMMERCIAL FEEDS.

Station No.	Name of Feed.	Manufacturer or Jobber.	Retail Dealer.
	Middlings, Spring Wheat.		
7314	Middlings, M	Hecker-Jones-Jewell Co., New York	New Haven, R. G. Davis
7451	" M	Hecker-Jones-Jewell Co., New York	Plantsville, Atwater Mills
7492	"	H. H. King & Co., Minneapolis	Norwich, Norwich Grain Co.
7432	"	H. H. King & Co., Minneapolis	Wallingford, E. E. Hall
7504	" Fancy White	Listman Milling Co., Lacrosse, Wis.	Jewett City, J. E. Leonard & Son
7506	" Coarse Shorts	Listman Milling Co., Lacrosse, Wis.	Jewett City. J. E. Leonard & Son
7524	"	New Prague Milling Co., New Prague, Minn.	Danielson, Quinnebaug Store
7653	" Red Dog	New York City Milling Co.	Bridgeport, Wm. H. Terry & Co.
7408	" Manhattan	" " "	East Haven, Hawkins & Forbes
7444	" "	" " "	Southington, South. Lumber & Feed Co.
7464	" "	" " "	Stonington, S. H. Chesebro
7545	"	Northwestern Con. Milling Co., Minneapolis	East Hampton, R. H. Hall
7456	" B	Pillsbury, Minneapolis	Centerbrook, W. J. Prann
7542	" B	" "	Colchester, E. F. Strong
7637	" A	" "	Thompsonville, H. K. Brainard
7650	"	Sheffield Milling Co., Minneapolis	Bridgeport, Wm. H. Terry & Co.
7475	"	Sheffield Milling Co., Minneapolis	New London, Arnold Rudd
7557	"	Sheffield Milling Co., Minneapolis	Willimantic, W. D. Grant
7543	" Northland	Simpson, Hendee & Co., New York	Colchester, E. F. Strong
7695	"	Thornton Chester Mill Co., Buffalo	Torrington, E. H. Talcott
7455	" Standard	Washburn-Crosby Co., Minneapolis	Centerbrook, W. J. Prann
6003	" Adrian	Washburn-Crosby Co., Minneapolis	Merrow, C. G. Wilcox
7486	" "	Washburn-Crosby Co., Minneapolis	Yantic, A. R. Manning & Co.
7534	" Snow's Fancy	E. S. Woodworth & Co., Minneapolis	Colchester, E. F. Strong
7497	" Snow's Cream	E. S. Woodworth & Co., Minneapolis	Norwich, A. A. Beckwith
			Average of above 36 analyses
			Average digestible
7466	" Colonial	Miner-Hillard Milling Co., Wilkesbarre, Pa.	Groton, Groton Grain Co.
			Guarantee

SAMPLED IN 1902.

Station No.	Analyses. Water.	Ash.	Protein.	Fiber.	Nitrogen-free Extract. (Starch, gum, etc.)	Ether Extract.	Price per ton.
7314	11.50	4.58	18.94	7.48	52.76	4.74	$23.00
7451	11.08	4.45	17.87	7.77	53.71	5.12	24.00
7492	11.35	5.49	17.87	8.29	51.58	5.42	21.00
7432	11.98	4.71	20.31	6.81	50.16	6.03	26.00
7504	12.35	4.30	20.12	5.16	52.70	5.37	23.00
7506	11.68	4.71	20.75	5.76	51.47	5.63	21.00
7524	11.41	4.82	18.87	8.07	51.13	5.70	20.00
7653	11.70	3.23	19.62	2.41	57.88	5.16	24.00
7408	11.94	4.44	18.94	7.26	52.64	4.78	24.00
7444	11.31	4.93	16.87	8.08	52.91	5.90	22.00
7464	12.00	4.59	18.75	7.24	52.25	5.17	22.00
7545	10.25	5.30	16.87	10.32	51.84	5.42	24.00
7456	11.23	5.05	18.12	9.01	51.03	5.56	24.00
7542	11.81	5.37	16.37	11.18	49.77	5.50	22.00
7637	10.78	4.60	20.75	5.54	52.71	5.62	24.00
7650	11.72	4.00	20.00	4.56	53.92	5.80	21.00
7475	11.52	5.11	20.99	8.32	48.08	5.98	25.00
7557	10.67	5.27	18.00	8.52	52.13	5.41	19.00
7543	11.24	4.58	19.12	7.37	51.89	5.80	25.00
7695	11.69	4.08	18.12	6.46	54.52	5.13	25.00
7455	11.53	5.03	18.62	7.74	51.38	5.70	24.00
6003	13.13	3.04	20.06	2.41	56.99	4.37	27.00
7486	11.28	3.52	20.75	2.75	56.14	5.56	27.00
7534	11.69	3.88	20.50	3.09	55.50	5.34	26.00
7497	11.88	3.83	20.87	3.09	55.22	5.11	26.00
	11.56	**4.51**	**19.15**	**6.75**	**52.61**	**5.42**	23.44
			15.32	**2.23**	**42.61**	**4.66**	
7466	10.12	3.33	13.00	6.14	60.17	7.24	25.00
			13.6		62.5	6.8	

TABLE IV.—*Continued.* ANALYSES OF COMMERCIAL FEEDS.

Station No.	Name of Feed.	Manufacturer or Jobber.	Retail Dealer.
	Mixed Feed from Winter Wheat.		
7594	Mixed Feed, Acme	Acme Milling Co., Indianapolis, Ind.	Bristol, W. O. Goodsell
7423	" "	Acme Milling Co., Indianapolis, Ind.	Guilford, G. F. Walter
7636	" "	Acme Milling Co., Indianapolis, Ind.	Suffield, Spencer Bros.
7683	"	American Cereal Co., Chicago	Canaan, Ives & Pierce
7538	" Bluebell Fancy	American Cereal Co., Chicago	Colchester, E. F. Strong
7697	" "	American Cereal Co., Chicago	Torrington, E. H. Talcott
7300	" Buckeye	American Cereal Co., Chicago	New Haven, Abner Hendee
7701	" "	American Cereal Co., Chicago	Watertown, C. W. & T. F. Atwood
7485	" "	American Cereal Co., Chicago	Yantic, A. R. Manning & Co.
7561	"	N. L. Berry, Providence, R. I.	Willimantic, H. A. Bugbee
7610	"	Blish Milling Co., Seymour, Ind.	Hartford, Smith, Northam & Co.
7431	"	Blish Milling Co., Seymour, Ind.	Wallingford, E. E. Hall
7317	"	L. C. Breed, St. Louis, Mo.	Guilford, F. H. Rolf
7529	"	Camp Spring Mill Co., St. Louis, Mo.	Putnam, Bosworth Bros.
7581	" "516"	C. M. Cox Co., Boston, Mass.	New Britain, C. W. Lines
7696	" "	C. M. Cox Co., Boston, Mass.	Torrington, E. H. Talcott
7647	" Hoosier	Geo. T. Evans, Indianapolis, Ind.	Ansonia, Ansonia Flour & Grain Co.
7708	"	Isaac Harter & Co., Toledo, Ohio.	North Haven, Co-op. Feed Co.
7555	"	W. S. Hills & Co., Boston, Mass.	Willimantic, W. D. Grant
7609	" Sunshine	Hunter Bros., St. Louis, Mo.	Hartford, Smith, Northam & Co.
7449	" "	Hunter Bros., St. Louis, Mo.	Plantsville, Atwater Mills
7513	"	Kehlor Bros., St. Louis, Mo.	Danielson, Waldo Bros.
7415	" Snow Flake	Lawrenceburg Roller Mills Co., Lawrenceburg, Ind.	New Haven, J. T. Benham Est.
7496	" "	Lawrenceburg Roller Mills Co., Lawrenceburg, Ind.	Norwich, A. A. Beckwith

SAMPLED IN 1902.

Station No.	Analyses.						Price per ton.
	Water.	Ash.	Protein.	Fiber.	Nitrogen-free Extract. (Starch, gum, etc.)	Ether Extract.	
7594	11.62	5.21	17.75	7.11	53.65	4.66	$22.00
7423	12.35	5.35	16.94	7.71	52.95	4.70	24.00
7636	11.01	5.35	17.75	6.88	54.47	4.54	22.00
7683	11.66	5.53	18.00	7.38	53.12	4.31	21.50
7538	11.65	5.53	17.69	7.02	53.63	4.48	21.00
7697	11.13	5.69	17.56	7.46	53.94	4.22	24.00
7300	12.72	4.36	16.87	5.78	55.73	4.54	20.00
7701	11.89	4.72	17.12	6.55	55.35	4.37	19.00
7485	11.80	4.73	17.75	7.12	54.03	4.57	21.00
7561	10.81	4.88	18.06	6.98	54.60	4.67	21.00
7610	11.21	5.59	17.50	8.64	52.21	4.85	23.00
7431	12.64	5.29	18.00	7.19	52.26	4.62	22.00
7317	11.90	5.15	17.62	7.27	53.44	4.62	21.00
7529	11.90	5.18	17.87	7.17	52.97	4.91	22.00
7581	10.77	5.62	17.37	7.94	53.12	5.18	21.00
7696	10.99	5.43	17.00	8.42	53.18	4.98	24.00
7647	11.09	5.47	17.69	7.06	54.23	4.46	22.00
7708	10.85	5.04	16.87	6.21	56.52	4.51	22.00
7555	11.47	5.23	18.69	6.90	53.49	4.22	20.00
7609	11.20	4.96	18.37	8.36	52.47	4.64	23.00
7449	11.86	4.86	17.69	6.99	53.91	4.69	24.00
7513	11.58	5.49	16.94	7.47	53.82	4.70	24.00
7415	12.55	5.56	17.69	7.43	52.51	4.26	21.00
7496	11.42	5.47	17.62	6.96	54.28	4.25	24.00

TABLE IV.—*Continued.* ANALYSES OF COMMERCIAL FEEDS.

Station No.	Name of Feed.	Manufacturer or Jobber.	Retail Dealer.
7585	Mixed Feed, Kyome	J. E. M. Mill Co., Frankford, Ky.	New Britain, Hugh Reynolds
7575	"	Rex Milling Co., Kansas City, Mo.	Berlin, J. C. Lincoln
7443	"	Rex Milling Co., Kansas City, Mo.	Southington, South. Lumber & Feed Co.
7673	"	Simpson, Hendee & Co., New York	Danbury, F. C. Benjamin & Co.
7528	"	Sparks Milling Co., Alton, Ill.	Putnam, F. M. Cole & Co.
7641	" Quincy	Taylor Bros. Milling Co.	Thompsonville, H. K. Brainard
7517	"Farmers Favorite	Valley City Milling Co., Grand Rapids	Danielson, Quinnebaug Store
7677	" "	Valley City Milling Co., Grand Rapids	New Milford, Ackley, Hatch & Marsh
7559	"	Washington Flour Mill Co., Washington, Mo.	Willimantic, E. A. Buck
7635	" Erie		Suffield, Spencer Bros.
			Average of the above 34 analyses
			Average digestible
	Mixed Feed, unclassified.		
7407	Mixed Feed	M. F. Barringer, Phila., Pa.	East Haven, Hawkins & Forbes
7703	"	M. M. Co.,	Waterbury, Spencer & Pierpont Co.
4938	" *	T. B. Atwater, Plantsville	
	Mixed Feed from Spring Wheat		
7484	Mixed Feed, U. S.	Chapin & Co., Boston	Yantic, A. R. Manning & Co.
7577	" Columbia	Chas. M. Cox Co., Boston	New Britain, M. D. Stanley
7602	" Queen	Hecker-Jones-Jewell Co., New York	Hartford, L. C. Daniels Grain Co.
7554	" "	Hecker-Jones-Jewell Co., New York	Willimantic, W. D. Grant
7541	" "B"	Abner Hendee, New Haven	Colchester, E. F. Strong
7512	" Boston	Imperial Milling Co., Duluth, Minn.	Danielson, Waldo Bros.
7425	" "	Imperial Milling Co., Duluth, Minn.	Guilford, Morse & London
7621	" "	Imperial Milling Co., Duluth, Minn.	Manchester, Manchester Elev. Co.
7520	" Hiawatha	Wm. Listman Milling Co., Superior, Wis.	Danielson, The Young Bros. Co.
7676	" Fancy	Pillsbury, Minneapolis	Danbury, O. H. Meeker
7679	" "	Pillsbury, Minneapolis	New Milford, Ackley, Hatch & Marsh
7700	"	Red Lake Falls Milling Co., Red Lake, Minn.	Watertown, C. W. & T. F. Atwood
7584	" Angola	Simpson, Hendee & Co., New York	New Britain, Hugh Reynolds

* Sent by Miss M. A. Neale, Southington, Conn.

SAMPLED IN 1902.

Station No.	Analyses. Water.	Ash.	Protein.	Fiber.	Nitrogen-free Extract. (Starch, gum, etc.)	Ether Extract.	Price per ton.
7585	10.55	4.83	18.37	8.15	53.63	4.47	$23.00
7575	10.62	5.67	18.50	7.61	52.98	4.62	22.00
7443	12.00	5.68	19.00	8.24	50.36	4.72	21.00
7673	10.71	5.19	17.75	6.59	54.84	4.92	20.00
7528	11.44	5.68	18.25	7.54	52.69	4.40	22.00
7641	10.88	5.72	17.50	7.96	53.37	4.57	24.00
7517	12.17	5.02	17.19	7.60	53.58	4.44	23.00
7677	10.57	5.48	16.75	7.49	55.00	4.71	22.00
7559	10.86	5.46	17.87	6.60	54.45	4.76	21.00
7635	11.39	5.12	18.62	6.92	53.69	4.26	22.00
	11.45	**5.28**	**17.72**	**7.31**	**53.66**	**4.58**	22.00
	----	----	**14.18**	**1.82**	**41.85**	**3.57**	-----
7407	11.75	5.52	16.81	6.39	55.04	4.49	23.00
7703	10.87	5.53	17.19	6.36	55.61	4.44	24.00
4938	----	----	18.00	----	-----	----	22.00
7484	11.46	5.41	17.31	7.88	52.52	5.42	21.00
7577	11.10	4.96	16.31	8.48	53.99	5.16	22.00
7602	10.79	6.24	16.62	10.45	51.03	4.87	22.00
7554	10.23	6.04	16.50	8.75	53.83	4.65	20.00
7541	11.50	5.22	17.94	7.51	53.19	4.64	21.00
7512	11.86	5.83	18.62	8.68	49.98	5.03	24.00
7425	13.00	5.74	17.94	9.14	48.92	5.26	21.00
7621	11.14	5.21	18.62	7.44	52.49	5.10	24.00
7520	10.51	5.22	17.75	7.77	53.48	5.27	20.00
7676	10.81	5.59	17.62	7.70	52.73	5.55	24.00
7679	11.11	5.44	17.87	7.29	52.67	5.62	23.00
7700	11.07	5.74	17.25	8.07	52.85	5.02	20.00
7584	8.53	5.63	17.75	10.01	52.87	5.21	22.00

TABLE IV.—*Continued.* ANALYSES OF COMMERCIAL FEEDS.

Station No.	Name of Feed.	Manufacturer or Jobber.	Retail Dealer.
7709	Mixed Feed, Star and Crescent	Star and Crescent Milling Co.	North Haven, Co-op. Feed Co.
7616	Mixed Feed	Thornton & Chase, Buffalo, N. Y.	East Hartford, W. J. Cox
7458	" Diamond		Saybrook, J. H. Day, Jr.
7548	" "Erie"		Stafford, E. C. Dennis
			Average of the above 17 analyses
			Average digestible
	MAIZE PRODUCTS. *Corn Meal.*		
7648	Meal	Ansonia Flour and Grain Co., Ansonia	Ansonia, Ansonia Flour and Grain Co.
7573	"	Husted Milling Co., Buffalo	Berlin, J. C. Lincoln
7668	"	Johnson & Morrison, Bethel	Bethel, Johnson & Morrison
7654	"	Berkshire Mills Co., Bridgeport	Bridgeport, Berkshire Mills Co.
7652	"	Wm. H. Terry & Co., Bridgeport	Wm. H. Terry & Co.
7593	"	G. W. Eaton, Bristol	Bristol, G. W. Eaton
7599	"	W. O. Goodsell, Bristol	W. O. Goodsell
7686	"	Ives & Pierce, Canaan	Canaan, Ives & Pierce
7535	"	E. F. Strong, Colchester	Colchester, E. F. Strong
7674	"	F. C. Benjamin & Co., Danbury	Danbury, F. C. Benjamin & Co.
7526	"	Quinnebaug Mill, Danielson	Danielson, Quinnebaug Store
7521	"	Young Bros. Co., Danielson	Young Bros. Co.
7617	"	W. J. Cox, East Hartford	East Hartford, W. J. Cox
7410	"	Hawkins & Forbes, East Haven	East Haven, Hawkins & Forbes
7319	"	Coles Co., Middletown	Guilford, F. H. Rolf
7622	"	Manchester Elev. Co., Manchester	Manchester, Manch. Elev. Co.
6004	,,	Cutler Co., North Wilbraham, Mass.	Merrow, C. G. Wilcox
6005	"	S. H. Vilas, Swanton, Vt.	" "
7572	"	Coles Co., Middletown	Middletown, Coles & Co.
7568	"	Meech & Stoddard, Middletown	Meech & Stoddard
7586	"	Hugh Reynolds, New Britain	New Britain, Hugh Reynolds
7579	"	M. D. Stanley, New Britain	M. D. Stanley
7315	"	R. G. Davis, New Haven	New Haven, R. G. Davis
7307	" Buckeye Pure Gold	American Cereal Co.	Abner Hendee
7474	"	E. W. Bailey & Co., Montpelier, Vt.	New London, E. H. Caulkins

SAMPLED IN 1902.

Station No.	Analyses. Water.	Ash.	Protein.	Fiber.	Nitrogen-free Extract. (Starch, gum, etc.)	Ether Extract.	Price per ton.
7709	11.04	4.95	18.62	6.64	54.04	4.71	$23.00
7616	10.60	5.72	18.12	9.52	50.88	5.16	22.00
7458	11.67	5.24	17.50	8.93	52.30	4.36	26.00
7548	10.26	5.67	17.81	7.83	53.48	4.95	25.00
	10.98	**5.52**	**17.66**	**8.36**	**52.42**	**5.06**	22.35
	....	....	**14.13**	**2.09**	**40.89**	**3.95**	
7648	12.99	1.29	10.12	2.76	68.75	4.09	29.00
7573	13.01	1.03	10.19	0.67	71.83	3.27	29.00
7668	12.60	1.15	9.62	0.98	71.74	3.91	29.00
7654	13.30	1.42	9.44	1.55	70.20	4.09	30.00
7652	13.66	1.12	9.56	2.07	70.14	3.45	27.00
7593	8.38	1.25	10.31	1.53	74.50	4.03	30.00
7599	12.96	1.27	10.12	2.02	69.33	4.30	29.00
7686	13.77	1.32	10.94	1.60	68.76	3.61	28.00
7535	13.99	1.27	9.69	1.35	69.51	4.19	28.00
7674	13.49	1.38	9.62	1.91	69.50	4.10	30.00
7526	13.36	1.31	9.87	1.69	69.67	4.10	28.00
7521	12.80	1.52	10.31	2.00	68.58	4.79	28.00
7617	13.48	1.23	9.75	1.48	70.05	4.01	29.00
7410	14.11	1.31	9.56	1.81	69.26	3.95	30.00
7319	13.70	1.34	9.69	2.11	69.28	3.88	28.00
7622	13.46	1.19	10.12	1.57	69.67	3.99	29.00
6004	13.85	1.11	10.25	2.41	68.30	4.08	28.00
6005	13.53	1.45	9.44	2.49	69.01	4.08	28.00
7572	13.00	1.36	9.69	1.74	70.13	4.08	30.00
7568	11.77	1.33	9.69	1.69	71.59	3.93	29.00
7586	13.13	1.28	9.94	2.91	69.01	3.73	29.00
7579	13.38	1.17	10.12	1.43	70.25	3.65	29.00
7315	14.32	1.27	9.69	1.71	68.94	4.07	28.00
7307	14.15	0.35	9.19	0.13	75.14	1.04	35.00
7474	13.44	1.36	9.87	1.82	69.43	4.08	28.00

TABLE IV.—*Continued.* ANALYSES OF COMMERCIAL FEEDS.

