Public documents of the State of Connecticut

Connecticut

PUBLIC DOCUMENTS

OF THE

STATE OF CONNECTICUT

VOL. IV

1902

Printed by Order of the General Assembly

HARTFORD
1903

NOTE.

Commencing with the documents for the year 1900, a Document Number has been assigned to each State departmental report.

This number is determined by the chronological order of the first printed independent issue of such report and will in future be retained by it, thus showing the relative chronological place it occupies in the printed reports of the State.

A list of these reports, with the date of first printed issue and the document number of each, appears on the following page.

WM. E. SEELEY,

Comptroller.

CHRONOLOGICAL ORDER OF FIRST PRINTED REPORTS OF DEPARTMENTS.

Document Number.		
1.	Comptroller,	1807
2.	School Fund,	1809
3.	Governor's Message,	1817
4.	State Prison,	1828
5.	Bank Commissioners,	1838
6.	Adjutant-General,	1838
7.	Quartermaster-General,	1839
8.	Board of Education (first issued by Commissioner of Common Schools),	1839
9.	Vital Statistics (first issued by Secretary of State),	1847
10.	Treasurer,	1852
11.	Connecticut School for Boys (Reform School),	1853
12.	Railroad Commissioners,	1854
13.	State Librarian,	1855
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16	Manual and Roll,	1864
17.	Insurance Commissioner,	1866
18.	State Board of Agriculture,	1866
19.	Fish and Game Commissioners,	1867
20.	Connecticut Hospital for the Insane,	1867
21.	Connecticut Industrial School for Girls,	1870
22.	Indebtedness, rate of tax, etc.,	1874
23	Bureau of Labor Statistics,	1874
24.	Connecticut Agricultural Experiment Station,	1878
25.	State Board of Health,	1879
26.	Statement of Vote for State Officers,	1880
27.	Criminal Business of Courts,	1880
28.	State Board of Charities,	1882
29.	Connecticut (formerly Storrs) Agricultural College,	1882
30.	Shell-Fish Commissioners,	1882
31.	Estimate of State Expenditures,	1885
32.	Dairy Commissioner,	1887
33.	Factory Inspector,	1887
34.	Storrs Agricultural Experiment Station,	1889
35.	Board of Education of the Blind,	1895
36.	Highway Commissioner,	1897
37.	Building and Loan Commissioner,	1898
38.	Commissioner on Domestic Animals,	1898
39.	Sewerage Commission,	1899
40.	Attorney-General,	1900
41.	Commission of Public Records,	1900
42.	Dental Commission,	1901
43.	Israel Putnam Memorial Camp Ground Commissioners,	1902

LIBRARY NOTE.

In order that each department report of the State of Connecticut for a series of years may be quickly located in the bound volumes of Public Documents, the Comptroller has also given each report a Binding Number by which its position in the bound volumes is permanently established, thus enabling each report to be found in the same position and volume from year to year.

That these several reports may be placed in the libraries of our several exchanges as soon as possible after publication, he has provided that the State Librarian shall be supplied with two hundred sets bound in volumes of convenient size, each volume to be bound and labeled in harmony with the regular set and sent out as soon as possible after the printing of the reports belonging therein. This arrangement to begin with the reports for 1902.

GEO. S. GODARD,
State Librarian.

Connecticut State Library,
Nov. 7, 1903.

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PART II.

State of Connecticut

PUBLIC DOCUMENT No. 18

THIRTY-SIXTH ANNUAL REPORT

OF THE

SECRETARY

OF THE

Connecticut Board of Agriculture

1902

PRINTED BY ORDER OF THE LEGISLATURE

Hartford Press
The Case, Lockwood & Brainard Company
1903

TO HIS EXCELLENCY

GEORGE P. MCLEAN,

Governor of Connecticut:

In accordance with the provisions of an Act creating the State Board of Agriculture, I have the honor to submit herewith the Report for year ending December 31, 1902.

JAMES F. BROWN, *Secretary.*

NORTH STONINGTON, December 31, 1902.

STATE BOARD OF AGRICULTURE.

1901–1902

HIS EXCELLENCY GEORGE P. McLEAN, *ex officio.*

APPOINTED BY THE GOVERNOR AND SENATE.

		Term expires.
CHARLES L. TUTTLE,	Hartford,	1905
JAMES F. BROWN,	North Stonington,	1905
CHARLES E. CHAPMAN,	Westbrook,	1903
IVERSON C. FANTON,	Westport,	1903

APPOINTED BY THE GENERAL ASSEMBLY

Hartford County,	EDMUND HALLADAY, Suffield,	1905
New Haven County,	D. WALTER PATTEN, North Haven,	1905
New London County,	JAMES B. PALMER, Jewett City,	1905
Fairfield County,	SEAMAN MEAD, Greenwich,	1905
Windham County,	N. G. WILLIAMS, Brooklyn,	1903
Litchfield County,	EDWIN G. SEELEY, Roxbury,	1903
Middlesex County,	E. D. HAMMOND, Cromwell,	1903
Tolland County,	CHARLES A. THOMPSON, Melrose,	1903

OFFICERS OF THE BOARD.

GOVERNOR GEORGE P. McLEAN, *President ex officio.*

EDWIN G. SEELEY,	Roxbury,	*Vice-President.*
JAMES F. BROWN,	North Stonington,	*Secretary.*
CHAS. A. THOMPSON,	Melrose,	*Treasurer.*
Dr. E. H. JENKINS,	New Haven,	*Chemist.*
Dr. G. P. CLINTON,	New Haven,	*Botanist.*
Prof. B. F. KOONS,	Storrs,	*Entomologist.*
N. S. PLATT,	New Haven,	*Pomologist.*

Auditors.

SEAMAN MEAD, D. WALTER PATTEN, CHAS. E. CHAPMAN.

AGRICULTURAL FAIRS IN CONNECTICUT, 1902.

WITH VISITING DELEGATES FROM BOARD OF AGRICULTURE.

Name.	Place.	Date.	Delegate.
New London County	Norwich	Sept. 16–18	J. F. Brown
Windham County	Brooklyn	Sept. 18, 19, 20	C. E. Chapman
Beacon Valley	Naugatuck	Sept. 23, 24, 25	E. G. Seeley
Berlin	Berlin	Oct. 1, 2	E. Halladay
Branford	Branford	Sept. 18, 19, 20	E. D. Hammond
Chester	Chester	Sept. 24	N. G. Williams
Danbury	Danbury	Oct. 6–11	D. W. Patton
Farmington Valley	Collinsville	Sept. 10, 11	J. B. Palmer
Granby	Granby	Sept. 24, 25	E. Halladay
Guilford	Guilford	Sept. 24	C. E. Chapman
Harwinton	Harwinton	Oct. 7	Seaman Mead
New Milford	New Milford	Sept. 16–18	D. W. Patten
Newtown	Newtown	Sept. 30, Oct. 1, 2	I. C. Fanton
Orange	Orange	Sept. 10, 11, 12	I. C. Fanton
Putnam Park Asso'n	Putnam	Aug. 26, 27, 28	J. B. Palmer
Rockville Fair Asso'n	Rockville	Sept. 23, 24, 25	C. L. Tuttle
Simsbury	Simsbury	Oct. 2, 3	C. L. Tuttle
Stafford Springs	Stafford Springs	Sept. 30, Oct. 1, 2	C. A. Thompson
Union (Monroe, etc.)	Huntington	Sept. 24, 25	C. A. Thompson
Union (Somers, etc.)	Enfield	Oct. 1	E. D. Hammond
Waterbury Driving Co.	Waterbury	Sept. 30, Oct. 1	E. Halladay
Wethersfield	Wethersfield	Sept. 23, 24, 25	J. F. Brown
Willimantic Fair Asso'n	Willimantic	Sept. 23, 24, 25	C. A. Thompson
Woodstock	So. Woodstock	Sept. 15–17	N. G. Williams
Wolcott	Wolcott	Oct. 15	D. W. Patten
Conn. Dairymen's Asso.	Hartford	Jan., 3d week	E. G. Seeley
Conn. Pomol. Society	Berlin	Oct. 1 and 2	Seaman Mead
Lyme Grange	Lyme	Sept. 25	I. C. Fanton

JAMES F. BROWN,
Secretary State Board of Agriculture.

NO. STONINGTON, July 25, 1902.

FARMERS' INSTITUTES IN 1902.

During the past year Farmers' Institutes have been held in all sections of the state where local interest could be sufficiently aroused to gather an audience, and the results, wherever held, have been helpful and stimulating. No work promises larger returns for the expenditure involved, and no agency is so well fitted to reach the masses and carry to them the latest results of scientific investigation.

The United States Department of Agriculture has just established the office of Farmers' Institute Specialist, and it is hoped that new impetus may be given to work along this line.

I take pleasure in expressing my great obligations to the officers of the Connecticut and Storrs Experiment Stations, and to the President and Faculty of the Connecticut Agricultural College, for generous coöperation and untiring zeal in Institute work, much of which is often undertaken at great personal inconvenience if not sacrifice.

The Prospectus for 1903 hereto annexed has been widely distributed to Granges, Farmers' Clubs, Agricultural Societies, and others interested in rural pursuits throughout the state, and all have been urged to avail themselves of the gratuitous services of any of the distinguished speakers on the list.

The Prospectus has been prepared by a committee of the Board in coöperation with representatives of the Experiment Stations, and the object has been to secure the best talent available in a wide range of subjects, that would be adapted to the needs of all sections of the state for both entertainment and instruction.

It has been the aim of the committee to provide speakers who could present the latest results of scientific investigation in their special fields of research in a thoroughly practical manner, so as to be available and useful in the everyday work of the field and farm.

How far their work has been successful must be left to the decision of those in whose interest it has been undertaken, and it is hoped that early and frequent calls for speakers will give the people in all parts of the state opportunities to form an intelligent opinion upon the merits of the Prospectus submitted to their consideration.

PROSPECTUS.

Farmers' Institutes under the auspices of the Connecticut State Board of Agriculture for 1902-1903.

The committee on Farmers' Institutes of the Connecticut State Board of Agriculture respectfully submit the following list of speakers and subjects for the winter of 1902-1903.

Granges, Farmers' Clubs, or any association of individuals who may desire an Institute should make early application to the Secretary for such speakers as they wish.

It is the earnest desire of the Board that applications for Institutes should be made early and often, and it is hoped that at least three may be held in each county during the winter.

The board pays for printing, traveling expenses, and services of the speakers.

It is expected that places applying for Institutes will furnish a suitable hall, local transportation for speakers and visitors, music if desired, and entertainment by collation or otherwise, unless there are convenient hotel accommodations.

When application for Institutes is made, four speakers and subjects may be selected from the list, and two of them may be expected to meet the call, but each speaker has the privilege of sending a substitute in case of disability from illness or otherwise.

Applications for Institutes should be made to the Secretary at an early date, giving post-office, name of R. R. station, name of hall and distance from R. R. station. Signify the day of the week preferred. The Secretary should have two weeks' notice to send to speakers.

Attention to these details will save much delay in correspondence. As good speakers are offered, the responsibility of securing a good attendance must rest with each locality. Local speakers, especially ladies, will be welcome at these Institutes. An exhibit of fruit and flowers is solicited.

The Question Box will be an important feature, allowing the introduction of any topic pertaining to agriculture.

A large choice of speakers and subjects is offered, but if we are obliged in some cases to send substitutes we trust this will prove no disappointment. Some other speakers have been solicited, so that some may be sent as substitutes who are not on the list.

After a Grange or Farmers' Club or neighborhood has decided to apply for an Institute, a committee should be appointed with whom all of the local arrangements should rest. This committee should designate the place for holding the meeting, appoint one or two local speakers, provide music, arrange for transportation, collation, and otherwise enlist local interest.

Some one has said, "The Farmers' Institute is the missing link between the farmer on the one hand and the Agricultural College and Experiment Station on the other." It is up to the farmer now to supply this link by applying for an Institute wherever an audience can be gathered.

LIST OF SPEAKERS AND SUBJECTS.

Connecticut Experiment Station.

Dr. E. H. Jenkins.
1. Farm Sanitation.
2. Disposal of Sewage.
3. Fertilizers for Tobacco.
4. The Raising of Sumatra Tobacco under Cloth.
5. How to Buy Commercial Fertilizers.

Dr. G. P. Clinton.
1. General Talk on Parasitic Fungi.
2. Fungous Foes of the Onion.
3. Smuts Injurious to Cultivated Plants.

Mr. W. E. Britton, State Entomologist.
1. Insects and Their Relation to Agriculture.*
2. The Lives and Habits of Insects.*
3. Mosquitoes as Carriers of Disease.
4. Scale Insects and Plant Lice: How to Fight Them.*
5. Insects Attacking Shade and Forest Trees.*

* May be Illustrated with Stereopticon.

Mr. A. L. Winton.
1. Agriculture in Other Lands.*
2. How Plants Eat, Drink, and Grow.*
3. The Adulteration of Foods.

* May be Illustrated with Stereopticon.

Mr. Walter Mulford, State Forester.
1. Making the Wood Lot Pay Better.
2. What Forestry Means.

Storrs Experiment Station.

L. A. Clinton, M.S., Acting Director.

1. Raising Potatoes for Quality and Quantity.
2. Principles of Soil Tillage.
3. Buying and Using Commercial Fertilizers.
4. A Balanced Ration for Plants: How to Get It.
5. Successful Management of Grass Lands.
6. The Silo and Crops for the Silo.
7. Underdrainage of Farm Lands.
8. Lime and Its Uses in Agriculture.
9. The Soil a Factor in Dairying.
10. Management of Orchard Lands.

W. A. Stocking, Jr., B.S.A., Assistant Bacteriologist.

1. How can We Improve the Quality of Milk?
2. The Work of Bacteria on the Farm.

E. R. Bennett, B.S., Assistant Horticulturist.

1. Pruning of the Orchard.
2. Insect Pests of the Orchard.
3. Fungous Pests of the Orchard.
4. Orchard Management in Michigan.
5. Inspection of Orchards and Nurseries in Michigan.
6. Pedigree Fruits.

Connecticut Agricultural College.

President R. W. Stimson, A.M., B.D.

1. The Connecticut Agricultural College.
2. Agricultural Education in some of the Northern Agricultural Colleges.
3. Culture and Agriculture.
4. College Life.

Prof. B. F. Koons, Ph.D.

1. Insects in Their Relations to Disease.
2. Insects and Their Economic Relations to Man.
3. Soils: Their Origin and Composition.
4. Yellowstone National Park. Illustrated with the Stereopticon.
5. Alaska. Illustrated with the Stereopticon.

Prof. A. G. Gulley, M.S.

1. Arranging and Planting Home Grounds.
2. Why Apple Growing is not More Profitable.

Prof. E. A. WHITE, B.S.

1. Ornamentation of the Home Grounds.
2. The Propagation and Care of Roses and Hardy Perennials.
3. Suggestions for Village Improvements.
4. How Plants Feed. A study of plant physiology illustrated by charts.

Prof. L. P. CHAMBERLAIN.

1. The Rock Problem.
2. Agriculture as an Art.

Prof. C. L. BEACH, B.Agr., B.S.

1. The Selection of the Dairy Cow.
2. Observations from the Experience of the Elimination of Tuberculosis from our Dairy Herd.
3. What Advantages are Offered by the Dairy School?

Prof. H. S. PATTERSON.

1. The Relation of the Mechanic Arts to Agriculture and Commerce, and the Importance of All to the Prosperity of a Nation.
2. The Origin and Development of the Arts and Sciences, particularly as applied to Architecture and Sculpture. Illustrated with the Stereopticon.
3. 12,000 Miles through the Dominion of Canada. The Relation of Canada to the United States.

Prof. E. H. LEHNERT, B.S., D.V.S.

1. The Horse's Foot and Diseases.
2. Hygiene of Farm Animals and How to Prevent Disease.
3. Horses, Sound and Unsound.
4. Sanitary Stable Construction.
5. Common Diseases of Dairy Animals.

Prof. H. R. MONTEITH, B.A.

1. Constitutional History of Connecticut.
2. Roads and Taxes.
3. The Trolley Car and the Country Towns.
4. The District School.
5. The Connecticut Town.

C. A. MESERVE, Ph.D.

1. Food Adulterations.
2. Foods: Relative Values and Costs.
3. Common Life as Influenced by Bacteria.
4. Farm Sanitation.
5. Energy, with Chemical Experiments.

Prof. Alberta T. Thomas.

1. The Meaning and Import of Domestic Science Training for the Country Girl.
2. Household Arts in Country Schools. How they may be Introduced.
3. The Value of Household Science to the Coming Home-maker.

Prof. Fred H. Stoneburn.

1. The Production of Eggs.
2. Poultry upon the Farm.

E. C. Birge, Southport.

1. Intensive Dairy Farming.
2. Home Manufacture of Farm Machinery.
3. The New England Farmer's Manure Heap.

COMMITTEE ON FARMERS' INSTITUTES.

Connecticut Board of Agriculture.

James F. Brown, Secretary, North Stonington.

Edmund Halliday, Suffield.	N. G. Williams, Brooklyn.
D. Walter Patten, North Haven.	E. G. Seeley, Roxbury.
James B. Palmer, Jewett City.	C. E. Chapman, Westbrook.
I. C. Fanton, Westport.	C. A. Thompson, Melrose.

Connecticut Experiment Station.

Dr. E. H. Jenkins, Director, New Haven.

Connecticut Agricultural College.

President, R. W. Stimson, Storrs.

AGRICULTURAL CONVENTION AT NORWICH.

The annual mid-winter meeting of the Board was held at Norwich, December 9th, 10th, and 11th, in the Town Hall, at the County Courthouse, which was admirably fitted for the purposes of the meeting.

The list of speakers upon the program seemed to justify the expectation of a large attendance, but a severe blizzard which swept over New England during the three-days session kept many from the meeting. All the speakers were present, however, and the stenographer has preserved a full and faithful record of the proceedings — excepting the music, which was beyond the power of his art to transcribe and of which we had during the entire session a most generous supply of the best that Norwich could give, and no better is to be had anywhere.

The exhibit of the Connecticut Experiment Station in several lines of scientific investigation was universally commended, and deserves a more extended notice than space will permit.

The display of fruit, as was fitting in so bountiful a year, was an attractive feature, the exhibits of the Connecticut Agricultural College and of Messrs. Stephen Hoyt's Sons being specially noticeable.

For further particulars of this exhibit reference is made to the report of Mr. N. S. Platt, Pomologist of the Board, at the close of the session.

The meeting was conducted in accordance with the following program, which contains a complete list of the speakers with their subjects:

Tuesday, December 9th.

10.30 A. M. INVOCATION.

ADDRESS OF WELCOME.

By His Honor Charles F. Thayer,
Mayor of Norwich.

RESPONSE TO ADDRESS OF WELCOME.
By Hon. E. G. Seeley.

11.30 A. M. ADDRESS — "Our Land-Grant College."
By President R. W. Stimson,
The Connecticut Agricultural College.

2.00 P. M. ADDRESS — "Making the Wood Lot More Profitable."
By Mr. Walter Mulford,
State Forester.

2.30 P. M. ADDRESS — "The Farmer and the Hen."
By Mr. F. H. Stoneburn,
Of the Connecticut Agricultural College.

7.30 P. M. ADDRESS — "Forestry for the Farm."
By Dr. John Gifford,
Of the College of Forestry, Cornell University, Ithaca, N. Y.

Wednesday, December 10th.

10.00 A. M. ADDRESS — "Beef Production in Connecticut."
By Hon. J. M. Hubbard,
Middletown.

11.00 A. M. ADDRESS — "Improvements in Cereals and Fruits by Cross-Fertilizing."
By Prof. Wm. Saunders,
Director Central Experimental Farm, Ottawa, Canada.

2.00 P. M. ADDRESS — "Cattle Foods."
By Prof. Chas. D. Woods,
Director Agr. Experiment Station, Orono, Maine.

DISCUSSION.

7.30 P. M. ADDRESS — "A Balanced Ration for Plants: How to get It."
By Prof. L. A. Clinton,
Acting Director Storrs Agr. Exp. Station.

DISCUSSION.

Thursday, December 11th.

10.00 A. M. ADDRESS — "Practical Methods for Maintaining the Fertility of the Soil."
By Prof. Wm. Saunders,
Director Central Experimental Farm, Ottawa, Canada.

DISCUSSION.

2.00 P. M. ADDRESS — "Mosquitoes and Malaria."
By Mr. W. E. Britton,
State Entomologist.

2.45 P. M. ADDRESS — "Parasitic Fungi."
By Dr. G. P. Clinton,
Of the Connecticut Agricultural Experiment Station.

7.30 P. M. Music.

8.00 P. M. ADDRESS — "The Village Beautiful."
By Mrs. Mabel L. Todd,
Amherst, Mass.

It is confidently believed that the above program offers subjects and speakers that will be both profitable and entertaining to all engaged in rural pursuits. All are cordially invited, and this especially includes the ladies.

Music will be provided at intervals.

A Question Drawer will furnish ample opportunity for full and free discussion of any subject of interest to the practical farmer.

To make this feature of the meeting profitable, bring in your questions and take part in the discussions.

Ample facilities will be afforded for the exhibition of Fruits and Flowers, Grains and Vegetables, Butter and Cheese; and the bountiful harvest just gathered warrants the hope that there will be a generous exhibit. Mr. N. S. Platt, Pomologist of the Board, will give his personal attention to this feature of the program.

Articles for exhibition may be sent, properly labeled, by express, at the expense of the Board, to the Secretary at Norwich, to arrive on Monday, December 8th.

RAILROAD ARRANGEMENTS.

The N. Y., N. H. & H. R. R. Co. has provided certificates which, when countersigned by the Secretary, will entitle the holder to return over any of its lines at half rates. These certificates must be shown when purchasing tickets at railroad stations in Norwich.

The Central Vermont Railway Co. will sell tickets from stations on its road in Connecticut at 2 cents per mile each way, to Norwich and return.

HOTEL ACCOMMODATIONS.

The Wauregan, Del Hof, and American afford ample facilities for guests, at reasonable rates.

A committee of the Board will be at the Wauregan to furnish delegates and others such information as may be required.

Gov. GEO. P. McLEAN,
EDWIN G. SEELEY,
JAMES B. PALMER,
JAMES F. BROWN,
Committee.

NORTH STONINGTON, Nov. 25, 1902.

REPORT OF THE PROCEEDINGS

OF THE

Mid-winter Convention

OF STATE BOARD OF AGRICULTURE

AT NORWICH, CONN., Dec. 9, 10, and 11, 1902.

Convention called to order by Hon. James F. Brown, Secretary, at the Town Hall, at 10.45 A. M.

The SECRETARY. Ladies and Gentlemen: The hour now having arrived for the opening of this Convention, in accordance with an honored custom of the Board of Agriculture we invite you to unite in prayer by the Rev. Dr. Howe of this city.

Dr. HOWE. Let us pray: Almighty God, our Heavenly Father, it is fitting that we acknowledge Thee in all our ways, Thou who art the source of all good, and the giver of every good and perfect gift. We acknowledge Thee as the author of our being, the giver of our lives, and of all good things. The earth is the Lord's and the fullness thereof. We remember, O Lord, that Thou hast given the earth to man that he may control and master it even as Thou hast reserved the Heavens in thine own keeping. We believe that Thou wilt bless all efforts put forth by man for the recovery of his lost sovereignty over the world, and we pray that every one so engaged in developing and securing the forces of nature, and of the world, may know and understand that they are working in close partnership with God, and are really workers at these things through Thee.

We pray that Thy blessing may rest upon this Association, upon those who attend this meeting, and may great advantage and benefit accrue to those who are gathered here together. Bless this noble commonwealth, and wilt Thou favor every effort which is put forth for the development of its best life, its industrial prosperity, and everything that is for the upbuilding of the people.

Wilt Thou bless the great nation of which we are a part, making us in Thy good providence a mighty people not only for the development of those things that are for our interest, but may we become a nation which shall reach out a helpful hand to weaker peoples than ours. May we exercise an ennobling, upbuilding influence everywhere. Hear us in these, our petitions, through Jesus Christ, our Lord. Amen.

The SECRETARY. In the absence of Governor McLean, who is the President *ex officio* of the Board, I have the honor to introduce to you the Hon. Edwin G. Seeley, Vice-President, who will preside during the sessions.

The PRESIDENT. I see that our program calls for an address of welcome by the Mayor of this city, but I understand it is not practicable for him to be present, and Judge Fanning is to take his place. I now have the pleasure of introducing to the audience Judge Fanning of Norwich.

Mr. J. T. FANNING. Mr. Chairman, Members of the State Board, Ladies and Gentlemen: I have been requested by the Mayor, who has received a peremptory call to other duties this morning, to extend to you a greeting and all possible assurances of welcome on this occasion of your convening in Norwich. Every worthy stranger who comes to mingle with the people of our historic city can count on a cordial reception, but in your case, coming together to increase the public interest in the oldest pursuit known to man, and to give it new vigor and influence in Connecticut, our people feel that they honor themselves when, at this opportunity, they rejoice that your deliberations in this mid-winter convention are to be carried on at their hearthstone.

It is no part of my purpose to cut into the valuable time of your delegates, who have your own program of important business to develop, by any personal views on the merits of the work which calls for your attention during these days of conference. But I must tell you that I feel honored to have a part in extending a welcome to the men who are zealous in the effort to promote the public agricultural interests of this State, who are aiming to give a deserved dignity to the soil, and to secure a just reward for the diligence, the intelligence, and the honesty of those who till it.

Farm life and industry are the corner-stone of the country's welfare and happiness. Every honest business has its merits, and the laborer in every calling should have his reward and his efforts should be commended and applauded; but to those who work to supply the blood and bone of mankind should be given special respect and honor by their brethren everywhere. I believe that the lot of the farmer is becoming more happy as the business which he prosecutes is carried on more scientifically. It is your purpose, I believe, acting for the State, by study, by suggestion, and by coöperative interest, to apply to agriculture the benefits of science discovered from experiments, and the comparison of results in your work. There are many problems for you to handle, and I know that everyone in our community wishes you well in your undertaking in striving for the betterment of crops, the enrichment of the soil, increased markets for cattle, and making farming so profitable that in a few years the "abandoned" farm in Connecticut will not be heard of. With the interest of the whole country centered in the progress of agriculture, with the appropriations made by our State for proper experimental work, with the extension of rural postal deliveries, and by your zeal and its continuance by your successors the influence of successful husbandry will be increased and strengthened, and there will be an increase, too, in the influence and prosperity and happiness of all our citizens.

Now, ladies and gentlemen, I wish to say specially, that His

Honor, Mayor Thayer, regrets exceedingly that he cannot be here in person to extend to you the welcome that this convention deserves, but I have been authorized to represent him and the city in extending to you this welcome, which I do most heartily, and I know that all the people of the city and of all the outlying districts here adjoining will join with me in wishing the greatest success to you in your deliberations, and in your work here, and in extending to you a very hearty welcome and greeting.

(Applause.)

The PRESIDENT. I can only wish that His Excellency, the Governor of this State, was here this morning to respond to this cordial welcome which we have received. I know that I but voice the sentiment of the Board of Agriculture, and those who come from outside, when I extend to you the hearty thanks for what you have already manifested, and for the message that has come from the Mayor. It will have much to do in making our stay with you pleasant and profitable.

If you will look on your programs you will see that this response of welcome is to be given by Mr. Blank. Well, we never expected much from a Blank, and when we draw one we must make the best of it.

I am reminded today of what our Governor said to us one year ago in regard to his experience in farming. He was a farmer's boy. He lived on the farm. He knew what it was to put on a pair of cowhide boots which he had great difficulty in getting off. He went barefooted, and he went woodchucking. He went all over the fields as almost every farmer's boy does at various times. And then he tried farming himself and did not make a success of it, but he told us plainly the reason why he did not make a success. It was because he did not work at it. He didn't understand it properly. But he acknowledged, after all those years of experience, that there is no better place to be reared than on a farm; that there is no better avocation than the avocation of the farmer, and that there is no better place for schooling boys and girls than on the farm, and that really, on the whole, it was no fault of farming as an industry that he did not make a success of farming. He acknowledged that frankly, and said it was because he did not have proper knowledge and understanding of the matter. There was a good deal of food for thought in what the Governor said to us. There is no better place to be reared than on the farm. I am a farmer, and have always been a farmer. My father was a farmer before me, and my mother was a farmer's daughter. My grandfather and great-grandfather were farmers, and their wives were farmers' daughters. My brothers are all farmers, and my sisters have married farmers for their husbands. So you see I come from a farmer family, and I am proud of it, and I stand here today to say one word in regard to this matter, and I am going to take for my text a subject which Prof. Bailey of Cornell University of Ithaca took for an address which was delivered before this Board of Agriculture a few years ago at Willimantic. I do not remember the exact phraseology of it, but the sense of his subject was, "Are we drifting towards peasantry in this country?" Well, what do you think about that? Are we drifting towards peasantry in this country? If we are drifting towards it, what are the causes that are bringing us there? Is this nation going to the dogs, as some say? Imperialism, and all these "isms" which have crept in recently, are they what are going to swamp us, and we go down as a nation? Just go back five or six years. A nation is a good deal the same as what its leaders are.

It may be said of one man, — you have all heard of him, William McKinley, — it may be said as truly of him as of one in ancient times that you might as well undertake to turn the sun from its course as to turn that man from his convictions of right and wrong, or to sway him from his integrity. He is gone, but what a mighty influence he had? Coming down to the present time, there is another man that you hear much about in these times — Theodore Roosevelt. What is he doing? With one hand hold of the mightiest corporations in this country, leading spirits in financial circles, and strongly grasping with the other he has reached down into the depths of the coal mines and taken hold of the poor, oppressed miner, and he is holding them both up and proclaiming to them both the great doctrine of the fatherhood of God and the universal brotherhood of man. He is bringing them together. God help him to do it. Is any country drifting towards peasantry that has for its leaders such men as those I have just mentioned? Are we going on the decline where Rome went? Why did she go? Because she sold her places of trust to the highest bidder, and went down in corruption because of it. Where do we stand then? Our progress is steadily for the better. We have had many trials and hard times, but there is nothing, there is no better place, or one naturally better calculated to train the energies, and train the mind, and to discipline it in all its various phases, and in all its various forms, than the agricultural industry. The homes on the farm — why, the farmer should be the best educated man in the world. He has to deal with the earth, and the air, and the sky — everything around him. He has to deal with animal and vegetable life in all its various forms. We want to bring our boys up to be leaders in agricultural knowledge and science, and the country is fast waking up to the fact that such knowledge is essential and necessary to success. Look around you, and see if the farmers of this country are of any importance? Read the last report of our Secretary of Agriculture, Mr. Wilson, and what does he say? Forty millions of the inhabitants of this country have their dwellings on the farms — more than one-half of all there are in the country. Of the thirty millions of wage-earners, those that are earning money, more than one-half of them are engaged in the farming industry. Just think of that. And the capital invested is over twenty billions in our agricultural work — more than four times that invested in manufacturing, or any other important industrial line. That is an industry well worth considering.

But the prospects in this country are not all bright. There are some things that look bad which are looming up in the future.

But if this country is ever saved the farmers have got to be one of the principal factors in doing it. There is no mistake about that. There is no doubt about that whatever. You talk about wealth, what is it? Bring me twelve boys from these hillsides around the country here, and twelve girls. Bring into this room that number of bright faced, strong, pure minded boys and girls of good intellect, and I will show you something that millions of dollars cannot represent. I will show you a mine of wealth in this community that far surpasses anything that you can bring here in gold or silver, or stocks or bonds. It is mind and not matter that is wealth, strictly speaking, to our nation. It is that that we ought to bear in mind. It is that which should make us honor our calling, — we men who are engaged in the farming industry. And we want to fit ourselves to be worthy of it, Do you think you know it all? That is one of the worst things that can happen to you. I presume that none of us have any adequate idea how much there is about farming that would be valuable to us that we do not know. The man back on the farm, unless he looks out for himself, is very likely to be narrowed, and contracted and circumscribed in his vision, but every little while something happens, and he breaks out and away from that. And it's a good thing when he gets out. He develops, and it's through these troubles we have and the constant effort to overcome them that develops us, and makes us able to make the best of things. We have not got anything to fear.

Now let's come a little nearer home. What is our own State doing? What kind of men are we training up and sending out? Take our own Congressmen. Take the one who has just fallen by death, or his successor who has taken up his mantle and just put it on. Take that old patriarch Platt from my native town of Washington, whose term is just about running out, and who is surely to be returned. What a credit he is to himself and to our State! There is not much to fear of the country going to the dogs, or to destruction, when we have got such men as leaders.

Now, what are we going to do? That is the next question. We are here because we feel it is good to be here. It's good to get together. It's good for us to have an interchange of thought and sentiment. It strengthens us, it keys us up, and it makes us feel better. We come here and we get some new ideas from each other, and it broadens us out. It makes life worth the living. We are here to help you, and we want to help you. We want to help each other. We are here because in this way is the only way that we ever come to the point where we can take a step forward. We never should be going backward. It's only forward we should go. The influence of coming in contact with one another is great. You have all noticed how a company of boys and girls gather around an old-fashioned schoolhouse out in the country. You know what they do. You take a cold morning like this, and in a spirit of selfishness, probably, an only son comes in by the fire in the old stove, and he tries to take the whole stove. Wants all the heat there is. He looks sour. You can tell that sort of a disposition just as soon as you see it. And by-and-by a little boy or girl comes in with a cheerful laugh, and the whole thing is changed at once. The fire is not greater, but there is the influence of personal contact, mind with mind, that warms and brightens things up. It has an influence, and you can see it there, not in the fire but in the minds and the faces of those about. Now, it's just so here. We hope you will take hold and get acquainted, and will have a good time with us. We want to learn all we can, and we have got some good speakers here who are going to tell us something about some of these things.

The SECRETARY. Mr. President: I did not intend to say a word here this morning, but I am reminded by the hearty welcome of the representative of His Honor, the Mayor, of a former welcome which I received to the city of Norwich. Forty years ago last August I came into the city of Norwich with a little company of men in the uniform of the United States. And the city of Norwich turned out to receive us as though we were already heroes. After spending a few weeks under canvas out on the Fair Grounds we marched out of this city again, and the citizens of Norwich poured out and filled the streets, and covered us with wreaths, and cheered us as though we were already victors. After three years of bloody strife we returned to the old State of Connecticut and resumed the arts of peace. Our swords were beaten into plowshares, and we have been following successfully ever since the arts of peace. And it's a singular coincidence that the very year following the restoration of peace this Board of Agriculture was formed in the State of Connecticut, and the history of this Board, and its doings, marks a complete revolution in the mode and methods of agriculture not only in Connecticut but in the country. The thirty-five volumes of the reports of this Board form a complete encyclopedia of the progress which agriculture has made. And now, friends, after seventeen years we are met here again in the city of Norwich, and we are going to add another volume to that collection of works which represents the development and the evolution of agriculture in Connecticut.

The PRESIDENT. We know that there have been special pains taken during the last few years in regard to the education of the farmer. We can see what our State has been doing, and we hear about what the other states are doing. Very recently a new phase of this movement for the education of the farmer has developed in Wisconsin. There they have established the first County Agricultural School. Now we have with us today one who is at the head of our Connecticut Agricultural College, which is teaching some very practical lessons in agriculture to our boys and girls up there, and you are now to listen to an address by President Stimson in regard to what The Connecticut Agricultural College is doing in this line of work.

OUR LAND-GRANT COLLEGE.

BY PRESIDENT R. W. STIMSON.

Mr. President, Ladies and Gentlemen: It is with a keen pleasure that I again have the honor of making you a brief report of the work of our land-grant institution, The Connecticut Agricultural College.

A year ago your attention was called to the fact that we are one of a large group of similar institutions distributed throughout the country. The statement was made that there are sixty-five land-grant colleges in the United States. Recently a man out in the western part of the State asked me if it is true that there are so many. It is true. The present number is accounted for by the fact that some states have more than one institution which receives the benefit of the Land-grant Act and of the Morrill Act of 1890, providing for the further endowment and support of the land-grant colleges. In the south, for instance, there are separate institutions for white and colored men. Both receive aid from these federal funds, and are supported by the states in which they are located. In the north, also, some states have two land-grant colleges; Massachusetts, for example. The Massachusetts Agricultural College is empowered to provide a liberal and practical education, but is expected to devote itself particularly to the things which pertain immediately to agriculture. The other part of the obligation which rests upon Massachusetts, in receiving federal funds, that of providing instruction in the mechanic arts and the sciences that pertain to these, is delegated to the Institute of Technology, Boston.

The Connecticut Agricultural College is the sole representative in Connecticut of the land-grant college movement. Consequently, in addition to providing the elements of a liberal education, its object is, and must necessarily be, the promotion of a practical education, both in agriculture and in the mechanic arts, — the promotion to the limit of its ability of the entire industrial movement. I should like to lodge this permanently in your mind, not to say that little so far has been done in the mechanic arts and that much has already been done in agriculture, but primarily to call your attention to the scope, the inherent and necessary scope, of this our land-grant college.

Now, in fulfilling our broad federal obligations, it should first be noted that we are not seeking to become a university. That is to say, we are not turning our attention to classical studies to any great extent; we are not to any great extent turning our eyes to economic, ethical, philosophical, literary, and musical studies, as such; and we are not turning our attention to history in the sense of making a specialty of history. We do not aspire to become a university, but all of these subjects enter into our instruction; for we are expected to give a liberal as well as a practical education at the Connecticut college.

It, further, should be noted that while so far our equipment for mechanical instruction is meagre, nevertheless, some excellent results are being achieved in the mechanic arts. We have a blacksmith-shop and give instruction in forging and general repairing. We have a carpenter-shop and teach wood-working. We have courses in mechanical and architectural drawing which promise to be of great advantage to the boys who take them when they go out to work for themselves. We give a good course in engineering, — we fit boys for practical work as surveyors. And along with our bookkeeping and stenography we teach penmanship and typewriting. Parallel with courses for young men, we have courses for young women in the practical arts of housekeeping. It is a good practical and efficient training that we give these students. Of course all this work is based upon thorough training in mathematics and the general sciences. Indeed some students have come to us only after discovering that such education is provided.

But it gives me particular pleasure to speak here today because the best part of our work, the part, certainly, for which we are best equipped, is agriculture. I have a letter here which has come in within a few days from the superintendent of the Dairy School at Kingston, Ontario, which is under the auspices of the Ontario Department of Agriculture. The writer, wishing to erect a modern model dairy building, had written to different agricultural colleges, and among them to ours. The plans of our dairy building had been sent to him. And this is his reply:

"I have your letter of the 2d inst., containing plans of your dairy building. I had some correspondence with the different experiment stations in New England, and from what I have been able to see of the different publications issued you have the finest dairy building and plant of them all."

We are strengthening our agricultural work and equipment at present by increasing the work of our experiment station, and by this means expect to be of greater use to the agricultural people of the State; and with improving our work in this department we are striving to induce the farmers of the state to take better advantage of it. While the Storrs Experiment Station has been at work for a long time, its utility to the farmers of the state has been very slight indeed.

How do you judge of the utility of an experiment station? Do you not judge its worth by its helpful relation to the work of practical farming through the State? You judge it in part, of course, by its relation to other agricultural experiment stations, and to the teachers and agricultural colleges who want to know what are your investigations in the science of agriculture. The Storrs Experiment Station stands particularly well for its bacteriological and its food and nutrition experiments among scientists, not only of the United States but of Europe. It has become famous at home and abroad because of that part of its work. But so far the work which has had immediately to do with practical farming has not amounted to very much.

Recently the direction of the Storrs Agricultural Experiment Station has been moved to the College, and we have found, on taking over the Station correspondence, that scarcely a farmer in the State has addressed it a question in regard to the practical operations of his farm. Professor Clinton, who has come to us from Cornell University, where he has been working for the last six or seven years, where he has seen the voluminous correspondence addressed to the Cornell Experiment Station and where he has come to know what are the symptoms of a healthy, thorough working relation between the experiment station and the practical farmer, came to my office yesterday morning and reported that the letters of inquiry from Connecticut farmers are only now beginning to come in.

These inquiries have begun to come in since he sent out copies of the recent bulletin prepared by Professor Beach giving the history of the tuberculous herd at the College. When that bulletin was issued Professor Clinton enclosed a little sheet telling the farmers of the State what we planned to do for them, and urging them to give us their coöperation. Some of you, and I presume a great many of you, received copies of that letter. We would like to have you all see that bulletin and that letter, and I have brought down a few copies to distribute. By all you value in agriculture, I would urge you to come into closer relations with The Storrs Agricultural Experiment Station and let it assist you in the practical operation of your farms. If we are endeavoring to teach anything at the Connecticut Agricultural College it is practical agriculture, and that is what you want. It is not merely book farming that we are teaching, but the practical operations, — how to till the soil to the best advantage, how to carry on real, earnest, intelligent, efficient farm work.

And I want to speak with some emphasis in regard to this matter because in looking about to find a man to fill the vacancy in the directorship of the Storrs Agricultural Experiment Station we had this primarily in mind. We wanted a scientist, but we wanted a practical man also. A farmer's opinion is usually pretty good on a question of this kind. We must know what you as farmers want. And we must know your opinion of the advice we give you. The test of our efficiency must be the practicality of our judgments.

Now, you are aware there are men who know something about farming, but whose interests are mainly in something else, and who, consequently, want farm-managers. These are men not able to be on their farms all the time. It is the proof of a good farm-manager that you can leave him alone, and come back once in two or three months, or once in six months, and find that things have been run better than you could have run them yourself. Professor Clinton was asked some years ago to visit the farm of a man of this type, the owner of a farm who was very busy in other pursuits. He was asked to look the farm over, and to give this man advice in regard to its handling. This he did. He laid out drains, said where he would put them, and how. He explained the different kinds of soil, and told how he thought they ought to be treated. When he had finished the gentleman said, "Cannot you send me a young man to take charge of this work for me, and carry it on as you think it ought to be done?" Professor Clinton replied, "I think I know a practical man that will suit you." And he sent there a man who only lately has left the position. I want to read you a letter which this business man has recently written, showing how he has appreciated the services of this young man and Professor Clinton's judgment. It is as follows:

"Some years ago you were good enough to put me in the way of securing the services of Mr. Stockbridge for the purpose of running a truck garden at Harrison, N. Y. He was with me until last year, when he went to Pennsylvania to take charge of a large farm. I have secured a good man in his place and the garden is now doing well.

"What I now have in mind is to secure a first-class, up-to-date farmer for a tract of land of 200 acres which I have purchased. While I expect, in the end, to run it as a dairy, I have no special settled purpose in the matter, but I have a pride to make it a first-class farm and devote it to the best uses to which it can be put. As I cannot give the matter my personal attention, I must have a farmer who can be relied to do the best for the land and for me. There is a good farmhouse on the place. I am not particular what wages I pay so long as I get the worth of the money. Such a man should be strong and industrious, and capable of getting the best work out of the men."

Is not this a pretty good tribute to the worth of the advice of our Acting Director of The Storrs Experiment Station and our Professor of Agriculture at the College? He has the confidence, you see, of this man, based on actual business relations with him as to the practical manipulation of the soil, both for profit and for pleasure.

Is not this something of a guarantee of what Professor Clinton can do for Connecticut? I wish you would come up to the College to meet him. I wish you would invite him to your meetings about the State. We would like to see him go to as many institutes as possible. He ought to go, because of the good he can do, but especially so that you may see what the ideal of the Connecticut Agricultural College at present is as to who should be Professor of Agriculture and Director of The Storrs Experiment Station. I believe you have every reason to have confidence in Professor Clinton, and I am glad that this body has done him the honor of inviting him to speak here during the convention. You will have the opportunity of hearing him later.

You have been told about our dairy building. Our work in dairying and our dairy plant are among the best, to say the least, in New England. You all know Professor Beach. I need not say a word about him, but I cannot refrain from saying two or three. There are but few men who have as much capacity for getting the students to work as Professor Beach. The students are up with him before breakfast, and they are out with him after supper, and when not at work in the stable, in the creamroom or butter-room, or in the class-room, they are in his office studying the breeding of dairy cattle, working out the pedigrees of the stock, making plans of buildings, or figuring out balanced rations. One of the rarest men on our force is Professor Beach. He with the dairy plant will take good care of our dairy interests. You have been told of Professor Clinton. He, with the Experiment Station staff, will take good care of our work in searching for practical results in agriculture. As to Professor Gulley, you all know him. You know his sterling ability. If he is anything, he is a practical man, a fine general horticulturist, but especially an exceptionally expert pomologist and gardener. We have another new man, but I cannot say a word about him because he is here and can speak for himself. His name is on the program, and you will hear him later. I cannot speak about Mr. Stocking in dairy bacteriology, about Professor White, or about Dr. Lehnert, because all are present.

We want you to know all of these men, not only for themselves, but also for your own immediate benefit. Get into personal contact with them. Try them and see if they cannot serve you in some way in your work. If you have a problem which bothers you, submit it to them and see if they cannot assist you. If they are not up in any given problem, they will be honest enough to tell you so; but on most things they will be able at once to give you expert advice. Do not consider it a symptom of insanity, of imbecility, or of utter ignorance, if every question you propound is not answered quite as you desire, or as soon as you expect. You must know what a wonderful science agriculture is. It is so manifold in its ramifications, it has such an immense number of details, that it requires a great deal of time to work them all out. It may be that your letter will raise some question that has never before come to the attention of the agricultural scientists at the College, but it will probably have come to the attention of some professor or investigator elsewhere; our men know the general field of agricultural science and will bring all of its resources to your aid at the earliest possible moment, if you will give them the chance.

We want you to know, also, all about our different studies and the divisions of our College year. Our fall term for our regular College and secondary school students begins the latter part of September. We push the opening on to that time, so as to leave the boys at home as long as possible to help with the fall work. When our fall term opens, we teach thirteen weeks before Christmas. We have a mid-winter vacation covering Christmas and New Year's. Our student-body is very diverse in its makeup. We have the Jew and the Gentile. Some of our students are of one nationality and some of another. Some wish to celebrate Christmas, some New Year's. As a public institution, we need to meet the wishes and customs of the parents of all of our students so far as possible in the matter of these holidays. After the mid-winter vacation we have a term of twelve weeks. Then in the spring we have a shorter term of eight weeks, and close our regular college course about the middle of June, so as to leave as much time as possible for the work of the boys at home during the summer.

Besides all the various means and objects of instruction to which your attention has been directed, we have asked ourselves what more we could do to be of benefit to the farmers of the State, or to those who are engaged, or are desirous of engaging, in any of its various industries. We have decided, first, that we can be of increased assistance by offering a winter school of short courses for practical men, — men who could not, for one reason or another, think of coming to the College for a year, or two years, much less for a four-years course.

Accordingly, we are now offering at the College short courses varying in length from twelve weeks to ten days. We made a beginning in such work when we began the short course in dairying several years ago. Experience proved that the idea was a practical one, and we have since opened courses in pomology, and in the raising and care of poultry. This year we have offered also thirty-three ten-day courses. So that you can come to us for twelve weeks; or, if you cannot get away for that length of time, you can come for six; or, if you cannot come for six weeks, you can come for two or three ten-day periods. If you cannot come for more than one ten-day period, we urge you to come for that.

Through our shortest courses we have been able to discover and to encourage some excellent students. One young man in particular the past year was first tried in a ten-day course, and later was welcomed into a class with much older men in a longer course, because he proved to have a good physique, good brain fibre, and good power of application to study. He was associated in his work with men twenty years old, and older, though he was but seventeen.

In previous years we have had a kind of extension department for guiding students at home in reading. We found, however, that that kind of work did not pay. I do not know but it pays elsewhere, but we found it did not pay with us. Circles sometimes were formed, would write to us for books, and on our telling them what books were available and setting prices, they would get the books and pay for them; but they would not read them. Sometimes a reading circle would persistently carry through a course of reading, but such a circle was the exception rather than the rule. It was a rare circle that would read enough to get any real good out of such kind of instruction as that. Finally we said to ourselves, "This is too distant. We cannot get close enough to these readers in this way."

With the establishment of our short courses, we have adopted a new plan of helping home reading. When we find persons who are interested in some subject, wish instruction in it, but at the same time feel compelled to stay at home, we send announcements of our ten-day courses and invite them to come up to the College for ten-days work with the professors who teach the subjects in which these persons are particularly interested. We say to them, "Come up and work in our library, examine all the books you find bearing on your subjects, and when you have made up your mind what books are going to be of most real use to you, buy them and go home with them for further study by yourselves." Following this method, we feel confident that students in these short courses have been, and will continue to be, greatly benefited.

These short courses are adapted, both to the practical needs of poor men and women, and to the practical needs of those who are well-to-do, — to the needs of all men or women who for one reason or another cannot get away from home for more than ten days at a time; for we have put the cost of these courses very low, just the bare cost of living. Perhaps you have received a copy of this year's short course booklet. In case you have failed to do so, I have a few copies here for distribution. It will be a great favor if you will extend as widely as possible knowledge of these advantages.

It will interest you to know that our dormitories, this year, are absolutely full of longer course students. We could not admit another boy today without putting three in a room. We could provide for three or four more girls in the girls' dormitory. We have one large room on the top floor of Agricultural Hall which will not be needed this winter for a laboratory, and we are going to fit that up with a ward of beds and try to accommodate all comers for the Winter School. The room is light, the windows are large, it can be well ventilated, and will make fairly comfortable quarters. In the gymnasium of the girls' dormitory we can put up cot beds and make comfortable a few Winter School women.

This condition may be taken as a healthy symptom of the good regard in which the College is now coming to be held. When the legislature meets we must ask for a new dormitory to accommodate a hundred students. Anything smaller than that will not do. We had over forty additional students enter on the opening of the fall term, most of them in the freshman class. As a result of the new inducements which are being offered to students who desire a scientific and practical education in our long and in our short courses, we are having, and are going to have, I am sure, a greatly increased number coming each year to the College.

There is another thing that we thought we might do to extend the benefits of the Institution. In one respect we stand contrasted with all other colleges that are not land-grant colleges; we have graduated very few people who have taken up the work of teaching. Most of our graduates have gone, as they ought to be expected to go, into the industries, that is, either into agriculture or into some other trade or business. We have very few graduates teaching in Connecticut schools. If a Harvard man goes into a high school to teach, every boy that comes to him to ask, "Where shall I go to college," will be told "Why, to Harvard, of course!" And the Yale man will say, "Go to Yale!" Why? Because the Harvard man knows Harvard from the inside and is fully persuaded of its useful and noble character, and the Yale man stands in the same position with regard to Yale. The Wesleyan man will send his high school boy to Wesleyan every time, and the Trinity man will send his inquirer to Trinity. The high schools as a whole, therefore, act as feeders of the other colleges, but not of The Connecticut Agricultural College. The teachers of our common schools, likewise, do not know or understand the special kind of training which the Connecticut College gives, and the result is we have few natural feeders anywhere, except among a limited number of the farmers of the State and some of the business men. It is no wonder, then, that the number of students, up to the present time, has been no greater. It will be a wonder, however, if the number of students does not increase with the succeeding years faster than we shall be prepared to provide accommodations for them. We have learned at last, we think, how to get into better connection with the schools, our natural feeding constituency.

We said to ourselves on opening the Winter School, these practical courses will assist us in bringing practical men to the College, and when they go away they will talk with others about the College and its advantages on all possible occasions. We wanted those men to come in order that they might get all the help they could for their own benefit. We hope now that the farmers themselves, much more generally, will from year to year come up to the College; because we feel that they will, when they have had our help and thus satisfied themselves of our real character, be more likely to succeed and to send us their boys and girls. But when we thought, on the other hand, of the great number of schools over the State with which we stood in almost no immediate connection, we said to ourselves, "There is our great chance! We will do two more things. First, we will provide something which will benefit the teachers themselves, and we will invite them to come to the College to get it. Second, while they are at the College we will enable them to see for themselves what benefits we have to offer to certain of the scholars that are passing through their schools." Accordingly, this last summer we started a Summer School in Nature Study and Country Life. We were asked to put in other things, but we resolutely said "No, everybody's attention shall be turned to out-of-door, country life and nature study, with about equal reference to the practical and to the beautiful things in nature." The teachers came, thirty or more. All attended most of the classes. Fully half attended no fewer than ninety-nine exercises inside the four weeks. We did not require any to take all the work, but those who did take all were given a special diploma. Seventeen diplomas were thus awarded.

In addition to the advantages of our College grade work, our Winter School and our Summer School, we have now what we call Supplementary Courses; these are arranged so that they will connect closely with the common schools, and provide liberal, scientific, and practical instruction of secondary school grade for boys and girls who have had a district or common school education.

In this we do not stand alone. In several of the larger western states there is a movement to establish agricultural schools in the different counties. Wisconsin, as your President has said, has lately taken a step in this direction. In a recent number of the *Rural New Yorker* an interview with President Schurman of Cornell has appeared, in which he holds that the next thing to do in New York is to establish in each county or judicial district schools of just this character. He urges that these should be affiliated with the Agricultural College of Cornell. And he recommends that the first school of that kind be established at Cornell in immediate connection with the university.

New York is a large State, our State is a little one. I do not think we need more than one such school in Connecticut, but I think our own experience demonstrates, and I think the judgment and experience of other states demonstrate, that there is a real field for such schools; and our College is the natural place for the Connecticut school. This agricultural and mechanical school work we have introduced, calling it our Supplementary Courses for boys and girls who have had a district or common school education. It is designed both for those who have no high school in reach, and for those who do not want to go to an ordinary classical high school, but would like to go to a high school in agriculture and the mechanic arts. So much for our labors and their objects.

In general, as an evidence of the value of land-grant college education, permit me to read you a clipping which was sent me yesterday. This is a letter which was written by a farmer, published first, it seems, in *Wallace's Farmer*, and afterwards copied into an Illinois paper. The clipping from the Illinois paper is the one I hold in my hand.

"For two years I have had a hired man who had graduated from our Agricultural College. Some of my neighbors called me a fool for paying the wages that he demanded, but I never made a better investment. His knowledge was my lemon, and I squeezed it. I bought some books on farm chemistry, botany, surveying, and horticulture, and took practical lessons of my hired help in those studies.

"My hired man honored his profession. In a few weeks my boy, lately indifferent to farm work, tagged around at his heels and begged to help him. My girl trailed after us with her botany. I stood speechless one summer day while she told me what Ruskin said about the clouds. Her fingers were in a book that had the hired man's name on the fly-leaf. I looked through it and showed it to my wife. She said if such culture was agriculture she was glad her daughter was finding it out.

"That summer we began war on insect pests by studying entomology. My children went wild with enthusiasm, and collected specimens under the hired man's directions. Because he was watching for a certain moth Will refused to go with some other boys to the circus, though a year before he came near running away to join the circus company. In his threat to do so he had quoted the frequent utterance of a neighbor, 'A farmer's life is a dog's life.' The life of my educated hired man by its very contrast with a dog's life had saved my boy. Before the summer was over our children knew the birds, their ways and haunts, from the bobolink to the owl. By October they had set themselves to protecting quail and partridges. Agricultural science had taught them that most birds are farmers' friends.

"I had tried to forecast the weather by a barometer, but concluded that the instrument was too mercurial to be reliable;

but Mr. Smith seemed to understand its changes sufficiently to keep our hay out of the way of long storms. His observation and mine were another example of the difference between educated and uneducated eyes.

"No new buildings were put up, but under Mr. Smith's directions I fixed over our barns and sheds until dryness, ventilation, and convenience for cleaning were as good as in costly structures."

The land-grant college educated hired man, you see, is a good investment. He will save your money, and he will keep the boys on the farm. We are asked constantly to recommend men for poultry work, for dairying, and for general farm superintendence. We have had more applications this year than we could fill. We have had to return requests for help in every one of those several departments, after having placed all our available graduates. I want to tell you frankly, however, we got fooled in one case. We had an application for a man, and we recommended a graduate who had already done most excellent work in a certain department. We thought he would be a good all-round man, but he did not turn out to be one. Naturally, you would suppose that that kind of thing would not be calculated to recommend the Connecticut College. But while we have had one such case, most of our graduates have done remarkably well. And the man who in this case was disappointed still has such confidence in us that he has sent a boy to us this winter for twelve ten-day courses, and is going to pay his expenses; because he thinks our institution is the place to train such boys for practical work. In all instances, excepting the one mentioned, so far as I have been able to discover, our men have given perfect satisfaction. The land-grant college graduate is in good demand.

One further thing, and I would not ask time for it if it were not of such radical importance. It is this: I do not know of another land-grant college that is so badly handicapped by its location as is The Connecticut Agricultural College. I say this in all sincerity and truth, and I say it without consultation with our Board of Trustees or with our Faculty, — I want you to understand that I say it on my own responsibility. I have been told that a former president, Professor Koons, at one time said that he thought the location was not all that could be desired, and that there were men "out after his scalp" because he ventured to do so. I do not know but there will be people after my scalp. Be that as it may, I feel today in honor bound, as head of our land-grant College, to tell you I believe that its present location operates greatly to the disadvantage of this institution. The location is objectionable because the College cannot now be reached with anything like the ease that the other agricultural colleges can be reached, and thus, as compared with them, is severely handicapped in its efforts to be useful.

When a man is fully persuaded that the College is a good place to send his boy, he will manage to get him there. Why, a man could walk from Warren to the College, or from New York, or from Providence. A man could get to the College from the farthest corner of the State walking on his knees, if it were necessary. The isolation of the College as a place for students is not such an important factor, when once its advantages have come to be known and appreciated. The trouble is that the ordinary means of making our advantages known and appreciated are not now at hand. The College would advance much more rapidly if people could reach it more readily. We would like to have every grange visit the College at least once a year. We would like to have every farmer who is interested in the advancement of his business frequently come there. Our agricultural experiments and methods should be observed and their results noted by increasing numbers of people. The results of the application of different manures and fertilizers to grasses should be seen. One treatment brings the grass up so high, and another treatment helps the grass up higher, and so on. Our tests of the varied tillage of other crops should be watched. In our present location we are practically inaccessible to the mass of farmers.

What is the difference, for example, between our College and the Michigan Agricultural College? One is this: The Michigan College has a spur track from the railway which runs right into the college grounds, and over which excursion trains are brought to the heart of the campus. That is the case with several of the land-grant colleges. No fewer than thirty thousand people have been entertained in a single month at one college because of easy railway communication. I refer to the college at Guelph, Ontario. The railways in some of our states encourage the land-grant colleges as good things.

They look upon them as institutions which it is good policy to build up, and they give the farmers almost free transportation to visit them. They make special rates for the benefit of the colleges, and they make them very low.

Now suppose, for example, our land-grant college were located at Hartford, or in its immediate vicinity, where the electric cars from the steam railway stations could reach it in from three to five, or even ten, minutes. How easy it would be for the people from the eastern, northern, southern, or western part of the State to get to the College. Many who now do not come to the College at all could get there at least once a year. How often, when you had an hour on your hands in Hartford, you would jump on an electric car and come out to the College to observe something that you wished to see, or to ask a question of one of our specialists about some matter which bothered you, or to see some cow, or new piece of apparatus. All of this would have a distinct educational value, and be a great pleasure and convenience to the farmers of the State. I cannot emphasize this too strongly, for don't you know that it is a constant source of stimulation to a man engaged in your business to have such opportunities? Why, it is one of the greatest incentives both to a college and to its visitors to have this flow of people back and forth. Many people by such a change of location would be brought at once into inspiring contact with the members of our Faculty, — many who now scarcely ever see us. On the other hand, such an influx of visitors and inquirers would be a source of great inspiration to the members of the Faculty. Besides coming to know more of the farmers of the State, we should be able to come into contact with more of the members of other educational institutions. Now we scarcely ever see a member of the Yale Faculty, we scarcely ever see a member of the Trinity Faculty, and if it were not because we have two members of the Wesleyan Faculty upon our teaching and experimenting staffs we never should see anybody from Wesleyan; because, either they do not happen to be coming our way, or, if they do happen to come our way, we are so far to one side of their lines of travel that they do not take the trouble to visit us.

Another thing: You must now charge yourselves with the entire support of the institution in even the smallest necessities and conveniences. You must build houses for the Faculty, and you must provide dormitories and boarding clubs for all of the students. You will soon need room for more than two hundred and fifty students. By-and-by, certainly, even at Storrs, you will have that number. Many of the students will be in modest circumstances. But some of you are well-to-do and would like to have your boys board at a better table than we can afford to set at $2.75 a week, our present price. If we were in the suburb of a city, you could have your boy board at a good club or hotel. The Faculty could find such apartments as their tastes and purses might lead them to choose among the houses of private landlords. There are, in short, so many things to be taken into account that I cannot forbear to speak of the importance of a better location for the College.

We have a good farm, good courses of study, and a good Faculty and Station Staff. What we need are a good farm, good studies, and good instructors and investigators, located where we can do with them the best educational work. We have started with this ideal, — we want to see The Connecticut Agricultural College not in a position to do merely passable work in an up-hill situation, but in a position to do effective work for scientific and practical farming and the other industries in the best of locations; we want to have you understand that in this particular, as in others, we are hitching our wagon to a star.

Whatever our location may be, however, there is one all-important fact to be borne in mind, and with this I close. For successfully carrying out the educational policy which this report has chiefly been occupied with outlining, our land-grant College ought in future steadily to have at least as good an annual appropriation from the State as it now has from the federal government.

The President. There are just a few minutes left. Have you any questions which you care to ask?

The Secretary. While President Stimson was talking I wanted to ask him if the disadvantages of city surroundings in training boys for farm work would not more than offset the advantages which the city life would offer? When you are training boys for farm work you do not need too much or too many of the attractions of city life.

President STIMSON. In reply I would like to ask the Secretary if he doesn't think it is a good thing for a farmer, once in a while, to go to Hartford?

The SECRETARY. Yes, I do.

President STIMSON. A lady in the western part of the State told me two or three years ago that she thought it was the duty of every farmer who had no city near him to take care that his boys and girls should go to a city to be trained, after the most had been made of the educational advantages provided at home. It undoubtedly does young people, as well as older ones, good to go to Hartford occasionally. I was not advocating a location at Hartford or near it, however, because Hartford is a city. I was not thinking of it solely because I think the boys ought to be taken to a city to be educated for agriculture, — I think we have a splendid location now in which to educate boys for farm life. Nor was I speaking of a change of location because it is impossible for our Faculty to do good work where we are, — we are doing good work now. My reason for speaking was the conviction that it is important to the farmers and other public spirited citizens of the State that they have easy access to the College, so that the work and value of the College may be better known to them and more closely followed by them. A change of location would surely justify itself in a very few years. As to a suburban location for an agricultural college, I certainly have no doubt, Mr. Secretary, I have no doubt at all, of the wisdom of locating such a college near a city. The history of the Massachusetts Agricultural College at Amherst is a case in point. I do not know of an agricultural college that has done more for the science of agriculture than that of Massachusetts. That college is doing excellent work, and one great reason why it is doing so well is found in its advantageous location. I have been told that the Michigan Agricultural College has gained very largely in students and in effective influence since the electric car line and the spur track of the steam railway from

Lansing came into the campus. The other strong agricultural colleges with which I am acquainted are strong because of the advantage they have in excellent locations. I do not know, Mr. Secretary, of another agricultural college which enjoys an isolation equal to that of the Connecticut College.

The SECRETARY. My objection was not to means of transportation, or means of accessibility to the College. My objection was, that when you place boys of the age which you have in charge in too close contact with many of the attractions of city life you will find it difficult to educate them in an agricultural line. They will too often become side-tracked and get away from agriculture rather than grow up and develop in agricultural lines. That is the objection I had. I certainly feel that the Storrs College should be made more accessible if possible, or the College of Agriculture should be made more accessible to the farmers of the State of Connecticut and elsewhere, not only for the benefit of the students but for the benefit of the greater number of patrons of the College and especially of the Faculty of the College.

President STIMSON. I hardly agree that such a location would result in educating the boys away from agriculture.

A MEMBER. Don't you think it would be bad for the discipline of the school to have it near a city?

President STIMSON. No, I think it would be an excellent thing for our College discipline if our students could once in a while be ruled and policed by the police and ordinary regulations of a municipality, and not have to feel that they were continually under the eye, more or less inquisitorial, of the Faculty. I do not think such a location would, on the whole, be bad for either the discipline or the morals of the students. It is only rarely that a boy goes to pieces in college — in other colleges, and I do not see why a land-grant college should be considered an exception to the general rule. Trust your boys. Trust them to control themselves, to go out now and then to walk up and down the streets, to glance into the attractive shop windows, to touch elbows with and look into the faces of the busy, enterprising metropolitan multitude. A boy in thus going to town will work off a little of his surplus energy which otherwise might result in mischief that would bring him up for college discipline. It will be as refreshing for him as for you to go to the city where there are objects of art and beauty — where there are many things new to him to be seen, where for example, there are better vegetables shown than he very often sees on his own farm or even at the best agricultural fair.

Sheer interest, interest frequently stimulated in the best things, is an aid to good discipline. We hear it said that the best things from the farm go to the city. They do. If you want to find the best fruit and the best vegetables, you must go to the city. It will do the boys good to go up the street and see better vegetables than you have been in the habit of growing, and to see how the city marketmen present their objects for sale. I went down here (pointing to the right) to a fair this last summer, on an invitation to address the people. I found there an exhibition of poultry. A cockerel and a pullet were put into a soap box that was so small that the cockerel could not stand up to save his life, and the pullet was down under his legs trying to look out; and the rest of the exhibit was presented in scarcely more successful fashion. A boy learns a good deal by contrast. In the cities, as a rule, all agricultural products are presented for sale in excellent shape, and I think the city object lessons in agriculture would justify the location of an agricultural college within, or near the city limits, since our formative years in agricultural education, as elsewhere, are not the least important years of our lives. Another thing: A suburban location would promote the dignity of agriculture as a calling, and thus be an important aid to good discipline. If you put your college away up on a hill in a few wooden buildings, and say to your boy at the same time that agriculture is the greatest and most glorious calling on the face of the earth, do you think he will be convincingly impressed? What is it at Washington that makes you blush for agriculture? Is it not that the buildings of the Department of Agriculture stand out in such bold and unfavorable contrast to the magnificent Congressional Library, the Capitol, and those other neighboring government buildings so beautiful and so full of dignity and honor? The first man you find in the Agricultural Building that says anything about it will tell you, "By-and-by we are going to have an Agricultural Building that will compare favorably with these others." And no doubt that prophecy will soon be finely fulfilled. Put your Federal and State buildings devoted to agricultural science and practice in the State of Connecticut near some central city, and make them the kind of buildings that the citizens of the State will be proud of, and I think you will do more than almost anything else can do to increase in the minds of your boys a sense of the value, attractiveness, and dignity of agriculture as a calling, and to turn their minds and hearts to studiousness and good order.

We, as officers of the College, thank you for what we have to work with; but, my dear ladies and gentlemen, we, as citizens of Connecticut, want something far finer than we now have, and we think that this is your due, the due of your boys and girls, and our due.

The PRESIDENT. There is one thing that I will ask President Stimson, and that is, if he doesn't think there is a radical defect and error in the way these boys and girls are started at home relative to farm life and the farming industry? If he does not believe that right there they may be taught and that it is essential that they should have small duties, and be taught to attend to them? I would not load upon a young boy what I would upon a stalwart man. I would not put on a young colt what I would put on an old horse, but I would have every boy and girl of mine assume some responsibility right at home in regard to some things, and then hold them to it. That is the starting point. I do not care whether your school or college is on a hill back from the railroads or in a city then. You are all right. You have something that will hold them. You may talk as much as you please about the other thing, they will get out if they are in the woods, somewhere. I believe in getting them started with that grand principle of responsibility when they are boys and girls. You get them started right and they will be pretty apt to come out right.

Recess until 2 P. M.

AFTERNOON SESSION.

TUESDAY, DEC. 9, 1902.

Convention called to order at 2.10 P. M., Vice-President Seeley in the Chair.

The PRESIDENT. If you have any questions will you please deposit them in the "Question Box," and we will try to answer them, or tell you we cannot, — one of the two.

Mr. Mulford, who was to be the first speaker this afternoon, telegraphs that his train is delayed by the storm but expects to arrive within an hour. We will therefore allow him to exchange places with the speaker who was to follow him, and I take pleasure in introducing Mr. F. H. Stoneburn, the poultry expert of the Connecticut Agricultural College, who will now address you.

THE FARMER AND THE HEN.

BY MR. F. H. STONEBURN,

Of the Connecticut Agricultural College.

Mr. Chairman, Members of the State Board of Agriculture, Ladies and Gentlemen: When I received a request to appear at this meeting to say a few words upon the subject of poultry culture I think I experienced the sensations of the lady who, after long years of waiting, finally received a proposal of marriage. Upon her first opportunity she told her friends about it, and one of them asked her to describe her feelings at the time. After a pause she replied, "Well, I was somewhat embarrassed but awfully tickled." Mr. Chairman, I was somewhat embarrassed at having to address a body of men with the wide experience in business and agriculture which you possess, but I am awfully tickled to have an opportunity to say a few words in behalf of the hen.

In taking up the subject of poultry-keeping today I shall confine myself to its strictly practical aspect, laying aside all else. As business men you desire the matter discussed from a business standpoint. Can this industry stand and grow upon a basis of pecuniary profit? I firmly believe that it can, and I hope to present facts today which will lead you to think that you have lost some opportunities if you have not taken up this line of agricultural endeavor. I may fail to convince you, but I hope to at least induce you to investigate the matter more fully, for when a man lays aside any prejudices he may entertain, and honestly seeks the truth regarding this great industry, he will almost certainly become a convert to the gospel of "better poultry and more of it." He will find that the business is far from being free from all unpleasant features, and that it is no "get rich quick" scheme, but he will also be convinced that no other branch of animal husbandry offers as many advantages.

An authority on poultry matters addressed the meeting of this Board some two or three years ago, and in the course of his remarks he said that this State annually imports eggs to the value of one and a half million of dollars. So far as I can ascertain this statement is founded upon fact, and has never been questioned. Please understand this vast sum is paid for eggs alone, and does not include the table poultry: chickens, ducks, geese, and turkeys. Would it not be a decidedly conservative estimate to say that the value of the latter equals one-third of the eggs, or about a half million dollars? If we admit this, we find there is a total of about two millions of dollars which, each year, leaves this busy little State of ours for products which we can and should produce at home. Do you believe for an instant that the kind-hearted citizens of our more strictly agricultural States are producing and shipping these goods to us at a loss merely because we do not care to produce them for ourselves? Hardly. They are growing chickens and eggs because it pays them to do so. I am strongly inclined to believe that a portion of this profit would be most acceptable to most of the farmers of this State. Fortunately they can have it if they wish it enough to try for it.

Every once in a little while Uncle Sam publishes a book which affords some mighty interesting reading. The last volume bears this title, "Twelfth Census of the United States." From the agricultural statistics I wish to take a few figures which may be somewhat instructive. We find that Connecticut has 26,948 farms, and of these 23,064 reported poultry. In 1899 these farms produced eggs to the value of $1,523,319 and stock valued at $984,207, which gives a grand total of $2,507,526, or only a little over half what the State consumed, being but a half million above the conservative estimate of the poultry products imported. It is plain, therefore, if we are to meet the demands of our own markets we must double the amount of poultry kept in the State. Every year these 23,064 farms must each produce eggs and table birds to the value of $85.00 more than at present. Now that does not look very large, so we will state it in another way. Suppose 5,000 of these farmers, about twenty per cent. of those now producing poultry, should decide to meet this home demand. Each would have to produce annually about $400 worth in excess of their present output. Of course we must not lose sight of the fact that we export somewhat to large neighboring markets like Boston and New York, but I am sure that this proportion is small, as the ruling prices at home compare very favorably with quotations in the cities mentioned.

Now, of course, I do not anticipate that immediately 5,000 farmers will devote themselves to poultry keeping, but I am happy to say that better days for the poultry industry are at hand. We may all note an increased interest on the part of all classes of people. This is not a touch of the unthinking "hen fever" which swept over New England half a century ago, but it's a solid growth based upon common sense. Better stock is kept; better methods practiced; products are marketed in better shape. And the encouraging part of the whole thing is that better prices prevail. I doubt if any of you can remember a year when the price of eggs has maintained the high average of the year just closing. Consumption easily keeps pace with production, and high-grade goods will always bring remunerative prices.

The earning power of a good hen is scarcely appreciated by the average farmer. She seems to be too small to be worthy of his attention excepting when her new laid eggs or toothsome body appear as an offering to his appetite. Very often he leaves the care of the birds to his good wife, and when she has collected a suitable quantity of eggs he will suddenly remember that he has to go to town, and that he may as well take along the eggs and save her the trouble later. So he hitches up and drives to the store, where he easily turns the eggs into cash, which, in too many cases, he calmly pockets. Then he spends the next half hour preaching upon the iniquity of capital in oppressing labor.

I have stated that poultry-keeping is one of the most profitable forms of animal industry, and in confirmation of that statement I wish to call your attention to a comparison with another profitable specialty, — the dairy. Now please understand that I have no quarrel with the dairy. I wish to state emphatically that I believe the dairy profitable. It is a good thing for the farmer and for the farm. But these two, the dairy cow and the hen, are found upon almost all of our farms, and the majority of us are more or less familiar with both, so a comparison will have greater weight than if I brought in some less familiar line. Let us again consult the census report.

On June 1, 1900, there were upon farms in this State 126,434 dairy cows. Since dairy animals are slow to mature, and have a comparatively long period of usefulness, it is safe to say that the number did not vary much from the preceding year. Now, in 1899, these animals produced dairy products to the total value of $7,090,188, and since this probably does not include the calves we will estimate this, and add it in order to be upon the safe side. Just to be liberal in the matter we will assume that each of these cows produced a calf which at birth was worth three dollars. You will admit that both the price and number are stated too high. At these figures the value of the calves would be $379,302, which, added to the value of the products as before stated, gives a gross income of $7,469,490 from the dairies of our State. Now what investment produced this amount of income? That depends upon the average value of the dairy cows of our State. One well posted man told me that he thought $40 would be about right, but again we will be charitable and put it at $35. At this price then, the value of Connecticut's dairy cows was $4,425,190. From these figures we readily see that from each dollar invested in dairy cows there was a gross return of $1.75. The percentage of actual profit I cannot state. But now let us take figures from the same unquestioned source and see if our hen fares any better. On June 1, 1900, there was found upon the farms of our State poultry to the value of $644,050. This is not an estimate, being the returned valuation. Considering that at that season of the year a large number of early hatched birds must have been enumerated which would not be found upon the 1st of January, it is safe to say that the value of breeding birds upon farms in January, 1899, did not exceed $600,000. In that year the total of eggs and young stock produced by these birds reached a value of $2,507,526, or a gross return of over $4.00 for each dollar invested in stock. Taking this ratio we find that $40 invested in a good cow returned $70, while $40 invested in poultry returned $160. These figures are somewhat surprising, but they become more so when we consider other factors. It is needless to say to you that the items of investment and labor determine largely the net profit. Upon this basis, again, the poultry leads, as it will cost less to house and care for $40 worth of hens than it will that $40 cow. There are doubtless some other minor points which, if taken into consideration, would affect this figure somewhat in one way or the other, but in the main I am sure you will find that they agree with our most reliable and unbiased authority. Please bear in mind that this is not a comparison of the best poultryman with the poorest dairyman, or the reverse, but it embraces all the dairy cows and all the poultry upon farms in Connecticut.

So to one taking a general view of the matter it would seem that poultry-keeping offers a chance for a fair profit. But let us go more into detail and find if actual experience will demonstrate this to be true. Just consider one part of the work of the poultry farmer, the production of eggs. Last winter Cornell University ran a coöperative experiment to find the actual food cost of eggs as produced upon farms in the State of New York. This experiment covered the months of December, January, February, and March, which in that State are winter months. In addition to the hens of the Experiment

Station there were included the flocks of seven farmers in different parts of the State, the total number of hens and pullets being 2,133. There were several varieties and all ages represented, so the work was carried on under a wide range of conditions. The actual work was done by the owners of the fowls, and no restraint was placed upon them as to the manner in which the birds were to be fed and managed. They were simply instructed to go ahead and produce eggs, reporting each week the number of eggs produced and the kind and amount of food used. The eggs were credited at New York current quotations while the food was charged at market rates. The result makes the hen-crank smile. These 2,133 birds under different systems of feeding and management produced eggs which were worth an average of $0.283 for $0.163 per dozen. This shows a profit approaching 100 per cent. over food cost. Notice that this was the average. As might be expected, some flocks were better managed than others and gave better results. One flock of 150 pullets produced eggs at $0.087 per dozen, a profit of about 250 per cent. That was better than shares in a producing oil well, and so you see it is possible to beat the oilmen right upon your rocky hillsides.

Of the twelve flocks represented in this test only one flock ate its head off and failed to produce eggs enough to pay for its food. This was a flock of 26 yearling and two-year old hens, which we all know are not winter layers. But these 26 birds cut very small figure when we consider that the total number in the test was 2,133. Only a little over one per cent., you see. Can you point out to me any other form of live stock which has but one dead head in every hundred?

The best records were made by early hatched pullets that began laying in the fall and kept at it all winter. The flock before mentioned as having produced eggs at a low cost showed a profit of $0.621 per hen for the four months. Five hundred birds of this kind could be cared for by one man, and in the four cold months when other farm work was light they would produce the comfortable profit of $310.50 from the sale of eggs alone at current market rates. And this, too, in the face of the extremely high price of grain which prevailed last winter. At the present time eggs are as high or higher than they were last year, while grain is much lower. Last Saturday I called up a grain dealer and got quotations on all kinds of feed, and just for my own satisfaction I figured out what those same birds would have made with grain at its present price. I found it would make a difference of $0.0728 per hen; therefore, our flock of five hundred would show a profit over food cost of $346.90 during the four winter months. But I happen to know that some of these men do not sell their eggs at market rates, but place them with select trade at four to eight cents premium above highest quotations, so in these cases at least the actual profit was greatly in excess of the amount shown. There is no secret about this extra price. If you have a regular supply of choice goods you can secure it also.

Now, gentlemen, and ladies, too, what these New York farmers have done, and are doing, you can do also, but you cannot do it unless you meet the necessary conditions. If you are willing to think and work, to accept set-backs as necessary lessons, willing to give this line the same attention you bestow upon your fruits, your dairy, or your field crops, you will reap your share of the profit and thank a kind Providence for creating the hen.