Station No.	Name of Feed.	Manufacturer or Jobber.	Retail Dealer.
7680	Meal	Husted Milling Co., Buffalo, N. Y.	New Milford, Ackley, Hatch & Marsh
7682	" from No. 2 corn	T. Soule & Co., New Milford	New Milford, T. Soule & Co.
7658	"	Brooklyn Elevator Co., New York	Norwalk, Holmes, Keeler & Selleck Co.
7500	"	A. A. Beckwith, Norwich	Norwich, A. A. Beckwith
7494	"	Cutler Co., North Wilbraham, Mass.	Norwich Grain Co.
7453	"	Atwater Mills, Plantsville	Plantsville, Atwater Mills
7532	"	Bosworth Bros., Putnam	Putnam, Bosworth Bros.
7623	"	Rockville Milling Co., Rockville	Rockville, Rockville Milling Co.
6001	"	Smith, Northam & Co., Hartford	Rockville, Edward White
7460	"	Meech & Stoddard, Middletown	Saybrook, J. H. Day, Jr.
7447	"	Southington Lumber and Feed Co.	Southington, So. Lumber and Feed Co.
7551	"	E. C. Dennis, Stafford	Stafford, E. C. Dennis
7663	"	Diamond Mills, Buffalo	Stamford, E. E. Scofield
7463	"	Narragansett Milling Co., East Providence, R. I.	Stonington, S. H. Chesebro
7631	"	Diamond Mills, Buffalo, N. Y.	Suffield, Arthur Sikes
7642	"	H. K. Brainard, Thompsonville	Thompsonville, H. K. Brainard
7707	"	Miner, Hillard Milling Co., Wilkesbarre, Pa.	Waterbury, Platt's Mill
6007	"	E. A. Buck & Co., Willimantic	Willimantic, E. A. Buck & Co.
6008	"	E. W. Bailey & Co., Montpelier, Vt.	H. A. Bugbee
6009	"	Cutler Co., North Wilbraham, Mass.	" "
6006	"	S. H. Vilas, Swanton, Vt.	W. D. Grant
7558	"	" " " "	" "
7489	"	A. R. Manning & Co., Yantic	Yantic, A. R. Manning & Co.
			Average of the above 48 analyses
			Average digestible
	Gluten Meal.		
7615	Cream Gluten Meal	Chas. Pope Glucose Co., Chicago, Ill.	Hartford, Smith, Northam & Co.
			Guaranty
			Digestible
4605	Atlas Gluten Meal*	Atlas Feed & Milling Co., Peoria, Ill.	
7530	" " "	Atlas Feed & Milling Co., Peoria, Ill.	Putnam, Bosworth Bros.

* Sent by F. B. Ashton, Middletown. See page 374.

SAMPLED IN 1902.

Station No.	Analyses. Water.	Ash.	Protein.	Fiber.	Nitrogen-free Extract. (Starch, gum, etc.)	Ether Extract.	Price per ton.
7680	12.13	1.61	10.19	2.28	69.25	4.54	$30.00
7682	12.44	1.29	10.37	1.94	69.83	4.13	30.00
7658	12.22	1.47	10.25	2.22	69.41	4.43	32.00
7500	13.50	1.33	10.94	2.22	68.59	3.42	28.00
7494	13.44	1.32	9.94	1.47	70.01	3.82	27.50
7453	14.53	1.24	9.75	1.54	69.06	3.88	28.00
7532	14.27	1.29	9.69	2.06	68.42	4.27	27.00
7623	13.57	1.29	9.87	1.61	69.72	3.94	29.00
6001	14.55	1.66	9.81	2.76	66.79	4.43	29.00
7460	13.94	1.14	9.56	2.02	70.20	3.14	30.00
7447	13.27	1.28	10.00	1.78	69.73	3.94	29.00
7551	12.19	1.36	9.75	1.90	70.71	4.09	28.00
7663	13.36	1.12	10.12	0.95	70.80	3.65	30.00
7463	13.30	1.26	9.75	1.78	69.98	3.93	27.00
7631	13.60	1.04	9.25	1.01	71.94	3.16	29.00
7642	13.48	1.43	9.94	1.58	69.56	4.01	28.00
7707	12.56	1.37	9.25	1.68	71.16	3.98	28.00
6007	14.33	1.27	10.19	2.57	67.67	3.97	28.00
6008	14.35	1.28	9.25	2.34	68.70	4.08	28.00
6009	14.48	1.57	11.00	3.09	65.90	3.96	28.00
6006	15.01	1.37	9.50	2.44	67.71	3.97	27.00
7558	13.19	1.23	9.87	1.59	70.09	4.03	27.00
7489	13.35	1.26	9.87	1.26	70.40	3.86	28.00
	13.35	**1.30**	**9.89**	**1.83**	**69.73**	**3.90**	28.75
	----	----	**6.73**	----	**66.24**	**3.59**	
7615	10.23	0.83	43.00	1.20	43.26	1.48	30.00
	----	----	34.12	----	----	3.20	
	----	----	**37.84**	----	**38.93**	**1.39**	
4605	5.29	1.64	36.44	11.54	29.04	16.05	22.70
7530	8.31	1.61	36.12	11.35	27.63	14.98	26.00

TABLE IV.—*Continued.* ANALYSES OF COMMERCIAL FEEDS.

Station No.	Name of Feed.	Manufacturer or Jobber.	Retail Dealer.
6135	Atlas Gluten Meal*	Atlas Feed & Milling Co., Peoria, Ill.	
			Guaranty
			Average of above 2 analyses
			Average digestible
7537	Chicago Gluten Meal	Glucose Sugar Refining Co., Chicago, Ill.	Colchester, E. F. Strong
7553	" " "	Glucose Sugar Refining Co., Chicago, Ill.	Stafford, E. C. Dennis
7487	" " "	Glucose Sugar Refining Co., Chicago, Ill.	Yantic, A. R. Manning & Co.
			Guaranty
			Average of the above 3 analyses
			Average digestible
6122	Atlantic Gluten Meal†	Atlantic Starch Works, Westport, Conn.	
7252	" " " †	Atlantic Starch Works, Westport, Conn.	
9759	" " " ‡	Atlantic Starch Works, Westport, Conn.	
9750	Extra Strong Gluten Meal§	Atlantic Starch Works, Westport, Conn.	
7614	King Gluten Meal	National Starch Co., Indianapolis, Ind.	Hartford, Smith, Northam & Co.
			Guaranty
			Digestible
	Gluten Feed.		
7598	Buffalo Gluten Feed	Glucose Sugar Refining Co., Chicago, Ill.	Bristol, W. O. Goodsell
7406	" " "	Glucose Sugar Refining Co., Chicago, Ill.	East Haven, Hawkins & Forbes
7420	" " "	Glucose Sugar Refining Co., Chicago, Ill.	Guilford, G. F. Walter
7427	" " "	Glucose Sugar Refining Co., Chicago, Ill.	Hamden, Ira W. Beers
7567	" " "	Glucose Sugar Refining Co., Chicago, Ill.	Middletown, Meech & Stoddard
7578	" " "	Glucose Sugar Refining Co., Chicago, Ill.	New Britain, M. D. Stanley
7414	" " "	Glucose Sugar Refining Co., Chicago, Ill.	New Haven, J. T. Benham Est.
			Guaranty
			Average of above 7 analyses
			Average digestible
7304	Globe Gluten Feed	New York Glucose Co.	New Haven, Abner Hendee
7473	" " "	" " "	New London, E. H. Caulkins

* Sent by E. M. Miller, Newtown. See page 374.
† Sent by F. T. Bradley, Saybrook. See page 374.
‡ Sent by R. G. Davis, New Haven. § Sent by Atlantic Starch Works, Westport.

SAMPLED IN 1902.

Station No.	Analyses. Water.	Ash.	Protein.	Fiber.	Nitrogen-free Extract. (Starch, gum, etc.)	Ether Extract.	Price per ton.
6135	----	----	35.62	----	----	14.17	$23.70
	----	----	36.0	----	----	14.0	
	6.80	**1.63**	**36.28**	**11.45**	**28.33**	**15.51**	24.10
	----	----	**31.92**	----	**25.49**	**14.58**	
7537	10.68	1.75	34.50	1.13	49.30	2.64	31.00
7553	9.82	1.46	37.44	1.66	46.16	3.46	32.00
7487	10.88	1.63	34.44	1.15	49.53	2.37	31.00
	---	----	38.0	----	----	3.0	
	10.46	**1.61**	**35.46**	**1.31**	**48.34**	**2.82**	31.30
	----	----	**31.19**	----	**43.51**	**2.65**	
6122	10.95	3.64	48.88	5.61	28.72	2.20	31.00
7252	----	----	52.88	----	---	----	31.00
9759	9.70	4.04	43.56	9.01	31.01	2.68	28.00
9750	7.93	1.87	68.88	5.74	15.03	0.55	
7614	10.20	1.24	33.75	1.99	50.78	2.04	30.00
	---	----	35.5	----	----	3.7	
	----	----	**29.70**	----	**45.70**	**1.92**	
7598	8.98	2.52	26.31	5.61	53.06	3.52	25.00
7406	10.70	1.77	26.81	6.07	50.79	3.86	25.00
7420	10.78	2.30	28.19	6.65	49.07	3.01	26.00
7427	11.95	1.72	27.37	6.19	49.96	2.81	24.50
7567	10.15	2.45	27.50	6.44	50.50	2.96	26.00
7578	9.25	2.41	27.44	6.60	51.08	3.22	27.50
7414	10.38	2.17	27.06	6.14	51.50	2.75	25.00
	----	---	27.5	----	----	3.3	
	10.31	**2.19**	**27.24**	**6.24**	**50.86**	**3.16**	25.60
	----	----	**23.43**	**4.87**	**45.27**	**2.65**	
7304	9.76	1.52	26.00	7.24	51.56	3.92	27.00
7473	10.17	1.48	27.62	7.19	49.58	3.96	26.00

TABLE IV.—*Continued.* ANALYSES OF COMMERCIAL FEEDS.

Station No.	Name of Feed.	Manufacturer or Jobber.	Retail Dealer.
7499	Globe Gluten Feed	New York Glucose Co.	Norwich, A. A. Beckwith
			Guaranty
			Average of the above 3 analyses
			Average digestible
7509	Pekin Gluten Feed	Illinois Sugar Refining Co., Chicago, Ill.	Danielson, Waldo Bros.
7612	" " "	Illinois Sugar Refining Co., Chicago, Ill.	Hartford, Smith, Northam & Co.
			Guaranty
			Average of the above 2 analyses
			Average digestible
7424	Queen Gluten Feed	National Starch Co., New York	Guilford, Morse & Landon
7476	" " "	National Starch Co., New York	New London, Arnold Rudd
			Guaranty
			Average of the above 2 analyses
			Average digestible
7514	Waukegan Gluten Feed	U. S. Sugar Refining Co.	Danielson, Waldo Bros.
			Guaranty
			Digestible
7645	Gluten Feed	J. E. Soper & Co., Boston	Ansonia, Ansonia Flour and Grain Co.
			Digestible
	Hominy Feed.		
7576	Hominy Meal	Husted Milling Co., Buffalo, N. Y.	Berlin, J. C. Lincoln
7685	" Feed	Suffern, Hunt & Co., Decatur, Ill.	Canaan, Ives & Pierce
7536	" Meal, Geneva	Simpson Hendee, New York	Colchester, E. F. Strong
7672	" "	C. M. Cox & Co., Boston	Danbury, F. C. Benjamin & Co.
7515	" " K'yst'ne F'cy	Fish & Co., New York	Danielson, Waldo Bros.
7522	" Chop	C. M. Cox & Co., Boston	The Young Bros. Co.
7603	" Feed, "G"	M. F. Barringer, Phila., Pa.	Hartford, L. C. Daniels Grain Co.
7607	" "	Hunter Bros., St. Louis, Mo.	Hartford, Daniels Mill Co.
7507	" "	Simpson Hendee, New York	Jewett City, J. E. Leonard
7436	" Meal	Miner, Hillard Milling Co., Wilkesbarre, Pa.	Meriden, A. H. Cashen
7439	" Feed	Buffalo Cereal Co., Buffalo, N. Y.	Meriden, Meriden Grain & Feed Co.
7565	" Chop	A. F. Lane, New York	Middletown, Meech & Stoddard

SAMPLED IN 1902.

Station No.	Analyses. Water.	Ash.	Protein.	Fiber.	Nitrogen-free Extract. (Starch, gum, etc.)	Ether Extract.	Price per ton.
7499	10.27	1.44	26.00	7.12	52.44	2.73	$28.00
	----	----	27.5	----	----	3.3	
	10.07	**1.48**	**26.54**	**7.18**	**51.19**	**3.54**	27.00
	----	----	**22.82**	**5.60**	**45.56**	**2.97**	
7509	9.65	2.23	26.62	6.47	52.03	3.00	26.00
7612	9.02	0.90	27.19	7.82	51.29	3.78	30.00
	----	----	27.5	----	----	3.3	
	9.33	**1.56**	**26.91**	**7.14**	**51.67**	**3.39**	28.00
	----	----	**23.13**	**5.57**	**45.99**	**2.85**	
7424	10.54	0.59	24.87	7.21	54.53	2.26	25.00
7476	9.80	0.62	24.06	7.97	55.57	1.98	27.00
	----	----	27.1	----	----	3.2	
	10.17	**0.60**	**24.46**	**7.59**	**55.06**	**2.12**	26.00
	----	----	**21.04**	**5.92**	**48.99**	**1.78**	
7514	11.50	1.11	25.12	6.81	51.95	3.51	26.00
	----	----	27.3	----	----	3.3	
	----	----	**21.60**	**5.31**	**46.24**	**2.94**	
7645	8.59	1.42	24.69	6.65	56.04	2.61	25.00
	----	----	**21.23**	**5.19**	**49.87**	**2.19**	
7576	9.98	2.78	11.14	4.17	62.29	9.64	27.00
7685	10.10	3.08	11.56	4.64	60.85	9.77	28.00
7536	8.56	2.62	11.50	4.27	64.51	8.54	26.00
7672	7.56	2.95	12.12	4.39	62.57	10.41	24.00
7515	10.52	2.64	9.69	8.84	62.19	6.12	26.00
7522	9.43	2.80	11.50	4.20	63.00	9.07	25.00
7603	9.83	2.92	12.50	4.29	61.86	8.60	25.00
7607	10.26	3.45	11.75	4.52	59.95	10.07	25.00
7507	9.90	2.82	12.06	4.71	60.64	9.87	27.00
7436	11.20	2.57	11.12	4.62	63.17	7.32	27.00
7439	9.52	2.73	11.62	4.45	62.78	8.90	28.00
7565	10.82	2.76	11.81	3.73	62.06	8.82	25.00

TABLE IV.—*Continued.* ANALYSES OF COMMERCIAL FEEDS.

Station No.	Name of Feed.	Manufacturer or Jobber.	Retail Dealer.
7309	White Hominy Meal	Chas. Payne, New York	New Haven, R. G. Davis
7479	Hominy Meal, Niagara	Chapin & Co.	New London, Beebe & Bragan
7678	" Feed	Hunter Bros., St. Louis	New Milford, Ackley, Hatch & Marsh
7661	" "	Miner, Hillard Milling Co., Wilkesbarre, Pa.	South Norwalk, M. T. Hatch
7503	" Chop		Plainfield, J. P. Kingsley & Son
7664	" Feed	Hollister, Chase & Co., N. Y.	Stamford, E. E. Scofield
7462	" Chop	Narragansett Milling Co., East Providence, R. I.	Stonington, S. H. Chesebro
7632	" Feed	Buffalo Cereal Co., Buffalo, N. Y.	Suffield, Arthur Sikes
7634	" "	Chapin & Co., Boston, Mass.	Spencer Bros.
7434	" "	C. M. Cox & Co., Boston, Mass.	Wallingford, E. E. Hall
7699	" Meal	Simpson Hendee, New York	Watertown, C. W. & T. F. Atwood
7560	" Feed	Hunter Bros., St. Louis	Willimantic, H. A. Bugbee
7688	" Meal	W. T. Reynolds & Co., Poughkeepsie, N. Y.	Winsted, Balch & Platt
7482	" Chop	M. F. Barringer, Phila., Pa.	Yantic, A. R. Manning & Co.
4611	Chops	C. W. Campbell & Co., Westerly, R. I.	
7873	Hominy Feed*		
			Average of 26 analyses
			Average digestible
	RYE PRODUCTS.		
7644	Rye Bran	Blodgett Milling Co., Janesville, Wis.	Ansonia, Ansonia Flour and Grain Co.
7544	Rye Feed	Coles & Co., Middletown	East Hampton, R. H. Hall
7566	"	H. D. Stone & Co., Rochester, N. Y.	Middletown, Meech & Stoddard
7412	"	H. D. Stone & Co., Rochester, N. Y.	New Haven, J. T. Benham Est.
7306	"	H. D. Stone & Co., Rochester, N. Y.	Abner Hendee
7694	"	Miner, Hillard Milling Co., Wilkesbarre, Pa.	Torrington, E. H. Talcott
			Average of above 6 analyses
			Average digestible
	BARLEY PRODUCTS.		
7675	Malt Sprouts	M. F. Barringer, Philadelphia, Pa.	Danbury, O. H. Meeker
7308	" "	Mueller & Co., Milwaukee, Wis.	New Haven, R. G. Davis
			Average of above 2 analyses
			Average digestible

* Sent by S. T. Stockwell, West Simsbury.

SAMPLED IN 1902.

Station No.	Analyses. Water.	Ash.	Protein.	Fiber.	Nitrogen-free Extract. (Starch, gum, etc.)	Ether Extract.	Price per ton.
7309	12.12	2.63	11.44	4.16	61.16	8 49	$25.00
7479	9.33	3.00	12.00	4.05	62.11	9.51	27.00
7678	9.96	3.07	12.37	4.77	61.27	8.56	28.00
7661	8.27	2.70	11.62	4.64	63.65	9.12	27.00
7503	9.71	2.82	10.87	6.62	61.55	8.43	24.50
7664	10.70	2.53	11.37	4.81	62.47	8.12	26.00
7462	10.01	2.29	9.37	10.10	63.12	5.11	26.00
7632	8.41	2.76	11.50	4.55	64.11	8.67	27.00
7634	11.01	2.66	11.75	4.00	62.13	8.45	26.00
7434	9.67	2.60	11.62	4.32	63.15	8.64	25.00
7699	9.87	2.94	11.56	4.54	61.42	9.67	27.00
7560	9.83	2.85	11.37	4.18	62.78	8.99	26.00
7688	11.59	2.60	11.00	4.13	62.71	7.97	26.00
7482	10.17	2.73	11.12	6.48	60.86	8.64	27.00
4611	8.53	----	11.87	----	----	9.00	
7873	12.00	2.74	10.94	4.12	61.64	8.56	26.00
	9.99	**2.80**	**11.57**	**4.53**	**62.20**	**8.91**	28.25
	----	----	**7.87**	----	**59.09**	**8.19**	
7644	8.63	5.66	15.19	6.33	60.42	3.77	27.00
7544	11.81	3.07	14.94	3.58	63.60	3.00	24.00
7566	11.91	3.27	15.12	4.18	62.66	2.86	24.00
7412	12.60	3.58	16.19	4.25	60.37	3.01	25.00
7306	13.78	2.80	15.00	3.39	62.16	2.87	30.00
7694	11.91	3.49	16.12	4.76	60.62	3.10	25.00
	11.77	**3.64**	**15.43**	**4.41**	**61.65**	**3.10**	26.00
	----	----	**12.95**	----	**56.72**	**1.98**	
7675	8.67	5.43	26.94	13.72	43.95	1.29	18.00
7308	10.34	5.81	28.56	12.30	41.60	1.39	19.00
	9.50	**5.62**	**27.75**	**13.01**	**42.78**	**1.34**	18.50
	----	----	**22.20**	**4.29**	**29.09**	**1.34**	

TABLE IV.—*Continued.* ANALYSES OF COMMERCIAL FEEDS.

Station No.	Name of Feed.	Manufacturer or Jobber.	Retail Dealer.
4635	Brewers Grains A*		
4636	" " B*		
			Average of above 2 analyses
			Average digestible
	OAT PRODUCTS.		
7601	Ground Oats	W. O. Goodsell, Bristol	Bristol, W. O. Goodsell
7588	"	Hugh Reynolds, New Britain	New Britain, Hugh Reynolds
7580	"	M. D. Stanley, New Britain	M. D. Stanley
7411	"	J. T. Benham Est., New Haven	New Haven, J. T. Benham Est.
			Average of above 4 analyses
			Average digestible
7671	Royal Oat Feed	Great Western Cereal Co., Chicago, Ill.	Danbury, F. C. Benjamin & Co.
	BUCKWHEAT PRODUCTS		
7525	Buckwheat Middlings	Quinnebaug Mill, Danielson	Danielson, Quinnepaug Store
9747	Buckwheat Hulls†		
	MISCELLANEOUS BY-PRODUCTS.		
6002	Peanut Bran	Phœnix Milling Co., Petersburg, Va.	Rockville, Edward White
7625	Broken Peanuts	Phœnix Milling Co., Petersburg, Va.	Rockville, Edward White
4829	Biles' Distillers Grains XXXX‡		
4592	Cornaline§		
4716	Gee's Germ Middlings	G. E. Gee Grain Co., Minneapolis, Minn.	
4682	" " "	G. E. Gee Grain Co., Minneapolis, Minn.	
6112	Seed Meal‖		
6111	Ready Bits (damaged)¶		
4591	Corn Feed**		
7310	White Meal	M. F. Barringer, Philadelphia, Pa.	New Haven, R. G. Davis
4612	Dam'g'd Cerealine Feed††		

* Sent by Vine Hill Farm Co., West Hartford.
† Sent by L. C. Hunt, Madison.
‡ Sent by James H. Webb, Hamden.
§ Sent by Smith, Northam & Co., Hartford.
‖ Sent by P. A. Holt, Elmwood.
¶ Sent by C. L. Burwell, New Haven.
** Sent by Vine Hill Farm Co., Elmwood.
†† Sent by James F. Brown, Jr., North

SAMPLED IN 1902.

Station No.	Analyses. Water.	Ash.	Protein.	Fiber.	Nitrogen-free Extract. (Starch, gum, etc.)	Ether Extract.	Price per ton.
4635	9.31	2.98	31.62	12.83	36.35	6.91	22.00
4636	8.44	3.15	27.81	15.17	38.52	6.91	22.00
	8.88	**3.06**	**29.72**	**14.00**	**37.43**	**6.91**	
	---	----	**23.47**	**7.28**	**21.71**	**6.29**	
7601	11.34	3.25	12.06	10.72	57.52	5.11	32.00
7588	11.30	3.28	13.06	10.97	56.70	4.69	30.00
7580	7.51	2.64	13.00	7.40	65.78	3.67	39.00
7411	12.47	3.01	13.69	8.58	57.54	4.71	31.00
	10.65	**3.05**	**12.95**	**9.41**	**59.40**	**4.54**	
	----	----	**10.10**	**1.88**	**45.14**	**3.77**	
7671	7.88	9.88	6.87	24.91	48.51	1.95	18.00
7525	15.51	4.78	28.56	3.14	40.27	7.74	20.00
9747	9.06	2.42	3.13	49.66	35.12	0.61	
6002	10.75	10.00*	10.50	43.77	20.18	4.80	24.00
7625	7.29	5.96	22.94	13.72	17.72	32.37	22.00
4829	----	----	34.50	----	----	----	34.10
4592	6.84	0.90	2.56	64.06	25.36	0.28	
4716	7.08	11.68	14.75	9.92	49.60	6.97	
4682	6.95	11.79	14.44	9.58	50.76	6.48	
6112	8.95	12.98	18.00	6.47	44.33	9.27	16.00
6111	8.95	2.67	11.44	1.93	73.02	1.99	12.00
4591	8.78	5.55	11.50	13.55	58.53	2.09	
7310	8.81	4.40	13.12	4.15	58.98	10.54	25.00
4612	9.71	----	11.75	----	----	6.58	17.00

* Sand 6.20 per cent.

TABLE IV.—*Continued.* ANALYSES OF COMMERCIAL FEEDS.

Station No.	Name of Feed.	Manufacturer or Jobber.	Retail Dealer.
	MISCELLANEOUS MIXED FEEDS.		
7600	Provender	W. O. Goodsell, Bristol	Bristol, W. O. Goodsell
7687	"	Ives & Pierce, Canaan	Canaan, Ives & Pierce
7454	"	Smith, Northam & Co., Hartford	Centerbrook, W. J. Prann
7540	"	E. F. Strong, Colchester	Colchester, E. F. Strong
7527	"	Quinnebaug Mill, Danielson	Danielson, Quinnebaug Store
7618	"	W. J. Cox, East Hartford	East Hartford, W. J. Cox
7409	"	Hawkins & Forbes, East Haven	East Haven, Hawkins & Forbes
7421	"	Morse & Landon, Guilford	Guilford, Morse & Langdon
7430	"	Ira W. Beers, Hamden	Hamden, Ira W. Beers
7587	"	Hugh Reynolds, New Britain	New Britain, Hugh Reynolds
7472	"	E. W. Bailey & Co., Montpelier, Vt.	New London, E. H. Caulkins
7624	"	Rockville Milling Co., Rockville	Rockville, Rockville Milling Co.
7698	"	E. H. Talcott, Torrington	Torrington, E. H. Talcott
7435	"	E. E. Hall, Wallingford	Wallingford, E. E. Hall
7706	"	G. L. Dickinson, Waterbury	Waterbury, G. L. Dickinson
7702	"	C. W. & T. F. Atwood, Watertown	Watertown, C. W. & T. F. Atwood
7689	"	Balch & Platt, Winsted	Winsted, Balch & Platt
			Average of above 17 analyses
			Average digestible
7590	Victor Corn & Oat Feed	American Cereal Co., Chicago, Ill.	Bristol, G. W. Eaton
7305	" "	American Cereal Co., Chicago, Ill.	New Haven, Abner Hendee
7461	" "	American Cereal Co., Chicago, Ill.	Saybrook, J. H. Day, Jr.
7433	" "	American Cereal Co., Chicago, Ill.	Wallingford, E. E. Hall
			Guaranty
			Average of above 4 analyses
			Average digestible
7681	Vim Oat Feed	American Cereal Co., Chicago, Ill.	New Milford, Ackley, Hatch & Marsh
			Guaranty
			Average digestible
7669	Boss Corn and Oat Feed	Great Western Cereal Co., Chicago, Ill.	Danbury, F. C. Benjamin & Co.
7619	" " " "	Great Western Cereal Co., Chicago, Ill.	Manchester, Manchester Elev. Co.

SAMPLED IN 1902.

Station No.	Analyses. Water.	Ash.	Protein.	Fiber.	Nitrogen-free Extract. (Starch, gum, etc.)	Ether Extract.	Price per ton.
7600	12.66	1.78	10.44	3.89	66.80	4.43	$31.00
7687	12.04	2.14	11.12	5.65	64.92	4.13	28.00
7454	12.72	2.03	10.00	4.50	66.46	4.29	32.00
7540	12.48	1.61	10.06	2.60	69.04	4.21	28.00
7527	11.95	1.69	10.44	3.70	67.99	4.23	30.00
7618	12.21	1.92	10.81	4.29	66.52	4.25	32.00
7409	13.07	1.58	10.50	3.35	67.26	4.24	31.00
7421	13.02	1.76	10.50	3.47	66.90	4.35	32.00
7430	13.89	2.03	10.94	3.86	65.01	4.27	29.00
7587	12.87	2.35	11.19	4.53	64.94	4.12	30.00
7472	12.87	1.94	10.31	4.38	66.45	4.05	32.00
7624	11.97	1.54	10.00	2.93	69.77	3.79	----
7698	11.77	1.95	10.19	4.80	67.11	4.18	30.00
7435	13.40	1.92	10.12	3.82	67.70	3.04	32.00
7706	10.82	1.92	11.00	3.77	68.13	4.36	30.00
7702	13.03	1.82	10.12	3.57	67.27	4.19	28.00
7689	11.11	1.96	10.25	4.06	68.55	4.07	30.00
	12.47	**1.88**	**10.47**	**3.95**	**67.10**	**4.13**	30.30
	----	----	**7.43**	**1.89**	**55.69**	**3.59**	
7590	9.60	3.42	9.06	11.84	61.69	4.39	26.00
7305	10.53	3.55	9.06	11.56	61.68	3.62	24.00
7461	10.11	3.79	9.37	10.92	61.47	4.34	21.00
7433	10.83	4.12	9.37	11.20	60.44	4.04	24.00
	----	----	9.0	----	---	4.0	
	10.27	**3.72**	**9.21**	**11.38**	**61.33**	**4.09**	23.75
	----	----	**6.54**	**5.46**	**50.90**	**3.56**	
7681	8.15	6.06	8.25	23.27	51.17	3.10	18.00
	----	----	6.3	----	----	2.4	
	----	----	**5.88**	**11.17**	**42.47**	**2.69**	
7669	9.75	5.47	8.12	14.00	59.96	2.70	24.00
7619	9.67	6.56	7.87	13.46	59.89	2.55	25.00

TABLE IV.—*Continued.* ANALYSES OF COMMERCIAL FEEDS.

Station No.	Name of Feed.	Manufacturer or Jobber.	Retail Dealer.
7311	Boss Corn and Oat Feed	Great Western Cereal Co., Chicago, Ill.	New Haven, R. G. Davis
			Guaranty
			Average of above 3 analyses
			Average digestible
7659	Excelsior Corn and Oat Feed	Great Western Cereal Co., Chicago, Ill.	So. Norwalk, M. T. Hatch
			Guaranty
7582	De-Fi Corn and Oat Feed	Ellsworth & Co., Buffalo, N. Y.	New Britain, C. W. Lines
			Guaranty
7626	Corn and Oat Feed	Diamond Mills, Buffalo, N. Y.	Suffield, Arthur Sikes
			Guaranty
	CORN, OATS AND BARLEY.		
7656	Schumacher's Stock Feed	American Cereal Co., Chicago, Ill.	Bridgeport, Berkshire Mills Co.
7592	" " "	American Cereal Co., Chicago, Ill.	Bristol, G. W. Eaton
7438	" " "	American Cereal Co., Chicago, Ill.	Meriden, A. H. Cashen
7413	" " "	American Cereal Co., Chicago, Ill.	New Haven, J. T. Benham Est.
7483	" " "	American Cereal Co., Chicago, Ill.	Yantic, A. R. Manning & Co.
			Guaranty
			Average of above 5 analyses
	PROPRIETARY HORSE FEEDS.		
7597	H-O Horse Feed	H-O Co., Buffalo, N. Y.	Bristol, W. O. Goodsell
7467	" "	" " "	Groton, Groton Grain Co.
7303	" "	" " "	New Haven, Abner Hendee
			Guaranty
			Average of above 3 analyses
			Digestible
7629	Horse Feed	Buffalo Cereal Co., Buffalo, N. Y.	Suffield, Arthur Sikes
			Guaranty
			Digestible
	PROPRIETARY POULTRY FEEDS.		
7469	H-O Poultry Feed	H-O Co., Buffalo, N. Y.	Groton, Groton Grain Co.
7583	" "	" " "	New Britain, C. W. Lines
7655	" "	" " "	Norwalk, Holmes, Keeler & Selleck Co.
			Average of above 3 analyses
			Guaranty

SAMPLED IN 1902.

Station No.	Analyses. Water.	Ash.	Protein.	Fiber.	Nitrogen-free Extract. (Starch, gum, etc.)	Ether Extract.	Price per ton.
7311	9.78	5.60	8.06	14.90	58.67	2.99	$21.00
	----	----	7.8	----	----	4.2	
	9.73	**5.88**	**8.01**	**14.12**	**59.51**	**2.75**	
			5.69	**6.78**	**49.39**	**2.39**	
7659	9.90	5.18	9 37	12.40	58.62	4.53	20.00
	----	----	8.2	----	----	4.6	
7582	9.35	4.14	9.25	15.30	58.77	3.19	22.00
	----	----	8.3	----	----	3.0	
7626	10.27	2.90	8.81	10.43	62.05	5.54	26.00
	----	----	9.4	----	----	4.8	
7656	9.67	3.99	12.50	10.64	58.10	5.10	26.00
7592	9.47	4.09	12.50	12.71	56.03	5.20	30.00
7438	10.11	4.66	13.12	11.90	55.15	5.06	27.50
7413	10.65	3.88	12.12	10.06	58.19	5.10	30.00
7483	9.96	4.28	13.06	10.80	56.69	5.21	28.00
	----	----	13.0	----	----	5.0	
	9.97	**4.18**	**12.66**	**11.22**	**56.84**	**5.13**	28.30
7597	9.49	3.13	12.62	9.98	59.64	5.14	29.00
7467	10.20	3.55	12.87	10.08	58.71	4.59	30.00
7303	10.37	3.49	12.81	9.71	58.94	4.68	29.00
	----	----	12.0	----	---	4.5	
	10.02	**3.39**	**12.77**	**9.92**	**59.10**	**4.80**	29.25
	----	----	**9.45**	**3.47**	**46.68**	**4.03**	
7629	9.57	3.30	12.75	10.10	59.50	4.78	29.00
	----	----	12.5	----	----	4.5	
	----	----	**9.44**	**3.54**	**47.00**	**4.02**	
7469	10.57	2.92	17.62	4.99	58.56	5.34	35.00
7583	9.55	3.47	16.94	4.80	60.08	5.16	35.00
7655	9.76	3.25	17.19	4.53	60.38	4.89	37.00
	9.96	**3.21**	**17.25**	**4.77**	**59.68**	**5.13**	
		----	**17.0**	----	----	5.5	

TABLE IV.—*Continued.* ANALYSES OF COMMERCIAL FEEDS.

Station No.	Name of Feed.	Manufacturer or Jobber.	Retail Dealer.
7595	H-O Scratching Feed	H-O Co., Buffalo, N.Y.	Bristol, W. O. Goodsell
			Guaranty
7539	Success Poultry Feed	Case & Co., Colchester	Colchester, E. F. Strong
7448	American Poultry Food	American Cereal Co., Chicago, Ill.	Southington, Southington Lumber and Feed Co.
			Guaranty
	BONE AND MEAT MEAL.		
7523	Meat Meal	Rogers Mfg. Co., Rockfall	Danielson, The Young Bros. Co.
			Guaranty
7547	Beef Scrap	C. M. Shay, Navy Yard, Conn.	East Hampton, R. H. Hall
7468	" "	Am. Agr. Chem. Co., New York	Groton, Groton Grain Co.
			Guaranty
7446	Bone and Meat Meal	McCoy & Best, Peekskill, N. Y.	Southington, Southington Lumber and Feed Co.
			Guaranty
7643	Meat Meal	The Armour Co., Chicago, Ill.	Thompsonville, H. K. Brainard
7491	Swift's Lowell Bone and Meat Meal	Lowell Fertilizer Co., Lowell, Mass.	Yantic, A. R. Manning & Co.
			Guaranty
	PROPRIETARY DAIRY AND STOCK FEEDS.		
7620	Quaker Dairy Feed	American Cereal Co., Chicago, Ill.	Manchester, Manchester Elev. Co.
7666	" "	American Cereal Co., Chicago, Ill.	New Canaan, C. H. Fairty
7312	" "	American Cereal Co., Chicago, Ill.	New Haven, R. G. Davis
			Guaranty
			Average of above 3 analyses
			Average digestible
7440	H-O Dairy Feed	H-O Co., Buffalo, N. Y.	Meriden, Meriden Grain & Feed Co.
7481	" "	" " "	New London, Beebe & Bragaw
			Guaranty
			Average of above 2 analyses
			Average digestible

SAMPLED IN 1902.

Station No.	Analyses. Water.	Ash.	Protein.	Fiber.	Nitrogen-free Extract. (Starch, gum, etc.)	Ether Extract.	Price per ton.
7595	12.18	2.26	11.87	2.69	67.30	3.70	$38.00
	----	----	**12.0**	----	-----	**3.0**	
7539	12.09	3.98	13.37	4.44	61.85	4.27	30.00
7448	11.73	2.94	14.56	4.78	59.87	6.12	32.00
	----	----	**14.0**	----	----	**4.50**	
7523	6.94	46.98	28.31	----	----	14.28	38.00
	----	----	**40.0**	----	----	**15.0**	
7547	14.35	21.50	46.87	----	----	13.66	50.00
7468	8.35	26.36	49.00	----	----	13.86	45.00
	----	----	**50.0**	----	----	**16.0**	
7446	5.99	40.26	36.75	----	----	13.94	34.00
	----	----	**41.4**	----	----	**19.8**	
7643	7.43	4.67	66.25	----	----	14.97	40.00
7491	10.62	27.50	50.75	----	----	10.07	40.00
	----	----	**50.0**	----	----	**10.0**	
7620	8.89	5.21	14.81	14.95	52.42	3.72	21.00
7666	8.46	5.30	14.44	15.76	52.51	3.53	21.00
7312	9.29	4.46	14.25	15.88	52.65	3.47	21.00
	----	----	14.0	----	----	3.5	
	8.88	**4.99**	**14.50**	**15.53**	**52.53**	**3.57**	21.00
	----	----	**11.31**	**6.37**	**36.77**	**3.07**	
7440	10.08	3.98	18.25	12.43	50.64	4.62	30.00
7481	9,42	4.02	17.19	14.05	50.66	4.66	30.00
	----	----	18.0	----	----	4.5	
	9.75	**4.00**	**17.72**	**13.24**	**50.65**	**4.64**	
	----	----	**13.82**	**5.43**	**35.45**	**3.99**	

TABLE IV.—*Continued.* ANALYSES OF COMMERCIAL FEEDS.

Station No.	Name of Feed.	Manufacturer or Jobber.	Retail Dealer.
7442	The Great Western Dairy Feed	Great Western Cereal Co., Chicago, Ill.	Meriden, S. A. Billings
7569	The Great Western Dairy Feed	Great Western Cereal Co., Chicago, Ill.	Middletown, Meech & Stoddard
			Guaranty
			Average of above 2 analyses
7563	Daisy Dairy Feed	Great Western Cereal Co., Chicago, Ill.	Willimantic, H. A. Bugbee
			Guaranty
7670	Lenox Stock Food	Strong & Lefferts Co., New York	Danbury, F. C. Benjamin & Co.
7705	" "	Strong & Lefferts Co., New York	Waterbury, D. L. Dickinson
			Guaranty
			Average of above 2 analyses
7604	Chester Stock Feed	Chester Mills, New York	Hartford, Daniels Mills Co.
			Guaranty
7630	Empire State Cow Feed	The Diamond Mill, Buffalo, N. Y.	Suffield, Arthur Sikes
			Guaranty
7628	Creamery Feed	Buffalo Cereal Co., Buffalo, N. Y.	Suffield, Arthur Sikes
7627	Dairy Feed	Buffalo Cereal Co., Buffalo, N. Y.	Suffield, Arthur Sikes
7691	Blatchford's Calf Meal	The Bardwell Mills, Waukegan, Ill.	Winsted, Balch & Platt
			Guaranty

SAMPLED IN 1902.

Station No.	Analyses. Water.	Ash.	Protein.	Fiber.	Nitrogen-free Extract. (Starch, gum, etc.)	Ether Extract.	Price per ton.
7442	9.60	7.06	11.81	20.20	48.98	2.35	$22.00
7569	8.09	6.00	9.37	21.47	52.00	3.07	22.00
	----	----	12.2	----	----	3.2	
	8.85	**6.53**	**10.59**	**20.83**	**50.49**	**2.71**	
7563	9.01	7.82	9.56	24.86	46.67	2.08	20.00
	----	----	12.2	----	----	**3.2**	
7670	11.06	2.49	10.37	6.72	64.52	4.84	27.00
7705	11.01	2.88	10.12	7.75	63.74	4.50	24.00
	----	----	10.4	----	----	3.3	
	11.03	**2.68**	**10.25**	**7.23**	**64.14**	**4.67**	
7604	10.82	2.72	12.87	9.29	60.11	4.19	26.00
	----	----	9.0	----	----	3.5	
7630	9.87	8.71	14.25	15.75	47.74	3.68	20.00
	----	----	14.9	----	----	3.5	
7628	9.22	3.90	20.37	11.36	50.72	4.43	26.00
7627	6.28	3.70	14.31	13.84	57.47	4.40	26.00
7691	11.41	4.84	25.53	4.61	49.40	4.21	70.00
	----	----	26.0	----	----	5.0	

MISCELLANEOUS FEEDS.

Sent for Analysis by Individuals.

Fifteen samples of this kind have been examined. The analyses of twelve of the number are given below:

9841. Atlantic Gluten Meal, sent by the manufacturer, the Atlantic Starch Works, Westport. This is a wheat gluten and the most concentrated feed in our market.

9778. Ajax Flakes, sold by Chapin & Co. of Boston. Sampled and sent by E. Manchester & Sons, Winsted. Price $27.50, with guarantee of 34 per cent. of protein and 12 of fat. This is claimed to be a corn gluten meal. The analysis fully meets the manufacturer's guarantee.

9883. Bought for Hominy Meal, and sent by Ackley, Hatch & Marsh, New Milford. It is a pure corn product with very little fat and scarcely more than half as much protein as hominy meal should contain, but with correspondingly more nitrogen-free extract (starch). It is really an impure corn starch.

9840. Hominy Meal, sent by J. H. Crowley, Canton Center. This contains less protein and fat, and correspondingly more nitrogen-free extract than hominy meal of average quality.

9921 and 9866. Blomo-Feed, made by the Blomo Manufacturing Co., 437 East 53d St., New York. 9921 sent by C. W. Lines, New Britain; 9866 sent by J. H. Webb, Hamden. The manufacturers state that this feed is made of dried blood, which furnishes the protein, beet root molasses, which supplies the nitrogen-free extract, with some absorbent to hold the molasses and give the feed bulk. In these samples these absorbent materials are a barley product with hulls, also an oat product with hulls. The analyses show the material to contain about as much protein as the wheat products, bran, middlings and mixed feed.

9793. Sugar Beet Feed. Sampled and sent by Francis Deming, Berlin, from car lot bought by C. M. Jarvis, New Britain, cost $3.75 per ton. This appears to be the residue of beet pulp which has been extracted by the diffusion process. It was wet but had no sour or mouldy smell.

The question whether at the price this was as cheap as ensilage was answered emphatically in the negative.

Analyses of Feeds Sent by Individuals.

	Atlantic Gluten.	Ajax Flakes.	Hominy Meal.	Hominy Meal.	Blomo Feed.	Blomo Feed.	Sugar Beet Feed.	Distillery Grains.			Apple Pomace.	Beef Scrap.
								Wet.	Dry.	Dry.		
	9841	9778	9883	9840	9921	9866	9793	9827	9828	9779	9824	9829
Water	6.35	6.90	10.00	10.23	----	11.95	90.58	77.74	4.58	6.55	82.00	4.95
Ash	2.91	----	0.43	2.01	----	5.60	0.44	0.51	4.51	----	0.67	25.64
Protein	52.31	35.62	5.62	10.06	17.25	18.50	0.94	5.95	23.31	32.62	1.45	51.56
Fiber	5.44	----	0.17	3.03	----	9.21	2.01	2.83	8.00	----	4.66	----
Nitrogen-free Extract	30.41	----	81.97	68.80	----	52.75	5.98	10.61	53.21	----	9.69	3.50
Fat	2.58	13.63	1.81	5.87	1.46	1.99	0.05	2.36	6.39	13.68	1.53	14.35
	100.00	----	100.00	100.00	----	100.00	100.00	100.00	100.00	----	100.00	100.00

9827 and 9828. Distillery Grains, one sample in the fresh state, the other dried, made by the Gowdy Distilling Co., East Windsor.