But my subject particularly mentions the farmer in connection with poultry. That is because the farmer is the proper person to keep poultry successfully. He has the conditions which will make for success in the poultry business. Many of us think that the bulk of our poultry products come from special poultry farms, farms where the poultry products are the chief money crop; but this is far from being the actual fact. The product of these farms is not a drop in the bucket. The out-and-out hen man, the fancier and breeder, may help the industry by creating new breeds to meet particular needs, or by perfecting strains of existing breeds, but they cannot meet the demands of the open market. You farmers must do this, and there are several reasons why it is to your advantage to do it.

To begin with, you already have the land, and more or less in the line of buildings. Therefore, you can make a very fair start with but slight expenditure, because these two items usually take the greater part of the necessary investment. Then, too, most of you have more or less in the line of waste products and by-products upon your farm, and you will find the hen a capital little machine to turn these into salable goods. The sprouted grain, the scraps from your table, the clover chaff, the skim milk, the waste parts of the animals you slaughter, your cull fruit and inferior vegetables, yes, even the insects which prey upon your crops, are by her matchless chemistry transformed into gold, or what is as good as gold, the egg.

Another pleasant feature of this line is that it will permit you to utilize labor which is not available in other farm operations. Does your dairy require that you keep more help than you otherwise would on account of the single operation of milking? Put the spare time into poultry work. With but little trouble you can rear a few turkeys and ducks to use upon special occasions, with plenty of plump chickens to fill in between them. As for eggs there is scarcely a meal at which they will not work in to good advantage. Many of you are so situated that you cannot always secure a supply of fresh meat, and possibly you worry along on a diet of salt pork. It is impossible for you to step out and slice off a sufficient quantity of steak from a beef animal and leave the balance until it is wanted, but you can kill a duck or chicken and have a satisfactory meal with no waste. In this respect, at least, the advantage of size is with the poultry.

I fear I have taken up so much time with the "why" of poultry-keeping upon the farm that I will not be able to give the "how" the attention it deserves. However, some few points are so prominent that I will briefly touch upon them.

If you decide to give a part of your time to this work you will find it wise to gain as much information as you can concerning it. Send for the bulletins of our Department of Agriculture and Experiment Stations, and study them. Get one or two of our best poultry books, and read them carefully. Take one or more of our leading poultry journals and study each issue, gathering all the hard facts you can. Thus you will make yourself well acquainted with the theory of poultry keeping, and you will then be ready to adapt these theories to meet your own conditions. Remember that your own farm presents separate problems from any other, and that it is up to you to solve them.

If you have carefully weighed what you have read and observed, doubtless you will decide to keep nothing but pure bred stock. The reasons are not hard to find. One of the most important is that you will undoubtedly give better care to a flock of fine birds than you will to a lot of culls. You will experience a sense of pride and satisfaction in the ownership of well-bred fowls, and you will give them more attention. Many a man has been made a poultryman because, in some manner, he obtained possession of some really good birds. Now, I fear that too many of us keep hens about as one man kept a pig. He had the animal in his possession so long that finally a neighbor asked him why he didn't kill it. "Kill it," he replied, "what for? I've got to keep a pig and I don't know why it shouldn't be this one as well as any other." Get rid of the old patchwork flock and get good birds of one variety. You will find it easier to profitably handle a uniform flock than one containing specimens of several types. You do not feed and care for your roadster as you do for your draft animals, and you will find that the treatment which exactly suits the Leghorn will not do for the Brahma at all. Further, your flock of fine birds will give you a uniform product; eggs alike in color and size, and dressed stock in shape and weight. This means bigger profits, as uniform lots command the best prices. And you must not overlook another source of profit from your thoroughbreds which your mongrels cannot give you. I refer to the sale of eggs for hatching and breeding stock. You will not, of course, get the high prices secured by the leading fanciers, but you will find that many of your neighbors will pay you a good advance over market prices in order to get your stock.

Now, when I refer to thoroughbred birds I do not mean the high-priced show birds. For your purpose the color of a feather or two, or an extra point on the comb, will not make much difference. If you can get all the "frills" with real practical worth, well and good. It can be done. For instance, breeders of one of our leading varieties still delight to tell how a fancier took a fall'out of a critic who remarked that this man's birds were bred for show only. He had two beautiful pullets that were full sisters, and these he entered in the big Boston show, one in the open class for pullets of that variety and one in the dressed poultry section. He won first prize on each bird, thus proving most decidedly that it is possible to breed show birds with some practical value. Sometimes, however, you will get hold of stock which has been bred strictly for the show-rooms, with health, vitality, production, all disregarded.

Such birds will disappoint you. But we have many breeders who are producing business stock, so you need have no trouble on that score. If you are afraid to purchase pure stock you can, at least, head your present flock with a male of some of our standard varieties, and by careful selection of the young stock secure a fairly uniform flock. But be sure to use a pure male each year or your flock will go back.

What particular breed to use is a question to be answered by each individual. Get the breed you like, but be sure to like the breed that meets the requirements of your market. In other words, if your customers demand eggs with brown shells it would be folly to serve them with white shells; while, if they demand a bird with yellow skin and legs it would not be good business policy to try to educate them to using white skin and dark legs. It would cost you too much time and money to do this. As a general proposition it would be safe to say that for the production of white eggs the Leghorns lead, the single comb white being the favorite. For brown eggs any of the Plymouth Rocks or Wyandottes will please you. For market birds white plumage is to be preferred, for white birds are free from the ugly black pin feathers which are found in those of dark color.

The question of housing is one which is ever being raised and never settled. The columns of our poultry papers teem with plans and specifications of structures, ranging from the single board half muslin affair to the building with brick walls and steam heat. Again, your own conditions must determine how you shall care for your birds in this respect. The shelter you have, the lay of the land, the amount of snow you must contend with, all bear upon the matter. For instance, in eastern Rhode Island, a region of comparatively mild winters and light snow fall, the colony plan is much in evidence. Here great numbers of small houses, say about eight by ten in size, are scattered all over the farm. But in the northern part of New England, with long and severe winters, and heavy snow fall, the long house would answer better because of the great amount of labor required to attend to the widely separated flocks when there is much snow upon the ground. But all poultry houses, no matter what particular form, should have several things in common. For the comfort of the birds they should be dry, free from draughts, sunny, and fairly warm.

For the comfort of the poultryman, and the economical conduct of the business, they should be convenient. It is generally admitted that a house which may be opened up to the sun and air, when conditions favor, is the best for the health of the stock, and therefore, for the production of eggs. I refer to the so-called scratching-shed and scratching-pen houses. There are many types, but each has a protected room with movable front, which is thrown open on fair days, permitting the birds to exercise in the open air and unobstructed sunshine. In bad weather these fronts are left in place, thus keeping the exercising-room comfortable. Then there is a comparatively small and tight roosting room where the birds may sleep in comfort during cold nights, the heat of their bodies serving to keep the room warm. You will note that this system equalizes the temperature. I do not think that a reasonable amount of cold will do the birds any harm. It is the great variation between the day and night temperatures in the ordinary hen-house which causes most of the trouble. This variation is most noticeable in structures with a large amount of glass. Such a building will become very warm during the sunny winter days and correspondingly cold at night, due to the rapid radiation of heat through the large glass surface. If any of you have houses of this kind you will find that they will be decidedly more comfortable if curtains are placed before the windows at night to prevent this radiation of heat gathered during the day.

The furnishings of the house should be simple, and it is best to make them movable, so they may be readily taken outside and cleaned in case they become infested with lice. For the mash-feed supply a simple trough, long enough to accommodate all of the birds without crowding. The water-dish may be a simple tub or pail, set, if possible, where no dirt can get into it. One of the regular poultry fountains is desirable on account of the latter consideration. The roosts should be placed in the warmest part of the house. Under them, for the sake of cleanliness and convenience, should be a dropping-board. With the dropping-board elevated eighteen inches from the floor a secluded place is made in which the nests may be placed to good advantage. A hopper for grit and shells and an elevated coop for broodies and surplus males, and your house is complete.

Let the buildings be located, if possible, so that the work in them can be attended to with the smallest possible effort. The labor item is one of the heaviest expenses upon a poultry farm, and it pays to reduce it as far as possible by convenient location and arrangement. It will take about so many pounds of grain to produce a pound of chicken or a dozen eggs, so you must save on the labor bills. Convenient location often means that extra care in bad weather which will fill the egg basket; care which will not be given in too many cases if inconvenient conditions prevail. Make your house large enough for the flock, or else the flock small enough for the house. You will be better satisfied when you strike your balance at the close of the year's work. Overcrowding means trouble and loss. In scratching shed-houses six to eight square feet of floor space per hen will give satisfactory results. In closed front-houses allow a little more space per bird. The yards should be of generous size, if possible large enough to have growing grass in them constantly. In a small yard the fowls will clean out every particle of green growth. Growing grass keeps the soil sweeter, and affords a constant supply of green food to which the birds may help themselves.

But if we have fulfilled all the conditions just mentioned we are likely to fail to secure the early eggs, the profitable kind, unless we have stock which has been reared with this object in view. It is the early hatched pullets which begin to lay in October or early November and keep it up all winter. But they must not be hatched too early, mind you, for such are likely to go into molt in the early winter. For the American varieties the best hatching time is from the 20th of March to the 20th of April. Hatch the chicks between these dates and then keep them healthy and growing, and you will find that they will come to laying maturity in the fall. If you have had pullets laying in the preceding fall you will experience no trouble in getting them to set by the first of March. The reverse also holds, that birds which begin to lay late will also set late. But thanks to the modern incubator and brooder we are quite independent of biddy's whims, and we may hatch and rear our chicks any time we choose. The quality of stock reared artificially compares very favorably with that raised by natural methods.

The feeding of the chicks requires close attention. For the first twenty-four to thirty-six hours they need nothing in the line of food, and are better without it. In fact, some poultrymen feed nothing for the first three days, but I cannot bring myself to adopt this system. I formerly fed at first rolled oats and what is usually termed "Johnny cake," including in the latter some bran with the corn meal. Infertile eggs are worked into it, and the whole mixed with skim milk. After a day or two a little millet seed and finely cracked corn and wheat were added in small quantities, increasing these grains as the chicks grew. Plenty of fine grit and oyster shells were supplied from the first. If convenient, we often fed some liver, thoroughly cooked and chopped. After two or three weeks one meal per day of mash was given, increasing this as rapidly as the chicks would stand it until about one-half the total feed was in this form. This mash should be mixed with milk whenever possible, and fed in a crumbly, never sloppy condition. A very simple and satisfactory mash consists of two parts bran, one part corn meal, one part ground oats. After a few days of this feeding a small amount of beef scrap may be added, increasing the proportion as the chicks seem able to stand it. For the first five or six weeks the little fellows should be fed five times per day, but after they are able to shift for themselves three feeds per day will do very well. In addition to the mash let them have cracked corn, wheat, buckwheat, and occasionally oats, soaking the latter on account of the tough hulls. We have now discarded the Johnny-cake rolled-oat feed for something more convenient. We use one of the well-known "Chick foods" which is prepared for this special purpose. This food is always fed dry, and contains finely cracked corn, wheat, and peas, millet seed, chopped oats, beef scrap, charcoal, oyster shells, and grit. It is not expensive, is handy to feed, and the chicks like it and thrive upon it. Otherwise our system is unchanged. It is not necessary to add that there should be a constant supply of green food and fresh water.

As soon as weaned the chicks are placed in small roosting coops, twenty-five in a coop, and these are scattered around the place so the youngsters may have a chance to rustle around and develop strong vigorous bodies. Plenty of shade is necessary all the time, and the coops must be kept clean. As soon as it is possible to distinguish the sexes it is best to separate the cockerels from the pullets. Let the latter have as much range as possible, but the cockerels, excepting those intended for breeders, may be placed in comparatively small yards and fed all they will stand. Market them as soon as they can be fitted.

Early in the fall get the pullets into their winter quarters and then do all you can to start them laying. I do not mean by the use of stimulants, but by good care and feeding. The feeding is particularly important just at this time. It takes some little experience to become a good feeder. Interest and constant watchfulness of little things are necessary.

There are lots of poultrymen who advocate the feeding of dry grain exclusively, but I personally can secure better results from giving about half the feed in the form of mash. This mash may contain a great variety of grain, vegetables, meat, clover, lawn clippings, table scraps, etc., etc. I prefer to cook it by steam if possible, and if not, to at least mix it with hot water. A simple mash which can easily be made up on any farm is the one I just gave,—2 parts bran, 1 part cornmeal, 1 part ground oats. Add a small amount of middlings, fifteen per cent. beef scrap, and about one-fourth of the bulk vegetables or clover. Whenever possible to secure it it will pay to use skim milk to mix it with. But be sure to feed it crumbly and not wet. For the other grain food use cracked corn, oats, wheat, barley, and buckwheat. The relative amounts may be determined largely by the market value of each.

When to feed is another point to consider. We have all heard of the hot morning mash which will surely fill the egg basket. Now, a large number of our practical men do not feed a mash at all in the morning, but supply this meal in the afternoon. The reason for this is, that if you give a hen at one meal what mash she should have for the day, and do this in the morning, you will find that she will gorge herself and act lazy all the rest of the forenoon. As the hustling hen is the producer we endeavor to induce exercise by feeding the whole grain in the morning, throwing it into several inches of straw and leaves upon the floor. As a result, the hens are busy scratching in this litter a good share of the day, thus keeping warm and happy regardless of the weather. Late in the afternoon they are given all the mash they will eat, retiring to their roosts with full crops. This system offers many advantages to the farmer. We all know that upon the farm the morning hours are crowded full of duties, each one of which seems to require immediate attention. If a part of this work can be pushed over for a few hours it will lighten the load very materially. Do it this way. Discard the morning mash idea and feed the hens as I have indicated, throwing the morning grain in the litter when closing up at night. In the morning just a glance is needed to assure yourself that all is well, and you can go on with your other work knowing that for some time your birds will be all right. Don't neglect green food; provide plenty of grit and oyster shells; keep yards and houses clean; fight lice all the time. In short, keep the birds healthy and comfortable and they will well repay you for the time and effort bestowed upon them. As these pullets go into moult select a few of the best for the next year's breeders and put the rest upon the market. Then again fill up the houses with early pullets, and look to them for your supply of winter eggs.

This is, of course, but the faintest outline of the methods to pursue to reach success in this one branch of poultry-keeping — egg production. I will not go further into detail, as the discussion will doubtless bring out the points upon which your minds are not clear. I thank you for your attention.

DISCUSSION.

The PRESIDENT. Now there is a chance for anybody who wishes to ask questions. Mr. Stoneburn is chock-full of information on this subject.

There is one question I want to ask him. He spoke about getting rid of the young cockerels that you did not want to keep. Have you ever had one of these stuffing machines?

Mr. STONEBURN. I hope to have some experience on that, and I can tell you better about that a little bit later. From all the information I have been able to get, the chicken that has been well filled, with the body plump up with good soft mash, they tell me it's about as good eating as you can get.

The PRESIDENT. It's rather an unnatural operation, and an unhealthy one for the fowl, isn't it? I should think it would be to force fat in that way.

Mr. STONEBURN. You will have to ask a veterinary whether forced fat is unhealthy or not. I don't know.

A MEMBER. That is not much like the fellow who said if his hens kept on eating their own eggs before long they would be self-supporting.

The PRESIDENT. I do not think there are a great many that do that.

Mr. STONEBURN. Yes, and they are not self-supporting, either. I believe some experiments have been tried which show that the cooked food is more easily digestible, but for ordinary use on the farm I am much in favor of the mixture I recommended, 2 parts bran, 1 part of ground oats. Add a small amount of middlings, fifteen per cent. of beef scrap, and about one-fourth the bulk of vegetables or clover. You want to take your clover hay and cut it up in quarter-inch lengths. Have a clean place upon the floor and throw down all your hay there, and you will find there will be about a bushel or so of heads. You can supply a part of the green food in this way, and when it's mixed in with the mash you have got something which will help very decidedly to fill the egg basket. We feed it mixed sometimes.

Mr. PLATT. You spoke about oats. Do you refer to oats in the hull?

Mr. STONEBURN. That is what we use. You will find you will have to pay a good price for the hulled oats. While I like the hulled oats for the little fellows for chickens it is not necessary.

A MEMBER. The gentleman said something about the use of an incubator.

Mr. STONEBURN. One gentlemen asked me about the incubator when I came in. We have used several different types, and, of course, there is considerable choice in them, but we have had very fair success and have produced considerable stock.

Mr. PLATT. What percentage of your eggs do you generally hatch out in that way? I mean of the eggs you place in the machine?

Mr. STONEBURN. That depends largely on the eggs you put in. One of the greatest considerations to look out for in regard to that is the care of the breeding stock. You have got to be careful to get fertile eggs. It's easier to get a chick out of a fertile egg than out of one that isn't. (Laughter.) In other words, you can hatch fertile eggs. I have hatched all the way from nothing up to a hundred per cent., but I would say that, on the whole, with a good incubator properly run you will have anywhere from sixty to eighty-five per cent. of your fertile eggs hatch out.

QUESTION. Have you ever had the experience of finding fifty or sixty per cent., or a good big part of them, that did not come from the shell?

Mr. STONEBURN. That is a question of artificial incubation. We have got to work the thing out practically. There are many things which have got to be taken into consideration and which may bring about such a result. One man will say they couldn't break through the shells, and another man will say that you supplied too much moisture, and another will say something else. So it's hard to tell. In running an incubator, as I have said before, it will be proper to run it exactly as the instructions which accompany the machine tell you. In other words, if I were buying an incubator I would not buy it unless the manufacturer would guarantee it to do satisfactory work. If the machine does not do satisfactory work then you can return it. If the manufacturer said to me to run it at a temperature of 110, and I knew 110 was fatal, I would run it, and then if he spoiled my eggs he would have to settle.

QUESTION. What incubator do you use?

Mr. STONEBURN. I do not like to advertise anybody's make. There are a number of good machines.

QUESTION. Do you think it's necessary to have the temperature uniform at all times?

Mr. STONEBURN. Yes and no. I would not absolutely say no. I do not think that an egg in the middle of the tray has exactly the same temperature as the one outside a little way, but it's practically uniform. Of course, when you turn your eggs you will see to it that the eggs at the outside are brought to the middle.

A MEMBER. We tried to run an incubator at 103 and 102½, but when we have come to take out the eggs in the morning we have found them nearly cold. The thermometer runs down to 85 or 90. When we put them back, by the time the thermometer gets back to 103 we are ready to take them out and turn them again. Now, is that the proper course to pursue?

Mr. STONEBURN. I never experienced anything like that. I am not quite sure whether the machine does not furnish heat enough, or whether your regulator is right. You mean to say, if you get your eggs out and then put them back into the machine the thermometer or the temperature will run down? You mean to say it will not get back to 103 until twelve hours later?

A MEMBER. I do not mean to say quite that, but I mean to say it takes a long time for it to get back. We have followed the directions, but we have always noticed that it takes the incubator some time to get back to that temperature. Unless we turn up the heat it will take the incubator much longer to get back. Now, should we turn up the heat in order to bring it back to 103?

Mr. STONEBURN. I cannot understand it. I have never experienced any difficulty that way. Are you sure that your thermometer is quite active?

MEMBER. Why, no, I am not sure of that.

A MEMBER. I noticed when I was at the college that you had there a chart showing the condition of the egg on each day of incubation. Now, where can we get one of those? Can we get them at the college?

Mr. STONEBURN. That chart is something which I obtained. It is what is called Gamble's Chart. It shows the embryo in the different stages, and it shows the amount of air space in the egg and so on. You take your egg-tester and test your eggs on different days to see how much they dry down. Now, if that is uniform, we should expect to get a chart that was accurate, but if it's not, then you can get only the average. They have got some very advanced notions in this respect, but I have never paid a great deal of attention to it. I want to see the germ in the egg.

QUESTION. How soon do you test them?

Mr. STONEBURN. For a white-shelled egg sometimes in five days. I have seen the embyro in four with the acetylene gas lamp. For the brown-shelled egg in from seven to eight. The sooner you test your eggs the better you are off. If the testing is done early those eggs are perfectly good to use. A perfectly clear egg is one which has not been fertilized, and with the right light you can very easily tell them. We test them then, and then take it again usually along the middle so as to throw out any dead eggs, and then just before they hatch. We do this for the reason that we do not care to have the smell in the machine for one thing, and we want the chicks in the machine to have all the room possible.

QUESTION. How long do you cool usually?

Mr. STONEBURN. We do not cool a very great deal excepting in the summer. This time of year I would not do very much of it. Different machines will give you different conditions to face as to that, but we do not think it is necessary to cool the eggs as much as you would do under other conditions. We run the machine up to June, and along that time of year when the thermometer begins to run up pretty well we leave the eggs out quite a little while. As to the time, you have got to learn it from experience. All these little things are things which you have got to get from experience. You cannot figure them out in advance. The poultry business is a business for which it is pretty hard to give a rule or definite information on these little points which will fit all cases.

QUESTION. What do you consider the most important point in having good success in raising and hatching chickens in the incubator?

Mr. STONEBURN. To get good fertile eggs every time. If you get fertile eggs you can get chickens. I do not think it would pay you to try to hatch many chickens from eggs from pullets that began laying in October or November and that have been at it all winter. Take the yearling hen. Let them go along naturally. Take the best of your pullets of the preceding year, and along about the first of January or the middle, mate them up with good vigorous cockerels, and then when your birds begin to lay you will find that practically all of the eggs will be fertile. That was particularly impressed upon me last year. We had several pens of Barred Plymouth Rocks, and in testing the eggs I noticed that one pen in particular showed practically every egg fertile, and I said to one of the young men that was working on the place, "What does this mean?" "Well," he says, "you know they did not lay very late, and they have just commenced again about now." That was the secret of it. They had not exhausted their vitality. One breeder that I have in mind never pretends to get eggs from yearling hens in the winter time. He keeps his pullets in the houses and does not keep the male with them at all. All the eggs he sells are from yearling stock.

QUESTION. Do you think that these pullets kept in that way are more apt to give you fertile eggs when they begin to lay?

Mr. STONEBURN. Yes, sir. We do this: we select a bird. You will soon get your eye on one of these pullets of good form and build, and then we take her and put a leg band on her. In that way pick out some more, and presently we have got enough selected. Put them somewhere, and let them range around and they will get into the very best of health. Then feed them well, and when they begin to lay you can get eggs that are reasonably worth while.

I happened to be down at the Rhode Island Experiment

Station two winters. They had some finely bred birds of practically all varieties. In one pen there was a little scrub Rhode Island Red hen that they happened to save because she had a brood of chickens. And one day they found her in the nest. She was laying, and that old hen laid about 220 eggs that year. Now, I am not advocating scrub stock, but that is what that hen did.

The PRESIDENT. And is that a sample of what can be done right along?

Mr. STONEBURN. No, I guess not.

QUESTION. Did you ever know a hen to lay two imperfect eggs in one day?

Mr. STONEBURN. I have never seen it, but I have heard of two or three cases of that kind.

Mr. PLATT. What do I understand you to mean by that Rhode Island Red hen being a scrub hen?

Mr. STONEBURN. The Rhode Island Red is a bird which is probably made up by a cross of the Game male with a Buff Cochin hen. They are a good bird for the egg farmer. They are a red bird, and lay lots of eggs. They lay little brown eggs. They are all right in that respect, but unfortunately they will not breed true to color. If you had a hundred of them the chances are you would have a hundred different colors. This one was a particularly poor colored one. She was a scrub. She was not a bird you would think much of except to send to the pot, and she was not worth much for that.

The PRESIDENT. There is one thing, in the light of what you have been telling us, that I would like to ask about. It has been my experience that one of my hens would steal a nest off by herself, lay a nest full of eggs, hatch out her chickens, and I have found time after time that every one of those eggs would hatch. Those chickens would range around with the hen, and they would not get all the grains and things you have been telling us about, for all the grain they would get would be a little rye they would find around the place. And they have done the best of any chickens I ever had.

Mr. Stoneburn. Did they always hatch every egg?

The President. I never found a nest out in the field that I can remember but I found that every egg had been hatched out.

Mr. Stoneburn. Nor how many birds had stolen in and laid in that nest you do not know?

The President. I don't know that. The nest would be off by itself, away from the other fowls entirely.

Mr. Stoneburn. Well, one of the reasons why those eggs hatched well was this: They were all laid probably by one bird, and were uniform. If one would hatch, the chances were that under the same conditions a good proportion of the whole would hatch because they were all probably produced under the same conditions. Most always in getting a setting of eggs a man will go into his house and pick up thirteen eggs. They have come from several hens. They are of various sizes. The conditions are different. The probability is in that case you speak of, if one or two of those eggs had failed to hatch the greater part or the whole of them would have failed, and that would have been more liable to be so if several hens had laid in that nest.

The President. Well, why should those chickens do so well on that rye? They picked up some seed, and everything of that kind, but all the grain they got was a little rye. I can't understand why they should do so well. There must be some reason for it.

Mr. Stoneburn. What did you feed your other chickens that you are comparing these with?

The President. Nothing. They ran out around and picked up their living, with a few scraps, or something of that kind. There was plenty around the buildings there. We did not make a specialty of the poultry business, but we have remarked often that the hen that went off that way and stole her nest and brought up her brood that way would raise the best chickens. Now, what I want to know is, was the feed better adapted to them, or what was it? They grew up better and quicker than the others, and yet all they got was a little rye.

Mr. STONEBURN. I do not care very much for rye for chicken food. I can use other things for less money and better results. We used to grow considerable of it, tie it up, fasten it in the house, and let the hens thresh it out. A small amount of rye is all right. I believe it pays to feed a variety of grain. It doesn't cost you any more to feed a little wheat, corn, barley, or buckwheat, and your results will be better.

QUESTION. What is the Experiment Station going to do with the poultry work?

Mr. STONEBURN. The Experiment Station has taken up one or two lines. At present we are running an experiment with ducks. It has been thought that the average farmer cannot afford to keep ducks; that the money in ducks was not in keeping a few upon the farm but in making a specialty of it. I believe that is true in a broad sense, but I believe further that it will pay every farmer to have a flock of ducks on the place. We are making some little investigation as regards the markets; the best way of marketing the birds and what the market demands. We hope to publish a bulletin before long on that.

At the present time there is a good deal of interest in breeding squabs for market. We have begun to make arrangements for some comprehensive experiments on that. There is really at present no reliable data to go by. Most of this at present you must gather from the fellow who has got breeding stock to sell. While he may not tell an exact untruth he can stretch things if he wants to. I believe there is a good opening to the man who will devote himself to that line, as our game birds are getting very scarce. It is becoming practically impossible to get quail, and squab one month of age is now served on hotel tables and to a certain extent takes the place of game birds. This specialty will pay well, I believe.

At the College the work of the Poultry Department is this:

We have a boarding-hall where board is supplied at $2.25 per week, and one of our objects is to supply this table. Another is to afford birds for instruction, and the main points of poultry-keeping are well gone over in the Poultry Department. The main topics are covered by lectures and the students have a certain number of birds to care for, and in that way they get a fairly good working knowledge of many of the details of poultry-farming. Of course, for some of them in the time that is assigned them they do not make much progress, but if a man is very much interested he can make arrangements so as to cover the entire year's operations there and become well equipped in the work. We are running a six-weeks short course in the winter time which we hope and which we feel will be of benefit to the industry here in the State. A young man comes there with practically no knowledge, and in that time we can give him some insight into the business anyway. We do not know it all regarding poultry, not by any means, but there are a few things that the young men upon the farms do not know that we do, and these we are very glad to give them.

The PRESIDENT. Mr. Mulford has now arrived, and I am very glad to be able to introduce him to you. He will speak to us about our wood lots. I think he will be able to tell us a good many things that our farmers need to know on this important subject.

MAKING THE WOOD LOT MORE PROFITABLE.

BY MR. WALTER MULFORD, State Forester.

Mr. President and Gentlemen: This talk on the wood lot properly belongs out on the wood lot, and I certainly wish that Jack Frost had not come upon us so severely as to prevent us going out into some wood lot. I think it would be more or less pleasant for us, and we might in that way get a little profit from talking the matter over together.

Now, if you ask a Connecticut farmer or any owner of a small timber lot about his lot the chances are about three in five that he will say, "Oh, pshaw. That wood lot of mine? That doesn't bring me in anything. It barely pays the taxes, to say nothing of interest on the capital that is represented there. I cut it over, perhaps, once in forty years, and at that time it brings me in a fair return on the money per acre, but before I can cut it again, or before someone else can cut it that money is all eaten up in taxes." Now, this complaint is undoubtedly too often true, and it is not to be wondered at. What would you expect if you left your garden to nature's erratic care? We would certainly expect disaster from any such proceeding, and we would certainly get it too. Why then should we be surprised at that wood lot if left in the same way, as it too often is? We have neither sown nor cultivated, why then should we reap? Truly we are following somewhat the plan of the savages of the tropical world in doing this. They take what they want of the growing fruit that nature supplies them and give care to nothing. Now, this may be all very well for the barbarian in a climate where growth is luxuriant, but transfer the same principle of action to civilization and to the temperate zone and what do you get? Where would our corn come from, or our winter supply of any grain, or our early Crawford, or our Northern Spy, if we went on this principle? You admit that we would not get the corn, but you say it's different with the wood lot. We cut it over and leave it to nature, and she will make it grow for us. Very true, nature does favor forest growth greatly, and will, unaided, provide us with another timber growth of some kind. Sometimes, especially in New England, the growth thus established is quite good. More often, however, it is only fair, or perhaps poor. In any event, it is safe to say that is it never anything like what it could be made to be. Nature is not a good yankee. She is not thrifty. It is necessary, as a rule, that we direct her efforts; help her. We are fond of saying "let's go and study nature, and see what she does and pattern after her." This is wrong. Her ways are not good enough for us. We must go to nature and learn her ways first, and after that we should improve upon her methods. If Benjamin Franklin had simply said, "I will go to nature to study electrical phenomena," and no improvement upon nature's method of using electricity had ever been made, I would not have been relying upon the trolley cars this morning, and so late to the meeting this afternoon. Not long ago I was down in the mountains of Tennessee, in a region where an old Indian discovered what is said to be a pretty good rattlesnake poison antidote. The story is that he found one day a rattler and a black snake engaged in a battle. Rattlers and black snakes are enemies there and the mountaineers will never harm the black snake, regarding him as their friend. The rattler was a little too much for his enemy, and finally got in a good sting. Mr. black snake immediately crawled off and took a bite of a certain herb, and went back to the fight apparently all right. This process was repeated three times. The Indian finally pulled up the herb and when the black snake came back the fourth time there was none for him, and the black snake died from the effects of the rattlesnake poison. This is what the Indian saw, and from this herb, it is said, he concocted a very powerful rattlesnake poison antidote. Now, it was all very well to go to nature and learn of her there, but if we wanted that herb in very large commercial quantities it would not be long before somebody would be trying to cultivate that so that we could raise a ton of it on one acre instead of roaming for square miles through the woods and perhaps finding a few leaves. Nature is always imperfect, and always wasteful. She may have sown a million seeds to get that one plant. In reproducing our forests she certainly sows hundreds of thousands of seeds to get one tree. Man should so improve upon nature that he can sow a hundred seeds and get seventy-five trees. Nature raises a crop in the American forest which the German forester easily makes five times greater for the same area, and in less time. How does he do it? In the same way in which some farmers get two tons of hay where nature, perhaps, would have had half a ton. It is done by making timber a crop, to be sown and cultivated and harvested as such. True, nature will sow a crop for us, and in fact it is ideal forestry practice to make her do it for us, but she will usually not do it in a satisfactory manner if left to herself. If we know how to press the button she will indeed do the rest satisfactorily, but we must know how to press that button.

Now, let us consider a few of the ways in which our wood lots are not what they should be, and in so doing make some suggestions as to how the wood lot may be made more profitable. We will suppose your wood lot has just been cut. Perhaps there was little money at that time in the sale of cord wood, and the poor kind of trees were not taken out. These are now taking possession. You have cut out your chestnut, and ash, and tulip, and basswood, and white pine, if you are so lucky as to have any, and left your black birch and your red maple, and so on. Of course, these tree weeds will take possession, and form even a larger portion in your next cutting than they did in this one. Supposing it were possible to do so, would you ever think of going to your clover hay field and cutting out only the clover, leaving the weeds to go on growing and go to seed?

Now, again, if there were large, old, decayed trees on that lot, useless as timber, of course you left them. They are spreading out their useless limbs and shutting out available sunlight from young and thrifty trees which, perhaps, may be growing in places.

Then, again, perhaps you did strip that woodland clean. Was it all ready to cut? That is, was there not a considerable part of the material you took out taken out at the very time it was just beginning its most profitable growth? It is one of the serious faults in our method of managing woodland that large amounts of material are cut just when they ought not to be. It is like cutting a half-grown hay field because you happen to be short of hay, thinking you cannot afford to wait until harvest. It may be much better for you to cut only the largest trees, provided, at the same time, you take out the old decayed trees and the poor kinds and those which are stunted and deformed.

Did you give any thought to having it cut at such season that the ensuing sprout growth would be favored? Did you see to it that the cuts of the axemen were smooth, and did not unnecessarily strip the bark from the wood of the stumps? These things are of very great benefit in inducing a vigorous sprout growth.

How did you sell that timber? Probably some sawmill man came around and wanted to trade with you, and you sold him the whole thing for a certain sum. Is that a business way of selling? Surely a cloth manufacturer would not sell a room full of cloth in that way, and not know whether there

A FORESTER'S HARVEST.
FORESTRY INCLUDES THE CUTTING OF THE TIMBER CROP WHEN IT IS RIPE. THESE LOGS WERE CUT BY A PRACTISING AMERICAN FORESTER.

THINNING SPROUTS.

A CLUMP OF CHESTNUT SPROUTS BEFORE AND AFTER THINNING.— MIDDLETOWN.

FIRE—THE GREATEST ENEMY OF THE FOREST.
THE BEST METHOD OF GETTING PROPER PROTECTION FROM FIRE IS THE AROUSAL OF PUBLIC OPINION TO DEMANDING SUCH PROTECTION.

ANOTHER METHOD OF FIRE PROTECTION, CLEARING A FIRE LANE.—WINDSOR.

were twenty-five or seventy-five bales of cloth there? It would seem that the only fair way to sell timber is at so much per thousand feet of sawed timber, or at so much for every cord of wood obtained, and so much for each tie or pole which the buyer gets out. I ran across a rather interesting example of that not long ago. A man sold a fine little wood lot for $200 while the amount of timber which was taken off that lot ought to have brought at least a thousand dollars on the stump. Now, this, of course, is an exaggerated case, but it is no wonder that that man's wood lot did not pay.

Now, when the lot is cut you have left the tops and branches lying scattered in all directions. Soon they will be like tinder, and a great temptation to any fire which may put in an appearance in the neighborhood, or for any stray cigar stump which may happen to fall in a favorable place. The time is coming when many a wood lot owner will have this brush thrown into piles at the time cut so that it may be easily burned at such a season when the fire can be kept under control. The time has already come when some men are doing this. If a man thinks he cannot afford to do this, he can, at least, swing his axe a few more times on each tree and lop down the branches somewhat so that they will lie closer to the ground, and will sooner decay, thus ceasing to be a fire trap.

Now, let us suppose you have let your wood lot grow up again for fifteen or twenty years. Let us go out and take a look at it. The first thing we notice is that there are many sprouts from one stump, and especially from the chestnut stumps. This is a bad thing. Each sprout is claiming its share of the nourishment supplied by the mother root, and there are so many of them that the sprouts cannot make their best growth. If we cut out all but two or three of those sprouts the increase in the rate of growth of those is surprising. I wish you had been with me the other day in the town of Madison. I was out with a man who has spent all his life around our Connecticut wood lots. We came to a chestnut sprout lot, and I spoke of this matter of thinning out the sprouts. He had never thought of it in that light, but in a few minutes he saw, before I did, what was an excellent illustration of what we had been talking about. There were two large old chestnut stumps a few feet apart, the trees on which this man had himself cut a few years before. They were both cut at the same time. On one of the stumps there were perhaps a half dozen sprouts all growing, and their diameter was not over one inch. On the other stump there was one sprout left. We found the places where the others had, in some way, been accidentally broken off when very small. Now, this single sprout, of the same age, had grown until it was over three inches in diameter, and was tall, thrifty, and very vigorous. Not only are the sprouts from single stumps on that wood lot of yours very apt to be too crowded, but you will also probably find that the trees coming from seed or from neighboring stumps are standing too closely together. Now, if the trees are crowded too much they are deprived of their proper share of sunlight, and wood cannot be made without sunlight. By leaving only a portion of the trees on our lots, selecting for that purpose the very best young specimens, we will find that we will get a larger-sized lot of timber in a much shorter time.

The PRESIDENT. Did you find that that second growth of chestnut was decayed at the butt? That has been my experience with it.

Mr. MULFORD. Yes, sir. Each succeeding generation of chestnut sprout growth grows steadily more defective at the butt, shorter lived, and not so high in growth. You may not notice it, perhaps, between one generation and the next, but in the long run it seems to be that way. Decay at the base is very natural, because the sprout comes up from the old stump, and when decay begins in the old stump the chances are good of its getting into the heart of the tree. However, it is almost never that this rot runs up very far.

Now, on the other hand, you will find open spaces in that wood lot. I do not mean that these openings are necessarily large ones, but any opening where a considerable amount of sunlight is allowed to reach the ground unused by the leaves for making wood, is lost. Moreover, the fact of this sunlight reaching the soil will be a serious injury by causing a drying out of the soil. Water is a more important factor in forest growth than in the garden. If you had such openings as this in your orchard you would consider yourself a great loser thereby. How is it you have never thought of your wood lot in the same light? A few seeds can be sown, or a few young trees planted in such openings very cheaply, thus materially increasing the future value of your land. Here is an evergreen tree that is usually set out. This does not happen to be a tree that we would plant in Connecticut. It's a red fir from the Pacific coast. (The speaker here showed specimens of these different trees.) I did not have any white pine handy of just the right size. This is a white pine two years old. A seedling of that age is sometimes used in planting, but it is usually better to set stock that is one year older — three years old.

Moreover, I venture to say that you will find in every timber lot in Connecticut a considerable proportion of trees which will never make good timber. If a weed is a plant out of place, as it has been defined to be, such trees are rightly termed weeds. Each one of these trees is taking up room which properly belongs to the kinds which will produce for us something of real value.

If a progressive Connecticut fruit farmer should see a neighbor's fruit orchard, one-third of which was poor wild fruit, or if the trees were so crowded as not to allow enough sunlight for each to do its best, or if there were many openings where trees ought to be but were not, he would probably mutter "shiftless." But let that progressive farmer hide his wood lot from any stray European forester who might come that way, or he, himself, may be subjected to that same remark.

Now, what is the result of our method of treatment, or rather of the non-treatment of our wood lots. Just come to a large Connecticut lumber yard for an answer. I venture to say you will not find any considerable portion, and I know you will not in one of our large lumber yards, find any considerable portion of material raised in Connecticut. You will find spruce from Canada, tulip from Tennessee, white pine from Minnesota, and southern pine from Georgia or Texas or Arkansas, red fir from Oregon, and redwood from California. Now, this is really a disgraceful state of affairs. And it becomes even more of a serious matter when we stop to consider that wood is a commodity of such great weight relative to its value that the cost of transportation therefor is very great. Think of having to haul lumber to Connecticut three thousand miles. There is no need for this state of affairs. I brought along with me today a map which undertakes to show, and I think does show fairly well, the woodland area in this State. It will be here if any wish to look at it. On this map the woodland area is indicated in green, and it shows that at least forty per cent. of the area of our State is what may be called, by courtesy at least, woodland. That is a large proportion, an unusually large proportion of woodland, and if properly managed it should be able to supply our demand for most of the products of the forest. The trouble is in the condition of this area. On large areas in Connecticut there is nothing but gray birch, pitch pine, and scrub oak where white pine ought to be and would be if things were managed properly. Also sumac, hardhack, pin oak, and black birch where there should be chestnut, white oak, yellow oak, tulip, ash, and so on. Large areas in this State are subject to fires, but as yet little has been done to arouse public sentiment against this great enemy of the forest. Even in woodland commonly called "good" we have seen that the conditions are very far from being what they should be. We do not, necessarily, need more woodland in the State; though there are extensive tracts bare of trees, unfit for agricultural purposes, and which could, to good advantage, be artificially covered. What we need most is better woodland.

Now, Mr. Chairman, we will take the time, if you so wish, to go on and say a little more in detail on one or two definite points in the management of this woodland. It would be impossible to try to cover the ground fully in a paper of this kind, but I hope at least that some suggestions can be thrown out, and that in the time given up to discussion some questions may be asked which will bring out further details in regard to this matter.

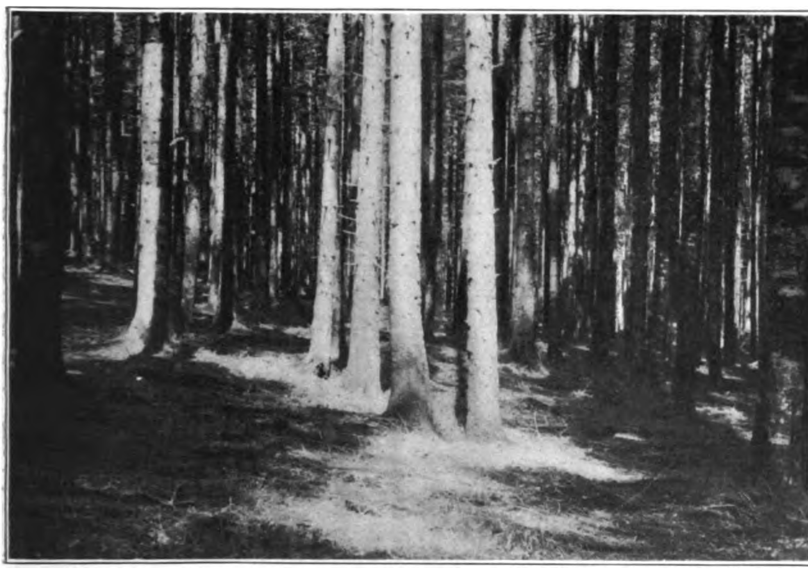
Now, let us take up this fire question. It has been well said that we might as well try to raise beets on Broadway as to bring about satisfactory forestry in a region where there is no reasonable assurance of protection from fire. Parts of Connecticut are almost free from this scourge. In other portions there appear to be but few woodlands which are not burned over every few years. It is a fact, too, that most of these fires occur in those localities where the wood industry is of the least importance. In such neighborhoods as rely, primarily, upon the timber business for a livlihood fires are, as a rule, infrequent, or are almost unknown. This fact should give us a valuable hint as to the way to go to work to teach the public. The force of a little public opinion makes a vast difference. If people do not care much if their woodland is burned over, or perhaps even prefer to have it burned over occasionally for the sake of better pasturage, and a feeling of carelessness in regard to fires pervades the neighborhood, — in such a neighborhood there are apt to be a good many; but, on the other hand, where one's bread and butter depends upon it, he is not only careful himself, but he sees to it that other people are. He watches tramps and hunters, and he is ready to put out small fires whenever they start. The result is a great reduction in the amount of fire damage. I have in mind two towns in this State which illustrate this point quite well. Fires started by engines upon the railroads do not come in as a factor in the problem in these two towns to any considerable extent.

We can all do something towards educating public opinion against forest fires, but this is, after all, a very indirect way of giving our own woodlands better protection, and it may be years before any such effort has any visible result. What can we do this year to give our land greater security? If our lot is not surrounded by roads, or streams, or open spaces, it may possibly, not always by any means, but it may possibly be well to cut a fire lane around the piece on sides next adjoining woodland. By this I mean to cut off a strip perhaps one rod wide, or less, along the edge of the property. All inflammable material should be removed from this strip. It can be done most cheaply by burning, preferably at some season when you can prevent the fire from spreading. This strip should be burned over every one or two or three years. In some sections these fire lanes are easily kept open by plowing. This is the case on some of our land in the town of Windsor, where we are planting forest trees, and this fall we plowed fire lanes and have sown rye there, which will give us a green cover when there is the most danger from fire, — in the fall and early spring. This fire lane might not stop a severe fire if there was no one there to watch it, but it gives an excellent place from which to fight the fire. Wood roads can often be utilized to very good advantage as fire lanes, and especially for breaking up a large piece of woodland into sections. Probably it would not pay every owner of Connecticut woodland to establish fire lanes around their property in the way described. It depends on the local conditions and the local danger from fire. But there is one thing every owner can do, and that is as I have described, either burn or lop down the brush at the time of lumbering.

Let us look now to improvement cutting. That is a big word, but it is a very simple matter. By improvement cutting we simply mean the taking out of the poor kinds of trees, or the stunted, diseased, or deformed specimens of the better kinds. Remove your black birch and give the chestnut a chance; take out your pin oak and let your yellow oak be bringing you a future harvest. Cut out the crooked tree, or the one with the broken top, or the one partly decayed. Give the thrifty young trees an opportunity for growth. Every one acquainted with the woods knows poor growth when he sees it, and knows which ones are of relatively no importance to him. Why not try a little of it this winter? One advantage of this work in the wood lot is that much of it can be done when very many people are not very busy and when their time counts but relatively little.

Now, as to thinning, we mean the cutting out of a portion of the trees when they are growing too closely together. We have already discussed this somewhat, but I shall say a few words more which may be of some service in helping to determine how much we should thin. A tree growing in a crowded position has a cleaner trunk than one growing in the open. That is, in the crowded forest the lower branches are being continually killed, and the tree is forced to run up well to the sunlight. As you know, a branch causes a knot in the lumber. Of course, we want lumber free from knots, and hence it should be our policy to keep the forest crowded when it is young. But after the forest has been kept crowded long enough to make the trees shoot up and clean themselves to a sufficient height to yield good saw logs, we should then do something to give the best specimens in our forest a chance to grow more rapidly. To do this we must cut out some of the trees. The materials which go to form wood are digested in the tree leaves, and the leaves require sunlight to carry on this work. Hence, the more light we can give the tree the more wood it will be liable to produce. No hard and fast rule can be laid down as to how much to take out. Each one must judge of that for himself and learn by experience. One thing

WHITE PINES WHICH STARTED BEFORE COLUMBUS LANDED.



A STAND OF SPRUCE AND SILVER-FIR IN BLACK FOREST, GERMANY.

should be always kept in mind, however, and that is that too severe thinnings are wrong because they let in the sun and the wind too much. The loss of moisture in the soil is a thing we need to guard against carefully in the raising of the timber crop. The growth of the forest tree depends principally upon the amount of moisture in the soil and the amount of sunlight above. The chemical constitution of the soil is of very much less importance. Hence, we must do all in our power to keep the forest soil like a great sponge, and must keep it from the drying action of the sun and wind as much as possible. The more severely a man thins the more growth he gets on each tree remaining. But, on the other hand, the more severely he thins the more of that increased growth will go into the branch wood instead of into the available trunk wood. The more he thins the more danger there is of bringing about unfavorable moisture conditions in the soil. If we let the soil dry out too much the slower growth caused thereby may more than counterbalance the more rapid growth which we would expect to be induced by the extra moisture admitted to the tree. Thinning should be less severe on the edges of the woods, and especially on those sides from which the prevailing winds come. This is also necessary because of the necessity of maintaining the soil moisture. The more densely crowded the trees are around the edges of the lot makes a great difference in the circulation of the air through the timber. We want to reduce this circulation of air as much as possible.

Now, how are we to treat those open spaces in the wood lot? In the first place, see if there is not some available young stuff present of good kinds, seedlings, perhaps only a foot or so high, which will, in time, fill in the gaps. If not, we should either sow a few seeds or plant a few trees, depending on the local conditions and the kind of trees you are going to start. If you put in chestnut, or any of the oaks or hickories, it will be well to try and sow the seed. The nuts should be gathered in the fall, and excepting the white oak are best kept over winter buried in a pit. The white oak nuts should be sown at once because they will not keep over winter; or, at least, we have not succeeded in doing so to good advantage yet. The pit for the nuts should be scooped out in the soil, which, preferably, should be a sandy loam. Make the pit about ten inches deep. Spread the nuts in this pit in layers, perhaps two or three inches deep. The sooner they are put in there after being gathered the better, provided you first allow any surplus moisture on the outside of the nuts to dry off. After you put in your nuts cover them with leaves, say to the depth of a foot, and this again should be covered with soil to the depth of a foot. Bank it up well around the edges of the pit. You now have a little mound which, if necessary, should be protected from washing by the rains. You need to watch this pit to see that the mice or squirrels do not carry off the nuts. Sometimes it is necessary to line the pit with wire netting to keep them out. In this way we kept fifteen bushels of chestnuts over winter last season. They came out this spring with hardly a single one in bad condition.

The PRESIDENT. How deep did you bury them?

Mr. MULFORD. The pit is made about ten inches deep in a sandy, well drained soil, and covered with leaves, and them with dirt on top of that. The idea is, we want to prevent them from drying out too much.

The PRESIDENT. In many sections I should think these little chip squirrels would have them all out.

Mr. MULFORD. Sometimes in sowing them out in the field and woods they will get them, but I think there is less of that trouble in burying them in a pit near a house. This spring we sowed several bushels of these chestnuts we had kept over winter on some of our sandy plain land in the town of Windsor. We put them in in April, making holes a foot apart and in rows five feet apart, dropping the chestnuts in, one chestnut in a hole, which was covered by putting the dirt over it with the foot. Three weeks afterwards the squirrels had not bothered the nuts at all, but one day after that I went up there, and the squirrels had been going up and down those rows regularly, and we could see where they had dug the chestnuts out. They seemed to know where the chestnuts were, as they never dug in the wrong place. The funny part of it was, I, myself, had tried to find the holes to see how the chestnuts were coming along and I had had a good deal of difficulty to find where the holes were. But the squirrels had no trouble, so far as I could see. They never made a mistake. We planted them thickly on purpose to allow for this. We have some very fine chestnuts growing this summer from that seed.

So, then, take them out in the spring from the pit as soon as the last frost comes out of the ground, sow them in the woods by making a small hole with a hoe or mattock or dibble, and some times it is better to drop two or three nuts in a hole. Cover the nuts to a depth of two or three times their own size. An easy rule for sowing all forest tree seeds is to cover them to a depth of two or three times their own size. That is an old garden rule, and this old garden rule applies to tree seeds as well. No further care need be given them. If you find that the squirrels trouble them you will have to plant or sow the nuts in your garden, and then move the trees out into the woods. This may be better anyway. It depends entirely on your local conditions.

Now, in putting evergreens out, it is very rarely that sowing the seed in the wood lot has been successful. It is usually better to plant them in your garden. We have not the time now to go into that. I am not going at all into a discussion of how to raise these trees in your garden. If you want information on that point I would refer you to a bulletin, which you can get for nothing, or for a very small sum, from the Bureau of Forestry, Department of Agriculture, Washington, D. C. It is called " The Forest Nursery," and it gives full directions for all such work in much better shape than I can do it here.

In raising evergreens we should plant, perhaps, two or three year old stock. In placing these, grub up a space about a foot square so that it is free from weeds. The trees should then be set in the holes. Five feet apart each way is sufficiently close to set them, and six feet is often considered near enough.

Now, just one more point and I am through. I do want to speak a little more in detail regarding one or two things relative to the chestnut sprout lot because the chestnut is the most important timber tree we have today in Connecticut. There is no doubt that cutting out a part of the sprouts from each stump will save many years of the time ordinarily required to produce ties and poles. When the thinning out should be done is a matter that no definite rule can be given for. It would seem that two or three sprouts should be left on each stump unless the old stumps stand too close together. This is because the forest should be kept crowded when it is young.

Sometimes they have been thinned down to one per stump, but this seems rather severe. There is a difference of opinion as to the best time to do the work. If it is done when the sprouts are only two or three years old the labor of thinning is the smallest possible, and the sprouts left get the advantage of the thinning for a longer time. On the other hand, if the thinning be put off until the sprouts have become three or four inches in diameter we get material in the thinning which, possibly, may be of sufficient value to partially pay for the labor of cutting. Each one must judge for himself until we have some definite information proving which way is better. It is in obtaining just such information that we hope the Experiment Station may accomplish something.

Now, as I said before, each succeeding generation of chestnut sprouts becomes more defective, shorter lived, and tends constantly towards lessening the height of the growth. We cannot, then, continue our present system of raising chestnuts indefinitely. Some trees must be started upon new roots of their own. This is best done by raising from the seed. The seed may be planted in the forest as I have described, or the trees may be grown for one year in the nursery and then planted in the woods. Why not cut out some of the poor kind of trees in the chestnut lot, and in their places put in seedlings?

I want to mention just one example, for which I cannot vouch absolutely. In the town of Portland a man is said to have thinned a chestnut sprout lot when it was eight years old, cutting the sprouts down to one per stump. Seventeen years after that, that is, when the sprouts were twenty-five years old, they tell me that he cut from that lot one of the finest yields of large poles and first-class ties that has ever been cut in that region, while on similar land right next to it they never thought of cutting for poles oftener than once in forty years. Of course, I cannot swear absolutely to this statement because I have not been able to verify it, but it is not unreasonable.

Now, in conclusion, let me say once more that it is not primarily more wood land that we need in Connecticut but better wood land.

The PRESIDENT. If there are no questions this convention will stand adjourned until 7.30 this evening.

EVENING SESSION.

December 9, 1902.

Convention called to order at 7.30 P. M., Vice-President Seeley in the chair.

The PRESIDENT. The first on our program this evening will be some vocal and instrumental music.

Music.

The PRESIDENT. We will now have a paper by Dr. John Gifford.

FORESTRY FOR THE FARM.

BY DR. JOHN GIFFORD.

Of the College of Forestry, Cornell University.

Silviculture, or the culture of forests, is of especial interest to farmers for the following reasons: The forest yields fuel, wood for constructive purposes, litter, and other material of use to every farmer. Every now and then a farmer cuts a stick from his wood lot for a fence post, for a vine prop, for an axe-handle or swingletree as a matter of course. Were all the materials yielded by the wood lot counted at their full value I believe the wood lot would be rated the most important feature of the farm. For a large portion of the year, at least, wood is the common farm fuel. The fence problem is also an important one, and the farmer who produces his own fence material saves an important outlay. The fences on a farm often represent a larger cash outlay than the land itself.

These materials, over and above what the farmer may need for home consumption, may be sold to good advantage. In this way he may earn something when there is little else to do. In many cases fuel wood is sold for about what it costs to cut and haul it. Although in such cases a man may get nothing for his wood he gets paid for his work. The woods are a means to an end.

Poor land on a farm may be used to better advantage for forest than any other purpose. Even in very fertile districts there are few farms without some land which is unfit for cultivation, dry, or rocky, or sandy, or land subject to washing; and such land should be used for forest.

A farmer ought to be able to make his forest yield a high return. Supervision costs him little. He works in his woods when he can do nothing else. He has his own teams, and usually his own boys to help do the work. Forestry and agricultural pursuits may often be combined to the advantage of both. The forest improves the quality of the soil. The forest is a protection against the destructive forces of nature. The forest adds variety and beauty to the landscape. The presence of forests, by yielding useful materials, renders possible the presence of other industries. These are not only sawmills, but wood alcohol establishments, pulp factories, box factories, kindling factories, and a host of small industries which thrive in the presence of an abundance of wood.

The planting of forests on bare land, from a commercial point of view is, however, for several reasons, difficult. First of all, it is only a small percentage of the farmers of this or any other country who have the requisite skill and knowledge to produce forests fit for high class timber. After many experiments have been performed, and knowledge on the subject has become widespread, many agriculturists will take hold of it from a business point of view. At present it would be wise to consult an expert before expending money in an extensive enterprise of this kind. Men are short lived, but trees to be good for timber are hardly fit under a hundred years. We are cutting some white pine in the State of New York which were good-sized saplings when Columbus landed.

Then, again, if a man plants a forest his money is tied up for a long period of time. The interest ultimately yielded, even if compounded, may be large, still it is uncomfortable to have it unavailable for such a long period of time. Every man gets hard up at times, and then the temptation to cut the wood lot is almost irresistible. The wood lot has kept the sheriff off in many instances in New York and New England.

To be sure there are many exceptions. A plantation of hardy Catalpa, four hundred acres in extent, was made by a railroad in Kansas in 1877 and 1884, and counting all expenses and allowing compound interest at 6 per cent. there is left a clean value of $138.19 per acre.

But there is lack of protection from fire in almost all parts of this country; there is danger of wind, frost, and disease, and in addition, there are unjust taxes which must be paid. I can see only one good, sure way out of all these difficulties for the production of old, high class timber. I can see nothing impractical in the practice of coöperative forestry. Let the farmers of a certain district pool their interests, and share the profits by placing their forests under the control of an expert, or of a State forester. Such lands should be exempt from taxation, or, if taxed, there should be a nominal ground rent with the main tax on the amount of material produced. This savors of the communal system of the old world. If every individual is allowed to do just as he pleases wherever and whenever he pleases it is anarchy. When every one makes a few slight sacrifices for the good of all it is true democracy. Whenever a man cuts a piece of timber in a few days which has been centuries growing, and then leaves it to revert to the State, a desolate waste, he does every other tax-payer in the district an injury. It is not my intention, however, to enlarge upon this side of the subject. I want to simply tell you in as few words as possible how to form and tend a forest.

The first point to settle in the formation of a forest is the species. If you have a forest, even if it is poor, make the best of it. You can reap something from it from time to time. By sowing seed, planting here and there, and cutting with care, always favoring the best, you can, in time, bring order out of chaos.

The choice of species to plant or favor in the improvement of forests is extremely important, and should always receive much consideration. The selection of the wrong species means disappointment and labor lost after long years of waiting. It is, of course, safe to plant indigenous species. It is not wise, however, to cling tenaciously to those species which are native when it is positively known that certain foreign species will serve your purpose better.

In the choice of species for planting or encouragement, three points at least are worth considering:

First, the adaptability of the species to the soil and climate in which you wish to plant it.

Second; its silvicultural qualities, such as rapidity of growth, ease of propagation, freedom from disease, etc.

Third, that it will serve the purpose for which you are growing it.

It would be risky to plant a species out of its natural climatic range, or in a soil to which it is not perfectly adapted. It would be discouraging to select a species which grows slowly, which is naturally tender, which suffers from disease, and which, on the whole, is difficult to propagate. Above all, select the species which will serve your purpose in the end. This requires good judgment, because products which may be of value at present may not be fashionable a quarter of a century in the future. Fashion often plays a very important rôle in the value of wood.

The value of wood may often be modified by the application of preservatives. Wood may be injected with chemicals so that decay is resisted, or combustibility reduced, or stained in such a way that precious woods may be counterfeited. Instead of stains or paints inferior woods may be covered with choice veneers.

If the purpose of the forest is protection against the destructive forces of nature, or for æsthetic or sanitary influences, the quality of the wood is a secondary matter; but whenever possible those species should be selected which will serve as many purposes as possible.

For the sake of convenience more than any other reason the formation of forests may be divided into two categories: the first, cases in which man prepares the seed bed and sows the seed, or plants little plants; and second, cases in which nature sows the seed, and man simply aids her by preparing a seed bed under the mother trees in such a way that natural regeneration follows. Nature does most of the work in both cases. In fact there is little that is artificial about it in the first case. Man aids nature a little more in one case than in the other.

Again, the seeds may be collected and then sown in a nursery where the young trees may be carefully tended, and when of sufficient size planted on areas where they are destined to remain until the time of reaping. This is essential in the case of many tender species. In other instances direct sowing may be practiced. The seeds may be sown in various ways upon the area which one may desire to stock. Only those species which are not delicate may be sown in this way. In the case of small and expensive seeds direct sowing is risky. Much depends also upon the nature of the locality. In poor soils, and in regions where squirrels, mice, and other seed-eating animals are abundant direct sowing generally results in failure. Vigorous, quick-growing seedlings which need no protection in youth may be successfully produced by direct sowing.

This is, of course, nature's method; but nature's method is characterized by the extremest kind of lavishness. Millions of seed are wasted every year. Every seed is a ball of rich concentrated material which has consumed a large part of the tree's energy in the process of manufacture. Were there no forest fires, no lumbermen, no injurious insects, or other destructive agencies except old age, a tree would have to produce only one mature offspring to fill its place in order to maintain the forest regions of the world intact. Owing to the awful struggle which the individuals of the world must wage against their enemies and their kind every tree must produce millions of seed and thousands of seedlings to surely leave in its place a single representative. By coming to its aid and guiding the forces of nature over which the tree has no control, man may rescue from extinction many valuable individuals and even species. He can control the production of wood just as he controls the production of corn or wheat.

In the formation of the forest nothing is more important than the quality of the seed. Seed should be ripe, fresh, and of standard weight and size, and all seeds should be tested before sowing.

It is usually conceded that the dominant trees of the forest are produced by the largest and richest seeds.

In the struggle for existence a small advantage in the beginning may mean life and vigor to one tree and suppression and death to many others.

It is best, then, to collect your own seed in your own district from the best trees you can find. In that way, and in that way only, can one be absolutely sure that what he gets is what he wants. This is often impossible, and then one must do what is next best, — purchase the seed from a reliable seed dealer. All seeds bought of seed dealers should be carefully tested before sowing, because no seed dealer for various reasons will guarantee his seed.

Nothing is more unfair or disappointing to the farmer or forester than to pay well for seed which is partly, if not mainly, dirt, weed seeds, and infertile kernels. To work long and hard in the careful preparation of the soil, to sow it with care, and then to reap weeds because of inferior seed, is enough in itself to account for the fact that the sons of farmers leave the farm and engage in other pursuits.

In order to have success in broadcast sowing the conditions must be very favorable. In the majority of cases it is necessary to carefully prepare the soil and cover the seed. In some instances it is sufficient to wound or scratch the soil with a rake or harrow, in others, a grub hoe may be necessary, and in still others, the plow. Tree seeds should be sown thinner than wheat. It is a good plan to mix them with dirt and sow both ways in order to get them evenly distributed over the soil. After sowing the seed should be raked or harrowed into the soil.

Partial sowing is sometimes practiced, that is, the seed is sown in strips or patches and not broadcast. In almost every woods there are small places which might be successfully and easily seeded with desirable species. A good plan is to dibble in the seed here and there. A dibble is a pointed instrument of iron or wood. The seed is simply dropped into the hole, which is easily and quickly closed with one's foot. Dibbling might be easily and advantageously practiced in many of our forests. It is an easy and efficient method of gradually improving a stand by the introduction of more desirable species here and there. Seeds of spruce, pine, and other species may be sown with agricultural crops. I have had remarkable success with sowing spruce with white beans and peas.

The second method of forest-forming is by planting. Planting may be practiced with all species, but it is especially adapted to tender kinds which require attention in youth and to species the seed of which is expensive. The simplest form of planting is by means of cuttings. With the forester this is only of use in the case of willows, poplars, mulberries, and a few others. A cutting is a detached portion of the ripened wood of the parent tree. Good cuttings are usually about a foot and a half in length, and from one-half to one inch in diameter. These slips or cuttings should be placed slanting in the ground with a small portion of the tip exposed. The Carolina poplar,

NORWAY SPRUCE SEEDS AND SEEDLINGS

SEEDLINGS ONE YEAR OLD SHOWING LENGTH OF ROOT. LARGEST PLANT IS TEN INCHES IN LENGTH.

PLANTING WHITE PINE AND SPRUCE ON A BURNT-OVER AREA
IN THE ADIRONDACKS.

UNDERPLANTING IN THE ADIRONDACKS.

which is of value for paper pulp, may be easily propagated from cuttings.

Before planting we must assure ourselves of good plant material. Little plants may be secured in several ways. We can grow them ourselves from seed in nurseries, we may transplant them from the woods, or we may buy them of nurserymen. At first thought many would say that the second suggestion is the best, that little plants could be collected from the woods where they are too thick by the million, and that they would never be missed, and those which remain would be benefitted by the increase in room. This is, in fact, such a poor way that it is seldom if ever practiced, because it seldom yields good results. Trees from woods are used to the conditions prevailing in the woods, such as shade, leaf-mold, etc., and are also of unequal quality. When one raises his own plants there is no delay, no shock in planting, and the little plants are already accustomed to the climate in which they are to remain until they are cut for their wood. These plants can almost always be raised cheaper than they can be purchased from the nurserymen.

Every farmer should have a permanent nursery in the corner of his garden. Whenever in his travels he finds seeds of desirable species he should sow them. In this way with little expense and little trouble he may have an abundance of good plants on hand for planting whenever needed. It is impossible in this connection to give the details of nursery practice. Much, if not the most of it, must be learned from experience. Almost every species must receive special treatment. If you lack knowledge on the subject consult your State forester, Mr. Mulford.

A lot of time is lost fussing with plants. There are certain rudimentary principles which must be fulfilled, and when these are fulfilled further attention is superfluous. Success in planting is dependent on the following principles: Remove the plant from the nursery with as many roots as possible. Keep it moist and protect it from the sun while out of the ground. Plant it so that it will set in the ground, when the earth settles, as near as possible as it was in the seed bed. Remove the weeds from its immediate neighborhood.

Natural regeneration may be effected in two ways — by seed and by coppice. A coppice growth consists of the shoots which spring from a stump when a tree is cut, and of suckers from the roots. Only a small percentage, however, may be regenerated by coppice. In order to be successful in regenerating forests from seed two conditions at least are necessary. The mother-trees must be capable of producing good seed, and the soil must be in such condition that it forms a good germinating bed. Seed years must be watched for, and the cutting conducted to admit sufficient light, but not too much, and the ground must be wounded in some way so that the mineral soil is exposed.

Natural regeneration by seed is effected by leaving seed and shelter trees, and by cutting in strips or in patches in such a way that the wind will sow the seed.

Under the head of tending forests should be included improvement cutting and protection. Improvement cuttings include cleanings, prunings, and thinnings.

The removal of dead, injured, diseased, or otherwise undesirable trees from the forest is called cleaning. This includes, in the beginning, the removal of weeds or other useless species. Every tree, living or dead, which harbors injurious insects or fungi or mistletoes, is a dangerous center of infection. Brush, injurious vines, and creepers may do great damage if allowed to seed and spread. The removal of dead branches is classed under the head of cleaning. The value of timber may be increased in this way. A dead branch forms loose knots in boards and planks.

The removal of living branches is called pruning. The fewer branches the better will be the quality of wood. Trees should be grown in such a way that they will naturally shed their lower branches. Trees grown in the open retain their branches close to the ground. On the whole, however, the pruning of green branches is not advisable in the forest except for æsthetic purposes because it is expensive, and if the limbs are large the wound must be covered with antiseptic paint in order to prevent rot. If the wound exceeds two or three inches in diameter it should be covered with creosote, coal tar, or paint, which will prevent the entrance and growth of fungi. The cut must be smooth, and great care should be exercised that the bark is not split when the limb falls.

I have already defined a cleaning as the removal of all dead, dying, diseased, and distorted stems and weeds. A thin-

STUDENTS OF N. Y. COLLEGE OF FORESTRY.
SOWING THE SEED OF WHITE PINE AND NORWAY SPRUCE.

A SCENE IN FRANCE.

CUTTING THE TREE CLOSE TO THE GROUND AND CAREFULLY PILING THE BRUSH.

ning consists in lessening the crowded condition of the crowns of the good trees in the canopy, so as to provide room for those which remain as they grow older and larger. Thinning should be frequent so that the canopy may be lightly and gradually opened and not interrupted. As the forest grows in age the number of trees it is capable of supporting decreases proportionately. As they crowd one another some are strangled, and in time become suppressed and die. Nature will do her own thinning in her own way. Man, however, can hasten and improve the process. He aids her in such a way that she can produce better material in larger quantities, and in a shorter length of time.

The difference between a cleaning and a thinning may be rendered clear by the following example. If, in a room full of men there are several obnoxious persons their removal would constitute a "cleaning." If, on the other hand, because of a lack of room, a reduction of the number became necessary, the removal of every other person, or every third or fourth person, would constitute a "thinning."

Of course, in rough woods such as exist in this country in many places, where even lumbering is not profitable, it is not possible or advisable to practice the finesse of forestry. In wood lots on farms, however, the farmer may often increase the value of his forest by a little improvement, cutting here and there now and then. Often two trees may be too close. If left neither would develop into a good tree. If one is cut the other will have opportunity to form a symmetrical crown. Often clumps of trees are so crowded that long, spindling stems have developed. A little thinning, or a series of thinnings would stimulate growth and wood production. Often one tree may outstrip the others to such an extent that its wide spreading branches may hinder the growth of many promising young trees. These wolf-trees should be removed. And so on, if a man cuts with other purposes than the mere reaping of the wood he may gradually improve the condition of the forest, increase its productive capacity, and reap at the same time considerable useful wood. There will always be an abundance of fuel wood in this country. We want good, clean timber for constructive purposes. The production of this requires time and skill.

No part of the subject of forestry is of more importance than the subject of protection. The protection of all forests, both public and private, against fire, and against the careless or malicious actions of individuals, is the duty of the State. This should be controlled by well-enforced laws. The State owes protection to the persons and property of law-abiding citizens. This function of the State has never been fully performed in the forested districts of this country.

The greatest enemy of the forest in America is fire. With the exception of a few instances, from unavoidable natural causes such as lightning, fires are caused either directly or indirectly by the carelessness or maliciousness of mankind. Fires may be prevented by patrols during the dangerous season, by the construction of fire lanes, and by the removal of combustible materials, such as slash and litter, from the surface of the soil.

If the forest is large, the telephone is, of course, of great value. By means of it fires may be quickly located and time saved in securing help.

Roads and trails are also a great help in that they render fires more accessible, and serve as vantage points in fighting them.

As a protection against frost we should avoid low, wet places, and holes where there is stagnation of air. If we plant in such places we should drain the soil and use only frost-hardy species. The best way to protect a forest against wind and storms is to open it sparingly and to plant deep-rooted species. As a protection against insect pests we should plant mixed forests, and species which are proof against their ravages. We should encourage the birds, toads, snakes, lizards, and insect-eating insects. We should do all we can to keep "the man with the gun" in check. We should not allow grazing or browsing animals in our forests except under special conditions. For the prevention of fungus disease we should cut out all diseased trees which are centers of infection. Every fungus supplies millions of spores which settle in wounds and cause rot, thus reducing the value of the tree for timber. To protect a forest against noxious weeds we should keep the canopy close and cut them back whenever possible. A weed from a forester's standpoint is a plant out of place. It may be even a large defective tree which is crowding out a lot of young and more valuable species. When it does not pay to remove such specimens girdling may be practiced to advantage. We must not forget that a forest consists not only of trees but of a mass of struggling organisms, some good, some neutral, some noxious. It is the duty of the forester to hold the noxious element in check, and to favor the good so that the best results may be obtained in the shortest length of time.

MORNING SESSION.

Wednesday, December 10, 1902.

Convention called to order at 10.15 A. M., Vice-President Seeley in the chair.

The PRESIDENT. The Secretary, I believe, has an announcement to make to the audience.

Secretary BROWN. Mr. President: I desire very much that every member of this convention should register his name and post-office address. There is a vast amount of literary material at my command, and at times I want to distribute this to those who take an interest in these matters, and if you will register your names and post-office address I will remember you in the distribution of such agricultural literature as comes to me for disposal.

And one other request. We have here a question-box. I presume these scientific gentlemen who came here to talk to us will suggest to you a great many questions that you will want to ask in relation to the subjects of which they treat. Now, if you will frame your questions and place them in this box as opportunity offers they will be brought up for discussion. We will discuss all of them that time will permit.

The PRESIDENT. Now, gentlemen, as you will see by the announcement on your programs we are to have this morning one of the most interesting topics for discussion that can be presented at this meeting. One of the most necessary things for us to learn about is the production of beef in our State. It's a subject which concerns our welfare, and concerns the welfare of others who are to come after us. The question often comes up in our minds, can it be profitably produced in these New England States. We have been getting the most of our beef from away off in the western States for some time, but it does not seem to be coming from that way quite so well as formerly. The prices have been getting pretty high for some of us, and it's getting to be a great question with some of us if we cannot produce some of that beef nearer home. It's an important question, and I am very glad to introduce to the audience the Hon. J. M. Hubbard of Middletown, who will treat of this matter. He will talk to us about it, and then leave it for our discussion.

BEEF PRODUCTION IN CONNECTICUT—CAN IT AGAIN BECOME A FEATURE OF OUR AGRICULTURE?

The high price of beef in recent and present times makes this question one of general interest and justifies the measure of attention accorded to it in the program of this meeting.

Practically all of us are consumers of beef. We are a meat-eating people. The doctrine of vegetarianism makes small impression upon us. And of all forms of flesh food that of the bovine race of domestic animals stands preëminent in acceptability. There are times when we want pork and times when we don't want it, and the same thing is true of mutton, poultry, fish, and other forms of flesh food. But there is never a time when beef is out of season. It is gratifying to the palate, acceptable to the digestive organs, and from it the whole system derives health and vigor.

There seems no probability that we, as a people, shall give up eating beef, or degrade it from its high rank as our leading form of flesh food, even if it continues to be more expensive than it has been.

Is the price of beef likely to recede to its former level or thereabouts?

This is a question of interest to both producers and consumers. On the one hand, in favor of the proposition that it will so recede, it may be argued that the recent rise in price was owing to the shortage in last year's corn crop, in consequence of which the price of corn in the great beef producing regions was more than doubled, and the cost of producing beef was greatly increased.

The inference is a very natural one that with the abundant corn crop of 1902, the price of corn should go back to about the old figure, and the price of beef should follow it. But this reasoning only takes account of one of the elements of the cost of producing beef, while if we study more deeply into the situation, we shall find that all the other elements have likewise experienced a very material advance.

The beef animal is finished upon corn, but he is reared largely upon pasture, and a variety of forage crops other than corn. Time was, not many years ago, when in the great stock growing regions pasture was almost literally without cost. A seemingly boundless area of grazing land lay open to free use, and the care of the stock was the only expense involved in their growth during the animal season. And even when the situation changed so that ownership and enclosure of pasture lands became the general practice, the price of these lands was so very low that the cost of rearing beef animals advanced but slowly. But in recent years a very great advance in the price of pasture lands in the beef-producing region has taken place.

In central Kansas, I have personal knowledge of pasture lands which were sold for four dollars per acre twelve years ago, were resold for $8.50 per acre three years ago, and have recently changed hands again at $15 per acre. Further west on the great plains pasture lands are lower in price for the reason that the product is scantier and the problem of watering more difficult and expensive, but here, as well, recent years have witnessed a material advance in the price of these lands. At the same time corn land in the great corn-producing sections has advanced in price in much the same ratio. In Kansas, where I am personally familiar with the situation, choice corn land sells at from $50 to $75 per acre, and in northern Missouri, Iowa, and Illinois, the range of price is higher.

Less than two years ago I was in Oklahoma, mingling with the crowd of homeseekers attracted thither by the impending opening of the Kiowa Indian reservation to settlement. Among those with whom I talked was a group of sturdy young men from Iowa.

"Why," I asked, "should anyone leave Iowa for Oklahoma? What is the matter with Iowa?"

"The matter with Iowa," they said in reply, "was simply this: that land there was so high that a farm was entirely out of the reach of a young man with but little capital, and they had left Iowa simply because they were compelled to do so in order to become possessors of farms of their own."

So, I think, we must conclude, that with this advance in all the elements of the cost of producing beef, the price is not likely to go back to the former standard.

The deficient corn crop of 1901 has simply accentuated the situation, which is based upon causes of a deeper and more permanent nature. I look for something of reduction and considerable oscillation in price of beef before a steady balance between demand and supply is attained, but I cannot see anywhere in the situation facts which justify the expectation that it will go down to its former level.

Assuming then, as I do, that beef will continue to be in demand at prices relatively high, the question comes back to us, can the beef-producing industry be restored to Connecticut farms and farmers? I believe that the question should be answered affirmatively. In former years the production of beef was a familiar feature of Connecticut agriculture, standing upon practical equality with dairying, fruit growing, and other lines of agricultural production. We had to give it up because we could not meet western competition. The product of that immense area of cheap and fertile land was brought to our markets at small cost by the wonderful development of transportation facilities, and it simply took the market away from us. It was impossible for us to hold it, and we had to turn our attention to other lines of production in which the pressure of western competition was not so severely felt.

But the balance of advantage is, as I have shown, turning once more in our favor. Western lands are fertile still, but they are cheap no longer. The cheap lands of this country are in the east, and New England, in Connecticut; in close proximity to the great centers of consumption which furnish the best markets in the country for all farm products. Land quite close to our large cities and land adapted to the production of some profitable specialty may still retain or even increase its old time value, but land only a little remote and adapted only to the production of staple crops is in many cases almost without market value.

I read not long ago in a Hartford paper of the purchase of two thousand acres of such land in the town of Marlborough for the sum of one dollar per acre, and I have information from one personally conversant with the facts that large quantities of land in New London county, including entire farms upon which in former years a prosperous agriculture had been carried on, have changed hands at a uniform price of two dollars per acre. Some years ago an acquaintance of mine, speaking of a locality where a number of farms were for sale, made this statement: " If you want to buy one of those farms, go and look over the buildings, and offer half what you consider the buildings worth and you will get the farm." I think almost any one familiar with rural life only a little remote from our populous centers can bear testimony from their own observation to the existence of similar conditions. Contrast this state of things with conditions existing in the great beef-producing region and it would seem that a presumption was established in favor of the practicability of growing beef at a profit in Connecticut. A related fact of much interest is that the dairy industry in Connecticut has been able to maintain itself in the face of western competition.

It has been helped, of course, by the fact that the transportation of whole milk for immediate consumption is impracticable for long distances, so that in that line the pressure of western competition has not been severely felt. But eastern dairymen have not only held on to the production of milk in which the advantage of proximity was of value to them; they have also held on to the production of butter, which is a concentrated product readily transported and in regard to which they have been subjected to competition from a wide extent of country.

Another related fact of interest is that mutton is produced for market in Connecticut in at least one instance on a scale of considerable magnitude. I allude to the work of Mr. Charles E. Lyman of Middlefield, who every year fattens sheep by the thousand, and finds the business profitable.

Now, while the details of management may vary widely the main elements of cost in the production of milk, mutton, and beef are substantially identical. The crude materials used in all three cases are pasture, hay and other forage plants, and grain. All of these materials except the grain can, in my opinion, be produced on Connecticut farms nearly as cheaply as on those of the west. And it would seem that the expense of importing grain might be fairly offset by the cost of transporting the finished product in the form of fattened cattle or of beef. Surely we are not ready to admit that the Connecticut farmer is so inferior in business capacity to his western brother that he will make a failure under conditions where the other achieves a success. But the Connecticut farmer who would go into beef raising must not think he can go back to the practice of fifty years ago and make a success of it.

Beef for the markets of today, if it is to yield a profit to the producer, must be made through the agency of something other than worn-out working oxen and heifers rejected from a herd intended primarily for other uses. These animals may, it is true, be utilized for food purposes. They have a certain value and should not be thrown away, but their utilization is not the business of beef production.

This, like many other branches of farming, has become a specialty, and he who would engage in it successfully must not only provide needed material but must equip himself with the machines which will convert this material into the required product in the best and most economical manner.

Only well-bred animals of the best beef breeds will do this for the beef producer, either in Kansas or Connecticut. Making beef of anything else is — I repeat the statement — not the business of beef production. It is rather the utilization of a waste product of some other industry.

Two years ago this month I spent a day at the international fat stock shows in the city of Chicago, and the lessons of what I saw and heard at that exhibition abide with me to this day. These lessons seemed to me both clear and forcible. Nowhere on earth, I think, could better stock be gathered than was shown there, and if the secret of success is not to be obtained from the men who rear these animals it were vain to seek for it anywhere else. The ideal beef animal is the one which will transmute the largest amount of feed into beef of the highest quality in the shortest time, and so distribute its flesh as to produce the largest proportion of choice cuts. The animal which won the sweepstakes prize for this last requirement was an Aberdeen Angus steer, and the animals of this breed, though inferior in size to the Short Horn and Hereford, impressed me as being the closest approach yet made to the perfect beef animal. This, however, is a matter which the necessarily superficial observation of a single day would not go far to determine. It involves elements which the casual observer may not even get a hint of. Not only the form of the animal but its constitutional tendencies, its disposition, and what might be called its mental equipment are all of them considerations of importance. A tendency to early maturity is held to be of great value. One beef producer with whom I talked placed all his beef stock on the market at from eighteen months to two years of age. Beyond that age he declared there was no profit in feeding animals intended solely for beef. His place of business was within one hundred miles of Chicago, and on land which I am sure must have borne a higher price per acre than land of equal producing capacity in Connecticut. His stock was Hereford, and his practice was to crowd the animals from birth. It was because he believed the Herefords better adapted to this treatment than any other breed that he had chosen to make use of them in his business. His calves ran with their mothers for about six months, and besides having all their mother's milk were taught to eat ground feed as early as possible and always kept abundantly supplied therewith. I wish I were able to give the weights of these animals when sold at less than two years of age, but my memory refuses to store and carry information of that nature and I can only say that they seemed to me well-nigh incredible. These large weights, combined with the highest quality and obtained in the shortest possible time, formed a combination which made the business a profitable one, and only by such a combination was it possible, in his judgment, to realize a satisfactory profit. I have no doubt of the soundness of his judgment as to the essential conditions of success, and these conditions are the same for the east as for the west.

Nowhere is it possible for the beef producer to do a profitable business under the old slipshod haphazard methods of the days of our fathers and grandfathers. Especially has the beef producer got to get rid of the old false notion that the animal which could dine on the least amount of food was the economical animal to own. As a general rule the exact reverse of this is true, and the animal which will consume the largest amount of food and make good use of it is the most economical. Only such an animal will, at all events, serve the purpose of the beef producer.

Now, let me say that I am not advocating beef production in Connecticut to crowd out and take the place of any established and profitably conducted industry. If any Connecticut farmer is established in any line of production which utilizes his land and labor and yields him a satisfactory return I would certainly advise, if I were to advise at all, against a change. I believe in the soundness of the old maxim "Let well enough alone." But when large tracts of land suitable for agricultural uses are being sold from one to three dollars per acre and turned into game preserves, there is something about Connecticut agriculture which is not "well enough," and should not be "let alone." Speaking, not from statistical information, but from quite extensive observation, it is my firm belief that the percentage of land suitable for agricultural uses and not utilized therefor is greater in Connecticut than in Kansas or Oklahoma or other western States in a like stage of development. It is this waste and now valueless land which I would like to see utilized for the production of beef. No other agricultural interest seems disposed to make any use of it. Of them all the dairy interest is the only one which could do so, and the dairy interest in Connecticut seems to have about reached the limit of its expansion.

With obvious points of difference the situation as regards beef production in Connecticut seems enough like that of peach growing twenty-five years ago to justify an appeal to experience in the one case for an illustration of what might be done in the other.

All the natural resources and adaptations, which, now that they have become known and in some measure developed, have made Connecticut peaches known and wanted in all accessible markets — have added an industry of great value to Connecticut agriculture and affected favorably the prosperity of the entire State — all these things had been in existence for years before it was discovered that we had them and had in them a possession of great value. What we needed then was a leader, and the leader came and what followed is known to you all. What we need now is a leader in this new line of discovery and development. I advertise our need as follows:

Wanted, a man possessing faith, intelligence, enthusiasm, and persistence, to embark in the beef producing business, to encounter its risks and show (as I surely believe he would) that they are chained lions and not dangerous, to tackle it's practical problems and solve them, and to work out in the field and stall and market, a demonstration of the question which would be conclusive.

If this paper were a recital of the story of such a demonstration it would have a value far beyond what can now attach to it. But if it shall put into the heart of the right man the impulse to go forward and work out such a demonstration it will not be entirely without value.

Now, let me briefly recount what seem to me the essentials of success in such an experiment.

First, and chiefly, the right man to manage it. Besides the general qualities mentioned, of faith, intelligence, enthusiasm, and persistence, he must be a stockman; one who finds enjoyment in the care and handling of stock and with a trained eye to tell at a glance much of the condition and capacity of each animal of his herd. So much for the man. Now, as to the raw materials for the beef factory which he is to operate. I name first, good pasture, and in this connection I mourn and lament that in Connecticut so much good pasture has been sacrificed by neglect in allowing bushes and scrubby timber growths to obtain possession of it and choke the life out of the pasture grasses. I know that the battle with bushes is one requiring unceasing vigilance and prompt and energetic action; but many other good things are saved to us, if saved at all, by the same means, and Connecticut pastures are worth saving. Large areas of those which are lost are, I believe, worth the cost of restoration. Our State lies well within the natural grassy belt, and if the requisite fertility of soil is maintained and protection afforded from foul and greedy robber growths, our pastures could nowhere be excelled. The manager of a beef factory needs also grass in the form of nutritious and palatable hay, and with the benefit of a few lessons from our Higganum apostle of hay culture he ought to be able to supply himself abundantly with this material at a cost which will enable him to make profitable use of it in the production of beef. Let me say in passing, that in my judgment Mr. Geo. M. Clark has rendered a service of great value to the farmers of Connecticut by his experiments in grass culture. The average farmer may have to follow him at considerable distance, but he has shown what course to take and one may keep as near to him as he can.

Corn ensilage is another material of which I believe large and profitable use might be made in the production of beef. The task of the beef producer, as I conceive it, is to grow as well as to fatten his animals, and corn ensilage is well adapted to promote rapid and healthy growth. All these materials should be produced upon the farm, and in their economical production and handling and consumption there is scope for the services of business qualities of a high order. Not all the material needed for successful beef production can be grown to advantage upon a Connecticut farm. Many beef-growers in western States find it for their advantage to buy a portion of the feed their animals consume rather than grow it. Their practice is governed by the familiar principle of concentration — limiting the scope of their work to what they can do thoroughly. For what they need in addition to this they go into the open market, and the eastern producer would go into the market where the range of prices is somewhat higher and do the same thing. Just what he would buy is something I cannot tell. That is a problem he must study and solve for himself. But I think I can tell him what he should try to accomplish by his system of feeding. He should aim to keep the digestive machinery of the animal destined for beef at work to its utmost capacity and to the very best advantage from the day of its birth to the day it is slaughtered, in accumulating the largest possible amount of valuable meat in proportion to the necessary waste material of the animal organism. I do not think this can be accomplished by following rules and administering prescriptions. One must use sound judgment based upon keen and constant observation. The animal is always a variable factor in the feeder's problem, and to be successful he should be much with his stock and study them until he knows the peculiarity of each individual animal and is able to adapt his treatment to the needs of each. I believe that one reason for the high standard of attainment in the dairy business is the close intimacy between the man and his animals which that business compels. When a man milks a cow twice a day he is pretty sure to get acquainted with her — to know her temperament, her capacities, and her needs, and how to minister to them so as to enable her to perform her maximum of service. I do not think the beef animal as complicated a problem as is the dairy cow, but both are problems, and each requires study for its right solution.

It is very far from my purpose to encourage anyone to go into beef raising in Connecticut with the idea that it is a business which will take care of itself. Any business, agricultural or other than agricultural, left to run itself goes inevitably to ruin. If anyone desires a business of that nature I cannot undertake to tell him where to look for it; but I can inform him in most positive terms that he will not find it in beef growing, or in any branch of agriculture. And I say this without one particle of regret, that it is so. I have no wish to be identified with a calling which confers unearned rewards upon its followers. It is enough to say of any calling that it pays a fair price for faithful work. I believe the beef growing industry will do this right here in Connecticut, and in its favor it is but just to say that it is less exacting in its requirements than many other lines of farming. In this respect it compares very favorably with the dairy industry, which I think is rightly regarded as about the most exacting line of agricultural production in which one can engage.

Nights and Sundays a man ought to have, as a general rule, free from business exactions, but in the case of the dairyman both nights and Sundays are invaded too often and too far.

The beef producer must give the requisite attention to his business, but be not bound down to a daily routine so closely as to suggest the word "slavery" as an appropriate descriptive term for it.

His product is marketed in large quantities and at infrequent intervals, and while this feature of his business calls for keen attention it is not carried as a burden every day in the year. A larger freedom of action, a wider outlook upon the trend of things in the business world, an income handled in large amounts instead of in driblets; these seem to me attractive features which the business of beef production offers as compared with its nearest relative and natural rival, the business of dairying.

Somewhere about here it was my thought that I would work in a concluding paragraph and draw this paper to a close.

I had in mind the economic problem, and thought to limit my discussion to that phase of the subject. Really, that ought to cover the whole problem of beef production in Connecticut. But, unfortunately, it seems that it does not.

In a letter received from your honored Secretary in regard to this paper I find the following sentence:

"I hope you will be able to convince us that we can successfully meet the opposition of the beef trust," and this suggestion seems to call for some attention to the great question which looms so large and with an aspect so threatening upon the field of public discussion. Perhaps I ought not to be surprised that the trust question intrudes itself into this discussion, for scarce anything in the line of business seems exempt from its influence either baleful or beneficial. So far as the business of beef production is concerned there need be no fear of harm from direct competition with any trust or large producing concern of whatever name or nature.

The business does not lend itself readily to concentration and monopoly. Its necessary distribution is too wide for that, and it is in quite another way that the opposition of the beef trust is likely to be felt effectively.

You will notice that your Secretary with keen discrimination made use of the word opposition rather than competition. The trust question in its relation to the problem of beef production in Connecticut is not whether we can produce beef here in competition with growers elsewhere, but whether or not we shall be permitted to sell our product when grown. The beef trust, meaning thereby the four or five large firms which make a business of handling meat products, and which undoubtedly have an understanding with each other so that they act in harmony and may be treated in this discussion as one concern, aims to control the market, to stand between producer and consumer, and permit no transactions between them except through its agency. If it can accomplish this it is in a position to fix prices in both directions — to say to the grower what he shall receive for his product, limited only by the consideration that it must be sufficient to induce him to continue in the business; and on the other hand to say to the consumer what he must pay for this form of food, limited only by the consideration that the price paid must not be prohibitory and drive the consumer to quit eating beef and substitute for it some other form of food.

Now, this community has in recent years been related to the beef trust as a consumer. It has controlled our supply, dictated the price we should pay, keeping always within the limitation above mentioned, and things have gone on smoothly if not always satisfactorily. In the great beef producing regions the control of the trust has been equally complete, and its management characterized by equal wisdom and the accumulation of immense fortunes by the firms which compose it has followed as a natural consequence. All over the country the channels of business and facilities of transportation are adapted to the situation as it exists, and, to those interested in maintaining it, I have no doubt it seems to be just right, and any disturbance of it a thing to be resisted and defeated if possible.

Now, if we in the east go to growing beef in sufficient quantities to be felt in the market as a competing force, we shall certainly disturb the serenity of the situation. With what tactics such a development would be likely to be met has already been indicated in more than one instance. An attempt would be made to shut us out of the markets accessible to us by a cut-throat competition, local and temporary in its nature, which would be a burden hardly felt by the financial strength of the trust while it would be crushing to its comparatively weak competitor. There is the bald situation, and the question is, what should be our attitude with reference to it? Ethically, the attitude and action of the trust in this respect seems fairly comparable to piracy or highway robbery, only it is lacking in the element of courage which sometimes lends a measure of dignity to the robber or pirate. From behind the secure covert of technical legality these modern pirates and robbers prey upon those who come within the scope of their power, and back comes the question of Boss Tweed, "What are you going to do about it?" It is a question of tremendous import, far too wide in its sweep and far too weighty for me to attempt anything like a complete answer here and now. But this I will say, that our attitude towards it should not be one of tame and unresisting submission to outrage. Resistance will cost something — the suppression of piracy and highway robbery under the old forms has been and still is somewhat expensive, but in the situation supposed the sharply-defined alternative is upon us, of resistance or submission, and it will not do to submit. We have not yet reached that stage of moral development in which evils of this kind, the fruitage of the greed in human nature, can be trusted to cure themselves. One remedy for them in which I have great faith is the power of an enlightened and aroused public opinion.

Laws are excellent as rules for the guidance of those who wish to do the right thing; but for the control and restraint of those who desire to do the wrong thing, law, as administered by our modern machinery, is clumsy and bungling, and frightfully inefficient. But the court of public opinion is always open, its jurisdiction is very comprehensive, its process cannot be evaded, its verdicts are given upon the merits of the case, and its penalties are effectively enforced. Even the big trust dreads this power and tries to evade the publicity which comes to summon it before this tribunal.

And so what I would like to see when the trust or big corporation steps out of its legitimate sphere of action and enters upon a course of cutthroat competition for the purpose of killing off some weaker competitor would be not a surrender, but a fight. In such a struggle the weaker party would not be without effective weapons in its hands, nor would it be left to fight alone. The press would lend its powerful aid, and every instinct of righteousness in men's hearts could be counted as an ally. An aroused public opinion would be a tremendous force in its favor, and it is possible and perhaps probable, that legislation might come tagging along in the rear and help some.

But all these helps are conditioned upon a fight. The party who surrenders at the beginning of the struggle can count upon none of them. Connecticut is a small State but one of wonderful diversity of surface and soil and situation, and to some extent of climate also. Beyond any other tract of land of equal area with which I am at all familiar it is adapted to a great variety of products, and only through such variety can its agricultural resources be utilized. The genius of its people seems in harmony with its landscapes. Their aptitudes are exceedingly varied and they reach successfully many avenues. It might almost be said of anything which needs doing and promises to pay that a Connecticut man can be found to do it. Run over in your mind, if you will, the long list, far too long for me to write down here, of her agricultural products, from staples like hay, corn, and potatoes, to the latest novelty of tent-grown tobacco, and see if this be not true in regard to her agriculture. The same thing is characteristic of her manufactures.

The list is very long and its variety very great, and something new in product or process is constantly being introduced and tested. Pioneering both in agriculture and manufactures is going on all the time, and pioneering is grand work. Generally it pays the individual who undertakes it, and always it is profitable to the community to which the pioneer belongs. There are risks and hardships connected with it, but we, as a people, are not over-much afraid of risks and hardships. We meet risks and conquer them, we endure hardships and grow strong by reason of them. All honor, then, to the pioneers. We await a pioneer to lead a goodly following in the production of beef in Connecticut.

DISCUSSION.

The PRESIDENT. Now, gentlemen, this question is broad and comprehensive enough for a two-hours discussion. Have you any questions?

Prof. SAUNDERS. Mr. Chairman, I would like the privilege of saying a word or two in this connection in order to give you good people here some idea of the experimental work we have been carrying on at Ottawa along these particular lines for the last few years. It may not be known to all of you, but Canada is a great exporting beef country. We not only grow all the beef we need for ourselves, but we have a great deal to spare to send to the motherland. At Ottawa, our agriculturist, some three years ago, planned some experiments along this line. He selected ten young calves about four weeks old, fairly well bred Shorthorns, graded and weighed each animal, and the animals were divided into two groups, one being subjected to special treatment and the other not, the object being to see to what extent the advantage would lie with the group which was going to be subjected to special treatment. One of these groups of calves was fed in the way advocated by the speaker who has just closed his excellent paper; that is, feeding it for a while very sparingly, and then giving the calf, as soon as it could assimilate it, a small quantity, and increasing the quantity gradually as the young animal was able to bear it. The other group of five was treated in this way: they were given plenty of coarse food and a little grain, not very much. Now, as these well-fed animals grew they soon out-weighed the other group which had been fed in the usual way, and progressed to such a degree that by the time they were two years old the well-fed animals weighed on an average about eleven hundred pounds, while the others which had been treated in the usual way were about four hundred pounds lighter. They were what would be called fairly good calves, but these special fed animals showed most distinctly the economy of liberally feeding young stock. The result was that they were sold to a butcher when they were less than two years old at a profit of $30 a head, counting all the food they had eaten. The only element not taken into consideration was the labor. The labor was put against the manure, as we considered that the manure from such well-fed animals was equal to the labor cost. Figuring in this way it gave us a profit of $30 apiece in cash over and above the cost of feed from the time they were four weeks old. The other five, which had been treated in the usual way, could have been sold at a profit of about $5 a head, but not more than that. The butchers did not want to look at them as animals for beef, while they were most eager to get hold of this "baby beef" as they called it, as it was just the material which their customers were willing to pay a good price for. I mention this experiment to show how well and how thoroughly the speaker who has just concluded has put that point, namely, the importance of feeding the animals liberally from the start.

President STIMSON. Last summer my business called me to the Central Experimental Farms at Ottawa, and one of the things to which my attention was directed was this department of experiment stations there. And the man who took us about said that they were continuing the same line of experiments there from year to year, not because they needed to find out any further facts or any further confirmation of the truth arrived at in the first experiments, but as object lessons for the farmers who came there. This kind of experimenting was being carried on continuously, and it struck me that the contrast presented as the results of different methods was an extremely valuable feature of the work there.

Mr. Fosdick. While I do not come from the town that the speaker referred to I just want to call attention to one thing, or a statement that our speaker made. While he may be correct, and I agree with his suggestion that there are some lands in our country towns that could be used to raise excellent beef, yet I think he has rather given us the idea that there are towns where we can buy land at from $2 to $3 an acre that is suitable for raising beef. That is certainly very misleading. A game preserve is not what you want to make good beef. You might buy some land that is suitable for a game preserve in Connecticut for some such price, but to raise good beef you must have grass and not brush for a pasture. Now while the speaker has had opportunities for visiting some of these places, and also where live stock is handled, that has also been my opportunity. I have also had opportunity in selling beef and calves to visit Brighton and East Albany, and I find where you get the best steers is from the country where you get the best natural food. You can get any quantity of land for a low price in this State, but it is not the kind of land that is suitable for raising beef. You can buy some of this land that has had the wood and timber taken off from it, a growth of fifty or seventy-five or a hundred years, and where the owners have got to wait for a long term before they can get another crop — that kind of land you can secure for $1.50 to $2.00 an acre, maybe, but that is not the kind of land, in my experience, that is suitable for beef raising. Land that is suited for raising beef is worth $10, $12, and $15 an acre. I mean fair pasture land.

I don't want you to get the idea that you can go out here and buy a large area of this cheap land, and that it will make a large quantity of nice beef. You can't do it. That is not the kind of land that you can get for any such price.

Now, another matter relative to selling beef. My experience has been that when we had anything of first-class quality we could get good prices without much trouble. If you have got the quality, and you know how to sell, you can get about what your beef is worth, but the trouble is we are not fitted for raising beef in Connecticut. Our farmers have gone out of the business. They have not been breeding for beef. We have been raising too many scrubs that would never make good beef no matter how much you fed them. They are not started right. Nobody wants to go into the beef industry in Connecticut without finding out the conditions which surround it. If a man has got a large pasture that is quite a little distance away from either a large place or a city, and cannot well go into dairying, perhaps it would be a good idea for him to go into the beef business here in Connecticut, but you do not want to go off with the idea that you can go out and buy a lot of this back country land, scrub land, that is hardly good for anything and make a big success in the beef business. You have got to have good pasture to do that.

Mr. HUBBARD. Perhaps I did not give the impression that I meant to. My information is that there is a good deal of this land which is really old farm land that can be had at a low price for this purpose. That is, it is land which comprises a considerable proportion of the land which has been utilized for producing feed for the stock which was kept on these farms. Some of it, of course, is rough land, and wood land, and intervale, but there are many fields scattered about in these tracts of land which I certainly believe will raise good beef. I believe the best pasture in the land is one that is partly shaded, and one which may include much rough land, and which also includes intervales, and swales, and that kind of land which, with proper attention, may be maintained so as to make an excellent pasture. I believe Connecticut pastures are naturally adapted to it, and will raise good beef. It has been done, and I believe they will do their part now towards raising a good quality of beef.

The gentleman is right in regard to this fact, that we cannot make good beef out of the stuff we have got on them now, but we have got to learn how to work up this material we have got on them now and to replace it with better stock.

The PRESIDENT. I would like to inquire if you think you can take an old pasture in Connecticut, or some of these old farm lands that have recently been used for making milk to send to New York, and where but little has been done for them, and produce good beef on them now?

Mr. HUBBARD. I certainly believe they will. That is, they will do their part towards producing it, but they may need to be supplemented by other things.

The PRESIDENT. Will they do what they formerly did before they were used for the dairy business?

Mr. HUBBARD. As to that, I said in the course of my remarks that a dairy herd upon a pasture was exhausting in its effect. I think a pasture is deteriorated under a dairy herd. I think, perhaps, where they have been used for that purpose for some time they may require fertilizing to bring them up, but I think under beef pasturing, with the animals constantly upon the land the pasture is supplemented and helped to grow feed. I think such pastures will maintain their fertility and increase in their productiveness.

A MEMBER. Some years ago there was a farm left in East Haddam to the Baptist Church of Chester. It comprised about two hundred acres, and at the time the farm was left it was appraised at $2,000. There was, perhaps, a third of it wood land, but the rest of it was good, average farm land and capable of supporting about sixty head of cattle a year. They sold that farm, I think three years ago, for $500. There was all of thirty acres of good mowing land. The pasture land was pretty fair. It was not scrub pasture, but the most of it was cleared land. There was a stone wall on it that would cost, if the money had to be paid right out, over $2,000 to build. There was a house and barn, and it sold for $500.

Mr. HUBBARD. There have instances of that kind come to my attention in a great many portions of the State, so that I cannot but believe that there are lands in Connecticut that are suitable for beef production, and that might be utilized for this purpose if a little effort was made to locate them. I am sure of it.

Mr. FOSDICK. I want this thing to be understood just as it is. I know something about some of that land that the gentleman speaks of. If I understood him correctly he said that that farm would keep about sixty head of cattle. Am I correct?

ANSWER. Yes, sir. That is what I understand it used to do.

Mr. FOSDICK. I know that territory well. It will pasture about ten beef steers through the summer the way we give them ordinary pasture. I have been there. There are not sixty head of cattle in that society there in Chester.

A MEMBER. I didn't say at the present time. I said at the time the farm was given to the Baptist Church. That is some years ago. The land has been allowed to run down some since. It has been leased to different parties, and they have done nothing only to rob the farm. I would not expect that farm to keep that number of cattle at the present time.

Mr. HOYT. I believe that there can be money made in growing beef in Connecticut, but I do not believe there can be money made by attempting to grow it upon our abandoned and worn-out farms. If I was going into the beef business I would not see how many acres of land I could get for a little amount of money. My first object would be to see how good a farm I could get and how little waste land; how many acres I could get in that farm that were clear, and then I would put it in the highest state of cultivation. I would put my cattle in the stables and feed them. I would raise the food upon that farm. In that way you can treat ten steers where you can feed one in the pastures and fields, and in that way you will all the while be improving your farm and making it more and more productive so that it will raise you more steers. The other way, by pasturing your land, you would be all the while reducing its productiveness, in my opinion. You have got to do with steers as you would with dairy cows, — give them plenty of the proper kind of food. So, if I was going to raise beef, I would get the best land I could, and put every acre of it under the plow. With your ensilage and your green fodder you can raise on a hundred acres from fifty to a hundred steers without any trouble, and your farm would be growing richer and better all the time. You can do it cheaper and you can make more money out of the business, in my opinion, by running it in that way than in the other way, — by pasturing this worn-out land.

Prof. Clinton. I happen to know of a case where this practice which Mr. Hoyt has just recommended has been carried out, and where a man, at the present time, is caring for thirty head of stock upon about fifteen acres of land. I will guarantee that there is not a foot of waste land on those fifteen acres. Of course he does not depend upon pasturage, but he has his silos, and he makes every foot of that land produce to its utmost. That means intensive farming, and it is this system of intensive farming which I believe will help us greatly in making a profit, not only in the dairy, but in this respect also.

A Member. I know of a man that keeps between two and three hundred cows on about a hundred acres, about seven miles back of Montclair, N. J. He gets twelve cents a quart for all the milk he produces. Of course he buys grain cargoes, and everything he has to use except what he raises in quantities.

Mr. Barber. It seems to me from what has been said that it would depend a good deal upon a person's conditions, whether he could make a success of beef raising. If you could go into some sections of our State, say into the western part of Windham county, and pass from that over into the eastern part of Tolland county, and you could, perhaps, do better raising beef than you could by running a dairy. But you take a man that is situated near a good market, as all in the eastern part of our county, and in fact, in most all the counties in the State, and I do not believe that today, with the conditions as they are, it is for his interest to give up dairying and go into beef raising.

And another thing. It seems to me that the impression that has been given out here by some that dairying will run out a farm is not right. When I started out I couldn't keep much more than four cows and a horse, but I have had in the past year nearly forty head of horned cattle, and I didn't buy anything either. I believe we can increase the productiveness of our farms by dairying.

QUESTION. What do you do with the product of your dairy?

ANSWER. We make butter which goes to private families. I could sell just double what I can produce.

The PRESIDENT. It will not hurt the farm a bit to keep a dairy herd on it if you keep the skim milk back.

Mr. HOYT. I would like to inquire of the gentleman from Ottawa if those steers which he spoke of, and which brought such a good price, were kept in the stable or whether they were left out to pasture.

Prof. SAUNDERS. They were kept in the stable about nine months in the year, and during about three months, when the pasture was at its best, they were pastured outside. The other steers were treated in the usual way. We put them out early in the spring and left them out till quite late in the autumn.

Mr. HOYT. I would like to inquire of Mr. Hubbard what he thinks as to the best breed for beef cattle?

Mr. HUBBARD. I think the general judgment of the majority of the beef producers at the show in Chicago was in favor of the Hereford. That is the case throughout the west. They lend themselves to the necessary treatment better. They mature early. Their disposition seems to be very favorable. While I was impressed with the merits of another breed, yet I think the judgment of the majority was rather in favor of the Hereford.

Mr. MANCHESTER. Quite a number of years ago my attention was called to this subject of bringing up our pasture lands. A gentleman in the western part of the State had a pasture which was what they called "worn out" when this gentleman took it. He put it under treatment to bring it up, and his practice was this: every other year he sowed plaster on it, and then he turned on his beef stock. And in that way he brought that pasture up to a very highly fertilized condition. The grass upon it was very good when I saw it.

Mr. STIMSON. When up in Canada my attention was called to this problem. Should a farmer have a permanent pasture, or should he cultivate his pasture one year in every two or three years, and then put it into pasture again? That seems to be a good problem. In riding through Canada you will see that they have a difference in their practice. You will find the land is laid out in series beside the railway. You will see one field that apparently has been pastured for a long time and which shows a high degree of infertility, while perhaps the soil has been cultivated in one immediately adjacent and shows a high state of cultivation, the ground being well concealed, and a good crop of grass. I would like to have Director Saunders tell us what has been their experience in Canada in regard to this matter of cultivating pastures.

Prof. SAUNDERS. Mr. Chairman, wherever the land is suitable for mixed farming purposes, that is, where you can grow a succession of crops, — and, of course, that throws out all the sodden land, — where the land is of that character we find more money in treating it to a succession of crops than there is by any other system we can adopt. The most common system throughout the best part of Ontario and Quebec is a four-years rotation. We begin, say, with a hoed crop. The land is broken up, and we finish with a pasture crop. The land being manured that year you turn it under, and for the next season put on a hoed crop, or, in some cases, a hay crop. There are many of the large farms where a part is put into a hay crop and a part into turnips or potatoes. If a man has, say, a hundred acres of arable land on his farm, he will do well to divide it into four parts of twenty-five acres each. One of these sections to be in a hay crop, and then the next year it is sown with a grain crop and seeded with clover or timothy at the time of sowing. The grain crop may be wheat itself. Mostly it is oats. That is the hay crop mostly raised in the eastern part of Canada. More so than any other grain. When the oats are cut the young clover and timothy plants begin to grow and establish themselves thoroughly by the end of the season, so that the next year you get an extremely good crop of clover hay. And we find the clover hay for use for feeding cattle much more valuable than the timothy hay. Now, clover with us being mostly a biennial plant, after the next winter we find that the timothy predominates. Now, if a man has a hundred and fifty acres, and has enough cattle to pasture 37½ acres, or a fourth of this area that he has followed in rotation, he can leave it all for pasture, but the pasture is so rich that there are many farmers who have not cattle enough to occupy it, and then it is better to divide it into two portions, one being cut for the timothy hay and the other being used for pasture. That takes us, you see, to the end of the third year. Then, late in the autumn or early in the spring, the clover and timothy sod is turned under, having been previously manured, or it may be manured through the winter, and, in that case, it has to be plowed again in the spring for the hay crop. Now, our farmers are pretty fully awakened to the importance of maintaining the fertility of the land, for they find there is more money in that than in anything else they can do. We are all after what we can make out of the farm. They take good care of their manure and utilize it to the last pound in putting it on their land. Some of them use artificial fertilizers to supplement the manure where they do not think the manure itself is sufficient to keep up the fertility of the land. Every crop takes just so much out of the land, and if you figure what is taken out of an acre and then figure to put back a little more, then your land goes on improving and you have good crops assured to you as long as you continue that system of cultivation.

The PRESIDENT. The time has now arrived to proceed to the discussion of another question. We must take up now this other question which comes to us, and it is a very important one, and that is the address which we are now to have by Prof. Saunders of Ottawa on

IMPROVEMENTS IN CEREALS AND FRUITS BY CROSS-FERTILIZING.

This is the first time I have had the privilege of taking part in an agricultural meeting in the State of Connecticut. I am glad of the opportunity of making the acquaintance of the farmers in this part of the great republic. Our object, I believe, in meeting together, is to give and gain information, and we should on such occasions try to get all we can out of each other, for we can all contribute to the general fund of information if we will.

On the program prepared for this meeting I notice that the word "discussion" occurs after the titles of several of the papers, but it is not placed after either of the subjects on which I am to talk to you. I sincerely hope that some time for discussion will be allowed in each case, so that if there is anything in what I may have said which may suggest questions these may be permitted, as I shall esteem it a privilege to be allowed to answer such queries.

Another thing I notice on your program on which I wish to say a word, as I think this may help you the better to understand the importance to Canada of the work of which I am about to speak. You will pardon me for referring to a matter somewhat personal. I am announced to you as Director of the Central Experimental Farm, Ottawa, Canada. This is correct as far as it goes, but it does not go far enough. It should be Director of the Dominion Experimental Farms.

The system of experimental farms organized in Canada in 1886-87 includes five farms — a central and four branch institutions. The central farm is located near the capital, Ottawa, and serves the purposes of the two larger provinces, Ontario and Quebec. One of the branch farms, that at Nappan, N. S., serves for the three Maritime Provinces, Nova Scotia, New Brunswick, and Prince Edward Island. One has been established at Brandon in Manitoba, another has been placed at India Head in the Northwest Territories, and a fourth at Agassir in the coast climate of British Columbia.

The object in this arrangement was to cover all the more important climatic conditions found from the Atlantic to the Pacific, so that the work might be made helpful to the farmers throughout the Dominion. All these farms are under my direction, and my business is to study the needs of the farmers in all parts of the country so that the work may be made as helpful to them as possible. My parish, as you will see, is a very large one, and, although I have made eighteen trips across the continent in the past sixteen years and have driven five or six thousand miles over the plains, I have as yet only become thoroughly familiar with a part of it.

The subject on which I have been asked to speak today is "Improvements in Cereals and Fruits by Cross-fertilizing." While this will be the main topic referred to it will be necessary, in order to understand the subject fully, to refer also to improvements by selection, for the two go hand in hand.

Improvements in flowering plants by cross-fertilizing have been carried on for many years with great success, and to the exercise of this art we are indebted mainly for the many improvements effected of late years in roses, carnations, gladioli, cannas, irises, lilacs, and a host of other species which adorn our garden from year to year and give us great pleasure.

It seems rather strange that while this special field — the improvement of ornamental flowers — has commanded the attention and services of a multitude of experts, comparatively little thought has been given to the improvement of cereals.

In Europe the name of the late Henry Vilmorin, — member of the well-known seed firm of Vilmorin & Andrieux of Paris, France, — stands out prominently in this connection. During his lifetime he made a close study of the different varieties of wheat in cultivation, and made many useful and interesting crosses between the different sorts. Some of these are said to have done exceedingly well in France, but I am not aware that any of his varieties are grown in a large way in any part of America. Mr. Vilmorin's writings on this subject have been most useful to all workers in this interesting field. When visiting his establishment two years ago I found that his work was being carried on with much enthusiasm by his son, Mr. Philippe de Vilmorin; that he had under cultivation about 900 varieties of winter wheat including about 250 cross-bred sorts, about 150 varieties of spring wheat, 100 varieties of barley, and 150 different sorts of oats. These are mostly grown in very small plots each containing from 40 to 50 plants, and each year the relative productiveness of these sorts is studied and the strongest and most productive plants in the plots saved for seed the following season.

The Garton Brothers of Newton le Willows, England, have come prominently before the public during the past few years as breeders of new varieties of grain by cross-fertilizing, and some of the oats they have lately introduced, such as Waverly, Tartar King, and Goldfinder, promise to be useful introductions in this class.

In the United States Mr. Jones of New York State has attained some eminence as a breeder of winter wheats, and some of his varieties are much grown throughout the United States and Canada. Professor Hayes of the Experiment Station also has produced some excellent varieties of wheat by cross-fertilizing.

The first efforts to improve wheat by cross-fertilizing in Canada were made by the late Charles Arnold of Paris, Ont. In 1872 he exhibited a new variety of winter wheat produced by this method which is said to have been of rare excellence. having the hardiness of some of the dark skinned sorts with the thin white skin of some of the more tender kinds. That wheat was awarded a gold medal that year by the Ontario Agricultural Association. He subsequently sold a portion of his stock of this grain to the United States Department of

Agriculture, and it has since been grown in different parts of the United States and Canada under the names of Arnold Hybrid and Gold Medal wheat.

My own efforts in cross-breeding were begun in 1868, and have been continued at intervals ever since. The work done has included experiments with the gooseberry, red and white currant, black currant, raspberry, blackberry, grape, apple, pear, plum, cherry, sand cherry, Japanese quince, rose, and barberry; also with different sorts of wheat, barley, oats, peas, and rye, and with several species of flowers.

Before referring to these cross-breds more in detail, permit me to say a few words as to the methods employed in carrying on these different lines of work.

In the breeding of plants the term cross-bred is used when referring to the crosses produced between different varieties of the same species, and the word "hybrid" when speaking of new forms obtained by crossing such plants as are generally regarded as distinct species.

The results obtained from efforts at crossing or hybridizing depend much on the care taken in conducting the operation. In a general way it is believed by many experimenters that crosses in fruit inherit their constitution largely from the pistillate or female parent, while the quality and flavor of the fruit is much influenced by the other sex.

The tools required in cross-breeding are few, but a steady hand has an important bearing on the success of the work. The following is all that is needed: A pair of finely pointed forceps, some camel hair pencils, paper and gauze bags large enough to enclose the branches on which the blossoms to be worked are situated, twine for tying these bags in place, and a few wired labels to attach to the branches, on which the number of the cross or other particulars may be written.

In choosing flower buds to work on all those which are partially open should be rejected, also those which are very immature, the aim being to work on those which are so far advanced as to be nearly ready to open. Having chosen the flowers to be operated on remove carefully with the finely pointed forceps the floral coverings, calyx and corolla, without bruising or injuring the internal organs. The stamens with their anthers are then torn away, leaving the pistil or pistils exposed. When all the flowers selected have been thus prepared they are at once enclosed in a paper bag which is tied to the branch until pollen from the other variety to be used in the cross is secured.

In obtaining the pollen from the apple, pear, plum, cherry, strawberry, blackberry, gooseberry, etc., it can generally be had in sufficient quantity, and often in abundance, if branches well provided with blossom buds which are just about to open are cut and placed in a vessel of water in a sunny place indoors. The anthers usually discharge their pollen in the morning, and by lightly pinching them between the finger and thumb the fertilizing powder can be seen in small patches on the surface and with care can be transferred by the hand to the flowers awaiting fertilization. Where one depends on obtaining pollen from flowers outside it will often be found that bees and other insects have preceded the hybridist, and in their efforts to gather nectar from the flowers the anthers have been so knocked about that much of the pollen has been scattered. If the variety from which it is desired to obtain the pollen is later in blooming than the individual to be crossed the opening of the flowers may be hastened by cutting small branches well furnished with blossom buds a few days before the pollen is needed, placing them in water and exposing them to heat and sunlight in a greenhouse.

In working with grape blossoms the pollen may be collected by holding closely under the recently opened flower clusters a piece of smooth blue paper, when, by a sharp tap with the finger on that portion of the branch, a cloud of pollen dust will be liberated which will settle on the paper below. By repeating this operation several times the quantity of pollen on the page may be materially increased. The caps of the grape flowers will also fall plentifully, but these can be carefully removed without disturbing the pollen below. With a camel hair pencil slightly moistened this pollen can be collected and easily applied to the pistils of the variety to be fertilized.

In applying the pollen from the raspberry and blackberry it has been found better to break off the expanded blossoms and, having removed the petals and the central bunch of pistils, carry the mutilated flower on which the fringe of stamens alone remains and twirl these about among the many pistils in the flowers previously prepared for crossing.

In operating on such cereals as wheat, barley, and oats, the process is much more difficult. In working with wheat the head should be selected soon after it has pushed out from the sheath. This head consists of a series of clusters known as spikelets, which are arranged alternately on opposite sides of the stalk. Later, each spikelet will contain from two to five kernels of wheat. In the early stages of the growth of the head the kernels are not formed, but the hollow centers they are destined to fill are occupied by the more or less developed flowers of the plant.

In the figure on the chart we have a portion of a wheat ear from which all the spikelets but one have been removed, and on one side of this one of the floral chambers has been opened. The outer covering of chaff has been torn off and the inner covering turned down so as to expose the flower of the wheat plant to view. This is seen to consist of a double branched, pucculent feathery pistil and three stamens, which are thread-like at base with large anthers overhanging the pistil. These anthers contain the fertilizing pollen.

In nature fertilization takes place within the tightly closed chaffy case, where, as the anthers mature, they open and the pollen is shed on the delicate, feathery pistil below. Portions of this pollen remain attached to the surface of the pistil, and from one or more of these minute miscroscopic bodies a small, thread-like growth proceeds which pierces the soft tissues of the pistil and, gradually lengthening, soon extends to its base, where it enters the ovary and fertilization is accomplished, followed by the rapid growth of a kernel.

When operating on wheat to effect a cross the outer layer of chaff is torn off with the finely pointed forceps, and the inner coating pulled back by seizing it near the tip and bending it downwards, which exposes the flower. The anthers are then carefully examined and, if their condition is sufficiently advanced to offer the possibility of any of the pollen having been shed, the spikelet to which it belongs is torn off and other flowers opened until some are found in the desired condition, with the stamens green but almost mature. These are removed with much care, as the slightest injury to the soft and delicate pistil will cause it to wither. The flower is then covered by replacing the inner coating of chaff in its natural position. After the removal of the stamens from a sufficient number of selected flowers all other portions of the head are torn off and rejected.

Having previously selected heads of the variety or species which is to serve as the male, flowers are sought for which contain anthers fully matured and covered with pollen. Then the individual flowers which have been prepared for fertilization are opened again in succession and the soft, feathery pistil is gently touched with one or more of the pollen-laden anthers from the other variety until a perceptible quantity of the fertilizing powder has been applied, when the flower case is again closed. After all the flowers in a prepared head have been operated on it is wrapped in thin paper and so secured by tying as to prevent the possibility of access of other pollen. As a further precaution the covered head is then tied to a piece of stick or bamboo cane, where it remains untouched until harvest time, when any kernels which have formed will be mature and may be safely gathered. Each kernel, when sown the following season, will form the starting point of a new variety.

In crossing different sorts of barley the head should be worked before it is fully out of the sheath, as natural fertilization takes place earlier with this grain than with wheat.

In cereals the single plant grown the first year will produce heads all alike, and these will usually resemble closely the variety on which the kernel has been produced. Occasionally, however, it will to some extent take after the plant from which the pollen has been gathered. If the cross has been successfully made the grain obtained from the plant of the first year's growth when sown the next season will usually produce several different forms, some resembling one parent and some the other, while other plants will produce heads more or less intermediate in character. After selecting the most desirable type or types from a cross all other forms are discarded, and only those retained from year to year which are true to the type or types selected. After several seasons of careful selection the type usually becomes fairly permanent. Variations will, however, still in some cases occasionally occur; these should be watched for and separated whenever they appear if the new grain is to be preserved true to the chosen type.

In efforts to cross cereals many failures may be looked for, and with all the skill which trained hands can bring to bear on the work the ripened kernels are always few compared with the number of flowers operated upon. A partial record of the crossing which has been done on wheat at the Canadian experimental farms shows that from 1,650 flowers carefully worked only 220 kernels were obtained, about one in every eight.

In all efforts at cross-fertilizing paper bags are recommended for covering the flowers on account of the closeness of their texture. Pollen grains are sometimes blown about by the wind, and are in most instances so very minute that they would pass readily through the finest gauze. With grain the paper bags have been allowed to remain on until the close of the season, but with fruits or flowers, after the fruit or seed is so far advanced as to be beyond the possibility of further influence from pollen, the practice has been to replace the paper bag with one of fine gauze, which will give free access of air and light and thus promote healthy development.

As the summer season in many parts of Canada is comparatively short early ripening varieties of grain are desired, hence efforts have been made to obtain early ripening sorts from other counties, notably from the northern parts of Russia and from India. From Russia several varieties were introduced, including Saxonka, Kubanka, Mega, and Ladoga. From India, in 1889, through the kindness of the late Lord Dufferin, then Viceroy, a number of different sorts were received for test on the Canadian experimental farms, including specimens grown at different heights on the Himalayan Mountains from 420 to 11,000 feet. All the Indian varieties have been early in ripening, and two of the earliest and most promising of the wheats, Hard Red Calcutta and Gehun, were found to ripen as early as the Ladoga, which was about one week earlier than the Red Fife, which is the variety of wheat chiefly grown in the Canadian Northwest. The Indian varieties named, in common with all others tested from that country, have lacked vigor and productiveness, and the grain has not been as good in quality as the best sorts in cultivation in Canada.

Crosses have been made of Hard Red Calcutta, Gehun, and Ladoga, all early sorts, with the Red Fife and the White Fife, with the view of combining the vigor, productiveness, and high quality of the Fifes with the earliness of the imported sorts. Many of these crosses ripen from three to four days earlier than the Fife wheats, and some of them have manifested great vigor and have proven very productive. They produce hard wheats of excellent quality which make almost, if not quite, as good a flour as the much esteemed Red Fife.

In productiveness one of the crosses named Preston has taken the lead. This is a cross of the Red Fife with the Russian variety, Ladoga. Ladoga is a week earlier in ripening than Red Fife. Preston is about four days earlier. During a test of six years it has given an average crop, taking the results of the trials made on all the experimental farms, of 33 bushels 53 lbs. per acre, whereas the Red Fife grown under like conditions has given during the same period an average of 32 bushels 30 lbs., a difference in favor of the cross-bred sort of 1 bushel 28 lbs. per acre. Laurel, a cross of Red Fife with Gehun, has grown still larger crops, but this has been under trial only three years while Preston has had a test of eight years. Many of the other cross-bred sorts have also made excellent records.

In the growing of new sorts of wheat there seems to be a tendency to bearded forms. Where a bearded wheat has been used as a pistillate or female form and the pollen obtained from a beardless sort a large proportion of the progeny has been bearded. Variations, however, occur in both bearded and beardless sorts, the beardless forms frequently producing bearded heads while the bearded ones more rarely produce those which are beardless. In one cross where both parents were beardless several bearded sorts were produced in the second generation. The bearded varieties will vary in the length and stiffness of the beards and many of them vary in the color of the chaff, some in the same cross having white chaff, others red chaff; the chaff also varies as to its smooth or downy character. Any of these variations may be made permanent by persistent selection.

Spring wheats have been crossed by winter sorts. These have all ripened when sown in the spring, but although the plants have had vigorous foliage they have been slow in heading and later in ripening than most other spring wheats, and as they have not been specially productive most of them have been discarded.

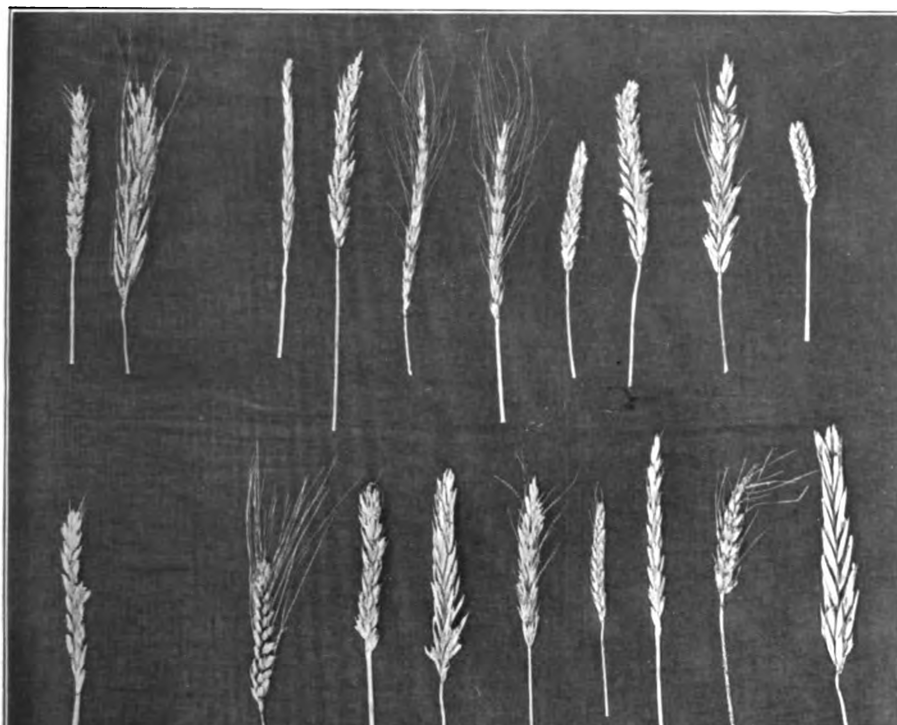
In breeding for earliness the best results have been had from a cross with the Onega and Gehun. The Onega wheat was brought from the most northern wheat district in Russia on the Onega River, near the Arctic Circle, the Gehun came from India from a high elevation in the Himalayan Mountains. Two of these crosses, Early Riga and Harold, have been fully a week earlier in ripening than the Red Fife, but the grain is small and the crop only medium. In our experience any marked advantage gained in a variety of wheat in the way of early ripening usually involves a lessening in the weight of the crop.

Some very interesting varieties have been recently originated at the Central Experimental Farm at Ottawa by fertilizing the Red Fife with pollen of the Polonian wheat (*Triticum polonicum*). This cross was effected in the spring of 1900. From a kernel so fertilized in a head of Red Fife a plant was produced which, contrary to the usual experience, produced heads and kernels quite unlike Red Fife. The seed from this plant sown in 1902 sprouted much and gave a number of different sorts of heads; scarcely any two of them were alike. The photograph shown has the parents and some of the offspring shown on it.

The Polonian wheat has a very large kernel, and the object in making this cross was to try to produce a good cropping wheat with a kernel much larger than the ordinary grain.

BARLEY.

Very distinct hybrids have been produced by crossing the two-rowed and six-rowed barleys. These are ancient types which have long been regarded as distinct species. In the two-rowed barley the additional rows on the six-rowed form are represented by chaffy scales lying flat on the face of the head. On the hybrids produced by using the six-rowed form as the male these chaffy scales are in some instances all filled, in others only a part of them are filled and the kernels are often smaller and thinner than those found in the natural position in the two-rowed head. With subsequent cultivation the relative size of the kernels usually becomes more equalized and, in some instances, they have become very even in size throughout. Where the two-rowed has been used as the male the extra four rows of the grain in the six-rowed head have been partly or wholly obliterated. Perfect heads of both two-rowed and six-rowed barley have been produced from hybrids obtained by both of these methods. Crosses have also been made be-



SPECIMENS OF WHEAT PRODUCED BY CROSS FERTILIZATION,
BY DR. WM. SAUNDERS, DIRECTOR OF EXPERIMENTAL FARMS, CANADA.

tween the bearded and beardless six-rowed sorts. The two-rowed barleys stool much more freely than the six-rowed sorts, the heads also are longer, and the main purpose in view in attempting to produce these hybrids has been to originate varieties of six-rowed barley with longer heads and an increased tendency to stooling, hoping to increase the crop thereby. Some of these new sorts have made promising records.

OATS.

In oats crosses have been made between varieties with branching heads and those with sided heads, also with white and black oats, white and yellow, and with thin-hulled and thick-hulled sorts, and a number of intermediate forms produced, some of which have given excellent crops.

PEAS.

More than 150 crosses have been made in this group. By rigid selection and the rejecting of all the less promising sorts the varieties under trial have been reduced to less than one-third of the original number. There are among these cross-breds some varieties of special merit.

CROSS-BRED FRUITS.

Among the breeders of new fruits there are many prominent names, notably in France, Belgium, and England. In the United States there have also been many enthusiastic laborers in this interesting field. In Canada work has been progressing along this line for about forty years. The late Charles Arnold was a worker in fruits. By crossing the Clinton with Black St. Peters he produced some excellent grapes, two of which, Canada and B———, are included in many vineyards in Canada, and five of the seedlings of this group are now grown in France; one of them, the Othello, is said to be extensively cultivated in that country for the manufacture of wine.

Mr. Arnold also did some good work in apples. In 1873 he exhibited at the meeting of the American Pomological Society held in Boston, Mass., eighteen varieties of cross-bred apples, all seedlings of the Northern Spy crossed with Wagener. Only one of these seedlings has found its way into general cultivation, but that is one of superior excellence known under the name of Ontario. This apple is now grown on a large scale by some Canadian orchardists, and is found to be a very valuable sort for export. For thrifty growth of tree, early bearing, productiveness, good quality, and long keeping, it stands among the best.

Mr. Arnold also worked on strawberries and raspberries, and obtained some useful results. He also devoted some attention to garden peas. He crossed McLean's Little Gem with the Champion of England and produced a very dwarf variety, an excellent bearer which produced peas of high quality. He subsequently sold this pea for a satisfactory consideration to Bliss & Sons, the well-known seedsmen, and it has ever since been in general cultivation under the name of American Wonder, and is still very highly esteemed.

Among other Canadian workers who have passed away and who have left behind them rich legacies in the form of useful fruits which they have produced, are the names of P. C. Dempsey, W. H. Mills, William Harkins, and James Dougall. The work done by these honored men was in apples, pears, cherries, grapes, and gooseberries.

In my own work the first crosses attempted were in 1868, and these were with the gooseberry. These were made with the object of improving the size and quality of what are known as the American gooseberries, by introducing strains of some of the best English sorts, and, at the same time, obtain varieties less liable to the gooseberry mildew, which usually affects nearly all the English gooseberries grown in this country so badly in fruit and foliage as to discourage their cultivation. Those which are known as American sorts are generally supposed to have sprung from the wild species with perhaps more or less mixture of European blood. They are noted for their hardiness, productiveness, and freedom from mildew. They lack, however, the size and quality of the English sorts. The experiments in producing new gooseberries were continued during 1870 and 1871 and several hundred seedlings were obtained, some of which are still in cultivation. Two of them, one named Pearl, a cross between Downing and Ashton's seedling, and another called Red Jacket, a cross between Houghton and Warrington, are popular sorts on account of their size, productiveness, and freedom from mildew. They are extensively grown both in Canada and the United States. Other promising sorts not yet in general cultivation are Ruth Saunders and several unnamed sorts. The early experiments also included some crosses of the wild sorts with cultivated forms. Trials were made with the wild prickly gooseberry (*Ribes cynosbate*) and the Warrington, a noted English sort, large, red, and slightly hairy. Among the new sorts produced were several of an interesting character, one of which was quite smooth, another slightly hairy, and a third rather strongly hairy. It is an abundant bearer of good size and fair quality. The bush has the strong upright habit of growth characteristic of the wild form from which it was derived.

From 1868 to 1875 a large number of cross-bred grapes were produced by fertilizing flowers of the native and cultivated American grapes with pollen chiefly from grapes of European origin. During this period more than 3,000 flowers were pollenized and about 400 seedlings obtained. Many of these were too tender for the Canadian climate and many others were imperfect in their floral organs, others were inferior in quality, and only a few have survived the test of years.

Two of these are worthy of mention namely, the Kensington and Emerald. The Kensington is a yellowish-green grape which was obtained by fertilizing the Clinton, which is an improved form of the native frost grape, with pollen of the Bucklands Sweetwater, a large greenish-white grape grown under glass. The Clinton vine is a robust grower, very hardy. Its clusters of fruit are of medium size, long, narrow, very compact, and slightly shouldered; the berry is small, round, and black, and is quite acid. The Bucklands Sweetwater is a less vigorous grower, is tender, the berries are large, pale, yellowish-green, oval in form, and sweet, while the bunch is large and loose. The cross resembles the Clinton in vigor of growth, hardiness of vine, and the character of the foliage. The fruit resembles the Bucklands Sweetwater in color, form, size, and looseness of cluster, and in quality it is intermediate between the parents. In the fruit of the Clinton the seeds are short and plump, while those of the Bucklands Sweetwater are long and less plump. In Kensington the seeds resemble in form those of the Bucklands Sweetwater.

Many crosses have been made between the red and black raspberries, from which purple berries have been produced with characteristics of both parents combined.

Many efforts have also been made to cross the blackberry and raspberry, but with very little success; the seeds obtained have usually failed to germinate, and, occasionally, when the seeds have started, the plants produced have been weakly and worthless. Efforts are being continued along this line.

Some interesting results have been had from crossing the black currant with the gooseberry. The crosses have been intermediate in form of leaf, flower, and fruit. The bushes are nearly sterile, only an occasional fruit being found, while both parents fruit abundantly.

In the Canadian Northwest country the climatic conditions are unfavorable for the production of large fruits. During the past twelve years experiments have been carried on at the experimental farms at Brandon and Indian Head with all the promising sorts of hardy fruits obtainable from all parts of the world. Many varieties have been brought from Northern Russia and other northern countries in Europe. Also from the northwestern states. About 200 varieties of the hardiest sorts of cultivated apples and crab apples have thus been introduced and planted on these farms under varying conditions of shelter, but, with the exception of a few fruits on a Transcendent crab had last year after ten years' trial, no success has attended these efforts.

In 1887 a small package of seed was obtained from the Royal Botanic Gardens of St. Petersburg, Russia, of a small wild Siberian crab, abundant in the northern parts of that country and known as the Berried crab (*Pyrus baccata*). A number of young trees were raised from this seed, some of which were sent to the branch experimental farms at Brandon and Indian Head, where they have been tried for ten years, have proven perfectly satisfactory and have borne fruit abundantly. The fruit, although varying in size, does not average much larger than a cherry. During the past seven years efforts have been made to improve this crab by cross-fertilizing it with many of the hardiest sorts of larger apples grown in the east. This work has been very successful, and a number of new varieties have thus been produced intermediate in size between the small crab and the larger apple. The best in these are large enough to be useful for culinary purposes, and the introduction of the blood of the larger apple does not appear to lessen in any way the hardiness of the tree.

From seedlings of these cross-fertilized fruits further improvement in size may be expected, and, in the meantime, the best of the varieties thus far produced are being rapidly multiplied so as to distribute them for further trial over all the settled parts of the northwest country.

Time will not permit me to refer to interesting crosses among the barberries, between the sand cherry and plum, between the wild plum of the west and the plum of the east, or between different varieties of flowers.

Enough has, I trust, been said and sufficient evidence brought forward to establish the great usefulness of this line of work, and to show that it is possible to originate by this method new varieties of cereals and fruits with hardiness, earliness, and other characteristics which shall adapt them for the service of man under all the different climatic conditions which obtain in the widely distributed settlements on this continent.

The PRESIDENT. Now, are there any questions you would like to ask Prof. Saunders?

The SECRETARY. I should like to repeat the request that I made at the opening of the session. If any of you have not registered please do so, and give your post-office address. And in return for that I promise you any literature which I may have for distribution.

The PRESIDENT. Remember the question-box this afternoon. There should be a good many questions which you should like to have answered.

It is time for us to adjourn now, and we will take a recess until 2 o'clock.

AFTERNOON SESSION.

Wednesday, December 10th, 2 P. M.

Convention called to order at 2 P. M., Vice-President SEELEY in the chair.

The PRESIDENT. I want to repeat what I said last night, that a farmer ought to go on his way singing. And so we are going to have a little music to open our session with this afternoon.

Music.

The PRESIDENT. Now, we are to have an address this afternoon, the subject of which is "Cattle Foods." This matter of feeding cattle, or feeding anything, is a great subject, and we have one with us who is abundantly able to give us a great deal of information about it, Prof. Charles D. Woods, director of the Agricultural Experiment Station at Orono, Maine. I am happy to introduce the gentleman to you this afternoon.

CATTLE FOODS.

By CHARLES D. WOODS,

Director Maine Agricultural Experiment Station.

Ladies and Gentlemen: In accepting the invitation of the Board of Agriculture to speak at this meeting I was partly influenced by the pleasure of again looking into the faces of Connecticut farmers, among whom it is my privilege to count many friends, and partly by the hope that I might be able to bring a little that would be helpful to you in the problem of the food of the dairy cow. That I could bring much to you that you do not know I could not hope, but if what I shall say leads you to consider more carefully the facts you already possess my trip will have been successful.

THE NUTRIENTS OF THE FOOD.

It is not my purpose at this time to go into the discussion of the chemistry of food, but to briefly call to your mind certain terms which must be used in this paper and their meaning.

Food is composed of many compounds differing greatly from each other. While not exact, the usual grouping of the nutrients as protein, fats, carbohydrates, and mineral matters will answer our purpose. The mineral matters are essential to animal growth and repair, but since in the usual cattle foods they are abundant for the needs of the animal they will not enter into this discussion. The carbohydrates and the fats are made up chiefly of carbon, hydrogen, and oxygen, while protein contains, in addition to these elements, nitrogen and small amounts of phosphorus and sulphur. It is the nitrogen that distinguishes protein from other food constituents, both in composition and in use. Familiar examples of protein, of the nitrogenous constituents of food, are found in the curd of milk (casein), the gluten of wheat, the lean of meat (gmyosin), the clot of blood (fibrin). In concentrated feeding-stuffs the protein is mostly present in form resembling the gluten of wheat, but in some of the coarser feeds part of the protein is present in a much less complex form and is not so valuable a nutrient. For this reason the protein in coarse foods such as the grasses, corn-stalks, potatoes, beets, and turnips, is not so valuable as that of the grains.

Sugar, starch, gums, and woody fibre are familiar examples of the carbohydrates, while olive oil, corn oil, linseed oil, and other vegetable oils are familiar illustrations of fats. Of most materials used for cattle foods the carbohydrates make up the larger proportion of the dry substance; often three-quarters of the weight of a food is carbohydrates. Just as the protein differs in value so do the carbohydrates. The insoluble woody fibre is of little food-worth, and in most food analyses this is reported as fibre. The more soluble starches and sugars are of greater worth, and are usually grouped under the name of nitrogen-free extract. The amount of the oil or fat in different food materials varies within wide limits. In some materials it is so abundant that only a little pressure (as in the case of olives or flax or cotton seed) is necessary to obtain a portion of it freed from the other nutrients, while in hay and similar materials it is present in such small amount that only by special solvents such as ether or naphtha can it be obtained at all. In tables of food analyses under the fats are included all materials soluble in ether, and as other materials than the true fats are dissolved by ether the fats or ether extracts do not all have the same food value. The true oils differ but little in food value from one another, and these make up, practically, all of the fats of the concentrated foods and grains. The grasses, roots, and other coarse foods contain but little ether extract, and much of this consists of matters of little nutritive value.

Very little is known about the digestibility of the individual compounds that go to make up a feeding stuff. While we know from experiment the approximate percentage of the protein of wheat which an animal will digest under normal conditions, we know almost nothing of the differences in digestibility of the half-dozen different bodies that together constitute wheat protein. While the sugars and starches are pretty nearly if not quite completely digestible, the different kinds differ greatly in time necessary for their digestion. Investigations show that "this variation reaches such a degree that under precisely the same conditions certain of the starches require eighty times as long as others for complete solution." From this it follows that at present we must base the digestibility of different feeding stuffs upon the results of experiments with that material and not upon its chemical composition. The chemist can take a new feeding stuff and from analysis tell quickly and accurately how much protein, fats, and carbohydrates it contains, but he can not tell until after definite digestion experiment with animals how much of these are available for the purpose of nutrition. It is not enough to know the chemical composition of a given food material, but it is equally essential to know how much of the nutrients will go into solution through the action of the ferments of the different digestive juices of the stomach and intestines. While a comparison of the composition of closely-allied feeding stuffs will be a fair measure of their comparative food values, this is not true of different classes of food materials. For example, wheat, bran, and clover carry about the same percentage of protein, but nearly eight-tenths of the wheat protein is digestible and less than seven-tenths of the clover protein.

THE FUNCTION OF THE NUTRIENTS.

Food serves the two-fold purpose of building and repairing the body and furnishing the needed energy for work and maintenance of animal temperature. Protein alone can be used for purposes of construction. All the tissues of the body, blood, bone, milk, flesh, etc., depend upon protein for their formation. Because of this fact protein is sometimes called the plastic material or the tissue-former. But this tells only half of the story, for the protein not only can furnish energy but part of the energy is always thus supplied. The fats and carbohydrates are, however, the chief and the most economical sources of energy. The value of the nutrients as sources of energy may be measured by their heats of combustion. In burning, a pound of fat will give about two and one-fourth times as much heat as a pound of protein or a pound of carbohydrates. The heat unit is the calorie, or the heat required to raise four pounds of water one degree Fahrenheit. A pound of protein or a pound of carbohydrates when burned in the body yield 1,860 calories and a pound of fat 4,240 calories.

The value of a food can be measured by the amount of digestible protein it contains and by the heat of combustion or fuel value of its digestible dry matter, and in the discussion which follows the value of food materials will be thus measured.

FEEDING STANDARDS.

In discussing the question of feeding standards it will be simpler because more familiar to give special attention to the cow and her needs.

Milk from the same cow may vary in composition from day to day within narrow limits, but there seems to be no ground, or almost no ground, for the quite common belief that the quality of milk varies with the food. There is not time to cite the numerous experiments which confirm this conclusion, but there is no fact in connection with the feeding of cows that is better established than that the cow and not the food chiefly determine the quality of the milk. The quantity of milk is influenced by the kinds and amounts of foods, the quality is almost if not quite independent of either the kind or amount of food. In studying the kinds and amounts of food that are most suitable for a dairy cow, by far the most important effect to be noticed is upon the yield rather than the composition of the milk.

Differences in breed and individual peculiarities of the animals and in the food and handling, as well as other conditions known and unknown, bring it about that the best ration for one cow may not be the best for another. The feeder must know his cows and fit the food to their wants. But in so doing he may be greatly helped by feeding standards.

What is a feeding standard? To answer this we must, first of all, avoid a confusion of terms which has become common.

We must distinguish between three different kinds of standards, or rather, since the word standard cannot be applied with equal propriety to all, we must distinguish between three different kinds of formulas which may be used to express quantities and proportions of nutrients for feeding. These may be designated as the physiological standard, the formula for profitable feeding, and the formula which expresses the actual practice of feeders.

PHYSIOLOGICAL STANDARDS.

The physiological standards would express the proportions of the different nutrients, protein, fats, and carbohydrates which best fit the demands of the animal for the particular kind of product demanded of it, whether the product is growth, as in the case of young animals; or meat, as in the fattening of cattle, sheep, and swine; or milk, with milch cows; or work, as with horses and oxen. In all of these cases a certain amount of nutrients is required for maintenance and a certain additional amount for production. The functions of the several classes of nutrients in meeting the demands for maintenance and production have been more or less definitely shown by feeding experiments. But unfortunately our knowledge is still deficient, and furthermore, the differences of individual animals are so wide that with the most perfect knowledge of the laws of nutrition it will hardly be possible to set up accurate physiological standards; and when we get that standard we shall, doubtless, find that it is after all indefinite, that it varies with the animal as well as with the conditions of feeding; in other words, it will be at best only an average estimate and not an unvarying formula.

FORMULAS FOR PROFITABLE FEEDING.

But the practical feeder feeds for profit, and the ration which will produce the largest amount of growth, or of total flesh, or of lean or fat meat, or the largest amount of milk or butter fat, or enable the animal to do the largest amount of work from a given quantity of nutrients, is not always or generally the one which will bring the most profit to the feeder. In other words, the physiological standard may not be the most profitable formula for feeding. The factors of profit are numerous. One of the chief is the physiological action of the nutrients, but the cost of the food and the value of the product have to be taken into account. It may be to the feeder's advantage to use a wide ration when a narrow one would give more yield for less raw material. There is a very wide difference with respect to the width of a ration between the physiological standards as we now understand them and the actual feeding practice of most American farmers, but it would be as unwise for them to conform exactly to the physiological standard as it would be to take the average of the practice of successful feeders for either a physiological standard or a formula for profitable feeding.

Rather more than 25 years ago Prof. Wolff proposed certain standard rations which have become familiar. That for milch cows called for 24 pounds of organic matter carrying 2.5 pounds digestible protein, .4 pound digestible fat, and 12.5 pounds digestible carbohydrates. The nutritive ratio was 1 : 5.4. It had a fuel value of 29,590 calories.

In the *Experiment Station Record* Prof. Kuehn criticises this standard for a milch cow as follows: "For milch cows it is advisable, first of all, to determine the quantity of nutrients which represent the minimum requirements per 1,000 pounds live weight of the animals, that is, the quantity which covers the needs of the cows which are dry or nearly dry, and which, while producing little or no milk, are usually more or less advanced with calf. This minimum amount may be designated as the *basal ration*. It will, naturally, be more liberal for breeds of high productive capacity and those which keep up their milk yield well in the latter part of the lactation period and only go dry a short time than for those of inferior milking qualities. For the latter the basal ration need not contain more than 1.5 to 1.7 of digestible actual albuminoids per 1,000 pounds of live weight, while with the former up to 1.8 pounds and with breeds of exceptionally high capacity even more will be needed. The same consideration will enter into account in determining the amounts of fat and non-nitrogenous substances for the basal ration. Amounts ranging from the minimum to a medium amount are to be recommended. In addition to this basal ration each cow should receive as much concentrated food as she will yield profitable returns for. The cow of the highest productive capacity will naturally need a larger quantity of nutrients, commensurate with her larger production of milk.

But the amount of nutrients in the daily ration of one and the same cow should also vary as her milk production varies, being greatest early in the milking period, when she is producing the most milk, and gradually decreasing with the advance of the period, until as she becomes dry, the concentrated food is discontinued altogether and the basal ration alone is fed. While this means of feeding of course requires attention, it insures the greatest possible profit from the animals and results in the highest development of the milking qualities of the herd, which, being transmitted by heredity, effects a continual improvement of the stock.

"To feed an animal highly during the most productive part of lactation pays well, but to feed the entire herd equally well, without regard to individual production, can prove remunerative only when, in addition to yielding milk, the cows are fattened. Otherwise such feeding results in great waste of food, is not infrequently the cause of the low profits in dairying, and makes the barnyard manure expensive."

After the death of Prof. Wolff, his feeding standards have been revised by Doctor C. Lehmann of the Agricultural College of Berlin. He has changed the arrangement somewhat, but the most important departure from the standard of Wolff is that the standards recognize the varying wants of dairy cows by classifying them in four divisions according to the milk yield. The heaviest milkers receive the most nutrient. These modifications of Wolff's tables are such as must commend themselves to those who have, up to the present time, been using Wolff's standard rations as a basis. Based upon the Wolff-Lehmann standard the Storrs Experiment Station has suggested feeding formulas similar to those of Lehman. "In these the protein is increased according as the milk yield is larger, although the increase in protein is less rapid in our proposed formula. Allowance is thus made for the relative cheapness in this country of feeding stuffs rich in carbohydrates. These formulas provided for a basal ration which shall be fed to all cows of the herd giving ten or more pounds of milk per day. This is supposed to include all of the cows giving milk except those that may be drying off preparatory to calving."

There are some important differences between the way in which the Germans are feeding and the common practice in America. The Wisconsin Experiment Station obtained, although in rather a crude manner, the feeding practices of 128 different men in different parts of the country. The practices of twenty-five men have been studied in Connecticut by the Storrs Experimental Station in very nearly as thorough and painstaking a manner as practicable.

The following table shows the German standards, the average as ascertained by the Wisconsin Experiment Station, and the actual feeding practices in Connecticut so far as 32 men are concerned, and a suggested standard by the Storrs Station:

DIGESTIBLE NUTRIENTS.

	Dry matter Lbs.	Protein Lbs.	Fat Lbs.	Carbohydrates Lbs.	Nutritive ratio
Wolff's German Standard	20.0	2.5	.4	12.5	1:5.4
Average of 128 American rations compiled by the Wisconsin Experiment Station	24.5	2.15	.74	13.27	1:6.9
Average of 32 rations found in Connecticut by the Storrs Station	26.4*	1.97	.73	11.57	1:7.0
Wolff-Lehmann Standards:					
11 lbs. milk per day	25.0	1.6	.3	10.0	1:6.7
16½" " "	27.0	2.0	.4	11.0	1:6.0
22 " " "	29.0	2.5	.5	13.0	1:5.7
27½" " "	32.0	3.3	.8	13.0	1:4.5
Storrs Station Formula:					
Small cows					
10 to 20 lbs. milk per day	21.0	2.0	.4	11.0	1:6.0
20 to 25 " " "	22.0	2.3	.5	11.0	1:5.3
25 to 30 " " "	22.0	2.6	.5	11.0	1:4.7
30 to 35 " " "	23.0	2.9	.6	12.0	1:4.6
35 to 40 " " "	23.0	3.2	.6	12.0	1:4.2
Large cows					
10 to 20 lbs. milk per day	22.0	2.3	.5	13.0	1:6.1
20 to 25 " " "	24.0	2.6	.6	13.0	1:5.5
25 to 30 " " "	24.0	2.9	.6	13.0	1:5.0
30 to 35 " " "	25.0	3.2	.7	14.0	1:4.9
35 to 40 " " "	25.0	3.5	.7	14.0	1:4.4

INFLUENCE OF DIFFERENT CONDITIONS UPON THEIR DIGESTIBILITY.

The results of digestion experiments with reference to different conditions of coarse fodders will help to a clearer understanding of the way these crops should be handled.

* Average of 16.

The Digestibility of Green or Dry Fodder. Fodders, if cut at the same time and cured without loss of leaves, etc., seem to be equally well digested whether used after curing or fed green. In general, owing to loss of leaves in curing, the green fodders are better digested than are the cured.

The Influence of the Method of Hay-Making. As implied in the above, the method of hay-making has a great influence upon both the composition and the digestibility of hay. Other things being equal, the more rapid the curing the better. The following results illustrate the differences found in one instance in the composition and digestibility of curing alfalfa:

COMPOSITION OF DRY SUBSTANCE OF ALFALFA.

	Carefully dried	Ordinarily hay cured
Protein	20.62	18.44
Fat	3.65	2.32
Nitrogen — free extract	57.57	37.99
Fiber	30.34	34.00

In ordinary field-drying and handling there were enough of the leaves and more delicate portions of the plant lost to reduce the protein one-tenth and the fat one-third, and to increase the fiber correspondingly.

Its digestibility was changed as follows:

COMPOSITION OF DRY SUBSTANCE OF ALFALFA.

	Carefully dried	Ordinarily hay cured
Protein	77.8	73.4
Fat	49.6	32.0
Nitrogen — free extract	65.0	64.9
Fiber	34.8	36.6

In this case there was 4.4 per cent. less of the protein and 17.6 per cent. less of the fat digested in the hay as ordinarily cured than in that which was dried without loss of the finer and more delicate portions of the plant. There was no added digestibility of the nitrogen-free extract and very little of that of the fiber to compensate for this loss.

This indicates the great advantage of making hay with the least possible handling, and the advantage of drying only enough to insure the hay keeping, and thus avoid, so far as possible, the loss of the delicate and more digestible portions.

The Influence of Period of Growth of Fodder Plant. In general, the percentage of protein, fat, and nitrogen-free extract decrease as the percentages of fiber increase with the age of the plant. Also, as a rule, with added age, the nutritive ingredients of the plant are rendered less digestible.

Both of these facts are illustrated by the following trial made with red clover:

COMPOSITION OF CLOVER CUT AT DIFFERENT STAGES OF GROWTH.

	Before bloom per cent.	Early bloom per cent.	Late bloom per cent.
Protein	19.6	16.3	13.2
Fat	2.5	2.9	2.9
Nitrogen — free extract .	42.5	44.9	48.4
Fiber	25.3	28.1	28.8

DIGESTIBILITY OF ABOVE.

	Before bloom per cent.	Early bloom per cent.	Late bloom per cent.
Organic matter . . .	64.6	61.0	56.8
Protein	70.0	65.0	58.9
Fat	58.0	64.4	60.1
Nitrogen — free extract .	70.2	68.4	66.3
Fiber	50.6	46.6	39.8

It does not follow, however, of necessity from these facts that a given plant should be harvested as early as possible. The total yield of digestible nutrients is of more importance than percentage composition and digestible coefficients. It has been found by careful experiment that the largest yield of digestible nutrients is not obtained by repeated cuttings of a forage plant. The important practical point is to harvest the crops when there is the maximum of digestible nutrients. On the whole, probably, the best time to cut most of the plants used for forage, whether to be fed green or to be cured and fed as hay, is when they are in full bloom. If cut much before this there will be a loss in yield per acre, and, if allowed to stand much later than this, the deterioration in quality is greater than the increase in quantity.

Influence of Weather in Different Years. Crops grown upon the same soil in different years, even when supplied with the same fertilizers, differ greatly in composition from year to year. As would be expected the crops also differ very considerably in digestibility. This is largely due to the weather and conditions outside of the control of the grower and hence does not need consideration, as it is of importance in estimating the value of a feeding stuff.

Influence of Long Keeping. Many experiments agree in showing that keeping impairs the value of a fodder, rendering it less digestible. There is a loss in dry matter due to the loss of leaves, etc. The "dust" that is always in hay indicates that a loss is taking place. In addition to this there is probably a loss of dry matter going on even when the hay is so kept that a mechanical loss is impossible. Samples of hay stored in the laboratory have lost from two to five per cent. of dry matter. This loss is important, and taken in connection with the impaired digestibility points out the disadvantage of keeping over hay from one year to another.

Influence of Concentrated Foods Upon the Digestibility of Coarse Fodders. In the case of coarse fodders it is possible to make direct experiments, that is, without the use of other foods. This is not, however, practicable with the concentrated foods since the ruminants are supposed to need coarse fodders in order that the digestion may be normal. The plan of the experiments is, then, to feed a coarse fodder and ascertain its digestibility, and then feed in connection with the concentrated food. Obviously, this method would be applicable only in case the digestibility of the coarse fodder was unaffected by the other food. This difficulty is overcome by feeding varying quantities of the concentrated food and noting the variations, if any, in the quantities of total nutrients digested.

The following summarizes the results of digestion experiments upon this subject:

The addition of an easily digestible substance, rich in protein as gluten meal, leaves the digestibility of the coarse fodder unchanged.

The addition of small quantities of oil or fat, seven to ten ounces per day to 1,000 pounds of live weight, produced no depression, but, on the contrary, seemed to increase the digestibility of all nutrients, even including the fat. Larger quantities than the above, however, has a depression upon the total digestibility. If the oil is not separated, that is, not fed by itself, but fed in the form of oil cake or meal (as linseed meal, etc.,) sixteen to eighteen ounces per day per 1,000 pounds live weight may be fed to advantage.

A considerable addition of carbohydrates, sugar or starch, produces a depression upon the digestibility of the other food. In general, it follows that the addition of the pure carbohydrates in quantity equal to ten per cent. or more of the dry substance of the food produces depression in the digestibility. Especially is this true in the case of the protein and fiber. Starch produces greater depression than carbohydrates which are soluble in water, as, for example, sugar. The addition of a fodder rich in the nitrogen-free extract produces about the same effect as starch. So long as the nutritive ratio is under one to eight the carbohydrates themselves are not affected. If over one to eight some of the carbohydrates escape digestion.

If the dry substance of the roots is not more than fifteen per cent. of the total dry matter and the nutritive ratio is not greater than one to eight, no depression in the digestibility follows. The addition of a food rich in nitrogen at the same time as the roots makes it possible to add much more than fifteen per cent. of roots or tubers without affecting the digestibility of the food. Above fifteen per cent. with nutritive ratio greater than one to eight the digestibility is reduced the same as when carbohydrates are used.

CLASSES OF CATTLE FOODS.

The numerous and ever-increasing number of materials used for feeding animals can be readily grouped in two general classes: the coarse fodders including ordinary plants, green or dry, and roots and tubers and concentrated fodders; the seeds and grains, milling products, and the refuses. The forage plants of the greatest value belong, for the most part, to two great botanical families: the legumes, which include the clover, alfalfa, peas, lupines, vetches, and beans, and the grasses, which include all the English grasses and the grains. The roots, for the most part, belong to the mustard family, and rape, which is coming to be used considerably as a green fodder, also belongs to this family.