9779. Dried Distillers' Grains. Sent by a dealer for analysis.

9824. Apple Pomace, sent by F. E. Prentice, North Haven. This material, while it contains, in the fresh state, only 18 per cent. of dry matter (1.45 per cent. of protein), is relished by cattle, is free from a large part of the acids and salts which are said to make fresh apples an unsafe feed for milk cows; if free from straw it can be readily kept in the silo, and is well worth saving as an addition to the ration.

9829. Beef scrap, made by A. L. Warren, Northboro, Mass., sampled and sent by P. A. Holt, Farmington. Cost $40 per ton delivered.

Eight samples of feeds have been examined microscopically or chemically at the request of other stations and do not need further notice.

CONDIMENTAL AND MEDICINAL CATTLE FOODS.

9762. A preparation claimed to be a valuable tonic, made by the Banner Stock Food Co., Auburn, N. Y., sampled and sent by N. G. Williams, Brooklyn, who states that it is sold in twenty-five pound boxes at seven cents per pound.

It consists chiefly of wheat bran, linseed meal, a corn product, fenugreek, some bitter substance and iron oxide.

Its chemical analysis shows it to contain less protein than wheat bran, middlings, or mixed feed.

9809. Banner Stock Food, made by the Banner Stock Food Co. of Auburn, N. Y. Sampled and sent by Charles H. Potter, North Woodstock. Price 9½ cents per pound.

This mixture contains linseed meal, a wheat product, charcoal, fenugreek, epsom salts and common salt. The analysis, given below, shows it to contain 24.10 per cent. of protein, being rather less than is contained in the gluten feeds.

9888. Wilbur's Horse and Cattle Food, made by Wilbur's Seed Meal Co., Milwaukee, Wis., sent by T. S. Scranton, Madison. This mixture is chiefly composed of wheat bran, linseed, fenugreek, charcoal and salt. The percentage of protein in it is about the same as in wheat bran.

ANALYSES OF CONDIMENTAL AND MEDICINAL CATTLE FOODS.

	Banner Stock Food Co.		Wilbur's Horse and Cattle Food.
	9762	9809	9888
Water	11.80	10.11	11.17
Ash	6.82	11.80*	10.96†
Protein	13.44	24.10	16.87
Fiber	5.36	14.50	9.30
Nitrogen-free Extract	58.50	33.09	46.44
Fat	4.08	6.40	5.26
	100.00	100.00	100.00

* 4.84 per cent. salt. † 5.96 per cent. salt.

The above mentioned articles, considered as cattle foods simply, are worth no more than the standard feeds found in our markets, which are sold for from $20 to $30 per ton. Yet they are sold in small packages at very much higher prices. Considered as medicines they contain the old-time simples commonly used on the farm, epsom salts, salt, fenugreek, etc., all of which are cheap, and easily found at country stores. The claims made for such condimental and medicinal mixtures by the manufacturers are, in many cases, ridiculous. Thus one pound of one of the articles above cited, it is stated by the maker, will save fifty cents worth of grain, which is somewhere about 40 pounds!

EXAMINATION OF BABCOCK TEST APPARATUS.

Section 4887 of the General Statutes requires that every bottle or pipette employed to determine the relative amount of butter-fat in milk or cream, to be used as a basis of payment for the latter, must be tested and marked as accurate by this Station or by the Connecticut Agricultural College.

Since the law was passed, this Station has tested, without charge to the creameries and dairymen of the State, 3,095 pieces of Babcock apparatus.

During the year covered by this report, 600 pieces have been tested, as follows:

	Number tested.	Number found inaccurate.
Pipettes	85	0
Milk-test bottles	224	0
Cream-test bottles	290	6
Acid measures	1	0
Total	600	6

Percentage of inaccurate pieces found in 1902 ..... 1.0

" " " 1901 ..... 2.3

ANALYSES OF SALT.

Four samples of salt, sent by Hollister Sage, of Pomperaug Valley Creameries, South Britain, have been analyzed as follows:

6114. Brand unknown, sold by Wing Bros. and Hart, Albany, N. Y.

6133. Worcester Salt.

7267. Brand unknown. Sold by F. C. Bushnell Co., New Haven.

9743. Cadillac Salt, sold by F. D. Moulton & Co., New York.

ANALYSES.

	Wing Bros. & Hart.	Worcester.	Bushnell.	Cadillac.
No.	6114	6133	7267	9743
Insoluble in water	0.02	0.02	0.03	0.02
Lime	0.46	0.47	0.52	0.55
Magnesia	none	none	trace	trace
Sulphuric acid	0.58	0.13	0.65	0.74

These four brands of salt are so nearly pure and so nearly alike in chemical composition that no preference can be given to either, on the score of chemical analysis.

For creamery use something depends on the fineness of the grain. If it is very fine it does not gather the butter-milk sufficiently to make it easy to work it out of the butter; if too coarse the salt is not distributed in the mass of butter evenly enough to flavor and preserve it properly.

TESTS OF THE VITALITY OF VEGETABLE SEEDS.

By E. H. Jenkins.

During the year 1902, one hundred and ninety-nine samples of field and garden seeds have been tested as to their sprouting capacity for seed growers or purchasers. The tests have been made by Mr. V. L. Churchill.

The methods followed are those adopted by the Association of American Agricultural Colleges and Experiment Stations.

Large quantities of onion seed are raised for sale in this State and more tests of this seed are annually made than of all other kinds taken together.

TABLE I.—GERMINATION TESTS OF SEEDS OF GARDEN AND FIELD CROPS.

	Age of Seed in years, when tested.	Number of samples.	Average percentage by number of Seed sprouting.	Maximum.	Minimum.
Beans	0–1	7	86.5	100.0	56.7
	1–2	15	91.1	100.0	72.0
	2–3	8	87.0	100.0	59.0
	3–4	15	92.3	99.0	83.0
Beets	0–1	33	128.0	211.0	55.5
	1–2	25	135.6	230.0	44.5
	2–3	7	140.8	192.0	73.5
Brussels Sprouts	1–2	1	77.8	----	----
	3–4	2	18.4	36.0	0.8
Cabbage	0–1	30	82.8	95.8	44.0
	1–2	28	71.1	96.5	28.3
	2–3	5	68.3	88.0	43.0
	3–4	4	62.8	91.5	27.0
	4–5	2	64.9	85.8	44.0
	6–7	1	63.8	----	----
Carrots	0–1	34	61.4	90.8	35.0
	1–2	35	43.8	91.3	14.5
	2–3	5	43.6	54.2	31.0
Cauliflower	0–1	2	77.5	84.5	70.5
	1–2	9	56.6	93.5	27.5
	2–3	3	59.6	75.5	48.8
	3–4	1	77.3	----	----
Celery	0–1	29	53.9	83.5	8.3
	1–2	32	26.8	63.8	1.3
	2–3	10	55.5	79.3	9.8
	3–4	5	55.4	63.5	27.3
Corn, Sweet	0–1	11	59.0	99.0	18.0
	1–2	13	75.9	98.0	37.5
	2–3	4	86.5	92.0	78.0
Corn Salad	1–2	1	63.0	----	----
Cress	0–1	3	61.5	91.3	35.5
	1–2	3	51.2	69.8	40.0
Cucumbers	0–1	14	86.4	99.0	57.0
	1–2	30	73.6	99.0	18.0
	2–3	2	81.2	83.0	79.5
	3–4	3	37.0	75.0	6.4
	4–5	1	79.0	----	----
Dandelion	0–1	1	70.3	----	----
	1–2	2	38.7	54.5	2.30

TABLE I.—*Continued.* GERMINATION TESTS OF SEEDS OF GARDEN AND FIELD CROPS.

	Age of Seed in years, when tested.	Number of samples.	Average percentage by number of Seed sprouting.	Maximum.	Minimum.
Egg Plant	0–1	3	45.8	58.5	40.0
	1–2	1	58.5	----	----
Endive	0–1	2	50.1	53.8	46.5
	1–2	5	42.6	54.0	34.0
Kale	0–1	3	90.2	96.0	80.5
	2–3	1	6.0	----	----
	3–4	1	45.8	----	----
Kohl Rabi	1–2	4	67.8	72.3	58.8
Leek	0–1	5	81.3	86.0	76.3
	1–2	7	69.1	79.3	53.3
	2–3	1	35.5	----	----
Lettuce	0–1	54	64.9	100.0	4.3
	1–2	43	78.7	100.0	8.8
	2–3	14	76.2	98.8	23.8
	3–4	2	47.1	87.8	6.4
	4–5	1	82.0	----	----
	5–6	1	10.3	----	----
Mangel Wurzel	0–1	2	190.0	203.0	177.0
	1–2	8	89.4	176.0	20.0
	2–3	4	103.5	181.0	21.0
Musk Melon	0–1	10	77.5	100.0	28.0
	1–2	22	71.1	99.0	18.0
	2–3	6	33.2	92.5	2.5
	3–4	11	36.7	81.0	10.0
Onion, Connecticut grown	0–1	375	76.5	97.5	36.8
	1–2	99	63.0	92.8	0.8
	2–3	24	21.9	68.3	0.5
	3–4	1	59.5	----	----
California grown	0–1	71	90.3	98.0	55.8
	1–2	30	78.2	98.0	41.5
	2–3	7	66.1	91.5	22.3
	3–4	1	10.0	----	----
Parsley	0–1	3	67.0	73.3	58.8
	1–2	10	29.5	72.0	7.8
Parsnip	0–1	10	48.0	63.5	34.3
	1–2	4	15.6	42.8	2.5
	2–3	1	30.3	----	----

TABLE I.—*Continued.* GERMINATION TESTS OF SEEDS OF GARDEN AND FIELD CROPS.

	Age of Seed in years, when tested.	Number of samples.	Average percentage by number of Seed sprouting.	Maximum.	Minimum.
Peas	0–1	1	45.5	----	----
	1–2	1	77.2	----	----
	3–4	2	98.5	99.0	98.0
Pepper	0–1	7	76.0	89.5	61.0
	1–2	13	51.5	76.5	7.5
Pumpkin	0–1	6	74.0	95.0	40.0
	1–2	9	59.1	92.0	1.1
	2–3	1	97.3	----	----
Radish	0–1	28	88.9	99.8	72.0
	1–2	25	66.8	98.8	4.8
	2–3	19	35.2	72.5	1.8
	3–4	15	24.9	69.5	0.0
Salsify	0–1	3	67.0	80.5	41.0
Spinach	0–1	23	82.8	94.3	59.5
	1–2	13	82.6	88.3	64.3
	2–3	3	63.4	91.5	40.0
Squash	0–1	12	87.4	100.0	68.8
	1–2	9	91.6	98.0	75.0
	3–4	13	38.8	89.0	0.5
Sunflower	1–2	1	97.5	----	----
Tomato	0–1	27	85.4	96.5	73.8
	1–2	21	80.5	96.0	55.3
	2–3	2	58.3	65.5	51.0
	3–4	3	70.2	96.2	43.5
Turnips	0–1	9	95.4	98.8	88.8
	1–2	9	87.4	98.0	40.3
	2–3	3	91.0	93.3	89.5
	3–4	4	59.7	94.5	28.0
Watermelon	0–1	7	82.7	100.0	56.3
	1–2	21	47.0	88.0	0.0
	2–3	12	32.7	85.0	0.1
	3–4	2	21.5	42.0	1.0
	4–5	1	15.0	----	----
	5–6	1	69.5	----	----

Table I presents the average, maximum and minimum vitality of all the seeds tested at the Station by the newly adopted methods. The age of the seeds given in the table is that

reported by the seedsmen or growers who sent the samples. The samples were in all cases drawn by the persons sending them. Since the samples were sent by the seedsmen for their own information, and it was understood that the results of the tests were not to be published as representing the character of their goods, there was no motive for any misrepresentation as to the age of the seed. The samples for the most part undoubtedly represented cleaned seed as prepared for market.

The "percentage" of beet seed and mangel wurzel sprouting, as given in the table, is considerably over 100. To test the vitality of beet seed, one hundred "seeds" are put in the germinating apparatus and all the sprouts are counted. As each beet "seed" is a fruit which may contain from two to six separate seeds, it is evident that the possible number of sprouts may be 600. To count the actual number of seeds in the one hundred fruits examined, which would make a true percentage statement of sprouting power possible, would be extremely laborious; but the form of statement here followed is sufficiently intelligible and is justified by usage.

Vitality of Onion Seed as affected by the Age of the Seed.

Since November 1, 1896, the Station has examined 375 samples of onion seed, less than one year old, of the crop of 1896, and of every succeeding crop. The results appear in Table II, together with those of tests of onion seeds, which were more than one year old when examined. In the samples examined, the percentage by number of seed which sprouted was as follows:

TABLE II.—VITALITY OF ONION SEED.

	Connecticut Grown.		California Grown.	
	No. of samples.	Per cent. sprouted.	No. of samples.	Per cent. sprouted.
Seed stated to be less than 1 year old	375	76.5	71	90.3
Seed stated to be between 1 and 2 years old	99	63.0	30	78.2
Seed stated to be between 2 and 3 years old	24	21.9	7	66.1
Seed stated to be between 3 and 4 years old	1	59.5	1	10.0

While the number of samples examined of California-grown seed is not large enough to make a close comparison, it is quite

evident that a larger percentage of the California seed germinates than of the Connecticut seed.

Table II also shows that onion seed more than one year old, as a rule, has much less sprouting capacity than new seed, although in Table V are numerous cases of onion seed more than a year old which sprout as well as most samples of new seed. Whether the plants produced from old seed are as vigorous and productive as those from fresh seed is quite another question, on which laboratory germination tests can give no light.

Comparison of the Vitality of Crops of Connecticut-grown Onion Seed in the years 1894–1902.

The average sprouting capacity of Connecticut-grown onion seed, as determined for a number of years at this Station, has been as follows:

TABLE III.—VITALITY OF CROPS OF ONION SEED.

	No. of Samples Tested.	Average Percentage Sprouted.
In 1880	14	87.0
1894	25	82.9
1895	13	85.5
1896	44	72.4
1897	39	77.9
1898	68	69.3
1899	62	89.0
1900	77	88.5
1901	60	71.0
1902	60	80.6

Average for 9 consecutive years 79.7 per cent.

The Sprouting Capacity of Different Varieties.

The average sprouting capacity of four varieties, of which a considerable number of samples has been tested, is as follows (only those samples are here included which were alleged to be less than one year old at the time of testing):

TABLE IV.—SPROUTING CAPACITY OF DIFFERENT VARIETIES OF ONION SEED.

Variety.	No. of Samples Tested.	Average Percentage of Sprouting Seed.
Yellow Globe	180	77.0
Red Globe	151	81.3
White Globe	91	79.1
White Portugal	30	70.1
Wethersfield Red	12	78.2

The three globe varieties and the Wethersfield Red are essentially alike in sprouting capacity, but the White Portugal appears to be distinctly inferior to them in this regard.

TABLE V.—GERMINATION TESTS MADE IN 1902 OF ONION SEED RAISED IN CONNECTICUT.

VARIETY.	Station No.	Age of Seed in years at time of testing.	Percentage of Seeds by number.		Number of days within which one-half of the sprouting Seed germinated.
			Sprouted in 14 days.	Remained hard.	
Yellow Globe, Crop of 1900	3061	1–2	66.3	20.2	4
Crop of 1901	3019	0–1	46.8	1.8	3
	3020	0–1	42.8	2.5	3
	3021	0–1	83.5	2.5	3
	3055	0–1	70.8	15.5	5
	3187	1–2	69.8	5.0	3
Crop of 1902	3068	0–1	72.8	6.8	3
	3072	0–1	84.3	2.5	3
	3080	0–1	88.5	0.8	4
	3084	0–1	61.3	6.2	3
	3091	0–1	82.8	1.8	4
	3092	0–1	81.8	1.5	4
	3118	0–1	82.3	2.8	4
	3119	0–1	84.3	1.2	4
	3120	0–1	85.8	2.8	4
	3121	0–1	84.8	2.2	4
	3122	0–1	85.0	1.8	4
	3123	0–1	90.3	3.1	4
	3124	0–1	81.5	1.5	4
	3125	0–1	75.4	2.0	4
	3126	0–1	73.0	3.1	4
	3127	0–1	79.0	1.0	4
	3129	0–1	79.5	1.8	4
	3130	0–1	82.3	2.5	4
	3131	0–1	75.9	2.5	4
	3132	0–1	91.8	2.2	4
	3133	0–1	78.5	1.2	4
	3134	0–1	80.5	1.8	4
	3136	0–1	86.0	2.8	4
	3137	0–1	84.3	4.2	4
	3141	0–1	82.0	2.0	3
	3144	0–1	94.5	1.5	3
	3151	0–1	75.0	4.2	3
	3152	0–1	64.3	2.5	4
	3153	0–1	65.8	2.1	3
	3185	0–1	44.5	3.5	3
	3186	0–1	46.3	4.8	3
	3192	0–1	82.5	9.2	3
Red Globe, Crop of 1900	3018	1–2	81.3	7.5	3
	3056	1–2	50.8	13.1	4
	3062	1–2	47.5	20.3	5
	3076	1–2	64.5	19.8	5
Crop of 1901	3075	1–2	87.0	6.0	4
	3008	0–1	95.5	1.0	3
	3050	0–1	86.5	0.5	3
	3054	0–1	73.5	5.0	3
	3065	0–1	80.3	12.3	6
	3066	0–1	74.8	1.8	4
	3067	0–1	54.0	16.2	4
Crop of 1902	3070	0–1	92.3	1.1	3
	3085	0–1	86.0	2.8	3
	3094	0–1	80.0	2.1	4

TABLE V.—*Continued.* GERMINATION TESTS MADE IN 1902 OF ONION SEED RAISED IN CONNECTICUT.

VARIETY.	Station No.	Age of Seed in years at time of testing.	Percentage of Seeds by number.		Number of days within which one-half of the sprouting Seed germinated.
			Sprouted in 14 days.	Remained hard.	
Red Globe, Crop of 1902, *continued*	3095	0–1	86.8	1.1	4
	3128	0–1	82.5	4.5	4
	3135	0–1	83.3	2.8	3
	3138	0–1	75.8	3.8	4
	3139	0–1	86.5	2.0	4
	3146	0–1	70.8	3.8	3
	3149	0–1	88.8	2.8	3
	3154	0–1	77.0	3.5	3
	3155	0–1	78.0	3.8	4
	3156	0–1	82.5	3.2	4
	3157	0–1	82.8	4.8	3
	3158	0–1	77.3	3.2	4
	3189	0–1	92.0	2.2	3
	3191	0–1	93.8	2.0	3
White Globe, Crop of 1900	3016	1–2	83.3	6.5	3
	3017	1–2	91.3	3.5	3
Crop of 1901	3010	0–1	59.5	1.8	3
	3011	0–1	64.8	1.1	3
	3012	0–1	66.0	1.5	3
	3013	0–1	53.0	0.5	3
	3014	0–1	66.0	1.8	3
	3015	0–1	66.8	3.5	3
	3048	0–1	66.0	2.8	3
	3071	0–1	92.5	0.8	3
	3093	0–1	68.8	1.0	4
	3143	0–1	74.8	3.0	3
	3147	0–1	74.5	2.5	3
	3150	0–1	79.3	2.2	3
	3188	0–1	92.3	1.5	3
	3190	0–1	74.5	12.5	4
Wethersfield Red, Crop of 1901	3074	1–2	75.8	8.0	3
	3090	1–2	64.3	5.8	4
	3009	0–1	60.8	8.1	3
Crop of 1902	3078	0–1	55.3	4.8	4
	3140	0–1	88.3	3.0	4
Wethersfield Yellow, Crop of 1901	3007	0–1	83.8	1.7	3
	3049	0–1	67.3	6.8	3
Crop of 1902	3142	0–1	87.8	3.2	3
Danvers Yellow Globe, Crop of 1900	3053	1–2	78.8	5.0	3
Crop of 1902	3159	0–1	91.0	1.0	3
	3160	0–1	81.5	1.2	4
White Portugal, Crop of 1902	3069	0–1	80.8	1.8	3
	3145	0–1	82.8	1.0	3
	3161	0–1	86.3	2.5	3
Extra Early Red, Crop of 1902	3073	0–1	82.3	4.4	4
	3079	0–1	85.8	6.0	3
	3162	0–1	92.0	1.0	3

A FRUIT CENSUS OF CONNECTICUT.

By E. H. Jenkins, W. E. Britton and B. H. Walden.*

During June and July, 1902, the Station in coöperation with the Connecticut Pomological Society gathered information relating to the fruit-growing industry of the State. The work was organized, conducted, and the expense borne by the Station. The membership list of the Pomological Society, containing over four hundred names, was used as a basis for mailing inquiries and the following circular letter accompanied by a blank to be filled out and returned to the Station and a stamped and addressed envelope, was mailed to each address.

Dear Sir:—The Connecticut Agricultural Experiment Station and the Connecticut Pomological Society are collecting statistics regarding the important and increasing fruit interests of the State. The value of such a census is apparent. The figures will serve as a record of progress and should be kept for future reference. The Experiment Station would like to know about the prevalence of the various insect and fungous enemies of fruit, in the different parts of the State, as an index to future work in this direction, and the list of leading varieties will be a guide to prospective planters of orchards. It will show the transportation agents how much fruit has to be moved next fall, when freight facilities will be needed, and at what points. It will also show commission men what this State is likely to put on the market, and in these ways, as well as others, it will aid the growers in shipping and selling their crops.

But to be of any use these figures must represent not guess work, but an intelligent and carefully made estimate based on the condition of the crop *now*, and these estimates must be reported *at once*.