Valuable as are the ordinary grasses on many accounts the legumes are still more valuable for feeding and manure. Among the reasons that legumes are especially valuable are:

They contain large proportions of protein, which serves to form blood, muscle, bone, and milk. As, for instance, hay from our ordinary grasses carries from 4 to 6 per cent. of protein, while hay from clover or cow peas will carry 8 per cent. or more.

Plants of the clover family respond readily to the application of mineral fertilizer. The plants of the clover family have the ability to acquire atmospheric nitrogen, and on this account can be grown without the more expensive fertilizers.

The manurial value of the legumes depends upon the large amount of plant food in both the tops and the roots. When the crop is fed four-fifths or more of the nitrogen and a still larger proportion of the mineral fertilizer constituents go into the excrement, and, if these are preserved, make a very rich manure. If the crop is plowed under, this plant food, including that acquired from the air and that gathered from the subsoil, is left for the use of succeeding crops. When the crop is removed the roots and stubble, with their large amounts of fertilizing material, still remain to be plowed in and enrich the land.

GREEN FODDERS FOR SOILING CROPS.

The production of green crops as a supplement to or substitute for pasture is a practice essential to the highest success on many farms. There are few Connecticut farms that can be relied upon to offer grazing in August and September sufficient in quantity and quality to maintain a satisfactory milk flow. Doubtless, on many farms soiling can be substituted entirely for grazing to advantage. On the farm with upland rocky pastures in which native grasses of high quality grow soiling may not be called for, but, wherever the conditions call for intensive farming, grazing on permanent pastures cannot be a part of such practice.

Much more feed can be produced on a given area by soiling than by pasturage. Furthermore, grazing is wasteful because of the imperfect use of the growth that is made. Much grass is tramped down and fouled. The matter of fencing, which is saved by soiling, is also an important item in farm economy. If soiling is to be practiced to help out pasturage during the late summer or early fall, a limited number of crops will meet the demand. Three or four sowings of peas and oats in late May and early June and two plantings of corn a fortnight apart, would usually furnish sufficient green food when it is most likely to be needed.

If a system of soiling is to be adopted nothing more suggestive can be offered for the Connecticut farmer than the scheme prepared by Prof. Phelps several years ago in a bulletin of the Storrs Station:

PROF. PHELPS'S SCHEME OF SOILING CROPS.

Species of crop.	Time of seeding.	Approximate time of feeding.
Winter rye	Sept. 1	May 10–20
Winter wheat	Sept. 5–10	May 20–June 5
Clover	July 20–30	June 5–15
Grass (from meadows)		June 15–25
Oats and peas	April 10	June 25–July 10
Oats and peas	April 20	July 10–20
Oats and peas	April 30	July 20–Aug. 1
Hungarian	June 1	Aug. 1–10
Clover, rowen		Aug. 10–20
Soy beans	May 25	Aug. 20–Sept. 25
Cow beans	June 5–10	Sept. 5–20
Rowen grass (meadows)		Sept. 20–30
Barley and peas	Aug. 5–10	Oct. 1–30

SILAGE.

In the neighborhood of 25 years ago this process of preserving green crops was introduced into the United States. At first the silo met with considerable opposition from the more conservative, but now it is unquestioned that it is usually the most economical way of handling certain fall crops, more particularly Indian corn. Many farmers have gone so far as to feed silage the year around; certainly there are some reasons why this is more advisable than growing soiling crops, for soiling has the disadvantage of harvesting in small quantities, which is always more expensive than harvesting on a larger scale. There has been considerable discussion and experimenting as to the relative losses in the ordinary method of curing corn fodder and the losses which take place in the silo. The results of these experiments seem to show that there is about as much loss in one case as in the other. Silage has the enormous advantage over field curing of furnishing succulent food throughout the winter months. Corn, oats, and peas sown together, and clover and cow peas, include the plants that can be well made into silage in this State. Abundant experiments have shown that silage made from corn well along in the dough stage contains larger amounts of digestible matter than if harvested earlier. It follows from this that the variety of corn to be grown for silage must be one which would in ordinary seasons mature. The difference in feeding value between silage from mature corn and immature corn is shown from the table (see p. 156). It would take 180 pounds of immature southern corn to equal 100 pounds from the silage made from mature field corn.

CURED FODDERS AND HAYS.

In general, it is true that the maximum quantity of dried matter is secured when crops are allowed to fully mature and ripen. But legumes, such as clover, are an apparent exception to this, because when at maturity the leaves rattle off and are lost during the process of curing. It, however, does not follow that because the crop increases in the yield of dried matter that the nutritive value has proportionately increased. The change in texture and in composition of the dried substance sometimes renders it less digestible, and is thus made to more or less affect the greater yield. In the ordinary English hay this is the case. The dried matter of matured grass contains a much larger proportion than the immature. The fiber is not only quite indigestible of itself but it reduces the digestibility of the other food constituents. For example, three American digestion experiments with timothy hay cut in full bloom showed an average digestibility of 62 per cent., while hay from the same fields cut when past bloom had a digestibility of only 55 per cent. The increasing yield with the mature hay showed that there was practically the same amount of digestible dried matter in both the early and the late cut, but the early cut was much more palatable, which gave it added feeding value.

While early cutting should be the rule with the ordinary grasses used for hay it does not follow with Indian corn.

Mature corn contains less fiber and more soluble carbohydrates than immature corn, and, as is well known, the dry matter in corn continues to increase until the corn is mature. Hence, for palatability, digestibility, and yield, it is advisable to allow corn to mature before harvesting; and this is equally true however the corn is to be cured, as fodder or made into silage. The advantage of the clovers and rowen hay as a source of protein is very evident, since they have about double the digestible protein found in ordinary grasses.

OATS AS HAY.

It is quite a common practice with many farmers to harvest oats before the grain is mature and cure them for coarse fodder. This is a very desirable plan to follow at times when the hay crop is short or in localities where the land is badly infested with noxious weeds like the Canada thistle or wild mustard, both of which should be cut before they seed.

The oat plant, however, is not an ideal one for making hay. The stalks are hollow, coarse, and hard, and unless dried very quickly in a bright sun they become bleached, even when cut green, so that they look little better than straw. To cure the crop in its best condition and retain its bright green color and palatability it should be dried in a bright sun for a few hours with liberal use of the hay tedder, when there is a heavy growth, then raked together, and the curing completed in the windrow or cock, with as little exposure to moisture as possible. If the weather is unfavorable, as is frequently the case during the latter part of July or first of August, when oats are mature enough to cut for hay, they are very liable to be seriously injured and rendered unpalatable.

Oats, however, when not sown too thickly, have an advantage over other plants, which make more desirable hay, of being a fairly good catch crop for seeding to grass, as they mature early enough to allow the young grass to get a good start in the fall, and for this reason are desirable on the farm.

Experiments at the Maine Experiment Station show that oats cut in milk stage contain a great deal more digestible protein than at any other stage of their growth, and also that they contain a maximum amount of digestible dry matter at this stage. A study also was made of different sections of the oat plant, one of which was the first eight inches of the lower part of the stock, another the second eight inches, and the third, the remainder of the plant or top. The bottom section had very little food value, the second section had only about half the protein of the top section and is less digestible. In cutting oats, therefore, for hay, it is better to leave a high stubble, for the loss incurred by leaving the coarsest part of the stalks on the ground is more than compensated by the improved quality and palatability of the remainder.

OAT AND PEA HAY.

Oats and peas grown together and harvested when the oats are in the early milk stage make a forage crop very much superior to oats alone for either hay, soiling, or silage. As peas are a leguminous plant they increase the protein of the fodder, and also improve the soil by leaving behind, in their roots and stubble, a part of the nitrogen which they take from the air. By growing the mixture then, both the fodder and the soil are improved, whereas if oats are grown alone a rather poor fodder is obtained and the soil reduced in fertility. This combination makes one of the best soiling crops for feed in July and August before corn or Hungarian is mature enough to cut. If the crop is allowed to mature and the two grains are ground together, the result is a most excellent feed for dairy cows and is much used by Canadian farmers. The chief objection to the material for making hay is that it dries rather slowly. The pea vines are like clover in this respect and should be cured in much the same manner, in the windrow or cock. When well cured without too much exposure to moisture and sun it makes a fodder fully equal to our best English hay. In case of bad weather the silo can be resorted to as a means of caring for the crop, but the material should be run through a silage cutter before ensiling, otherwise it is liable to be poorly preserved.

Oats and peas cut green run through the silage cutter and put into the silo have, at the Maine Station, kept perfectly. At time of feeding they were in a palatable condition and were as well relished by cattle as corn silage.

ROOTS AND TUBERS.

Roots and tubers are advantageous foods because they furnish very palatable, succulent food which may be kept in perfect condition during the entire season. Because of their palatability they have an advantage which cannot be wholly measured by the actual nutrients which they carry. The disadvantage of this class of foods, particularly as compared with silage, is that they are expensive to grow. It is, however, possible to get practically the same yield of digestible dry matter per acre from roots and tubers as from corn.

Potatoes have a greater nutritive value than the roots, but because of their market price and the relatively small amount which can be grown per acre, they cannot usually be fed economically. While from the table (p. 156) it will be seen that they contain considerable protein, much of the protein of the roots and tubers is not in the best nitrogen form. In order to store roots through the winter without loss, they should be kept as near the freezing point as possible and be well ventilated.

BY-PRODUCTS — OFFALS.

The waste materials which are used for cattle feeds are constantly changing as processes of manufacture change. They can, however, be grouped into a few distinct classes like the milling offals, the refuses from the manufacture of oat meals, etc.; the by-products from the manufacture of alcoholic drinks, as brewers' grains, distillers' grains, either wet or dried; the corn refuses from the manufacture of starch and glucose and the oil cakes, whole or ground, such as linseed and cotton seed oil cakes.

All of the milling offals from wheat are important both because of their quality and quantity. In the past it was customary to separate the wheat offals into bran, short, middlings, etc., but now the refuses from most mills are run in together and sold under the name of mixed feed. The middlings differ from the bran in containing less of the outer coating and more of the finer parts of the kernels. Red dog flour, which is usually used as a feed but occasionally as food of man, is on the dividing line between middlings and high grade flour. The bran from the roller mills contains more of digestible protein than did that from the old-fashioned process. The refuses from the manufacture of spring wheat average to carry more protein than those from winter wheat, but some lots of winter wheat are more nitrogenous than some spring wheat. Hence chemical analysis is necessary to decide upon the quality of milling refuses and the chemical composition, particularly the protein, of this class of feeding materials should be stated when they are offered for sale. Adulterated mixed feeds are too abundant in the market. There is so much profit in selling ground corn cobs and broom corn at the price of wheat bran that the consumer must be ever on the watch against this fraud. The safest thing is to buy only well known, reliable brands of this class of goods.

The brewer and distillers' grains contain the major portions of protein, the fat and the mineral matters of the grains used in the manufacture of these beverages. The starches and the sugars for the most part are largely used up in the process of manufacture. These grains are valuable sources of protein, and when they can be purchased in good condition at reasonable prices are economical cattle foods. Certain distillers' grains are now being placed on the market which very closely resemble in chemical composition some of the gluten meals.

The gluten meals and gluten feeds are by-products left in the manufacture of starch from glucose and Indian corn. Corn consists largely of starch. The waste product from the manufacture of starch or sugar is relatively much richer in oil and protein than the corn from which it is made. As at present manufactured the corn oil is largely removed from these wastes so that some gluten meals carry a low percentage of fat. These materials vary within wide limits in composition and in nutritive value. Gluten meal comes from the flinty portion of the kernel and gluten feed is a manufacture of the hulls and the flinty portion. The hulls are separated by themselves, sometimes known as corn bran, and the germ portion, after the oil has been pressed out, is called germ oil meal. Differing so greatly as these materials do in composition they should never be purchased except under guaranteed composition; the protein and the fat are two important things to be noted. In none of these milling refuses are the names always safe guides, for the gluten meal of one manufacturer may be the gluten feed of another.

Cotton seed meal is a by-product from the manufacture of cotton seed oil. After the cotton has been taken from the seed in the cotton gin, the remaining down or "linters" and the hard, black seed coats or hulls are removed by machinery. The remnants of the seed are cooked, and the oil expressed by high pressure. The resulting cotton seed cake is ground into the bright, yellow cotton seed meal of commerce. Such a meal carries from 40 to 50 per cent. or even more protein.

Sometimes the black hulls are ground with the cake, and a dark-colored meal of very inferior feeding value is the result. Not all dark-colored meal is necessarily adulterated with hulls, but strictly first-class, *fresh* cotton seed meal is always bright and yellow.

Linseed is made by grinding flax seed from which the oil has been more or less completely extracted. "Old Process" contains more fat and somewhat less protein than the "New Process" linseed meal. The Cleveland Flax Meal is a linseed meal from which the fat has been thoroughly removed by extraction with naphtha. The naphtha is removed by treatment with steam which leaves a coarse, flaky product.

BY-PRODUCTS OF THE OAT.

In the manufacture of oat products for human food, the kernel of the oat is separated from the hull. Oat hulls are, in themselves, low in food value, being worth but little more than the same weight of oat straw. Their value may be materially greater if broken kernels or small oats are ground in with them. Manufacturers of oat products are putting ground oat hulls on the market in many forms and mixtures, such as oat feed, oat chop, corn and oat feed, chop, etc. The bulk of all these materials is ground oat hulls, with admixtures of oat kernels, ground corn, etc. The feeding value is variable, and they should never be bought except on a guaranteed composition, and then it should be remembered that the oat hulls are not as digestible as the kernel of oats or other grains. Unscrupulous dealers frequently sell "oat feeds" as ground oats, the unsuspecting buyer thinking he is getting the whole oat meal, which is much more valuable than most oat feeds.

The various oat feeds, corn chops, and corn and oat feeds are largely sold usually under guarantees. Some of these are the straight refuse from the manufacture of oat meal and others, like the H-O Company's goods, are mixtures of such refuse with other by-products of higher protein content. With a few exceptions they are well up to their respective guarantees and no fault can be found with the manufacturers for their desire to sell these goods, as they are making no claims for nutrients which the goods do not contain. Some oat feeds, such as Viking Dairy Feed, have a feeding value about equal to ground oat straw. The intelligent buyer of feeding stuffs, who has his barns well filled with hay, corn fodder, and silage, will have very little use for these feeds low in protein content.

FEEDS LOW IN PROTEIN.

Very few farmers can afford to buy feeds low in protein and high in carbohydrates at any price at which they have been or are likely to be offered. The farmer should grow all the coarse feeds that he needs. Oats and similar feeds are very much like corn stalks or oat straw in composition. Some of these feeds have cotton seed or other nitrogenous feeding stuffs added to them so that they carry more protein than straight oat feeds, but these mixtures are always more expensive sources of protein than are the glutens, cotton seed, and linseed meals. One hundred pounds of an ordinary oat feed has from eight to eleven pounds of protein. At seventy-five cents per hundred the protein costs from seven to nine cents a pound. One hundred pounds of a good gluten meal has from thirty-four to forty per cent. of protein. At $1.50 per hundred the protein costs about four cents a pound, and it not only costs but half as much per pound as the protein in an oat feed but it is much more digestible. As a source of protein, it would be as good economy to pay $60 a ton for high grade cotton seed meal as to pay $15 a ton for the ordinary oat feed.

MANURIAL VALUE OF FEEDING STUFFS.

The economical user of concentrated feeds must take their manurial value into account in his purchase. Cotton seed meal with its high manurial value is a cheaper feed than gluten meal at the same price. Time will not permit me to go into the discussion of this subject, but a few figures are given in the table which will give an idea of the value of the fertilizing constituents contained in the different classes of feeding stuffs.

RATIONS.

To this paper there are added a few "rations" for cows, as illustrations of the way the grains and coarse feeds can be combined. They are no better than many others which could be devised. They are probably too small for the largest producers of milk and too large for economy for cows giving only a little milk. Time will not allow a discussion of these rations, but they are given in the hope that they may prove suggestive.

CONCLUSION.

The wise cattle feeder will grow upon his own land the largest possible amount of the food that he is to feed. He will grow as much of the nitrogenous feeds, the clovers, peas, etc., as possible, but the corn plant will be his main dependence for succulent winter food. Under favorable circumstances he may grow enough to carry his stock advantageously through the winter, but for the most part the home-grown foods must be supplemented from the market. To do this most economically the man who has sufficient hay and silage for his animals will usually need to lay special stress on the protein content of the feeding stuffs that he is to buy. While protein is not the measure of a food material, for his purpose he can consider it as such, for he goes not to the market to buy starch and sugar but to obtain the nitrogenous materials needed to balance his ration. Hence he will have little use for low grade oat feeds; he will buy some bran because it will furnish needed mineral matter, and he will buy more largely of the gluten, the oil meals, distillers' grains, and other materials high in protein. Which of these that he purchases will be largely determined by the market price. Under ordinary conditions he will probably find cotton seed meal to be the cheapest source of digestible protein, particularly when its high manurial value is taken into account.

CONNECTICUT BOARD OF AGRICULTURE.

Winter meeting, Norwich, December, 1902.

Cattle Foods.

By Chas. D. Woods, Orono, Maine,
Director of Agricultural Experiment Station.

Feeding stuffs vary greatly in composition and in digestibility. The following table is an *estimate* from the best data of the digestible nutrients in the more common materials used for feeding.

Weights of Total Organic Matter and of Digestible Nutrients, and Calories of Potential Energy in Digestible Nutrients of One Pound of Different Feeding Stuffs of Average Composition and Digestibility.

Kinds of Feeding Stuffs.	Total Organic Matter.	Digestible Nutrients.				Nutritive Ratio.	Approximate Manurial value per 1000 lbs.
		Protein.	Fat.	Carbo-hydrates.	Fuel Value.		
Green Fodders at Cutting.	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Cal.*	1 :	$
Barley fodder	.223	.026	.004	.138	320	6.0	
Hungarian fodder	.257	.022	.005	.169	375	8.2	
Corn fodder (dent)	.170	.015	.004	.110	250	8.5	
Corn fodder (flint)	.188	.015	.005	.123	280	8.9	
Corn fodder (sweet)	.122	.010	.002	.080	175	8.5	
Oat fodder	.233	.013	.003	.161	335	12.9	
Rye fodder	.180	.014	.009	.114	275	9.6	
Wheat fodder	.242	.021	.006	.157	355	8.1	
Orchard grass	.274	.021	.007	.182	405	9.4	
Pearl millet	.254	.016	.003	.175	370	11.4	
Red-top	.319	.017	.005	.222	465	13.7	1.00
Timothy	.300	.019	.005	.205	440	11.4	
Clover	.194	.026	.005	.100	255	4.3	
Cow pea vines	.151	.019	.004	.081	205	4.7	
Oat and pea fodder	.179	.024	.005	.100	250	4.6	
Vetch and oats	.217	.018	.005	.134	305	8.1	
Silage.							
Field corn, mature	.240	.018	.007	.136	315	8.4	
Southern corn, immature	.200	.010	.004	.079	180	8.8	
Oat and pea	.161	.025	.012	.120	320	6.0	

Cured Fodders and Hays.	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Cal.*	1 :	$
Blue (June) grass...........	.855	.062	.018	.423	975	7.5	
Corn stover (stalks).........	.762	.027	.009	.450	925	17.4	
Fowl meadow.............	.800	.057	.016	.396	910	7.6	
Hungarian.......	.701	.039	.012	.362	800	10.0	
Hay (mixed grasses).......	.809	.042	.016	.422	930	10.9	
Oat Hay..................	.819	.042	.015	.427	935	11.0	3.00
Oat Straw	.805	.019	.010	.396	815	22.0	
Orchard grass.............	.822	.047	.018	.418	940	9.8	
Red-top	.844	.044	.015	.441	965	10.8	
Timothy..................	.847	.036	.015	.451	970	13.5	
Timothy and red-top.......	.816	.040	.013	.430	930	11.5	
Clover (alsike)............	.806	.082	.015	.370	905	4.9	
Clover (red)...............	.839	.081	.010	.394	925	5.1	5.00
Rowen hay................	.787	.084	.015	.407	975	5.3	
Roots, Etc.							
Carrots....................	.099	.008	.002	.080	170	10.5	
Mangolds...........	.087	.011	.001	.068	150	6.4	
Ruta-bagas................	.099	.009	.002	.079	170	9.3	
Turnips...................	.088	.008	.002	.068	150	9.3	0.75
Potatoes	.199	.012	.001	.156	315	13.2	
Pumpkins...	.133	.027	.019	.068	255	4.0	
Milling and By-Products.							
Oats	.607	.090	.044	.474	1230	6.4	6.00
Corn meal.................	.836	.070	.035	.608	1410	9.8	3.50
Corn and cob meal.........	.858	.066	.031	.587	1345	9.9	3.50
Pea meal..................	.869	.168	.006	.518	1300	3.2	6.00
*Hominy chops............	.864	.074	.068	.552	1450	9.5	3.50
*Gluten feed	.906	.178	.100	.496	1675	4.0	6.00
*Gluten meal, high in fat..	.912	.282	.140	.397	1855	2.5	9.00
*Gluten meal, low in fat...	.912	.333	.057	.401	1605	1.6	
*Royal oat feed	.896	.046	.027	.337	825	8.7	
*Malt sprouts.............	.841	.188	.012	.437	1215	2.5	5.00
*Brewers' grain (dried).....	.882	.137	.045	.368	1130	3.2	
*Wheat bran..............	.823	.120	.030	.418	1130	4.0	6.50
*Wheat middlings..........	.846	.122	.030	.450	1190	4.2	6.00
*Cotton seed meal	.846	.376	.131	.178	1580	1.3	13.00
*O. P. linseed..............	.851	.283	.071	.327	1435	1.7	11.00
*N. P. linseed meal........	.841	.286	.027	.354	1305	1.5	12.00

* These materials are subject to great variation in composition and should only be purchased under guaranteed composition.

RATIONS FOR DAIRY COWS PER 1000 POUNDS LIVE WEIGHT.

The following suggested rations are adapted to cows giving a moderate amount of milk. Heavy milk producers would need to be fed more liberally.

No. 1.

Wheat bran	4.0 pounds
Wheat middlings	2.0 pounds
Linseed meal	2.0 pounds
Buffalo Gluten feed	3.0 pounds
Hay	4.0 pounds
Oat Hay	8.0 pounds
Ensilage	25.0 pounds
Digestible protein	2.5 pounds
Fuel value	31,550 Calories
Nutritive ratio	1 : 5.8

No. 2.

Wheat middlings	5.0 pounds
Chicago gluten meal	5.0 pounds
Corn meal	1.0 pounds
Poor hay	3.0 pounds
Ensilage	50.0 pounds
Digestible protein	2.5 pounds
Fuel value	31,450 Calories
Nutritive ratio	1 : 5.8

No. 3.

Corn meal	2.0 pounds
Wheat middlings	5.0 pounds
Cotton seed meal	3.0 pounds
Oat hay	5.0 pounds
Stover	14.0 pounds
Digestible protein	2.5 pounds
Fuel value	31,000 Calories
Nutritive ratio	1 : 5.6

No. 4.

Corn meal	2.0 pounds
Cotton seed meal	1.5 pounds
Wheat bran	2.0 pounds
Stover	8.0 pounds
Rowen	16.0 pounds
Digestible protein	2.5 pounds
Fuel value	30,800 Calories
Nutritive ratio	1 : 5.6

No. 5.

Wheat fodder (green)	75.0 pounds
N. P. linseed meal	3.0 pounds
Digestible protein	2.4 pounds
Fuel value	30,600 Calories
Nutritive ratio	1 : 5.6

No. 6.

Hominy chop	2.0 pounds
Wheat bran	4.8 pounds
N. P. linseed meal	2.0 pounds
Corn silage, mature	35.0 pounds
Clover hay	10.0 pounds
Digestible protein	2.6 pounds
Fuel value	30,870 Calories
Nutritive ratio	1 : 5.3

No. 7.

Wheat bran	5.0 pounds
Linseed meal	2.0 pounds
Buffalo gluten feed	5.0 pounds
Oat hay	3.0 pounds
Ensilage	50.0 pounds
Digestible protein	2.5 pounds
Fuel value	31,350 Calories
Nutritive ratio	1 : 5.7

No. 8.

Wheat bran	5.0 pounds
Cotton seed meal	3.0 pounds
Corn and cob meal	5.0 pounds
Hay	5.0 pounds
Stover	15.0 pounds
Digestible protein	2.5 pounds
Fuel value	31,300 Calories
Nutritive ratio	1 : 5.6

No. 9.

Wheat bran	5.0 pounds
Corn and cob meal	7.0 pounds
Malt sprouts	4.0 pounds
Hay	12.0 pounds
Digestible protein	2.5 pounds
Fuel value	30,850 Calories
Nutritive ratio	1 : 5.6

No. 10.

Corn meal	2.0 pounds
Wheat bran	6.0 pounds
Buffalo gluten meal	4.0 pounds
Linseed meal	2.0 pounds
Poor hay	6.0 pounds
Stover	7.0 pounds
Digestible protein	2.5 pounds
Fuel value	31,000 Calories
Nutritive ratio	1 : 5.6

No. 11.

Green clover	75.0 pounds
Hay	8.0 pounds
Corn meal	3.0 pounds
Digestible protein	2.5 pounds
Fuel value	30,600 Calories
Nutritive ratio	1 : 5.5

No. 12.

Wheat bran	3.0 pounds
Cotton seed meal	2.0 pounds
N. P. linseed meal	1.0 pounds
Corn silage, mature	40.0 pounds
Timothy and red-top hay	10.0 pounds
Digestible protein	2.5 pounds
Fuel value	30,715 Calories
Nutritive ratio	1 : 5.6

DISCUSSION.

The President. This is a very valuable paper, and it ought to develop a good deal of lively discussion. I want to ask a question myself. Prof. Woods, do you think that this cotton seed meal which we are feeding to our cattle is injurious as a cattle food? There is no doubt that it contains nutriment, but I have been a little in doubt about it lately.

Prof. Woods. I do not know, sir. It depends, of course, how it is fed. We have cows that we have been feeding with it, and they are still doing well on cotton seed meal. I do not believe that any man that is watching the milk pail and his pocket-book at the same time, a man that has to buy grain and is a good business man, will ever feed any animal heavy enough to injure the animal. If a man is striving for a record to see how many possible pounds of milk he can get regardless of cost he may over-feed, but the man that is feeding purely from an economical and financial standpoint will never over-feed on cotton seed or any other material. The lowest ration on this sheet (the sheet referred to is published at the end of Prof. Woods's paper), No. 12, is a ration that we fed for two years to a large number of animals, and with a good deal of success. It was made up of about 200 lbs. of bran, 200 lbs. of cotton seed meal, 100 lbs. of linseed meal, this material being mixed together and fed about eight lbs. to a cow that was doing good average work, and the cows gave good returns on it. It's a very economical ration in my opinion.

Mr. Clinton. I would like to ask Prof. Woods if he ever tried Spring Vetch and oats for hay?

Prof. Woods. That was tried at the Storrs Station years ago when I was connected with it and we found it to be very desirable indeed, particularly the variety that was called Scotch Vetch. That made a large growth. The great drawback to using vetch that we found there was in getting a large enough yield, and also the high cost of the seed. With that exception it makes good hay.

The President. Do these gluten feeds and gluten meals differ as much as they formerly did in value?

Prof. Woods. Yes, sir, I think they do. I do not know but they differ more. They are constantly changing the process of manufacture. For example, our gluten meal carried, at one time, a large amount of fat. It probably did make soft butter. Then they found out that corn oil was a valuable oil, and this was discovered in connection with the interesting fact that one of the companies that manufactured the most gluten also owned one of the largest linseed oil plants that we have in this country, and now their gluten meal carries very little of the corn oil in it.

A Member. I see in that ration, No. 12, you have got corn silage 40 lbs. What time do you usually cut your corn for that?

Prof. Woods. Our corn is always cut in the dough stage. This has more that would answer to the corn ensilage given first on the opposite side of this sheet.

A Member. This ration foots up six instead of eight pounds of grain.

Prof. Woods. You will see it's cut down. That is not the ration I was talking about. As I have told you here at the top of this sheet, the following rations are suggested as adapted to cows giving a moderate amount of milk. Where we would give eight pounds we reduce our corn feed. Not so much the coarse feeds, but we reduce the concentrated feeds in accordance with the milk flow. When the animals are fresh not so much is needed. If we were using that ration we might make up a little on the cow that was giving thirty-five pounds of milk and, when she cut down, and was giving not more than ten pounds we might cut down to five pounds, and then if she got dry the grain ration is principally left out.

A Member. Don't you get a good deal of shrinkage in that way? I have had a theory that as good a ration as we could get for milk was June pasture. It's good enough for most any cow. I have had a theory that we wanted to get a ration as near as we could to approach that, and then to keep it up largely through the season in order to avoid, as long as possible, the natural shrinkage. If you shrink your feed continually as the cow shrinks it seems to me you do not save enough on your ration to pay for that additional shrinkage that you get in your cow.

Prof. Woods. A few experiments that have been made upon that, while they show in a general way that liberal feeding pays they do not show that it pays to feed a cow as liberally when she is not liberal herself.

A Member. I should make some allowance, of course.

Prof. Woods. Unless we are feeding for some other purpose than from a strictly business standpoint we have found that to reduce the grain ration as the cow descends in lactation is profitable. I do not know that you should do that right off. Of course, most of our cows will keep right on for six months or so, but after a cow has been in milk for eight or nine months we commence to drop off her grain ration. We do not want our cows to be fat, and we certainly do not want

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them to be fat when they are coming in. Of course, we are feeding our cows partly for experimental purposes and partly for business, but, as I say, where we are feeding from a business standpoint we think we have found that to reduce the grain ration as the cow descends in lactation is profitable.

SAME MEMBER. In my practice I have never fed more than eight months. I do not believe in much stimulation after that. I have usually fed the full ration for eight months. After that it is dangerous to continue the concentrated food because you wish the cow to dry off.

The PRESIDENT. What do you think of this "Red Dog" for feed?

Prof. WOODS. Why, it's a good food. It's high in protein contents, and it contains a good deal of soluble starch and carbohydrates. It's good for swine particularly. I do not think it is hardly equal to some of the other feeds for a cow ration. It depends, of course, on what you have got at home in the way of feed.

The PRESIDENT. You spoke of its being used for making bread if I understood you right. Is it a healthy bread to eat?

Prof. WOODS. I guess it's good enough to eat so far as health is concerned, but we do not use it in our family.

The PRESIDENT. Well, isn't that the very thing we ought to eat and do not?

Prof. WOODS. No, sir, I don't think it is. I do not think there is any reason for using "Red Dog" flour for man. As long as we have an abundance of other flour for the use of man there is no occasion for the use of it. There is no occasion, in my opinion, for using anything for that purpose but the finest quality of wheat flour. The entire wheat does not contain the same amount of digestible nutrient matter as does the best wheat flour.

The SECRETARY. If there are no further remarks on this paper I would suggest in the interim we have a little music.

The PRESIDENT. That motto which we adopted last evening, that the farmers should go on their way singing, is a good thing to put in practice now. I understand there are two ladies here now who will give us a little music.

Music.

The SECRETARY. Prof. Gulley has made a very fine exhibit from the Connecticut Agricultural College, and as there is opportunity I would ask that he be given a chance to explain in regard to the exhibit which he has brought here.

Prof. GULLEY. Mr. President: We are continually being asked now about some of the new varieties of apples that are coming out for orchard purposes, and that is something which I suppose the most of you who have an orchard want to know about. In the first place, that is something that cannot be answered right off at short hand because the question of cold storage has come in. That is going to change the use of some varieties a good deal. It's going to enable us to use some of our varieties, and make them valuable to us in a way that we have not thought of much before. In the first place it is going to enable us to carry some varieties about as long as we see fit. If you will go in the other room you can see some that are just as sound and fresh as the day they were put in. That is going to enable us to grow varieties like the Gravenstein. A man can put his whole crop in storage, handle the whole of them in that way, and make a good thing on them. A man will be able to grow a whole orchard of Gravenstein and take care of them in good shape, and deliver them at any time he sees fit. But it is not of that that I wanted to speak more particularly, but it's of some of the new ones. There are three or four that are attracting a good deal of attention in this State, and which I wish specially to speak about. I think probably half a dozen men here have asked me about the McIntosh Red, or the McIntosh, as it is commonly called. That is going to be one of our most desirable apples in this State.

I think you will be perfectly safe in planting that apple in this State at least. This apple that I have here is high colored, as you see, but that is about as they run in the ordinary barrel. It's a fall apple. It comes along rather late, but it's going to go into cold storage in good condition without any question and it's going to keep finely. We know that it will keep, and it's an apple that will sell. The color is going to sell it, to say nothing of the qualities inside. It's the old Snow Apple improved. It's a seedling of that. It has all the qualities of that apple with some others which are desirable. I have tested some of them which have been in cold storage, and they do not show any evidence of breaking down at all. This that I have here is just about what it was when it went into cold storage in the fall. It is an apple which can be used as a filler, or it can be put in as a part of your regular orchard. It bears long branches. Not so much so as some others, but it's a steady, fine, nice grower, and, as I say, it can be used either as a filler or for the regular orchard. The color is what will make it take. It always has that handsome red color. It does not need any special training over what you give the Baldwin and some of the other trees with which you are more or less familiar.

A question that I was asked was whether we put in all one kind in an orchard? I think the time is passed when we want to plant all one variety, as a rule, unless you have some special reason for it. With cold storage and with these varieties you have a little more time to handle the crop and get a good deal better results than you have been getting, because it is going to enable us to put the crop on the market at a time when the prices are better.

Now, there is another variety that you can put down as being pretty likely to be a winner in this State among the new ones that have come in, and that is the Sutton Beauty. I presume the College has more of these than all the rest of the growers in the State together. We have had for several years a number of trees in bearing, so that we had this year about fifty barrels of this variety. The treatment of this tree must be entirely different from any apple tree we are growing at the present time. It is not going to do to use it for top growth on any upright growing tree. It must be grown very narrow headed at the ground. You have got to keep it down because I know of no apple that will grow as upright as this one. Unless you are particular about it it makes a tall, ungainly-looking tree, and it's one of the meanest apples to pick on the tree of any apple I know of. It must be headed low, and headed back for several years to get a good stocky appearing tree. We happen to have at the College some that were top-grafted upon Spies, and it took a twenty-four foot ladder to get at the apples. We did not try to get some of them this year. This tendency of the Sutton Beauty is something that you must watch out for, and be particular to keep the tree down. It has another peculiarity. There is no stem of any account to the apple, and it makes it exceedingly difficult to pick them. The stem is stronger on the tree than it is to the apple, and a little pains must be taken in picking them to prevent their being bruised. This apple goes into storage well along in the fall, and just before they are ready to pick they color beautifully. They maintain that color after they are put in storage. I saw some that were taken out in May, and they came out as bright as they were when they went in. So far as bearing qualities are concerned it's an apple that is fully up to the Baldwin, but with the same trouble of probably bearing every other year. This apple will need thinning. It is sure to over-bear when it bears at all, and that fact makes a wonderful sight of difference as to its size.

Another variety which we are asked about a good deal and which is an illustration of what cold storage may do for us in extending the apple season is called Grim's Golden. In quality there is no better apple in the State of Connecticut. In yield it is equal to some of our best ones. Its color is yellow, which is against it when you come to market it unless you know where to place it. If a buyer gets some of them once he is sure to want some more, but I am afraid it is going to go down in cold storage. The samples that I have we have only had in cold storage about six weeks, and they have begun to go down. Whether we can overcome that or not I do not know, but for an early winter apple it is bound to have a good sale in my opinion. Of course its color is going to be against it in some markets, but it's a perfectly hardy tree and gives an apple of very high quality.

The Wealthy is another one which is being asked about some. This is a very early bearer and should be used, if used at all, wholly as a filler in the orchard, and as something which you can throw out when you come to thin. It bears very young — very young indeed. It's a fall apple, but it will keep in cold storage all right. It's one of those varieties which will have to be thinned, but it's a variety which I believe will give a lot of money to those who raise it very soon. It's essentially more valuable as a filler where one wants to plant thick with the idea of thinning.

This matter of storage is going to have considerable influence on our orcharding in the future. On some varieties you can note quite readily the amount of difference that storage will have in keeping them back or in keeping them in condition for some length of time. That cold storage is going to be a success is settled, but it's a question yet whether we can keep all these varieties without their coloring or spotting. Some will do it readily and some will not.

Prof. SAUNDERS. I am glad to hear so good a report of the McIntosh Red. That apple originated about sixty miles from where I am located, and the original tree is still there. It is now being distributed over the wide world, and I think is generally regarded as a desirable apple everywhere. I think it is the best eating apple that exists. It is very high flavored, pleasant to the taste, and the flesh is white in character, juicy, and in every way agreeable. We have tried some few experiments in shipping it to the old country, and it has taken remarkably well there. I think it is one of the coming apples. I hardly agree, however, with Prof. Gulley that you can carry it forward indefinitely in cold storage. It soon loses that agreeable, juicy character of the flesh when it is past its season. It is much better to be used when it is in its season. The season lasts a good while, beginning usually about October, and we can keep them in an ordinary cellar in good condition until about the 1st of December.

He also spoke of Grim's Golden, which I think is an apple well worthy of a wider dissemination. I think Prof. Gulley referred to it as a Northwestern variety. If he will pardon me for correcting that, I will say that it originated in Ohio. I got the first fifty trees that I ever planted from the originator in Ohio, and these trees are bearing very large crops today. The samples shown here are very poor representatives of the variety. When well grown it is a bright golden yellow. I do not think the color is any objection. When the late Prof. Warder of Ohio was asked as to what sort of a keeper it was he said that he never had enough of them yet, that he always wanted to keep what he had and eat them all. It's an apple that everybody appreciates, and it will keep in good condition easily until January. It is a very delicious apple, and one the character of which I am sure every one will appreciate well.

As to the Wealthy, we have had some experience in growing it as Prof. Gulley recommends, as a filler. It is a very prolific apple. We had an orchard of Wealthy which fruited well, the trees being ten feet apart, and I am almost afraid to venture to say how many apples they gave us, but it was almost twice as many as I expected they would. When we came to measure them we found we had a very large yield. I think it was between two and three hundred barrels off from a limited area. The apple itself is a good apple to eat in its season. It's a splended cooker, and, owing to its Northern origin, I am sure it's an apple which will be successful everywhere in the East. I think, for general purposes, it is one of the most desirable apples that we have.

Mr. Hoyt. Prof. Gulley spoke of the Wealthy as a filler. I wish he would explain what he means by that.

Prof. Gulley. I mean if I want to plant my apples, or plant an orchard so as to utilize all the ground space while the trees are young, I can put in some of these varieties which can be thrown out when the trees that you are going to keep grow larger and take up all the room. I think Mr. Hoyt knows what I mean just as well as I do.

Mr. Hoyt. I did not know whether everybody else did or not.

Prof. Gulley. I want to say that in the other room there is an apple almost like the McIntosh, but it's on the table as the Princess Louise. I believe they are identical, but if they are not they are so near alike it is very hard to tell them apart. I suspect they are about the same thing.

Prof. Saunders. I think you will find it is an entirely different apple. I know something about its origin, and it has not at all the qualities of the McIntosh Red. The flesh, of course, in appearance, is much the same, and the look of the apple is very much the same, and it's very easy to confound the two for that reason, but if you undertake to compare them in other respects, and particularly as to flavor, you will find that the flavor of the McIntosh is very distinct. It is a much higher flavored apple. They are both very good apples.

Mr. Hoyt. These apples are very much alike, but when you grow them side by side you can see that the trees grow differently, and there is a difference in the apple itself. The Princess Louise is the prettier apple. It's the more attractive apple of the two. It's a more highly colored apple than the McIntosh. If I was situated so that I could plant an orchard I would soon have a hundred acres of Princess Louise. I would sooner have those two varieties than any other variety of apple. If I had them I wouldn't care anything about cold storage. I would send those apples to England or Liverpool as soon as I could pick them in October. There is no danger of over-stocking the market with those two varieties. They are beauties, they are attractive, and their color will sell all of them that can be raised. A fruit man said to me this fall, "Mr. Hoyt, if you had a thousand barrels of those two varieties I would get you now $5.00 a barrel for them, and I am selling some of the others for $1.50 to $2.00 a barrel." There is something about these apples which grew on our soil that makes them the most attractive varieties that I ever saw. They are good bearers, good fair yielders, and the apples are almost all perfect. There are very few that are at all imperfect in their make-up, round and smooth, handsome, no mildew on them, and just beautiful to look at. I do not speak of them in words of high praise because we have got the trees to sell. I have not got any Princess Louise. I wish I had.

Prof. SAUNDERS. I would like to say that we tried the experiment at our experimental farms of sending over a hundred cases of Wealthy and McIntosh Red this year to Glasgow. They were sold there in bushel cases, and they returned to us nearly double the price over what we could get by selling them by the barrel at home. It is an encouraging outlook for these special varieties of apples.

The SECRETARY. Mr. Chairman, I wanted to ask Prof. Gulley what time, after gathering the fruit, he puts it in cold storage, whether he puts it in immediately after gathering or whether he allows it to stand some time, and at what time he had the best success in keeping it in cold storage.

Prof. GULLEY. We haven't gone far enough with that to tell. We have been putting it in a good deal as it has happened to come. In a few cases I put it in at once to see what the result might be. It wasn't always convenient to do this just at the time I would like to. In other cases I have put it in quite a little time after the fruit has been picked. As a matter of fact, it varies some, but the practice was, so far as we could, to run the apples in just as quick as I could, but in other cases, as I say, it was two or three days after they were picked before they were attended to. We are trying to do what we can to see how this is going to work. It is rather a new thing and we don't know quite how to take it as yet.

Another thing, we had quite a lot of apples, we had something like seventy-five varieties, and we put in what we happened to have that we wanted to try more or less. We had a large quantity of varieties like the Sutton, and we tried to get them in just as soon as possible. I think the experience has been that that should be done.

Prof. SAUNDERS. I would like to ask Prof. Gulley at what temperature he kept the storage.

Prof. GULLEY. We are trying to carry the apples at 32, but that is a question that is not settled. It makes a difference whether the cold storage is a large plant or a small one. If your plant is a small one you may have a little more trouble with it, it is a little more difficult to regulate than a larger one, that is, you have more fluctuating temperature.

There is a thing I neglected to say. You may expect in growing Sutton trees for the orchard that you must give them one or two more years ahead of some of the other varieties. Although they are perfectly straight they are a beautiful tree to grow, but it takes about four years to make a Sutton tree as big as one will be in three years of such varieties as the Baldwin. You take two trees, one of the Sutton and one of the Baldwin, and the Baldwin will have gained one year on the Sutton at the end of that time, that is, in size. I should say it would take another year with the Sutton to get a tree of the same size as the Baldwin. So I should expect it would take about a year or two more to grow an orchard of the Sutton than it would of the Baldwin for that reason.

Mr. Hoyt. I would like to ask Prof. Gulley what is the use of carrying early apples in cold storage and over into the season when they come in conflict with apples that are much better than the early apples. Why put the early apples into cold storage to carry them? If you do carry them is the flavor as good?

Prof. Gulley. Why are you quoting today in Boston the Gravenstein at a higher figure — selling them at a higher price than anything else? That will explain it. It is simply because some of these varieties are popular and will sell. You can sell the Gravenstein all the way up if you have got good ones. Now, in regard to the McIntosh, it isn't necessary to carry them into March, you can carry them a month or two later and still have them good. I shouldn't think of carrying them 'way into the spring. This cold storage is something that is going to be a big help to us, it is going to enable us to carry these apples along into the spring if we want them. It might or might not always be convenient to get rid of the stock early; sometimes if it can be carried over in that way you will get a better market.

Mr. Hoyt. Prof. Gulley speaks of the Gravenstein. Of course, that has got a reputation, but whether the flavor is as good now as it was in September or not, the latter part, is a question. I know that the question of locality comes into this matter a good deal. In New York they want the Spitzenberg and are willing to give $5.00, when you can get other varieties for $2.00. Now, if there are other varieties in the market like the McIntosh and they could be educated up to the quality of them, why, I think they would take the place of the Gravenstein. I feel pretty sure of that, and that is the reason I don't see any advantage in carrying in cold storage a fall apple in competition with a winter which is just as good.

Mr. Sprague. Answering Mr. Brown's question, I was talking with a New York commission man a short time ago about this matter and he told me that the concensus of opinion there seemed to be that apples should go into storage immediately on picking. I disagree on that somewhat, because apples will sweat. I think the apples should remain long enough to get through their sweating and then they will be better, but their opinion seems to be that immediately on picking they should go into cold storage.

Prof. SAUNDERS. Mr. Chairman, we had a great deal of experience at the time of the Chicago Exposition. I happened to be commissioner for Canada and had charge of the gathering the fruit for one season to show there the next season, and my experience leads me to the opinion that the sooner the apples are put in the better. Where we put the apples in cold storage, where a chemical change had begun, or taken place, it went on to a certain degree sufficient to affect the flesh and quality of the apples, so that they did not have the freshness that they ought to have. In many cases, however, decay set in if they were left too long. I think what I learned from the experience of most growers goes to show that the earlier the apples are put in the better. I think that has been the experience of the growers in our country.

Prof. GULLEY. Did you carry that far enough to notice the effect on the color, whether when put in right away it had any effect on the color?

Prof. SAUNDERS. I think they were affected. Our apples color up quite early. They do not usually add anything to their color after picking. There is a slight change after the maturity of the apple. A green apple will very often change to a yellow shade. I do not think, however, there is much actual change of color except in regard to the greenish tint.

Mr. SPRAGUE. A single word to corroborate that statement. One of my neighbors put in a large quantity of apples and among the rest were some fall Pippins. A week ago Monday I went to see these apples; we opened a barrel or two of every kind and they were in perfect condition and seemed to be the same as when they were put in, in almost the same condition as when they were taken from the tree. That goes to corroborate that statement, which was made to me by the commission men.

Speaking of carrying fall apples, unless a man has a large quantity of some variety like the Gravenstein I don't think it is necessary for a man to do that. Once the market gets hold of that fruit I don't believe there are many who have got any too many trees. They are very large trees; I sold 25 barrels off from three trees. I obtained an average of $1.75 a barrel, which was a pretty good price this year; I got them and sold them all at that price. So I don't think for an apple of that character it will pay to go to the additional expense of putting them into cold storage. I think it is better if the market is good at that time to let them go and then you know what you have got, and you do away with any of the difficulty of putting them into cold storage.

Mr. HOYT. I want to call attention to this matter of color which has been referred to. There are four apples, those two are red and those are nearly green, they are the same variety of apples. Now, can Prof. Saunders or any of the professors here tell us why one is red and the other is another color?

Prof. SAUNDERS. One variety has had some light and the other has had shade. We find that very common in trees of other varieties. In my experience it is usually due to the matter of exposure to the sunlight.

Mr. HOYT. Will it make all that difference?

Mr. SAUNDERS. I have known it to.

Mr. HOYT. I would inquire of Prof. Gulley if on that tree he spoke of there were any apples red on one side like that?

Prof. GULLEY. There were plenty of them red when I picked them.

Mr. HOYT. This has been a question to me. Those grew on a tree in our orchard and every one of them was that color.

Prof. SAUNDERS. I never saw a Pewaukee that color.

Mr. HOYT. Do you see any of the characteristics of the Pewaukee in that?

Mr. SAUNDERS. Yes, there is a likeness. I shouldn't call that a Pewaukee if I was asked to name it, still, it may be.

Mr. HOYT. I will grant that is a Pewaukee.

The PRESIDENT. I think the audience is a little curious to know what makes that difference in the color. I wish you would explain that a little more fully, Prof. Gulley.

Prof. GULLEY. I will tell you, Mr. President, what I think about it: I don't think anybody can tell; I think it is largely accidental. Very often on some trees you will get them that way and sometimes on different trees you will get something else as to the color of the fruit. Mr. Saunders speaks about sunlight. It wasn't that so far as those were concerned, for in fact they were on the south side of the tree.

Mr. HOYT. I would like to ask Prof. Gulley the condition under which those were grown, and I would also like to ask him if there is any difference in the eating quality of them?

Prof. GULLEY. I don't think so.

The PRESIDENT. Were the trees especially different from any other apple trees?

Prof. GULLEY. No, sir, they were not special trees, at the same time I don't imagine that those apples will taste at all like that.

The PRESIDENT. Are you quite sure they are the same apple?

Prof. GULLEY. I have no reason to doubt it.

The SECRETARY. I find a few questions in the question box here. The first is this, "Has the gasoline torch been successful in Connecticut in destroying noxious insects?" I have seen the gasoline torch advertised but never saw it in operation. Can anyone answer the question?

Prof. SAUNDERS. I don't know, Mr. Chairman, what the gasoline torch is. We have our traps in Canada for collecting injurious insects. The trouble is they collect all sorts and a great many friendly insects get into them and are killed, also a good many that do neither good nor harm. We do occasionally get some injurious species, but there are some of them that do not fly at the light and are not caught in that way, so I don't think myself there is much in that method.

Prof. GULLEY. I think that Prof. Saunders has the wrong idea. The question referred to the torch that is used for burning out insects, as I understand it, for burning out nests, the same sort of nests as we find in the tent caterpillar. I don't think, myself, there is any great value in it; I think it can be used, but I know there is something a great deal better.

Mr. CLINTON. I have used it, and it certainly kills the insects. You must catch the insects in order to kill them; I have tried it but find it is too much work.

Prof. BRITTON. I think this has been used as a method for destroying the San José scale and the Gypsy moth and the Codlin moth, but the claims made for it are far too broad. Its uses are very limited. In the case of the Gypsy moth it can be used to kill out those that hide under the bark of the tree and under the leafy part of the tree, but I don't think we can expect to use it to any great extent in Connecticut.

The PRESIDENT. The subject for this evening's session is to be "A balanced ration for plants, and how to get it," by Prof. Clinton. We are to have music this evening also.

We will adjourn until 7.30.

EVENING SESSION.

WEDNESDAY, December 10, 1902.

Convention called to order at 7.30 P. M., Vice-President Seeley in the chair.

Music.

The PRESIDENT. We are going to hear tonight a little about a balanced ration for plants. We have heard something about a balanced ration for cattle, for animals, and for man, but there is no such thing as getting a good balanced ration for animals unless we know how to get a good balanced ration for plants first. Professor Clinton is going to tell us something about that. He is the Acting Director of the Storrs Station. I am very much pleased to introduce that gentleman to you.

A BALANCED RATION FOR PLANTS — HOW TO GET IT.

By Prof. L. A. Clinton,

Acting Director, Storrs Agricultural Experiment Station.

Mr. Chairman, Ladies and Gentlemen: I have been asked several times today what I meant by a balanced ration for plants. We have heard, as the Chairman says, of a balanced ration for animals and of a balanced ration for man, but when we speak about a balanced ration for plants we are not so familiar with that expression. Yet I see no reason why plants should not have a balanced ration as well as man or animals. Words are sometimes misleading, and from the title which is sometimes given we can draw no conclusion as to what the talk is going to be about. It reminds me somewhat of a man who had advertised his horse for sale. He put an advertisement in the paper, "Horse for sale. The only reason I have for wanting to sell this horse is because I wish to leave the city." And so he sold the horse to a man, and the man drove the horse around town and was very well satisfied with his new purchase. One day the man thought he would drive out into the country, and so he started off out into the country, but by the time he reached the city line he came to a hill, and the horse refused to go up the hill. So the man turned round and thought he would leave town by another route. So he went out to another part of the town and there, also, was a hill that was necessary for him to climb. The horse refused to go up that hill, and by no persuasion could the man make that horse leave the city. So he went back and he said to the man that he had purchased the horse of, "You told me the only reason you had for selling this horse was the fact that you wanted to leave the city." The man said, "That is true. I never could leave the town with that horse." And so you see we are not always able to draw the proper conclusion from an expression that is given, but I did, in giving this subject, "A balanced ration for plants," mean just what I say by it.

There is such a thing as securing a balanced ration for plants. Perhaps we have not attained it exactly, but we can come just as near to it as we can, we can come just as near as possible to securing a balanced ration for animals or for man and I think the same can be obtained to a very large extent for plants.

Now, of all the statements made here today the one that has given me the most to think about was a statement made with reference to a Connecticut farm, an old Connecticut farm which was recently sold for $500.00, having a large number of acres, I have forgotten the exact number, but, as I remember, it figured up about $1.50 to $2.00 per acre. And that was a farm which formerly was able to pasture sixty head of cattle, but at the present time can care for only ten. Now, that statement went here today unchallenged. The truth of it was not challenged. A farm which formerly could care for sixty head of cattle can now support but ten. If that condition prevailed upon that farm alone then it might not be such a serious case, but there are farms I am afraid in Connecticut where the condition is just as serious, and there are farms which were not abandoned but which will be in the course of time if the methods used in running them are not changed.

We look sometimes upon the productive lands of the west, those prairie soils where the farmer can start out with the plow in the morning and plow all day without striking a stone, where he can turn a furrow as straight and as long as the eye can see, and we think there we have the ideal conditions for agriculture, that that is the place for the young man to go if he would succeed in farming. And yet these Connecticut hills, these Connecticut farms, possess a fertility which will be here after those Western soils have become depleted of their fertility. Now, the trouble is not with our Connecticut land. The trouble with this farm which was mentioned this morning is not with the farm itself, but with the way the soil has been handled. Had it been properly treated, had the man who owned it made some effort to secure a balanced ration for the plants which he raised upon it, all the conditions which prevail there today would not be found. Let us ask ourselves this question: If, after farming this Connecticut land for 150 or 200 or 300 years it gets into such a condition that a farm which formerly could care for sixty head of stock can now care for only ten, if that is to be the condition of things, what has the future in store for us or for our children? Evidently something is wrong in the condition which prevails, and it is with a view to see how we can remedy this condition that I wish to speak on a balanced ration for plants.

By a balanced ration for plants I mean the presence in the soil in an available form and in the proper proportions of the various elements necessary for the growth of plants and for the development of fruit and seed. I am not going tonight into a discussion of the elements which enter into plant growths, but I am going to speak of only two or three things, how we can secure those elements most economically.

Fortunately for the tiller of the soil nature has made wise and liberal provision for plant food, and in all our arable land there is usually found an abundance of the various plant foods required. We find, however, that as the soil is subjected to cultivation and plants are grown and removed from the soil, they draw unequally upon the mineral elements stored until, ultimately, there is a deficiency of some one or more of the elements which are necessary, and, although there can be no deficiency in the total amount present, yet the elements of plant food are not all present in proper proportion, and some measure must be taken to balance up again.

The soil is a part of nature's great chemical laboratory, and, if the work is left to nature, she will do her work well though she may take a thousand years in which to do it, but we cannot wait for nature to perform her work. We may coöperate with her, however, in hastening the process which is going on in our soils and we may even draw from nature's laboratory, where she has made with marvelous foresight a business of manufacturing phosphates or nitrates or salts of potash. Whether, then, we assist in the work by tillage or by the use of commercial fertilizers, we are simply coöperating with nature. It is this coöperation with nature that I would call your attention to particularly tonight. There are certain forces constantly at work, and there are also certain forces in the soil which are at work depleting it. Now, these forces work constantly, they have worked through all time, and it is our business to learn something of these forces so that we may work in harmony with them rather than to work at odds or crosswise with them. Our object should be to assist nature in her work, to hasten her work some and make her productive. "Man does not live by bread alone" is an expression the truth of which is recognized.

The term "a balanced ration" has become familiar to all as applied to animals, but we have not come as yet to recognize it generally as applied to plants. The most careless breeder of animals now recognizes that in order to produce the best results there must be a certain relation between the food of the animal and the requirements of the animal with reference to what the animal is intended to produce. This relation varies according to the condition and according to the product desired, whether that product be energy, or milk, or flesh. This relation of rations may vary within certain limits without materially affecting the amount or quality of the food produced, but the variation cannot go beyond certain limits without in some way affecting the product. In feeding plants the lines are not so definitely marked, and yet certain it is that in order to produce the best results some attention must be paid to the character and availability of the soil and the elements contained in it with reference to an available form of nitrogen and phosphoric acid and potash. Now, as in feeding animals protein or nitrogen are expensive parts of the ration, so in feeding plants nitrogen is an expensive element if it must be procured in the market. While we cannot say that any one of several different elements is more important than the others, yet in securing a balanced ration for plants the nitrogen usually demands the most attention. It is this element which is most easily lost from the soil. A superabundance of it in the soil may over-stimulate and produce a larger growth of plant and foliage, but at the expense of fruit and grain. Too much nitrogen may also cause a growth which is lacking in hardiness, and the plant is likely to become a victim to blight and disease. A deficiency of nitrogen, on the other hand, means a slow growth, and there will be a lack of wood and a lack of fruit and grain because the essential factor in the food of the plant is deficient in amount.

Nitrification, or the changing of compounds containing nitrogen into the form of nitrates, the form available for plants, takes place most rapidly when the soil temperature is from 90° to 100° Fahrenheit. It will thus be seen that in the early spring, when the soil is cold, plants may suffer from the lack of nitrogen when later in the season there may be an abundance made available through the process of nitrification. If it is desired to stimulate the growth of plants in the early spring some quick-acting form of nitrogen should be used, as the nitrate of soda. This is often found to be especially valuable when wheat or grass in meadow or pasture is slow in beginning growth in the spring. It would be folly in such cases to apply a slow-acting nitrogen, because it could not be made use of before the temperature and soil conditions were favorable for nitrification, and then no commercial nitrogen would be needed.

We have already learned that there is a vast difference in protein, that the protein secured from one source for our animals may differ from that secured from some other source. We have learned that foods for our cattle differ in this essential particular. This difficulty in feeding protein or in feeding nitrogen to plants can be overcome, especially so far as the plants are concerned, by applying it in some form in solution. Nitrate of soda is one of these forms.

I will relate the case of a nurseryman in western New York. This man once wrote to a club and he stated somewhat as follows: My currant stock is making a slow growth. Unless there is something I can do to stimulate its growth rapidly I must sell all of my currants as second grade stock. If there is any way by which I can stimulate and make them attain a certain size they will all go as first class stock. Is there anything I can do to hasten the growth of this currant stock?

He was advised to apply nitrate of soda, and he followed the advice. It quickened the growth of his currant stock and he was able to sell it as first grade stock rather than second. Knowing what to use he had used it, and it saved for him in one season $500.

When it is known that a certain soil is deficient in nitrogen and that plant growth is likely to be slow even during the periods when nitrification is most rapid, commercial nitrogen should be applied, a part of which is in the quick-acting form as nitrate of soda and a part should be in a slower-acting form as dried blood, tankage, cotton seed meal, or other organic form of nitrogen, all of which are somewhat slower in action than is nitrate of soda. A balanced ration so far as nitrogen is concerned should be obtained from the soil, if possible, without the application of any fertilizer. If commercial fertilizer is used a study of the conditions and needs of the plant will enable one to decide what shall be the source of the nitrogen supplied. High grade quick-acting nitrogen should be used in relatively small amounts, for the soil does not possess the power of fixing the nitrates that it does of fixing phosphoric acid and potash. From what I have said in reference to nitrogen you may draw the conclusion that I believe that nitrogen must be purchased in general farm practice. On the contrary, I believe that a system of farm practice should be adopted which will not require the purchase of a single pound of nitrogen in the open market. The average price of nitrogen sold as commercial fertilizer is about fifteen cents per pound; this is more than a farmer can afford to pay for the general farm crop. Now, there may be some special cases, as in the case of this nurseryman I mentioned, where by knowing just what to use and by using it at the right time it means dollars and cents to the farmer.

Through judicious rotation of crops and improved methods of tillage we can secure for our soils nitrogen in abundance, nitrogen without money and without price. In a little experiment one time I sowed some clover on the first day of August. This was in central New York, where the climate is generally about as we have it here; it is a climate nearly as severe as the climate here in Connecticut. This seed was sown the first day of August, and on the second day of November I took a sample of the clover. I dug down to the roots, I dug through one cubic foot to the depths to which the roots went. This clover I had analyzed in the laboratory and calculated per acre from the first day of August to the second of November that the clover had brought to the soil what would have cost me $20 if I had gone into the markets and purchased the nitrogen at the prices then prevailing. Now, that is a case of making the clover plant do the work for us. As the result of actual field experiments it is found that phosphoric acid is more often needed in balancing the ration of plants than is any other element of plant food. This is, without doubt, due in part to the fact that phosphoric acid combines with many substances contained in the soil, as lime and iron, and as the result of such combination phosphoric acid is very effectually fixed or locked up in the soil. So firmly is it fixed in combination that it is often impossible for the plants to "unfix" or liberate it fast enough to supply their demands, and hence plants may suffer for lack of this important element of their food even though it be present in the soil in large quantities. As a principle it should be remembered that the phosphoric acid in a high grade fertilizer is never available in any larger percentage at any one time than when it is applied to the soil, but that the tendency is constantly toward a reversion to forms which are less available.

There has in recent years been much discussion as to the relative value of soluble and insoluble phosphoric acid as plant food. The claim is made, and correctly made, that if soluble phosphoric acid is applied it soon becomes insoluble. The value of any fertilizer depends to a considerable extent upon its even and thorough distribution through the soil. The soluble phosphate is distributed in solution, and, when it is finally "fixed" by the soil, it has been distributed evenly and so that the plants can come into intimate contact with the fertilizer. It is not necessary in all cases to purchase high grade phosphate fertilizers. Under certain conditions insoluble phosphoric acid as contained in floats, crude ground rock, may prove beneficial. The conditions, however, under which it may be used to advantage have to be carefully studied or failure will result instead of success. Insoluble phosphoric acid of the soil is rendered slowly available for plants' use by means of the fermentation and decomposition of organic matter and by the action of plant roots in the soil; that process goes on most rapidly in those soils which are well supplied with humus, moisture, and high temperature.

In using insoluble phosphoric acid as a fertilizer we fertilize the soil rather than the crop which is growing upon the soil, and immediate result should not be expected, but there is some satisfaction in knowing that the total amount of phosphoric acid in the soil has rather been increased than diminished. If you will study the results obtained by recent experiments at the stations with soluble and insoluble phosphoric acid, you will find that some of these results indicate that insoluble phosphoric acid will give as good or even better results than soluble phosphoric acid. But in drawing this conclusion you should know definitely just the condition under which those fertilizers are used.

Now if we should take this abandoned farm, this farm which formerly cared for sixty head of stock and which can now take care of only ten — if we should take this farm and apply insoluble phosphoric acid to it, we might just as well keep our money in our pockets. *There* is a soil which is deficient in organic matter; it has been depleted of its humus and other forms of mineral matter put there by nature. There is no decomposition going on in that soil and the insoluble phosphoric acid might remain there for ages without becoming available.

Now take another case: Here is a field where clover has been plowed under, with the farm manures, or perhaps, in what is called alluvial soil, which is organic matter. Insoluble phosphoric acid may be applied to such soil as that with good results. The depletion and fermentation which is going on there tends to liberate or set free the phosphoric acid so that the plants can use it. Insoluble phosphoric acid can best be made available through tillage combined with the use of farm manure and with green manuring and cover crops.

The wise practice then in using phosphate fertilizers of a low grade of solubility, but high in per cent. of phosphoric acid total, is to apply them to some hardy, strong, feeding cover crop, as rape or turnips, always sowing with the cover crop some rye, if it is expected to let the land remain unplowed during the winter. Now, as I go by fields in Connecticut, I see many which are exposed to the winter rains just as the grass was taken from them, or just as the potatoes were dug; no attempt made whatever to put a cover crop on the soil or to hold the plant food which is there; no attempt made to hold that soil in place or to keep the winter rains from washing it down into the valleys, that is, if the land lies upon the hillsides, and making some other man's farm better, or to prevent it from being carried off into the streams. Every foot of ground should go into the winter prepared in some such way as I have indicated. This is a broad statement. There are exceptions, however, to every rule, and there are exceptions to this rule, but as a principle that should be followed by our farmers, we warn the farmers against the use, to any considerable extent, of insoluble phosphate. While it is true that this plant food may in time be made slowly available, yet the conditions most favorable for its use are not usually present. We must remember that the same conditions which will render the plant food in insoluble phosphate fertilizers available will also liberate phosphoric acid, which is already contained in most soils in liberal quantities. We recommend as the wise practice the use of high grade phosphates for the purpose of feeding the immediate crop, but we also recommend that the soil be made to give up some of its stores of plant food by means of thorough tillage and the use of cover crops and manures. The potash required for general farm crops may at present be most economically obtained from muriate of potash. This is a form of potash very acceptable to all plants uniform in composition and may be used in all cases except for some special crops, as tobacco, where the sulphate or carbonate seems best adapted. Those soils which are formed as the result of glacial drift seem to be well supplied with potash, and upon glacial drift soils intensive tillage apparently gives more marked results than it does upon those soils which are largely alluvial in character. Another thing which should be mentioned in this connection is ashes. If hard wood ashes could be secured at a reasonable price, there is no source of potash more acceptable to plants than that which is secured through the use of ordinary wood ashes. The usual trouble with using this form of potash, however, is the fact that the price put upon ashes is about double what the plant food in the ashes is worth. The ash fertilizer agents will try to impress you with the fact that the lime in ashes is of some particular and especial value; he will tell you that it is an agricultural lime, it is a vegetable lime but different in some way from ordinary stone lime. Well, don't let him fool you on that. It is a lime just the same, the very lime that you are familiar with. Carbon of lime possesses known qualities that are not possessed by caustic lime or by carbonate of lime, which it usually is.

It has in times past been the dream of some experimenters that they would be able in time to figure out a balanced ration for plants, the same as we do now for animals; but this idea is now held by but few. Indeed, field fertilizer experiments are not nearly so popular in Experiment Station work as they formerly were. We cannot as the results of our experiments lay down any general rules and say that corn should be fed in this way, and wheat in that way, because there is always an unknown and uncertain element which enters into the problem, namely the soil.

I know of one man who went around through the country visiting various farmers. He would go to a farmer and offer for five dollars to go over that farm and tell him what fertilizer was needed. Here was a man who for the small sum of five dollars would tell the farmer just what fertilizer to apply here and what fertilizer to apply there, and so on. That man gets five dollars for imparting information, although any farmer worthy to be called a farmer ought to know more about it than the man does.

The hardest problem I think I ever had presented to me for solution was in central New York at a meeting of the farmers. A farmer came in and asked me if I would go out to his buggy. I went out with him and he pulled out from under his buggy seat a bag of soil. I should say he had about a hundred pounds in the bag, and he said to me, "I wish you would look at that soil." I looked at it and asked him what the matter was, and he said to me, "I wish you would tell me what that soil needs." I couldn't tell him, and so far as I have been able to learn, no one could tell him. The only one who can tell what the soil needs in the man who is actually working the soil, who is growing crops upon the soil; he is the man to tell what the soil needs.

And in order to learn what constitutes a balanced ration for plants, we must know the soil and its capabilities, and having determined them we are then prepared to proceed intelligently along certain lines. The art of feeding plants is not fixed and definite. He who would acquire a knowledge of the subject must study plants as they grow, and must be so in touch with nature that he can understand the language of plants as the good feeder understands the language of his animals. We must make a study of the process of plant growth and make that the principal thing, with the fertilizer supply as an active agency for the attainment of that end.

We must learn how to use the soil properly and how not to abuse it by the irrational use of commercial fertilizer. We must learn how to hold the fertility of the soil and how by a judicious use of cover crops we can conserve those elements of plant food in the soil upon every possible occasion. These things combined with thorough tillage will solve the problem of a balanced ration for plants.

The PRESIDENT. Have you any questions to ask Prof. Clinton, now?

While you are getting the questions ready we will have a little music.

Music.

The PRESIDENT. Prof. Clinton, what would you recommend as a general cover crop for these barren potato fields which you spoke of?

Prof. CLINTON. My idea is that in the fall rye is the best thing we can use; if you can't sow the crop by the 1st of September or the middle of August I would put in some winter vetch with the rye. If you can commence earlier in the season I would recommend clover. I think it is always a good idea to mix in a little rye.

The PRESIDENT. What do you do with the rye?

Prof. CLINTON. Plow it under in the early spring. You don't want to leave it there to feed. If it should become necessary you have got it, but, generally speaking, turn it under.

The PRESIDENT. You advise that in all cases, do you?

Prof. CLINTON. I do. I think that all fields ought to be covered with some green plants this winter.

Prof. SAUNDERS. I would like to ask Prof. Clinton what he means by the insoluble phosphate which he would advise us not to use, whether that is the finely ground rock phosphate in its nitrate form or some other?

Prof. CLINTON. Yes. That is commonly called ground rock, not treated with ashes.

Prof. SAUNDERS. I would just like to give the meeting some experience which I had at Ottawa. Sixteen years ago I planned a series of experiment plots at Ottawa in which this finely ground mineral phosphate was one of the ingredients used. It was ground so fine it was almost like flour. The manufacturer and others interested in it assured me it would do wonders. I bought some of it and applied it to the soil of different crops and in different quantities, using not less than 2,000 pounds to the acre, and from that running up to 5,000 pounds to the acre. I had lots alongside of this treated with the phosphate that didn't receive anything and the land was very uniform in its character. I applied the same quantity the next year, and so on for ten years, and at the end of the ten years, in footing up the results that I had accomplished, I found that I had plots that had had nothing on them which had given me as much as plots which had received from 20,000 up to 50,000 pounds during the period of ten years. I think that was a conclusive test, and I think it showed very clearly the wisdom of Prof. Clinton's advice to the farmers to avoid such fertilizers as that.

Prof. WOODS. Did you use only the ground?

Prof. SAUNDERS. I used only the ground. I had another experiment and that was this: We planted a plot that had been treated with barnyard manure, rotted barnyard manure, and alongside of this another one with barnyard manure in a state where it was actively fermenting, and with this was added about 6,000 pounds, about 4,000 to 6,000 pounds of crude phosphate, so as to give it conditions of fermentation which were claimed by the producers were needed, and which were conditions which ought to be provided. During the course of the ten years that didn't give me anything more than I would expect to have from the amount of barnyard manure which was applied. Then we submitted this phosphate which had been fermented in the way I speak of to chemical analysis, and the chemists found it was not affected in any way by the fermentation and that it was still in its crude, insoluble form, and unaffected by the conditions under which it had been treated. I think that has some bearing, and also tends to bear out the soundness of Prof. Clinton's position.

The PRESIDENT. I would like to ask Prof. Clinton this question: About how much seed rye to the acre do you sow for that purpose?

Prof. CLINTON. About a bushel and a half to the acre. I have a field of rye that was sown with about a bushel and a half to the acre, and it is so thick that the ground is properly covered. I have always recommended that if it can be used vetch is a good thing to put in, but there are some objections to it.

Mr. MILES. Will you please tell us where the seed can be obtained and what the reason is that the price is so high?

Prof. CLINTON. The only drawback to the use of it, or one of the principal ones, is the fact that you cannot obtain the seed at a reasonable price. It is very expensive at the present time. I expected that if there was a demand for vetch the price would go down after a time because more people would begin to grow it and there would be more of it, but I don't think that theory has been borne out. Indeed, I approached some people in New York and have ascertained that the price has remained about where it has been. I think the seedsmen in our own State can supply it as cheaply as anyone.

A MEMBER. From what Prof. Clinton said I would presume that he does not believe in what is commonly known among farmers as summer plowing. Perhaps he knows what the custom is?

Prof. CLINTON. On the contrary I have just been plowing a piece this fall; the men were working on it when they were driven in by the coming on of winter weather. You remember that I said very carefully that there were exceptions to every rule. Sometimes a frost and a thaw are worth more than a cover crop would be; it is a matter of judgment. No rule can be given which will apply in all cases.

Mr. HOYT. I would like to ask the gentleman what he knows about slag and phosphate, or what is known as basic slag?

Prof. CLINTON. It is true that this slag contains phosphoric acid in a form which is slightly available. It is a different form from any other form you have. It is a combination of about four parts of lime and one of phosphoric acid. The chemists tell us that its availability is about the same as what we know as reverted phosphoric acid, that is, it is soluble in weak acid, so the plants do make some use of it, but I would not advise its use except upon soils well filled with organic matter and soils which are likely to be benefited somewhat by lime, because this basic slag contains a considerable quantity of lime as well as phosphoric acid.

Mr. POTTER. There is a weed that has come in on many market garden farms called chickweed. Can the professor give us a good way of ridding our farms of that weed? It has become, practically, a nuisance among the market gardeners in New Haven county; it is a weed which will grow late in the fall and even in the open winter. I would like to know if anything can be done to check it.

Prof. CLINTON. Mr. Chairman, I think in many places this chickweed is one of the greatest blessings we have. I have seen soils where I think it is worth many dollars as a protection to have that chickweed growing in the soil in the late fall. It forms a perfect mass and it furnishes a sort of cover crop without your going to any expense for seed, and when plowed under in the spring it is valuable as a garden manure crop. An effective way to get rid of it is through a thorough process of cultivation. Market gardeners I think should not have very much trouble with it during the growing season. When it does come on in the fall I am disposed to regard it as a blessing rather than a curse.

A Member. You think it would pay a man to raise it then?

Prof. Clinton. No, I don't know that I should recommend that, but I think there is rather a mistaken notion held as to its being a nuisance.

Mr. Hoyt. Prof. Clinton says that the fall that he sowed his clover the first of August it analyzed at a rate of $20 worth of nitrogen to the acre. I would inquire where that nitrogen came from. Did it all come from the atmosphere?

Prof. Clinton. The larger part of it did. I ascertained that the greater part of it came from the atmosphere but some, of course, came from the soil. This I have found out by an experiment that I have been conducting for six years back. I took two plots side by side. I built a solid brick wall around one, selecting my soil, and that was put into these two. From an analysis I knew that the soil was uniform when I started on the two. One of the plots I grew clover on, and on that I secured double the amount of nitrogen, while on the other I diminished it somewhat. In view of that experiment I knew where the larger part of it came from.

The President. Do you imagine that on these abandoned farms here in Connecticut there is a scarcity of plant food if we only took a little pains to coax it up?

Prof. Clinton. These Connecticut farms are full of plant food, plenty of it; all they need is to have it liberated; to have it unlocked by means of tillage and by means of cover crops through the winter.

The President. According to your paper I should almost conclude that about the only way to find out what our soils need is for a farmer to experiment himself. As I understand you, you could not tell that farmer anything about his farm when he brought you a specimen of the soil.

Prof. Clinton. I think that is about the right statement. All we can do is to give general suggestions as to the treatments which will probably prove beneficial and then a man must work it out himself; a man has got to work out his own salvation largely.

The President. That is rather contradictory to what we have been told before. We have been given to understand by some of the professors that if they could analyze the soil they could tell us what its deficiencies were so we would know what to do.

Prof. Clinton. If you should have your soil analyzed, the chemist would tell you that on every acre of your farm, or acre of your soil, there would be contained about 3,000 pounds of nitrogen, about 6,000 pounds of phosphoric acid, and about 2,000 pounds of potash. He would tell you that a corn crop of 60 bushels of corn per acre would use up 84 pounds of nitrogen, that is, 84 out of the 3,000 pounds; also 32 pounds of phosphoric acid, 32 out of the 6,000 pounds; and 34 pounds of potash from that 2,000 pounds. Suppose he did tell you that, how much benefit would it be to you to know that you had 2,000 of potash, etc? The point of it all is that the chemist cannot tell you how much of it is available for your plants.

The President. That is just the point I desired to bring out; that is the thing I am very glad to know.

Mr. Fosdick. Just one point relative to this abandoned farm. I think the abandoned farms that the gentleman spoke of are, generally speaking, rough farms. With the most of them if they are tilled at all it would have to be by hand labor, and I am sure there would not be any profit in that. I would not advise any one to go on to one of these rough farms where you cannot use modern improved machinery, with the belief that it can be made profitable in this state of Connecticut. I mean, of course, from a financial point of view. That's my. opinion about it. I would like to know what some professors think.

Prof. Clinton. That is a hard question to answer. There are some of these fields on these farms which have been cleared, there are some of these fields which, in order to clear them of stone, will cost much more than the original cost of the land, and then there comes the question: Will it pay? Will it pay to spend $30 or $40 an acre possibly in getting the boulders out of this soil? But here is another question, here is another view which we can take with reference to this: We have these farms and men are going to live on them; we have this soil and men are going to make a living on it; the taxes must be paid upon this land. Now then, here comes a practical question for us: What can we do to make the most of this soil? I should say first, to take these fields on the farm which can be tilled to advantage and till them as they should be tilled; till them thoroughly and give them intensive tillage, and then try each year to encroach upon these other fields which must be improved; to gradually reach out and improve the other fields, but in the meantime make the fields already improved furnish sustenance for yourself and animals while you are doing it.

Mr. Fosdick. I think the gentleman tries to answer the question, but if I understand him his position is to take what money a man can make by the tillage of the smooth part of the farm and throw it away on the rough land. Is that right?

Prof. Clinton. I don't think that is quite right. I don't think you have drawn quite the right conclusion from what I said. Every farmer during a certain time of the year and certainly in the autumn and in the fall has time which could be devoted to good advantage to this purpose. He can then go out into this other field and do some improving work. When the crops are in in the fall there is opportunity for this and sometimes in the late fall, and sometimes in the spring. If you can't improve more than a square rod I say improve that square rod and gradually reach out and keep increasing the amount which you improve. You do not need, of course, to sink on that part of your farm what you have been fortunate enough to make on the rest of your farm, but my idea is that this spare time at these seasons of the year when no other work is pressing, can be used to improve these rough spots and gradually bring them into subjection.

A MEMBER. I agree with that thoroughly. I think in regard to many of these places that are sometimes so troublesome that if they are attacked with skill and energy they can be conquered. I wish some of our people here could go over and see what George M. Clark has done in the town of Higganum, and the crops he is raising on just such land as this. I wish you could see the land on which it was done and see what crops have been raised on it. I think it would be a revelation to many people as to the possibilities of Connecticut's soil. What he has done in the town of Higganum we can do in lots of cases where we look at it right and do not shrink from it, because there is a little hard work involved. There is lots of this land which can be worked up.

Mr. BARBER. The gentleman who spoke about throwing away money that is earned on one part of the farm by improving these rough places has given us the key to the abandoned farm question in this State, he tells the whole thing in a nutshell. The farmers of our State, that is, those who have lived on abandoned farms, cannot see any profit under the sun except money in the savings bank or in the shape of non-taxable bonds. Every dollar that they put into the work trying to bring these rough places into subjection is regarded as so much money thrown away; they have not looked at it as so much money invested but as so much money thrown away, and that is the reason that up in Litchfield county some of the best land that the Lord ever made or that lies out doors and which is strong in plant food has never been reclaimed. There is lots of it, land which, if it was properly taken care of, would make as good an investment for a man's money as almost anything that a farmer, at least, could find. The reason is that the people who have been on these places have got so out of the fashion of doing anything that they have tried to skin the place out of every dollar there was on it, and have gone away. I think that's the whole situation in a nutshell. (Applause.)