You are therefore asked to fill out the enclosed blank *immediately*, and return to the Station in the enclosed addressed envelope.

These reports will be kept on file, and the essential facts regarding total crop, shipping points, etc., will be given to those who have contributed the data.

It is distinctly understood that the separate reports from orchardists will be considered confidential. Only the summary obtained from them will be made public.

Please send, with your report, the names and addresses of those whom you may know to be engaged in fruit raising commercially, and who are not members of the Society.

Please give this your immediate attention.

Connecticut Agricultural Experiment Station:
E. H. Jenkins, *Director.*
W. E. Britton, *State Entomologist.*

Connecticut Pomological Society:
N. S. Platt, *President.*
H. C. C. Miles, *Secretary.*
J. H. Hale, *Chairman of Committee on Markets and Transportation.*

New Haven, Conn., June 1, 1902.

* The work was planned and this paper prepared by Mr. Jenkins and Mr. Britton. Mr. Britton has directed the work of gathering the statistics. Mr. Walden assisted in making the canvass and has done most of the clerical work involved in the calculations and preparing the tables for publication.

The blanks contained a list of the tree fruits, grapes and berries commonly grown in Connecticut and a special effort was made to obtain the acreage and approximately the number of trees or plants, both newly set and of bearing age. The Pomological Society, in order to assist its members in marketing and shipping the crop, asked for an estimate of the crop for 1902. The growers were also requested to name the most destructive insects and plant diseases. It was thought that a record of varieties would be of use to prospective planters, but it was very hard to obtain information of this sort from any except the leading growers.

About six hundred of these circulars were mailed to members of the society and others who were known to be fruit growers.

Some growers receiving blanks did not reply at once, and about July 1st the following appeal was mailed on a postal card to each grower who had not reported:

AGRICULTURAL EXPERIMENT STATION.

New Haven, Conn., June 25, 1902.

Dear Sir:

A short time ago we mailed you a blank and asked you to fill it out, giving the statistics (approximately) of your own fruit plantation. A circular letter explaining the proposed work accompanied the blank, and a stamped and addressed envelope was enclosed for the return of the latter.

We are anxious to make this census as complete as possible, but it cannot be complete unless the growers are willing to give us the information. In order to be of value to peach shippers the returns should be made within the next few days.

Kindly fill out and return the blank immediately, whether you are a commercial fruit grower or not. If you have mislaid the blank, please notify us and another will be furnished you. *We expect to hear from you.*

Very truly yours,
W. E. Britton, *State Entomologist.*

Several reports came in soon after sending out the cards.

Mr. B. H. Walden and Mr. V. L. Churchill were directed to make a personal canvass of the State, and each was employed in this work for a considerable portion of the time during June and July. The eastern part of the State was first covered and later Mr. A. Vincent Osmun was employed to make a similar canvass in Litchfield County. Many of the blanks sent by mail were gathered by the canvassers and many growers were reached in this way that were not formerly known to us. In

all 1,256 reports were obtained. The results are summarized in the following tables.

The whole is intended to give a fairly accurate census of commercial fruit-growing in this State. The figures, therefore, differ very widely from those of the last United States census, which are intended to include all the trees found in the State, whether in city yards or in the country, whether standing by roadsides, in pastures or in orchards, whether carefully tended or utterly neglected.

While our own figures are probably far from complete, they only include such orchards as are cared for and from which fruit is commonly sold.

Of apples, cherries and plums the United States Census counts from five to nine times as many as appear in the following enumeration, while the peach trees which we have found in orchards exceeds the number found in the United States census by some 44,000. This is in part explained by the increase in peach orchards since the census of 1900 was taken.

TABLE I.—FRUIT STATISTICS OF CONNECTICUT.

KINDS OF FRUIT.	ACREAGE.			NUMBER OF TREES AND PLANTS.			Estimated Crop for 1902.
	Bearing.	Newly Set.	Totals.	Bearing.	Newly Set.	Totals.	
Apples	3,527¼	1,190	4,717¼	136,132	50,876	187,008	353,508 bu.
Pears	114⅞	83½	198⅜	9,404	6,669	16,073	6,370 "
Peaches	2,575	1,041	3,616	406,240	180,520	586,760	312,174 "
European Plums	9	2¼	11¼	1,063	313	1,375	304 "
Japanese "	139½	123⅛	262⅝	25,432	22,142	41,393	8,878 "
Grapes	54⅛	11	65⅛	26,315	6,048	32,363	189,500 lbs.
Strawberries	247⅛	198⅛	445⅜	----	----	----	743,658 qts.
Quinces	11¼	10⅜	21⅝	2,542	2,165	4,707	1,626 bu.
Cherries	14⅝	8⅛	22¾	1,491	786	2,277	28,351 qts.
Red Raspberries	51⅜	15⅜	67	----	----	----	85,190 "
Black "	76½	29½	106	----	----	----	136,430 "
Blackberries	53¼	6¼	59⅜	----	----	----	110,320 "
Dewberries	10½	⅜	11¼	----	----	----	15,075 "
Currants	22	7⅜	29 1/16	----	----	----	47,861 "
Gooseberries	1⅜	1/16	----	----	----	----	2,735 "
Cranberries	49½	1	50½	----	----	----	4,925 bu.

TABLE II.—FRUIT STATISTICS. (SUMMARY BY COUNTIES.)

FAIRFIELD COUNTY.

KINDS OF FRUIT.	ACREAGE.			NUMBER OF TREES AND PLANTS.			Estimated Crop for 1902.
	Bearing.	Newly Set.	Totals.	Bearing.	Newly Set.	Totals.	
Apples	497	118	615	17,068	5,093	22,161	44,484 bu.
Pears	10⅝	20⅝	31¼	843	974	1,817	670 "
Peaches	145¼	90⅛	235⅜	26,962	16,886	43,848	15,330 "
European Plums	1½	----	1½	206	16	222	36 "
Japanese "	15¾	3	18¾	3,060	507	3,567	1,504 "
Grapes	5	½	5½	2,466	165	2,631	9,380 lbs.
Strawberries	44½	36½	81	----	---	----	130,555 qts.
Quinces	1	⅛	1⅛	222	25	247	76 bu.
Cherries	2	1	3	193	90	283	2,615 qts.
Red Raspberries	7	2	9	----	----	----	9,200 "
Black "	17⅛	6¾	23⅞	----	----	----	26,400 "
Blackberries	4⅛	1¼	5⅜	----	1,000	1,000	6,900 "
Dewberries	----	----	----	----	100	100	----
Currants	4½	½	5	----	600	600	14,100 "
Gooseberries	¼	----	¼	986	18	1,004	1,102 "

HARTFORD COUNTY.

Apples	723¾	206½	930¼	26,723	8,782	35,505	59,657 bu.
Pears	18¼	3½	21¾	1,715	272	1,987	789 "
Peaches	740¾	226	966¾	122,871	44,095	166,966	78,535 "
European Plums	3	----	3	394	6	400	150 "
Japanese "	37¼	34	71¼	7,201	6,058	13,259	2,030 "
Grapes	16	¾	16¾	8,250	491	8,741	32,000 lbs.
Strawberries	47⅝	60⅜	108⅜	----	----	----	110,644 qts.
Quinces	3	¾	3¾	563	142	705	378 bu.
Cherries	6	½	6½	664	50	714	10,000 qts.
Red Raspberries	15½	1¾	17½	----	----	----	23,155 "
Black "	13⅜	3	16⅜	----	----	----	23,710 "
Blackberries	8½	½	9	---	----	----	13,980 "
Dewberries	2	----	2	----	----	----	2,500 "
Currants	4¾	----	4¾	----	----	----	7,000 "
Gooseberries	⅜	----	⅜	750	100	850	400 "

LITCHFIELD COUNTY.

Apples	710½	142¼	852¾	33,676	9,426	43,102	89,962 bu.
Pears	11⅜	12⅛	24 1/12	1,342	1,924	3,266	710 "
Peaches	99¼	46⅛	145⅜	11,164	7,545	18,709	6,800 "
European Plums	½	¼	¾	40	25	65	18 "
Japanese "	19¾	1¾	21½	3,326	6,031	9,357	772 "
Grapes	3¾	1¾	5½	2,226	950	----	15,700 lbs.
Strawberries	15 11/24	9 17/24	25⅙	----	----	----	30,104 qts.
Quinces	1½	3	4½	501	928	1,429	200 bu.
Cherries	1	2½	3½	60	225	285	1,915 qts.
Red Raspberries	6½	5 1/16	11 9/16	----	----	----	12,300 "
Black "	5¾	6½	12¼	----	----	----	16,130 "
Blackberries	6	3	9	----	----	----	17,040 "
Dewberries	2	----	2	----	----	----	500 "
Currants	3½	----	3½	----	1,500	1,500	7,026 "
Gooseberries	----	----	----	40	7	47	66 "
Cranberries	1	1	2	----	----	----	100 bu.

TABLE II.—*Continued.* FRUIT STATISTICS. (SUMMARY BY COUNTIES.)

MIDDLESEX COUNTY.

KINDS OF FRUIT.	ACREAGE.			NUMBER OF TREES AND PLANTS.			Estimated Crop for 1902.
	Bearing.	Newly Set.	Totals.	Bearing.	Newly Set.	Totals.	
Apples	101	154	255	4,322	5,265	9,587	9,357 bu.
Pears	7¼	8¼	15½	591	760	1,351	244 "
Peaches	220¼	92¼	312½	38,350	15,803	54,153	30,769 "
European Plums	2	½	2½	204	50	254	26 "
Japanese "	30	18½	48½	6,173	3,673	9,846	3,011 "
Grapes	1	⅜	1⅜	467	358	825	50,000 lbs.
Strawberries	19	19½	38½	----	----	----	43,900 qts.
Quinces	1	¼	1¼	123	50	173	24 bu.
Cherries	2	2	4	216	206	422	5,000 qts.
Red Raspberries	3⅛	¼	3⅜	6,200	200	6,400	5,000 "
Black "	10⅜	2	12⅜	20,750	4,000	24,750	13,350 "
Blackberries	13¾	----	13¾	27,500	----	27,500	23,140 "
Dewberries	1¼	¼	1½	2,500	500	3,000	850 "
Currants	¾	⅛	⅞	1,188	212	1,400	1,025 "
Gooseberries	----	1/16	1/16	16	100	116	20 "
Cranberries	17	----	17	----	----	----	2,000 bu.

NEW HAVEN COUNTY.

Apples	682¾	376¼	1,059	25,219	14,157	39,376	73,213 bu.
Pears	37	27½	64½	3,527	1,771	5,298	2,707 "
Peaches	1,014¾	390	1,404¾	156,828	61,540	218,368	148,240 "
European Plums	1	1	2	95	123	218	14 "
Japanese "	24	18⅓	42⅓	3,639	3,549	7,188	929 "
Grapes	26	5	31	12,000	3,000	15,000	77,800 lbs.
Strawberries	73⅜	39⅜	112¾	----	----	----	260,655 qts.
Quinces	3	6	9	680	900	1,580	700 bu.
Cherries	2½	2	4½	248	192	440	7,890 qts.
Red Raspberries	14¼	1⅛	15⅝	----	2,600	2,600	30,535 "
Black "	27⅓	9¾	37 1/12	----	----	----	54,220 "
Blackberries	19⅛	¾	19⅞	----	----	----	47,820 "
Dewberries	6	½	6½	----	500	500	11,025 "
Currants	6¾	----	6¾	----	25	25	12,800 "
Gooseberries	----	----	----	220	----	----	725 "

NEW LONDON COUNTY.

Apples	291½	47½	339	9,822	1,904	11,726	28,291 bu.
Pears	9¾	1⅜	11½	432	105	537	197 "
Peaches	140¼	123¾	264	18,776	22,290	41,066	13,592 "
European Plums	¼	½	¾	39	93	132	30 "
Japanese "	0	0	0	0	0	0	----
Grapes	¼	----	¼	82	26	108	1,000 lbs.
Strawberries	36	27⅓	63⅓	----	----	----	133,500 qts.
Quinces	1⅜	----	1⅜	320	20	340	197 bu.
Cherries	⅛	⅛	¼	16	18	34	160 qts.
Red Raspberries	¾	----	¾	1,100	100	1,200	500 "
Yellow "	----	----	----	100	----	100	300 "
Black "	----	----	----	----	100	100	----
Blackberries	----	----	----	----	----	----	----
Dewberries	----	----	----	6	----	6	----
Currants	----	----	----	62	----	62	64 "
Gooseberries	----	----	----	87	----	87	124 "

TABLE II.—*Continued.* FRUIT STATISTICS. (SUMMARY BY COUNTIES.)

TOLLAND COUNTY.

KINDS OF FRUIT.	ACREAGE.			NUMBER OF TREES AND PLANTS.			Estimated Crop for 1902.
	Bearing.	Newly Set.	Totals.	Bearing.	Newly Set.	Totals.	
Apples	235¼	41½	276⅜	8,651	1,614	10,265	22,683 bu.
Pears	6½	1	7⅓	610	71	681	411 "
Peaches	123	33¼	156½	18,032	6,600	24,632	9,722 "
European Plums	½	----	½	61	----	61	25 "
Japanese "	8¼	1	9¼	1,445	121	1,566	463 "
Grapes	1	2¼	3¼	348	1,022	1,370	1,880 lbs.
Strawberries	4	2¼	6¼	----	----	----	10,000 qts.
Quinces	⅛	----	⅛	25	----	25	9 bu.
Cherries	⅛	----	⅛	44	5	49	320 qts.
Red Raspberries	3¾	3½	7¼	7,380	7,000	14,380	2,750 "
Black "	1¼	½	1¾	1,705	1,000	2,705	1,070 "
Blackberries	1¼	½	1¾	2,247	1,000	3,247	1,040 "
Dewberries	----	----	----	3	----	3	----
Currants	1½	7	8½	2,305	1,450	3,755	5,250 "
Gooseberries	⅛	----	⅛	221	----	221	175 "
Cranberries	26½	----	----	----	----	----	2,325 bu.

WINDHAM COUNTY.

Apples	285½	104	389½	10,651	4,635	15,286	25,861 bu.
Pears	13¾	8½	22¼	344	792	1,136	642 "
Peaches	91½	39½	131	13,257	5,761	19,018	9,186 "
European Plums	¼	----	¼	24	----	24	5 "
Japanese "	4½	18	22½	588	2,203	2,791	169 "
Grapes	1⅛	----	1⅛	476	36	512	1,740 lbs.
Strawberries	7⅓	2⅝	10	----	----	----	24,300 qts.
Quinces	¼	¼	½	108	100	208	42 bu.
Cherries	½	----	½	50	----	50	451 qts.
Red Raspberries	⅜	1½	2¼	1,400	1,400	2,800	1,750 "
Black "	1	1	2	1,400	900	2,300	1,550 "
Blackberries	½	⅛	⅝	800	100	900	400 "
Dewberries	¼	----	¼	300	----	300	200 "
Currants	¼	----	¼	569	----	569	596 "
Gooseberries	⅛	----	⅛	259	----	259	187 "
Cranberries	5	----	5	----	----	----	500 bu.

TABLE III.—FRUIT STATISTICS. (SUMMARY BY FRUITS.)

APPLES.

COUNTY.	ACREAGE.			NUMBER OF TREES AND PLANTS.			Estimated Crop for 1902.
	Bearing.	Newly Set.	Totals.	Bearing.	Newly Set.	Totals.	
Fairfield	497	118	615	17,068	5,093	22,161	44,484 bu.
Hartford	723⅜	206½	930¼	26,723	8,782	35,505	59,657 "
Litchfield	710½	142¼	852⅜	33,676	9,426	43,102	89,962 "
Middlesex	101	154	255	4,322	5,265	9,587	9,357 "
New Haven	682⅜	376¼	1,059	25,219	14,157	39,376	73,213 "
New London	291½	47½	339	9,822	1,904	11,726	28,291 "
Tolland	235¼	41½	276⅜	8,651	1,614	10,265	22,683 "
Windham	285½	104	389½	10,651	4,635	15,286	25,861 "
Totals	3,527¼	1,190	4,717¼	136,132	50,876	187,008	353,508 bu.

PEARS.

Fairfield	10⅝	20⅝	31¼	843	974	1,817	670 bu.
Hartford	18¼	3½	21⅜	1,715	272	1,987	789 "
Litchfield	11⅜	12⅛	24 1/16	1,342	1,924	3,265	710 "
Middlesex	7¼	8¼	15½	591	760	1,351	244 "
New Haven	37	27½	64½	3,527	1,771	5,298	2,707 "
New London	9⅜	1⅜	11⅛	432	105	537	197 "
Tolland	6½	1	7½	610	71	681	411 "
Windham	13⅜	8½	22¼	344	792	1,136	642 "
Totals	114⅞	83½	198⅜	9,404	6,669	16,073	6,370 bu.

PEACHES.

Fairfield	145¼	90⅛	235⅜	26,962	16,886	43,848	15,330 bu.
Hartford	740⅜	226	966⅜	122,871	44,095	166,966	78,535 "
Litchfield	99¼	46⅜	145⅜	11,164	7,545	18,709	6,800 "
Middlesex	220½	92½	312½	38,350	15,803	54,153	30,769 "
New Haven	1,014⅜	390	1,404⅜	156,828	61,540	218,368	148,240 "
New London	140½	123⅜	264	18,776	22,290	41,066	13,592 "
Tolland	123	33¼	156¼	18,032	6,600	24,632	9,722 "
Windham	91½	39½	131	13,257	5,761	19,018	9,186 "
Totals	2,575	1,041	3,616	406,240	180.520	586,760	312,174 bu.

EUROPEAN PLUMS.

Fairfield	1½	----	1½	206	16	222	36 bu.
Hartford	3	----	3	394	6	400	150 "
Litchfield	½	¼	⅜	40	25	65	18 "
Middlesex	2	½	2½	204	50	254	26 "
New Haven	1	1	2	95	123	218	14 "
New London	¼	½	⅜	39	93	132	30 "
Tolland	½	----	½	61	----	61	25 "
Windham	¼	----	¼	24	----	24	5 "
Totals	9	2¼	11¼	1,063	313	1,376	304 bu.

TABLE III.—*Continued.* FRUIT STATISTICS. (SUMMARY BY FRUITS.)

JAPANESE PLUMS.

COUNTY.	ACREAGE.			NUMBER OF TREES AND PLANTS.			Estimated Crop for 1902.
	Bearing.	Newly Set.	Totals.	Bearing.	Newly Set.	Totals.	
Fairfield	15⅜	3	18⅜	3,060	507	3,567	1,504 bu.
Hartford	37¼	34	71¼	7,201	6,058	13,259	2,030 "
Litchfield	19⅜	30½	50¼	3,326	6,031	9,357	772 "
Middlesex	30	18½	48½	6,173	3,673	9,846	3,011 "
New Haven	24	18⅛	42⅛	3,639	3,549	7,188	929 "
New London	0	0	0	0	0	0	----
Tolland	8¼	1	9¼	1,445	121	1,566	463 "
Windham	4½	18	22½	588	2,203	2,791	169 "
Totals	139½	123⅛	262⅝	25,432	22,142	47,574	8,878 bu.

GRAPES.

Fairfield	5	½	5½	2,466	165	2,631	9,380 lbs.
Hartford	16	⅜	16⅜	8,250	491	8,741	32,000 "
Litchfield	3⅜	1⅜	5⅛	2,226	950	3,176	15,700 "
Middlesex	1	⅜	1⅜	467	358	825	50,000 "
New Haven	26	5	31	12,000	3,000	15,000	77,800 "
New London	¼	0	¼	82	26	108	1,000 "
Tolland	1	2¼	3¼	348	1,022	1,370	1,880 "
Windham	1⅛	----	1⅛	476	36	512	1,740 "
Totals	54⅛	11	65⅛	26,315	6,048	32,363	189,500 lbs.

STRAWBERRIES.

Fairfield	44½	36½	81	----	----	----	130,555 qts.
Hartford	47⅝	60⅜	108⅜	----	---	----	110,644 "
Litchfield	15½	9¾	25¼	----	----	----	30,104 "
Middlesex	19	19⅓	38⅓	----	----	----	43,900 "
New Haven	73⅜	39⅜	112¾	----	----	----	260,655 "
New London	36	27⅛	63⅛	----	----	----	133,500 "
Tolland	4	2½	6½	----	----	----	10,000 "
Windham	7⅛	2⅝	10	----	----	----	24,300 "
Totals	247⅛	198⅓	445⅜	----	----	----	743,658 qts.

QUINCES.

Fairfield	1	⅛	1⅛	222	25	247	76 bu.
Hartford	3	¾	3¾	563	142	705	378 "
Litchfield	1½	3	4½	501	928	1,429	200 "
Middlesex	1	¼	1¼	123	50	173	24 "
New Haven	3	6	9	680	900	1,580	700 "
New London	1⅜	----	1⅜	320	20	340	197 "
Tolland	⅛	---	⅛	25	----	25	9 "
Windham	¼	¼	½	108	100	208	42 "
Totals	11¼	10⅜	21⅝	2,542	2,165	4,707	1,626 bu.

TABLE III.—*Continued.* FRUIT STATISTICS. (SUMMARY BY FRUITS.)

CHERRIES.