Mr. HOYT. Mr. Chairman, if I was going to answer that question which the gentleman asked I should do it by asking another. I should ask him if it paid not to do it? If it paid not to clear his land? I have found out from experience that it does not pay not to clear the land. If you want your farm to pay you have got to put it into condition to make it pay, and that requires that the stones shall be gotten out and the land enriched and, if it wants drainage, to drain it. There is no question in my mind but that if that is conscientiously done it will pay, in fact you do not know how much it will pay. If we clear a piece of land, it is done forever, and we do not know whether it is going to pay or not ourselves; but it will pay somebody some time or other, and we have done a good act when we have cleared this land. Even if we ourselves do not get the benefit of it our children will who are to follow after us; they will then have something to work upon besides the rough land of these so-called abandoned farms which some of us have had to attack. A farmer who leaves a farm worse off when he is done with it than when he commenced is a land robber, and is not fit to own a farm. A farmer should leave his farm in better condition when he gets through with it than when he commenced with it. There is no reason why it should not be so excepting the desire to have money in the bank instead of a productive farm.

The PRESIDENT. In our section, just at the present time, there is quite a little excitement relative to clearing up these rough farms on these hills by the use of Angora goats. I would like to know if any of you here have had any experience in clearing up any of these farms with Angora goats?

Mr. FOSDICK. A little observation gives a man who owns land some idea of what he may do and of the difference between this rough land which is cleared up and good land.

Now, before going into this Angora goat question, I just want to say this: I live out in the town of Lyme, where the late James A. Bill used to live. He took some stone out of a tract of land and made it comparatively smooth. I asked him what it cost and he said $150. Then I asked him if it was worth as much to him as some land within a mile of his place that was naturally good land and also free from stones, and he seemed to think it was not. Now, what is the use of a farmer in any town going to work and digging out stone on one of those abandoned farms when he can find hundreds of acres of land that are comparatively free and do not have any stones? What is the use of going to that expense and all that additional labor for practically no good purpose? I cannot see the economy of it.

Relative to the Angora goats: A gentleman who is wealthy and who, I will say, lives in Chicago, but who still takes an interest in his old home farm, bought one hundred of these goats last spring and had some fences made about a lot which covered about 40 acres and which was almost entirely covered with brush, every kind of brush, barberries and hazel bushes, and blackberries, and so on. I was up there about a month ago, and I will tell you what the goats had done. They had eaten up practically everything there was in the way of brush. An Angora goat will reach up high and clear everything off clean. When he cannot get anything to stand on he will reach up sometimes it seems as though twenty feet to get hold of twigs and so forth. He will reach up anyway ten feet standing on the ground, and clean everything within his reach. They will eat it up so clean that it looks just as though a fire had been through the lot. There was some pretty fair feed on that land in a few places where there was no brush, but these spots had been neglected by the goats to live on the brush. In other words, they neglected the grass to eat up the brush. I don't know what others of you may think, but I should say that they had done pretty well so far as they have gone.

A MEMBER. What did they do with the stone?

Mr. FOSDICK. Oh, they used those to stand on.

The SECRETARY. I find in the question box here a question that seems to pertain to the discussion that is now going on: "'Do the abandoned farms of Connecticut denote agricultural thrift or decay?" Is there any gentleman here who will answer that?

The PRESIDENT. Prof. Clinton, perhaps, can answer that.

Prof. CLINTON. Mr. Chairman, I don't think I am the one to answer that. Let some man who has been living for years on these Connecticut farms answer that question.

The PRESIDENT. I think Prof. Woods lived here some years ago. Perhaps he can say a word on that.

Prof. WOODS. I did not live on a farm. It seems to me, however, that that is a question which you can answer both ways. One can easily go over this State and see many abandoned farms which he will say it was a great mistake to have cleared, for they appear to be worth no more than what the man got off the land and more particularly for the wood that he was able to get. On the other hand, one can hardly go over the State, driving through it, without finding, undoubtedly, farms that have been abandoned merely because the people grew old who had occupied the farms and the children had left, so there was nothing for them to do but give up their agriculture and give up the land that ought to have been kept in agriculture. You do something here that we do in Maine, you live so horribly long that the boys cannot, as they grow up, have an opportunity on the farm, and so they go out and wander away. I think that will account for some of our abandoned farms in Connecticut just as it does in Maine. We are not all right in agriculture, neither are we all wrong here in Connecticut. I believe that farms that have been abandoned, that ought not to have been, will in time come back into culture again, and many of the mistakes that our fathers made in clearing up land that they saw a possibility in, but in which, as a fact, there were no possibilities, will go back where it belonged, into rough land and also into forest.

The SECRETARY. I want to say, Mr. Chairman, that that term, "abandoned farm," as applied to Connecticut farms is entirely a misnomer. There are no abandoned farms in Connecticut in fact. There are plenty of farms in Connecticut that are not occupied, but they are not abandoned. They are used for pasture, they are used for growing wood and timber, and they have owners, and they have their taxes paid.

Now, the State Board of Agriculture issued, some years ago, a list, not of the abandoned farms, but of the farms for sale in the State of Connecticut. The first edition of that work was published in 1892, the second edition was published in 1899, and last spring attention was called to it by a large number of agricultural publications; *Country Life in America* took it up, other papers took it up, and finally, the *Ladies' Home Journal,* which has a circulation wherever the English language is spoken, took it up, and that paper referred to the work that was published by the State Board of Agriculture as a little green book that was filled with beautiful illustrated cuts of country life, and from every quarter of the globe there came applications for that work. Everybody seemed to think that we had a bargain counter in Connecticut of farms that were abandoned that were to be given almost for the asking. They came from New York city, from Chicago, from Philadelphia, from Washington, from every city and every state and territory in the Union, even from Cuba, Porto Rico, and the Hawaiian Islands, yes, even from Australia and New Zealand I received application for that work on the abandoned farms of Connecticut. The consequence was that the edition was exhausted long before the demand had been satisfied, and the Board of Agriculture authorized the preparation of a new edition. There are now on file in the office of the secretary applications for over 2,000 copies of the list of abandoned farms in Connecticut. There were all sorts of excuses and claims put in for the edition. There was a class of people who thought these abandoned farms had been taken over by the State, that they were held by the State of Connecticut and were to be delivered for a nominal sum to any applicant. There were others who thought they were up for sale for taxes, and there was all sorts of misapprehension in regard to the condition of them. I sent out circulars as broadcast as possible for the farmers in Connecticut to hand in lists of farms that they knew of for sale, and I have received a large number that are now ready for publication. I have here some copies of these applications, and if any of you know of any farm in Connecticut that is a so-called abandoned farm I wish you would come up here and get a copy of this circular and have it filled out and send it to the secretary. We will publish it in the next edition, which we plan to issue about the first of the new year so that it will be the edition of 1903.

Now, Prof. Woods has stated the case very fairly. There are farms that have ceased to be occupied as homesteads for the very reason that the occupants could do better elsewhere. We do not want to keep anybody upon the land if they can find a better location anywhere else in the world, whether it is here in Connecticut or in our western possessions, or even if they go over the border up into Manitoba, northwestern Canada, where they are absorbing 50,000 Americans per year; there are farms of that character that have been abandoned because they never ought to have been occupied as farms and they have been abandoned because the owners of them could do better.

Then, there is another large class which Prof. Woods has very fairly referred to, and which is in a condition to return to agricultural pursuits: there are thousands of people who want these farms if they can be brought to their attention, and this list when it is published will be extensively circulated and sent to all of these two thousand applicants that I have, and we hope from that publication that many of the so-called abandoned farms in Connecticut will be reoccupied.

Here is another question: "Why do cattle eat green apples in preference to red?"

That reminds me of a question a society of English scientists discussed very warmly. They discussed the question why it was if you fill a globe with water level with the surface and then put a fish weighing a pound into it, it would not run over. They discussed that question in a very heated manner for a long time, and finally one of the number suggested that they try it, and when they did put a fish in, it did run over.

Mr. HOYT. I supposed it was because a cow was color blind, that is a fact.

Here is another question: "Can you get any grapes from a large Concord vine where the rose bugs attack it?" Prof. Gulley, you ought to be able to explain that.

Prof. GULLEY. I can tell you what you can do, and what you must do. When that is the case it means that you have just got to go out every morning and catch those rose bugs, that is all. You will have to do that for about three weeks. The trouble is they attack them just as the grapes are coming in blossom. They eat the blossoms first and then they go under the leaves. By doing very thorough and careful picking for about three weeks you can get a crop of grapes — that is the only way. You cannot treat them by spraying, it doesn't affect them a particle — they like Paris green anyway pretty well.

Prof. SAUNDERS. They are so very sluggish in the morning you can easily brush them off into a pail of water with kerosene oil on top.

Mr. HOYT. Can you hit them?

Prof. GULLEY. Oh, yes, those little fellows will do something every morning and the only way to do is to get after them sharp. They will eat three or four blossoms and the next morning before you get there they will eat some more and increase rapidly, and before long they have done considerable damage. I have had some experience with them and about the only thing you can do that is effective against them is thorough picking. Sometimes they will attack little bunches of grapes. A few good lively rose bugs will pair up and pretty soon there are about 200,000 of them, so you see there is capacity in them to do considerable work.

Mr. Hoyt. There is one thing I noticed about the work I did, and that was that after I had followed it up a few years I found I had very few to contend with. While it might be the first year, while they were so thick, that they would do considerable damage and you would not succeed in saving your grapes entirely, but if you keep at it for two or three years I think the matter will be remedied.

A Member. While Prof. Clinton was speaking he spoke about the variety of soils. I would like to ask him if there is any very great variety of soil in a comparatively small area, as for instance, on a single farm.

Prof. Clinton. Yes, even in the same field there will be quite a difference.

A Member. The point which I wanted to make was, of course, what Prof. Woods has stated. A field, some twenty-five years ago, was cleared of brush-wood, such as birches, white pine, maple, and among the pines was one which was pulled up by the roots and then taken to the owner's home and set out in the door yard. That pine is now some eighteen inches through at the base, and the field that was cleared off utterly, and which there was an attempt to get into shape for use as a pasture, is now being allowed to grow up to pine just as rapidly as possible. If the owner had only known enough he would have been able to go on now and cut a large crop at least of wood, and probably some timber. In that case the attempt to clear rough land and turn it into cultivated land was not successful, and it shows that judgment has got to be used in clearing the land.

The President. Our time having arrived when we should adjourn, I will ask the Secretary if he has another question or two to discuss tonight, and then we will close with music.

The SECRETARY. The only question I find here is "What variety of early peach is best adapted for sandy soil such as that on Long Island, and also what variety of raspberry is best under the same conditions?"

Perhaps Prof. Gulley can answer that?

Prof. GULLEY. I would rather not say anything on that. There is Mr. Platt over there, call on him.

Mr. PLATT. Well, for rocky or hilly land I should recommend the Mountain Rose Peach. None of the earlier ones are fit to sell — nothing earlier than the Mountain Rose.

The SECRETARY. What about the raspberries?

Mr. PLATT. I am not raising raspberries, but so far as I know I think the Cuthbert is as good as any. Mr. Molumphy was in the raspberry business. The Cuthbert is one of the best, and also one of the best is the Phœnix; I think that is better in some respects than the Cuthbert. It bears for a longer period, so it is fully as good for market; good in every way.

Music.

Adjourned to 10 A. M. Thursday morning.

MORNING SESSION.

THURSDAY, December 11, 1902.

Convention called to order at 10 A. M.

Vice-President Seeley in the chair.

The SECRETARY. Mr. President, as everybody knows, the Governor of Connecticut is *ex officio* President of this Board, and nothing but illness has detained him from being present and taking part in its deliberations at this time. I have this morning received a letter from him which, by your permission, I will read to the Convention:

"Holly House, Simsbury, Conn., Dec. 10, 1902.

"My dear Mr. Brown:

I regret exceedingly my inability to be with you and the Board at Norwich. I have so many lost threads to pick up that I cannot leave Hartford this week. Please remember me to all my friends and accept my best wishes for a successful meeting.

"Thanking you most kindly for your invitation, I am, with high personal regards,

Sincerely yours,

(Signed) GEORGE P. McLEAN."

Now, Mr. President, I think it is eminently proper that we show our appreciation of the interest taken by Governor McLean in the proceedings of this convention, and I beg leave to offer the following resolution:

"Resolved by this convention that the assurances of interest in the success of this meeting, contained in the letter of the Governor just read, and the intimation which it conveys of his returning health and resumption of official duties, are received with the highest satisfaction by the members of this convention."

I move that it be adopted. I think that any member of this convention who was present a year ago and heard the eloquent address which he made, and the enthusiasm which the Governor displayed in the cause of agriculture, will be pleased to join in voting for this resolution.

Motion seconded and resolution passed.

The President. I am sure the Governor is worthy of the vote of thanks for the kind letter which he has sent us this beautiful morning.

Now we will listen to an address on the "Practical Methods of Maintaining the Fertility in our Soils," by Doctor Wm. Saunders, Director of the Dominion Experimental Farms at Ottawa, Canada. We are to have the pleasure of hearing the doctor this morning; you have heard him before and will undoubtedly be pleased to hear him again.

PRACTICAL METHODS FOR MAINTAINING THE FERTILITY OF THE SOIL.

By Dr. Wm. Saunders,

Director of the Dominion Experimental Farms, Ottawa, Canada.

There is probably no subject in which the thoughtful farmer feels so deep an interest as that of how he can best maintain the fertility of his land. On the other hand there are a large number of farmers who, while economical and careful in the general management of their affairs, have got into a careless, "happy-go-lucky" way of managing the stores of plant food which are available to them in the way of animal manures. What would be thought of a man complaining of poverty or hard times going about with holes in his pockets so that the spare cash he put there from time to time could drop through and be lost. Such a man would be regarded by most people as insane on that point. Yet many farmers who are hard-working men and men of intelligence on many points treat their farm-yard and manure on which their land must largely depend for its fertility much on that hole-in-the-pocket principle.

The only object of the present paper is to call attention to this wicked waste and to point out the most practical methods by which the fertilizers available to the farmer may be managed so that his land may get the full benefit of the plant food which is thus available for its enrichment.

The plant food in a soil has been aptly compared to an account in a savings bank. If it is yearly drawn on by the crops he raises and sells from his farm and no sufficient returns made, the capital in that savings bank will sooner or later become exhausted.

That we may the better understand what follows it may be well for a few moments to consider the subject of soils. A farmer cannot remake his soil, but, if he understands what are its needs, he can do his best towards supplying these requirements, and, as he has his land as long as he lives on it for better or for worse, it is wise that he try and make the best of it.

SOILS.

Soils as we find them differ much in character. They are usually distinguished by the farmer as light, medium, or heavy. Light soils contain variable proportions of sand and are usually regarded as lighter as the proportion of sand increases. Heavy soils contain varying proportions of clay and are said to be heavier as the proportion of clay increases. There are also peaty soils which are highly charged with vegetable matter. A medium or loamy soil, which is generally regarded as the most desirable, contains a happy mixture of the three and combines the good qualities of all. It is easier worked than the clay and more retentive of moisture and of plant foods than soils of a light or sandy character.

Soils have all been formed by the gradual decomposition and pulverizing of rocks by the forces of nature. Heat, sunshine, rain, and frost have all helped in this work, and this pulverized rock has in the course of time been enriched by the decay of vegetable and animal matter.

The surface layer of the soil, varying in depth from six inches to a foot, has in time become mixed and fairly uniform in its color, texture, and in the proportion of plant food it contains.

Under this layer of soil we find a varying depth of what is known as subsoil. This may consist of sand, gravel, or clay, or mixtures of these. One of the essential differences between the soil and the subsoil is that the upper layer contains by far the larger proportion of those elements necessary for plant growth, commonly known as plant food. The most important of these are nitrogen, phosphoric acid, and potash, for on the supplies of these three elements all crops draw largely.

Soils vary in their fertility partly from difference in the composition of the rocks from which they have been formed, partly to their mechanical condition, their fineness and texture and their power of holding moisture, and partly to the proportion of organic matter they contain.

It is estimated that an acre of soil a foot deep weighs about 3,500,000 pounds, and that good ordinary loam in Europe calculated from the results of many analyses will contain on an average about 3,500 pounds of nitrogen, from 3,000 to 6,000 pounds of phosphoric acid, and from 5,000 to 8,000 pounds of potash.

From many analyses which have been made of soils in America it would appear that soils in this country compare favorably with those of Europe in the proportion of plant food they contain. The soil which covers the face of nature may be defined as her great storehouse of fertility where untold treasures are laid up for man's use, of far greater value to national life than mere silver or gold.

These stores require careful handling. In this way they may be conserved and added to, or by careless and injudicious management may be prodigally wasted. Fortunately a soil only parts with its fertilizing constituents gradually. There is always present in soluble form more or less plant food which is immediately available for growing plants. On the other hand there is always a large proportion of the elements of fertility stored there in insoluble forms, the immediate use of which can only be made available gradually by frequent and thorough cultivation and the beneficial action of air and frost. Nature is inexorable in this respect. The lazy man who merely scratches his land and neglects cultivation, gets but a niggardly return, but the industrious worker who cultivates his soil thoroughly and who avails himself of every opportunity to improve its character and quality realizes bountiful returns dealt out with a generous hand.

The soil is a resting place for the seed, affording suitable conditions for germination, and material in which the roots may fix themselves firmly, and give stability to the plant, and where also the roots can range widely in search of food.

The productiveness of a soil also depends partly on its power of holding water and of drawing by a sort of capillary attraction supplies of moisture from below. Water, which as found in the soil is usually charged with more or less carbonic acid gas, is the universal solvent which nature employs to convey food to plants through their rootlets. A good loamy soil will hold much more moisture than either clay or sand, and by good cultivation and thorough working, the power which a soil has for retaining moisture may be increased, and the loss of water by evaporation lessened.

There are quite a number of mineral constituents which are taken up in small proportion by living plants, but of these the store contained in the soil is very ample. Occasionally a soil will be found deficient in lime, when a reasonable dressing will improve succeeding crops, and occasional dressing of salt is also useful.

The farmer's main efforts should be directed to the keeping up of the supply of the three important elements of fertility to which I have already referred, nitrogen, phosphoric acid, and potash, since every crop draws heavily on the soil for these.

A crop of timothy hay of two tons per acre takes from the land 60 lbs. of nitrogen, 40 lbs. of phosphoric acid, and 90 lbs. of potash; hence when a farmer sells the hay from an acre of land on his farm he disposes of this much fertility which is part of his capital, and his farm is made poorer to that extent.

A crop of oats of 50 bushels to the acre of grain with 2200 lbs. of straw, takes from the land 46 lbs. of nitrogen, 16½ lbs. of phosphoric acid, and 35½ lbs. of potash, and if he sells his oats and oat straw he sells with them these elements of fertility which go to make part of his capital — and so it is with all the crops he produces.

On the other hand, if he feeds his coarse grains, his hay and other fodder crops to stock on the farm, from 75 to 80 per cent. of these elements of fertility are returned to his land, provided the manure be carefully handled.

Where no systematic efforts are made to maintain the fertility of the land, and where there is also a neglect of cultivation, the small proportion of plant food existing in the soil in soluble form is soon so far exhausted that satisfactory crops cannot be grown, and such land is often regarded as worn out and useless. The fact is, that usually it is only the soluble plant food which is exhausted, the larger portion, in insoluble form, is still ready to respond to good farming, by which it may be gradually brought to such condition as will result in profitable returns.

Reduced yields must inevitably follow successive cropping unless plant food is from time to time returned, especially since the amounts referred to as taken from the land are for the most part withdrawn from that limited store of immediately available plant food to which reference has been made. Where land receives regular dressings of barnyard manure once in four or five years, of about 20 tons to the acre, associated with a suitable rotation of crops, this return would do much to make up for the losses mentioned. If the farmer buys an occasional ton of bran or grain to supplement the coarse fodders grown on the farm, these will form important additions to the plant food in the manure, and if such additions are regularly made and the manure well cared for, the farmer may not only be enabled to maintain the fertility of his land from this source alone, but also to increase it.

The crop producing power of a soil depends somewhat also on the proportion of humus or organic matter which it contains. Humus, which is the term applied to semi-decomposed vegetable matter, results from the partial decay in the soil of roots and other parts of plants. This is one of the most important constituents of all fertile soils. This humus is the natural storehouse and conservator of nitrogen, the most expensive of all plant foods to buy in the form of commercial fertilizers. When humus is abundant in the soil, it is associated with a liberal supply of nitrogen. It has also been observed that as the proportion of humus is lessened in a soil, the nitrogen goes with it. Humus furnishes the food upon which the micro-organisms in the soil live, which convert its organic nitrogen into nitrates, the compounds which alone can supply crops with their nitrogen. Humus also increases the power of soils to absorb and hold moisture, it also opens up and mellows heavy soils, and serves materially to diminish the loss of fertilizing elements by drainage.

By a wise provision of nature, the elements of fertility viz.: nitrogen, phosphoric acid, and potash, so essential to plant growth, are not needed to any large extent in the growth of the animal. A small proportion of the nitrogen is appropriated by growing animals in the formation of flesh and a little phosphoric acid is used with lime in the formation of bone. Where butter making is carried on, there is practically no loss in these elements beyond this, but in cheese-making districts there is some additional loss of nitrogen, which goes to form the curd, and some phosphoric acid in the milk. Practically in cheese districts, from 70 to 75 per cent. of this plant food reverts to the soil, and in butter making and beef growing, from 80 to 90 per cent.

Here, then, is the farmers' opportunity, and in barnyard manure he has the material by the use of which the fertility of his land may be largely maintained. Not only does he find in it the nitrogen, phosphoric acid, and potash which the crops have taken from the land, but in manure he has a material which will supply the soil with a considerable quantity of humus.

By barnyard manure we understand a mixture of the solid and liquid excreta of farm animals together with a portion of the straw or other litter used in their bedding. The value of any sample of manure will depend chiefly on the amount of nitrogen, phosphoric acid, and potash it contains. Where animals are fed in part on cotton seed meal, oil cake, gluten meal, or bran the manure will be correspondingly richer and more valuable.

In speaking of the relative value of the solid and liquid excrement it should be borne in mind that one-half, and frequently more than half, of the total nitrogen given off by the animal is found in the liquid portions, while more than 90 per cent. of the total potash is to be found there. Hence the farmer who allows the liquid portions of the manure to trickle through the cracks in the floor of his barn is allowing his substance to waste, and deserves a place alongside of the imaginary individual said to carry his ready cash in unsound pockets.

The actual cash value of the liquid deposits of the horse and cow is more than double of what the solids are worth; straw absorbs these fluids readily and, if it is used cut, it takes up a great deal more than it can do if it is used in a long state. Hence it is economical to cut straw for bedding purposes.

The floor of the stall should be tight, and a trough well pitched and six or eight inches deep should run along in rear of the stalls. There the solid and liquid materials collect and are mixed with the cut straw, which absorbs the fluids, and the whole is wheeled to the barnyard. What should be done with it next is a question often asked. In our opinion it is wasteful to ferment it in heaps, and the best method is to get the fresh manure on the land as quickly as possible. This is not always practicable, but wherever it is practicable this is the wisest course to adopt. As this is a question on which there are many differences of opinion it is but reasonable that I should give you the experience on which this opinion is based.

Experiments in connection with the use of fresh and rotted manure have been conducted at the Central Experimental Farm for the past fourteen years, and the following facts have been established:

With regard to the rotting of the manure and the waste attending this process it has been shown that a manure pile weighing four tons at the start and composed of equal parts of cow and horse manure will, at the end of three or four months when thoroughly rotted, weigh less than two tons. Fresh manure usually loses about sixty per cent. by this process. Our experiments on this line have been carried on in the open barnyard, thus following the practice of most of the farmers on our side of the line.

For ten years in succession we used such rotted manure on plots of one-tenth of an acre on wheat, oats, barley, Indian corn, and roots, and alongside of those treated with the rotted manure was another series treated with the same weight of fresh manure. The quantity used in each case was fifteen tons to the acre, and this was applied each year for ten years. It was then discontinued on all the plots and for the last four years no manure has been applied, but common red clover has been sown each year with the grain and plowed under at the close of the season. The results with grain and Indian corn in every case has been slightly in favor of the fresh manure. The average yield of oats for the whole period has been 50 bushels and 31 pounds from the plots where rotted manure was used and 55 bushels 13 pounds where fresh manure was used, showing an average of 4 bushels 16 pounds per acre in favor of the fresh manure.

Fourteen years of experience with crops of spring wheat have given an average of 21 bushels 49 pounds from the rotted manure and 22 bushels 14 pounds from the fresh manure, an advantage of 25 pounds per acre in favor of the fresh manure.

Fourteen years of experience with barley show an average of 34 bushels 23 pounds from the rotted manure and 34 bushels 35 pounds from the fresh manure, a difference of 12 pounds per acre in favor of the fresh manure.

In Indian corn the average of thirteen years' experience was 16 tons 508 pounds from the use of rotted manure and 16 tons 1,383 pounds from the use of the fresh manure, an average advantage of 775 pounds per acre in favor of the fresh manure. With these facts before us I think we are justified in saying that the manure fresh from the barn-yard is equal in crop-producing power to that which has been fermented and rotted, notwithstanding it has shrunk to less than half its weight during the process of rotting.

The reason for this great loss in the weight and value of the manure while rotting no doubt lies in the fact that during this process the liquid portions so rich in plant food are largely decomposed, the nitrogen escaping in the form of ammonia and more or less of the other valuable constituents are lost by leaching. We have no hesitation in saying that the farmer who gets his manure while still fresh into the soil returns to it for the future use of his crops much more plant food than he who allows the manure to accumulate in piles where there is much waste by excessive fermentation or leaching or both. Most of the manure on a farm is made during the winter months, and our practice is to draw the manure out from the barnyard from day to day as made and place it on the land in small heaps of about one-third of a cartload each. These small piles will soon freeze through, when all fermentation will be checked and remain so until spring, when the manure will still be practically fresh and may then be spread and plowed under.

It is not always practicable to put fresh manure on the land without delay, but wherever practicable this should be done. Considerable quantities of nitrogen may be added to the soil by the plowing under of clover.

It is now a common practice with most of the best farmers in Eastern Canada to sow clover with their grain crops in the spring. A clover-seed attachment to the grain drill enables this to be done without additional cost. About twelve pounds of clover seed is used to the acre, and the common red clover is generally used. After the grain crop is harvested the young clover plants produce a rapid growth, and by the middle of October a heavy mat of foliage is formed from eight to twelve inches high. If it is intended to use the land for spring grain the following season the clover is plowed under about the middle of October, but if the land is to be used for corn or potatoes the clover is left until the following spring, when, by the second or third week in May, it will have made a heavy growth and will furnish a large amount of material for turning under.

The increase in crop on land so treated has been very manifest, and the good influence of the clover is seen the second year after plowing under as on the first. Indeed, on the third year the difference in crop on land so treated is quite considerable when compared with the same crop on land adjoining which has had no clover.

Twelve trials have been made with clover for oat crops during the past four years, and the average increase in the crop has been seven bushels of grain per acre. In a field crop of four acres, grown in 1899 alongside of another field of similar land with no clover, the difference in the yield of grain was ten bushels. The effect on the yield of straw has been remarkable. From the added fertility and humus thus supplied the straw, when compared with adjoining crops on which clover had not been sown, was increased 78 per cent. the first year and 35 per cent. the second year.

The increase in grain in the case of barley has been about 28 per cent. the first year, and the second year after clover shows about the same increase.

Eighteen experiments have been made with corn after clover during the past three years and the average increase for the whole period has been 3 tons 1,694 pounds per acre, thus showing the great benefit of clover for that crop. Similar experiments have been tried with potatoes with an increase on the clover-sown ground of 33 bushels 20 pounds per acre.

Average barnyard manure contains about ten pounds of nitrogen per ton with five pounds phosphoric acid and nine pounds potash. The chemical investigations which have been made in connection with these experiments have shown that a vigorous crop of clover will contain, at a moderate estimate, in its foliage and roots, from 100 to 150 pounds of nitrogen per acre, from 30 to 45 pounds phosphoric acid, and 85 to 115 pounds of potash.

With regard to the nitrogen, it is evident that we can, with the use of a single crop of clover, furnish the soil with as large a quantity of this element as would be supplied by a dressing of ten tons of manure per acre. The greater part of the nitrogen is gathered by the clover from the air, and is therefore a distinct addition to the soil. This nitrogen is obtained through the agency of a multitude of minute bacteria which attach themselves to the roots of growing clover, forming thereon small nodules or tubercles. These nodules, swarming with their countless inhabitants, are to be found in sizes varying from a pin's head to a pea, scattered in numbers over the roots of the plant. The nitrogen taken in from the air by these microbes and converted into soluble compounds is used by the clover and stored in the tissues of the roots, stems, and leaves.

The amounts of phosphoric acid, potash, and lime in the clover have, it is true, been obtained from the soil, but have been largely drawn from depths beyond the reach of ordinary crops.

By the plowing under of clover there is also a large addition of humus whereby the soil is made more retentive of moisture, thus assisting in deepening and mellowing the soil.

In conclusion, let me urge on you to see that no part of your barnyard manure is wasted, that you handle it carefully and get it on the land in a fresh condition whenever practicable, that you use clover freely as an additional means of fertilizing your land and putting it in good condition for crop. Cultivate your soil thoroughly and use the most productive sorts of grain for sowing. Do your part well and you will receive your reward.

The PRESIDENT. (Referring to map exhibited by speaker.) How far, Dr. Saunders, have you known those roots to extend into the ground?

Prof. SAUNDERS. In clover that had been in from eighteen to twenty months, I have found the roots extending more than four feet below the surface of the ground. On cutting away the sides of the soil you could trace the roots on down beyond that depth. This plant can collect by means of this long root system fertilizing material from depths in the soil which the ordinary crop cannot reach.

The PRESIDENT. Can you give any reason why those clover roots do not get the nourishment nearer home or nearer the surface? What is the reason that they run down into the earth?

Prof. SAUNDERS. I do not know, unless it is the same reason that makes our boys wander away off into the northwest in search of what they might get nearer home. It is the characteristic of the individual. It is a good thing that such a feeling as that exists in some countries. If everybody stayed at home we would become too crowded.

The SECRETARY. In preparing this program you will notice that I have purposely provided but one speaker for this morning, but he has assigned to him a subject of such wide interest to everybody engaged in agriculture, that I knew there would be time wanted for discussion, and let me say, Mr. President, that I know that Doctor Saunders is a gentleman eminently qualified to answer any questions along this line that any in the audience may see fit to ask him. I hope that everyone will feel perfectly free to ask him any questions that occur to them, and I know it will give the doctor pleasure to answer them.

The PRESIDENT. I would like to ask the doctor if he would have the rule that he made relative to hauling fresh manure on to the farm — if he would have that apply in both the summer and winter seasons of the year under all circumstances.

Prof. SAUNDERS. I think, Mr. Chairman, that my words were guarded in that respect. I said, I think, in the course of my address, that it was not always practical to do this, but wherever it was practical it should be done. I think perhaps that covers the ground of your question.

The PRESIDENT. I remember that very well, but what I wish to know is whether that is better for the earth.

Prof. SAUNDERS. Most decidedly.

The PRESIDENT. Under all circumstances?

Prof. SAUNDERS. It should be handled, if possible, in such a way that it can be retained practically in its fresh condition and be spread on the ground as soon as the season opens in the spring, and turned under so that the fermentation that goes on in the manure may be carried on in the soil. Then the ammonia and other products given off are taken up by the land for the benefit of succeeding crops.

A MEMBER. Do you think there is any danger of its being washed off, and may it not in that way lose a great part of its goodness?

Prof. SAUNDERS. I would not, of course, recommend any one who was living on a steep side hill and in a climate where there was very much rain in the spring, to place his manure in any such location. It would be a question of two evils, and I should choose the lesser. Under such circumstances I should keep the manure in the barnyard; in that case, I think it would be better to keep it under a shed, especially in a climate of that kind. This question of keeping manure under cover is a question which will admit of any amount of differences of opinion. Neither practice can be advocated in all climates; no hard and fast rule can be laid down for the government of all cases; we must be governed by what good sense and judgment indicate. I mentioned in my address that no speaker can take the place of the farmer's own brain. Every man must use his own good common sense in adopting such measures as are recommended, as possibly they suit his particular situation and that is where the use of common sense should come in.

The PRESIDENT. I have talked with certain farmers in Long Island where they have not used a bit of stable manure, they even question whether it is not better to use commercial fertilizer altogether, because they say it is not worth the effort and time and money to get and handle it when they can use commercial fertilizer to so much better advantage in growing their crops, and they claim it is more profitable. It has seemed to me that they cannot be correct. I should like to know what your view about that is.

Prof. SAUNDERS. In such cases there would be some ground for supposing that they might be partly right, but they certainly overlook the fact that they are losing humus in their soil by the exclusive use of the commercial fertilizer. I do not see how they can supply that. They are probably working the bottom lands where there is an adequate supply of humus.

As I said before, a man must be guided by his knowledge of his own conditions. I think, in the main, the best practice has approved the use of the stable manure.

Prof. GULLEY. How are you going to treat land where you do not want to grow stock, how will you keep it fully fertilized with a stock of trees growing on it and for all that sort of work? Take it in land where there is no danger of washing or anything of that kind to take into consideration. Take it on one of those mountain sides where we are putting out our trees.

Prof. SAUNDERS. I think I should attempt to go out of the business for a time, and still I don't think I would lose for any great length of time.

We have been carrying on a series of tests with the commercial fertilizers, different kinds of fertilizers, using them without manure for the last ten years. We found that before that time had elapsed that the experiments were not at all doing justice to the artificial fertilizer for the reason that there was not enough humus left in the soil to hold the water that these artificial fertilizers needed in order to dissolve the elements of fertility they contained, and that to an extent prevented their full usefulness. We therefore abandoned the commercial fertilizers and have since been keeping a careful account of the crops, and we find that without any the crops have increased every year owing to the additional humus. By the addition of humus and of some nitrogen we have found that there has been an increase in the crops so that they are growing better and better every year. My own idea as to the judicious use of artificial fertilizers is this: That they should be associated with some other fertilizer, in such cases as you refer to well-rotted barnyard manure, so that the supply of humus in the soil can be kept up, and thus these other conditions to which I have referred maintained. To use artificial fertilizers without any such manure from year to year cannot, in my opinion, be successful very long.

Prof. GULLEY. Can you keep up the land in that way? Do you think that the land will run down? That's what I meant. Do you think it can be kept up with the commercial fertilizer?

Prof. SAUNDERS. Most certainly, but you will not have land so rich in humus. I hope that there will be no misapprehension here. My remarks have been in the direction of showing how the fertility of the land can be kept up by keeping up the use of a proper proportion, that farmers can accumulate and grow on their farms without spending any of their hard-earned money, the elements which they need to put back into the land. I have no prejudice against commercial fertilizers, I think they have their place, especially with those who are working under a system of cultivation of crops. There they are a necessity and their use is to be commended.

Mr. HOYT. The question in my mind is: How much humus do we need in the soil to protect a good crop? I think sometimes we are laying too much stress upon this point of humus in the soil. I look upon the soil as the medium through which, by the use of the brains of man, we can grow vegetation. If we put seed and plant food in the soil, with proper care we can produce out of that plant food its kind. Experiments have been made where trees have been grown without a particle of humus in the soil if the plant food is put in for the plant to feed on. I believe that we can grow crops upon sandy soil without any humus. The only thing is to put plant food in the soil for the plants to take up. Of course, the humus acts as a softener and mellower of the soil, and perhaps to a certain extent holds moisture. I do not go back on humus. I believe a farm can be kept up and kept in good condition without a barnyard upon it, although I am not saying anything against barnyard manure, yet I believe it is an expensive way to get the farm rich.

Prof. SAUNDERS. Don't you use barnyard manure on your nursery stock?

Mr. HOYT. All I can get. I also make a good deal of my own. It is better to use for growing trees, some of the humus which we have in our own barnyard, and inasmuch as we keep twenty-three or twenty-four horses and about forty to fifty young hogs, we make some. We do not throw it away. When you put on yard manure, when you put it on next spring for your crop, how much of that manure is plant food for the crop that summer? There is not a particle of that phosphoric acid and potash that is plant food except what little may be liberated. There is but a small part of plant food until decomposition takes place.

Now, the humus in the soil is all the while throwing off potash. There is the advantage of it, in my opinion. There is a lot of humus with the manure that we haul three or four miles, which is what we have to do in our case, but we are carting 1,600 or 1,700 pounds of water to get 25 pounds of fertilizer. I don't believe in hauling so much water. I believe in hauling your concentrated food and putting it where the plants can get it. If you put on muriate and soluble phosphoric acid, your crop at once feeds upon what it wants, and those who think it is economy to put $50.00 worth of manure in the soil this year in order to feed plants four or five years hence, I believe are mistaken in their notion of what constitutes a good financial investment.

I want my plants to have food this year. I don't want to put in plant food this year that is going to be wanted two years hence. What I want is something my plants can use this season. That is the way I look at it. I would rather produce my own fertilizer than to have the fertilizer that we buy in the market. We don't know what we buy a great many times.

The analysis may show that it contains four per cent. of ammonia, but I do not know where it comes from or what its real value is. When you buy your chemicals and make your own then you can save $10.00 a ton, and you know what you have got, and we have at this moment a fertilizer that we have made which I know when it is applied will do the work. I know that within two weeks after the crop is up we will be able to see the effect.

So I say in treating plants you want to feed them just as you would feed your horses and put the stuff where they can get it. You want to put your plant food where your plants can get it, just as you want to put your grain where your horses can get it. When we farmers make up our minds that we are not the gainers by some of these practices which have been in vogue relative to feeding the better it will be.

Prof. SAUNDERS. How does the gentleman account for the condition outlined by the gentleman a few moments ago? Do you not think there must be something to bring nitrogen? Can you depend entirely on bringing nitrogen from the air?

Mr. HOYT. There are a great many questions that the professors don't answer and that they cannot answer, either.

I don't know what was in my analysis of the soil. There may have been a ton of nitrogen there. There may have been all the plant food necessary to raise a crop. You cannot give an opinion, of course, unless you know all of these conditions. Another thing, what do you add when you apply clover to the soil? Where does it come from? Whatever you add is merely your nitrogen. If there is any phosphoric acid or potash, it comes out of this same soil. You do not add anything at all unless you get nitrogen. In my opinion it is an expensive way of getting nitrogen. I would rather take that clover and sell it, and the money will buy twice the nitrogen that you will get in that way.

Prof. SAUNDERS. I am very forcibly reminded by the gentleman's remarks of the story of the old Scotch lady who was very free in stating that she was always open to conviction, but at the same time she always said that she would like to see the man that could convince her. The facts that I have spoken of should, I think, be sufficient to convince any man of the truth of the statements I have made. I may have stated these facts in a crude way, but the facts that I have submitted can all be verified to the most extreme point. Now, my friend who has just sat down does not believe in humus at all.

Mr. Hoyt. Yes, he does. I beg your pardon.

Prof. Saunders. Well, he said that crops will grow on pure sand. I have never seen grain thrive on pure sand, or considered it good for trees, either. I know that they want the richest ground that can be found, — the richest in humus that they can get.

I didn't prepare this address for nurserymen, but prepared it for those engaged in general agriculture, and I think the force of it will come home to them. I shall be surprised if that is not the case, for that is the result, judging from some of the testimony that has been given here and from some of the information that has been brought out before the audience.

I had occasion to speak in Nova Scotia on this subject some years ago at one of the meetings held before the farmers, and though I had not the accumulation of facts that have since come to hand from experiments that we have tried, yet it was so convinving to the farmers in that locality that I hardly ever go into that district without hearing about it. One man said to me, "Do you remember the clover scheme that you recommended? I said, "Yes, what was the result?" "Oh, well," he said, "I thought I would try it and I found I got a much bigger crop from it and it pays me well, and now my neighbors are all doing the same thing." I thought it was a very good way of putting it. You have got to put these things to the test. It is a good way for a farmer to divide or apportion his field. Then if he is not a strict believer in all that has been said about it, he may convince himself by dividing part of his field and sow clover in one part and oats in another, and he will be able to trace the line by the increase in the height of the grain. We have had as much as a foot's difference, as well as a great difference in the abundant character of the crop.

SECRETARY. Mr. Chairman, I wanted to ask Prof. Saunders if any experiments have been made in increasing the depth of the soil; that is, in regard to what we call subsoiling. And if so, what the result has been?

Prof. SAUNDERS. We have never made any experiments in the way of trying to draw the subsoil up towards the top or any part of it. The soil that we have to work with is usually about eight inches, — just the ordinary soil. We generally plow about the full depth, but I think recent investigations have shown that the bacteria which work in the soil and which do a good deal towards converting the insoluble plant food into soluble forms, work most actively in the first three or four inches of the soil, and especially in the spring when the plant food is needed most for the young, growing crop. There is rather a feeling in favor of shallow cultivation, but that is a misnomer. If it is properly carried on, it is not a shallow cultivation. It means this, that the soil is only disturbed to a depth of about four inches instead of going down seven or eight inches. Now that practice, so far as I have been able to ascertain, — although we have not tried it to any great extent ourselves, — is a very good one and the results have been very fair. But how far you can go down and draw the lower part of the soil to the top to advantage is a question which I am hardly prepared to discuss.

PRESIDENT. That raises a question about which I would like to ask, and that is what the experience has been with regard to deep plowing, and the effect of deep plowing?

Mr. HOYT. Most of the farmers have learned a way you can do it. I would like to know what Prof. Saunders thinks about it.

PRESIDENT. Are there any of the others who have had any experience in subsoil plowing?

Mr. Barber. The experience that we have had, that is, my father and myself, and of course his experience goes further back than mine, has been this: It has been carried on about fifty years on the same premises and the plan has been to try to plow about a half inch deeper each time. You must understand that it is up in Litchfield County, where, when you put down a cultivator with strong teeth, we have to hitch on four horses to pull it, and sometimes it will probably take hold of the foundations of the world before you get to the end of a furrow. But what I want to say is this: There is a piece of ground right in sight of our farm — I have often heard my father say none was so poor as that on Hayden Hill — but for that locality it is a fairly good piece of ground and it had been cropped for years and years until it had got so that nothing would grow upon it. It was taken in hand by Prof. Palmer at the time which the president spoke of and subsoiling was practiced. He did it in this way: When he plowed one furrow he put on another team and plowed another furrow right in the bottom of the first furrow, plowing down eight or ten inches deep; and that field has ever since, according to my recollection, been kept top-dressed, and they have been getting a big crop of hay from it without any great amount of top-dressing, while there is a lot of other land around there that has received more but which has not been yielding as much, nor anywhere near as much. This piece has just been kept along with a fair amount, and it would appear from the condition of things that they have been getting a far greater amount of plant food than they have been putting on. I do not understand that this subsoil was brought up and put on top. I simply understand that the soil was stirred deeper by the operation and by that causing a chance for a further loosening of the mineral fertilizer which was naturally in the soil.

Now, there is one question I would like to ask. We have a large orchard which was set thirty-two feet apart each way.

It was planted in the early sixties, I think. If I remember right it was set out in 1861 or 1862. That orchard, through considerable fertilizing, has grown until it has become much too thick, and we have ceased to plow it, as the trees have got rather large, and we have used it as a night pasture for cows. The cows have been allowed to run in it.

I would like to ask the professor if he knows whether there is any increase of excrement during the night. Do we add anything to the fertility of the soil by using it in that way? That's the point. Do we gain anything more than we would by simply using it as a night pasture?

Prof. SAUNDERS. I don't know that I could answer just that particular point, although some experiments have been carried on, digestive experiments, where the amount of excrement at night and by day has been considered. But I have not the figures by me and I would not venture an opinion on that point. There is no doubt, however, that the animals do deposit on the soil a very fair quota or return for the food that they have eaten off from the land.

In speaking of orchards and their treatment, and with reference to the question of cover crops at particular seasons, it is well to bear in mind that the orchard draws very much more heavily on the soil in the early months of the year when the wood growth is being made. Those who raise orchard trees well know that there is a definite wood growth made by the tree during every year. There is a certain length made and then the growth stops. When they have made that definite length of growth then the tree matures the wood that has been formed. Now, while that activity of growth is going on the tree is a much larger consumer of plant food than it is later in the season. In order to get that plant food there must be more water in the soil. Hence a favorable condition of moisture in the land is very essential while that rapid growth of the tree is going on.

Our practice at Ottawa, under our horticulturists there, who have paid a great deal of attention to this matter, is this: They have found that it depends a good deal upon the growth which they make. If the trees are making too rapid progress then it might indicate that unfavorable conditions are present, but as far as possible you want to encourage the growth of your trees and provide your soil with a good proportion of moisture. Then our plan is to turn under, about the middle of May, the clover crop which we generally grow on our orchard, and bury it under. The plowing that the land receives at that time breaks up the cobblery structure of the ground, and the water does not find its way up to the surface and evaporate as would be the case if the ground were bare and not plowed. Then the turning under of the clover also gives a good deal of additional food for the use of the trees. Then the ground is scratched over with a cultivator so as to give a little mulch on the ground as the weather gets hotter so as to prevent undue evaporation from the soil, and that serves to carry the tree long enough to make its annual growth of wood. Then the ground is seeded with clover again, generally about the beginning of July, and left undisturbed the rest of the year.

Clover, when it begins to grow, uses up considerable amount of water in the soil by evaporation through its leaves, and the quantity of water in the soil can thus be increased by a large amount by turning it under and saving that water for the use of the trees. That tends to give the trees an opportunity to mature their wood.

I have spoken of this so as to draw your attention to the fact that the orchard does not require just the same amount of water at one season that it does at another. But it wants it in its season of need.

Prof. Gulley. Suppose you have a heavy crop of apples on those trees, do you recommend the same practice then?

Prof. Saunders. The moisture is generally quite sufficient to supply the crop of apples with water. Relative to the proportion of water taken by the crop it is a small matter compared to the evaporation from the field. It takes about 350 tons of water in the land to produce one ton of dry matter, and that is due to the fact that so large a proportion escapes in the air by continuous evaporation. It seems to the casual observer that it must take a lot of water to make a crop, yet the actual quantity would not be as much as would be evaporated every evening in the week.

A MEMBER. I want to say just a word about picking. It is a good deal of labor to pick fruit. I believe myself that if the trees are headed down, if the branches are kept down pretty low to the ground, so that you can get around to pick the apples off without requiring so much labor, it is a great gain.

Prof. SAUNDERS. As to the apples, that plan is being generally adopted in the country I live in. You know that we raise a very large proportion of apples. We have about six million apple trees in Ontario alone, and we raise a great many hundreds of thousands of barrels. The tendency of our orchardists is to keep the trees pretty low down. I think you should leave not more than three or four feet of trunk. That brings them well down within reach if there is not more than three or four feet before they begin to branch. If you have an orchard pruned that way then, of course, your cows, if they are fond of apples, would be disposed to relieve you of a good part of the crop before they are ripe. If the trees are kept well up there is more difficulty in the picking. They will grow up seven or eight and even ten feet in some cases before commencing to spread. Another thing, some of the apples are on these upper limbs, and if you pasture your cattle under these trees of course they will eat more or less of the fallen fruit. I do not think myself that it is a good plan. In fruit-growing a man wants to make all the money he can, but I think a man will make more money out of his trees and with less labor if he has low-branched trees than he can if he grows them tall. Of course, there are some arguments for both ways. I think so far as feeding the animals is concerned that it is a good thing, of course, to have the trees tall, providing it is not associated with any disadvantages.

Mr. BARBER. I agree perfectly as regards the high-headed trees, and, of course, there are disadvantages. But what are you going to do with these old trees, some of them about forty years of age, that were set too thick and then permitted to stay?

We are getting a fair growth of wood, but as regards the fruit there is a good deal of it that we are unable to get, and the apples come down through the trees themselves and are picked up by the cows.

Prof. SAUNDERS. I do not see as there is much to recommend in that case. I should say that it is another case which calls for the use of common sense. A man gets one of these orchards as he gets his wife, for better or for worse. If it is for worse, he has to put up with it and do the best he can with it.

I would not like the idea to go out from this convention that the convention advocates the keeping of cows in orchards, because, as a general principle, I think it would be rather disadvantageous on the whole than otherwise.

Mr. KINGSBURY. I was reminded a few moments ago of the story of the New York justice who, after hearing the lawyer on one side, said he had got his case, but after hearing the man on the other side he said, well, he had got his case, too. It is hard to make up one's mind which is the proper way.

We have all been very much interested in the paper this morning, and, if it is not too late, I want to ask a question. Before I ask the question, however, I shall have to give a little explanation. Some twenty years ago a field of two acres which lay some distance from the house and, on account of the difficulty in reaching it with barnyard manure, we thought we would apply commercial fertilizer to it, and started an experiment to see if it could be kept up by the use of such fertilizer. From that day to this no humus has been put on it except what the cattle dropped and what was left through the process of cutting the grass. Now, the result has been so satisfactory that I have said, and I still say, that I believe that I could take an old worn-out farm, such as we have been talking about, and without putting on any manure and without doing any labor except the overseeing of it, I could make money out of such a farm by the use of commercial fertilizer. I would like to inquire of the professor what he would advise me to use as a fertilizer should I plow up this piece of ground and sow clover, also what he would advise using in connection with the sowing of the clover in order to secure a good stand to plow under. Possibly there is a way of enriching that soil with humus that would, perhaps, give better results than I have been getting.

Prof. SAUNDERS. Mr. Chairman, I am not surprised that pretty good crops of apples can be had under such conditions.

Mr. KINGSBURY. This is not an orchard. It is mowing land. It has been kept in mowing most of the time. It has been under the plow only about three or four years of the twenty. The first time I think for twelve years, and we were getting what we called a large crop of grass and after the grass was cut, the aftermath was fed. After that twelve years it was, perhaps, run out. It did not respond, and then we put it under the plow and used nothing but commercial fertilizer to bring it up. It was broken up and we put in corn or potatoes with very satisfactory results, and that followed by rye or oats put on with Hungarian. After three years it was re-seeded, and it is now in grass. There are no trees upon it.

Prof. SAUNDERS. I think I understand, and what I was going to say was this, that an orchard will often thrive very well under what would be very negligent conditions if we should apply them to an ordinary farm crop.

The reason that is so is this: the wood of the trees takes very little from the soil and the leaves of the trees, although they take a certain amount, yet they generally feed the soil because they fall from the trees and decay, and thus find their way back. Then the fruit of the tree takes practically nothing, scarcely nothing but potash, so that the potash which the trees need could be derived from commercial fertilizer. That would be enough very often to keep an orchard in fairly good condition under such circumstances, although I would not recommend going into orcharding in general along these lines.

With regard to growing clover as a fertilizer that could be used for the crop I would say it does not need any fertilizer containing nitrogen, because it gets its own from the air. It does, however, need potash and lime. Those two elements the clover crop has, and in consequence gives a strong and vigorous growth.

Mr. Hoyt. I do not see how we can come to any conclusion from the gentleman's question. What he ought to have told us was what kind of fertilizer he uses on that land.

Mr. Kingsbury. The year that we started we used a certain grass manure. I think that was the year — I will not say that it was twenty years ago. I do not remember just exactly. If some of you remember the year that we had a very heavy frost on Decoration Day, the morning of the 30th of May. That was the year.

Mr. Hoyt. I remember it. We had a field of rye destroyed.

Mr. Kingsbury. That was the time. One of our neighbors remarked that he had watched that field, and, while other grass fields seem to have been affected by the frost, that field withstood the adverse action of the frost and was not injured. We had used various fertilizers. I am not advocating the use of any particular fertilizer, because I am local agent for fertilizers, but I would like just to contribute that statement of our experience.

Personally I prefer to buy muriate of potash and phosphoric acid in bulk or bone, but we have used various kinds of fertilizers.

SECRETARY. There are two gentlemen in the hall from whom we desire to hear, and the first gentleman is our Dairy Commissioner, Mr. Noble. We want to hear from him in regard to the condition of the dairy interests of Connecticut, and after him we shall hear from our Cattle Commissioner in regard to the danger which threatens our dairy interests from the foot and mouth disease, a disease which we hope has not yet reached Connecticut, but which we know is quite serious in two of the adjoining states.

PRESIDENT. We are very glad that the Dairy Commissioner and the Cattle Commissioner are present, and we would like very much to hear from Mr. Noble.

J. B. NOBLE. Mr. President and gentlemen: I certainly am very loath to stop this discussion on this very interesting subject which we have had here this morning. This is one of the most vital questions to Connecticut agriculture. I just want to say this: If we did depend here in Connecticut in fertilizing our places upon the fertility which is furnished by the barn, we should have a good many more of those abandoned farms for sale which were spoken about here last night. It would be a practical impossibility to fertilize the farms of Connecticut so that they would produce remunerative crops if we had to depend on the fertilizer furnished by the barn.

I would say this: That there are many pieces of land in Connecticut which have not seen a particle of fertilizer except commercial fertilizer for years and years, and they are still growing good crops every year.

The dairy interest of Connecticut, Mr. President, is among the most, and I might say the most, important agricultural interest which we have in our state. The milk producing farms on the eastern and western sides of our state sell large quantities to cities like Providence and Boston on the east and to New York on the west. The farmers of Fairfield and Litchfield counties ship large quantities to New York city. That is the great industry in those sections, and anything that can be said in a meeting of this kind, or anywhere, to give new light on the subject of the dairy in Connecticut is of great value to the dairymen in all sections of the state.

The creameries which we have in our state, fifty-five in all, are doing a good business. They are making and producing a good quality of butter, which finds a ready sale. No butter is stored at the present time. It all finds a ready market, and, as you all know, butter is commanding high prices. The best western butter struck thirty cents within a week, and butter is going to be high this winter. And right there, on the line upon which you have been talking this morning, the fertility of our farms, comes up that subject which has been so ably handled here by Prof. Woods in an excellent paper on cattle foods. The same ideas predominate. That is, to do successful dairying you want those foods which will produce, which will give the largest production at the smallest cost, just as we wish to furnish the greatest amount of fertility to our soil for the least expense. We want to decrease and not increase the cost of production. We do not want to do it, however, at the expense of quality. The quality of our milk is to be kept at all times up to a high standard. I want to congratulate the people of the state on what has been accomplished along that line.

We have here today, as our president has said, and you are going to hear from our Cattle Commissioner on the subject of this disease, which is so prevalent in our border states, but which, I am happy to say, has been kept out of this state thus far. It would do great damage to the people of the state should the disease enter the state, and I want to congratulate the people of the state on the vigorous measures which the Cattle Commissioner has taken. I think you will agree with me that he has been of great aid and assistance in keeping this disease out of Connecticut.

In the summer season we have a good deal of trouble in some portions of the state from the use of preservatives, formaldehyde and antiseptics, used in milk. Now, for the protection of the farmers themselves, it should be their aim to produce the very best quality of milk and produce it in the best way for the consumer, so that their products will command good prices.

Some of the creameries of the state have been obliged to close, owing to the large increase in the sale of milk in neighboring cities. One at Lyme and one at Colchester also have been obliged to close because their milk has been sent to other sections. The milk at Colchester goes to Providence. The demand for milk in the large cities is reachig out into these sections, and in consequence the creameries of the state are doing a smaller business, and some of them have been obliged to close. In the main, however, the creameries have been doing a very successful business.

The subject of pure foods is one that is engaging the attention, not only of the public of Connecticut, but the people of the whole country more and more every year. If people want to put chicory in their coffee, if they want to use coffee made out of wheat bran or any of these things, I do not think we have any right to stop them; but I think the principle should be that a person should not be obliged to pay the price for Mocha and Java coffee which has been adulterated with wheat bran or some other low priced substance. I think every person should know just what he is buying. A person should know what an article contains which he is purchasing and pay the price accordingly.

The good work which has been done by the experiment station along the line of investigation of the adulteration of foods under the pure food law and by Prof. Winton here ought to be commended. He has been doing a grand work in the way of his investigations and collecting samples, and has reported to the Dairy Commissioner quite a number of different articles of food which showed a large amount of adulterations. We are glad to say, however, gentlemen, that this is on the decrease; that those laws which are particularly under the charge of the Dairy Commissioner relative to adulterations have been enforced. There is less of this adulteration now than there has been for several years, and the dealers in the state are in hearty sympathy with the law. They want to have the articles which they are selling pure. They want to sell to their consumers articles which are satisfactory and which have not been adulterated. These laws are not for the producers any more than they are for the consumers. What we want is to have all the consumers know just what they are paying a price for.

The new oleomargarine law passed the 9th of May and signed by the president entirely changes the aspect of the status of oleomargarine. As you all know, that law increases the tax on colored oleomargarine from two to ten cents per pound, and it has lessened the production of oleo in the United States. The manufacture and sale of it was increasing each year until this law was passed, but the passage of the law has checked it. But under the ruling of the secretary of the interior, who has charge of this department with the secretary of agriculture — the secretary of agriculture more particularly with renovated butter or oleo butter which is uncolored or not artificially colored — they can use as much butter as they see fit in the manufacture of oleo, and some of the factories are using as much as twenty per cent. and thirty per cent., and some of them as high as fifty per cent. of pure creamery butter. That gives the oleo a light straw color and takes away the white lardy color which it has had formerly, and the result of that has been to increase the sale of oleo in Connecticut. There are now a good many more dealers in oleo in Connecticut than there were under the old law, but they are selling it according to law. They sell it for oleo and, owing to the high price of butter, there are a good many people in the state who do not feel that they can pay from thirty to thirty-five cents a pound for butter, and this substitute fills its place and people are ready to sell it. In many respects it may be better than some of the renovated butter of which we have had so much on the market for the last few years. Renovated butter does not really come into competition, only in this way, as it did under the old law. The only question is that we must keep a close watch of it and see that it does not threaten our other butter sales.

There is no oleo sold without a sign. Of the renovated butter there have been large quantities of that sold in Connecticut and throughout the United States. The production of it has increased very largely, but under the new law they are all obliged to stamp "renovated" butter, both on the wrapper and package, and also have it printed on the tubs. Thus, under the charge of Secretary Wilson, secretary of agriculture, dealers are conforming to this law, so that our consumers will know just what they are purchasing. We have no state law as yet in regard to renovated butter in Connecticut, while a number of states have laws governing the sale of this butter in conformity or along the same line with the United States law. I hope at the next session of the legislature Connecticut will place upon her statute books some law covering this. It would be well to have some law so that somebody in the state would have some authority in regard to this and so help to carry out the United States law and so that we might act in conformity with that law.

There has been, as you know, some demand for the passage of a national pure food law. There have been several such bills presented to congress right along. We want a pure food law so drawn that interstate commerce will not interfere with it and then we will have a uniform system of controlling trade and consumption under pure food laws throughout the United States.

I think this, gentlemen, is all that I have to say now. The time is short, and I thank you very much indeed and the secretary for the opportunity which you have given me to speak to you.

PRESIDENT. Our Cattle Commissioner, Mr. Averill, is present, and I am sure that we would like to hear from him relative to the foot and mouth disease, which is causing so much excitement in this state.

Cattle Commissioner H. O. AVERILL. Mr. President and gentlemen: There has been so much printed in the papers during the last two or three weeks in regard to this foot and mouth disease that I think I will be able to add very little to the information of those present in regard to it. One thing has been developed or brought to light during the emergency which has arisen, and that is the weak features in our laws. No one in the state is invested with authority to prevent cattle coming across the border line from an adjoining State, although it may be well known that a highly contagious disease has existed among the cattle of that State. When we were confronted with this problem the foot and mouth disease was prevalent in Massachusetts and in certain sections of Rhode Island, also in certain sections of Vermont. We know that it is a most highly contagious disease, and it will be a great calamity to the people of the State if it should gain a foothold here. No one in the State, not even the Governor, is vested with authority to prevent cattle from those States coming into this State. There are weak features in the law that I do not need now to refer to or, perhaps, to call attention to.

I would say in regard to the foot and mouth disease that the mortality among cattle affected is not as great as the general public have been led to believe. It is not on account of the high mortality that we dread its entrance to the State, but on account of the highly contagious character of the disease. An animal that has once had the disease can have it a second time. It is said that they can have it a second time within a year after the first attack. An attack of the disease usually lasts but two weeks. The animal is first taken with a fever, and then small vesicles or blisters appear on the sides of the tongue and the lips. The animal stops eating. Rumination ceases, and frequently the animal makes a smacking sound with its lips. The animal grows poor very rapidly, and there is a falling off in the milk. The flow of milk diminishes or almost entirely ceases. After a period of about two or three days these vesicles or blisters break and discharge. The flow of saliva is very largely increased and falls from the mouth in ropy strings, falling to the ground.

Mr. Gold wrote me that during the outbreak of the disease thirty years ago, in the winter, that it was not an infrequent thing to see animals that had lain out-of-doors with a mass of frozen saliva attached to them as big as a half-bushel basket. The animals recover quickly from this disease, although, of course, the flow of milk never returns to the animal until the animal freshens again. The loss of flesh is very considerable, owing to the fever and the fact that the animal does not eat.

But very little is done for an animal in the way of treatment. Of course, it is necessary to give them a soft bran mash and some soft food, but they will eat very little of that. Disinfectants are used and soothing lotions are sometimes applied to the animal's mouth to relieve them from pain. The animal suffers considerable pain in connection with the disease.

I would say in regard to the infectiousness of the disease, where the disease appears the herds are quarantined and it is very essential that they should be quarantined against even contact with visitors, because the contagion may be carried in the clothing. I presume you all have heard or read about the case in Massachusetts where the disease had broken out in a certain herd where the animals had not come into contact with any other animals and no new animals had been admitted into the herd. There was no doubt but what the disease in that instance had been conveyed to that herd by the people who had visited it and thus infected it. The serious infectious character of the disease has been such that instructions have been issued by Dr. Salmon, Chief of the Bureau of Animal Industry, who is in Boston and who has taken charge of the work there for suppressing the disease, to the veterinarians who are working under him to wear waterproof coats and rubber gloves and rubber boots when making their examinations, and at the close of their work at each place of examination to thoroughly cleanse and disinfect their garments before going among another herd.

The milk of the animal given during the period of infection is unfit for use, as the disease is very readily contracted by other animals from using the milk; and human beings are also affected by their use of the milk, but they are not so seriously affected, perhaps not more than a little canker in the mouth or a little sore mouth.

Now, if any of the gentlemen present wish to ask any questions I will be only too glad to answer them if I can, and, if I cannot, I will certainly tell you so.

I would say, by the way, however, that I have taken up the matter, with the Secretary of Agriculture, of having the embargo against moving Connecticut cattle out of the State removed. While I said that our State authorities had no power to issue an order for the quarantine of cattle coming into the State from outside, a quarantine was laid by Secretary Wilson against the removal of cattle out of any New England state with the exception of Maine, so that no cattle can be removed out of Connecticut across the border line or in any of the five New England states. Cattle may be brought into this State from New York, but from none of the other border states.

Dr. Salmon, Chief of the Bureau of Animal Industry, has been consulted in reference to the matter. I talked with him over the telephone, Monday, in regard to having the embargo removed, and he said that he would send two inspectors down on the Rhode Island line to make an investigation there in regard to the extent of the disease and, if their report was favorable, that the embargo would be removed.

There is no danger of Connecticut spreading the disease, and so there would seem to be no reason why Connecticut cattle should not be shipped out of the state. I have been surprised within the last week or ten days at the large number of letters I have received from people who wish to send cattle out of the state, or live-stock, particularly swine and goats. Angora goats are included in the embargo.

I do not think there is a case of the disease in the state. To the best of my knowledge and belief there is not one. I have received a communication from Mr. Stockwell of Rhode Island, secretary of the State Board of Agriculture, in which he states that the nearest case to the Rhode Island line is about twelve or fifteen miles from the Connecticut-Rhode Island line.

PRESIDENT. I notice, Mr. Averill, that you have said nothing of the disease in the hoof.

Commissioner AVERILL. Yes. The disease does not invariably appear in the feet, but frequently it does. It is distinct, of course, from foot rot, or from that disease as it is known by the farmers of the state. It appears in the form of a swelling at the cornices, a little heat will be noticed and vesicles appear between the claws of the hoofs. After a short time these discharge and, of course, contaminate the ground so that other animals passing over the ground would contract the disease in that way. So that in relieving any case of the disease it is very necessary that the greatest care be taken to prevent the spread of it.

Mr. HOYT. I have been very much interested by this report of the Cattle Commissioner. I would like to ask him if he has heard anything of the disease in the border counties of the State of New York, that is, in Putnam and Westchester counties. Have you heard anything of the disease there?

Mr. AVERILL. I think there is none of the disease in New York.

The PRESIDENT. Most of our cattle coming into Connecticut come from that way, great quantities of them. Some people down my way bring carloads of cows from over there nearly every week.

Mr. AVERILL. About thirty years ago this winter the disease prevailed very largely through the western part of the State, especially in the border towns on both sides of the line in Litchfield and Fairfield counties, especially in a good many of the small towns of Litchfield county. It is estimated that there were about 100 herds that were affected. The disease then was brought in from New York State. There were also some cases about Hartford and in the eastern part of the State that were traced to the Brighton market. This year it has not been determined where the disease did originate. It first made its appearance in Brighton. Some question whether the disease was carried to Brighton from animals shipped from Rhode Island, but further than that they are not able to trace it.

This is a disease that has prevailed in Germany and on the Continent of Europe, and a great deal of money has been expended there to stamp it out.

I think that the government here is going to take strenuous measures and, if necessary, adopt drastic measures to stamp it out. It is certainly true that the government was exceptionally successful in stamping out the pleuro-pneumonia some years ago, and this is a disease which can be more easily controlled than pleuro-pneumonia.

The SECRETARY. I have found in the question box a subject in which we are all interested and something that is entirely new in the State of Connecticut. The question is: "What is the idea in establishing a State park?" We know that steps have been taken to establish a State park, and Mr. Mulford of the School of Forestry at the Connecticut Experiment Station at New Haven, perhaps, can answer the question.

Prof. MULFORD. Mr. President, at the last meeting of the legislature $2,000 were appropriated for buying land, and it was provided in the bill that that land was to be called a State Park. There has been a great deal of misapprehension as to what this was intended for, as to what was to be done with it, and I am very glad to have the opportunity to say just a few words to explain it. The bill provided that this land should be bought at a price not exceeding $4.00 per acre, and that it should be planted with seeds or seedlings of oak, pine, chestnut, or other trees at a cost not exceeding $2.50 per acre.

Now, the idea of the promoters of this bill was to reclaim some of Connecticut's idle land, that is, to plant some of the land in fruit for agricultural purposes or forest trees. We realize, however, that this work is of only secondary importance to the planting work. I overheard a remark recently which was very apt. Some gentlemen were talking and said that they considered the work of planting a forest as important as the work of protecting and taking better care of those that we did have. Now, that is just the point. That is what we want to bring about. That is what we have planned at the Experiment Station at New Haven, but so far as possible we are going to try to change the idea that was involved in this, that was entertained by the promoters of this bill, and they have agreed with us in regard to it. What we want to do is to make of this State park a demonstration area and an experimental area for the benefit of those who own land which can be used for this purpose or which is now covered with wood which ought to be treated.

This bill is entirely inadequate and, as you will see, it is almost ridiculous to try to do anything with $2,000 for a space of two years, but we are going to make a start with it, and that leads us to hope that the State will ultimately put it upon a more liberal basis. Certainly it must be put upon a more liberal basis if it is to amount to anything at all.

Negotiations are in progress for the purchase of a tract of land in the central part of the State, and on this land we hope to carry out thinning and improvement cutting, the processes of which I spoke yesterday afternoon, and other similar work involved in the betterment of woodland.

This is a matter which should be of almost immediate benefit to woodland owners in the State and of much more benefit than our planting work. In the future it will certainly be of benefit to the State. I think there is no doubt that before very long the State will follow the example of other States, notably New York and Pennsylvania, and establish a large reservation for the sake of protecting the flow of the smaller rivers of the State. The protection of the flow of these rivers has become of importance to Connecticut because of the large number of manufacturing establishments which depend upon water power. Moreover, I think it is a public function of the State to provide, for the future, large sized timber, something which private owners probably never will do, but that is not an immediate work. My idea at present is to find out what the best methods of treating the small woodlands are in this State, and then to provide object lessons which others may observe and may use more or less as a pattern. I thank you for the opportunity.

The PRESIDENT. I see Prof. Sturgiss is with us and I know he is anxious to talk. I wish he would come forward and tell us a little something on the result of his investigation of adulterated foods. We want to have him give us the results of his past year's endeavor to find out about these things.

Prof. WINTON. I think that the President has got me mixed up a little. Prof. Sturgiss is not here. He is now in the West.

Prof. Woods has so ably treated this subject of cattle foods that it is hardly necessary to add anything more to the general information on the matter. It may be desirable, however, to call your attention to some of the various feeds which are now on sale in Connecticut. On the table there are two or three dozen bottles representing some of the feeds actually sold in the State within the last few months. These do not include any of the ordinary feeds but those which are remarkable for one thing or another, some for their excellence, others for their badness, and others still because of the ingenuity of their manufacture.

Now, the subject of human foods has been thoroughly aired in this meeting. You have heard how dairy foods have been adulterated, but owing to the excellent work of the Commissioner this adulteration has been gradually diminished in the State. We have taken every opportunity to emphasize the extent to which human food has been adulterated and, at the same time, we have not overlooked cattle foods. It has seemed, however, in the past year, as though cattle foods were but little adulterated.

My father was a miller. He was brought up in the corn bin, and knew if the meal pit contained about what went into the hopper. I do not recollect that anything very objectionable was ever put into my father's mill, but I have heard that occasionally a milkman on his way home would insist on rinsing his cans in some running stream or trough. Now, while I have these encouraging words to say as to the extent to which adulteration is carried at present, yet I must say that there are some of these things on the market today. Before I speak of adulterated things, however, let me call your attention to two or three foods of recent introduction — of more or less recent introduction — and which are worthy of mention because of their excellence. You will find one of these is simply a buckwheat bran. This does not contain any of the black hulls, but is from the inner hull. This is one of the cheapest on the market, at least for the money. It is made in a small mill somewhere in this vicinity, I think not far from Danielson. Considering its excellent feeding value and its price it is certainly worthy of attention.

Another product alone made in this State is known as Atlantic Gluten Feed. This is rightly named a gluten feed.

It is a wheat gluten. Corn, we know, does not contain gluten, but the product made from corn, although sometimes called a gluten, yet it is to some extent something else. This, however, is a gluten feed; it is made from the gluten of the wheat. The protein runs from 40 per cent. up to 60 per cent. and over. In protein it is the cheapest thing on the market. It contains, however, another ingredient which we have noted recently, and that is rice hulls. As I have remarked, that makes a very rich food. It contains a small quantity of rice hulls. It is sold on a guarantee and is certainly a remarkably rich product.

Another product of recent introduction is the broken waste of our broken peanuts. That is also placed among the concentrated feeds and is worthy of attention. I cannot tell how it will agree with Connecticut cows. Southern cows are more used to it, but certainly it analyzes well and is worthy of note.

Now, a word with regard to feeds that have no business to be sold. These are largely mixed feeds or bran. Last year we found two or three lots of some of those so-called feeds which were more or less adulterated with corn cob, ground corn cob. One of them contained something like a quarter of its weight in ground corn cob. The price, however, was the same as for good wheat bran. The value, however, to the feeder was possibly $5.00 less. So, roughly figured, you might say there was a loss to the farmer of $5.00 or over on that product.

During the past year we have run across none of this particular bran, but two or three other kinds of mixed feed have been found containing a large admixture of corncob — I have forgotten the name of the manufacturers. When you go home, in buying products of this kind, I wish you would keep watch, and if you find any of these kinds of feed on sale let us know. Another is one adulterated with corn bran. I do not say that corn bran has no feeding value, it has. It should not, however, be sold for the price of wheat bran, and feeds adulterated with it are not, of course, worth the same price. They contain a lower proportion of protein, the proportion decreasing from 16 to 18 per cent. down to 12 or 14 per cent., so you see there is a very decided loss in feeding value. Corn bran is perhaps not so objectionable as corncob, but still it is, none the less, adulterated, and, if it is to be sold, should be sold for what it is.

Mr. HOYT. Have you come across any of this H. O. feed?

Prof. WINTON. I was going to say a word about that. I don't know as I care to go into detail about it at present. All I have to say about them is that they belong, perhaps, in the same class as mixed fertilizers. You know a scientific man does not like to advocate the use of these ready mixed feeds any more than a physician will advocate the use of patent medicine. A physician always has on his list the drugs which go into these proprietary articles, and he thinks he is better fitted to prescribe the proper mixture for each particular case. And so most of the Experiment Station people advocate in some degree the mixing of fertilizers when it can be done properly, and unquestionably cattle feeds should be treated in much the same way. These feeds are mostly composed in large part of refuse stock mixed in with something else, and put on the market in that way. They are ground feed, or the by-product found in the manufacture of other feeds. They are put up under the head of horse feed, and cow feed, and other various names, so you see we have special feed for different animals just as we have special fertilizers for onions and for other plants. You see that the cattle are getting now what the plants have been getting heretofore. They are getting special mixtures supposed to be made up to suit their particular requirements. Now, as I said a moment ago, these feeds are largely mixtures of waste stock put in with corn meal or something of that kind to make them go, but the question comes up all of a sudden: why does the manufacturer prepare these things ready for use? Of course, he knows that the farmer gives his stock bran, and he gives them cotton seed and linseed, but he has not as a rule heretofore bought them mixed. Now, the question arises, why has the manufacturer been anxious to save the farmer the trouble of mixing? Is it so much trouble for the farmer when he puts the feed into the manger to mix it up a little? Of course, if you take that view of the case there is a good deal to say, but in the case of cattle foods it can hardly be said that the manufacturer is saving the farmer very much trouble.

Now, in the case of an oatmeal factory, they have a great amount of refuse oat hulls, and, in justice to them, also, it should be said that they have some inferior oats and small sized oats. That stuff has to be worked off. Now, they want to make them into a cattle food; how are they going to do it? They have got to put it up in some form so that it will be palatable and so as to give a fair analysis. So in order to make it marketable they put in other things, things that will raise the low grade of the by-product included so as to make the stuff acceptable to the cattle, and, as a consequence, in some cases, they get a food that has a good feeding value. Now, then, they have all sorts of mixtures, they are never twice alike; no mixture can ever be twice alike; they vary greatly, and whether it will pay to buy them or not must be determined each time. You must look at the price and you must look at what they contain, and then you must consult such tables as these and see what you can ascertain about them. You must inform yourself upon the question whether it is more profitable to use things like these or to use the old-time product on the farm.

The PRESIDENT. Do you find that the H. O. has varied very materially?

Prof. WINTON. That runs quite uniform. There are some slight changes, of course, as the mixed product will not run as uniform as the natural product. I wish that every farmer would call attention to all new feeds on the market and would send us samples before purchasing. We will try and give an early report, and give as much information as we can. An analysis of these feeds will very quickly determine their value.

Mr. BARBER. I would like to inquire if you are familiar with rye middlings, and what you think of that.

Prof. WINTON. Yes, with rye bran. That is hardly distinguished with ordinary middlings in bran. There is just a little of it on sale in the State. It runs a little lower in protein than wheat bran, but there is a good product and is unadulterated, so far as I know.

A MEMBER. How is it about this rye feed?

Prof. WINTON. That is very good.

A MEMBER. Did I understand you that this buckwheat was rich in protein?

Prof. WINTON. The buckwheat itself is not particularly rich in protein. Some buckwheat flour is rather poor in protein. The richest part is that lying between the black hull and the inner portion.

The SECRETARY. I would like to ask Prof. Winton if he has found any rice flour on the market, as a cattle food?

Prof. WINTON. We haven't found any recently. The nearest we have come to it was rice hulls. Quite a number of years ago we found a sample of cotton seed meal which had been adulterated with rice hulls, but we haven't run across this so far as I remember. There is only a scattered sample now and then.

Adjourned to 2 P. M.

AFTERNOON SESSION.

THURSDAY, December 11, 1902.

Convention called to order at 2.20 P. M.

Vice-President Seeley in the chair.

The PRESIDENT. There are two things on the program for this afternoon which I think will prove very interesting. Prof. W. E. Britton, our State Entomologist, will now address you.

MOSQUITOS AND MALARIA.

By W. E. BRITTON, State Entomologist.

Mr. BRITTON. Mr. Chairman, Ladies, and Gentlemen: At this meeting you have heard papers on various subjects pertaining to agriculture, on the feeding of stock and the feeding of plants, on fertilizers, and the growing of trees and plants, and we will now consider a question which, however, does not concern you in the matter of dollars and cents in the same way that these other questions concern you, but which, nevertheless, is an important one as regards the public health and public comfort.

Several years ago experiments were conducted in killing mosquitos. Recently, however, this subject has been brought up anew, and you have all read the newspaper articles during the last two or three years about mosquitos and their relation to the carrying of various diseases. Of course, we always look at these newspaper stories as if they could not be exactly true, and some of them we know are not. Yet the question of carrying disease by insects is one which has been thoroughly established by scientific investigation, so that the newspapers, so far as this subject is concerned, are not wholly false. We will first consider, for a few moments, the disease known as malaria and its cause. The malarial parasite was discovered in 1880 by a French army surgeon named Laroiant. This parasite of malaria is not like the germ of typhoid fever, diphtheria, and many of the other contagious diseases. It is not a plant belonging to the family of bacteria, but, on the other hand, it is one of the lower animals, one of the lowest forms of animal life. This parasite inhabits the red corpuscles of the blood in the human body. Perhaps you all know that the blood is liquid, and in it are floating around little bodies called red corpuscles and white corpuscles. The red corpuscle is inhabited by this little parasite. Now, this gets into the corpuscles and there increases in size until it fills the corpuscle, and then it divides into a great many separate parts until the corpuscle can no longer hold them, then these are discharged into the serum of the blood. We call these spores. Now, when these spores are discharged into the serum of the blood, that is the time that the chills and fever begin. Previous to this time we do not know that we have malaria, but at this time the symptoms begin of chills and fever, and it is also at this particular period that the use of quinine is most effective; before that it will not do any good.

Now, it has been demonstrated that this organism goes through various stages of development, and it has also been established during the last few years that the different stages cannot develop inside the human body. I have already referred to the chills and fever which accompany this disease, and it is a remarkable thing that while the chills may be at their height, so to speak, the temperature of the blood itself will be very high indeed and yet the person is very cold apparently.

Now, it was suggested in 1882, or within two years after the discovery of this parasite, that possibly insects might have something to do with carrying the parasite or in transmitting it. King suggested that mosquitos probably played an important part in this, but this fact was not established until about two years ago.

Now, these free spores which are thrown off from the corpuscles may again go through the same development as I have related. They may also die in the blood and be deposited by the white corpuscles, but there is still another stage that takes place outside the human body. It may take place anywhere, in fact, outside the human body, and that is what is called sexual generation. These spores then go through a certain development, and the theory is that the two unite and finally form a large spore, and it is here that the mosquito plays an important part in the development of the malarial parasite. While this sexual generation may take place anywhere outside the human body the resulting spore is not found except inside the body of a certain kind of mosquito. Now, our common mosquito belongs to the genus culex — our most common one. There is another genus of mosquito which is now named the anophele, and it is only inside of the body of the mosquito belonging to this latter genus that the full development of the sexual spore is formed.

Now, if one of these mosquitos bites a person suffering with malaria, it draws into the body some of the blood containing some of these corpuscles with parasites in them. The spores from these are taken into the body of the insect and then they go through their sexual development and sexual generation, and these resulting spores are found. They are very much larger than the others, and when they have reached their full size they break open and throw off large strings of small cells which enter the salivary glands of the mosquito, and when that same mosquito bites another person some of this is sure to enter the system of the person by means of the mosquito's proboscis. Now, it does not necessarily follow that this person will have malaria, but this may go on developing inside the human body in the nature I have described and thus give the disease.

Now, while all this was being worked out one thing at a time very carefully, and the scientific part of it was all well developed, there were still needed some practical experiments to show that the thing was right, and in the summer of 1900 two Englishmen named Lowe and Samuels, of the London Tropical School of Medicine, went to Italy, and there, in one of the most malarious districts of the whole country, they built a small five-room house on the Roman marshes and remained there for a period of several weeks. Every one said they would die of malaria. The theory of their experiment was to see whether this would work out practically, and also whether there was anything in the idea that the bad air and the bad gases coming from the swamp would indicate malaria.

They were very careful to keep all mosquitos out of the house. The house was thoroughly screened and the men themselves entered it before sundown every night and remained until after sunrise the next morning. In order to give this bad air from the swamps free access to the room the windows were elevated. There was nothing but screens covering the windows, so there was a free circulation of air. They remained there for several weeks and kept perfectly well.

Another thing which they did was to capture a mosquito which had bitten a person suffering from malaria. I presume they captured more than one, but, at least, they sent some to London, and there took the trouble to have the mosquito bite a person who did not have malaria, or at least it was not known that he had it. The malarial parasites were afterwards found in the blood of this person, and a very marked case of malaria resulted.

Now, a great many arguments have been put forth to show that this has not been demonstrated to be true, yet we can consider that it has been from a scientific point of view and also from a practical standpoint. One of these arguments was that the same kind of mosquito existed in regions where malaria is unknown. That is true. They do exist all along the eastern States and in many regions where they do not have malaria. It is also true that these mosquitos do not have the malarial parasite unless they have first bitten someone who is suffering from malaria, so that that argument is good for nothing.

This mosquito may live in any region for a great many years and not transmit the disease, but if a sufferer from the disease comes into the region and is bitten by one of these mosquitos, and the same mosquito flies away and bites somebody else, why, then they are carrying the disease. So much, then, for a very brief account of malaria, what it is, and how it is carried by mosquitos.

Now, we will consider for a short time the mosquitos themselves. We all know what a mosquito is when we see it; it is too well known to need a scientific description. It belongs to the same group as some of our flies, has two wings, and it feeds by inserting a long tube or proboscis into the flesh and then sucking out the sap, or blood in our case. It feeds on vegetable matter to some extent; we can keep a mosquito for many weeks on bananas, so that animal life is not absolutely necessary for their existence. They breed in the water and, so far as known, all kinds pass through a larva stage in the water. It is a common occurrence to hear people say that they breed in the grass, but that is not true unless the grass is growing in the water. Sometimes, of course, they hide during the day in grass and come out from it at night, but as a rule they breed in standing or slowly running water. They do not breed in swift streams, but in slow flowing canals, in undrained swamps, and in patches of water standing around. These are the places where we find them. There are several generations each season. They may also pass the winter either in the adult stage or in the larva stage. It has been recorded that the larvæ have even been found in the pitcher plant. These are gathered in and in the winter they will be frozen, and, if taken out and thawed, inside will be found mosquito larvæ, which, after being thoroughly warmed up, become as lively as ever.

The larvæ feed upon small particles floating about and upon such minute structures as algae, and upon any small particles of refuse matter in the water itself. One case was cited where the adult mosquitos were reared from the larvæ, and the females have laid eggs in the water without mating at all with the male.

The eggs of our common mosquito, that is of the species culex, are deposited in masses on the surface of the water, and they always float. It is impossible to make them sink. Usually they number from two to four hundred. These hatch in about sixteen hours after being laid, and the larvæ, of course, go down into the water and begin to swim about, and feeding there they become full grown in about seven days, when they change to pupae stage, which is also in the water and which lasts two days longer, so that about ten days are required in warm weather for the development of the mosquito.

The adult may exist for almost any length of time; some indefinitely and some only a short time after reaching the adult stage. We often find them in cellars, where they have lived for many months.

The females are the ones that do the biting, and they always do the singing. The males have a long furry organ coming out from the head which are called antennae, and these feathery organs are said to be aural organs of the male and they are supposed to be made in such a way that they hear the singing of the females.

Mosquitos also have a poison gland attached to their mouth part, and a little poison is inserted probably each time they bite. It is a very active poison, and that is what causes the irritation and swelling.

Now, mosquitos occur all over the world. It is not necessarily the same species in each case, but there are some in the frigid zone and even in Alaska. Mosquitos are said to torment one more there than they do in this climate. As far north as Davis Strait plenty of them are found.

It is a common thought among many people that the mosquito flies long distances, yet it is not true. As a rule they do not fly far, but there are many ways in which they are carried from one place to another. If we have a lot of mosquitos in this neighborhood the chances are that they bred not far from our own door, and the probability of their flying a mile is extremely small. Of course, there are times in the case of a strong wind where they might accidentally be carried some distance, but the chances are much greater of their being carried instead by railroad trains, especially evening trains, than that they are carried by the wind or that they fly. There are many cases on record where certain kinds of mosquitos were not known in many cities and villages in Pennsylvania until evening trains were put on going to those places from the coast. Of course, a train is left at a station and, with the doors and perhaps the windows open in the evening, and these mosquitos fly in and are carried in that way. That is probably the way they are carried from one place to another instead of getting there by flying long distances.

Now, the most common form will breed in a rain-water barrel as well as anywhere else. Dr. Hooker of Minnesota took the trouble to count the mosquitos in a barrel of rain water. He found on July 6th that there were 17,259 eggs, larvæ and pupae, in a single barrel of rain water. These were all taken out, and on July 22d the same barrel contained 19,110 more. That will give you some idea of the rapidity with which the mosquito multiplies.

Now, all this, while it may be interesting to some of you and give you an idea of the rapidity and manner in which the mosquito breeds, yet it is simply introductory to what I want to bring out now, and that is how to prevent them, how to rid ourselves of this pest to some extent.

Now, the malarial mosquito does not breed in exactly the same kind of places that our common mosquito breeds in, neither does it breed, as has been suggested, in the marshlands of the State. They may breed along near the marshes, but they cannot breed where the water is very salt. In fresh water pools, in the hollows, quiet places along by canal banks, and in pools of stagnant water they are to be found, but they are not so apt to be found breeding in the rain-water barrel or tin can thrown on the dump where our common mosquito often breeds.

Dr. Howard, who has written a book on the subject, records many curious instances of mosquitos, and among other things told of a tomato can thrown on a dump which had been filled with water and which afforded a prolific breeding place. Some cases have been found where swarms of them have been bred in some such way as that, furnishing enough for a whole neighborhood. Another case was where a table in a dining-room of a house had had the legs placed in basins of water. It was found that those basins of water contained mosquito larvæ.

In New Jersey they are trying to fight the mosquito on the marshes, and this particular mosquito which breeds there most abundantly is neither the malarial mosquito nor our common culex. It is another species. They are doing this there for the sake of making the land inhabitable. You know that the Jersey mosquito has a very bad reputation and consequently the State has a bad reputation on account of its mosquitos, and it is thought if the marshes can be drained or treated properly, in order to rid them of the mosquito pest, much land can be reclaimed which will be of value for building and for agricultural purposes. This particular mosquito breeds in the brackish water of the marshes. While we have a great deal of salt land in Connecticut it would involve a tremendous expense in this State to do anything of that kind. If that work is required in Connecticut it would involve not only individual effort and the effort of townships bordering on the marshes but, perhaps, that of the State itself. We have in the State of Connecticut, of salt marsh land, something like 34 miles, which equals 22,664 acres, while we have about 1 67/100 square miles of fresh water swamp of the marsh, aggregating over 1,000 acres.

Now, some of the remedies which we employ against mosquitos are filling and draining places where water naturally stands. If we fill up a hole so that water will not stand there, of course we destroy a breeding place. In many cases we can drain off the water so that the water is not stagnant, and thus destroy a breeding place. If it is practicable neither to drain nor to fill an area there are two other things we can do, one is to put oil on the surface of the water to kill the larva of the mosquito in it. The mosquito larva is obliged to come to the surface of the water very often to get air; it breathes the same as we do except that it has a special breathing apparatus coming from the body instead of the head. It has a tube going from the body toward the tail; this tube has to be put out of the water so that it can draw in the fresh air. When we put a volume of oil on the water they cannot get the air without pushing this tube up through the oil. The oil itself may kill them in one of two ways. It may stop up their breathing apparatus so that they are suffocated or it may kill them if taken into the system.

The PRESIDENT. What kind of oil do you recommend using?

Mr. BRITTON. Any kind of oil will do it, but we have found that crude oil is the best, crude or fuel oil. It is cheaper and will spread well over the surface of the water.

Now, if you wish to use this water for dairy purposes or for any other purpose so that we do not wish to put oil on it, the next best thing is to stock it with some kind of fish to eat the mosquito. The mosquitos do not breed in water where fish are abundant. Of course, in pools or stretches of water filled with grass or weeds there is always a chance around the edges for mosquitos to enter places where the fish cannot swim after them, and of course the fish do not kill these out. The number in such cases is comparatively few. Dragon flies, were they sufficiently abundant, would hold mosquitos in check, but it has been shown very well that they are not, and, as we have no method of making them multiply artificially, they are not a very great factor in controlling mosquitos.

On this question of oil perhaps I might say this: Dr. Howard used it as far back as 1867, using it on some where he found the mosquito breeding in a watering trough. In 1891 he conducted some extensive experiments on the Atlantic coast for the purpose of getting at the proper use of the different kinds of oil and the quantity required to cover a given space. It has been ascertained that it is necessary to use something like an ounce to each fifteen or sixteen square feet, and this may be thrown on top of the water and will spread to cover the whole surface. In an infected district it is an important thing also to screen our houses thoroughly if we wish to keep free from malaria, and also if we wish to be rid of the common mosquitos which torment us but which do not produce or carry malaria.

Now, perhaps this subject will not appeal to the farmer as strongly as it does to some of the people who live at summer resorts, but there probably is not a farm in this State where the mosquito is not a great nuisance, and the chances are nine out of ten that the mosquitos which cause the trouble breed within a few feet of the house and a very little effort on the part of the owner is necessary to prevent their growth and remove the nuisance.

I see my time is about up, so that I will now close. I thank you for your attention.

The PRESIDENT. Will you inquire of Prof. Britton, have you any questions? I know we would all like to get rid of the mosquito sometimes.

Now, we are to have another address which comes on at this time, if there are no questions to ask of Prof. Britton, and that is by Dr. Clinton of the Connecticut Experiment Station.

PARASITIC FUNGI.

By Dr. G. P. Clinton,

Of the Connecticut Agricultural Experiment Station.

It is my purpose to treat in this paper of some of the lower forms of plant life known as parasitic fungi. To some, possibly, the words "parasitic fungi" may convey little or no meaning. Perhaps we may obtain a clearer idea of the subject if I spend a few moments in considering the relation of these plants to the great groups that go to make up the vegetable world.

It was less than one hundred and fifty years ago that Linnæus, the father of scientific botany, divided all known plants into two great groups, namely, the flowering, or those that reproduced themselves by means of seeds, and the flowerless, or those whose method of reproduction was more or less obscure or unknown. In the former group were included some ten thousand kinds, while the latter were a few hundred in number. Since the days of Linnæus, through the perfection of that most wonderful of instruments, the miscroscope, and through the labors of numerous men whose lives have been given to the study of botanical subjects, our knowledge of the plant world has been greatly enlarged. The ten thousand species of flowering plants have increased to over one hundred thousand described forms and the few hundred of flowerless ones to over seventy thousand, most of which were never seen by that great botanist of the last century or, if seen, were unrecognized by him as true plants. Today, instead of but two great groups botanists recognize at least four, the flowerless forms of the older investigators having been split up into three groups of equal rank with the flowering plants. These four great divisions may be described as follows:

1st. The flowering plants, including, as I said, over one hundred thousand kinds, are the most common, and, at the same time, the most highly developed members of the vegetable kingdom. They usually have considerable differentiation into various organs, practically always having roots, stems, and leaves, and perpetuate themselves, as you know, by means of seeds. Examining their parts under the microscope we find that the cells of which they are formed vary greatly in character. This group includes nearly all of what most persons recognize as plants, namely, all our herbs, shrubs, and trees.

2d. The next lower group in the vegetable world is that of the ferns, and these differ chiefly from the flowering plants in that they do not have seeds but are reproduced by means of much smaller and simpler bodies called spores, which are usually borne in little clusters on the backs of the leaves. As a whole the ferns are not as highly developed as are the flowering plants, and belong to a group that has seen its greatest period of development in the geological ages that are past. There are less than thirty-five hundred known living species in this group.

3d. The third group, the mosses and allied plants, as with the ferns, reproduce by means of spores, but are much simpler both as to their organs (the separation into roots, stem, and leaf not always being carried out) and as to the cells which make up these parts. They are small in size, as a rule being three or four inches or less in height. They occur in most regions of the world, and in this locality, while not abundant or prominent, are still easily found on search. Altogether they number something over three thousand kinds.

4th. The remaining plants are usually placed in a fourth group called thallophytes, because with them there are no such divisions as root, stem, and leaf. They are also made up of cells very similar in character and reproduced as in the two preceding groups, by means of spores. They are the lowest and simplest forms of plant life, being usually quite small, frequently too small to be seen by the naked eye. However, they are rather common, as about sixty thousand kinds have already been described. The thallophytes includes the algae (the green slimes of fresh water and the sea-weeds of salt water) and the fungi, the plants about which I am to speak.

Having thus placed the fungi as the lowest forms of plant life let us consider, in a general way, something of their common characters and of their nature before turning our attention to a brief consideration of some of the special forms that have been found injurious to the cultivated plants of this state. It is a fact that the flowering plants and the fungi are by far the most important of the preceding groups to man, the former, because they are the source of the great share of his food, the material for his houses, clothing, etc., and the latter chiefly because of the diseases they produce in both plants and animals, although in part they are also exceedingly useful friends.

The most conspicuous of the fungi, as far as size is concerned, are the toadstools, puff-balls, etc. The smallest are the bacteria, so small, in fact, that usually it would take millions of them placed side by side to cover the area of a square inch. The molds that appear on canned fruits, stale bread, or decaying leaves, are also plants belonging to the fungi. Then there are those forms occurring on other living plants, as the rusts and smuts of grain, the scab of apples, the mildew of grapes, and the various leaf-spot fungi.

You all know that plants differ from animals in part because they have the power of taking directly from air, water, and soil, certain substances which they elaborate into food, and then, as with the animals, use this food for growth. The thing that enables the plant to accomplish this is chlorophyll, that substance which gives the green color to leaves. All four groups of the vegetable world, except the fungi division of the lowest, are possessed of this chlorophyll. The fungi, lacking it, are like animals in that they must have food that has already been elaborated. This they obtain either from decaying animal or vegetable matter, as in the cases of toadstools and molds, or they steal it from living plants or animals, as in the case of our rusts, smuts, etc. These latter we call parasitic fungi, the kind of fungi we are especially interested in today.

A parasitic fungus, then, we have learned, is one of the lowest in development, both as to general structure and character of its cells, of the forms of plant life. It reproduces by simple bodies called spores, is usually microscopic in size, and lacks the green matter necessary to the direct manufacture of food. Let us now consider more minutely the structure of these plants. In general, we find that they consist of two parts, namely, spores and mycelium.

Spores. These, as you have been told, are the reproductive parts, corresponding in a general way to the seeds of flowering plants. Though usually the prominent part of the fungus they are quite simple, consisting of one, or at most a few, quite similar cells. They are generally produced in such abundance that the mass of them becomes quite evident to the naked eye. It is almost entirely upon the shape, size, color, and manner of formation of these bodies that we distinguish between the different species. It is also a common thing for the same fungus to have two or even three or four different kinds of these spores, but, as a rule, all but one kind are short lived, growing soon after their production and being easily killed by unfavorable conditions for growth. Such may be called summer spores, and their object is to propagate the fungus as widely and quickly as possible. They are, therefore, usually formed on the outside of the infected plants or so near the surface that they easily break through by their rapid growth. Then there are also produced spores that are thick walled or are protected in special pockets or sacs that do not germinate readily and are not easily killed by unfavorable conditions. These we may call winter or resting spores, and their object is to carry the fungus over the winter or unfavorable periods for growth. These bodies are frequently produced inside the tissues of the infected plant, as it is not so necessary that they be easily scattered.

Mycelium. This, we might say, corresponds in a way to the stem and branches of the flowering plant. It is the growing or vegetative part of the fungus. This mycelium is not usually a conspicuous part, however. First, because it is frequently produced out of sight, entirely within the infected plant, and second, because it does not vary so widely in character in different fungi as do the reproductive parts. It is generally made up of thread-like cells more or less branched and usually colorless. These threads by growth push their way in or between the cells of the plant they inhabit or they merely spread over the outside, sending a few threads for nourishment down into the plant tissues. From certain modified threads of the mycelium the spores are produced, and the spores, when they germinate, send out short thread-like growths that, under favorable conditions, develop into the mycelium.

The life history of a parasitic fungus is then something as follows: When favorable conditions present themselves the spores of the fungus germinate. These conditions are sufficient moisture, a certain amount of heat, and the right internal condition of the spore. But besides having these conditions the fungus must germinate in a certain place in order to be successful. That place is on the plant which it is to inhabit. We call this plant the host of the parasite. There is a close relationship between the host and its parasite. So close, for instance, that certain fungi will only grow on a single species of host plant, others only on those that are closely related. There are some, however, that have quite a wide range of plants that they can infect. Finally, the fungus must generally germinate at a certain place on its host. Usually the fungus must be started to germinating on the plant either when the plant is just beginning to grow or on certain parts of it when the tissues of those parts are young and easily penetrated by the fungus germ threads. This infection may take place through the germinating seedling, the stem, the leaves, or even through the flower parts. It is because of these various essential conditions to successful germination that the fungus produces such large numbers of spores, for the chances are that very few of them will reach all of these requirements. If all of these conditions be supplied, however, the germ thread sent out from the spore pushes its way over the leaf surface until it comes to one of the little openings that lead inside, down which it grows into the tissues beneath, or else it bores its way directly into the leaf, or whatever part of the plant it is to infect. Once inside, this germ thread, by growth, develops between the cells of the plant, and thus forms the mycelium. With some species, however, the mycelium is formed entirely on the surface of the plants, only the short food branches being sent inside. Sooner or later the mycelium becomes more prominent in places and forms those special branches from which the spores are produced. Usually the summer spores are first formed, and these being very abundant on or near the surface are easily scattered to other parts of the plants, thus spreading the disease. It is a curious thing that not uncommonly, when there are two or more of these summer spore stages, they are developed from and after one another, sometimes not only on entirely different individual plants but even on different species of plants. When such conditions occur the life history of the fungus becomes quite complicated and very difficult of tracing, and so not infrequently what originally were thought to have been entirely different fungi have been found, upon careful study, to be merely stages in the life cycle of a single fungus. Finally, the mycelium produces the winter or resting spores, and these serve as a means of new infection at the proper time the next season.

The fungus to go through this more or less complicated development needs food. The little that is stored in the spore is soon exhausted, and then the fungus must look to its host for the proper supply. The food of the plant is situated within the cells, and as most of the mycelium usually pushes its way between these cells it is chiefly the short food branches that penetrate into the cells that act as food gatherers. It may be that in some cases this use of food on the part of the fungus does not mean a corresponding loss to the plant but only the necessity of manufacturing that much more, but it is more likely that in many cases the plant suffers directly from this act of robbery on the part of the fungus. The parasite does not often stop with this injury, however, for it usually causes a deranged or even diseased condition of the plant cells. This is carried far enough in some cases to destroy or even prevent the formation of very essential parts of the plant, as for example, where smut prevents the formation of seeds in grain. It is when the fungus thus injures some plant that is of economic value that it becomes of especial interest to man, particularly so when the injury is severe or widespread.

Perhaps we may be able to better appreciate the economic relations of these parasites to our agricultural operations if we consider for a moment the injury they sometimes inflict on their hosts, and the consequent loss in dollars and cents to man. Take hog cholera, for instance. No farmer needs to be cited special cases to know that this is an injurious and hence costly disease, though perhaps he might not know that it is caused by one of the lowest forms of parasitic fungi, the bacteria. The loss caused by the smuts of wheat and oats has frequently been estimated by men competent to know, to amount in the different States in a single year up into the hundreds of thousands of dollars.

This will not seem so vague, possibly, when I state that on a trip made into several counties of southern-central Illinois some years ago, I found that out of the one hundred oat fields visited that there was an average loss of about fifteen out of every one hundred heads, due to the loose smut, and that in one or two extreme cases this went as high as thirty-five out of a hundred. These are the results obtained from a careful survey and the counting of several thousand heads in every field. Smut, however, it must be said, was especially bad in this district. Take the grain rusts, for another example. It is a hard matter to determine just how much damage is done by these, as the seed of the grain is affected only indirectly by the attack of the fungus. Yet, in Australia, the loss became so serious that a commission was appointed to make extended investigations, looking to the prevention of this their most serious grain pest. Potato blight, a trouble due to a mildew that grows in the leaves and tubers, has occasionally been so bad in Europe as to practically destroy the entire potato crop of certain localities. This was so injurious at one time in Ireland, where the potato was largely the food supply, that the loss of a couple of crops in succession caused a serious famine. A few years ago black rot became such a serious malady in the vineyards of France that the government sent botanists to this country to study this fungus in its native home. Brown rot of the peach, and you find more or less of it in every box of peaches you buy, in one year in a single county in Maryland destroyed over four hundred thousand baskets of this fruit.

These examples are sufficient to show that parasitic fungi frequently cause damage enough to incite man to try to prevent their ravages. At first the attempts were desultory and necessarily ineffective, but with a proper understanding of the nature of these plants and with detailed study of the life history of each form have come methods that are now quite successfully employed in the preventing, controlling, or checking many of the most serious of these. In the first place, it may be stated that the treatment of plant diseases depends almost always for its successful outcome upon preventive rather than upon remedial measures, that is, we must aim to prevent the fungus from gaining a foothold in its host rather than attempt to help the plant after the fungus has firmly established itself. I have selected for brief consideration three general methods that may be employed in warding off or controlling these foes. They are selection, pruning, and treatment with fungicides.

Selection. This may be used in several ways to lessen the injury done by fungi. It is known, for instance, that certain varieties of some plants are less able to withstand the diseases common to that species than are other varieties. For instance, the red rust of blackberries is more likely to occur on the variety Kittanning and injure it than it is on the Snyder blackberry. With wheat there seem to be some varieties that are somewhat better able to resist the rusts than are others, and our government has taken up the question of finding out those varieties, and, with them as starting points, by selection and by crossing is striving to obtain a desirable variety of wheat which is rust proof. Selection may also be carried out in choosing plants that are known to be free from disease, or the spores of the disease producing fungus. For example, peach yellows, black knot, etc., have been introduced into places by bringing stock from a locality in which these pests were common. This manner of spreading disease is so well known that certain States have passed laws against the importation of nursery stock likely to introduce such obnoxious forms. Again, with a number of plants, the spores of certain of their fungi are known to be carried on the seeds, and seeds and spores germinating together the host becomes infected. The choice of seed produced from plants free from the disease is a desirable procedure in such a case. This can be done with advantage with wheat and oats to avoid the smuts of those plants. Selection of different land is often a way to avoid certain fungi, as onion smut, the spores of the fungus becoming established in the old soil, serving to infect the crops from year to year. The selection of land and seed free from the germs is sometimes made for potatoes to avoid scab.

Pruning. Another way than selection of limiting fungus foes is by pruning. This, however, is largely a remedial rather than a preventive measure. The cutting off of infected parts below the lowest diseased point has been found, in some woody plants, a means of avoiding the spreading of the disease and the doing away of a source of infection for other plants. This is said to be the only way to treat the black knot of the plum and cherry, a disease which is very bad in some of our eastern States. Winter pruning of pear trees infected with blight is also recommended by one who has made a special study of this disease. All pruned parts in such cases should be burned. Somewhat similar to this operation of pruning is the destroying of infected fruit, thus removing a menace to the sound. In the case of the brown rot of plums the diseased fruit that remains on the trees or ground is a means of spreading the disease another season.

Fungicides. A third method of preventing plant diseases, by the use of fungicides, is one that has been perfected largely during the past ten years, and chiefly through the efforts of investigators in this country. It is a method of combating fungus foes that is being more and more used, especially in horticultural districts. Fungicides may be used in two general ways — to soak the seed, or as a spray to cover those parts of the plant through which the fungus gains entrance. Its object in either case is to kill the spores that have been carried to the treated parts, and thus lessen the danger of infection. Seed treatment of potatoes with corrosive sublimate or formalin for prevention of scab, and of oats and wheat with hot water, or blue vitriol, or formalin, for the prevention of smuts, have been found to be quite successful operations. With the potatoes, however, the seed must also be planted on land free from the disease germs. In the case of spraying, the copper salts have been found the most effectual of the many chemicals tried. The fungicide known as Bordeaux mixture, made from copper sulphate, lime, and water, has given the best satisfaction, and is the spray now generally used. Spraying has been used in preventing or lessening the injury done by fungi in quite a number of cases, although it is not a preventive for all such troubles. To be successful the spray should be applied to the parts where the fungus gains entrance to the plant as soon, or before, the fungus spores first begin to germinate, and the application should be repeated from time to time, as the spray wears or is washed off, during the season in which there is danger of infection.

From what has been said we should have some idea, at least, as to the position and character of parasitic fungi, the damage they may cause, and the means that may be employed in combating them. We may now turn our attention to the consideration of some of the general groups of these plants, taking notice in a brief way of such of the specific forms as have been found injurious in this State.

Bacteria. Lowest among the forms of fungi, in fact the lowest living things, are the bacteria. It is now generally recognized that the contagious diseases of animals, such as cholera, smallpox, tuberculosis, etc., are caused by different kinds of these organisms. It was not so early known that they also caused diseases in plants. Professor Burrill of the University of Illinois, in working with the malady of pears known as blight, was the first to prove that bacteria could cause disease in the vegetable kingdom. Since his investigations quite a number of plant diseases have been traced to this group as the cause. Bacteria are exceedingly small, the highest powers of the microscope being necessary to study them. They are also exceedingly simple, consisting of nothing more than single cells or lines or groups of cells loosely bound together. These cells may be spherical, rod shape, or even spiral. They are sometimes provided with a little whip by which the organism lashes itself rapidly about in water. They multiply by each cell dividing into two or more cells, these dividing similarly at so rapid a rate that in a few hours the original cell has become the ancestor of thousands of individuals. In this State, besides the blight of apple, pear, and quince, there is a disease of corn, usually showing as discolored areas on the inner surface of the leaf sheath or by the rotting off of the young plants at the ground, and another of sorghum, showing as red blotches on the leaves that are caused by bacteria.

Smuts. You are all familiar with those rather conspicuous and finally dusty outbreaks that occur on the stem, ears, and other parts of corn, and that are commonly known as corn smut. The smuts are generally characterized by the breaking-out on special places on their hosts of such dusty outgrowths, though usually much less conspicuous than in the case of corn. These sooty masses are made up almost entirely of the spores of the smut fungus, and when I state that a little bunch of them the size of a pinhead consists of thousands you can judge somewhat of the countless numbers that go to make up one of the corn smut boils. The vegetative part of the smut fungus is entirely concealed, consisting of fine threads that run within the tissues of the host plant; and until the fungus begins to form its spores one is unable to tell an infected from a free plant. With many of the smuts infection takes place through the germinating seed, the mycelium following the upward growth of its host. At the proper time the fungus threads multiply abundantly at some special place in the plant and give rise to the spore stage. In broom corn it thus takes one or two months after penetration of the germinating seed before the presence of the fungus is shown by the production of its spores in the flower parts of the host. As a rule the smuts are among the most injurious foes of our grain plants. In this state we have the grass smut of red top, which forms dusty elongated outbreaks on the leaves; the loose smuts of wheat, oats, and barley, which destroy all the grains in the heads; the stinking smut of wheat, which transforms each grain into a sooty body without destroying its shape; the grain smuts of broom corn and sorghum, which affect the seeds like the last; the leaf smut of rye, which forms dusty areas, usually on the inner side of the leaf sheaths; and the smut of Indian corn.

Rusts. These are fungi that also do considerable damage to our grain crops. They usually show as numerous rounded or elongated black or reddish small outbreaks on the leaves and stems of the infected plants. These little masses of spores are more compact than with the smuts. The rusts are also more complicated in their life history because of their having as high in some cases as three or four kinds of spores. The spores send their germ tubes into the leaves, giving rise to a mycelium that spreads but a short distance from the point of infection, when it forms the red colored summer spores. These occur just beneath the skin of the leaf, which is easily ruptured by their growth, and then they are scattered by the wind to other parts of the plants or to new plants. The winter spores are usually of a darker color and with thicker walls, and may or may not occur on the same plant with the summer spores. Besides the grain rusts we have a rust on corn not usually causing much injury, a rust that is quite prominent on the leaves of beans; an apple rust, which at times causes serious damage to the foliage, and whose winter spore stage occurs on such a distant plant as the cedar tree; the orange rust of raspberries and blackberries, which is so serious as often to kill the infected plants, and many other rusts on plants of less economic importance.

Downy Mildews. These fungi usually appear on the leaves as more or less dense whitish patches. Taking some of the threads that make up this outgrowth and examining them under the microscope we find that they are the fertile branches of the fungus. These are given off from the mycelium within the leaf through the little openings in the skin, and after reaching the air they branch somewhat after the manner of miniature trees bearing the summer spores on the tips of the branches. Later in the season the mycelium gives rise within the leaf to large round winter spores. Of all the downy mildews that of the potato is perhaps the most injurious, this being the fungus that brought on the famine in Ireland. The grape, lettuce, and cucumber and musk melon, are also the hosts of injurious species of these fungi.

Powdery Mildews. The powdery mildews are not very closely related to the downy, though they have somewhat the same appearance as seen on the infected leaves. Instead of growing in patches they generally spread over the leaf, forming a whitish growth somewhat resembling a coating of cobwebs. These fungi grow almost entirely on the outside of the plant they infect, only short food branches being sent down into the leaf tissues. The mycelium spreads over the surface as numerous branched white threads, which eventually give rise to simple upright fertile branches from which, chain fashion, are produced the summer spores. The winter spores are formed later in the season in a somewhat complicated manner, being produced in sacs that are borne inside of spherical colored receptacles. These receptacles can barely be seen by the naked eye as little black specks among the mycelium. One species of these mildews is almost sure to be found on lilac leaves late in the fall. Young cherry trees are also very apt to be infected by another form, and at times considerable damage is done to nursery stock of this plant. Another species commonly occurs on the grape.

Miscellaneous Fungi. Besides the preceding groups there is a great number of fungi belonging to various classes that occur as parasites of our cultivated plants. I will not take up further time with a description of these forms, among which are the scab of apples, leaf blight of pear, black knot and brown rot of the plum, and the many leaf spot fungi of various plants.

In concluding, let me say that if you find any part of a plant having a diseased area on it you can generally decide that it is the result of some fungus at work there. If interested in determining the special cause and nature of such injury the botanist of the Experiment Station is ready so far as possible to make specific determinations of such specimens as are forwarded to him.

DISCUSSION.

The PRESIDENT. What do you advise as to spraying for the rot of grapes; do you advise making the first spraying very early?

Dr. CLINTON. Yes. For the rot of grapes it has been found very essential that the first spraying be made before the leaves come, very late in the winter on the naked vines. The second spraying should be made soon after the leaves begin to unfold, and the subsequent sprayings thereafter as often as necessity seems to demand. The later sprayings with Bordeaux mixture may be objected to on account of the sediment deposited on the fruit as a seeming injury to the fruit. There is more or less prejudice against it for fear that it is poisonous. Now, Bordeaux is not a poison in the sense that insecticides are usually poisonous, so there is no danger in this respect. Even if there was much sediment left it would soon be washed off from the berries. Of course, this operation takes place comparatively early in the season and there is a considerable time before the fruit is used as human food.

The PRESIDENT. I know it is a difficult thing to keep grape vines free from this, and I was anxious to know what your opinion was. You recommend that it be done very thoroughly?

Prof. CLINTON. You must be thorough, especially if the disease is badly established. It sometimes takes one or two seasons to get it into shape. The success will depend largely upon the way in which it is done. Some people have success and others do not — depending upon the thoroughness with which it is applied and upon keeping it up.

A MEMBER. Can the doctor give us any information about this blight that comes on the potato vines?

The PRESIDENT. I should like to hear that discussed very much indeed. I have had some experience with that myself, and I know that it will appear in almost twenty-four hours upon a crop which you think is entirely free.

Prof. CLINTON. Here is an illustration of one of these blights which I will show you: The fungus seems to be a species of the mildew that I spoke of. It appears upon the leaves through the warm weather of July and August. It comes to the surface and throws out these thread-like appendages which penetrate the leaf. This is a very insidious form. It is the disease that was prevalent in Europe and which has wiped out entire crops and produced famine in Ireland. After the first of September it is almost impossible to see it. Of course, as I have already said, in regard to some of this fungus, it may not injure the tubers. It depends upon the weather. If the season continues moist there is more danger than otherwise. Dry weather will check it, and then later on, if there is any moist weather, it will begin to develop somewhat again. Experiments have been carried on in Vermont for years to find a remedy against this disease. Experience seems to show that beginning about the first part of July and spraying three or four times thoroughly with Bordeaux mixture will have some effect. I tried some experiments upon a patch of potatoes after the disease had become established to see if it would have any effect. I was successful in preventing the blight on that patch to a great extent, and when I compared those that had been treated with some that were unsprayed the difference was very wide between the two. While I did not expect to obtain as good a result from those which were not sprayed yet I was gratified at the result of the experiment. It has been found that they will always give a greater yield where the spraying is thorough and it is done in time. I would not advocate it if applied late.

The PRESIDENT. You think it may do some good in the early stages?

Prof. CLINTON. Oh yes, I am quite certain of that. You know it begins to come on between the middle of July and August. Of course, the seasons vary some, and this will vary some on that account. If the season is right there is likely to be a considerable development of the disease. In a dry season it would not do the damage it will do in a moist one.

Mr. PLATT. Does the use of the Bordeaux on any kind have any exhilarating effect on the leaves, that is, to make them larger and better able in any way to carry on the functions of the plants?

Prof. CLINTON. It has been found with certain things, and especially with potatoes, that it did have some influence of that kind. I tried an experiment in Illinois some years ago, when I found that the early blight on potatoes was due to fungus troubles. There I got a decidedly increased yield from those that were sprayed over those that were not, although there was no fungus on either. But it has been found to be true by investigation that there is some beneficial effect. I do not know whether it would hold good with other things altogether, but with sprayed potatoes it has been found that they do yield a greater quantity. It will do no harm for you to spray them anyhow.

Mr. PLATT. The point that I had in mind was this: whether the sprayed leaves would remain on a tree or plant much longer than the unsprayed. I have been of the opinion that that was so. I think it can be seen on the currant bushes sometimes. They frequently shed their leaves in the early autumn, but if the bushes have been sprayed the leaves can be kept on them until October. I don't know what part fungus diseases play in causing the shedding of the leaves on unsprayed currant vines, but it has this effect on currant leaves which have been sprayed that the sprayed ones will remain on the bushes late and the unsprayed ones will not.

Prof. CLINTON. I think that is so. It has been shown in the case of apple scab. On the sprayed plant they retain their leaves much longer and it has a tendency to prevent the scab.

Mr. PLATT. And are not those leaves giving life to the tree, which remain on it so long?

Prof. CLINTON. That is illustrated in the case of potatoes during the last few weeks that the vines remained green, when a large part of the nourishment is stored up in the tubers. If you can lengthen that, keep them alive at a time when there is a large amount of food stored, it is to the advantage of the crop.

A MEMBER. I would ask if you have made any experiments in spraying melons or if spraying with Bordeaux is of any use on the vines of melons or canteloupes?

Prof. CLINTON. I have been informed somewhat of your troubles with those vines, but as I came into the State in July I did not know anything about the disease personally, and then it had become established. I tried it in that case as in the case of the potatoes, but found it did no good. I knew of one or two who sprayed, and they claimed that they were able to keep the plants alive and that the crop was benefited. I am inclined to think, however, it will be a question whether there would be any financial gain in it or not. In order to be successful you must begin very early, as it is rather a difficult trouble to handle. This mildew that grows on the vines — the fungus breaks out on the under side of the leaf and spraying does not touch that part. These vines are different, of course, from upright plants where some of the spray will reach both sides of the leaves. When the fungus gets started in a field of melons, if the season is right, warm and moist, wherever the spore falls on a drop of moisture, there is nothing to prevent its gaining an entrance and doing damage. If that happens to be on the under side of course the spray does not reach it in all cases. Where it falls on a drop of water on the upper side, where the fungicide is, it will prevent it. So I think it is a question of beginning very early, of being very prompt and watching very closely, and that involves the question of whether it can be carried on to financial profit or not. Possibly some experiments will be conducted which will show how that can be better overcome.

It has been found, however, that this same disease on the cucumber can be treated, and it can be done to financial advantage. In the case of the cucumber it has been found that this disease does not kill outright, remember, as it does the melon, so that the cucumber vine can go on and produce a few cucumbers. In the case of melons, on the other hand, it strikes them suddenly, and the effect is most disastrous.

The SECRETARY. If there are no other questions I have one or two in the question box which I would like to offer. "What is the New Haven Experiment Station doing for Forestry?" Will Mr. Mulford answer that?

Mr. MULFORD. Not long ago I was talking over this matter with some men in one of our towns in the northeastern part of the State, as to the specific objection that they had to establishing a State park, when I ran up against this proposition. One of the men said that he was going to do all he could to prevent any State park coming into his vicinity because of the development of game. Now I think that is rather a common idea of what forestry is. Some people think that the movement means game or fish. A good many more people think it is landscape gardening, the setting of trees along the streets and roads, also the care of parks and things of that kind. Still others think that it means the putting aside of large areas, which are never to be touched, for the purpose of growing timber, etc. Now all of these things are equally far from the truth. Forestry means the care of the timber crop. It means that we will cut off the tree when it is ready just the same as we will cut any other crop. But it does not mean these other things.

Now there is a great lack of judgment and a lack of American experience to guide us in the work in our wood lot. The art of forestry has been well developed in Europe, but it is such a new thing here that we hardly know just what we want to do in regard to a great many of the details. It has come about, however, that the New Haven Experiment Station has added its department of forestry to its other lines of activity. The forestry work was started a year ago last spring, and one of the lines of work that has been laid out is that for the reclaiming of idle land. The station owns one hundred acres of land in the town of Windsor in the Connecticut valley; land which is too poor for agricultural purposes. You will see right here that our plan of forestry does not contemplate the taking of any land which is adapted to crops of any kind. I understand that there were some remarks made here the other evening that it was proposed to take for forestry lands that were adapted to cattle raising. If they are adapted to cattle raising we do not want them. There is going to be no conflict in Connecticut on that point.

On this land in the northern Connecticut valley we are trying to find the best way and the cheapest way to establish a forest on such land. We are also trying to find the different kinds of trees best adapted for the soil. We are experimenting with chestnut, and red oak, yellow oak, tulip, cottonwood, white pine, yellow pine, Norway spruce, and so on. We are trying different ways of planting and of sowing the seed in this sandy soil instead of planting. We have a nursery established in which there are about 250,000 young trees of various kinds. What we have planted outside of the nursery includes about 20,000, covering several acres which have been seeded. This work, however, is of secondary importance. As has been stated before, it is not more wood land that we need, but it is a better condition of the woods that we have.

The Station owns a little wood land, as poor wood land as there is in the State. It is land which was cut over about five years ago, and then two years ago it was severely burned. We have begun a little work on the treatment of this to bring it up, and in coöperating with private owners. In the central part of the state we have also done some improvement cutting in their wood lots. This winter we shall also do considerable work. One of our leading water companies realizes the importance of keeping their watershed clean and healthy, and has decided to go into forestry. They have opened up some land to be used for a watershed, for the improvement of which we at the Experiment Station are making plans. They are going to begin work on a tract of about 900 acres which they own.

We are doing all we can to reach the small owners of woodland — I mean the owners of small wood lots throughout the State. The station makes this effort in the hope that the owners of these lands may become interested in the work of forestry improvement, and anyone who gives us reasonable ground for thinking that they intend to carry out some practical work in forestry on their land, will be assisted so far as we can. The officers of the Station will visit such property and give any suggestions which it may be in our power to give, in regard to the proper treatment of such wood lots. The expense to the owners will simply be our traveling expenses to and from New Haven. Of course it is impossible to tell exactly what to do in any given case until we are on the ground. This makes it better to visit the wood lots which it is proposed to improve wherever possible.

In addition to this we are doing what we can by correspondence and by talking, yet we do not get right down to the actual work by such means, so well as we do by a visit to the woods and talks with the owners there. I speak of this work, because, as I have said, one of our main objects is to reach the owners of small wood lots; the farmers and other timber owners all through the State.

The State park which was mentioned this morning we hope will serve a further object in providing means for treating woodland by giving a useful object lesson. This State park is also under the management of the New Haven Experiment Station.

Now if there are any further questions, I will do what I can to give all the information possible.

Mr. Woodruff. I would like to inquire whether there is any statute in this State exempting from taxation any property which may be used for improvement in forestry. That is, property that is used for the improved culture of trees?

Mr. Mulford. Yes, sir, there is such a law on the statute book, which I think should be more widely known. It is a decided advantage to any one who contemplates planting or sowing forest trees. I do not remember the exact wording of the statute, but essentially it is this: that anyone who shall plant not less than 1200 trees to the acre, of various kinds — and there are a number of varieties, as I remember it, such as white oak, white pine, chestnut, tulip, and so on — anyone who shall plant not less than 1200 of these kinds of trees per acre shall, when they have reached a certain height — I am not sure whether it is a certain height or a certain age, but it is one or the other — and when they arrive at that, then the same shall be exempt from taxation thereafter for a period of twenty years, or until the timber is cut, provided it be cut within twenty years. Practically it gives an exemption from taxation for twenty years. I am sorry I do not remember the age or the number of years. It has slipped my mind.

The PRESIDENT. There is just exactly one point in regard to this subject that we have been talking about that I would like to bring out. We have been talking about these fungi and this mildew, and perhaps some of us have had the idea that it is not a very practical thing for us farmers, but I think after all it is rather a serious matter, because I have had some experience myself. A few years ago, on my own farm, I had a fine piece of potatoes. They had grown very large and nice, exceedingly so. The vines were vigorous and thrifty and when the time came I dug three cart loads of those potatoes one day and put them into my cellar. The next day there came on a rainstorm, and there were no more of those potatoes dug for three days. At the expiration of the three days I dug three loads more, and when they were brought in I looked at those potatoes and I suspected that decay had set in. I was fearful about having those potatoes stored in my cellar. I did not want them in that condition to come in contact with those which were sound and good. I provided for them outside, and they stayed there. In three or four days it was quite noticeable; the evidence of decay had become quite pronounced. Not any of the decay was found among the three loads that I had dug the three days previous in the same field, and I could not understand why it was, except from what information I had gathered on this subject of fungus diseases. It paid me in that case to have a little knowledge about it, because I kept those infected potatoes away from the others. You see it pays a farmer to have some knowledge, so as to be able to act quickly sometimes. Now I imagine that there is someone here who can tell us exactly what was the cause of that decay. We had, as I say, a warm rain for three days, and it struck the foliage of those potatoes, and if there was anything there it reached the tubers. The remarkable thing about it was the great rapidity with which the disease worked, if it was a disease. Those that I put into the cellar in the first place never decayed a bit or showed any signs of decay, and they were in my cellar for the winter. I wish Dr. Clinton would tell us what the reason was that that occurred.

Dr. Clinton. Mildew of this kind occurs not only on the foliage, but also on the tubers, and it spreads very rapidly. Sometimes it goes like wildfire in the field. One day your crop seems to be all right, apparently clear from any such trouble, and the next day evidences of the disease are quite prominent. Those first potatoes were dug when the vines were green, and they were placed in the cellar before this rain came on, so that the trouble had practically had no chance to come in contact with the tubers to any extent. In regard to the others, the warm, moist weather came on, which caused the spores to fall down on the ground and got on the tubers and began to infect them. So it was spread in that way from the leaves to the tubers. These little spores that are on the leaves fall down on the ground, and when the conditions of moisture are right, they germinate very quickly. These little animal-like bodies come in contact with the tubers, commence to germinate, and commence to rot the tubers.

The President. There was another experience that we had this year also in regard to tubers. In the same field, which was all planted at the same time and cultivated in the same manner, this blight struck a part of it very suddenly; the only difference in the treatment of the field was that a portion of it was fertilized with commercial fertilizer, some with well-rotten barnyard manure, and some was fresh. I was laid aside by my injury and I didn't see it myself at the time the crop was gathered, but I found on talking with my man that a certain part of the field of potatoes had decayed much worse than the other part, and I found that it was where this barnyard manure was spread. When the question came up in regard to fertilizers a while ago I wanted to ask Dr. Saunders in regard to this. I think he did touch upon the question to some extent, but I wanted to ask him to explain it more particularly.

Now, it was a fact my son thought that the potatoes had got to be decayed because the blight had struck them and the decay had already commenced. We took the potatoes off from the field and took them to the cellar and sorted them out as carefully as we could, but we did not get out all of it and then the tubers were sprinkled with slacked lime. They did not decay to any great extent after that.

Perhaps some other gentleman here has had a similar experience; if there is I would like to hear what that experience has been.

The SECRETARY. Mr. President, I find in the question box here some question which Dr. Britton, I think, will be able to answer, and if so, I am sure we would like to hear it.

The first is: "Has the gypsy moth or the brown-tailed moth been found in Connecticut?"

Prof. BRITTON. Mr. Chairman, there have been a great many reports that the gypsy moth had been found in the State, and during the past summer I think there were eight or ten newspaper reports from Hartford that the moth was present in that city. I investigated the subject and I found that the statement had been made by some one who was not familiar with the insect, and that in each case it had proven to be something else. In one case it was a moth somewhat resembling the gypsy moth, and in another case it was one of our larger moths, but one which is entirely different from the brown-tailed moth. The brown-tailed moth occurs up near Boston and in about the same region occupied by the gypsy moth. The gypsy moth has an established colony near here in the State of Rhode Island, at least not very far from Providence.

The State of Massachusetts made some large appropriations for exterminating this moth during the years from 1870 up to 1900, when the State legislature refused to continue the appropriation, so that all the work there against it by the State has been dropped. The only thing that has been done since against it is what individual owners choose to do on their own property. The consequence has been that the gypsy moth has again covered the large area which it formerly did, and has even exceeded it. It may be brought into Connecticut during any week in the breeding season.

Both the brown-tailed moth and the gypsy moth are dangerous insects; both of these insects feed upon a very large number of our trees, even upon the fruit trees and our ornamental trees, and in fact almost everything that grows in their path. It is well, therefore, to be always on the lookout for these insects. I hope if any indications are found which appear suspicious that the Station will be notified. Notice should be sent at once to some one who can inform the finder whether it is one of these pests or not.

The SECRETARY. Do you know whether the gypsy moth has a tendency to enlarge the area over which it has been ravaging?

Prof. BRITTON. It has decidedly. It is now present over an area of something like 900 or 1,000 square miles, whereas it was formerly found in a very limited area.

The SECRETARY. Another question in that line: "Is it advisable to employ trap lanterns in fighting injurious insects?"

Prof. BRITTON. That is an old question which has been answered many times. Each year probably some of you receive circulars from the firms which manufacture these lanterns. They claim all sorts of things for it. Among other things it has been claimed that the lanterns will destroy the codlin moth and almost everything which does damage in the insect line. These claims have been tested very carefully by entomologists in various parts of the United States and Canada, and their verdict has been an almost unanimous one to the effect that while some injurious insects are killed by the traps some of the beneficial ones are killed also, and on the whole that the use of it does more harm than good. The lanterns catch very few of the chief fruit-eating insects. It will kill a few of the cut-worm moths and other injurious species, but, of course, incidentally it kills many other things which are really a benefit. It will capture a great number of these flies which are parasitic on these insects. For that reason I think the lantern does more harm than good. We do not advise their use.

The SECRETARY. The next question is: "Is the lime, sulphur, and salt mixture effective in killing the San José scale in Connecticut?"

Prof. BRITTON. I do not think that has been used very much until the past season, Mr. Chairman. During the past season it has been used in several localities. Our information is that it is effective; it is just as effective as the 25 per cent. crude oil mixed with water, and the effect on the tree is much better, because the mixture, however carefully applied, is liable to cause a slight injury to the tree.

The lime, sulphur, and salt mixture kills the scale just as well, if not better, and it does not affect the tree. This is made after several formulas, but the one that we used is to take 30 pounds of fresh stone lime, 20 pounds of sulphur, and 15 pounds of common salt. The lime is slacked in a kettle, the other things added, and then covered with water and boiled one hour. It should then be diluted to make 60 gallons, and spread while fresh. This can be put on at any time now or until next spring, while with the oil mixtures we do not advise its use in the fall or early winter.

The SECRETARY. What amount of wood ashes would you use for peach trees, and how should they be put on, broadcast or close to the trees?

Mr. PLATT. I think that wood ashes, a bushel or so to a tree, or half a bushel or so to a square rod, would do no harm, but that would mean a good many ashes to the acre — a hundred or two hundred bushels or something like that. Where a large area is to be treated that, of course, involves the use of a large amount. Of course, they supply some potash and help the soil, and by that means we are returning some of the ingredients to the soil and making it fit for the growth of the trees.

The PRESIDENT. Would you put them close to the trees?

Mr. PLATT. No, I should sow them broadcast.

Mr. MEAD. Mr. Chairman, I would like to ask Prof. Britton if he had any knowledge in regard to the growing of melons under tents, or if he has heard of anyone who has made a success of that?

Prof. BRITTON. No, sir, I have not had any experience with that.

Convention adjourned to 7.30 P. M.

EVENING SESSION.

THURSDAY, December 11, 1902.

Convention called to order at 7.45 P. M.

Vice-President Seeley in the Chair.

Music.

The PRESIDENT. It has been the custom of the Connecticut State Board of Agriculture to have a closing address by a lady. We are going to follow our usual custom this evening, and it gives me much pleasure to introduce to you Mrs. Mabel L. Todd of Amherst, Massachusetts.

THE VILLAGE BEAUTIFUL.

BY MRS. MABEL L. TODD.

Mr. Chairman and friends: This is a subject upon which I have very emphatic ideas. I was very glad indeed when the committee finally decided to choose this subject rather than one of several others, which I am so happy as to have ready, for it is really a pleasure for me to speak upon this one.

I have also another pleasure in coming here tonight, but while I say it is a pleasure, yet it is indeed a melancholy one, because I am told that Mrs. Alice Freeman Palmer was here last year, and as perhaps you have heard, she has lately passed away. She was a very dear friend of mine, and we have just recently heard of her sudden death, so I feel in a way as if this is almost a memorial occasion, and as such it is indeed an honor for me to be her successor here.

This subject of village improvement societies and beautiful towns is one which is susceptible to quite exhaustive treatment. It is said that not so much as might have been has been accomplished, because this work has been so largely in the hands of women. Perhaps that is true. I think, myself, that I have come to the conclusion within the last few years, and with perfect consistency I think, that while women's clubs are a good thing — and I would not say anything against them for the world — yet I think it must be admitted that they have generally excelled themselves when they have included for such work as this both men and women, instead of having women alone. I think a club or a society of this sort will do the best work which has a man behind it. I must confess that most village societies with which I am familiar are composed of both men and women, that is, perhaps I should qualify that by saying that those which are the most successful include both men and women. I am afraid that some of my hearers may be disposed to take exception to that, but on the whole I am forced to make that confession.

Now, it is not to be expected, I suppose, in a new country like ours, that the development of a love of art whether in pictures or landscape gardening, or in other directions, should be so far advanced as it is in the old world. We have been too busy in our race to bring order out of the chaos of primeval conditions and to build wealth out of raw materials so profusely found around us, to establish manufactories and create wealth; we have been far too busy to pay much attention to mere æsthetics; to pay attention to such things has been regarded as a waste of time. It was wasting time as some have thought on what our forefathers would have probably called frivolities. At that time in the olden days man was indifferent and woman was dependent, and but little was done. If anything was to be undertaken in the way of public improvement to beautify the country places it was looked upon as a mere matter of taxes, and the result of it was an easy-going indifference to such æsthetic matters, the ultimate results of which have indeed been appalling. There was a little beginning, however, and from that time there has been handed down to us, who are their descendants, those conditions which we, with any kind of æsthetic taste, know so well generally prevail and which today, it is so regrettable to say, are to be found all over the country. So we must have organization, for there is a great work to do; there is a great sea to conquer. The conditions of the age are quite a different thing from what they were in those days. The people did not live in those days to make things beautiful for those who were to come after them. How many a beauteous place in the country might have been improved by the touch of a loving artistic hand. But now let us hope another spirit prevails, and let us hope that we shall not have to go abroad for these things, to enjoy the site of an educational institution or a church or a factory surrounded with sights delightful and attractive to the eye. The builders and founders of these institutions in our country are beginning to wonder what they shall do now to accomplish what they should have done earlier in this way. There are a few little signs of an awakening in that regard, and I hope I may be useful to increase the movement in that direction. Some of them now are wondering where they can put an artistic touch or a flowering plant so as to give it a chance to put forth its odor so delightful to the senses of us all. They do not, at least, take the position that such things are out of date or frivolous. The gentleman now has a landscape gardener surround his place with beautiful well-kept lawns, with their velvety surface of green, delightful in its effect upon an æsthetic sense, and, what is of more value, doing away forever with the barren rough places about a country house and putting in their place something not only delightful to the sense of sight but productive to health as well. Why should not every farmer have the same thing about his own place? Why should there not be vines and evergreens and green lawns and flowering shrubs put out with the artistic touch when such things can be made so pleasant to us all? What do many of you have out-doors in the way of surroundings to many of your houses? I am sure the time is coming, and coming fast, when there will be a change. Why should not the unsightly places in the streets of our villages be made attractive and delightful?

Now, what must we do? You say cultivate the love of the beautiful. Yes, cultivate the love of the beautiful. How shall we do it? How can we accomplish it so as to open the eyes of the people and to get them to our ideal, so as to make use, as much as possible, of the many opportunities which lie open before them of the many things so numerous in the country susceptible of improvement? How shall we teach correct principles of art, and so inspire an ideal to be worked out on our country sides, in the lanes, and in the garden? That is an important question. Pictures cultivate it. Oh yes, pictures do, the right kind of pictures, but oh, the pictures in so many homes. It is almost terrible to think of them; those imitation things which are so often thought to be artistic, they are so full of no meaning, many of them, if I may so express it.

Some one said to me the other day, "How many times do you suppose the people ever glance at the things they have on their walls?" Well, I don't know. I sometimes think it would be better if they didn't look at them at all, but at the same time people get so used to such things on the wall that they do not look at them at all, and that is probably the fundamental underlying fact why cheap prints and burlesques of arts are kept in the home. It is a fact that if they have some ornaments of really artistic beauty and value, that they often keep the shams in their rooms and store away in the warehouse their works of art, so that they never become associated with objects really great in their power for inspiring artistic instruction. The walls are decorated in that way, and the people never look at the decorations in consequence. That is the way it was explained to me, and I am not sure but that is the right idea. When we arrange our houses in such a way, or with the idea of cheapness, and slight the beautiful things which we might have, many of you would not look at a room full. So, as I said, the love of beauty is a growth.

In Japan they have attained a height to which we in time may aspire. In Japan you never see a room full of pictures. They don't want to look at more than one or two at a time. Among the French, their love for beauty is one of their strongest characteristics. I know of but few countries which represent so general a feeling for art as they have in France. Every one almost seems to have this taste. It is a national characteristic. While we were over there several years ago it was remarkably noticeable, and upon looking for the cause of it, we found it was the works of the famous artists which are exceedingly well known among the people. They have been in close and intimate contact with beautiful paintings and statuary and fountains and artistic decorations for years, and the effect of such a condition upon the public sense of art is very great. It is found only in the older countries.

But I must not talk of these any more. Now, so far as the village improvement societies are concerned, and their work, it is a very obvious work which is laid out for them to perform. A village, of course, cannot do things upon the same plan as a city, but to say the very least, a village can have its garbage and ash can for the removal of such unsightly and unsanitary articles from about the house. The work of the society more particularly is in providing for the removal of papers and refuse from the streets, the cultivation of a spirit of care among the citizens, so that the streets may not be littered unnecessarily. The school children many times will throw examination papers, or tear up papers covered with examples, and throw them to the four winds of heaven to be scattered through the streets. The school children and others will throw away papers which they have done with, and they are left to blow about the streets, to become soiled by the dirt and rain, and in a short time become altogether unsightly. A village society can do much to preserve a good appearance of the village streets by providing the means to have these unsightly objects taken care of and disposed of. How often we have seen persons go to a post office, get out of their carriage and receive their mail, and then deliberately throw away the envelopes and papers which they do not care to retain, or people coming from stores, throwing away the paper wrappers; doing so without any apparent consciousness that such carelessness detracts greatly from the neat appearance of the street. The village societies can accomplish a great deal to prevent the deposit of this refuse in the streets, and to create a healthy public sentiment for keeping them neat and orderly.

I cannot pass without drawing a picture of the contrast between two towns which I have recently visited. I have just finished within three or four months a tour where I have talked in four or five different towns. Two of them were famous old towns of New England, and I must say I never was so disappointed in famous old towns in my life. In one of them, in Massachusetts, it had not rained for a week or two. Most of the roads were perfectly dry and the sidewalks a sea of slippery sand and dust. One of these towns which I visited was worthy of a description by the pen of an artist. It had rained there, and the streets were a foot deep in mud; the sidewalks consisted of cheap plank laid down, and the people who lived on either side of the street laid the plank out to the middle of the street, and then the people who lived on the other side, laid one out to meet it. The village laid planks also, sometimes not very carefully, from one side to the other. The result was appalling. When you drove through this street, you were in the mud part of the way, and then jolted over the planks a part of the way; first you went down in a hole in the road, and then you rose to the peak of an eminence, jolted over the plank and then you went down in another bog, only to rise again. It was a most deplorable condition of things. In that same town, I passed by a high school about which, I should think, were about 500 large pieces of paper; they were not only all around, but they were up and down the street, so that they gave an unsightly appearance to the town. The children, of course, did not notice it; their attention had probably never been called to the desirability of putting their papers in a box or can. Their parents were careless about the public appearance. Now if someone goes into such a place as that and speaks to the children, and gives them a little proper instruction, after a short time you will observe a very great difference. I think the instruction of the school children to aid in keeping the streets in a clean condition, is a very important part of the work of the societies. In such a place as that, a village improvement society has work obviously at hand, or an association of this kind in such a town can accomplish a great public good. All it needs is to have public sentiment properly aroused. There are men and women, plenty of them, who, when their attention is called to the subject, will come forward to help in the work. Even with ever so small a membership if they will start to collect a small fee to begin with, the society can gradually interest the general public whose interest is so appallingly lax on the subject. It may not grow fast at first, it will grow a little at first, if properly approached, and if it is rightly cultivated, and a strong effort put forth, it will not be very long before the village, instead of remaining with unclean streets, will become greatly improved. The people, once their civic pride is aroused, can be taught the desirability of throwing their waste papers and refuse into one receptacle which can be taken away and the contents put in some suitable place. Small printed notices can be issued and put up in prominent places requesting that the people throw their waste envelopes and papers into baskets or boxes placed in the post office, or into receptacles in the streets, rather than on the post office floor, or thrown about the streets. I remember so well the great interest taken in China about some of these things. Verily we can learn even from the Chinese, and even the Japanese, about some of these things.

It was in striking contrast to some of the towns in this country which I could speak of, but even in this country, while it could not be said of all towns (I wish it could), yet even here we can put about the streets some sort of a carrier in which to deposit the refuse, and so make the street, by comparison, a lovely thing. There are things done in some of these towns that I refer to, that are not done in a great many cities. This is a very useful and essential part of the work of improvement societies. The attention of the people can be awakened, and an ugly, ill-kept village street made a lovely thing. To do the very least, receptacles can be placed for refuse, and these, of course, are very much needed to be placed on the streets, in which to put such stuff. Much depends on the town upon the cultivation of such a sentiment, or on what I call civic cleanliness, and I should like to say a few words about individual effort, that counts for much. I think all can have a great deal of influence in a town, and in these villages, by first of all setting a good example.

It is always a splendid thing in a village to have someone who takes interest enough to start such things. I have in mind two towns. They are both high among the hills, I do not know but higher than the top of Mt. Holyoke. One of them is still the home of many people of wealth; it is surrounded with many beautiful drives and stretches of scenery that would delight the soul of an artist. It has many natural scenic attractions which make it a lovely summer resting place, but the town is afflicted with dry rot. That town in spite of all its delightful natural advantages is sadly degenerating. The number of people is decreasing and a general air of neglect and decay pervades the place. There is no individual effort to bring it up, or to save its natural beauties, or to make the most of them through visitors in the summer season perhaps from the outside, yet there is no one there to reflect their opinion of what the town might be made. The general opinion among them seems to be that it is time to get away from the top of that hill. Dirt and refuse are allowed to accumulate in its beautiful places, its natural beauties have been dispelled, and the summer transient is fast coming to the conclusion that he does not care to include it in the list of his or her stopping places. The progressive-spirited break away from the town, and those that remain are all near-sighted. They seem to be content to drag on their melancholy existence; there is no village improvement society; there is no spirit of public helpfulness; there is no public sentiment or public spirit to push through the public improvements. Through the total lack of some individual to take the initiative or effort, that town in spite of all its beauties, and lovely scenes, which should make it famous as a summer place, if cared for and developed, just stagnates, and the people keep away. It is a wonder even that the farmers stay there, for so much could be done for it if a few progressive measures for public improvement were reasonably supported, but there is a total lack of that spirit, the growth of the town is checked, its course is downward to decay. It is dead to the world and the progress around it, and yet there it is on one of these very hilltops of New England, on which some of the loveliest spots in the world exist, and which might be a continuous source of revenue and enjoyment, if the residents would only choose to make them such. They need only the touch of a sympathetic hand and the effort of well-directed enthusiasm, to make them bloom like the rose and be a joy to the inhabitants, as well as attractive and winsome to those from outside who are looking for just such places for their summer rest, or for the establishment of their summer home. And yet, when so much might be done, the people are sleeping away the days, and the town goes down, down, as though swept with the fire of desolation.

In another town that I know of, equally high among the hills and very much like the other in the beauties of its natural attractiveness, a thing happened which seemed almost incredible: a little more than a year ago, one of the town's former residents who had been away, came back again; he had been away, and during the time had become imbued with some new ideals; he had come to see things in a new light. He came back and saw the condition of the place, and it looked all very desolate to him. He saw, as he thought, that he might do something for this place, but he did not like to do anything which would appear out of the common, and without the assent of the town, and so he asked the town fathers if they would be willing to let him put out a few elms and maples, so that they might grow and afford shade and add beauty to the roadside. And if you will believe me, ladies and gentlemen, there was really quite a fight in the town meeting to which the question was referred. There was no reason for passing such a vote, the opposition said, but there was a small majority, and so the consent was given, and so this progressive man got about fifty trees, maples and elms and oaks, etc., and they were planted, but such was the bitter feeling that had been engendered in that town over such a proposition, that within two days after they were planted, somebody came up there with a saw and cut off every one. To think of such a thing as that happening right here in a New England town! It did happen, and nobody has ever planted anything there since. The town is going down. The hotel burned up there and nobody has ever rebuilt it. There isn't a single summer visitor to buy the property, or build new houses, and to make the town happy and prosperous.

Now I want to describe a town which illustrates the other side of the picture. It is equally high among the hills of beautiful New England. Some one there with an artistic spirit and push, started an agitation which roused public opinion. The natural beauties of the place were conserved, the walks and roads have been well built and cared for. The streets are shaded with beautiful trees, the fences removed and the lovely green lawns about the houses come clear to the edge of the walks. They are scrupulously cared for. Waste paper and unsightly rubbish is kept out of sight, and cleanliness and neatness and order greet one on every hand. It is a delight to drive through the place. It is a joy to live in such a place. It is certainly health-giving. No wonder that the land is in demand by the wealthy and cultured, for summer homes. Oh, if our backward New England towns, placed amid nature's most magnificent scenery, where the air is as pure as the breath of the morning, could only realize their opportunities, what a blessing it would be. The village has its improvement society, and wealth and prosperity and beauty and culture have come to live in the place as the result of their endeavors. It is so easy to let things go, but when will some of our towns ever learn that neglect and indifference do not pay? It is just as easy, when you are building, to put up an artistic house, as it is an inartistic one. When you farmers are improving about your places, isn't it just as easy to do it well, and in a manner which will be a delight to you all the days of your life, as it is to leave things in a half completed condition and a slipshod manner, to be an eyesore to everybody who passes your door?

Oh, I wish I had the power of a Demosthenes, that I might speak as I feel. Let your buildings be artistically designed,—it pays. In a town not very far from Washington, which was the summer residence of a gentleman who was an architect, they wanted a new town hall. He offered to draw the plans for one for them to cost about $1,800. They wanted an inexpensive one, but he said that he would put it up so that it would not cost any more. He drew the plans. It was for a town hall which would have been a credit and an honor to the town. He showed them his plan at the town meeting, but they voted down his proposition and said that they would rather make their own. They put up a square, barn-like building without artistic effect or beauty of design, and which cost a few hundred. When he saw what they were doing he didn't help raise any money, but he would have been willing to have helped them upon an artistic building if they would but have allowed him. Certainly there is no accounting for public taste at times. A well-designed town house makes a great difference in the appearance of a village street. Land is usually plenty, and they can be built on ground and in an artistic style and as cheaply as any other kind, and their contribution to the appearance of the village is greatly and much to be desired.

One thing that makes a great difference in our village communities is the lack of proper leaders to take the initiative If it is only one man in a town he can do a great deal, once he becomes possessed of the right idea. The right kind of a leader, or one such man as that in a town, is not another man in another town. He is always the same. He is an addition to any town. It may depend a good deal upon having just such a man as that in such cases, or it may be the village improvement society, or it may even happen to be a woman.

I know of a case where a gentleman of some wealth, not enormously wealthy, but a man who is very fond of nature and of the country, and loves, whenever he can, to spend a great deal of his time in a certain town. He is just one of those kind of men that every town needs, and which I have been trying to describe, to inspire the people to rise to a higher plane of improvement of their rural surroundings. Around this town where he has his home, are many hundred acres of splendid woodland, affording delightful drives and cosey places, and his aim has been to preserve it. He has acquired a large tract about this place, and preserved it for the benefit of those who visit there. Whenever he has heard that somebody was trying to buy some of this land near this town and intended to introduce that diabolical invention for the destruction of landscape beauty, the steam sawmill, which works such devastation on our New England hillsides, he tries to buy the land. In a number of cases he has heard that they proposed to cut off a lot of fine old trees, and he has gone to the owners and said, "How much money are you going to get for it?" and then he has offered the same sum himself, and he says in almost every case they have been perfectly willing to sell, and he has been able to get the land with the trees standing. If the trees are saved, the man who has them to sell thinks all the better of it when he gets his money, for although he does not care anything about the trees, yet he is perfectly willing to do it, and to let them grow. In this way he has become possessed of some 1,400 acres of land around that town, and one immediate result of his patriotic effort is that that town has become famous for its rural beauty; its reputation has gone out far and wide as a beautiful place for a summer resort, the land has increased largely in value, and the result is, that there is more competition every year for land there for summer homes than there ever was before. Land in that place which could have been bought for ten dollars an acre a few years ago, has now gone up so that it is being sold by the foot to many people for summer cottages. The man with a patriotic spirit like that in a rural community, I think, is one in a thousand, but his civic patriotism has not only repaid him richly, but it has been a wonderful benefit to the town. A great many other people come into the town and become infected by his spirit to do a little, and in his effort to beautify the town, they go to him and offer to give him day's work. In that way, much has been done to beautify the land and to make this town just as beautiful as possible.

It seems to me sometimes as though the very spirit of destruction was abroad in these hill towns of New England. The local people seem to be possessed of the idea that they must cut off the timber, but they are blind to the fact that in so doing they are ruining to a large extent the natural beauties of the locality. Add to this, the indifference which prevails, and it is a sorry state of affairs. Of course, in many of these towns, if the trees are to be saved they must be saved in one of two ways. In some of these places much land is owned by manufacturing industries, and if the owners of these can be imbued with the proper public spirit, much can be done to save the natural beauties on such land. The second way is through the people who have settled in those places and come into the possession of the land which they have bought for summer homes; through those who have bought small plots of ground on which to build summer cottages. People who do not own the house they live in, do not take the same interest as a land owner; but you farmers do own your homes, as a rule, you are the most independent class in the community so far as that is concerned, and let me urge you to preserve these beauty spots upon your places. There are so many delightful nooks and spots upon your New England farms where a beautiful tree may be preserved, and saved from the axe of the woodman; there are so many points of vantage from which an enchanting view can be obtained, or shady dells where ferns and woodland flowers grow in profusion, where every rock and stone, just as nature left it, adds to the rugged beauty of the place; or where waterfalls trickle over the rocks and drop to a crystal pool below. Save these places and save them from becoming a mere dumping place for the farm and household rubbish. It is a desecration of nature's handiwork, an abuse of the heritage which she has left for our delight.

Now there is another point in connection with this subject of village improvement which is one very near my heart, and that is an attractive railroad station. In certain favored localities, it is true, the stations have been constructed with reference to some artistic design. There has some advance been made in this line. In some of the country places near Boston, and in some of the large cities, stations have been constructed which are drawn with true artistic foresight. In many of these places an old-fashioned barn-like structure has given place to an attractive station, but compared to the total number they are few and far between. There is a vast field of work in connection with the improvement of stations and their surroundings; some of the railway companies themselves manifest a sleepy indifference to the subject unless moved by the prodding of public opinion in a community. Few of them are making any systematic effort to construct new stations upon artistic lines. I have in mind a station in a foremost New England village town, and the scene that greets the eye of an incoming traveler is one of disorder and apparent chaos. It is not an inspiring place for an incoming guest or student. To alight in such a place with the idea of spending several years in search for knowledge is not altogether agreeable to some, especially if they have been used to different things. Certainly such a station or a shabby, barn-like, ill-constructed structure in a place must have some effect upon the idea which an incoming traveler gets of the town. It certainly cannot be favorable. There is no conceivable reason why a railroad company cannot have an artistically designed and attractive structure which shall be pleasing to the eye and a credit to the town, instead of a waiting-room with a low ceiling covered with cracked, smoke-stained plaster, and where bare banks of sand and a great array of inartistic freight cars greet the eye upon the outside. That is absolutely true of a certain station which I know of, in a famous college town. I do not see how the people of that town can keep their hands off that station. I know very often much can be accomplished by the village improvement society for the betterment of the appearance about the station and its grounds. Now and then a railroad agent is found, who in time does much himself to relieve the fearful barrenness of the place. The railroad companies themselves can sometimes be applied to with good success. They will almost always be willing to aid the village improvement society, or the people who want to improve the station surroundings. I have noticed in a great many instances that sometimes a town will vote a little money to be put with that which the railroad company provides to be put into a station, in order to make it a little better. That can almost always be done, but if that cannot be done, the clear-headed fellow of good taste and energy — if you are so fortunate to have one for your agent — can often accomplish a great deal, and what has been done in some places by such men in this line is quite surprising. In many places where the town is not disposed to act, the society can combine its effort with the railroad company, and bright, attractive grounds can be laid out about the dingiest of stations. The station work in a measure represents the town, and should be a place of neatness and order and not one of disorder and distress. A few flowers and shrubs and grassy plots about the station, with the drive well laid out, adds very much to the appearance of the place, and to the favorable impression which a visitor arriving in the town obtains. A little effort will accomplish so much that it is certainly worth trying.

I remember passing through one of these horrible-looking places upon a certain occasion, and later, when I went there again, I noticed a very great change for the better. I spoke of it to a lady, and she smiled a happy gratified smile and she said, "Yes, it is pretty." And I said, "Did the village finally take hold of it?" And she replied, "Oh no, our Women's Club did the whole thing." The prevailing habit in most American towns of using every pretty little dell and every ravine or pretty, shady little hollow because it happens to be a little out of the way as a dumping ground for the refuse and rubbish of the village is another subject which I must not fail to dwell upon for a few moments. Many a delightful spot of this kind, graceful with waving ferns and attractive with the sweet fragrance and luxuriant growth of the wood plant, shady and cool in every way, and desirable to maintain in its primitive beauty as a spot in which to escape the heat of the sun, or as a place to while away a leisure hour with a genuine book, has been ruined forever because it has been made the resting place of unsightly ash heaps, pieces of broken stone, glass and china, worn-out kitchen utensils, and old rubbish of every sort. How many of these beautiful dells around our farmhouses do we find in just such a state? I have always been glad that the old-fashioned crinoline or hoop-skirt has gone out of fashion.

Our beautiful New England woodland dell, by some strange fatality, seems to be a natural place where these outcasts of fashion could be laid at rest. I have one of these places in particular in mind which I have visited in days gone by. It was a dainty place in a little village in northern New England. The ravine ran across the road where it was easy of access and afforded a delightful place upon a heated day. I used to walk through it for a glimpse of nature's beauty when in her new spring dress. The ferns grew there with exquisite beauty and the shade and the coolness made it ever so attractive, the woodland flowers and plants abounded in profusion, and the sparkle of a nodding brook added to the beauty of this pretty little place. I took another walk through there last spring and I found that some enterprising person, totally oblivious of nature's sumptuous work of decoration, had filled it in with ashes, tin cans, and rubbish. There was a case where there was no reason for it. That dell was so beautiful as it was, there was no reason for filling it up. The maiden-hair ferns were knocked down and the willows drooped in graceful beauty, and all the beautiful things were there in part, but the artistic harmony of the whole was sadly marred. I wish I could arouse your interest to save these dells and fern-lined ravines from being profaned in this way, they add so much to the attractiveness of your farmhouse in the country and afford such a delightful retreat in which to go and sit and chat with a friend or read or sew. A few such places about your village add so much to the beauty of the location so far as the town is concerned. I make this just as a hint to your improvement societies. Personally I do like the old walled gardens of Maryland and Virginia, where sometimes in the summer you can go out and take supper under the trees while they are blossoming and bearing their fruit and the place is filled with intoxicating fragrance in the afternoon; but we do not have that so much, and so there is all the more reason why we should preserve these places where all the wealth and beauty of the wild woods is at our hand. They afford a touch of the shady beauty of these old gardens. The public must be educated to the fact that it is worth while to preserve these pretty spots. Of course, if everybody had a high wall around such places upon their property the beauty of the woods would not be there.

But let me emphasize another point, another thing. For the sake of the beauty of the town I should imagine that some would be willing to dispose of the fences, the coarse, ill-appearing fence that surrounds such a variety of country houses; there is no beauty to them at all. Here, again, the education of the public must come in. When the fences are taken away you must see then that the flowers and shrubs about your door are guarded, else you will have to contend with the same troubles that I had. It was a most unfortunate experience at a place where I lived. Our American children are not always trained to regard other people's property as not their own. It is not the small children either, but those who are large enough to go to a high school, that frequently take such exasperating liberties. In a place where I lived I had trouble of just that kind. I had the children continuously going by my door on their way to school in the morning and going home from school at night. They didn't seem to take my flowers because they wanted a pretty thing to carry home but seemed to take them more in a spirit of vandalism, they seemed to be possessed of a spirit of destruction, they seemed to like to destroy. I am sorry to say that that is a distinguishing yet a deplorable trait of some of our children here which I have never seen in any other country but this. It may differ somewhat in proportion to the size of the town, but in the place where I lived this spirit of vandalism was perfectly rampant. It was entirely unsafe to have any rare flower within reach, it was sure to be destroyed. I don't know why they should do so. I don't know why they should wish to destroy, but certainly it was so. Just to cite an instance: I had a small hydrangea in front of my house and the children every day picked off every one of the blossoms on the street side. They would go gaily and nonchalantly along just picking them off without any apparent thought whose they were and then deliberately throw them away. Another time we had a beautiful shrub that was growing finely and doing very well. It was very near the front edge of the place. It had been trained carefully so as to have it develop into a handsome, symmetrical bush, and on every twig it had large, beautiful blossoms. I was up-stairs one day and looking out the front window and who should I see come along but a girl of about fourteen or fifteen; what tempted her to do it I don't know, but she looked around a moment and, as she saw no one looking at her, with her arms she broke right into the entire shrub. Of course, we had trained it and pruned it very carefully into a perfectly round form, but as the child took hold of it she broke the whole center of the shrub. I started to call to her, but before I could do anything she had jumped up and run away, evidently thinking at the time that perhaps I would follow her. I did go to the school. The high school was on the street just above. I asked the principal if there wasn't any law, if there wasn't something that could be done to stop such lawlessness. He said that he would attempt it, but, of course, you know it is very discouraging. But the point of it all is, I believe that children who will do such things as that haven't home training. It is very hard to think that there are children who have never been taught to appreciate a lovely flower like that, to let it live, to say nothing about a respect for other people's property, but in a spirit of pure wantonness to break down and destroy. So when you take away the fences you must begin to have instructions given in the public schools to have the children have regard for other people's property.