COUNTY.	ACREAGE.			NUMBER OF TREES AND PLANTS.			Estimated Crop for 1902.
	Bearing.	Newly Set.	Totals.	Bearing.	Newly Set.	Totals.	
Fairfield	2	1	3	193	90	283	2,615 qts.
Hartford	6	⅛	6⅛	664	50	714	10,000 "
Litchfield	1	2½	3½	60	225	285	1,915 "
Middlesex	2	2	4	216	206	422	5,000 "
New Haven	2⅓	2	4⅓	248	192	440	7,890 "
New London	⅛	⅛	¼	16	18	34	160 "
Tolland	⅓	----	⅓	44	5	49	320 "
Windham	½	----	½	50	----	50	451 "
Totals	14⅝	8⅛	22¾	1,491	786	2,277	28,351 qts.

RED RASPBERRIES.

Fairfield	7	2	9	----	----	----	9,200 qts.
Hartford	15½	1⅛	17¼	----	----	----	23,155 "
Litchfield	6½	5	11½	----	----	----	12,300 "
Middlesex	3⅜	¼	3⅝	6,200	200	6,400	5,000 "
New Haven	14¼	1⅜	15⅝	----	2,600	----	30,535 "
New London	¾	----	¾	1,100	100	1,200	500 "
Tolland	3¾	3½	7¼	7,380	7,000	14,380	2,750 "
Windham	¾	1½	2¼	1,400	1,400	2,800	1,750 "
Totals	51⅝	15⅜	67	----	----	----	85,190 qts.

BLACK RASPBERRIES.

Fairfield	17⅛	6¾	23⅞	----	----	----	26,400 qts.
Hartford	13⅜	3	16⅜	----	----	----	23,710 "
Litchfield	5¾	6½	12¼	----	----	----	16,130 "
Middlesex	10⅜	2	12⅜	20,750	4,000	24,750	13,350 "
New Haven	27⅛	9¾	37 1/16	----	----	----	54,220 "
New London	----	----	----	----	100	----	----
Tolland	1¼	½	1¾	1,705	1,000	2,705	1,070 "
Windham	1	1	2	1,400	900	2,300	1,550 "
Totals	76½	29½	106	----	----	----	136,430 qts.

BLACKBERRIES.

Fairfield	4⅓	1½	5⅝	----	1,000	----	6,900 qts.
Hartford	8½	½	9	----	----	----	13,980 "
Litchfield	6	3	9	----	----	----	17,040 "
Middlesex	13¾	----	13¾	27,500	----	27,500	23,140 "
New Haven	19⅛	¾	19⅞	----	----	----	47,820 "
New London	0	0	0	0	0	0	----
Tolland	1¼	½	1¾	2,247	1,000	3,247	1,040 "
Windham	½	⅛	⅝	800	100	900	400 "
Totals	53¼	6⅛	59⅜	----	----	----	110,320 qts.

TABLE III.—*Continued.* FRUIT STATISTICS. (SUMMARY BY FRUITS.)

DEWBERRIES.

COUNTY.	ACREAGE.			NUMBER OF TREES AND PLANTS.			Estimated Crop for 1902.
	Bearing.	Newly Set.	Totals.	Bearing.	Newly Set.	Totals.	
Fairfield	----	----	----	----	100	100	----
Hartford	2	----	2	----	----	----	2,500 qts.
Litchfield	2	----	2	----	----	----	500 "
Middlesex	1¼	¼	1½	2,500	500	3,000	850 "
New Haven	6	½	6½	----	500	----	11,025 "
New London	----	----	----	6	----	6	----
Tolland	----	----	----	3	----	3	----
Windham	¼	----	¼	300	----	300	200 "
Totals	11½	¾	12¼	----	----	----	15,075 qts.

CURRANTS.

Fairfield	4½	½	5	----	600	600	14,100 qts.
Hartford	4⅜	----	4⅜	----	----	----	7,000 "
Litchfield	3½	----	3½	----	1,500	1,500	7,026 "
Middlesex	⅜	⅛	½	1,188	212	1,400	1,025 "
New Haven	6¾	----	6¾	----	25	----	12,800 "
New London	----	----	----	62	----	62	64 "
Tolland	1½	7	8½	2,305	1,450	3,755	5,250 "
Windham	¼	----	¼	569	----	569	596 "
Totals	22	7⅝	29⅝	----	----	----	47,861 qts.

GOOSEBERRIES.

Fairfield	¼	----	¼	986	18	1,004	1,102 qts.
Hartford	⅜	----	⅜	750	100	850	400 "
Litchfield	----	----	----	40	7	47	66 "
Middlesex	----	1/16	1/16	16	100	116	20 "
New Haven	----	----	----	220	----	220	725 "
New London	----	----	----	87	----	87	124 "
Tolland	⅛	----	⅛	221	----	221	175 "
Windham	⅛	----	⅛	259	----	259	187 "
Totals	1⅜	1/16	1 7/16	----	----	----	2,799 qts.

CRANBERRIES.

Fairfield	----	----	----	----	----	----	----
Hartford	----	----	----	----	----	----	----
Litchfield	1	1	2	----	----	----	100 bu.
Middlesex	17	----	17	----	----	----	2,000 "
New Haven	----	----	----	----	----	----	----
New London	----	----	----	----	----	----	----
Tolland	26½	----	26½	----	----	----	2,325 "
Windham	5	----	5	----	----	----	500 "
Totals	49½	1	50½	----	----	----	4,925 bu.

Peach Growing.

Commercial peach growing in Connecticut has developed rapidly during the past few years—more rapidly than has the growing of other kinds of fruit.

In the autumn of 1892, Mr. N. S. Platt, who had just been appointed pomologist of the Board of Agriculture, obtained statistics from the leading growers regarding the number of peach trees in their orchards and the crop for that year. The figures are given below in comparison with the statistics of the present year (1902)—ten years later.

Table IV.—Showing Increase in Peach Growing.

County.	Number of Trees 1892.	Number of Trees 1902.
Fairfield	7,850	43,848
Hartford	66,069	166,966
Litchfield	7,360	18,709
Middlesex	16,982	54,153
New Haven	37,778	218,368
New London	5,430	41,066
Tolland	2,470	24,632
Windham	1,907	19,018
Total	145,846	586,760
Acreage	730	3,616
Yield	40,603 bu.	312,174 bu.
Value of Crop*	$69,025.00	$437,043.00
Value of Orchards†	$109,500.00	$542,400.00

In 1892 there was a good crop, but the actual yield averaged only about half a basket per tree. In 1902 the estimated yield averaged over a basket per tree.

Mr. Platt informs us that in 1892 there were many unthrifty trees in the orchards, chiefly from "yellows," and that the growers then did not remove these trees promptly when discovered, as is the practice at the present time.

The orchards to-day are doubtless much better tilled and fertilized than they were ten years ago.

* The value of the 1892 crop is based on an average price of 85 cents per half-bushel basket. The 1902 crop is valued at 70 cents per basket.
† The value of the orchards have been estimated at $150 per acre.

New Haven County leads with a total of 218,368 trees and Hartford County follows with 166,966. Either of these counties has a larger number of trees in peach orchards than was contained in the whole State ten years ago.

Records of other fruits were not taken in 1892 but there were probably no Japan plums planted at that time, as the orchards of this fruit are of very recent planting. The pear and apple orchards have probably not increased very extensively during the past ten years.

OBSERVATIONS ON THE FERTILIZATION OF PEACH ORCHARDS.

By E. H. Jenkins.

An experiment on this subject was begun in 1896, in the orchard of Mr. A. E. Plant of Branford. It has been described in the Reports of this Station for the years 1899, 1900 and 1901.

We here add the data obtained in the year 1902, with such explanation as is necessary to make them intelligible, reserving discussion of the results for the present.

There are six plots included in the test, each containing 48 trees. These plots have been fertilized as follows, each year, since 1896:

A 65 pounds of muriate of potash, 160 pounds of acid phosphate.
B " " " " " "
and 170 pounds of cotton seed meal.
C 65 pounds of muriate of potash, 160 pounds of acid phosphate.
D 130 " " " " " "
E 260 " " " " " "
F 260 " high grade sulphate of potash, 160 pounds of acid phosphate.

Three and one-half bushels, 167 pounds, of slaked oyster shell lime have been annually applied to the northern half of each plot.

Until 1901, crimson clover has been sown each year, in August, on plots C, D, E and F, and has been plowed under in May. The sowing was omitted in 1901 and 1902.

It will be seen that Plot A has abundance of potash and phosphoric acid, but gets no nitrogenous fertilizer. Plot B has each year about 500 pounds of cotton seed meal per acre, containing 35 pounds of nitrogen, while all the other plots receive their nitrogenous fertilizer in form of crimson clover as a green manure.

Plots C, D, E should show the effects of heavy dressing with muriate of potash and F should show the comparative effects of a heavy dressing of high grade sulphate.

The southwest corner of the field, on Plot A, is the dampest part of the lot, in spite of an underground drain, and we believe Plot A is the least favorably placed of all the plots.

Each year a certain number of the trees have died and have been replaced by new ones in the spring. No case of yellows was found in the orchard until 1900.

Each spring a census of the trees which died during the last year has been made, which is as follows:

NUMBER OF DEAD TREES FOUND IN THE SPRING.

	1896.	1897.	1898.	1899.	1900.	1901.	1902.	Total.
Plot A	2	12	2	1	10	4	5	36
B	3	6	1	1	2	3	5	21
C	2	3	1	1	7	3	3	20
D	0	1	2	0	8	3	4	18
E	0	1	0	0	0	0	5	6
F	0	0	0	0	0	2	3	5
	7	23	6	3	27	15	25	106

Plot A has suffered most, losing three-quarters of the trees on it in seven years. This we believe, is partly due to the excess of water in the soil. Plot B has lost 21 trees, not quite one-half of the original number; D has lost three-eighths of the number originally planted, E and F six and five trees respectively.

Of the 25 trees removed in the fall and winter of 1901-1902, 7 were on the limed end of the plots and 18 on the unlimed.

In 1898 there was a fine set of fruit buds, but most of the very young fruit fell later in consequence of cold storms at, and just after, setting time.

In 1899 there was an excellent set of fruit in the large orchard of which the trees above referred to form a part, while in most orchards of the State every flower bud was killed during the winter.

The crops were as follows:

PEACH CROP OF 1899. NUMBER OF BASKETS.

Plot.	A	B	C	D	E	F
No. of baskets	65	117	81	110	155½	140½
No. of trees in bearing exclusive of Early Rivers	20	31	23	27	36	30
Average number of baskets per tree in bearing	3.2	3.8	3.5	4.1	4.3	4.7

The yield of peaches in 1900 was also a very good one. The drought during the summer was severe, but by constant cultivation from late June until harvest the crop was carried through successfully.

The crops were as follows:

PEACH CROP OF 1900. NUMBER OF BASKETS.

Plot.	A	B	C	D	E	F
No. of baskets	140¼	212½	151½	190¾	279	243¾
No. of trees in bearing	25	35	29	33	44	40
Average number of baskets per tree in bearing	5.6	6.3	5.2	5.8	6.3	6.1

Immediately after harvest, one tree on B and two each on C, D and F were pulled out and burned because affected with peach yellows. In the large orchard adjoining, the loss from yellows this year was not quite 3 per cent.

The yield of peaches in 1901 was much smaller than in 1900. The season was a wet one with much warm, foggy and rainy weather during harvest, so that the loss from rot was very large.

The crops were as follows:

PEACH CROP OF 1901. NUMBER OF BASKETS.

Plot.	A	B	C	D	E	F
No. of baskets	66½	99	73¾	112¾	168	172½
No. of trees in bearing	20	30	26	31	40	37
Average number of baskets per tree in bearing	3.3	3.3	2.8	3.6	4.2	4.6

Immediately after harvest, 15 trees were pulled out of the experiment orchard and burned, because they showed signs of yellows. Two were Early Rivers, the others were Champions. Two came from Plot B, three from C, three from D, five from E and two from F.

It is noteworthy that no trees affected with yellows were found on the half plots which had been limed each year. In the adjoining orchard 320 trees, or about 11 per cent. of the whole number, were pulled because of yellows.

PEACH CROP OF 1902. NUMBER OF BASKETS.

Plot.	A	B	C	D	E	F
No. of baskets	48½	117½	64	69½	125	80½
No. of trees in bearing	31	33	31	31	33	35
Average number of baskets per tree in bearing	1.6	3.6	2.1	2.2	3.8	2.3

The first picking was made on August 22d, the last on September 8.

In the fall of 1902 only one tree was destroyed because of yellows and that stood on the limed part of Plot C.

EXPERIMENTS IN GROWING TOBACCO OF THE SUMATRA TYPE UNDER SHADE.

SEASON OF 1902.

BY E. H. JENKINS.

The experiments in 1902 were planned to test the comparative value of cheese cloth and mosquito netting as a cover for the growing crop, and to compare the method of priming, i. e. plucking and stringing the single leaves, with cutting the whole plant, dividing it in the middle and curing the leaf on the stalk.

The same field and frame were used as are described in our report for 1901. The field, one acre in area, was fertilized, cultivated and set as in previous years. The crop started and grew well for several weeks, but then, quite suddenly, stopped growing and had an unhealthy appearance over more than half the field, while in other places it grew in normal fashion.

A soluble fertilizer was applied to the stunted tobacco and cultivated in. The plants started again and became more vigorous, but did not reach the same development as that part of the crop, in the same field, which had not suffered. No explanation can be given of this accident which greatly diminished the yield, made the year's experiment of little value and damaged the quality of the crop.

There was absolutely nothing in our management of the land to explain the matter. The same fertilizers used on neighboring land gave entire satisfaction, and a part of the tobacco on our own field grew well and after curing and fermentation was of excellent quality.

The year was not on the whole favorable for the tobacco crop and the trouble was not altogether with the weather during the cure. Our experience illustrates the uncertainties which beset the tobacco crop and the fact that the "profits" in tobacco-raising cannot be calculated accurately or even approximately from the results in a single year or in a group of a few years.

We found that the mosquito netting used as a cover was as durable as the cheese cloth and made much less shade on the plants. Unless sufficient "body" can be given the leaf by judicious topping, a shade which would cut off less sunlight than cheese cloth would be very desirable.

In this latitude, we believe, the crop does not need any shade,

and if the desirable things secured by shading, namely: protection from insects, high winds, hail and drought, higher and more equable temperature and damper atmosphere, could be obtained otherwise than by shading, then the shade itself would be discarded.

The trouble which has been above described made impossible any comparison of the relative merits of curing on the stalk and curing the primed leaves.

The pole-cured crop weighed not far from 1,000 pounds to the acre—250 pounds less than the pole-cured crop of the year before. The leaf was sorted and sized and it weighed, as it went into the bulk, 840 pounds. After fermentation in bulk, it was packed in boxes containing about 100 pounds each, the crop having lost but 46 pounds while in bulk. The leaf was packed in the same way that the Connecticut Havana is packed, and the boxes were left for six weeks in the same room with the fermenting tobacco. In this way the fermentation "finished off" well and the quality of the leaf considerably improved. It was then stored in a cool place to "age" through the summer of 1903. The management of the growing crop, the cure and the fermentation were all under the direction of Mr. John A. DuBon, who has had the practical oversight of our tobacco experiments for the last ten years. No final judgment of its quality can be made at present, but it is obviously quite inferior to the crop of 1901.

Regarding that crop, the last cases having been sold since our report of 1901 was issued, we give below the complete statement of sales.

Case No.	Kind of leaf.	Price per pound.	Total.
3	90 pounds stalk-cured leaf	$2.50	$225.00
4	89 " " " "	2.50	222.50
5	89 " " " "	2.25	200.25
6	81 " " " "	1.40	113.40
7	100 " " " "	1.25	125.00
8	101 " " " "	1.40	141.40
9	111 " " " "	1.25	138.75
10	94 " " " "	.47	44.18
11	90 " primed "	1.75	157.50
12	90½ " " "	1.75	158.37
A	21½ short leaf counted of no value	....	.....
	957		$1,526.35
	Average price per pound.....		$1.59

This tobacco was all disposed of at private sale by L. B. Haas & Co., of Hartford.

STUDIES ON THE VEGETABLE PROTEINS.

By T. B. Osborne and I. F. Harris.

Following are abstracts of papers, giving results of our recent work, which have been or are soon to be published in the Journal of the American Chemical Society, Vol. **25**, 1903. Persons wishing reprints of those papers can get them by applying to the Station.

Until recently the several recognized protein bodies, of both animal and vegetable origin, have not been thought to differ greatly in the structure of their molecules. Recent investigations, however, have shown that the differences in many cases are much greater than had been supposed.

It is, therefore, important to study these differences in as many of the proteins as possible.

Such a study may explain differences in the food value of the proteins, about which little is now known and is essential to a clearer understanding of the processes of protein assimilation, which have, in some respects, been put in a new light by the recent work.

These considerations have led us to make a comparative study of many of the proteins which have been prepared in this laboratory. The results are given in the following summaries:

I. The State of Combination of Nitrogen in Protein Bodies.[1]

To properly differentiate and classify the protein bodies it is necessary to employ some method based on the structure of their molecules. Many of the color reactions, it is true, give us evidence of certain complexes in the protein molecule, but most of these reactions are characteristic of the protein bodies in general, and in but few cases distinguish between individual proteins. Furthermore, these reactions give no quantitative measure of the different complexes which cause them, and in these quantitative relations lies one of the most important differences between the several protein bodies. Until recently, knowledge regarding the structure of the protein molecule has been chiefly obtained by

[1] Abstract of paper published in the Jour. Amer. Chem. Soc. **25**, 323.

detailed study of the decomposition products resulting from boiling the protein with strong acids. A quantitative determination is possible for only a few of these decomposition products, and, as large quantities of pure material and much time and skill are required for the examination, investigations of this kind have been applied to only a few of the known proteins.

As preliminary to a more exact study of our preparations, we have used a method proposed by Hausmann[1] for determining the proportion of nitrogen in different forms of combination that occur among the decomposition products which result after boiling the protein for a long time with acids.

We have, in the following investigation, determined the ammonia yielded by various preparations of the same protein on distillation with magnesia, and have, as inspection of the figures given in the following pages shows, obtained such uniform results that they afford a ready means for comparing supposedly identical proteins.

The question whether Hausmann's method can be modified so as to show the true proportion of basic nitrogen yielded by the proteins, will require more extended investigations than have as yet been undertaken. It is shown below that, under the conditions which we have employed, the amount of basic nitrogen precipitated by phosphotungstic acid corresponds pretty closely with that contained in the histidine, arginine and lysine which Kossel and Kutscher[2] found in several proteins from cereal grains, but falling, as would be expected from the known slight solubility of arginine phosphotungstate, a little below them.

In the following table we give the amount of nitrogen contained in the arginine, histidine and lysine as found directly by Kossel and Kutscher[3] and for comparison the amount which we found by Hausmann's method in the same proteins, the quantity of nitrogen found by the latter method being increased by an amount corresponding to the known solubility of arginine phosphotungstate.

[1] *Ztschr. physiol. Chem.* **27**, 92 (1899).
[2] *Ztschr. physiol. Chem.* **31**, 165 (1900).
[3] *Ztschr. physiol. Chem.* **31**, 163.

PERCENTAGE OF BASIC NITROGEN IN SEVERAL PROTEINS.

Zein	0.80	by Kossel and Kutscher's method.
	0.71	by Hausmann's modified method.
Gliadin	1.24	by Kossel and Kutscher's method.
	1.20	by Hausmann's modified method.
Glutenin	2.14	by Kossel and Kutscher's method.
	2.27	by Hausmann's modified method.
Casein	3.37	by Kossel and Kutscher's method.
	3.71	by Hausmann's modified method.

These results indicate that Hausmann's method, as we have applied it, gives a fairly accurate measure of the true proportion

PERCENTAGE OF NITROGEN IN THE DIFFERENT GROUPS IN VARIOUS PROTEIN BODIES.

Protein. Source.	Nitrogen as ammonia.	Basic nitrogen.	Non-basic nitrogen.	Nitrogen in magnesium oxide precipitate.	Total nitrogen.
Globulin—Wheat	1.42	6.83	9.82	0.28	18.39
" Cocoanut	1.36	6.06	10.92	0.14	18.48
" Squash seed	1.28	5.97	11.04	0.22	18.51
Edestin—Hemp seed	1.88	5.91	10.78	0.12	18.64
Excelsin—Brazil nut	1.48	5.76	10.97	0.17	18.30
Corylin—Hazel nut	2.20	5.75	10.70	0.16	19.00
Globulin—Cotton seed	1.92	5.71	11.01	...	18.64
" Castor bean	1.96	5.64	11.00	0.12	18.75
Corylin—Walnut	1.78	5.41	11.51	0.15	18.84
Conglutin—Lupine *a*	2.12	5.20	10.38	0.18	17.90
Conglutin—Lupine *b*	2.65	5.13	10.30	0.14	18.21
Legumin—Pea, lentil, horse bean, vetch	1.69	5.18	10.92	0.17	17.97
Globulin—Flax seed	2.00	4.77	11.47	0.22	18.48
Vicilin—Pea, lentil, horse bean	1.78	4.75	10.37	0.21	17.11
Nucleovitellin—Egg yolk	1.25	4.65	10.16	0.22	16.28
Vignin—Cow pea	1.91	4.28	10.81	0.25	17.25
Globulin—Sunflower	2.57	4.27	11.52	0.24	18.58
Conalbumin—Egg white	1.21	4.16	10.49	0-26	16.11
Amandin—Almond	3.05	4.15	11.55	0.17	19.00
Phaseolin — Kidney bean, adzuki bean	1,74	3.97	10.18	0.29	16.20
Glycinin—Soy bean	2.11	3.95	11.27	0.12	17.45
Legumelin—Pea lentil, horse bean, adzuki bean	1.04	3.71	10.96	0.38	16.09
Leucosin—Wheat	1.16	3.50	11.83	0.43	16.93
Casein—Cow's milk	1.61	3.49	10.31	0.21	15.62
Ovalbumin—Egg white	1.34	3.30	10.58	0.29	15.51
Glutenin—Wheat gluten	3.30	2.05	11.95	0.19	17.49
Gliadin—Wheat, rye	4.20	0.98	12.41	0.14	17.66
Hordein—Barley	4.01	0.77	12.04	0.23	17.21
Zein—Maize	2.97	0.49	12.51	0.16	16.13

of nitrogen belonging to the diamino acids. Before this can be demonstrated, however, quantitative determinations by Kossel and Kutscher's method must be made in other proteins, especially those yielding larger proportions of diamino acids.[1]

An examination of the figures giving the different forms of binding of the nitrogen in the many proteins which we have investigated shows that these vary chiefly in the proportion of ammonia and basic nitrogen which they yield. In the above table we give the average of the figures found for each of these proteins, arranged in the order of amount of basic nitrogen.