The walks of our rural villages may often be lined with a fringe of flower beds so that the passer-by may enjoy their beauty, and the areas in the front of the houses can be all graded or laid out into lawns with flowering shrubs by the borders of the paths and drives. But to make such things possible in most of our rural communities, I am persuaded that the children and the community must be educated to care for them, and to guard them, and not to destroy. That is one of the duties of the village improvement society, to go into the schools and enlist the sympathy and help of the children, and then wonderful results may be obtained.

Individual effort in a community, of course, will count for a great deal. Through individual effort it is perfectly wonderful, even though when exerted upon a comparatively small scale, what may be done to produce pretty effects. An azalia vine, or a few flowering shrubs or blossoming plants tastefully disposed about a place, or arranged in front of a dwelling, so as to be in view from the street, will often produce the prettiest effect upon an otherwise dull looking street, and especially if this is done in a triangle, or in a spot where two or three streets come together. In one place where we lived, there were two streets that happened to come together in that way, and there was a little triangle formed by the junction, making a great opportunity for the formation of a grass plot, and as a place for some trees and shrubs. And so they had the center of it raised, and a little rounded over, the weeds taken away, and then we had it grassed over, and before the season closed we had a little lawn, a three-sided grassy lawn, on which some plants were gracefully arranged, and in that way, what was a rough looking spot before, was transformed into, and remained, a scene of beauty to everybody throughout the season. If you are working as an individual, of course it does not pay to put much money into such public roadside decorations, unless you can have some assurance that they will be protected. But very often, in a perfectly inexpensive way, something of this kind can be done. You do not want to be elaborate at all, and that is especially so at first. The effort should be simple and still be sufficient to bring out a desirable artistic effect. A few such efforts in a town go far to elevate public sentiment, and to make the people enjoy, and love to care for such decorations. They gradually come to learn that it is something for the public benefit, and everybody should aid in that sort of work, if it can possibly be brought about to have them do so. It is much better for all to have it take that course, because the education of public sentiment in favor of such things is one of the principal objects we are aiming at. In one place I know of where an effort by an individual, of this sort, was started on one side of the street, the interest in it gradually spread so that after a little time everybody took a pride in going out and cleaning up their yards, keeping the grass cut in front, and putting out shrubs and flowering plants. The appearance of that street was transformed. From that one useful object lesson, others commenced to do something for themselves, and it was not long before the whole of that side of the town became beautiful. That shows that it does pay to do these things. And think how much more enjoyable the village homes look, to say nothing at all of the real increase of the value of the property which occurs. I am not advocating any individual going into it on an extensive scale. It should be done in a modest way, and without a thought of excelling what anyone else may do.

Of course, with our country towns it is many times impossible to influence their layout upon artistic lines except as to their future growth. Most of our rural communities are so situated that they will perhaps always be small, and nothing special can be done towards laying out the village upon a more consistent and symmetrical plan, but in the extension of a place; that is always a point to be considered. That is really the way that all those beautiful spots at the intersection of streets in Washington have been rendered possible. Those of you who have had the pleasure of visiting in that beautiful place, will remember how the avenues and the numbered streets run with respect to each other. The plan upon which the city has been laid out has been so ingeniously contrived, that at the intersection of the streets, there are spots and places for a beautiful arrangement of flowering shrubs, and magnificent foliage plants, for grass plots, and locations for statuary, and fountains. The city has promptly taken advantage of these, with the result that Washington is full of these beautiful floral decorations in the public streets, and they help to make it one of the most beautiful and attractive cities in the world. I do not know of anything that is more lovely than one of those triangles, forming a floral setting, as they often do, for works of monumental art, illustrative of our country's history, which are being rapidly placed in position throughout the city.

Another thing that was brought up in Washington; and I remember how we kept hearing about this so-called Boss Shepard, and what a terrible man he was. How he was throwing money away by adopting such large plans for the artistic decoration and layout of the city. The people said that the city would never grow to it in the world. But I think that all Washington has lived to bless the far-seeing vision of this man, and to praise him for the beautiful plans for the improvement and ornamentation of the city which he devised. While it may be that the adoption of his plans has been costly, yet his judgment has been amply vindicated, for they are now carrying out the improvements which he planned with so much care and foresight. We can all of us take a patriotic pride in his work, for the beautiful city which is springing up as a monument to his genius is our capital.

And now, going outside of the village, let me present to you another subject which is also very near to my heart, and that is the preservation of our beautiful New England country roadsides. I must say a few words about what can be done to improve their appearance and to relieve the dreary monotony and ugliness which so many of them present. Somehow, in so many of our rural communities, the people have not seemed to appreciate what a lovely transformation might be wrought in our ordinary country roadsides. It is the beautiful things which seem so lovely along the roadside which in our New England country make the drives the most beautiful and delightful of those to be found anywhere in any region of the world, but the grandeur of the surrounding scenery is oh, so often, so sadly marred by the appearance of the immediate roadside itself. Why the opportunity has been so grossly neglected to develop this source of rural beauty, and which, as I have already shown, as it seems to me, is such a source of riches to many a town, is something I cannot imagine. Now, it stands to reason that a specialist does the best work. The person who has made a detailed study of landscape gardening can do such work ever so much more satisfactorily than one who has no particular knowledge of plants and shrubs, their variety, coloring, grouping, growing, and care. This is a principle that has come to be generally recognized among most classes of civilized people. If a farmer has a puzzling question about the growing of a crop he goes to his experiment station for advice and help. If a member of his family is sick he sends for a physician. If he quarrels with his neighbor, or if his rights are being infringed in any manner, he goes to see his lawyer. If there is to be a wedding in his family or a funeral, or he wants consolation, the clergyman is his first thought, as he is always expected to attend to such matters which come up in his life. In all these different things he does not try to do them himself because he does not regard himself as competent, and he fails to regard it as any reflection upon himself that that is so. But when it comes to the building or the laying-out of roads and the care and arrangement of the roadsides, then he thinks he is just as competent as anybody else. He does not seem to realize the beauty of art, or that a common roadside affords an opportunity for the application of any principle of art. He does not seem to think that art itself may furnish the means to increase the value of his property or render the appearance of the drives through his rural surroundings infinitely more attractive and pleasant. He does not seem to think that the specialist in such a thing as that has any place in such an arrangement. The average farmer, I fear, has been disposed to laugh at such a thing as art applied to country roadsides, or at the idea of the skill of the landscape gardener being applied to rural highways. He is amply competent to care for the roads he thinks, and over many a hill and through many a pretty dell of New England he has built a monument to the littleness of his knowledge that only time in its mercy can efface. Isn't it a strange fact that it has not yet come home to the average town official in charge of such work that the care of our country roadsides offers a field for the use of art to the best possible advantage, and that it can be applied in so many cases so cheaply and with results so satisfying? If our village improvement societies can only succeed in awakening some of our towns to the possibilities in this direction they will indeed have done a grand work. So much can be done in an inexpensive way to add to the usefulness and attractiveness of our country roads, and without adding to the burden of the taxpayer to any great extent, that it seems almost a pity that the lesson of what might be cannot be learned quickly. In some Massachusetts towns there has been some advance. In some of the older towns the awakening has come. Of course, around Boston, in the Botanical Gardens and through her magnificent park system, an object-lesson has been afforded which has been of the utmost value. They are full of the most beautiful flowering plants, trees, decorative shrubs, and grasses. In places along the lines of Boston's rapid transit system something has been done to relieve the dreary barrenness of some spots. But I do not wish to speak particularly of this. That represents an advanced stage in the development. The thought that is uppermost in my mind is the question, why cannot the elementary principles of art be recognized and applied in our rural communities in the improvement of the highways? Instead of unsightly stretches of tangled brush and briars, of broken-down fence, and here and there a heap of stones or refuse, half-dead trees filled with the nests of worms which, to say nothing of their own unsightliness, have ruined all the surrounding foliage which might otherwise have added a little to the attractiveness of the scene, and in many places the whole being bordered by a ditch that is a horror to contemplate, why, pray tell me, in the place of all this ugliness and dreariness, waste and decay, cannot the banks be covered with a coating of color and richness instead of being left like a scar upon the face of nature? Tell me why these stretches of brush and thicket cannot be eliminated from year to year as a part of the regular highway work, and grasses, and ferns, and golden rod allowed to grow and bloom by the wayside? In so many places a little effort only is needed. A little effort to clear up such places, to grade and fill up the holes and unsightly depressions, and then, with the sunlight streaming through, and a little grass seed, and the thing is done. A transformation will be wrought that will bring an expression of approval from the most unsympathetic with nature's beauty. When you think of it, how much more attractive many of these places might be made, and, with a little care and foresight, be made to excel in natural beauty and attractiveness many of the places in the country regions of the old world, where the application of the principles of landscape gardening have wrought such a bewildering transformation. In so many of these places there is so vast an opportunity for beauty's touch. An old stone wall to straighten up with the opportunity which it offers to train clematis over the roughness of the stones, or some other vine that will hide the coarseness of the rock beneath its clinging tendrils and leaves. There are so many spots of just that kind where a vine may be taught to clamber over or beside them. On certain stretches where brush dominates the roadside it can be cleared away without much trouble. As I have already said, much of such work could be done when the roads are repaired, and thus the opportunity would be given for the tall golden-rod to grow, or for graceful ferns to cover the waste, rough places. The dead and unsightly trees ought to be cut out, and those that would furnish shade in summer or help to beautify the surroundings with the gracefulness and symmetry of their forms or the glorious coloring of their foliage in autumn given an opportunity to thrive.

Then too, oftentimes, there are groups of noble trees by the roadside that ought to be preserved. In some wooded sections where it is necessary that the wood shall be cut off strips from thirty to fifty feet wide on either side ought to be purchased by the town, if necessary, so as to prevent the utter destruction of such scenic places on country drives and to hide, if possible, the barrenness and desolation of the adjoining fields where the woodman's axe and the sawmill have left a great, ugly scar upon the face of nature. The destruction of many a shady nook with its setting of ferns and flowers is accomplished when the trees are cut. They can never be restored. The same artistic grouping can never be obtained through the landscape gardener's art. Do not let the beauty of your country drives be utterly destroyed. Save them while it is yet time. This is something which should really have the earnest support of every nature-loving man and woman in our country towns. In many of our country towns there are areas of beautiful forest which are constantly being encroached upon by the woodman, being cut off by the owners for the sake of the dollars. The steam sawmill has wrought a fearful work in so many forest areas upon our New England hillsides, leaving behind it simply a scene of disorder, wretchedness, and ruin. It has become so common that scenes like this can be seen in almost any country region where there is timber, and the damage is such that no landscape gardening can repair the desolation and no human power restore the natural beauty of those pretty places. Nature's grouping of plants and flowers and vines in many of these spots can never be imitated. They are gone, and, I am afraid, forever. But there are many such places that still remain that can be saved if public sentiment can be aroused in time to the necessity which exists, and that is my mission here. I want to arouse you to be on the alert. Some men seem to have a perfect passion for destroying these trees by the roadside. They do not see their beauty. They do not see the useful purpose which they serve or give a thought to the long years which must elapse before others will take their places. They are imbued with the passion of destruction. It is the unthinking and the uneducated who are the enemies of these roadside monarchs. One lady friend of mine had long admired a beautiful group of trees, part of which were by the roadside and a part over the wall in a country place where she made her summer home, and she was horrified one morning by finding a man at work cutting them down. She was blessed with ample wealth, and she thought it was such a pity to see those beautiful trees sacrificed, and so she stopped her carriage as she was passing and asked the destroyer what he would take for them. And she asked him what he was doing it for? He seemed to view with a great deal of satisfaction the ruin that he had already accomplished, and it was with considerable reluctance he agreed to part with those he had a right to sell. I have often thought what a good example she set. If many more of our country people, or people who make their summer homes in these pretty country places, would become imbued with a little of her pride in her town's appearance many more of these beautiful specimens could be saved and passed down for the benefit of succeeding generations.

What we need is more civilized methods in the cutting of trees. What we need is the more general knowledge of forestry and its principles as practiced abroad. Some of you may feel that I am not very practical, perhaps, and not very solicitous for the welfare of the lumber interests, but I think you will agree with me that the methods which have been followed in the cutting of our New England woods might have been very much improved, and especially so where the future wealth and thrift and fame of many a delightful mountain and hillside hamlet or little country town is destroyed with the destruction of the forests about it. A country town bereft of nature's ornaments, and ugly with the scars of the portable lumber mill and with heaps of dead brush all about, brown and barren and bare, is certainly not an attractive place for a summer home or for the permanent home of the well-to-do business man of the city who, with his capital and refinement and energy and brains, is doing so much for many an attractive country town. With the passing of the forests the streams dry up, the woodland flowers and ferns grow no more in luxurious beauty, and where was once a peaceful spot, replete with nature's inimitable setting and with her beauty and bounty on every hand, there is now only the abiding place of ruin and decay.

If the lumbermen must cut over these hills then let us preserve at least, if we can, a tract from thirty to fifty feet wide on each side, so that the ugliness and barrenness may be in part covered up and hidden from the eyes of nature-loving tourists, and so that we and our children after us may have the benefit of grateful shade from the trees on the immediate roadside.

In Japan and some of the European countries no such state of affairs as has been allowed to exist here would be tolerated. Perhaps I am not very practical from the standpoint of a lumberman. Lumbering is a legitimate trade, and the lumberman has a right to obtain his material wherever he can, I suppose. He will take care of himself. It is not his battle that I am fighting. I am fighting for the preservation of the shade and beauty along our rural roadside drives through the wooded districts of our back New England communities. I am simply here to protest that if the lumberman must be allowed to invade these regions these forest woods should be taken intelligently, and not in such a way that every bit of natural, picturesque scenery will be destroyed for all future time. The time must come when there will be a more intelligent interest taken in forestry and in the preservation of our forests from the total annihilation which is going on in some districts. The preservation of the water supply in the streams for manufacturing purposes and as a source of supply for the use of the larger places will demand intelligent action. The methods which have been in practice are certainly a mistake, but it's a happy sign that an intelligent public interest is beginning to awake on this important subject; but there is yet much to do before the needless and unintelligent sacrifice of many of the noble trees on our New England hillsides is stopped. Our village improvement societies can do a great deal, and public spirited citizens of means can often do a great deal to educate public opinion in favor of preserving and protecting the trees that border upon these lovely drives and which shade and beautify the public streets. Many of these most beautiful elms and maples and oaks that have weathered the storms of almost centuries have been ruthlessly sacrificed for no purpose whatsoever except for firewood, and that, too, right in the immediate vicinity of other wood which ought to have been cut for that purpose. When you ask some of these vandals what they cut trees of that kind for, or a group of them in a little grove, and why they should want to destroy such an addition to the beauty of the countryside, they are perfectly unable to give you any intelligent answer at all. As I remarked a moment ago, public spirited citizens can often do very much indeed in just such cases to prevent the destruction. I know a lady who, whenever she hears of a fine tree which is in danger of being destroyed, goes and buys the tree, if possible. She asks the person who is about to destroy it how much the timber is going to bring him, and when he tells her she buys it. She not only buys the tree but she buys a little bit of the land on which it stands, and she gets a regular deed of it, and in that way she has obtained and saved quite a number of large oak trees. Some of them stand on the street side and some on private property, but she owns fourteen of these trees, and she has purchased them solely so that they might be preserved and be a joy to others as well as herself.

I have here several quotations from forestry reports, which I should be glad to read, for they are very interesting, but I understand that you have already had a paper or two on forestry, so there is very little need that I should do this, and will only refer to them to call your attention to the great fact that in this country, we are far behind the great European States in this regard. In Japan, you cut down a tree and you must plant two in its place. That is a very good idea. I wish it prevailed in the United States. There is a waste of our timber lands and forests going on, which is wholly unnecessary. I hope the question of better forest protection will be vigorously taken up in Connecticut. There is no subject which deserves more careful attention by all classes of citizens. There are whole sections in this country which will be devastated soon, unless some intelligent, well-considered laws are passed on this important subject. I plead for more civilized methods in the treatment of American woodlands, and not only with regard to cutting, but with regard to improving and trimming. I anticipate that much will be accomplished through the gradual spread of nature study in our schools. I think that is a grand thing. It ought to be more generally applied in our schools. Even children who have lived in the country all their lives, and with the beautiful objects of nature all about them, have had their interest aroused in a manner that seems to point to a better and more intelligent understanding of some of these things in the future. It seems almost incredible that there could be such indifference as has been found to exist among many people who have taste and refinement. Some of them seem to have no love for the things of nature. I know one town where there was a church, an extremely pretty, modern little church. The people did not have many of the conveniences of city life, but about that church they had something which city life does not often provide, and that was a beautiful tract of land. But it had not been improved as it should have been. The church was of brick, and it did not look as one lady thought it should, and she thought it would be a good idea if some climbing vines could be set out about it, and so cover the barren appearance of the walls. So she went to the trustees, and they sent her to the pastor, and it took her three months to get the consent of the church people before she could plant what she desired. She went first to the trustees, and she had to go to different men, and she finally wrung from them a reluctant consent to do something, which it would seem as though they would have been only too glad to have anyone do. All sorts of objections were raised to her plan. It would eat out the mortar between the brick and stone, they said; it would do this thing, and that thing, and the other thing; and so it went. All of these arguments against her purpose had to be overcome before she was allowed to do something which added greatly to the beauty of the building.

Now there is another point to which I must call your attention before I stop; and that is, something must be done to stop the defacement of our country landscapes by the great increase in the number of inartistic and positively ugly advertising signs which are being placed everywhere, not only along our roadsides, but in every available place where they will catch the eye, in our public streets, and upon the sides of buildings, and even out in the fields, along the lines of our principal railways. I make it an absolute rule that I will not go into or patronize a store that advertises on one of these great flaring signs. I will never go near that store if I know it. No matter how much I may want something there, I make it an inflexible rule to go across the street and attend to my wants in some other place. I have no doubt they are good for the purpose which they serve, but I would scorn to patronize a firm which has so little regard for good taste, as to erect such an insult to refined or artistic sense as some of these advertisements that I have seen are. There should be a law against it, for they certainly, whatever may be their value in a commercial sense, do not tend to cultivate among the people any sort of a correct idea of pictorial art, beauty of coloring, or in any other way. We are very apt in our pride of our country and its great growth and possessions, to rather lean to the idea that in America we have the highest ideas and ideals of culture in about everything, but if the truth is to be spoken about it, we have very much to learn, and can learn very much from even such countries as we have been in the habit of regarding, until very recently, as heathenish. In no center of the old world would such a sight be tolerated. If it were attempted, there would be a protest at once from the natives themselves, who in many places have been educated to very much higher ideals. I have seen a greater popular love of art, and a more sincere admiration among the common people in Japan, for artistic work, than I have ever seen in America, even among those of the highest standing. They excel in their sense of form and coloring and symmetry, to a very remarkable degree. Even among the coolies of the seaports, these signs of an innate love of the beautiful and truly artistic can often be found. I was surprised and delighted at the evidence discoverable upon every hand in Japan, of this great national trait. In one of their great cities, I went once to buy a vase of a manufacturer, and when I came to the place, there was no real factory, in the sense in which we understand that word in America, but there in the master's house, he had about eight workmen. They were sitting on the floor with their little tables about eight inches square, in front of each the tables carrying the enamel which they used in their work, and at the back, they had their oven, where they did their firing to fasten the enamel. It's one of the real arts, you know, to successfully do this sort of work, and produce the beautiful effects for which they are so justly noted. One would put on a coating of enamel and send it up to be fired, and it was carefully tested in the most conscientious manner. Every vase was fired six or seven times. They were at work when I was in there, making some vases for the Imperial palace. As I looked about me, I saw just beyond me a scene of the most exquisite artistic beauty. There was a little yard, most beautifully laid out, with little palms, and a little pond, in which gold fish sailed gracefully about, and I said to the gentleman in charge: "What a beautiful little spot!" And he said: "The workmen have to have it you know. All the workmen of my village have to have something of that sort on which to rest their eyes." I could not help but wonder at it. There were beautiful things in profusion all around them, with everything in absolutely easy reach, and yet they must have something of that kind on which to rest their eyes. I think I have begun to appreciate what their feeling was.

Once when visiting another friend, the cook did not appear for dinner until after the dinner had been served, about an hour and a half after the ordinary time, and then she was found outside, and upon being asked why she did not come in for her dinner, she said: "How could I eat, in the face of such a sunset as that?" She was looking at the sun as it went down, and seemed to be completely entranced with the glorious coloring of the western sky. I wonder how many of our cooks would give up their dinner for the sake of watching the colors of the setting sun?

A friend of ours there had a beautiful wood carving, about two feet by one, and it was set in his gate, right at the sidewalk, where it was within easy reach of everyone who was passing by. It was where all the public could see it. That was in '87, during our visit. I said to him: "Why, is it safe to put that lovely old carving in such a place as that? I should think you would be afraid it would be stolen. I should think you would lock it up at night anyway." My friend looked at me with some surprise, and she said: "Is that what you would have to do in America? I am not afraid. I want it where the people can see it." In 1896, we were there again, and we went to visit the same friend, and to my pleasure and surprise, we found that same wood carving; a little bit weatherworn, it is true, but in absolutely the same spot as it had been in the first place. There it was, right where the people could see it, and we continually saw the people stop to look at it, and heard them speak of its beauty, as they stopped and folded their hands in their quaint way, and looked at it in that dreamy way so common to the Japanese. It was perfectly safe. Such a thing would not have been possible in America. And that is just the ideal that we should strive to attain in this country.

Now, in conclusion, let me emphasize one or two points. I have been obliged to pass over a great many that perhaps I should have spoken of, but I want to emphasize this, not only in New England but in other sections of our country there are great natural beauties which by all means should be preserved. The women of our country are doing much. The women of California, for example, have done much to promote the agitation which has resulted in the saving of the giant sequoia trees. I believe they have succeeded in having some sort of a national park organized in which they are to be included. Truly, it would have been a mighty mistake to have allowed those monumental specimens which link us to by-gone ages to have been destroyed. Long before the declaration of independence or the War of the Revolution, in which our forefathers struggled and fought that we might be free, long before the landing of the pilgrim fathers upon historic Plymouth Rock or the boats of Columbus had touched our West Indian shores, those trees were there, tossing their mighty heads in the breezes of the Pacific. Honor to those who have sought to preserve them. And so I might instance many cases in different parts of the country where these natural scenic beauties have been preserved and the surroundings made more pleasant for those who dwell about them and for those who come to feast their eyes upon them. Let me encourage you to use your best effort to carry into practice some of the hints which I may have been so fortunate as to have given you, and I know that your reward will be even a thousand fold. (Applause.)

The SECRETARY. Mr. President, I think it is eminently fitting, at this closing session of our convention, that we should make suitable acknowledgment of our obligations to those who have contributed so largely to the success of our meeting, and therefore I move the adoption of the following resolution by this convention:

Resolved, That to his Honor, the Mayor, and the citizens of Norwich, for their cordial welcome, and the free use of their Town Hall; to the press of the city and State, for liberal notices of this meeting and its proceedings; to the disti guished speakers of our own and other States, who have ma our meeting so valuable in practical and scientific instructio to the musical talent, which has added so largely to our ente tainment; to the railroads, for liberal concession in rate and to all who have aided in making our meeting a succe the thanks of this convention are hereby extended.

Resolution seconded and unanimously passed.

Motion to adjourn without day seconded and passed.

The PRESIDENT. I therefore declare this conventi adjourned.

EXHIBITS AT NORWICH,

December 9, 10, and 11, 1902.

(Reported by Mr. N. S. Platt, Pomologist of the Board.)

Apples — Connecticut Agricultural College, Storrs, 50 varieties.
Stephen Hoyt's Sons, New Canaan, 21 varieties.
Walter Scott, Cheshire, 7 varieties.
N. Dwight Platt, Milford, 2 varieties.
Selden Smith, Cheshire, 1 variety.
L. H. Healy, North Woodstock, 1 variety.
J. F. Brown, North Stonington, 8 varieties.
N. S. Platt, New Haven, 1 variety.

Grapes — Connecticut Agricultural College, Storrs, 4 varieties.

Pears — Connecticut Agricultural College, Storrs, 5 varieties.

Plums — Connecticut Agricultural College, Storrs, 1 variety.

Potatoes — Connecticut Agricultural College, Storrs, 5 varieties.
Edw. A. Geer, Griswold, 1 variety.

Corn — Connecticut Agricultural College, Storrs, 3 varieties.
Seaman Mead, Greenwich, 1 variety.

Millet — Edw. A. Geer, Griswold, 1 variety.

Madeira Nuts — Mrs. Jas. Graham, West Haven, 1 plate.

Hickory Nuts — Amos Northrop, Bridgewater, 1 plate.

The Connecticut Agricultural College exhibited a line of 12 bottles of sanitary brand of milk, and from the veterinary department of the College diseased bones of the horse and samples of jaws showing age of horse by the teeth.

The New Haven Agricultural Experiment Station made a notable exhibit, a bare catalogue of which gives a very inadequate idea of its extent and value:

8 varieties of scale insects on natural leaf or wood.

20 cases of insects, most of them showing growth from egg to maturity.

96 samples of natural leaves and plants, showing effects of different kinds of fungi — all under glass.

21 samples of some of the common moulds under artificial culture.

Samples of spraying pumps and nozzles in present use.

10 samples of liquid mixtures and 11 of dry materials used as insecticides.

24 samples of cattle foods on sale in Connecticut.

Photographs of different stages of progress in forestry work.

Samples of tree seeds and seedling forest trees.

OFFICIAL LIST OF AGRICULTURAL SOCIETIES IN CONNECTICUT, 1902.

Name of Society.	President.	Secretary.	Treasurer.
New London County,	E. Judson Miner,	T. W. Yerrington,	Chas. W. Hill.
Windham County,	Chas. S. Hyde,	Chas. A. Briggs,	Preston B. Sibley.
Beacon Valley,	Wm. J. Noble,	Wm. L. Lloyd,	E. A. Hotchkiss.
Berlin,	S. F. Raymond,	W. W. Christian,	Francis H. Shaw.
Branford,	Edwin Doolittle,	John P. Callahan,	John P. Callahan.
Chester,	George A. Bogart,	H. F. Hornbeck,	Geo. H. Bole, Jr.
Danbury,	Samuel H. Rundle,	G. M. Rundle,	John W. Bacon.
Farmington Valley,	Oliver Perry,	E. A. Hough,	Benj. F. Case.
Granby,	Geo. O. Beach,	F. J. Stone,	C. H. Deming.
Guilford,	John B. Hubbard,	M. Louise Hitchcock,	Harry W. Carter.
Harwinton,	Wm. J. Barber,	Albert W. Buell,	Patrick Hogan, Jr.
Madison,	Joseph D. Kelsey,	D. Eugene Smith,	D. Eugene Smith.
New Milford,	J. LeRoy Buck,	J. Edwin Hungerford,	Edwin J. Emmons.
Newtown,	Theron E. Platt,	P. H. McCarthy,	Henry G. Curtis.
Orange,	Watson S. Woodruff,	Arthur D. Clark,	Edward L. Clark, Jr.
Putnam,	John O. Fox,	Arthur D. McIntyre,	J. F. Carpenter.
Rockville,	Andrew Kingsbury,	Ed. F. Badmington,	Francis A. Randall.
Simsbury,	Edmund A. Hoskins,	Geo. C. Eno,	Charles E. Curtis.
Stafford Springs,	E. C. Dennis,	C. F. Beckwith,	H. S. Abel.
Union (Monroe, etc.),	F. W. Wheeler,	S. T. Palmer,	David S. Clark.
Union (Somers, etc.),	Alvah S. Brainard,	Milo Hamilton,	Chas. A. Thompson.
Waterbury Driving Co.,	Thomas Bland,	N. W. Heater,	Thomas H. Hayes.
Wethersfield,	Josiah G. Adams,	Chas. C. Harris,	Chas. C. Harris.
The Horseshoe Park Ag'l Ass'n,	Chas A. Gates,	Freeman R. Sadd,	Fred A. Sanderson.
Woodstock,	H. H. Davenport,	L. H. Healey,	A. E. Brunn.
Wolcott,	Charles S. Tuttle,	E. M. Upson,	E. M. Upson.
Conn. Dairymen's Association,	F. H. Stadtmueller,	John B. Noble,	B. C. Patterson.
Conn. Pom. Soc.,	N. S. Platt,	H. C. C. Miles,	R. A. Moore.

RETURNS OF AGRICULTURAL SOCIETIES, 1902.—FINANCES—RECEIPTS.

SOCIETIES.	Cash on hand.	Single Admission Tickets.	Membership or Season Tickets.	Grand Stand.	Donations and Unclaimed Premiums.	Entrance Fees, Trials of Speed.	Other Entrance Fees.	Rent of Grounds.	Other Sources.	State Appropriation, 1902.	TOTALS.
New London County,	$23.80	$2,743.50	$92.00	$456.25		$555.00	$68.50	$581.50		$306.50	$4,827.05
Windham County,	42.28	906.15	25.00	125.55	$15.00	200.00	108.00	345.87	$318.62	318.08	2,404.55
Beacon Valley,	62.69	551.55	95.00	28.70	25.00	99 00	19.00	95.60			976.54
Berlin,	518.26	858.50	147.00	77.70	129.25			101.07	95.25	141.63	2,068.66
Branford,		1,300.00		190.00		1,600.00					3,090.00
Chester,	40.26	81.60	47.75					6.75	125.78	128.36	430.50
Danbury,	3,594.17	17,371.25	10.00	3,446.50		1,731.09	1,899.40	8,398.61	425.24	1,410.04	38,286.80
Farmington Valley,	142.41	1,135.70		243.70		360.00	62.45	279.10	320.55	177.17	2,721.08
Granby,		484.95			10.00	222.50		81.05	277.84	122.84	1,199.18
Guilford,	982.51	105.15	69.00		78.50	5.50			113.36	142.26	1,496.28
Harwinton,	162.02		.25				28.20	380.25	5.55	147.00	723.27
Madison,	5.18	65.80	36.00		101.30		16.00	28.00	46.30		298.58
New Milford,	145.93	1,113.35		201.30		459.00		339.80	78.15	174.54	2,512.07
Newtown,	114.54	620.65		228.76	512.35	485.00	4.00	244.88	53.96	113.80	2,377.94
Orange,		1,745.19	100.00	333.42	5.00	160.00	106.50	367.57	59.77	173.89	3,051.84
Putnam,	159.00	1,999.30	35.00	471.40	10.00	445.00	69.00	613.35	207.99	250.07	4,260.11
Rockville,	1,385.07	1,853.95	139.20	417.75		105.00	106.20	629.83	70.00	240.46	4,947.46
Simsbury,	11.96	493.70				286.47		140.00	12.75	118.95	1,063.88
Stafford Springs,	4,613.79	2,935.80	153.00	841.56		562.50	120.50	1,085.00	191.36	303.58	10,807.09
Union (Monroe, etc.),	13.96	186.50	86.00	15.00		68.00		14.84	130.00	148.19	662.49
Union (Somers, etc.),	1,112.50		6.00					55.00	146.86	126.36	1,446.72
Waterbury Driving Co.,		778 45			187.00		71.00	259.00	258.72		1,554.17
Wethersfield,	104.93	68.00	73.50		112.95				162.89	101.12	623.89
Horseshoe Park,		2,136.60	120.00	480.00		282.50	32.20	399.00	3,257.68		6,793.29
Woodstock,	279.51	1,072.47	111.00	218.11	222 00	57.80	80.70	250.85	68.05	235.04	2,375.75
Wolcott,	2,003.05	631.90	73.00				7.50	172.00	137.00	209.59	3,234.04
Conn. Dairymen's Ass'n,	355.71		126.00		85.00				250.41	998.08	1,824.20
Conn. Pom. Soc.,	104.99		391.00							170.52	666.51

RETURNS OF AGRICULTURAL SOCIETIES, 1902 — FINANCES, CONTINUED.

SOCIETIES.	Expenses of Fair.	Premiums for Speed.	Premiums for Amusement.	Other Premiums and Gratuities.	Permanent Improvements.	Other Expenses.	Cash on hand.	TOTAL.	Indebtedness of Society.	Real Estate.	Personal Estate.	Number of Members.	No. of Stockholders.	Capital Stock.	Admission Tickets.	Season Tickets.	Grand Stand.
New London Co.,..	$849.88	$1,360.00	$650.00	$1,031.15	$58.74	$864.00	$13.28	$4,827.05	$4,300.00	$10,000.00	....	209	....	....	$0.35	$1.00	$0.25
Windham County,	421.12	450.00	330.00	1,031.00	137.72	31.90	2.81	2,404.55	....	5,000.00	$300.00	675	....	....	.35	1.00	.20
Beacon Valley,....	362.55	245.00	9.00	353.40	....	28.00	......	997.95	21.41	....	....	....	....	....	.25	.25	....
Berlin,............	584.38	....	41.60	252.25	234.96	952.47	3.00	2,068.66	1,951.22	4,000.00	....	147	....	....	.25	....	....
Branford,.........	300.00	2,700.00	....	202.30	....	....	......	3,292.30	....	....	....	....	....	....	....	....	....
Chester,...........	112 50	....	13.50	206.00	23.45	....	76 05	430.50	125.78	....	....	75	....	....	.10	.25	....
Danbury,..........	15,378.20	2,950.00	1,032.50	6,508.50	706.37	6,200.00	5,515.73	38,286.30	....	20,000.00	17,000.00	....	290	$12,000	.35	5.00	.25, .50
Farmington Valley	447.99	800.00	445.00	439.06	316.20	254.73	18.10	2,721.08	2,150.00	9,208.07	....	....	....	....	.25	....	....
Granby,...........	....	567 50	71.90	201.25	76.83	281.70	......	1,199.18	901.66	3,000.00	....	...	76	....	.15, .25	...	....
Guilford,..........	148.00	....	....	294.40	2.19	68.00	983.69	1,496.28	....	....	....	138	....	....	.15	.50	....
Harwinton,........	274.43	....	12.50	270.85	....	....	165.99	723.27	....	....	275.00	120	....	....	....	....	....
Madison,..........	88.00	....	2.65	322.88	....	....	......	413.53	....	....	....	36	....	....	.10	....	....
New Milford, ...	528 48	800.00	....	407.65	308.88	....	163.06	2,512.07	2,900.06	....	....	....	....	....	.25	....	....
Newtown, ...	942.81	855.00	240.00	225 05	....	115.55	......	2,377.94	900.00	....	6,000.00	...	....	5,000	.25	....	.25, .50
Orange,...	783.03	500.00	12.75	494.75	98.52	422 83	789.46	3,051.34	....	500.00	1,200.00	100	....	....	.25	....	....
Putnam, ...	1,186.65	1,000.00	180.15	952.67	....	864.61	126.03	4,260.11	7,900.00	17,901.09	....	....	165	10,000	.35	1.00	.25
Rockville,.........	910.93	972.10	776.98	871.60	....	750.00	665.85	4,947.46	....	6,000.00	....	....	118	10,000	.35	1.00	.25
Simsbury, ...	182.56	638.25	36.00	182.75	....	23.00	41.27	1,063.83	275.00	....	....	....	....	....	....	....	....
Stafford Springs...	1,236.17	1,453.04	1,564.46	1,263.82	1,466.35	....	3,823 25	10,807.09	....	10,000.00	350.00	56	....	5,000	.35	1.00	.25
Uni'n (Monr'e.etc.)	464.05	95.00	....	103.44	....	....	......	662.49	1,000.00	1,200.00	....	110	....	....	.25	1.00	.20
Uni'n (Som'rs,etc.)	52.70	....	5.00	179.15	5.50	107.80	1,096.57	1,446.72	......	....	....	....	....	....	....	. .	....
Waterbury Dr. Co.,	1,144.61	60.00	139.00	961.00	....	....	......	2,304.61	500 00	....	....	....	115	3,000	.25	....	....
Wethersfield,......	55.72	....	....	105.00	....	417.50	45.17	623.39	1,000.00	7,000.00	300.00	270	47	5,000	.25	.50	....
Horseshoe Park, ..	752.45	1,007.50	785.77	527.50	2,036.06	1,734 00	10.01	6,793.29	1,157.45	....	3,183.83	50	50	1,962.50	.35	1.00	.25
Woodstock,.......	507.53	199.00	205.00	806.30	....	461.25	196.67	2,375.75	....	8,000.00	....	525	....	....	.25	....	.15
Wolcott,...........	260.13	....	67.00	450.75	....	....	2,456.16	3,234.04	....	....	100.00	78	....	....	.25, .10	1.00	....
Con. Dair'n's As'n,	225.29	....	....	358.10	....	834.87	405.95	1,824.20	....	....	....	...	....	....	....	....	....
Conn. Pom. Soc.,..	111.15	....	....	379.50	....	....	175.86	666.51	....	....	....	500	....	....	....	....	....

ANALYSIS OF PREMIUMS AND GRATUITIES PAID.—FARM STOCK.

SOCIETIES.	Bulls.	Milch Cows.	Heifers.	Calves.	Working Oxen.	Steers.	Fat Cattle.	Horses.	Horses, Speed.	Sheep.	Swine.	Poultry.	All other Stock.	TOTAL.
New London County,	$64.00	$240.00	$31.75	$35.50	$42.50	$28.25	$16.00	$140.75	$1,360.00	$139.50	$22.00	$61.75		$2,185.00
Windham County,	51.00	68.50	38.50	30.00	91.00	52.00		176.00	450.00	22.00	12.00	14.50		1,095.50
Beacon Valley,	2.00	14.00	14 00	6.50	22.00	26.00	6.00	18.00	245.00		4.00	47.00	$11.50	411.00
Berlin,	4.00	20.50	3 00	2.00	5.50	1.50	1.50	14.00		8.00	11.00	26.25	8.25	100.50
Branford,	2.50	5.50	2.50	1.00	17.50		3.00	11.50	2,700.00		6.00	51.50	32.50	2,833.50
Chester,	1.00	6.00	3.00	3.00	10.00	5 50		3.50		1.00		2.50	2.60	38.10
Danbury,	205.00	176.00	208.00	61.00	99.00	117.00	9.00	399.00	2,950.00	104.00	5.00	403.00	2,085.00	6,821.00
Farmington Valley,	20.00	34.00	43.00	14.00	11.00	8.00	5 00	8.00	800.00		4.00	105.70	7.50	1,075.20
Granby,	8.00	33.00	25.50	6.75	26.00	17.00		22.75		4.50		24.50		168.00
Guilford,	6.00	10.00		1.00	30.25	7.50	9.00	13.50				14.50		91.75
Harwinton,	.75	.75	.75	3.25	54.25		1.50	22.00		1.50	1.50	69.40		155.65
Madison,	4.50	30.50	7.50	3.75	23.50	25.00	9.50	21.00		3.18	13.00	18.80	44.15	204.38
New Milford,	19.00	49.50	17.00	7.50	50.00	5.00	12.00	36.00				2.00	6.00	204.00
Newtown,	4.00	19.50	3.00		14.00	8.50	3.00	12.50	855 00	2.00		4.50	10.00	936.00
Orange,	2.00	20.00	4.50	1.00	39.00		8.00	60.00	500.00		6.00	10.25	18.00	668.75
Putnam,								420.00	1,000.00			82.00	227.22	1,679.22
Rockville,	13.00	54.50	5.50	2.50	62.00	8.00	3.00	58.00	972.10	12.00	11.00	221.50		1,428.10
Simsbury,												25.00	97.00	122.00
Stafford Springs,	18.00	58.00	33 00	16.00	28.00	31.00		48.00	1,453 04	8.00	10.00	317.62	28.00	2,048.66
Union (Monroe, etc.),	.67	2.00	2.50	.50	4.67	2.67	.67	3.34	95.00	1.67	1.34	5.84	3.00	123.87
Union (Somers, etc.),	8.00	15.00	19.50	10 50				16.00				31.75	7.85	108.60
Waterbury Driving Co.,	37.50	115.50	77.00	29.25	97.50	34.50	7.50	79.00	60.00	26.00	15.25	92.75	3.00	674.75
Wethersfield,														
The Horseshoe Park,	25.00	50.00	94.00	27.00	21.00	14.00	3.00	35.00	1,007.50		4.00	10.50	93.75	1,384.75
Woodstock,	19.00	87.00	71.00		37.00	37.00		150.00	199.00	24.00	17.00	15.25	15.00	666.25
Wolcott,	22.00	44.25	34.50	28.75	50.00	11.00	4.50	22.00				58.50	19.00	289.50

ANALYSIS OF PREMIUMS AND GRATUITIES.—Continued. FARM PRODUCTS.

SOCIETIES.	Indian Corn.	Wheat.	Rye.	Barley.	Oats.	Beans.	Buckwheat.	Grass Seeds.	Potatoes.	Carrots.	Beets.	Parsnips.	Turnips.	Onions.	Other products.	Total amount for Grain and Root Crops.
New London County,...	$2.25	....	$0.75	....	....	$1.25	$0.75	....	$6.75	$1.25	$1.25	$1.25	$0.50	$2.50	$17.25	$35.75
Windham County,......	1.50	....	.75	....	$0.75	.75	....	....	17.75	.75	.75	.50	....	3.50	....	27.00
Beacon Valley,.........	1.00	$0.50	1.50	....	3.00	1.25	....	....	28.00	2.25	1.75	.75	2.00	2.50	1.75	46.25
Berlin,.................	5.75	.50	1.75	$0.75	.50	1.75	1.00	....	5.50	2.00	3.75	4.50	2.50	3.75	21.25	55.25
Branford,...............	5.00	1.50	1.50	....	....	2.75	....	....	12.50	1.25	2.00	.75	2.75	2.50	10.00	42.50
Chester,................	6.80	....	.60	....	.60	5.20	....	....	9.35	1.90	4.15	.70	1.90	1.65	20.20	53.05
Danbury,................	13.50	1.50	1.25	....	2.25	23.75	.50	$1.00	68.25	9.00	40.50	2.25	19.00	19.25	216.50	418.54
Farmington Valley,....	1.00	.50	.50	1.00	....	3.10	....	....	39.20	2.00	4.50	.50	2.00	3.80	9.40	67.50
Granby,.................	1.75	....	....	....	....	....	....	....	.75	....	....	....	.25	.25	4.25	7.25
Guilford,...............	5.75	2.50	.50	....	....	1.60	1.25	....	10.00	1.75	4.00	1.80	1.25	1.50	21.70	53.60
Harwinton,..............	1.50	....	.50	....	.50	.80	....	....	5.75	.50	4.30	.30	1.00	7.65	12.65	35.45
Madison,................	4.00	.50	.75	.50	.50	1.50	....	....	13.50	1.25	3.25	.75	1.00	.75	12.75	41.00
New Milford,...........	3.50	.50	1.00	....	1.00	....	....	....	24.00	....	1.75	.50	.75	2.00	7.25	42.25
Newtown,...............	3.00	.75	....	....	.50	1.50	.50	....	3.75	1.00	1.50	.75	.50	1.50	4.75	20.00
Orange,................	2.00	....	.50	....	....	2.00	....	....	15.75	.75	1.50	....	.50	3.50	....	26.50
Putnam,................	1.00	....	....	....	....	4.00	....	....	19.75	3.50	4.50	1.00	2.25	13.25	13.25	62.50
Rockville,..............	6.00	....	1.50	....	1.50	6.25	1.50	.50	87.50	1.75	.75	.75	1.25	8.00	98.45	215.70
Simsbury,..............	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	60.75
Stafford Springs,.......	8.50	1.00	2.00	2.00	1.75	6.50	1.50	....	84.25	2.00	2.25	.75	3.25	6.00	42.00	163.75
Union (Monroe, etc.),...	1.00	....	....	....	.50	.15	....	....	2.75	....	....	....	.17	.17	3.00	7.74
Union (Somers, etc.),...	.75	....	.75	....	.50	....	.50	....	8.75	.75	.75	....	....	.75	11.50	25.00
Waterbury Driving Co.,	10.50	....	1.25	....	1.00	2.00	.50	....	66.25	7.35	6.00	2.00	8.75	7.75	50.25	163.50
Wethersfield,...........	8.25	....	....	....	....	....	....	....	11.00	1.50	....	....	3.00	9.00	6.25	39.00
The Horseshoe Park, ..	....	....	....	....	....	2.00	....	....	3.00	....	....	....	....	3.00	13.00	21.00
Woodstock,............	....	....	....	....	....	....	....	11.85	....	....	....	....	....	....	54.70	66.55
Wolcott,................	9.50	....	1.25	1.00	....	1.00	....	....	24.25	2.75	5.50	.75	2.25	2.50	.75	51.50

ANALYSIS OF PREMIUMS AND GRATUITIES.—CONTINUED. FARM PRODUCTS AND MISCELLANEOUS.

SOCIETIES.	Fruits.	Flowers.	Other Cult. Crops.	Butter.	Cheese.	Honey and Wax.	Bread and Cake.	Sugar, Syrup, Preserved Fruit.	Total Farm Products	Agricultural Implements.	Mechanical Inventions.	Fine Arts and Fancy Articles.	Decorated Carts and Trains of Oxen.	Plowing at Exhibition.	Grange Exhibit.	Medals.	Diplomas.	Total Miscellaneous.
New London County,	$23.40	$15.75		$5.50			$8.50		$86.90	$7.00	$47.00	$65.25				5	2	119.25
Windham County,	89.50	38.55	$15.25	4.50	$4.50	$1.00	16.15	$14.00	210.45		1.00	240.05					7	241.05
Beacon Valley,	70.45	12.00		.25			8.50	4.25	141.70		5.70	32.50	$7.50					45.70
Berlin,	84.50	9.25	.75	4.50			6.75	9.25	118.25		4 25	16.25	18.00					38.50
Branford,	44.00	5.75	3.30	.50			5.00	8.25	109.30			34.50	15 00					49.50
Chester,	27.10	7.45					4.55	20.20	112.45		27.90	19.60	10.00					57.50
Danbury,	363.75	150.50	181.00	4.00		41.50	113.25	116.00	1,393.50		549.75	691.25					63	1,244.00
Farmington Valley,	35.85	11.25	4.96	3.00		.80	8.80	9.30	141.46			22.40						22.40
Granby,	2.50	.80		1.00			5.25	4.15	20.95			12.30						12.30
Guilford,	48.75	13.00		.75		.25	11.25	9.05	136.65			38.50	27.50					66.00
Harwinton,	16.00	2 25		.55			5.35	1.90	61.50			13.20	40.00					53.20
Madison,	36.00	7.50		.30		.30	3.80	8.70	92.60		3.00	17.20	5.70					25 90
New Milford,	58.25	8.50					7.50	10.50	127.00			70.65						70.65
Newtown,	24 50	4.75	8.50	.75		6.50	8.00	6.75	79.75			62.30	2.00					64.30
Orange,	48.25	2.50				.50		7.50	85.25			42.25	138.00				1	180.25
Putnam,	49.75	10.75				1.00	13 75	7.00	144.75		66.75	61 95						128.70
Rockville,	69.00	27.35		6.00			18.50		336.55			84.05						84.05
Simsbury,									60.75									
Stafford Springs,	38.20	5 75		.75			3.75	17.75	229 95		44.50	94.50					19	139.00
Union (Monroe, etc.),	11.08	4.17		.50			6 42	.25	37.90			37.24	7.17				6	44.41
Union (Somers, etc.),	17.00			1.00			.80	2.00	45.80	10.00		14.75						24.75
Waterbury Driving Co.,	89 00	11.00		5.00		.50	16.25	6.50	291.75			16.25	38.00					54.25
Wethersfield,	19.75	16 25	7.25				5.50	2.75	90.50			14.50						14.50
Horseshoe Park,	28.75	4.00		1.50				3.50	58.75			83 00						83.00
Woodstock,	60.10	12 70		10.00	5.00		20.55	8.00	182.90	15.75	42.65	51.75	26.00	$20.00				156.15
Wolcott,	45.00	1.25	17.00	1 00			3.25	1.00	120.00			13.25	13.00		$15.00			41.25
Conn. Dairymen's Ass'n.,				358.10					358.10									
Conn. Pom. Soc.,	379.50								379.50									

NUMBER OF ANIMALS EXHIBITED.—1902.

SOCIETIES.	Bulls.	Milch Cows.	Heifers.	Calves.	Oxen (pairs).	Steers (pairs).	Fat Cattle.	Horses.	Horses — speed.	Sheep.	Swine.	Poultry (coops).	All other Stock
New London County,	21	183	23	28	27	24	10	25	27	138	30	68	....
Windham County,	22	55	46	18	39	32	1	34	18	60	22	27	....
Beacon Valley,	2	10	16	12	18	20	6	....	....	....	12	....	....
Berlin,	3	19	3	2	4	1	1	11	....	9	10	36	....
Chester,	1	6	3	3	10	4	....	3	....	3	....	12	9
Danbury,	52	83	82	43	41	96	4	83	106	48	6	642	380
Farmington Valley,	11	28	27	11	11	8	4	5	....	....	10	....	....
Harwinton,	1	1	1	8	38	....	4	19	....	8	8	106	....
Madison,	8	18	8	5	20	22	5	10	....	18	20	58	....
New Milford,	10	35	14	6	38	2	9	19	....	....	6	16	....
Rockville,	9	48	14	10	19	4	2	27	27	22	45	123	....
Stafford Springs,	5	26	19	10	20	28	....	....	....	....	....	....	....
Union (Monroe, etc.),	2	11	8	3	14	3	2	6	16	20	2	29	16
Union (Somers, etc.),	4	10	12	8	....	....	....	8	....	....	....	35	....
Waterbury Driving Co.,	20	48	47	21	42	29	7	....	....	....	....	68	....
Horseshoe Park,	8	18	43	17	4	4	1	13	20	....	10	20	....
Woodstock,	6	47	35	....	3	12	....	78	32	15	....	30	15
Wolcott,	10	32	26	18	38	13	6	18	....	....	....	156	....

AGRICULTURAL FAIRS IN CONNECTICUT.—1902.

SOCIETIES.	PLACE.	DATE.	Attendance.						
			Monday.	Tuesday.	Wednesday.	Thursday	Friday.	Saturday.	Total.
New London County,	Norwich,	Sept. 16-17-20,	....	1,000	7,500	....	....	1,500	10,000
Windham County,	Brooklyn,	Sept. 18-19-20,	....	....	....	250	2,500	1,000	3,750
Beacon Valley,	Naugatuck,	Sept. 23-24-25,	....	700	400	1,800	....	....	2,900
Berlin,	Berlin,	Oct. 2-3,	....	....	....	3,000	2,000	....	5,000
Branford,	Branford,	Sept. 23-24,	....	1,400	1,200	....	....	....	2,600
Chester,	Chester,	Sept. 24,	....	....	500	....	....	....	500
Danbury,	Danbury,	Oct. 6-11,	2,224	3,653	9,836	22,458	19,381	5,653	63,202
Farmington Valley,	Collinsville,	Sept. 10-11,	....	....	1,200	4,100	....	....	5,300
Granby,	Granby,	Sept. 24-25,	....	....	700	1,600	....	....	2,300
Guilford,	Guilford,	Sept. 24,	....	....	3,500	....	....	....	3,500
Harwinton,	Harwinton,	Oct. 7,	....	12,000	....	....	....	....	12,000
Madison,	Madison,	Oct. 1,	....	....	1,000	....	....	....	1,000
New Milford,	New Milford,	Sept. 16-17-18,	....	300	3,000	1,200	....	....	4,500
Newtown,	Newtown,	Sept. 30, Oct. 1-2-3,	....	500	....	2,500	1,500	....	4,500
Orange,	Orange,	Sept. 10-11-12,	....	....	1,000	4,400	1,850	....	7,250
Putnam,	Putnam,	Aug. 26-27-28,	....	....	6,000	2,500	....	....	8,500
Rockville,	Rockville,	Sept. 23-25,	....	1,500	6,000	4,000	....	....	11,500
Simsbury,	Simsbury,	Oct. 2-3,	....	....	....	....	....	....	....
Stafford Springs,	Stafford Springs,	Sept. 30, Oct. 1-2,	....	1,200	....	10,000	4,000	....	15,200
Union (Monroe, etc.),	Huntington,	Sept. 24-25,	....	....	586	475	....	....	1,061
Union (Somers, etc.),	Somers,	Oct. 2,	....	....	....	5,000	....	....	5,000
Waterbury Driving Co.,	Waterbury,	Sept. 30, Oct. 1-2,	....	800	2,500	....	2,000	....	5,300
Wethersfield,	Wethersfield,	Sept. 23-26,	....	190	245	215	225	....	875
Horseshoe Park,	Willimantic,	Sept 23-25,	....	1,500	6,000	2,500	....	....	10,000
Woodstock,	So. Woodstock,	Sept. 16-17,	....	2,455	1,323	....	....	....	3,778
Wolcott,	Wolcott,	Oct. 15,	....	....	3,500	....	....	....	3,500

OFFICIAL DIRECTORY

OF THE

CONNECTICUT PATRONS OF HUSBANDRY

FOR 1903.

OFFICERS OF CONNECTICUT STATE GRANGE.

Master, B. C. PATTERSON, Torrington.
Overseer, IVERSON C. FANTON, Westport.
Lecturer, FRANK S. HOPSON, Stratford.
Steward, J. B. BLIVEN, New London.
Assistant Steward, ROBERT W. ANDREWS, New Britain.
Chaplain, REV. F. COUNTRYMAN, North Branford.
Treasurer, N. S. PLATT, New Haven.
Secretary, HENRY E. LOOMIS, Glastonbury.
Gate-Keeper, E. H. WRIGHT, Clinton.
Ceres, MISS GERTRUDE W. BRADLEY, Waterbury.
Pomona, MRS. SABRA M. KELSEY, Higganum.
Flora, MRS. HATTIE J. WELTON, Plymouth.
Lady Steward, MRS. ALICE L. POTTER, North Woodstock.

EXECUTIVE COMMITTEE.

J. H. HALE, South Glastonbury,	Term Expires, 1906
H. F. POTTER, North Haven,	" " 1904
ORSON S. WOOD, Ellington,	" " 1905
B. C. PATTERSON, *ex officio*,	" " 1904
H. E. LOOMIS, *ex officio*,	" " 1904

FINANCE COMMITTEE.

H. C. DUNHAM, Middletown. R. R. WOLCOTT, Wethersfield.
P. B. SIBLEY, Danielson.

East Central Pomona,	3,	Geo. H. Carrier, Glastonbury,	Andrew Kingsbury, Coventry,	Laura J. Brewer, [illegible]
Mountain County Pomona,	4,	Lester N. Smith, Colebrook,	Miss Grace A. Hammond, W. Goshen,	K. K. Kimberly, Torrington.
New Haven Co. Pomona,	5,	G. A. Hopson, Wallingford,	Mrs. C. A. D. Allen, Wallingford,	Mrs. L. P. Tuttle, North Haven.
New London Co. Pomona,	6,	F. N. Taylor, Lebanon,	H. W. Morse, R.F.D., Jewett City,	Otto L. Pultz, Lebanon.
Excelsior Pomona,	7,	Stephen A. Talmadge, Prospect,	Miss Luella Hotchkiss, Prospect,	Mrs. Sara S. Talmadge, Prospect.
Seaview Pomona,	8,	Lovel D. Parmelee, Killingworth,	Geo. C. Carter, Clinton,	D. Eugene Smith, Madison.
Fairfield County Pomona,	9,	Wm. J. Wood, Westport,	Mrs. Lloyd Godfrey, Cannon,	Mrs. Nellie E. Blakeman, Oronoque.
Housatonic Valley Pomona,	10,	Gilbert A. Vincent, Kent,	Rev. Geo. H. Smith, Kent,	H. S. Comstock, Cornwall Bridge.
Subordinate Granges.				
Washington,	No. 11,	Edwin C. Whitehead, Wash. Depot,	Mrs. E. C. Whitehead, Wash. Depot,	Robert W. Squires, Wash. Depot.
Tunxis,	13,	Timothy E. Griswold, Bloomfield,	Fred L. Granger, Jr., Bloomfield,	Alfred C. Case, Bloomfield.
Hope,	20,	Howard Newbury, Torrington,	Mrs. Rebecca Newbury, Torrington,	Herbert R. Leach, Litchfield.
Lebanon,	21,	Otto L. Pultz, Lebanon,	Miss Elsie Geer, Leonard's Bridge,	Nathaniel S. Loomis, Lebanon.
Cheshire,	23,	Alfred L. Bennett, Cheshire,	C. A. Buckingham, West Cheshire,	Graham A. Hitchcock, W. Cheshire.
Berlin,	24,	Francis H. Shaw, Berlin,	Miss Fannie Griswold, Berlin,	Arthur H. Bushnell, Berlin.
Union,	25,	Mrs. Estella H. Barnes, Southington,	Miss Sarah E. Frisbie, Southington,	Mrs. Lillian Hancock, Southington.
Glastonbury,	26,	Wm. H. Carrier, Glastonbury,	Mrs. N. S. Hollister, So. Glastonbury,	Miss Lucy E. Miller, So. Glastonbury.
Suffield,	27,	John S. Gardner, Mapleton,	Mrs. E. F. Newton, Agawam, Mass.,	Fred. S. Kent, Suffield.
Meriden,	29,	Philip T. Vibert, Meriden,	John H. Francis, Wallingford,	Albert Hedler, Meriden.
Wapping,	30,	James M. Preston, Wapping,	Walter N. Foster, Wapping,	S. Rosa Dewey, Buckland.
Manchester,	31,	Albert H. Keeney, So. Manchester,	Miss Mary Strong, So. Manchester,	Keeney B. Loomis, South Manchester.
North Cornwall,	32,	Horace C. Hart, West Cornwall,	Miss Adele T. Peck, West Cornwall,	Mrs. Niles Scoville, West Cornwall.
Wallingford,	33,	Geo. W. Harrison, Wallingford,	Mrs. Rienzi H. Stone, Wallingford,	Flora E. Hough, Wallingford.
Cawasa,	34,	Albert F. Bidwell, Canton Center,	Mrs. Annette Case, Canton,	James Gladwin, Collinsville.
North Haven,	35,	A. Herbert Carlson, No. Haven,	Mrs. Lilla B. Munson, North Haven,	Myron R. Brockett, North Haven.
Little River,	36,	Chester P. Jewett, Hampton,	Mrs. Ellen A Weaver, Hampton,	William Jewett, Rawson.
East Hartford,	37,	Louis T. Judson, Silver Lane,	Charles R. Risley, East Hartford,	Miss Alice M. Warren, Silver Lane.
New Canaan,	38,	Frank N. Horton, New Canaan,	Mrs. D. A. St. John, New Canaan,	Mrs. F. J. Dennett, New Canaan.
Burritt,	39,	Hubert S. Blake, New Britain,	Mrs. Hubert S. Blake, New Britain,	Mrs. Fred H. Sharpe, New Britain.
Senexet,	40,	Dr. Joseph Spaulding, Woodstock,	Miss A. M. Sampson, Woodstock,	Edward P. Berrian, Woodstock.
Konomoc,	41,	E. J. Hempstead, New London,	Mrs. Mary D. Bennett, Waterford,	E. J. Hempstead, Jr., New London.
Mattabessett,	42,	John C. Bailey, Middletown,	Mrs. Emma Dunham, Middletown,	Fannie W. Prior, Middletown.
Brooklyn,	43,	C. S. Hyde, Brooklyn,	Mrs. Emma S. Allen, Brooklyn,	Warren Tanner, Brooklyn.
Newington,	44,	Henry Fields, Newington,	Edward Welton, Newington,	Mrs. Nellie Luce Eddy, New Britain.

OFFICERS OF THE GRANGES.—CONTINUED.

NAME.		MASTER.	LECTURER.	SECRETARY.
Ellington,	46,	Ortive C. Eaton, Ellington,	Mrs. Mary P. Wood, Ellington,	Charles H. Bancroft, Ellington.
Bolton,	47,	Miss Annie M. Alvord, Bolton,	Miss Adelia N. Loomis, Bolton,	Miss Maude E. White, Bolton.
Whigville,	48,	Lester L. Lowrey, Bristol,	Archie H. Bradley, Bristol,	Miss Miriam Curtiss, Bristol.
Westfield,	50,	F. E. Boardman, Middletown,	Rev. D. B. Hubbard, Middletown,	Mrs. Emma Addis, Middletown.
Tolland,	51,	John W. Edgarton, Tolland,	Mrs. Susan Reed, Rockville,	Mrs. Leila Hall.
Vernon,	52,	E. B. Lathrop, Rockville,	C. W. Pitkin, Talcottville,	Mrs. E. D. Pitkin, Talcottville.
Plainville,	54,	S. B. Carpenter, Plainville,	May Hart, Plainville,	Sarah E. Buckley, Forestville.
Stafford,	55,	J. M. Larned, Stafford Springs,	Miss May Colburn, Stafford,	Mrs. Abbie J. Ide, Stafford.
East Haddam,	56,	Robert W. Bingham, Little Haddam,	Mrs. Anna E. Murkett, Moodus,	S. E. Williams, Colchester, No. 1.
West Hartford,	58,	Philemon R. Day, West Hartford,	Mrs. Emma L. Dabney, W. Hartford,	H. D. Dabney, West Hartford.
Saybrook,	59,	A. D. W. Chalker, Saybrook,	Mrs. Emma C. Clark, Saybrook,	Mrs. Ida H. McAllister, Saybrook.
Crystal Lake,	60,	Miss Alice J. Carpenter, Eastford,	Miss Mary E. Bowen, Eastford,	Mrs. Lillian A. Keith, Eastford.
Wolf Den,	61,	A. Newton Vaughn, Abington,	Everett E. Brown, Pomfret,	Mrs. Anna L. Badger, Abington.
Eureka,	62,	G. C. Beckwith, Nepaug,	Clarence F. Loomis, Bakersville,	Mrs. M. V. Douglass, Collinsville.
Middlefield,	63,	Charles P. Augur, Middlefield,	Miss Lucina C. Miller, Middlefield,	Mrs. Clara E. Goodrich, Middlefield.
Mansfield,	64,	C. L. Beach, Storrs,	E. A. White, Storrs,	H. L. Garrigus, Storrs.
Quinnatisset,	65,	Oscar Robinson, East Thompson,	Mrs. Mary J. Woodard, Wilsonville,	Everett Rhodes, Thompson.
Killingworth,	66,	Chas. H. Coe, Killingworth,	Mrs. Bertha Waugh, Higganum,	Mrs. Hattie M. Davis, Killingworth.
Cromwell,	67,	Walter Fawthrop, Cromwell,	Mrs. Ellen C. Jewell, Cromwell,	Miss Hattie M. Hubbard, Cromwell.
Shetucket,	69,	Elwyn B. Inman, Scotland,	Leon J. Moffitt, Scotland,	Miss Edith A. Haskins, Scotland.
Canterbury,	70,	Geo. Rowland, So. Canterbury,	Hart W. Goff, So. Canterbury,	Levi N. Clark, So. Canterbury.
Mad River,	71,	Warren B. Hitchcock, Waterbury,	Miss Bessie White, Waterbury,	Mrs. Anna Hall Pierpont, Waterbury.
Plymouth,	72,	Ard Welton, Plymouth,	Mrs. Carrie B. Miller, Plymouth,	Miss Edith Sutliffe, Plymouth.
Indian River,	73,	Sherman T. Merwin, Milford,	F. M. Smith, Milford,	H. C. C. Miles, Milford.
Winchester,	74,	Lemuel P. Humphrey, Norfolk,	Mrs. Sarah Goodenough, Win. Center,	Wilbur L. Goodenough, Win. Center.
Coventry,	75,	Wm. C. Haven, Coventry,	Miss Fannie J. Kingsbury, Coventry,	Mrs. Flora L. Hall, Coventry.
Andover,	76,	W. A. Snow, Andover,	W. E. Fuller, Andover,	Mrs. Aurelia M. Snow.
Clinton,	77,	Geo. H. Brooks, Clinton,	Hosmer A. Tryon, Clinton,	Wm. H. Kelsey, 2d, Clinton.
Colchester,	78,	Myron R. Abell, Colchester,	Mrs. Maria Hall, Colchester,	Mrs. Hattie J. Strong, Colchester.
Housatonic,	79,	Ernest L. Vincent, Nichols,	Mrs. Lena Holmes, Stratford,	George Meachen, Stratford
Colebrook,	82,	E. B. Hawksley, Winsted,	J. W. R. Allen, Winsted,	Miss S. Ellen Northrop, Winsted.
Foxon,	84,	Geo. T. Fowler, No. Branford,	Miss Nellie D. Woods, East Haven,	Frank M. Sperry, East Haven.
Wangumbaug,	85,	F. A. Spaulding, South Coventry,	Miss Mary Greene, So. Coventry,	Miss Charlotte Albetine, So. Coventry.
Webutuck,	86,	J. S. Chaffee, Amenia Union, N. Y.,	Myra F. Barlow, So. Amenia, N.Y.,	H. V. D. Reed, Amenia Union, N. Y.
Hillstown,	87,	Laura J. Brewer, Hillstown,	Chas. Strickland, Addison,	Harry J. Brewer, Hillstown.
Ekonk,	89,	A. A. Stanton, Ekonk,	Elisha R. Bitgood, Voluntown,	John E. Tanner, Campbell's Mills.
Ashford,	90,	J W. Lanphear, Ashford,	Mrs. Hopie J. Snell, Warrenville,	Bert H. Gardner, Warrenville.
Harmony,	92,	Dr. Frank J. Wales, Stepney Depot,	Miss Rose Sinclair, Stepney Depot,	Edwin C. Shelton, Stepney Depot.

SUBORDINATE GRANGES.— *Cont.*

Border,	93,	Charles E. Little, Willimantic,	Mrs. Alice M. Larkin, Willimantic,	Mrs. Lillian M. French,
East Windsor,	94,	Rev. W. F. English, East Windsor,	Frank M. Thompson, Warehouse Pt.,	Miss Theodora Ellsworth, E.Windsor.
Jewett City,	96,	W. A. Edmond, Griswold,	A. T. Palmer, Jewett City,	H. W. Morse, R. F. D. No. 3, Norwich.
Hamden,	99,	Edward B. Alling, Highwood,	Oscar L. Smith, North Haven.	Thomas Dunn, Mt. Carmel.
Taghhannuck,	100,	Willis P. Connor, Cornwall Bridge,	Miss Mary Lennon, Cornwall Bridge,	Rev. G. F. Goodenough, Ellsworth.
Mashapaug Lake,	101,	Levi M. Reed, Union.	Mrs. Nancy E. Howard, No. Ashford,	George Towne, Stafford Springs.
Beacon Valley,	103,	Mrs. Delia B. Sanford, Naugatuck.	Mrs. Mary L. Ranslow, Naugatuck,	E. A. Hotchkiss, Naugatuck.
Somers,	105,	Louis A. Gowdy, Somersville,	Ernest W. Avery, Somers,	Erwin D. Avery, Somers.
East Haven,	106,	Reuben H. Coe, East Haven,	Mrs. John S. Tyler, East Haven,	Mrs. Martha E. Coe.
Litchfield,	107,	J. H. Putnam, Litchfield,	F. L. Thorp, Litchfield,	F. A. Stoddard, Litchfield.
Woodbridge,	108,	Chas. P. Augur, Woodbridge.	Chas. A. Bond, Woodbridge,	Leroy C. Beecher, Woodbridge.
East Hampton,	109,	Herman E. Rich, East Hampton,	Mrs. Lizzie Stevens, East Hampton,	Miss L. Louise Snow.
Killingly,	112,	W. F. Day, Danielson,	W. H. Shippee, Danielson,	Miss May E. Day, Danielson.
Highland,	113,	Chas. A. Sanderson, Moosup,	Mrs. Ella D. Tillinghast, So. Killingly,	Mrs. Freelie A. Sanderson, Moosup.
Wethersfield,	114,	Stephen F. Willard, Wethersfield,	Mrs. Wm. G. Griswold, Wethersfield,	Dudley Wells, 2d, Wethersfield.
Rocky Hill,	115,	Edward W. Tryon, Rocky Hill,	Mrs. Grace Austin, Rocky Hill,	Mrs. M. A. Griswold, Rocky Hill.
Bristol,	116,	Elbert Gaylord, Bristol,	Burdette A. Peck, Bristol,	Mary C. A. Perkins, Bristol.
Unity,	117,	Samuel S. Webb, Chester,	Adelaide M. Post, Chester,	Geo. W. Spicer, Chester.
Beacon,	118,	E. A. Hopkins, Northfield,	Florence A. Baisden, Northfield,	F. L. Grant, Northfield.
Morris,	119,	Sylvanus Titus, East Morris,	Joel W. Skillton, East Morris,	James M. Whittlesey, E. Morris.
Madison.	120,	J. D. Kelsey, Madison,	D. E. Smith, Madison,	Mrs. Ella M. Kelsey, Madison.
Bethlehem,	121,	George W. Percy, Bethlehem,	Miss Lucinda M. Smith, Bethlehem,	James W. Flynn, Bethlehem.
Watertown,	122,	Arthur Copeland, Watertown,	Mrs. Alice Barber, Watertown,	Geo. M. Fox, Watertown.
Westbrook,	123,	H. E. Kelsey, Westbrook,	Annie Heflon, Westbrook,	David C. Dibble, Westbrook.
Higganum,	124,	Fred Kelsey, Higganum,	Mrs. Sabra Kelsey, Higganum,	Robert H. Freeman, Middletown.
Hollenbeck,	125,	Harlan P. Morse, So. Canaan,	Miles Blodgett, Falls Village,	Lois E. Pendleton, South Canaan.
Pleasant Valley,	126,	Arthur N. Skilton, Woodbury,	Michael F. Skelley, Woodbury,	Miss Mattie E. Barnes, No. Woodbury.
Goodwill,	127,	Mrs. Rose E. Goodale, Glastonbury,	Miss Belle Burney, Glastonbury,	Harold B. Waldo, Naubuc.
Orange,	128,	Walter S. Hine, Derby,	Mrs. E. C. Russell, Orange,	E. C. Russell, Orange.
Pohtatuck,	129,	Mrs. Frank H. Mitchell, Newtown,	Miss Hattie M. Northrup, Newtown,	John J. Northrop, Newtown.
Farmill River,	130,	S. Byron Bronson, Shelton,	Miss G. S. Buckingham, Shelton,	T. F. S. Bartlett, Shelton.
Columbia,	131,	Hubert P. Collins, Columbia,	Wm. P. Johnson, Columbia,	Miss Amelia J. Fuller, Columbia.
Wichita,	132,	F. P. Johnson, Cornwall Bridge,	Mrs. Sarah Marvin, Cornwall Bridge.	Max Schnell, Warren.
Greenfield Hill,	133,	W. Sanford Jennings, Fairfield,	B. F. Pease, Fairfield,	D. Frank Brown, Fairfield.
Trumbull,	134,	Dwight M. Fuller, Bridgeport,	Albert E. Linley, Trumbull,	O. B. Burton, Trumbull.
Silver Lake,	135,	George B. Hamlin, Sharon,	Miss Anna Morehouse, Sharon,	Miss K. B. Whitford, Coleman Sta. N. Y.
East Canaan,	136,	H. K. Trescott, East Canaan,	Mrs. A. Mary Canfield, E. Canaan,	W. W. Howland, East Canaan.
Middlebury,	139,	Arthur S. Judd, Middlebury,	Arthur F. Greene, Middlebury,	Mrs. Martha E. Judd, Middlebury.
Plainfield,	140,	Charles O. Dodge, Plainfield,	Miss Susie H. Lathrop, Plainfield,	David C. Kinne, Plainfield.
Brookfield,	141,	Percy B. Hawley, Brookfield,	Miss F. S. Griffin, Brookfield Center,	Juliette W. Sagendorff, Brookfield C'r.
Rock Rimmon,	142,	Arthur M. Reffelt, Beacon Falls,	Mrs. Mary R. Clark, Beacon Falls,	Mrs. Jennie Burton, Beacon Falls.
Goshen,	143,	William J. Brennan, West Goshen,	Mrs. M. D. Campbell, W. Goshen,	Miss Mary B. Landon, W. Goshen.
Prospect,	144,	Ernest L. Wooding, Prospect,	Luella Hotchkiss, Prospect,	Harry B. Beers, Prospect.
Rippowam,	145,	Cyrus Sarles, Springdale,	Miss Sadie C. Walker, Stamford,	Mrs. Sarah G. Hoyt, Stamford.

OFFICERS OF THE GRANGES.— CONCLUDED.

Name.		Master.	Lecturer.	Secretary.
Norfield,	146,	William Lockwood, Georgetown,	Mrs. Lloyds Godfrey, Georgetown,	
Lyme,	147,	J. Warren Stark, Lyme,	Mrs. Lizzie Beebe, Hamburg,	Mrs. Martha E. Huntley, Hamburg.
Westport,	148,	J. Frank Elwood, Green's Farms,	Miss Dorothy R. Adams, Westport,	Mrs. Irving B. Stone, Westport.
Easton,	149,	Patrick G. McCollam, Bridgeport,	Joseph B. Hill, Bridgeport,	Samuel Turney, Bridgeport.
Woodstock,	150,	Chester E. May, East Woodstock,	C. H. Killam, East Woodstock,	Frank E. Barrett, No. Woodstock.
Enfield,	151,	Harry A. Gowdy, Scitico,	Mrs. Helen Killam, Thompsonville,	Henry J. Bridge, Hazardville.
Cannon,	152,	Wm. E. Hooker, Wilton,	Miss Emma Partrick, Cannon,	Fred S. Sturges, Georgetown.
Bridgewater,	153,	George A. Northrup, Bridgewater,	Miss G. I. Trowbridge, Bridgewater,	H. W. Treat, Bridgewater.
Kent,	154,	Gilbert A. Vincent, Kent,	Mrs. Frank S. Peet, Kent,	Frank S. Peet, Kent.
New Fairfield,	155,	J. R. Hatch, Danbury.	Alex. A. Brush, Danbury,	Charles Williams, Danbury.

OFFICIAL LIST OF FARMERS' CLUBS IN CONNECTICUT, 1902.

NAME OF CLUB.	PRESIDENT.	SECRETARY.
New Haven County,....	Prof. Wm. H. Brewer,.	Cullen B. Foote.
Green's Farms,.........	W. H. Burr,...........	J. Frank Elwood.
Greenwich,............	S. R. Close,...........	G. A. Lockwood.
Newington,.............	H. A. Whittlesey,......	J. S. Kirkham.
New Britain,...........	L. S. Wells,...........	....

CONNECTICUT DAIRYMEN'S ASSOCIATION.

F. H. STADTMUELER, *Pres't*. Elmwood.
J. B. NOBLE, *Sec'y*, Hartford.
B. C. PATTERSON, *Treas.*, Torrington.

CONNECTICUT POMOLOGICAL SOCIETY.

A. G. GULLY, *Pres't*, Storrs.
H. C. C. MILES, *Sec'y*, Milford.
ROSWELL A. MOORE, *Treas.*, Kensington.

CONNECTICUT HORTICULTURAL SOCIETY.

A. C. STERNBERG, *Pres't*, West Hartford.
L. H. MEAD, *Sec'y*, Keney Park Nursery, Hartford.
W. W. HUNT, *Treas.*, Hartford.

CONNECTICUT JERSEY CATTLE BREEDERS' ASSOCIATION.

S. C. COLT, *Pres't*, Elmwood.
R. A. POTTER, *Sec'y*, Bristol.
B. W. COLLINS, *Treas.*, Meriden.

CONNECTICUT CREAMERY ASSOCIATION.

JOHN THOMPSON, *Pres't*, Melrose.
FRANK AVERY, *Sec'y* and *Treas.*, Manchester.

CONNECTICUT SHEEP BREEDERS' ASSOCIATION.

R. S. HINMAN, *Pres't*, Oxford. JOHN H. WADHAMS, *Sec'y*, Goshen.

CONNECTICUT FORESTRY ASSOCIATION.

E. V. PRESTON, *Pres't*, Hartford.
MISS MARY WINSLOW, *Sec'y* and *Treas.*, Weatogue.

BROWN SWISS CATTLE BREEDERS' ASSOCIATION.

HENRY D. LAUGHLIN, *Pres't*, Chicago, Ill.
N. S. FISH, *Sec'y* and *Treas.*, Groton, Conn.

THE AUDUBON SOCIETY OF CONNECTICUT.

MRS. JAMES OSBORNE WRIGHT, *Pres't*, Fairfield.
MRS. HELEN S. GLOVER, *Sec'y* and *Treas.*, Fairfield.

THE CONNECTICUT BEE-KEEPERS' ASSOCIATION.

CHARLES H. CHITTENDEN, *Pres't*, Killingworth.
MISS ELLEN B. PECK, *Sec'y*, Clinton.

CONNECTICUT STATE POULTRY SOCIETY.

GEORGE B. FISHER, *Pres't*, Hartford. R. G. BAILEY, *Sec'y*, Hartford.

MERIDEN POULTRY ASSOCIATION.

L. E. COE, *Pres't*. JOSHUA SHUTE, *Sec'y*. W. B. HALL, *Treas.*

NEW HAVEN POULTRY ASSOCIATION.

EDWARD A. TODD, *Pres't*. W. R. KIRKWOOD, *Sec'y*.
EDW. L. JONES, *Treas.*

REPORT OF THE TREASURER.

CHAS. A. THOMPSON *in account with*
CONNECTICUT BOARD OF AGRICULTURE.