The most striking feature shown by this table is the wide range in the amounts of basic nitrogen obtained from the different proteins. While the difference between the highest total nitrogen and the lowest is 3.49 per cent. of the protein, or 18.3 per cent. of the highest nitrogen, that between the highest basic nitrogen and the lowest is 6.34 per cent., a difference of 92.7 per cent. of the highest figure. The proportion of ammonia yielded by these different proteins likewise differs greatly, the difference between the highest and lowest figures being 3.16 per cent. or 75.2 per cent. of the highest figure. The non-basic nitrogen, on the other hand, is much more constant even than the total nitrogen, the difference between the highest and lowest being only 2.69 per cent. of the protein or 21.5 per cent. of the highest figure.

Apart from the alcohol-soluble proteins, which all come together at the end of the table, no other relation depending on the proportion of basic nitrogen is apparent. The crystalline globulins from the hemp seed, squash seed and flax seed are so nearly alike in solubility, reactions, crystalline form and composition that a most rigid comparison has as yet failed to reveal any differences which indicated that they are not one and the same chemical individual; nevertheless the globulin from the flax seed differs from the other two in the amount of basic nitrogen which it yields by over 1 per cent. and the globulin from the squash seed differs in the amount of ammonia which

[1] Since this paper was in type Kossel and Patten, *Ztschr. physiol. Chem.* **38**, 39 (1903), have described an improved process for the direct determination of the diamino acids and have obtained results for edestin which are in good agreement with those which we obtained by Hausmann's method, namely 5.47 per cent. of nitrogen against our average of 5.91.

it yields by about 0.6 per cent. The molecules of these globulins evidently have a different structure.

In the table, all of the proteins down to legumelin are globulins, with the exception of the nucleovitellin, which, however, as obtained originally from the egg yolk in combination with lecithin, has the properties characteristic of globulin, but after washing with alcohol it passes into the condition in which it was used for these experiments, in which it is no longer soluble in saline solutions. Legumelin and ovalbumin, the proteins next following in the table, are soluble in water and in this respect differ from those preceding them, but no difference in the proportion of basic nitrogen exists between legumelin and phaseolin, which is a pronounced globulin, and ovalbumin does not contain very much less.

Those proteins which are characterized by dissolving in strong alcohol present, on the other hand, a marked contrast to the others, in that they all yield far less basic nitrogen and more ammonia than the others, with the single exception of amandin, which yields the same amount of ammonia as does zein but over eight times as much basic nitrogen.

The larger proportion of nitrogen which characterizes so many of the proteins of seeds, compared with the nitrogen in animal proteins, appears to be caused by a larger proportion of substances yielding ammonia and basic products. Some of the plant globulins contain nearly as much basic nitrogen as corresponds to the nitrogen content of the histidine, arginine and lysine which Kossel and Kutscher found in the histone from the thymus gland, namely, 6.43 per cent., while the globulin of wheat contains even more. If, as seems probable, the basic nitrogen of these vegetable proteins shall be shown by further investigation to belong wholly to the three diamino acids named, it would appear that the basic properties of the proteins are not caused simply by the diamino acid components of their molecules, as Kossel and Kutscher suggest, for the histones are much stronger bases than any of these vegetable proteins.

This wide variation in the proportion of basic decomposition products of the various proteins, as Kossel and Kutscher point out, raises important questions regarding their food value.

At Kossel's suggestion, Szumoski,[1] after feeding geese and

[1] *Ztschr. physiol. Chem.*, **36**, 198.

doves with maize for long periods, examined their various organs and tissues for zein, with negative results. That, however, zein is, in fact, assimilated is, in Szumoski's opinion, proved by the experiments which Grandeau, Leclerc and Ballacey[1] made with horses, and Rubner[2] made with men.

Feeding experiments with "gluten meal" present much stronger evidence on this point, since they show that the proteins of this meal are quite as well assimilated as those of cotton seed meal.

The "gluten meal" used in these experiments is a product of the manufacture of maize starch and contains a large amount of the alcohol-soluble zein, the proportion of which has not been accurately determined and doubtless varies with the different samples, but in a large number examined at different times by the writer not far from 25 per cent. of these meals were found to consist of alcohol-soluble zein.

The digestibility of the proteins of gluten meal has been found, as the average of several experiments, to be 88.2 per cent., while that of cotton seed meal is 88.4 per cent.,[3] from which it is evident that the proteins of gluten meal possess a high coefficient of digestibility, and as these consist largely of zein, it is almost certain that zein is assimilated without special difficulty.

In order to show the relative proportions of the several groups of nitrogenous decomposition products yielded by these meals when treated with boiling acids, we treated a portion of each meal containing 0.1600 gram of nitrogen, in exactly the same way as described in this paper for the proteins. The results were as follows:

PERCENTAGE OF NITROGEN IN THE DIFFERENT GROUPS IN THE PROTEINS OF THE MEAL, ASSUMING THESE TO CONTAIN 16 PER CENT. OF NITROGEN.

	Cotton seed meal.	Gluten meal.
Nitrogen as ammonia	1.52	2.38
Basic nitrogen	4.97	1.42
Non-basic nitrogen	8.67	11.63
Nitrogen in magnesium oxide precipitate	0.84	0.57
Total nitrogen	16.00	16.00

[1] *Ann. de la Science Agronomique*, **9**, Ann., T. I., 1892.
[2] *Ztschr. Biol.*, **15**, 150 (1879).
[3] Bulletin 77, Office of Experiment Stations, U. S. Dept. of Agr.

These figures show how great the difference is between the proportions of these several nitrogenous groups and, since no apparent difference in food value exists between these meals, it would seem as if, from the standpoint of nutrition, these very decided chemical differences were of but little importance.

Since zein contains 16 per cent. of nitrogen, the figures given for the gluten meal may be directly compared with those of zein. As the globulin of the cotton seed contains 18.6 per cent. of nitrogen, the amount of meal taken corresponded to only 0.8608 gram. If we calculate the figures given for cotton seed meal to this basis, they become comparable with those of the cotton seed globulin. In the following table the results of this comparison are shown.

	Protein in cotton seed meal.	Globulin of cotton seed meal.	Zein.	Protein in gluten meal.
Nitrogen as ammonia...	1.77	1.92	2.97	2.38
Basic nitrogen.....	5.77	5.71	0.49	1.42
Non-basic nitrogen.....	10.12		12.51	11.63
Nitrogen in magnesium oxide precipitate.....	0.98	11.01	0.16	0.57
Total nitrogen.....	18.64	18.64	16.13	16.00

From these figures it appears that the total protein of the cotton-seed meal yields practically the same proportion of the several decomposition products as the cotton-seed globulin, the differences shown being unquestionably due to the greater amount of humus arising from the carbohydrates, whereby a larger amount of nitrogen appears in the "magnesium oxide" precipitate and a smaller amount as ammonia. In the case of gluten meal, it is evident that some protein other than zein is also present, but its proportion is not indicated by the figures. Loewi[1] has just shown that a dog can be kept in nitrogenous equilibrium or even gain nitrogen when fed with food containing protein decomposition products which are wholly free from any substance giving the biuret reaction, that is, with food containing no protein whatever. The animal can therefore synthesize protein from a mixture of the crystallizable products produced by decomposition of protein. Since such a wide difference exists between the proportions in which the several groups of products are yielded by the different food proteins, this synthesis must

[1] *Archiv f. Exper. Path. u. Pharm.*, **48**, 303 (1903).

consist in something more than a recombination of the several fractions of the molecule of the food protein; it must involve a more or less extensive alteration of these fractions and conversion of one into another before the requisite number of groups of proper nature are at hand from which the new molecule can be constructed.

If we consider the probable number of these groups and the many kinds of them which must take part in this synthesis, the selective and constructive power of the cells in which this process takes place appears to be very great. Hofmeister[1] states that if a mean molecular weight of 130-140 is assumed for the splitting products of the protein molecule, there must be at least 40 such groups in the protein molecule if its molecular weight is 5,000, or 120 groups if it is 15,000.

There are already about sixteen different kinds of these groups known which are primary decomposition products of the protein molecule. The complexity of the process whereby the new protein molecule is constructed from the decomposition products of the food protein is thus easily apparent.

The fact that so many of the vegetable proteins, which serve extensively as food, have been shown, by our present investigation, to yield such different proportions of the various nitrogenous decomposition products, as compared with the animal proteins, makes it a matter of the greatest interest and importance to know something more of the processes involved in this synthesis.

II. THE GLOBULIN OF THE ENGLISH WALNUT, THE AMERICAN BLACK WALNUT AND THE BUTTERNUT.

As our recent investigations have shown that only those seeds which are closely related botanically contain the same protein substance, it became a matter of interest to know whether the American black walnut (*Juglans nigra*) and the butternut (*Juglans cinerea*) contained the same globulin as the English walnut (*Juglans regia*), which we had studied some years ago. We therefore took advantage of the opportunity to prepare the globulin of the black walnut from some of the oil-free residue

[1] "Ergebnisse der Physiol.," Vol. I, p. 774.

of these nuts which came into our hands and to examine a preparation of the globulin of the butternut which was kindly presented to us by Dr. A. L. Dean of Yale University.

We found no difference between the several preparations of the globulin from these three seeds and it is highly probable that they are one and the same protein substance. The reactions of the preparations from each of these seeds were the same as described by Osborne and Campbell for the globulin of the English walnut.[1]

The elementary composition was as follows:

	English walnut.	Black walnut.	Butternut.
Carbon	50.80	51.07	50.88
Hydrogen	6.84	6.87	6.84
Nitrogen	18.96	18.96	18.62
Sulphur	0.80	0.77	0.80
Oxygen	22.60	22.33	22.86
	100.00	100.00	100.00

The proportion of nitrogen belonging to the different groups of nitrogenous products, formed by decomposing the protein by boiling with hydrochloric acid, was found to be:

	N as NH_3	Basic N.	Non-basic N.	N in. Mg. o. pp
English walnut	1.84	6.08	10.93	0.11
Butternut	1.83	5.77	10.87	0.14
Black walnut	1.80	5.77	11.14	0.25

The specific rotation of the preparations from these three nuts was:

	$(\alpha)_D$ 20°
English walnut	45.21°
Black walnut	44.42°
Butternut	45.40°

The precipitation limits with ammonium sulphate correspond to the following number of cubic centimeters of a saturated solution of this salt in 10 cc. of the solution containing the globulin. The smaller quantity is the amount with which precipitation begins, the larger that with which all the globulin is precipitated.

The higher limit found for the butternut preparation is probably due to a slight contamination with some other protein, since, owing to the small amount at our disposal, it was not possible to purify this preparation by reprecipitation.

[1] Report of this Station for 1895, p. 288; also Jour. Amer. Chem. Soc. **18**, 609, 1896.

Precipitation limits with $(NH_4)_2SO_4$.	
Butternut	3.1cc—5.5cc
Black walnut	2.8cc—4.6cc
English walnut	2.8cc—4.6cc

The preceding statements show that between the preparations of the globulin from these three seeds no positive difference has been found sufficient to prove that the globulin obtained from these nuts is not one and the same substance.

III. THE PRECIPITATION LIMITS OF SOME VEGETABLE PROTEINS WITH AMMONIUM SULPHATE.

Hofmeister has shown that a protein body is precipitated from its solution whenever ammonium sulphate is added up to a certain definite concentration and that this concentration is different for different protein bodies. The limits between the concentration at which the protein begins to separate and that at which it is completely thrown out of solution, are quite narrow and characteristic for the different proteins.

As this process affords a convenient means of separating and purifying the different proteins and gives evidence of the purity of products made in other ways, we have determined the limits within which some of our preparations of plant proteins are precipitated. The results are stated in terms of cubic centimeters of saturated ammonium sulphate solution, the lower limit being the quantity required to produce a turbidity in a solution whose total volume is 10 cc. and the upper limit the quantity required to precipitate all of the dissolved protein.

In the following table are given the results of these determinations and also the limits between which the great bulk of the substance was separated. It is probable that, in some cases, where a considerably greater quantity of sulphate was required to precipitate the last traces of protein than was necessary to precipitate the greater part of it, a slight contamination of proteose was present in the preparation examined.

Protein.	Lower limit.	Most precipitated.		Upper limit.
Globulin, English walnut	2.8cc.	2.8cc.	4.6cc.	6.6cc.
Globulin, Black walnut	2.8cc.	2.8cc.	4.6cc.	6.6cc.
Edestin, Hemp seed	3.0cc.	3.0cc.	4.0cc.	4.2cc.
Edestin, Monochloride	3.0cc.	3.0cc.	3.9cc.	3.9cc.
Globulin, Flax seed	3.1cc.	3.3cc.	4.6cc.	4.7cc.
Globulin, Castor bean	3.1cc.	3.3cc.	4.3cc.	4.5cc.

Protein.	Lower limit	Most precipitated.		Upper limit.
Globulin, Squash seed	3.3cc.	3.5cc.	4.1cc.	4.4cc.
Amandin, Almonds	3.5cc.	3.5cc.	5.0cc.	5.3cc.
Corylin, Filbert	3.7cc.	3.7cc.	5.3cc.	6.6cc.
Excelsin, Brazil nut	3.8cc.	4.0cc.	5.0cc.	5.5cc.
Conglutin *a*. Lupine	4.2cc.	4.3cc.	6.0cc.	7.3cc.
Conglutin *b*. "	4.6cc.	6.4cc.	8.2cc.	8.7cc.
Globulin, Cotton seed	4.6cc.	5.0cc.	6.0cc.	6.4cc.
Legumin, Vetch, lentil, horse bean	5.4cc.	5.5cc.	6.5cc.	7.5cc.
Phaseolin, Kidney bean	6.4cc.	6.5cc.	8.2cc.	8.8cc.

IV. THE SPECIFIC ROTATION OF SOME VEGETABLE PROTEINS.

The specific rotation of carefully purified preparations of several vegetable proteins has been determined in order to get information respecting their relations to one another. The results of these determinations are given in the following table:

Protein. Source.	Solvent.	Amount per cc.	Observed rotation.	Length of tube.	Specific rotation. $(\alpha)_D^{20°}$
Edestin, Hemp seed	10% NaCl	.0338 gr.	−2.70°	2 dm.	−40°
Preparation *a*.	10% NaCl	.0247 gr.	−2.07°	2 dm.	−41.9°
	10% NaCl	.0609 gr.	−5.05°	2 dm.	−41.43°
	10% NaCl	.0610 gr.	−2.53°	1 dm.	−41.47°
Preparation *b*.	10% NaCl	.0415 gr.	−1.73°	1 dm.	−41.7°
Globulin, Flax seed	10% NaCl	.0415 gr.	−3.63°	2 dm.	−43.73°
	10% NaCl	.0413 gr.	−1.79°	1 dm.	−43.34°
Globulin, Squash seed	10% NaCl	.0598 gr.	−4.70°	2 dm.	−39.3°
	10% NaCl	.0534 gr.	−4.12°	2 dm.	−38.57°
	10% NaCl	.0535 gr.	−2.05°	1 dm.	−38.32°
Excelsin, Brazil nut	10% NaCl	.0396 gr.	−3.38°	2 dm.	−42.68°
	10% NaCl	.0463 gr.	−3.95°	2 dm.	−42.66°
	10% NaCl	.0460 gr.	−2.00°	1 dm.	−43.48°
Amandin, Almonds	10% NaCl	.0264 gr.	−2.98°	2 dm.	−56.44°
Corylin, Filbert	10% NaCl	.0332 gr.	−2.87°	2 dm.	−43.22°
	10% NaCl	.0326 gr.	−1.40°	1 dm.	−42.95°
Globulin, English walnut.	10% NaCl	.0357 gr.	−1.57°	1 dm.	−44°
	10% NaCl	.0227 gr.	−2.06°	2 dm.	−45.37°
	10% NaCl	.0227 gr.	−1.05°	1 dm.	−46.25°
Globulin, Black walnut	10% NaCl	.0272 gr.	−1.22°	1 dm.	−44.85°
	10% NaCl	.0273 gr.	−1.20°	1 dm.	−44°
Phaseolin, Kidney bean	10% NaCl	.0900 gr.	−7.42°	2 dm.	−41.22°
	10% NaCl	.0900 gr.	−3.75°	1 dm.	−41.70°
Legumin, Horse bean	10% NaCl	.0494 gr.	−2.2°	1 dm.	−44.53°
	10% NaCl	.0291 gr.	−1.27°	1 dm.	−43.64°
Zein, Maize	90% alcohol	.0536 gr.	−3.03°	2 dm.	−28.26°
	90% alcohol	.0523 gr.	−1.45°	1 dm.	−27.72°
Gliadin, Wheat	80% alcohol	.0308 gr.	−5.66	2 dm.	−91.9°
	80% alcohol	.0309 gr.	−2.86	1 dm.	−92.55°

V. THE CARBOHYDRATE GROUP IN THE PROTEIN MOLECULE.[1]

It has been known for some time that certain complex substances found in animal organisms, when decomposed with acids, yielded protein and carbohydrate bodies, together with other products. These substances, known as mucins, mucoids, chondroproteids, nucleins, hyalogen substances, etc., are generally regarded as compounds in which the protein is united with some other complex organic group, of which this carbohydrate is a part. Although several investigators long ago suggested the possible presence of a carbohydrate group in the protein molecule proper, no evidence of weight supported this view until Pavy[2] obtained, by hydrolyzing coagulated ovalbumin, a solution from which he prepared an osazone with a melting-point near that of glucosazone. In consequence of this discovery, Pavy concluded that his investigations brought "the extensive group of proteids of both the animal and vegetable kingdoms of nature into the class of glucosides."

This announcement of Pavy's led to numerous investigations followed by many contradictory statements respecting the presence of the carbohydrate group in the protein molecule proper. It has, however, been definitely proved that several of the animal proteins which are not, at present, considered to be compounds of protein with non-protein substances, yield carbohydrate which has been identified with chitosamine or glucosamine. Glucosamine has been obtained from crystallized ovalbumin and serum albumin and an osazone from the mixed globulins of the blood serum. From no other "simple" protein, so far as we can find, is it certain that carbohydrate has been directly obtained.

The presence of a carbohydrate group in the protein molecule is, however, generally assumed, because it is commonly supposed that all proteins, casein excepted, give Molisch's reaction. This is a furfurol reaction of great delicacy and is given by minute quantities of all carbohydrates when decomposed with strong sulphuric acid, even though they, like the hexoses, yield but a small proportion of furfurol. As Molisch's reaction has been

[1] This paper has been published in the Jour. Amer. Chem. Soc., **25**, 474, 1903.

[2] "Physiology of the Carbohydrates."

applied to only a few of the vegetable proteins, we have tested a series of them in order to see if they, like the animal proteins, would all give this reaction.

We have also attempted to determine quantitatively the amount of furfurol which these proteins yield, by boiling them with hydrochloric acid (sp. gr. 1.06), collecting the distillate and precipitating with phloroglucin in the usual way. The aniline acetate test was also applied to the distillate, in order to detect any minute quantities of furfurol which it might contain. The results of these experiments are given in the following table, in which the proteins are arranged as far as possible in the order of the intensity of the Molisch reaction which they gave under practically the same conditions, which were the following:

Ten milligrams of the protein were suspended in 1 cc. of water, 2 drops of a 15 per cent. alcoholic solution of α-naphthol were added, and then 3 cc. of concentrated sulphuric acid.

This method yields only approximately comparative results, but is sufficient to show, in a general way, the relative intensity of the reaction.

Those proteins which gave no Molisch reaction were also tested in larger quantity, but with perfectly negative results.

The outcome of these experiments was as follows:

FURFUROL REACTIONS GIVEN BY VARIOUS PROTEINS.

Protein.	Condition.	Source.	Molisch reaction.	Aniline Acetate.	Phloroglucin.
Avenalin	Crystals	Oat seed	None	....	....
Edestin	Crystals	Hemp seed	None	None	None
Globulin	Crystals	Castor bean	None	....	....
Casein	Amorphous	Cow's milk	None	....	....
Globulin	Crystals	Flax seed	Trace	None	None
Legumin	Spheroids	Vetch	Slight	None	....
Legumelin	Amorphous	Cow pea	Slight	....	....
Zein	Amorphous	Maize	Slight	None	None
Legumin	Spheroids	Horse bean	Slight	None	....
Amandin	Spheroids	Almonds	Slight	None	None
Globulin	Spheroids	Sunflower	Slight	None	None
Glycinin	Spheroids	Soy bean	Slight	None	None
Excelsin	Crystals	Brazil nut	Slight	None	None
Legumin	Spheroids	Lentil	Slight	None	None
Globulin	Spheroids	Cotton seed	Moderate	None	None
Glutenin	Amorphous	Wheat flour	Moderate	....	....
Hordein	Amorphous	Barley flour	Strong	None	None
Ovalbumin	Crystals	Hen's egg	Strong	Slight trace	Slight trace
Gliadin	Amorphous	Wheat flour	Strong	None	None
Vignin	Spheroids	Cow pea	Strong	None	None
Nucleovitellin	Amorphous	Hen's egg	Strong	None	None
Leucosin	Amorphous	Wheat flour	Very strong	....	....
Phaseolin	Spheroids	Adzuki bean	Very strong	None	None
Phaseolin	Crystals	Kidney bean	Very strong	....	....

It is to be noted that several of these proteins gave no reaction whatever[1] and therefore contain no carbohydrate; that a larger number gave only a slight reaction, which, in view of the great delicacy of Molisch's test, must be attributed to a slight contamination of the preparation with some carbohydrate; that the rest gave positive reactions, some even stronger than was given by ovalbumin, which is known to contain a considerable amount of carbohydrate. From this we conclude that these latter may possibly contain a carbohydrate group. None of the proteins yielded any furfurol when boiled with hydrochloric acid, except ovalbumin, which showed a trace, and none of these, therefore, contain a measureable proportion of any pentose-yielding group. After these tests had been made, Grund[2] published the results of similar attempts to obtain furfurol from animal proteins, but with the same negative results. Whether those proteins which do not yield an osazone but which give a strong Molisch reaction actually contain a carbohydrate group cannot thus be determined. Molisch's reaction is of such extreme delicacy that mere traces of carbohydrate are sufficient to cause a strong reaction, especially if these, like the pentoses and nucleic acids, yield large proportions of furfurol when hydrolyzed by acids.

In order to determine the intensity of this reaction with small quantities of carbohydrates, we tried the following experiments:

Cellulose.—0.5 milligram of filter-paper gives a very powerful reaction, much more intense than was given by any of the proteins tested.

Hexose.—0.1 milligram of dextrose gave as strong a reaction as those marked strong in the table.

Pentose.—0.1 milligram of arabinose gave a strong reaction; 0.05 milligram a decided one.

Furfurol.—0.01 milligram gave a strong pink.

Nucleic Acid.—0.5 milligram of nucleic acid gave a strong reaction, while 0.05 milligram gave one similar to those given by the proteins marked slight. 0.5 milligram of nucleic acid would correspond to a phosphorus content of 00.5 per cent., 0.05 milligram to 0.05 per cent. of the quantity of protein used

[1] Erb (*Ztschr. Biol.*, **41**, 309) has stated that edestin does not give Molisch's reaction.

[2] *Ztschr. physiol. Chem.*, **35**, 111 (1902).

in these tests—a quantity which would be readily detected. From these experiments it is evident that very small quantities of contaminating substances, many or all of which are liable to be present with the protein, especially in vegetable extracts, may be quite enough to cause a strong Molisch reaction.

The evidence of a carbohydrate group in the protein molecule which Molisch's reaction affords cannot, therefore, be accepted as conclusive, other evidence which shows that more than insignificant quantities of carbohydrate are present being also necessary.

VI. THE TYPTOPHANE REACTION OF VARIOUS PROTEINS.

As long ago as 1831 Tiedemann and Gmelin recognized among the decomposition products of protein bodies a substance whose solution was colored a deep violet-red with chlorine or bromine. The nature of this substance remained wholly unknown until Hopkins and Cole recently succeeded in isolating it in a state of purity and recognizing it as, most probably, either indol-amino-propionic acid or the isomeric skatol-amino-acetic acid. They also found that this substance yielded the violet reaction with acetic and sulphuric acid which has long been known as Adamkiewic's reaction. This latter reaction they further found was caused by glyoxylic acid contained in the acetic acid and they have therefore substituted glyoxylic acid for acetic acid in applying this test. This observation is of much importance, as formerly the Adamkiewic's reaction was attributed to furfurol and the presence of carbohydrates was therefore inferred among the protein decomposition products.

In the following table we give the results of the application of the Hopkins-Cole reagent to a number of different proteins, 50 milligrams of each being mixed with 6 cc. of the glyoxylic acid solution and 6 cc. of concentrated sulphuric acid added.

Zein, Maize ;	Very pale straw color. No reaction.
Alcohol-soluble Protein, Oat kernel;	Light brownish. No violet tint whatever.
Bynim, Malt ;	Red-brown. No violet tint whatever.
Vicilin, Pea ;	Very pale violet. Hardly any reaction.
Phaseolin, Kidney bean ;	Pale violet. A little stronger than vicilin.
Avenalin, Oat kernel ;	Light violet color.
Globulin, Wheat ;	Light violet color.

Hordein, Barley ;	The intensity of the reaction increased gradually from Hordein to Leucosin, the former giving a positive reaction, the latter a strong one.
Legumin, Vetch ;	
Legumin, Lentil ;	
Legumin, Horse bean :	
Vignin, Cow pea ;	
Conglutin, Yellow lupine ;	
Conglutin, Blue lupine ;	
Amandin, Almond ;	
Glycinin, Soy bean ;	
Gliadin, Wheat ;	
Ovovitellin, Hen's egg ;	
Globulin, Sunflower ;	
Glutenin, Wheat ;	
Globulin, Castor bean ;	
Edestin, Hemp ;	
Excelsin, Brazil nut ;	
Corylin, Filbert ;	
Conalbumin, Egg white ;	
Ovalbumin, Egg white ;	
Globulin, Flax seed ;	
Globulin, Squash seed ;	
Globulin, Black walnut ;	
Globulin, English walnut ;	
Leucosin, Wheat ;	

Whether any of the above proteins wholly lack the typtophane group could not be determined, as we were able to get a very slight reaction with a relatively large quantity of zein by cautiously adding the sulphuric acid up to one-half the volume of the glyoxylic acid. The color thus produced was at the most very slight and transitory. With the alcohol-soluble proteins of the oat and barley malt the brown color was sufficient to obscure a slight violet reaction and the result of the test in these cases was not conclusive. It is interesting to note the very marked difference in the intensity of the reaction with the proteins at the two ends of the table and it is fair to presume that the proportion of typtophane yielded by the several proteins differs considerably.

THE SOLUBILITY OF GLOBULIN IN SALT SOLUTIONS.

The peculiar property presented by many forms of protein matter of dissolving in saline solutions, although insoluble in water, is one for which we have as yet no satisfactory chemical explanation. The importance of this property from a physiological as well as from a chemical point of view, makes it very desirable that we should have more definite knowledge concerning it than we now possess.

Having found that edestin can be prepared in a crystalline condition, in which it is wholly insoluble in water, but readily soluble after the addition of acids, alkalies or neutral salts of many kinds, we have undertaken to determine quantitatively the solvent power of these salts. The experiments have not been completed, but, as many interesting facts have already been discovered, we here give a brief account of our results and state that as we are still engaged in studying this subject, we hope that this field may be reserved for us for a time longer. Edestin is not dissolved by solutions of the neutral salts consisting of a strong base united with a strong acid, unless the solution contains a certain proportion of the salt. With larger quantities of the salt the amount of edestin which is dissolved increases in proportion to the number of molecules of salt present, so that the curve, representing the amount of edestin dissolved by increasing quantities of the salt, is, after a definite molecular concentration has been reached, represented by a nearly straight line. The chlorides of potassium, sodium and ammonium have equal solvent power, providing the number of molecules in a given volume is the same. The chlorides of barium, calcium or strontium likewise have equal solvent power, which for the same number of molecules is almost exactly twice that of the alkali chlorides. The solubility in these cases is therefore determined by the proportion of chlorine atoms or by the quantivalence of the base or by both. On the other hand, solutions of lithium chloride dissolve much less edestin than molecularly equivalent solutions of potassium or sodium chloride. The bromides of potassium or sodium have equal solvent action, which is greater than that of the alkali chlorides, and about intermediate between

the alkali chlorides and iodides, the latter having approximately the same solvent power as the divalent chlorides.

Barium or calcium bromide have an equal solvent effect, which is but little greater than that of potassium or sodium bromide and distinctly less than that of barium or calcium chloride.

The sulphates of potassium, sodium, ammonium, lithium and magnesium have approximately equal solvent power, which is the same as that of the divalent chlorides mentioned.

With sodium sulphate the amount of edestin dissolved increases with that of the salt until a certain concentration is reached, but on further increasing the concentration the amount dissolved for a time remains uniform and then decreases until, in a molar solution, but very little edestin is dissolved. Sodium sulphate is one of the salts which has long been known to precipitate many proteins when introduced into solutions up to high concentrations. This precipitating effect is well illustrated by the curve representing the solubility of edestin in solutions of this salt. The curve showing the solubility of edestin in potassium sulphate solutions follows that of sodium sulphate very closely, but, owing to the limited solubility of this salt, the precipitating effect is only slightly indicated. If, however, the potassium sulphate solution is supplemented by additions of sodium sulphate, the precipitating effect is shown fully and the sum of the molecules of the two salts have the same effect as an equal number of molecules of sodium sulphate.

The salts thus far considered are those containing a strong base and strong acid. Salts of strong bases with weak acids, that is, those which are hydrolytically dissociated to a notable degree, and which therefore show an alkaline reaction, appear to be more powerful solvents for edestin the greater their degree of dissociation.

Sodium carbonate, which is a well known solvent for proteins, is an example of an extreme case of such a salt.

Potassium chromate has a strong solvent action, about four times greater than that of the sulphates and divalent chlorides mentioned previously.

Sodium sulphide and sodium thiosulphate are about equal in their solvent power, which is approximately one-half that of the potassium chromate.

Solutions of manganese sulphate dissolve edestin freely, but, as this is a salt of a weak base and strong acid, its solvent action is less than that of the other solvents, being about intermediate between magnesium sulphate and sodium chloride.

Ferrous sulphate has a somewhat less solvent effect than manganese sulphate but greater than sodium chloride.

Solutions of the nitrates of potassium and sodium are more energetic solvents than those of the chlorides but less than those of the sulphates. Even in strong solutions of calcium nitrate edestin dissolves so incompletely that the relation of this salt to others cannot be determined. On the other hand, solutions of strontium nitrate dissolve edestin freely, but not quite so readily as equimolecular solutions of sodium or potassium nitrate.

In solutions of sodium, potassium or ammonium acetate edestin is entirely insoluble, but in solutions of barium acetate it is as freely soluble as in those of the alkali sulphates. Solutions of manganese acetate dissolve edestin freely, but no such minute quantity is sufficient as is the case with some of the other metallic acetates mentioned below. The solubility of edestin in solutions of this salt has not yet been quantitatively determined.

In solutions of zinc acetate edestin is not soluble, but is apparently acted upon, for the dense crystalline protein is converted into a voluminous flocculent mass.

Edestin is extremely soluble in solutions of acetates of silver, copper or lead, providing all other salts are absent. The solubility is the same in equimolecular solutions of either of these acetates. Each molecule of these acetates has the same solvent power as one molecule of free acetic acid (see Osborne, Basic character of the protein molecule, etc., Report of this Station for 1900; also Jour. Amer. Chem. Soc., **24**, 39, 1902), and the metal evidently combines with the edestin to form complex organic ions, since the usual reactions of the metallic ions cannot be detected.

Although these solutions are not precipitated by an excess of the acetate, they are all precipitated by small quantities of other salts, even though these contain the same metal as the acetate used. Thus a solution of edestin with a minimum quantity of copper acetate gives no precipitate with any larger proportion of this salt but is abundantly precipitated by very small quantities of copper chloride, sulphate or nitrate, or by sodium chloride or sulphate or by other neutral salts.

These solutions in metallic acetates behave toward neutral salts exactly like those in pure acid, but the converse of this is not strictly true, for while solutions in sodium chloride are readily precipitated by small quantities of copper or lead acetate, those in manganese acetate are not precipitated by copper, lead or silver acetates unless a considerable quantity is added. The solubility of edestin in solutions of manganese acetate is of a different order from that in solutions of silver, lead and copper acetate, since the latter are, like those in acids, not precipitated by dilution, whereas those in manganese acetate are thus readily precipitated and behave throughout like solutions made with most of the neutral salts of potassium or sodium. It is our immediate intention to extend this investigation to a thorough and extensive study of the acetates.

Most of the salts of the heavy metals have no solvent action on edestin but convert it into a coagulated condition in the same way that a solution of a strong acid and neutral salt would do; e. g., a mixture of sodium chloride and hydrochloric acid. The salts which we have thus tested were the sulphates of copper, zinc and aluminium, the chlorides of zinc, copper, mercury and aluminium, the nitrates of silver, lead, ferric iron, copper, cadmium, chromium and cobalt, and mercurous acetate.

The solvent action of iron salts is peculiar. *Ferrous* chloride or sulphate solutions dissolve edestin quite freely, yielding a solution which is precipitated on dilution and which behaves like one made with sodium chloride or other neutral salt. *Ferric* chloride solutions dissolve edestin very readily and behave toward the protein like an acid. The solution gives no precipitate with an excess of the solvent salt, with several volumes of alcohol nor by dilution with water. It is not precipitated by hydrochloric acid, unless this is added in large excess.

It is evident from these results that many unexpected relations between protein and salts exist and that a further study is necessary before generalizations can be made. It is to be noted that nearly or quite all of the generalizations which suggest themselves on studying these results encounter striking exceptions which cannot be disregarded.

It is our intention to extend this investigation and we hope to soon be able to publish our results in full detail.

SECOND ANNUAL REPORT OF THE FORESTER.

(*April 15, 1902–May 1, 1903.*)

By Walter Mulford.

The Station has continued its efforts to help in developing the resources of the farm wood-lot along the two lines described in the forester's first annual report,* viz: the work as Station forester and that as state forester.

The Work as Station Forester.

Experimental work in reforestation.—Sixty-four experimental plantations were made on the Station's property in Windsor during the year. In these experiments, eleven acres were seeded, 3,900 cuttings set, and 66,972 trees planted on the final forest site. Twenty-two species were used.

Plantations were made by two private parties and by the city of Middletown on its water works property, according to plans prepared by the station forester.

The forest nursery.—A new nursery site of one acre was leased in Windsor, and the entire area utilized for seed beds and nursery rows.

Treatment of woodland.—The forest on about twenty acres of private property was thinned under the station forester's direction. Trees on about twelve acres of the Middletown city water works property were marked for thinning and improvement cutting by the station forester; the marked trees were felled and corded (182½ cords) by the city.

The Station owns a tract of forty-six acres in Windsor which presents the problem of treatment of land covered with young chestnut and oak coppice ("sprouts"), which has sprung up after clear cutting, and then been killed by fire. On this tract the effect of sowing and planting without cutting away the brush is being tried; one-half acre of it was seeded and about 17,850 trees were planted in 1903.

* Report of this Station, 1901, p. 354.

Note. The forester was granted leave of absence to teach for two months in the Yale Summer School of Forestry.

A system of fire lanes was opened on both of the Station's tracts in Windsor. Thanks to these fire lanes, a severe fire which swept across adjoining woodlands was stopped before it crossed the Station property.

Aid to private owners.—Five properties were inspected in accordance with the Station's offer of practical help to private owners of woodland and idle lands. Seven addresses on forestry were given. The forester's correspondence numbered 642 letters.

*Coöperative work with the Board of Water Commissioners of the City of Middletown.**—The field study for the planting plan of the Higby Mountain watershed was made. Major J. C. Broatch, superintendent of the water works, established nurseries for raising the stock to be used in the execution of the planting plan. A little planting on the final forest site was done. The treatment of the city's woodlands on the watershed was begun (see above).

The Work as State Forester.†

The Station forester continued to serve as state forester. Five possible sites for the state forest (2,850 acres) have been inspected since the date of the first report, making the total area inspected for this purpose 8,050 acres. A site for the state forest was chosen in the town of Portland, where land was bought during the winter of 1903. The prices paid ranged from $1.00 to $2.38 per acre. The total cost of 698½ acres, more or less, was $1,110.12.

The old boundaries of the many different lots making up the state forest were carefully located and eighty-seven iron boundary markers were set. The forest was posted against trespassing, hunting, fishing, trapping and grazing. Mr. John C. Reeves of Portland was appointed local warden. Two forest fires were stopped before they reached the state land.

Of the first appropriation ($2,000), there remains $659.13 to be used by September 30, 1903.

The principal powers given the forester by the original act were those of purchase, protection and planting. The first two

* See Report of this Station, 1901, p. 361.

† For origin of the work, see Report of this Station, 1901, p. 362.

have been duly exercised. Nothing was attempted with the last, because the act mentioned made planting impossible by limiting the cost to $2.50 per acre.

The new forestry act, which becomes effective July 1, 1903, makes the following important changes:

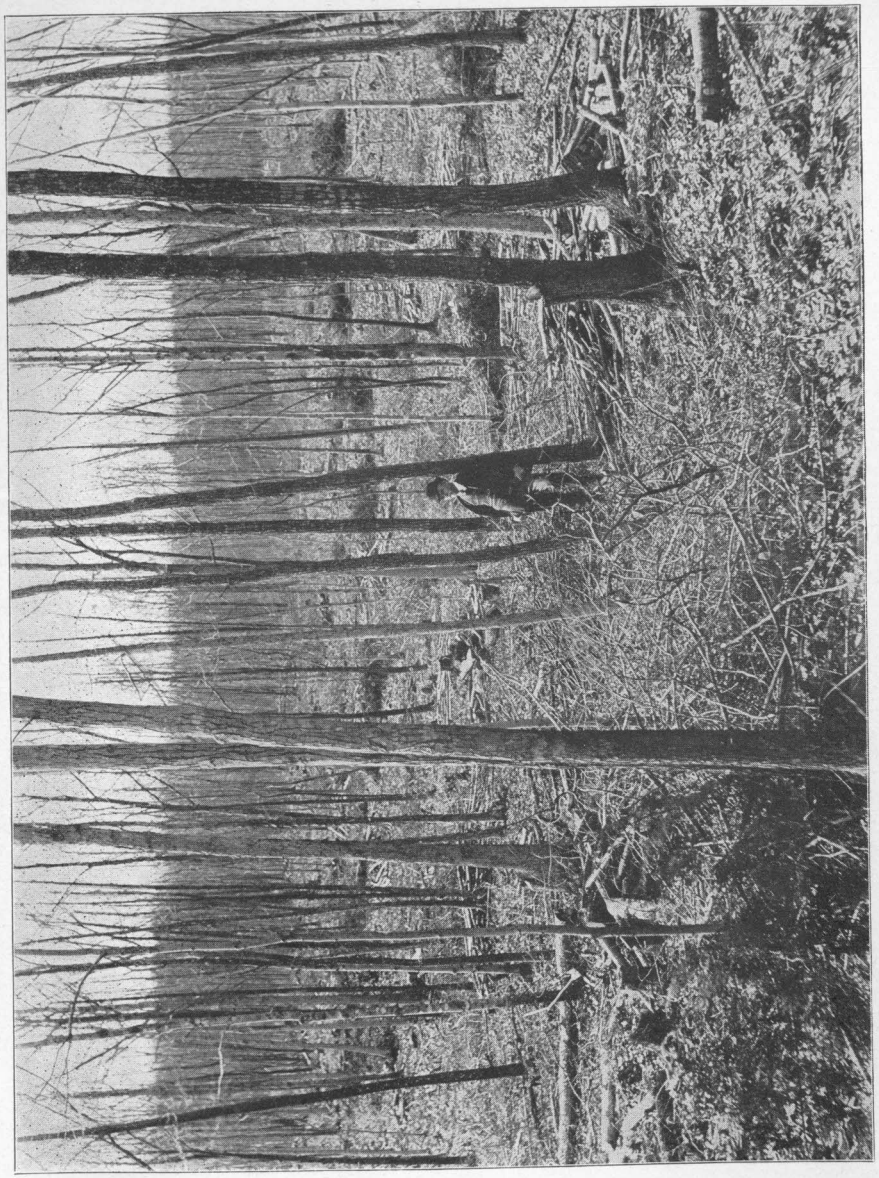
1. "The state forester is authorized to make thinnings in the woodland of the state forest, and to take such other measures as he deems necessary to bring about a profitable growth of timber thereon."

2. The state forester may sell wood and timber from the state forest whenever he shall deem such sale desirable, the proceeds to be devoted to the maintenance and care of the forest.

3. The restriction of $2.50 per acre on cost of planting is removed.

4. The name "state park" is changed to "state forest."

A very modest appropriation of two thousand dollars was made for the work as state forester, for the two years ending September 30, 1905.



Treatment of the Wood Lot. Woodland belonging to the Middletown city water works, as it looked after a thinning.

FIG. 1.—Planting forest tree seedlings on idle land. Windsor.

FIG. 2.—White pine (*Pinus strobus* Linn.) planted under white birch (*Betula populifolia* Marsh.) on a sand plain. One year after planting. Windsor.

THE CONNECTICUT AGRICULTURAL EXPERIMENT STATION

Report for 1902. Part III—Food Products.

ERRATA.

Page 207, read "coumarin" instead of "commarin."

Page 274, line 20, read "8 hours" instead of "3 hours."

Page 276, line 9, read "fat" instead of "starch."

Page 276, line 31, read "2 minutes" instead of "3 minutes."

Page 278, line 5, read "2 grams" instead of "3 grams."

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