			Cr.	Dr.
1901.				
July	2.	By balance amt. in Treasury,	$1,277.46	
"	17.	To E. J. Miner,		$3.38
Nov.	15.	" Case, Lockwood & Brainard Co.,		100.83
"	"	" Hartford Eng. Co.,		4.86
"	"	" T. S. Gold,		88.87
Dec.	20.	" W. A. Tomlinson,		44.00
"	"	" Alice Freeman Palmer,		50.00
"	"	" Railroad fares of delegates,		75.00
"	"	" Atlantic Hotel,		241.25
"	27.	" H. W. Collingwood,		10.00
"	"	" S. A. Beach,		46.90
"	"	" J. J. Northrop,		.75
"	"	" Cooper Curtice,		30.33
"	"	" Charles W. Whittlesey Co.,		9.45
"	"	" S. Ashwell,		1.43
1902.				
Jan.	22.	" Chas. E. Chapman,		21.10
"	"	" C. A. Thompson,		39.33
"	"	" James F. Brown,		644.53
"	"	" James Wood,		28.85
"	28.	" Seaman Mead,		19.55
"	"	" W. E. Britton,		2.13
"	"	" R. W. Stimson,		11.05
"	"	" I. C. Fanton,		8.30
"	"	" J. B. Palmer,		14.80
"	"	" Frederick Doolittle,		1.80
"	"	" Seaman Mead,		10.00
"	"	" H. W. Conn,		2.04
"	"	" W. O. Atwater,		2.04
Feb.	1.	" E. G. Seeley,		21.35
Jan.	2.	By State appropriation,	3,500.00	
Mar.	1.	To Chas. F. Roberts,		75.00
May	2.	" C. S. Phelps,		8.02

July	1.	To N. G. Williams,		$18.26
"	"	" E. H. Jenkins,		13.55
"	"	" F. H. Stoneburn,		11.60
"	"	" R. W. Stimson,		14.78
"	"	" E. C. Birge,		2.45
"	"	" C. L. Beach,		4.98
"	"	" Edmund Halladay,		30.50
"	"	" B. F. Koons,		12.36
"	"	" James F. Brown,		629 76
"	"	" C. A. Thompson,		33.50
"	"	" D. Walter Patten,		14 90
"	"	" I. C. Fanton,		14.04
"	"	" J. B. Palmer,		3.50
		" Chas. L. Tuttle,		15.08
		By balance amount in Treasury,		2,341.26
			$4,777.46	$4,777.46

This is to certify that we have examined the accounts of the Treasurer of the State Board of Agriculture and found them correct.

SEAMAN MEAD,
D. W. PATTEN,
CHAS. E. CHAPMAN, } *Auditors.*

HARTFORD, July 1, 1902.

INDEX, 1902.

State of Connecticut.

PUBLIC DOCUMENT No 32.

TWELFTH REPORT

OF THE

RY COMMISSIONER,

MADE TO THE GOVERNOR,

A. D. 1902,

FOR THE

ENDING SEPTEMBER 30, 1902.

DERED PRINTED BY THE LEGISLATURE.

MERIDEN, CONN.:
JOURNAL PUBLISHING COMPANY.
1902.

State of Connecticut.

IRY COMMISSIONER'S OFFICE,

ROOM 54, CAPITOL, HARTFORD.

TELEPHONE CALL, 1651.

E, ROBERT O. EATON,
mmissioner. *Deputy Commissioner.*

MISS B. WINONA PAGE,
Clerk and Stenographer.

REPORT.

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

SIR:—In accordance with the provisions of the General Statutes, I herewith have the honor to submit my report of this department for the fiscal year ending September 30, 1902.

Respectfully,

JOHN B. NOBLE,
Dairy Commissioner.

LAWS.

There has been no specific change in any of the laws connected with this department since the 1899 session of the Legislature.

They are presented to you in an entirely new and greatly improved form as taken from the revised statutes. The Committee on the Revision of Laws have made several changes in the wording and have so classified them as to bring all of the pure food laws together in a more connected form and putting each subject under its proper heading. These improvements, together with the marginal dates of passage, will be greatly appreciated by all interested in these laws.

They are here given as they appear in the revised statutes.

ADULTERATION OF FOOD.

1886. Rev. 1888, §2614 1893, ch. 114, §1. **Section 2557. Definition of imitation butter.** Any article resembling butter in appearance and not made wholly, salt and coloring matter excepted, from the milk of cows, shall be imitation butter within the meaning of this chapter. The words "butter," 'dairy," or "creamery" shall form neither the whole nor a part of the name of any imitation butter, nor shall it appear upon any imitation butter, nor upon any box, tub, or package containing imitation butter.

1886, 1887. Rev. 1888, §2615 1893, ch. 114, §2. 1895, ch. 82. **Sec. 2558. Sale of imitation butter regulated.** No person by himself, his agents or his servants, shall render or manufacture, sell, offer, or expose for sale, take orders for the future delivery of, or have in his possession with intent to sell, any article, product, or compound, made wholly or partly out of any fat, oil, or oleaginous substance or compound thereof, not produced from unadulterated milk or cream from the same, which shall be in imitation of yellow butter produced from pure unadulterated milk or cream of the same; but this section shall not prohibit the manufacture or sale of oleomargarine in a separate and distinct form and in such manner as will advise the consumer of its real character, free from coloration and from any ingredient that causes it to look like butter. No imitation butter shall be sold, exposed for sale, or delivered except under the following conditions: (1), the seller shall maintain in plain sight, over the main outer entrance of the premises where the selling is done, a sign bearing in plain black Roman letters, not less than two inches wide and four inches long, on a white ground, the words "sold here," preceded by the name of the imitation article. If the selling is done from a vehicle such vehicle shall conspicuously bear upon its outside on both sides of said vehicle such a sign. If the delivering is done from a vehicle, such vehicle shall conspicuously bear upon its outside on both sides of said vehicle a sign bearing in plain black Roman letters, not less than two inches wide and four inches long, on a white ground, the words "delivered here," preceded by the name of the imitation article; (2), all imitation butter shall be kept in an enclosing package which shall bear on the onside of its body and cover, at all times in plain sight of a beholder of the package in black Roman letters, not less than one inch wide and two inches long, on a white or light colored ground, the name of the imitation article; (3), the seller shall orally inform each buyer at each sale that the article he buys is not butter, and shall give the buyer the name of the imitation article; (4), every person, copartnership, or corporation, selling or offering for sale imitation butter, and every keeper of a hotel, boarding house, or restaurant, temporary or permanent, who shall furnish a guest with imitation butter, or food containing it, shall within fifteen days after commencing said business, and annually on the first of May, or within fifteen days thereafter, register in a book kept by the dairy commissioner for that purpose, the name, and the town, street, and number of street of the place of business of said person, copartnership, corporation, keeper of hotel, boarding house, or restaurant. All signs prescribed in §§ 2558, 2559, and 2560 shall be provided by the dairy commissioner, and all signs required to be maintained in plain sight over the main outer entrance of the premises where the selling is done shall be placed in position subject to the directions of the dairy commissioner or his deputy. All signs so furnished by the dairy commissioner shall be paid for by the parties receiving the same, at the actual cost thereof.

Sec. 2559. Vendor must expose sign. No baker or vendor of food shall sell or expose for sale any article of food containing imitation butter unless such baker or vendor shall maintain the kind of a sign as hereinbefore prescribed, in the way and manner prescribed in that connection, except that the word "used" shall be substituted for the word "sold" If the selling be done from a vehicle such vehicle shall conspicuously bear such sign. 1886, 1887. Rev. 1888, §2616 1893, ch. 114, §2.

Sec. 2560. Hotel keeper must expose sign. No keeper of a hotel, boarding house, or restaurant, temporary or permanent, shall furnish a guest with imitation butter, or food containing it, unless such keeper shall maintain in plain sight of all guests sitting at tables where food is served such a sign or signs as hereinbefore prescribed, except that the word "used" shall be substituted for the word "sold." 1886. Rev. 1888, §2617 1893, ch. 114, §2.

Sec. 2561. Sale of tub butter regulated. No person by himself, his agents, or his servants, shall sell, offer for sale, or have in his possession with intent to sell, butter known as "tub butter" which is pressed or printed into what is known as bricks, pats, or balls, except under the following conditions: every such brick, pat, or ball, shall have the words "tub butter" in one-half inch Roman letters, stamped or pressed upon it, and, if wrapped, the wrapper shall be marked in like man- 1897 ch. 145.

ner. Every person violating any provision of this section sl be fined not more than one hundred dollars.

1889. Rev. 1888, §2619 1893, ch. 114, §4.

Sec. 2562. Penalties. Every person violating any prov ion of §§ 2557, 2558, or 2559, and every person, except a boa ing-house keeper, violating § 2560 shall, for the first offense, fined not more than one hundred dollars, or imprisoned more than sixty days, or both; for each subsequent offense, shall be fined not more than two hundred dollars or impriso not more than four months, or both. Every boarding-ho keeper violating § 2560 shall, for the first offense, be fi twenty-five dollars, or imprisoned not more than thirty days both; for each subsequent offense he shall be fined not m than fifty dollars or imprisoned not more than sixty days, both. Evidence of any violation shall be *prima facie* evide of willful violation.

1887. Rev. 1888, §2622 1889, ch. 238.

Sec. 2563. Adulteration of molasses. Any person v shall adulterate molasses, or who shall sell or offer or exp for sale or who shall solicit or receive an order for sale or delivery within this state, or for delivery wi out this state for shipment into this state, of any lasses adulterated with salts of tin, terra-alba, glucose, d trose, starch, sugar, corn syrup, or other preparation of from starch, shall be fined not more than five hundred doll or imprisoned not more than one year, or both. The deliv of any of the above-mentioned preparations, upon an order licited or received within this state, shall be conclusive evide that the order, upon which such delivery was made, was such articles and shall render the person soliciting or receiv such order liable to the penalty above prescribed.

1889, ch. 60. 1889, ch. 234. 1897, ch. 67.

Sec. 2564. Sale of impure vinegar forbidden. No per shall make, sell, offer or expose for sale or exchange, solicit, receive any order for the sale or delivery within this state, for delivery without this state for shipment into this state (1), any vinegar, as cider vinegar, not wholly produced fr the juice of apples; (2), any vinegar or article sold or to sold as vinegar, to which has been added any drug, or any h ful or foreign substance, or any coloring matter, or any ac or, (3), any vinegar not having an acetic acidity equivalent the presence therein of not less than four per cent. by wei of absolute acetic acid, and in case of cider vinegar, not than two per cent. by weight of cider vinegar solids upon evaporation over boiling water. Every person violating any provision of this section shall be fined not more than fifty dollars for a first offense, and for a later offense not more than one hundred dollars or be imprisoned thirty days, or both. The delivery of any of the above-mentioned articles upon an order solicited or received within this state shall be conclusive evidence that the order upon which such delivery was made was for such articles.

1889, ch. 60.
1897, ch. 67.

Sec. 2565. Sale of vinegar regulated. No person shall make and sell, or make and offer for sale, any vinegar without conspicuously branding, stenciling, or painting upon the head of the barrel, cask, keg, or package containing the same, the name of the maker, his residence, place of manufacture, and the true name of the kind of vinegar contained therein as "cider vinegar," "wine vinegar," "malt vinegar," or "wood acid vinegar"; *provided*, that this section shall not apply to retail sales, at the place of manufacture, in quantities of less than five gallons, and in open packages. Every persons violating any provision of this section shall be fined not more than fifty dollars for a first offense, and, for each subsequent offense, not more than one hundred dollars.

1886, 1887.
Rev. 1888, §§2618, 2620, 2621.
1889, ch. 60, §§3, 4.
1889, ch. 234, §2.
1889, ch. 238.
1893, ch. 70.
1893, ch 114, §§2 3.
1897, ch. 145.
1897, ch. 171.

Sec. 2566. Powers and duties of dairy commissioner. The governor shall appoint a citizen of the state as dairy commissioner, who shall hold office two years from and after the first of May succeeding his appointment, and until his successor is appointed, unless sooner removed by the governor for cause. The governor may fill a vacancy in the office. The dairy commissioner shall attend to the enforcement of the preceding sections of this chapter. A room in the capitol shall be set apart for the dairy commissioner. He may appoint and remove a deputy, who may also act as clerk and who, under the direction of the dairy commissioner, shall have all the powers of the commissioner. The dairy commissioner and his deputy shall have free access, at all reasonable hours, for the purpose of examining into any suspected violation of the preceding sections of this chapter, to all places and premises (apartments of private families keeping no boarders excepted), where the dairy commissioner or his deputy suspects imitation butter to be made, sold, used, kept, or stored in transit, or where it is suspected that the provisions of the law relating to adulterated molasses or imitation vinegar, or the manufacture or sale thereof, are being violated. The agents of railroads and express companies having knowledge or record of any consignment of imitation butter shall inform the commissioner or his deputy of such consignment and the name of the consignee when requested by said commissioner or his deputy. On the tender of the market price of good butter, good vinegar, or good molasses, the commissioner or his deputy may take from any person, firm, or corporation, samples of any articles suspected to be imitation butter, tub butter, vinegar or molasses, which he suspects are sold, offered for sale, kept with intent to sell, made or manufactured, contrary to any provision of this chapter; he may himself analyze such samples, or have such samples analyzed by a state chemist or by an experiment station, and a sworn or affirmed certificate by such analyst shall be *prima facie* evidence of the ingredients and constituents of the sample analyzed; if such analysis shall show that such sample does not conform to the requirements of law, and shall give the dairy commissioner reasonable ground for belief that any provision of this chapter has been violated, he shall cause such violator to be prosecuted. The dairy commissioner shall make an annual report to the governor.

1886, 1887, Rev. 1888, §§2618, 2621. 1889, ch. 80, §5. 1889, ch. 234, §2. 1893, ch. 70. 1897, ch. 145, §1.

Sec. 2567. Obstructing dairy commissioner; penalty. Every person refusing the dairy commissioner reasonable access for said purpose of examination, or refusing to sell samples as provided in § 2566, shall be fined not more than seven dollars, or imprisoned not more than thirty days, or both. Evidence of any violation of this section shall be *prima facie* evidence of willful violation.

1895, ch. 235, §§1, 2.

Sec. 2578. 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. 1895, ch. 285, §3.

Sec. 2575. Analysis of food to be made. The Connecticut agricultural experiment station shall make analysis 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 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 1879. Rev. 1888, §2648. 1895, ch. 285, §§4, 5. 1899, ch. 22.

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.

1895, ch. 235, §6. **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.

1895, ch. 235, §7. **Sec. 2577. Appropriation.** To carry out the provisions of §§ 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.

1895, ch. 235, §§8, 9. **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 unadulterated or without disclosing or informing the purchaser that the same has been adulterated, shall be fined not more than five hundred dollars or imprisoned not more than one year. No action shall be maintained on account of any sale or other contract made in violation of § 2573.

1882. Rev. 1888, §2658 **Sec. 2585. Penalty for adulteration of milk.** Whoever shall knowingly sell, supply, or bring to be manufactured to any butter or cheese manufactory in this state, any milk diluted with water, or adulterated by the addition of a foreign substance or from which any cream or milk, commonly known as strippings, has been taken, or whoever shall knowingly bring or supply milk that is tainted or partly sour to any butter or cheese manufactory shall be fined not more than one hundred dollars.

Sec. 2586. Proof of adulteration. The usual test for quality and the certificate of analysis of the director of the Connecticut agricultural experiment station shall be deemed *prima facie* proof of adulteration. 1882. Rev. 1888, §2659.

Sec. 2587. Skimmed milk how labeled. No person shall sell, offer, or expose for sale milk from which the cream or any part thereof has been removed, without distinctly and durably affixing a label, tag, or mark of metal in a conspicuous place upon the outside, and not more than six inches from the top of every can, vessel, or package, containing such milk, and such metal label, tag, or mark, shall have the words "Skimmed Milk" stamped, printed, or indented thereon in letters not less than one inch in height; and such milk shall only be sold or retailed out of a can, vessel, or package so marked. 1882. Rev. 1888, §2660.

Sec. 2588. Impure milk, sale of prohibited. No person shall sell or offer for sale, or shall have in possession with intent to sell or offer for sale, any impure or adulterated milk. 1882. Rev. 1888, §2661.

Sec. 2589. Penalties. Every person who shall violate any provision of §§ 2587 or 2588 shall be fined not more than seven dollars, or imprisoned not more than thirty days, or both. 1882, Rev. 1888, §2662.

Sec. 2590. Notice to be posted in creameries. A printed notice of this section and of §§ 2585, 2586, 2587, 2588, and 2589 shall be conspicuously posted in all public places, creameries, or factories, where milk is received or sold. 1882. Rev. 1888, §2663.

Sec. 2591. Penalty for selling milk of diseased cow. Every person who shall knowingly sell, or expose for sale, milk, or any product of milk, from a cow which shall have been adjudged by the commissioner of domestic animals affected with tuberculosis or other blood disease shall be fined not more than seven dollars, or imprisoned not more than thirty days, or both. 1880. Rev. 1888, §2664.

Sec. 2592. Appointment of milk inspector. The warden and burgesses of a borough or the mayor with the approval of the common council of a city may appoint a competent person as milk inspector who may personally, or by some competent person appointed by him, inspect all milk sold or offered for 1899, ch. 209.

sale in such borough or city; may inspect all animals producing such milk, the buildings and places where such animals are kept, the dairy and other places where such milk is kept, handled, sold, or produced, whether the same be within the limits of such borough or city or not; and said burgesses or common council may prohibit the sale of such milk within the limits of such borough or city, except by such persons as shall register their names, residences, and numbers in a book kept for the purpose at the office of the clerk of such borough or city. The clerk shall receive for each name so registered fifteen cents from the treasury of such borough or city. Such inspector or assistant shall have the right to take samples of milk from any producer or vendor in quantities of not less than one pint, upon tender of the market price therefor, but he shall, if such producer or vendor so request, seal and mark a duplicate sample of such milk and leave the same with such producer or vendor. The warden of any borough or the mayor of any city may for cause remove the inspector.

CONCENTRATED COMMERCIAL FEEDING STUFF.

1899, ch. 219, §§2, 8, 9. **Sec. 4591. "Concentrated commercial feeding stuff" defined.** The term "concentrated commercial feeding stuff" shall include linseed meals, cottonseed 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.

1899, ch. 219, §1. **Sec. 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 association of official agricultural chemists of the United States.

Sec. 4593. Statement to be filed. Every manufacturer, importer. agent, or seller of any concentrated commercial feeding stuff shall, upon request, file with the Connecticut agricultural experiment station a certified copy of the statement prescribed in § 4592. 1899, ch. 219, §4.

Sec. 4594. Penalty. Every manufacturer, importer, agent, or person selling, offering, or exposing for sale any concentrated commercial feeding stuff in relation to which all the provisions of §§ 4592 and 4593 have not been complied with. shall be fined not more than one hundred dollars for the first offense, and not more than two hundred dollars for each subsequent offense. 1899, ch. 219, §5.

Sec. 4595. Samples for analysis. The Connecticut agricultural experiment station may collect a sample, not exceeding two pounds in weight, for analysis, from any lot, parcel, or package of concentrated commercial feeding stuff, or unmixed meals, brans, or middlings, which may be in the possession of any manufacturer, importer, agent, or dealer, but said sample shall be taken in the presence of the parties in interest, or their representatives, and taken from a number of parcels or packages which shall be not less than five per cent. of the whole lot inspected, and shall be thorougly mixed, divided into two samples, placed in glass vessels, carefully sealed, and a label placed on each stating the name or brand of the feeding stuff or material sampled, the name of the party from whose stock the sample was taken, and the time and place of taking the same; said label shall be signed by the state chemist or his deputy, and by the party or parties in interest or their representatives present at the taking and sealing of said sample; one of said samples shall be retained by said chemist or his deputy and the other by the party whose stock is sampled. Said station shall cause at least one sample of each brand of feeding stuff so collected to be analyzed annually by or under the direction of said chemist. Said analysis shall include determinations of crude fat and crude protein, and such other determinations as may be advisable Said station shall cause the analysis so made to be pub- 1899, ch. 219, §6.

lished in station bulletins, together with such additional information in relation to the character, composition, and use thereof as may be of importance. and issue the same annually, or more frequently if advisable.

1899, ch. 219, §7. **Sec. 4596. Enforcement of the provisions of this chapter.** The dairy commissioner shall enforce the provisions of this chapter, and when evidence is submitted by the Connecticut agricultural experiment station that said provisions have been violated he shall make complaint to the proper prosecuting officer.

1899, ch. 219, §8. **Sec. 4597. Term "importer" defined.** The term "importer" shall include such persons as shall bring into or offer for sale within this state concentrated commercial feeding stuffs manufactured without this state.

OLEOMARGARINE.

Previous reports of this department have given statistics which show quite fully the amount of oleomargarine manufactured in the different states, and also the amount consumed in each state.

The amount consumed in Connecticut as shown by these statistics has been quite small. Careful and thorough inspection has been made at different times during the year throughout the state to see that the provisions of the law concerning imitation butter are fully carried out. There were six dealers in the state who had taken out United States licenses and have sold oleomargarine according to law. We have not had as many prosecutions for violations of the law the past year as in some previous years. One party was found who was doing quite a large business selling butter in the eastern part of the state. Investigations were made, samples of butter taken, examined and analyzed. It was found to be oleomargarine. The man was prosecuted and convicted.

It has always been the ruling of this department that under the present law no oleomargarine could be sold colored in imitation of yellow butter under any circumstances or conditions. This ruling has been questioned at times by some dealers and during the unusual high price of butter last spring several dealers started to sell oleomargarine after putting up the lawful signs. These parties were prosecuted and in every case our ruling was sustained and the law upheld by the courts. The parties were all convicted and an appeal was taken in five cases, but these cases were finally settled without a trial in the higher courts.

THE NEW OLEOMARGARINE LAW.

The oleomargarine business throughout the country has now assumed an entirely new aspect. The bill that was before Congress for two years and finally passed at the last session and signed by the President May 9, 1902, is one in which all the butter dairymen throughout the state and country have been deeply interested. Great credit is due to Congressman Henry of the first district, who was a prominent member of the agricultural committee, for his earnest advocacy and untiring energy for the passage of this bill. This law increased the tax on artificially colored oleomargarine from two to ten cents a pound, and reduced the tax on uncolored from two to one quarter of a cent a pound.

The general effect of this law throughout the country has been to very largely reduce the manufacture and sale of colored oleomargarine which has been to so large an extent sold for butter and therefore will be of great benefit to the dairy interests of the state and nation. In Connecticut the effect has been to increase the sale of oleomargarine, but it is all sold for just what it is, uncolored, and therefore does not come into competition with the higher grades of creamery butter. The higher grade of oleomargarine is made from the following formula as taken from the ruling of the internal revenue department:

Oleo oil, 100 pounds; neutral lard, 130 pounds; butter, 95 pounds.

This will produce something over 300 pounds of oleomargarine. When high grade butter not artifically colored is a part of the formula and no other artificial coloring matter is used in the manufacture of the oleomargarine it is not liable to the ten cent tax but is sold at the reduced tax of one-fourth of a cent per pound. There is quite a large demand for this grade of goods. It is not artificially colored but is of a light straw color.

All the dealers are selling strictly according to law with signs posted. Seventeen dealers have made applications for signs and registering in this department. From all appearances at the present time the coming winter with the high prices of butter will be an active one on the part of the oleomargarine people and there will be a thorough examination to see that the provisions of the law are upheld.

The new law is here given in full:

An Act to make oleomargarine and other imitation dairy products subject to the laws of any State, or Territory or the District of Columbia into which they are transported, and to change the tax on oleomargarine, and to impose a tax, provide for the inspection, and regulate the manufacture and sale of certain dairy products, and to amend an Act entitled "An Act defining butter, also imposing a tax upon and regulating the manufacture, sale, importation, and exportation of oleomargarine," approved August second, eighteen hundred and eighty-six.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled:

That all articles known as oleomargarine, butterine, imitation, process, renovated, or adulterated butter, or imitation cheese, or any substance in the semblance of butter or cheese not the usual product of the dairy and not made exclusively of pure and unadulterated milk or cream, transported into any State or Territory or the District of Columbia, and remaining therein for use, consumption, sale, or storage therein, shall, upon the arrival within the limits of such State or Territory or the District of Columbia, be subject to the operation and effect of the laws of such State or Territory or the District of Columbia, enacted in the exercise of its police powers to the same extent and in the same manner as though such articles or substances had been produced in such State or Territory or the District of Columbia, and shall not be exempt therefrom by reason of being introduced therein in original packages or otherwise.

SEC. 2. That the first clause of section three of an Act entitled "An Act defining butter, also imposing a tax upon and regulating the manufacture, sale, importation, and exportation of oleomargarine," approved August second, eighteen hundred and eighty-six, be amended by adding thereto after the word "oleomargarine," at the end of said clause, the following words:

"And any person that sells, vends, or furnishes oleomargarine for the use and consumption of others except to his own family table without compensation, who shall add to or mix with such oleomargarine any artificial coloration that causes it to look like butter of any shade of yellow shall also be held to be a manufacturer of oleomargarine within the meaning of said Act, and subject to the provisions thereof."

Section three of said Act is hereby amended by adding thereto the following: "*Provided further*, That wholesale dealers who vend no other oleomargarine or butterine except that upon which a tax of one-fourth of one per cent per pound is imposed by this Act, as amended, shall pay two hundred dollars; and such retail dealers as vend no other oleomargarine or butterine except that upon which is imposed by this Act, as amended, a tax of one-fourth of one cent per pound shall pay six dollars.

SEC. 3. That section eight of an Act entitled "An Act defining butter, also imposing a tax upon and regulating the manufacture, sale, importation, and exportation of oleomargarine," approved August second, eighteen hundred and eighty-six, be, and the same is hereby, amended so as to read as follows:

"SEC. 8. That upon oleomargarine which shall be manufactured and sold, or removed for consumption or use, there shall be assessed and collected a tax of ten cents per pound, to be paid by the manufacturer thereof; and any fractional part of a pound in a package shall be taxed as a pound; *Provided*, When oleomargarine is free from artificial coloration that causes it to look like butter of any shade of yellow said tax shall be one-fourth of one cent per pound. The tax levied by this section shall be represented by coupon stamps; and the provisions of existing laws governing the engraving, issue, sale, accountability, effacement, and destruction of stamps relating to tobacco and snuff, as far as applicable, are hereby made to apply to stamps provided for by this section."

SEC. 4. That for the purpose of this Act "butter" is hereby defined to mean an article of food as defined in "An Act defining butter, also imposing a tax upon and regulating the manufacture, sale, importation, and exportation of oleomargarine," approved August second, eighteen hundred and eighty-six; that "adulterated butter" is hereby defined to mean a grade of butter produced by mixing, reworking, rechurning in milk or cream, refining, or in any way producing a uniform, purified, or improved product from different lots or parcels of melted or unmelted butter or butter fat, in which any acid, alkali, chemical, or any substance whatever is introduced or used for the purpose or with the effect of deodorizing or removing therefrom rancidity, or any butter or butter fat with which there is mixed any substance foreign to butter as herein defined, with intent or effect of cheapening in cost the product or any butter in the manufacture or manipulation of which any process or material is used with intent or effect of causing the absorption of abnormal quantities of water, milk, or cream; that "process butter" or "renovated butter" is hereby defined to mean butter which has been subjected to any process by which it is melted, clarified or refined and made to resemble genuine butter, always excepting "adulterated butter" as defined by this Act.

That special taxes are imposed as follows:

Manufacturers of process or renovated butter shall pay fifty dollars per year and manufacturers of adulterated butter shall pay six hundred dollars per year. Every person who engages in the production of process or renovated butter or adulterated butter as a business shall be considered to be a manufacturer thereof.

Wholesale dealers in adulterated butter shall pay a tax of four hundred and eighty dollars per annum, and retail dealers in adulterated butter shall pay a tax of forty-eight dollars per annum. Every person who sells adulterated butter in less quantities than ten pounds at one time shall be regarded as a retail dealer in adulterated butter.

Every person who sells adulterated butter shall be regarded as a dealer in adulterated butter. And sections thirty-two hundred and thirty-two, thirty-two hundred and thirty-three, thirty-two hundred and thirty-four, thirty-two hundred and thirty-five, thirty-two hundred and thirty-six, thirty-two hundred and thirty-seven, thirty-two hundred and thirty-eight, thirty-two hundred and thirty-nine, thirty-two hundred and forty, thirty-two hundred and forty-one, and thirty-two hundred and forty-three of the Revised Statutes of the United States are, so far as applicable, made to extend to and include and apply to the special taxes imposed by this section and to the person upon whom they are imposed.

That every person who carries on the business of a manufacturer of process or renovated butter or adulterated butter without having paid the special tax therefor, as required by law, shall, besides being liable to the payment of the tax, be fined not less than one thousand and not more than five thousand dollars; and every person who carries on the business of a dealer in adulterated butter without having paid the special tax therefor, as required by law, shall, besides being liable to the payment of the tax, be fined not less than fifty nor more than five hundred dollars for each offense.

That every manufacturer of process or renovated butter or adulterated butter shall file with the collector of internal revenue of the district in which his manufactory is located such notices, inventories and bonds, shall keep such books and render such returns of material and products, shall put up such signs and affix such number of his factory, and conduct his business under such surveillance of officers and agents as the Commissioner of Internal Revenue, with the approval of the Secretary of the Treasury, may by regulation require. But the bond required of such manufacturer shall be with sureties satisfactory to the collector of internal revenue, and in a penal sum of not less than five hundred dollars; and the sum of said bond may be increased from time to time and additional sureties required at the discretion of the collector or under instructions of the Commissioner of Internal Revenue.

That all adulterated butter shall be packed by the manufacturer thereof in firkins, tubs, or other wooden packages not before used for that purpose, each containing not less than ten pounds, and marked, stamped, and branded as the Commissioner of Internal Revenue, with the approval of the Secretary of the Treasury, shall prescribe; and all sales made by manufacturers of adulterated butter shall be in original stamped packages.

Dealers in adulterated butter must sell only original or from original stamped packages, and when such original stamped packages are broken the adulterated butter sold from same shall be placed in suitable wooden or paper packages, which shall be marked and branded as the Commissioner of Internal Revenue, with the approval of the Secretary of the Treasury, shall prescribe. Every person who knowingly sells or offers for sale, or delivers or offers to deliver, any adulterated butter in any other form than in new wooden or paper packages as above described, or who packs in any package any adulterated butter in any manner contrary to law, or who falsely brands any package or affixes a stamp on any package denoting a less amount of tax than that required by law, shall be fined for each offense not more than one thousand dollars and be imprisoned not more than two years.

That every manufacturer of adulterated butter shall securely affix, by pasting, on each package containing adulterated butter manufactured by him a label on which shall be printed, besides the number of the manufactory and the district and State in which it is situated, these words: "Notice.—That the manufacturer of the adulterated butter herein contained has complied with all the requirements of law. Every person is cautioned not to use either this package again or the stamp thereon, nor to remove the contents of this package without destroying said stamp, under the penalty provided by law in such cases." Every manufacturer of adulterated butter who neglects to affix such label to any package containing adulterated butter made by him, or sold or offered for sale for or by him, and every person who removes any such label so affixed from any such package shall be fined fifty dollars for each package in respect to which such offense is committed.

That upon adulterated butter, when manufactured or sold or removed for consumption or use, there shall be assessed and collected a tax of ten cents per pound, to be paid by the manufacturer thereof, and any fractional part of a pound shall be taxed as a pound, and that upon process or renovated butter, when manufactured or sold or removed for consumption or use, there shall be assessed and collected a tax of one-fourth of one cent per pound, to be paid by the manufacturer thereof, and any fractional part of a pound shall be taxed as a pound. The tax to be levied by this section shall be represented by coupon stamps, and the provisions of existing laws governing engraving, issuing, sale, accountability, effacement, and destruction of stamps relating to tobacco and snuff, as far as applicable, are hereby made to apply to the stamps provided by this section.

That the provisions of sections nine, ten, eleven, twelve, thirteen, fourteen, fifteen, sixteen, seventeen, eighteen, nineteen, twenty, and twenty-one of "An Act defining butter, also imposing a tax upon and regulating the manufacture, sale, importation, and exportation of oleomargarine," approved August second, eighteen hundred and eighty-six shall apply to manufacturers of "adulterated butter" to an extent necessary to enforce the marking, branding, identification, and regulation of the exportation and importation of adulterated butter.

SEC. 5 All parts of an Act providing for an inspection of meats for exportation, approved August thirtieth, eighteen hundred and ninety, and of an Act to provide for the inspection of live cattle, hogs, and the carcasses and products thereof which are the subjects of interstate commerce, approved March third, eighteen hundred and ninety-one, and of amendment thereto approved March second, eighteen hundred and ninety-five, which are applicable to the subjects and purposes described in this section shall apply to process or renovated butter. And the Secretary of Agriculture is hereby authorized and required to cause a rigid sanitary inspection to be made, at such times as he may deem proper or necessary, of all factories and storehouses where process or renovated butter is manufactured, packed, or prepared for market, and of the products thereof and materials going into the manufacture of the same. All process or renovated butter and the packages containing the same shall be marked with the words "Renovated Butter" or "Process Butter" and by such other marks, labels, or brands and in such manner as may be prescribed by the Secretary of Agriculture, and no process or renovated butter shall be shipped or transported from its place of manufacture into any other State or Territory or the District of Columbia, or to any foreign country, until it has been marked as provided in this section. The Secretary of Agriculture shall make all needful regulations for carrying this section into effect, and shall cause to be ascertained and reported from time to time the quantity and quality of process or renovated butter manufactured, and the character and the condition of the material from which it is made. And he shall also have power to ascertain whether or not materials used in the manufacture of said process or renovated butter are deleterious to health or unwholsome in the finished product, and in case such deleterious or unwholesome materials are found to be used in product intended for exportation or shipment into other States or in course of exportation or shipment he shall have power to confiscate the same. Any person, firm, or corporation violating any of the provisions of this section shall be deemed guilty of a misdemeanor and on conviction thereof shall be punished by a fine of not less than fifty dollars nor more than five hundred dollars or by imprisonment not less than one month nor more than six months, or by both said punishments, in the discretion of the court.

SEC. 6. That wholesale dealers in oleomargarine, process, renovated, or adulterated butter shall keep such books and render such returns in relation thereto as the Commissioner of Internal Revenue, with the approval of the Secretary of the Treasury, may, by regulation, require; and such books shall be open at all times to the inspection of any internal revenue officer or agent. And any person who willfully violates any of the provisions of this section shall for each such offense be fined not less than fifty dollars and not exceeding five hundred dollars, and imprisoned not less than thirty days nor more than six months.

SEC. 7. This Act shall take effect on the first day of July, nineteen hundred and two.

Approved, May 9, 1902.

RENOVATED BUTTER.

The law increasing the tax on oleomargarine, which went into effect last July, has also incorporated strong provisions governing the sale of what has been known in the market as "process or renovated butter." The manufacture of this butter has been fully treated in a previous report. The law requires that all process or renovated butter shall be plainly marked with the words "Process Butter" or "Renovated Butter," and that such marking shall be under the direction of the Secretary of Agriculture, and it also provides that the Secretary shall rigidly inspect the manufacture of this butter and all that enters into its composition. As there is a large amount of butter sold in Connecticut the rulings of the Secretary, under this law, will be of great interest to all who are dealing in this kind of butter. They are here given:

It will be noted that under his rulings the words "Process Butter" are eliminated, and that the marking is all confined to "Renovated Butter," process butter being rather an unmeaning term, but renovated butter showing the kind of butter that it is. It provides that these words shall be stamped upon the butter itself, and also upon the wrapper.

(REGULATIONS NO. 9. REVISED JUNE, 1902. SUPPLEMENT NO. 1)

This supplement to Regulations No. 9, revised June, 1902, is designed to modify in certain respects those regulations, and for the sake of uniformity and facility of reference the matter herein contained is substituted entire for all that part of the regulations commencing on page 89, from and including the heading "Process or Renovated Butter."

RENOVATED BUTTER (OR "PROCESS BUTTER").

INSPECTION, MARKING AND BRANDING, SUBJECT TO REGULATIONS OF SECRETARY OF AGRICULTURE.

Section 5 of said act of May 9, 1902, provides:

SECTION 5. All parts of an Act providing for an inspection of meats for exportation, approved August thirtieth, eighteen hundred and ninety, and of an Act to provide for the inspection of live cattle, hogs, and the carcasses and products thereof which are the subjects of interstate commerce, approved March third, eighteen hundred and ninety-one, and of amendment thereto approved March second, eighteen hundred and ninety-five, which are applicable to the subjects and purposes described in this section shall apply to process or renovated butter. And the Secretary of Agriculture is hereby authorized and required to cause a rigid sanitary inspection to be made, at such times as he may deem proper or necessary, of all factories and storehouses where process or renovated butter is manufactured, packed, or prepared for market, and of the products thereof and materials going into the manufacture of the same. All process or renovated butter and the packages containing the same shall be marked with the words "Renovated Butter" or "Process Butter," and by such other marks, labels, or brands and in such manner as may be prescribed by the Secretary of Agriculture, and no process or renovated butter shall be shipped or transported from its place of manufacture into any other State or Territory or the District of Columbia, or to any foreign country, until it has been marked as provided in this section. The Secretary of Agriculture shall make all needful regulations for carrying this section into effect, and shall cause to be ascertained and reported from time to time the quantity and quality of process or renovated butter manufactured, and the character and the condition of the material from which it is made. And he shall also have power to ascertain whether or not materials used in the manufacture of said process or renovated butter are deleterious to health or unwholesome in the finished product, and in case such deleterious or unwholesome materials are found to be used in product intended for exportation or shipment into other States or in course of exportation or shipment he shall have power to confiscate the same. Any person, firm, or corporation violating any of the provisions of this section shall be deemed guilty of a misdemeanor, and on conviction thereof shall be punished by a fine of not less than fifty dollars nor more than five hundred dollars, or by imprisonment not less than one month nor more than six months, or by both said punishments, in the discretion of the court.

RULES AND REGULATIONS PRESCRIBED IN REGARD TO "RENOVATED BUTTER" (OR "PROCESS BUTTER") IN ACCORDANCE WITH THE ACT OF CONGRESS APPROVED MAY 9, 1902.

1. As the terms "process butter" and "renovated butter" occur throughout the act as synonymous, the article will be designated as "renovated butter" in these regulations and in all correspondence relating thereto.

2. The following explanation of the definition of renovated butter as it occurs in the law has been prepared by the Department of Agriculture and is adopted for guidance in connection with these regulations:

(*a*) This grade or kind of butter may be made from one or more lots or parcels of butter, which has been or have been "subjected to any process by which it is melted, clarified, or refined and made to resemble genuine butter, always excepting 'adulterated butter' as defined by this act."

(*b*) The butter, to be subject to this definition, must have been melted —that is, so affected by heat as to become of sufficient fluidity to move in a continuous stream of even consistency from one vessel to another, by pouring or pumping, because butter can not be "clarified or refined" unless it be melted to that degree.

(*c*) The butter must, besides melting, have been subjected to some process by which it is "clarified or refined." Butter, or melted butter, may be clarified or refined by skimming, settling, ærating, washing, and other processes, through the action of heat, cold, agitation of motion, or rest.

(*d*) Butter thus melted and clarified or refined becomes an oil or fat almost free from taste and odor. To be again "made to resemble genuine butter" it must have restored to it the butter characteristics or similitude of texture, granulation, and flavor. For this purpose the processed or renovated butter is usually granulated by cooling, and churned or otherwise mixed with milk or skim milk, or buttermilk, or cream, sweet or sour. It may or may not have common salt or artificial coloring added. To "resemble genuine butter" the article must have passed through these or other processes, subsequent to melting, so that it looks, smells, and tastes like "butter," having a similar appearance, consistency, texture and flavor.

(*e*) It may be assumed that the object of subjecting a lot or lots of butter to such a process is to remove rancidity, sourness, mold, or other fault or feature which has impaired its merchantable quality, or to otherwise renew or improve the product, so that the substance is truly "renovated," although such object is not expressed in the act.

(*f*) But if, in such process, "or in any (other) way," "any acid, alkali, chemical, or any substance whatever is introduced" or used, or if "there is mixed (therewith) any substance foreign to butter" (including any fat or oil other than butter fat), or if in any way the substance is made to hold "abnormal quantities of water, milk or cream," the substance or commodity is to be recognized and treated as "adulterated butter" under this act.

(*g*) Renovated butter having 16 per cent or more of moisture will be held to to contain "abnormal quantities of water, milk or cream," and be, therefore classed as "adulterated butter."

3. Section 4 of this act of May 9, 1902:

Manufacturers of process or renovated butter shall pay fifty dollars per year * * *. Every person who engages in the production of process or renovated butter * * * as a business shall be considered a manufacturer thereof.

The special tax year begins July 1. The special tax of manufacturers who commence business in the month of July will be reckoned for one year, and the tax of manufacturers who commence business after the month of July will be reckoned proportionately from the 1st day of the month from which the liability to special tax commenced to the 1st day of July following.

4. Every manufacturer of renovated butter, before commencing business (or at least within the month in which liability to special tax commenced), must register with the collector of the district in which the business is to be carried on, his name, or style, place of residence, business, and the place where such business is to be carried on, and procure a special-tax stamp at the rate of $50 per annum, which stamp he is to place and keep conspicuously posted in his establishment or place of business; and on the 1st day of July in each year he will again so register and procure a new special-tax stamp and post it as above stated.

5. Under the provisions of section 4 of said act, the tax of one-fourth of one cent per pound imposed thereby on renovated butter is to be repre-

sented by coupon stamps, to be provided by the Commissioner of Internal Revenue as authorized by existing laws. A fractional part of a pound shall be taxed as a pound.

6. For this purpose tax-paid stamps will be furnished in denominations of 10, 20, 30, 40, 50, 60, and 100 pounds, each stamp bearing nine coupons. Such stamps must contain the name of the collector, his district and State, and show thereon the date of payment of the tax, the number of pounds, and the number of the factory.

7. On the withdrawal of a package of renovated butter, the proper tax-paid stamp must be affixed thereto by the manufacturer, by the use of adhesive material, and if the packages be of wood not less than five tacks must be driven through each stamp, one in each corner, and one in the middle of the stamp. The stamp when so affixed must be immediately canceled. For the purpose of cancellation the manufacturer will use a stencil plate or rubber stamp by which there shall be printed five parallel waved lines long enough to extend beyond each side of the stamp onto the package.

The printing on the stamp must be plain and distinct, and the waved lines must be fine enough to avoid obliterating the reading matter and figures contained in the tax-paid stamp. The imprinting must be with blacking or other durable coloring material, over and across the stamp, and in such manner as not to deface the stamp—that is, so as not to daub and make it illegible.

8. The stamp must be affixed to the side of the package, to a smooth surface, in such manner as to be readily canceled in the manner above described. When a package contains a number of pounds between 10 and 20, a *ten*-pound stamp with the necessary number of coupons attached will be issued to cover the net weight. Packages containing more than 20 pounds and less than 30 pounds will have attached a *twenty*-pound stamp with a suitable number of coupons to represent the contents. Larger sized packages will be similarly stamped.

9. Every manufacturer of renovated butter will be required to file with the collector a notice on Form No 507, together with an inventory, Form No. 509, when making application for special-tax stamp as manufacturer. At the same time he will file a bond, Form No. 508, in a penal sum to be fixed by the collector of internal revenue for his district, but in no case less than $500.

Collectors of internal revenue will decline to approve the bond of a manufacturer of renovated butter until they are satisfied that the premises to be used for the manfacture of that article are entirely separate from those used for the manufacture of adulterated butter or oleomargarine, or for the handling or manipulation of butter not taxable under the act of May 9, 1902.

10. Each manufacturer of renovated butter is required to keep books and make returns showing the quantity of materials received on the factory

premises, and the quantity of finished materials removed therefrom. Sample pages of book (Form No. 511) to be kept by manufacturers will be furnished to collectors, but the book must be provided by the manufacturer, as the same is not supplied by the Government.

11. Form No. 499 has been prescribed for monthly returns of manufacturers of renovated butter, and such forms will be furnished through the collectors of internal revenue.

12. Collectors will give to each manufacturer of renovated butter in their respective districts a factory number, the numbers to be consecutive, and not thereafter changed. The factory number applies to the manufacturer and his establishment rather than to the building.

13. Every manufacturer of renovated butter shall place and keep on the side or the end of the buiding wherein his business is carried on, so that it can be distinctly seen, a sign, with letters thereon not less than 3 inches in length, printed in oil colors or gilded, giving his full name and business and the number of his factory, as follows:

A——— B———
MANUFACTURER OF RENOVATED BUTTER.
Factory No.——

14. Whenever any manufacturer's package of renovated butter is empty it will be the duty of the person who removes the contents thereof to utterly destroy the tax-paid stamp on such empty package. Any person having in his possession empty renovated butter packages, the tax-paid stamps on which have not been destroyed, will be liable to a heavy penalty.

On the 6th day of October, 1902, the following ruling was made by the Commissioner of Internal Revenue:

It is now held that original packages of oleomargarine or renovated butter may be shipped from the manufactory or place of business of the wholesale dealer securely covered in such a manner as to protect the contents from injury, provided the words "Oleomargarine" or "Renovated Butter," as the case may be, are plainly marked or stenciled on the outside of such wrapper or covering, on two sides thereof, opposite each other, in gothic letters not less than one half inch square, and so placed as to be plainly visible and easly read.

It must be understood that the use of such covering is permitted for the purpose only of protecting the packages and contents from injury while in transit, and the same should not be allowed to remain on the packages after they have reached their destination, or when in the hands of the retail dealer. Neither will storage in warehouses of stamped packages thus covered be permitted, but the covering, whatever it is, shall be placed on the packages at the time of shipment and no longer in advance thereof than actually necessary.

It shall be further understood that authority to ship original packages with the stamps, marks, and brands concealed will in no manner abridge the right of internal revenue officers to examine such packages for the purpose of inspecting the stamps, marks, and brands thereon, or making other investigations.

The authority here given is merely experimental and will be withdrawn immediately upon evidence appearing that the concession is made use of for the purpose of evading the law or the deception of the public or the officers of internal revenue.

15. Section 5 of said act of May 9, 1902, requires that all renovated butter and the packages containing the same shall be marked with the words "Renovated Butter" or "Process Butter," and by such other marks, labels, or brands, and in such manner as may be prescribed by the Secretary of Agriculture. To carry this provision into effect the Secretary of Agriculture prescribes the following rules for labeling, marking, and branding:

16. Every manufacturer's package of renovated butter shall have affixed thereto a label, on which shall be printed the number of the factory and the revenue district and State in which it is located, together with the following notice:

MANUFACTURER'S DECLARATION AND NOTICE.

Factory No. ———, district, State of ———.

The manufacturer of the renovated butter (or process butter) herein contained has complied with all the requirements of the law and regulations authorized thereby. Every person is cautioned not to use again, either this package or the tax stamp thereon, nor to remove the contents of this package without destroying said stamp, nor to remove, alter, or deface this notice or any of the required marks in connection herewith, under penalty provided by law in such cases.

This label or notice shall be printed in black, upon white paper and shall be not less than 5, nor more than 7 inches long, and not less than 3 inches in width. The label must be securely affixed by paste to the side of the package and opposite or on a different side (not the top or bottom) from that to which the tax stamp is attached, and in such a way as to be exposed to view and easily read. After being affixed, this label must be covered with a coating of transparent and waterproof varnish or similar substance. The words "Renovated Butter" in this notice must be printed in one or two lines and in plain gothic letters at least three-eighths inch square. There must also be plainly marked or stenciled on the outside of every package the gross, tare, and net weight in pounds.

17. All renovated butter may be packed by the manufacturer thereof in firkins, tubs, or packages of wood or other suitable material not before used for that purpose; but each package must contain not less than 10 pounds; and, when packed in a solid body or mass, there shall be stamped or branded into the upper surface of the butter the words "Renovated Butter," in one or two lines, the letters to be of gothic style, not less than one-half inch square and depressed not less than one-eighth inch.

18. Manufacturers will be permitted to pack prints, bricks or rolls of renovated butter not less than one pound each in weight; but each print, brick, or roll must have stamped thereon the words "Renovated Butter," in two lines, the letters to be depressed, of gothic style, not less than three-eighths inch square and sunken not less than one-eighth inch. The contents of any package less than 10 pounds will be considered as a brick or roll.

19. Prints, bricks, or rolls as provided by rule 18 may be packed in manufacturers' stamped packages with or without coverings, wrappers, or inner packages of paper, cloth, wood, or other material; but every cover or wrapper of every description must have the words "Renovated Butter," in two lines, eonspicuously marked, branded, stamped, or printed thereon in black, full-faced gothic letters not less than three-eighths inch square and so placed as to be the only marking upon one side or surface of the inner parcel as packed. Upon wrappers usual for prints and rolls, this marking must be placed by itself near the middle of the wrapper, and the latter so used that the designated name will be the most conspicuous marking upon the outside of the wrapped print or roll, when removed from the stamped package.

20. If manufacturers of renovated butter desire to place upon the outside of their original package as above described, or upon any inner package, wrapper, or cover their names or the name of their establishment, or any words or marks descriptive of the product, or any character, sign, or trade-mark, this may be done provided the following conditions are strictly observed. Such additional markings must not cover, obscure, or be made more prominent than any of the stamps, marks, or labels otherwise required. For example:

JOHN DOE,	ARIZONA BUTTER COMPANY,
MANUFACTURER OF	MANUFACTURERS OF
RENOVATED BUTTER.	GOLDEN GRAIN BRAND
20 1-LB. PLAIN BRICKS.	RENOVATED BUTTER.
EXTRA QUALITY.	5-LB. BOXES, SOLID PACKED.

When so marked, the words "Renovated Butter" must be included in the brand, stencil, or mark, in plain capital letters, not less in size than the letters used for the manufacturer's name, or that of his establishment, or for his trade-mark or special brand. And no other words, letters, or figures used in such additional markings shall be greater than one-half the size of the letters used for the words "Renovated Butter." And no character, device, or trade-mark shall occupy more space in such marking, than is occupied by the word "butter" as prescribed in rule 19. All such additional markings, including wrappers of all kinds, should be submitted to the Secretary of Agriculture for examination and approval, before being used.

21. Whenever referred to by the additional markings allowed by rule

20, or otherwise, the contents of the package or inner package or wrapper, shall always be designated "Renovated Butter," and the word "butter" shall nowhere appear and be used in markings, without being immediately preceded by and having joined therewith, the qualifying word "renovated," in the same type, letters, or characters, excepting that the manufacturer may use the words "Process Butter," provided they be in addition to (but not in place of) the words "renovated butter," and in no way more conspicuous. No incorrect or misleading word or sign shall be included in any part of the markings; for example, the words "creamery" and "dairy" must not be used. To repeat, the article in question must be referred to, named, and marked "Renovated Butter," always and only so, as prescribed by law and by these regulations, with the single exception above noted.

22. The law neither defines nor imposes special taxes upon wholesale or retail dealers in renovated butter. Neither does it describe the manner of sale of such product by dealers. However, renovated butter shall always bear or be accompanied by the evidence that the manufacturer's tax thereon has been paid. Therefore it should not be removed or separated from the original package bearing the tax stamp and other prescribed marks, when it is in transportation, the subject of interstate commerce, exported, or whenever and wherever offered for sale, until delivered to the consumer or purchaser in retail trade. And dealers, as well as all other persons, should note the special and heavy penalties prescribed by law for removing, altering, or defacing *any* of the marks placed upon renovated butter, its wrappings, packages, etc., pursuant to law and regulations, except as provided in rule 14 of this series. Renovated butter can not be removed from manufacturers' packages and made into prints or any other form, and repacked in the same package, or any other, by dealers or any other persons, anywhere, without violation of the laws referred to in the first clause of section 5 of the act of May 9, 1902, and thereby made applicable to renovated butter.

23. Attention is called to the fact that the act named makes no provision for the exportation, free of tax, of renovated butter; nor for drawback of tax on snch articles when exported. Consequently all renovated butter for export must be stamped and marked the same as for the domestic market.

24. All factories where renovated butter is manufactured, packed, or prepared for market, as well as the materials used and to be used, the processes and the products, will be inspected from time to time by officers or agents specially designated for that purpose by the Secretary of Agriculture. Inspectors will be required to report upon "the character and condition of the material" and "the quantity and quality" of the product in such manner as may be prescribed.

25. Correspondence and all administrative details under the rules numbered 3 to 14, inclusive, above, are assigned to the Commissioner of In-

ternal Revenue, Treasury Department. And similarly, all matters under the rules 15 to 24, inclusive, are assigned to the Dairy Division, Bureau of Animal Industry, Department of Agriculture.

J. W. YERKES,
Commissioner of Internal Revenue.

Approved:
O. L. SPAULDING,
Acting Secretary of the Treasury.
JAMES WILSON,
Secretary of Agriculture.

DAIRY INTERESTS OF THE UNITED STATES.

According to the census of 1900 we have in the United States 5,739,657 farms of which 4,514,210 keep cows and produce milk. Although the creamery system of making butter has increased very largely during the last few years still the amount of butter made upon the farms of the country far exceeds it. The total amount made by the creameries in the year 1899 was 420,126,546 pounds, while the amount made on the farms was 1,071,745,127. Of the creamery or factory butter 328,956,590 pounds were sold in tubs and 91,169,956 pounds were sold in prints. The average value of this butter as shown by sales was twenty cents a pound, giving a total valuation of $84,079,754. The average selling price of farm made butter was 16.7 cents per pound, giving a total amount received for this butter $178,981,436.

We have, as shown by the census, 357,578 strictly dairy farms. The following estimate of the capital invested in the dairy business of the United States is quite interesting:

Value of 357,578 farms, buildings and stock	$1,693,467,302
Value of 13,717,940 cows on other farms	407,147,489
Value of 973,033 cows not on farms	28,487,115
Value of fixed capital of creameries	36,491,799
Total amount invested in dairying	$2,165,793,705

The following is a summary of the dairy industry:

Number of cows kept for milk on farms	17,139,674
Number of cows kept for milk not on farms	973,033
Total number of cows	18,112,707

Gallons of milk produced on farms	7,266,392,674
Gallons of milk produced not on farms	462,190,676
Total production of milk	7,728,583,350
Pounds of butter made on farms	1,071,745,127
Butter made in creameries	420,126,546
Estimate of butter not reported	90,000,000
Total butter production, pounds	1,581,871,673

GALLONS OF MILK PRODUCED ON FARMS IN THE UNITED STATES IN 1899.

	Produced.	Sold as Milk.	Sold as Cream.
Total in United States	7,266,392,674	2,134,915,342	14,227,641
By States.			
Maine	98,586,188	15,979,003	15,459,032
New Hampshire	60,724,590	28,988,306	3,041,038
Vermont	142,042,223	57,566,012	8,751,804
Massachusetts	105,571,873	68,180,759	12,736,598
Rhode Island	12,923,512	9,685,988	524,265
Connecticut	68,951,862	33,879,466	10,412,902
New York	772,799,352	445,427,888	3,354,263
New Jersey	77,714,055	50,726,011	197,928
Pennsylvania	487,033,818	171,045,659	2,955,948
Delaware	12,681,268	4,988,462	80,944
Maryland	64,040,517	20,654,446	743,429
District of Columbia	850,349	661,385	550
Virginia	105,068,428	6,899,183	329,109
West Virginia	83,861,660	3,391,523	213,703
North Carolina	89,525,749	1,826,631	24,887
South Carolina	44,031,528	1,186,045	26,378
Georgia	82,438,532	3,920,412	52,718
Florida	9,640,434	1,003,918	7,848
Ohio	425,870,394	84,543,703	2,360,286
Indiana	263,457,239	36,562,105	1,878,305
Illinois	457,106,995	186,549,335	3,082,926
Michigan	309,617,046	55,635,108	1,271,264
Wisconsin	472,274,264	252,450,051	9,012,305
Minnesota	304,017,106	103,768,172	6,632,148
Iowa	585,872,240	214,338,442	18,276,902
Missouri	258,207,755	25,954,163	1,366,981
North Dakota	48,845,280	3,177,971	127,022

	Produced,	Sold as Milk,	Sold as Cream.
South Dakota	99,244,975	20,395,625	318 505
Nebraska	190,477,911	23,492,560	4,867,808
Kansas	244,909,123	47,939,088	1,844,574
Kentucky	159,311,527	8,932,259	526,190
Tennessee	147,336,961	5,549,194	124,113
Alabama	95,882,103	3,087,433	149,232
Mississippi	97,030,385	2,041,443	97,030,385
Louisiana	39,251,413	4,356,979	21,192
Texas	251,382,698	8,091,205	255,233
Oklahoma	47,439,852	8,701,471	46,387
Indian Territory	26,493,855	482,082	13,832
Arkansas	109,861,850	4,238,852	33,044
Montana	15,696,214	3,162,568	180,746
Wyoming	5,121,974	698,490	7,904
Colorado	38,440,111	13,170,810	727,634
New Mexico	3,009,657	633,638	19,853
Arizona	3,056,109	1,022,472	31,036
Utah	25,124,642	9,964,903	11,286
Nevada	4,446,071	1,353,002	3,701
Idaho	15,122,948	2,789,638	31,158
Washington	50,182,415	14,897,273	800,552
Oregon	48,582,968	10,308,119	850,020
California	153,684,741	56,540,946	392,578

AVERAGE GALLONS OF MILK PRODUCED PER COW IN DIFFRENT STATES IN 1900.

	1890.	1900.
United States	316	424
Alabama	190	343
Alaska	..	327
Arizona	146	170
Arkansas	165	351
California	351	500
Colorado	256	384
Connecticut	425	545
Delaware	328	389
District of Columbia	533	680
Florida	57	122
Idaho	186	291
Illinois	338	454
Indiana	346	459
Iowa	325	376
Kansas	272	362
Kentucky	325	438
Louisiana	77	212
Maine	369	574
Maryland	328	435
Massachusetts	480	572
Michigan	451	549
Minnesota	308	403
Mississippi	164	324
Missouri	228	337
Montana	250	349
Nebraska	287	372
Nevada	275	327
New Hampshire	390	528
New Jersey	296	494

	1890.	1900.		1890.	1900.
New Mexico	39	179	South Dakota	284	367
New York	461	515	Tennessee	312	458
North Carolina	247	384	Texas	118	292
North Dakota	301	389	Utah	187	381
Ohio	411	520	Vermont	392	526
Oklahoma	92	286	Virginia	286	373
Oregon	219	397	Washington	281	468
Pennsylvania	398	516	West Virginia	315	408
Rhode Island	443	546	Wisconsin	383	473
South Carolina	222	348	Wyoming	262	280

GALLONS OF MILK PRODUCED.

	1890.	1900.
United States	5,210,125,567	7,266,392,674
Connecticut	54,325,673	68,957,862

GALLONS OF MILK SOLD.

	1890.	1900.
United States	530,129,755	2,184.915,342
Connecticut	12,289,893	33,879 466

GALLONS OF CREAM SOLD.

	1900.
United States	20,768,662
Connecticut	1,893,255

POUNDS OF BUTTER MADE.

	1890.	1900.
United States	1,024,223,468	1,071,745,127
Connecticut	7,196.095	4,591,789

POUNDS OF CHEESE MADE.

	1850.	1900.
United States	105,535,893	16,372,330
Connecticut	5,363,277	40,623

DAIRY INTERESTS OF CONNECTICUT.

We have 26,948 farms in Connecticut, valued at $97,425,068 and a large portion of these farms are devoted to the dairy business. The value of the dairy products of 1899 was $7,090,188 or over thirty-two per cent. of the gross income of all farm products. Connecticut produced last year 68,951,862 gallons of milk, of this there were sold as whole milk 33,879,466 gallons. There was used in the production of butter 16,071,262 gallons, in the production of cream sold 10,412,902 gallons, consumed on the farm 8,535,422 gallons. The total amount of butter made in Connecticut last year was 8,480,194 pounds; of this there was made on the farms 4,591,789 pounds and in creameries 3,888,405 pounds. The amount of butter made in the state is somewhat less than past years, but this is not because there is less interest in the dairy work, but for the reason that many dairymen adjacent to cities have dropped the business of producing milk for cream and have taken up the selling of whole milk, finding this more profitable where they have a good market. The farmers in the eastern and western parts of the state continue as in years past to produce large quantities of milk which is shipped to New York, Boston, and Providence. This trade has in some instances reached out into some of the territories covered by creamery routes and has so drawn from their supply that some creameries have been obliged to close.

The dairy industry continues to be the leading agricultural interest of the state and more thought and careful attention is paid to it each year, better cows are kept and they are better fed and cared for.

Milk is used so universally as an article of food by children and adults that people are more fully realizing each year the importance of having it pure and wholesome. Good healthy milk cannot be produced from cows kept in dark, ill-ventilated stables. Good sanitary conditions should prevail in all places where milk producing cows are kept; and we believe that no one is more fully alive to this fact than the active intelligent dairymen of our state.

In the eastern part of the state there has been some complaint during the year of adulterated milk and the analysis of several samples taken has shown a very low percentage of butter fat. Prosecutions have been brought by parties receiving the milk, since which the milk has been of far better quality.

As the result of analyses notice will be sent to all milk men who are found to be using preservatives and adulterants and if they persist in using the same prosecutions will follow.

THE CONNECTICUT DAIRYMEN'S ASSOCIATION.

The Connecticut Dairymen's Association is composed of practical dairymen organized for the purpose of elevating the standard of the dairy and all its connections. They believe in keeping better cows, producing better milk and making better butter. Institutes and field meetings are held each year in different towns of the state with practical dairymen as speakers.

The annual meeting held in Hartford the third week in January is one of the most important agricultural meetings of the year. Prominent men who are in close touch with the dairy business in all of its phases give addresses and are ready to take part in discussions In connection with this meeting there is always a fine exhibit of butter, both private dairy and creamery. There is also a fine exhibit of dairy implements.

The present officers of the association are:

President, Frank H. Stadtmueller, General Manager of Mr. Beach's celebrated Vine Hill Farm, Elmwood, West Hartford.

Vice-President, E. C. Birge, Westport.

Secretary, J. B. Noble, East Windsor Hill.

Treasurer, B. C. Patterson, Torrington.

DIRECTORS.

J. G. Schwink, Jr., Meriden.	H. O Averill, Washington Depot.
C. L. Tuttle, Hartford.	Harry T. Miner, Vernon.
I. W. Stark, Lebanon.	Richard Davis, Middletown.
C. B. Pomeroy, Jr, Willimantic.	H. W. Andrews, Brookfield Center

CREAMERIES OF THE STATE.

The creameries of the state have been doing an unusually good business throughout the year. Their butter retains its high trade and always finds a ready sale. As has already been stated some of them have been obliged to suspend operation for the reason that so many of their patrons have taken to selling whole milk. While this may be somewhat more profitable in some cases the fact remains that the creameries have been a great help to the dairy interests of Connecticut. It enables many of those dairymen who are somewhat remote from markets to dispose of their milk product in the way of cream at a good profit and a large amount of money is brought in to the dairymen of those sections.

Lebanon creamery is still the largest one in the state, receiving last year 1,314,537 pounds of cream and paid their patrons $60,502. Wapping creamery received 983,682 pounds of cream and paid their patrons $49,792. Suffield, Ellington, Somers and Canton creameries are all large and successful plants. All the other creameries have been and will continue, we believe, to do a good business and be a great benefit to all their patrons.

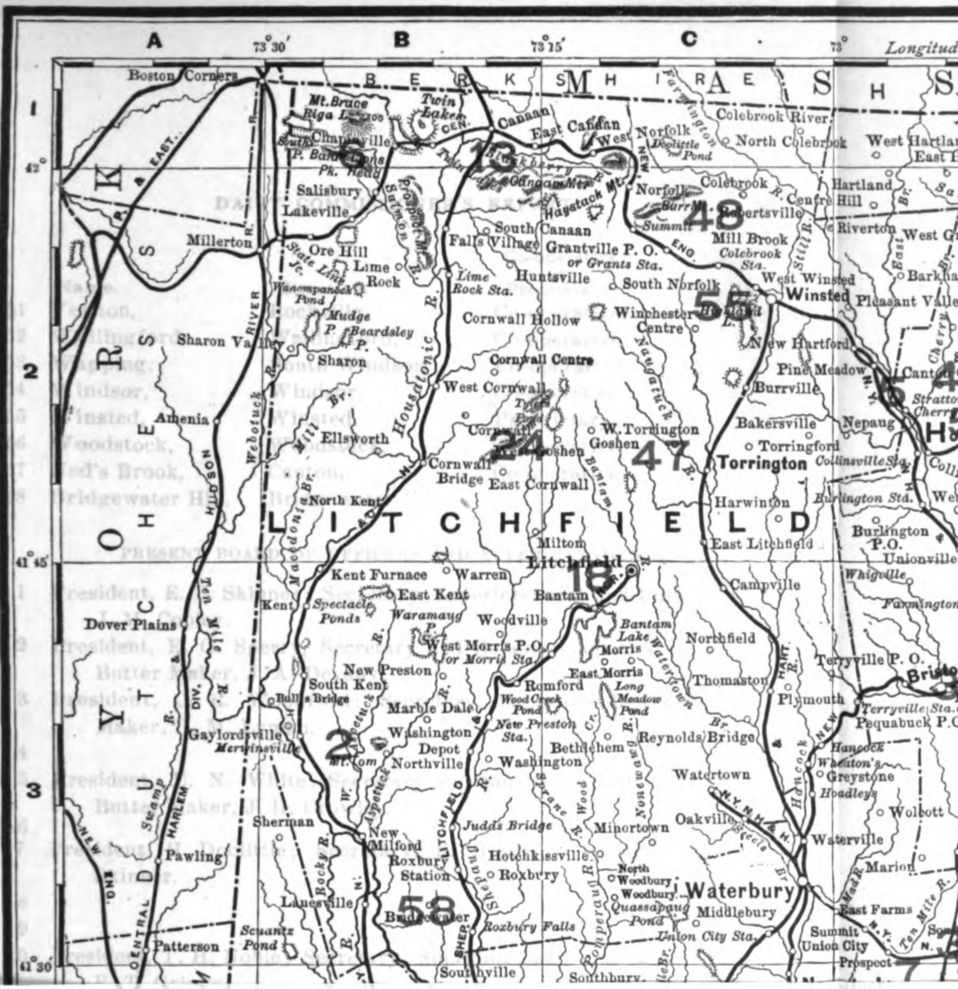
Statistics have been courteously given by the managers of the various creameries which enables me to make some statements regarding their business, and showing their officers.

The following map shows by numbers the location of each creamery:

LOCATION OF CREAMERIES.

	Name.	Situation.	Co-operative or Proprietary.	Amount of Capital.
1	Andover,	Andover,	Co-operative	4,000
2	Aspetuck,	Northville,	Co-operative,	1,500
3	Avon,	Avon,	Co-operative,	4,000
4	Brooklyn,	Brooklyn,	Co-operative,	
5	Canton,	Canton Center,	Co-operative,	3,675
6	Chapinville,	Chapinville,	Proprietary,	Handle milk only.
7	Cheshire,	Cheshire,	Proprietary,	2,000
8	Clover Farms,	Reading,		

	Name.	Situation.	Co-operative or Proprietary.	Amount of Capital.
9	Colchester,	Colchester,	Co-operative,	Closed.
10	Cromwell,	Cromwell,	Co-operative,	$ 3,500
11	Danbnry,	Danbury,	Proprietary,	3,000
12	Durham,	East Wallingford,	Rented to N. E. Dairy Corp.	
13	East Canaan,	East Canaan,	Co-operative,	3 500
14	Eastford,	Eastford,	Closed.	
15	East Granby,	East Granby,	Co-operative,	3,000
16	East Handam,	East Haddam,	Co-operative,	3,950
18	Echo Farm,	Litchfield,	Proprietary,	100.000
19	Ellington,	Ellington,	Co-operative,	4,850
20	Elmwood,	Elmwood,	Private,	Sell milk and cream.
21	Farmington,	Farmington,	Co-operative,	3.975
22	Glastonbury,	Glastonbury,	Proprietary,	3.700
23	Golden Ridge,	Berlin,	Co-operative,	3.000
24	Goshen,	West Goshen,	Co-operative,	3,000
25	Granby,	Granby,	Co-operative,	3.550
26	Green's Farms,	Westport,	Co-operative,	Closed.
27	Highland,	West Hartford,	Co-operative,	Closed.
28	Jewett City,	Jewett City,	Co-operative,	3,600
29	Lebanon,	Lebanon,	Co-operative,	3,400
30	Mansfield,	Merrow,	Co-operative,	3,600
31	Mountain Spring,	Durham,	Proprietary,	
32	Northford,	Northford,	Proprietary,	Closed.
33	Oakshade,	Cheshire,	Proprietary,	2,000
34	Old Lyme,	Black Hall,	Proprietary,	Closed.
35	Plainville,	Plainville,	Co-operative,	
36	Ridgefield,	Ridgefield,		
37	Riverside,	Warehouse Point,	Co-operative,	Closed.
38	Riverside,	Higganum,	Private,	
39	Scotland,	Scotland,	Co-operative,	8,000
40	Simsbury,	West Simsbury,	Co-operative,	3 500
41	Somers,	Somers,	Co-operative,	4,500
42	South Britain,	South Britain,	Proprietary,	5,000
43	Spring Brook,	South Wethersfield,	Co-operative,	Closed.
44	Suffield,	Suffield,	Co-operative,	5,500
45	Taugwank,	North Stonington,	Co-operative,	3,000
46	Thompson,	Thompson,	Proprietary,	3,000
47	Torrington,	Torrington,	Proprietary,	900
48	Tunxis,	Robertsville,	Co-operative,	3,000
49	Turnerville,	Turnerville,	Private,	Closed.
50	Valley Farm,	Valley Farm,	Proprietary,	


A
B
C
73° 30′
73° 15′
73°
Longitud
42°
41° 45′
41° 30′
1
2
3
BERKSHIRE
MASS
LITCHFIELD
Boston Corners
Mt. Bruce
Riga L.
Twin Lakes
Canaan
East Canaan
West Norfolk
Colebrook River
North Colebrook
West Hartland
East Hartland
Chapinville
Salisbury
Lakeville
Millerton
Ore Hill
Lime Rock
South Canaan
Falls Village
Grantville P. O.
or Grants Sta.
Huntsville
Lime Rock Sta.
Norfolk
Colebrook
Robertsville
Mill Brook
Colebrook Sta.
Hartland
Centre Hill
Riverton
West Winsted
Winsted
South Norfolk
Pleasant Valley
Winchester Centre
New Hartford
Pine Meadow
Burrville
Cornwall Hollow
Cornwall Centre
West Cornwall
Sharon Valley
Sharon
Amenia
Ellsworth
Cornwall
West Goshen
Goshen
W. Torrington
Bakersville
Torringford
Torrington
Collinsville Sta.
Nepaug
Cornwall Bridge
East Cornwall
North Kent
Harwinton
Burlington Sta.
Burlington P.O.
Unionville
Whigville
Farmington
Milton
Litchfield
East Litchfield
Campville
Kent Furnace
Warren
Kent
Spectacle Ponds
East Kent
Bantam
Waramaug P.
Woodville
Dover Plains
West Morris P.O.
or Morris Sta.
Bantam Lake
Morris
Northfield
Terryville P. O.
Bristol
New Preston
South Kent
Bulls Bridge
East Morris
Romford
Thomaston
Plymouth
Terryville Sta.
Pequabuck P.O.
Marble Dale
Wood Creek Pond
Long Meadow Pond
New Preston Sta.
Gaylordsville
Merwinsville
Washington
Depot
Northville
Washington
Bethlehem
Reynolds Bridge
Hancock
Wheaton's
Greystone
Hoadleys
Watertown
Wolcott
Sherman
New Milford
Judds Bridge
Minortown
Oakville
Waterville
Pawling
Roxbury Station
Hotchkissville
Roxbury
North Woodbury
Woodbury
Waterbury
Marion
Lanesville
Bridgewater
Quassapaug Pond
Middlebury
East Farms
Patterson
Scuantz Pond
Roxbury Falls
Union City Sta.
Summit
Union City
Prospect
Southville
Southbury
Housatonic R.
Naugatuck R.
Farmington R.
HARLEM
CENTRAL
N. Y. N. H. & H.
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	Name.	Situation.	Co-operative or Proprietary.	Amonnt of Capital.
51	Vernon,	Rockville,	Co-operative,	$ 3,675
52	Wallingford,	Wallingford,	Co-operative,	4,400
53	Wapping,	South Windsor,	Co-operative,	3,500
54	Windsor,	Windsor,	Co-operative,	7,000
55	Winsted,	Winsted,	Proprietary,	2,000
56	Woodstock,	Woodstock,	Co-operative,	3,000
57	Ned's Brook,	Canton,	Co-operative,	1,000
58	Bridgewater Hill,	Bridgewater,		

PRESENT BOARD OF OFFICERS AND SUPERINTENDENTS.

1 President, E. P. Skinner; Secretary, Superintendent and Butter Maker, J. M. Copley.

2 President, E. G. Sperry, Secretary and Superintendent, V. B. Hatch; Butter Maker, J. A. Devaux.

3 President, C. R. Woodford; Secretary, Superintendent and Butter Maker, H. M. Lyman.

4

5 President, E. N. White; Secretary and Superintendent, B. F. Case; Butter Maker, J. H. Crowley.

6

7 President, H. Doolittle; Secretary, E. Beadle; Superintendent, Ed. Skinner.

8

9

10 President, T. H. Noble; Secretary, Superintendent and Butter Maker, E. T. Griggs.

11 Superintendent, L. H. Boughton.

12

13 President, C. H. Sage; Secretary and Superintendent, E. S. Roberts; Butter Maker, E. E. King.

14

15

16 President, Sidney B. Warner; Secretary and Superintendent, L. M. Stark; Butter Maker, G. L. Thayer.

17

18 President, John S. Palmer; Secretary, A. B. Webster.

19 President, H. H. McKnight; Secretary, J. T. McKnight; Superintendent, H. C. Loveland, Butter Maker, J. M. Allen.

20

21

22 President, E. H. Andrews; Secretary and Superintendent, H. E. Loomis; Butter Maker, H. W. Lathrop.

23 President, W. H. Webster; Secretary and Superintendent, F. Deming; Butter Maker, W. C. Hills.

24 President, H. H. Ives; Secretary, W. H. Wadhams.

25 President, G. O. Beach; Secretary, F. S. Holcomb.

26

27

28 President, Edward A. Geer, Griswold; Secretary, Superintendent and Butter Maker, B. W. Smith, Jewett City.

29 President, William C. Smith, Secretary and Butter Maker, E. L. Pultz.

30 President, J. R. Hall; Superintendent, John Brown.

31

32

33 President, Higgins & Porter; Secretary and Superintendent, Charles F. Porter; Butter Maker, John Riley.

34

35 President, J. S. Corbin; Secretary and Superintendent, Hiram Carter; Butter Maker, L. M. Lauridson.

36 Proprietor, A. Blochman.

37

38

39 President, Jonathan Anthony; Secretary, William G. Anthony; Superintendent and Butter Maker, E. B. Inman.

40 President, A. L. Latimer; Secretary and Superintendent, S. T. Stockwell; Butter Maker, W. B Smith.

41 President, M. P. Avery; Secretary and Superintendent, E. B. Little; Butter Maker, W. H. Daniels.

42 Butter Maker, F. E. Merriman.

43

44 President, Arthur Sikes; Secretary, Treasurer and Superintendent, E. A. Russell; Butter Maker, C. E. Stratton.

45 President, Orrin Chapman; Secretary, Superintendent and Butter Maker, D. E. Johnson.

46 President, Linus Logee; Secretary, Louis Converse; Superintendent, Warren Logee; Butter Maker, L. A. Logee.

47 President and Secretary, George C Ives.

48 President, A. B. Ferry; Secretary and Superintendent, H. P. Deming; Butter Maker, F. W. Moore.

49

50

51 President, A. O. Thrall; Secretary, Superintendent and Butter Maker, A. W. Annis.

52 President. Marcus E. Cook; Secretary, Z. P. Beach.

53 President and Superintendent, H. A. Slater; Secretary, C. J. Dewey; Butter Maker, William Foster.

54 President, H. H. Ellsworth; Secretary, I. N. Hayden; Butter Maker, Walter Cushman.

55 President, E. Manchester & Sons.

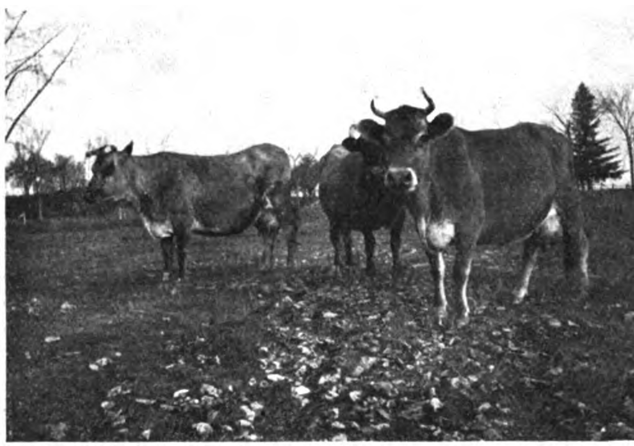
56 President, Abel Childs.

57 President, James Case; Secretary and Butter Maker, J. M. Gladwin.

58

No.	No. of Patrons.	No. of Cows.	No. lbs. Cream received past year.	Avg. price paid patrons for Butter fat.	Total amount paid patrons past year.	Avg. price paid per lb. for Butter past year.
1......	82	700	......	$0.25½	....	....
2......	100	?	......	.26¾	$24,087 00	$0.25
3......	45	240	30,046.5	.26	12,672 86	.27
4......	...	....	......	......	....	....
5......	100	?	491,749	.28	24,793 73	....
6 Milk station only.						
7......	...	....	......	......	....	....
8......	...	....	......	......	....	....
9......	...	...	......	......	....	....
10......	52	250	227,630.7	.25	10,600 19	.2719
11......	13	200	......	......	....	.284
12......	...	....	......	......	....	....
13......	67	600	481,922	.2497	23,859 01	.2532
14. Creamery suspended						
15......	...	....	......	......	....	....
16......	60	375	223,500	.2681	11,006 00	.27
18. Bottling and delivering milk and cream.						
19......	103	1,200	778,440	.2808	37,870 00	.2617
20. Out of business.						
21......	...	....	......	......	....	....
22......	34	....	194,335	......	7,259 63	....
23......	29	300	305,270	.25⅙	13,446 68	.25
24......	...	....	......	......	....	....
25......	...	....	......	......	....	....
26......	...	....	......	......	....	....
27. Out of business.						
28......	48	600	......	.2386	15,184 98	.2461
29......	160	....	1,314,536	.2575	60,502 81	.2525
30......	...	....	......	......	....	....
31......	...	....	......	......	....	....
32. Milk receiving station.						
33......	15	120	Handle whole milk.		4,800 00	.27

The following cut is a group of three cows taken from the herd of the Hon Charles L. Tuttle of Blue Hills avenue, Hartford:



Mr. Tuttle, one of the prominent dairymen of the state, has a fine herd of thoroughbred Jersey cows, of fine forms, robust constitutions, and strong milkers. He has taken a great deal of care in the building up of his herd and now has one of which any dairyman may be proud. He is producing about three hundred quarts of milk daily, which he retails in Hartford. Mr. Tuttle is a member of the State Board of Agriculture and a director of the Connecticut Dairyman's Association, in which he has always taken an active interest.

TUB BUTTER.

The law regulating the sale of tub butter was enacted in 1887, for the purpose of preventing deception in the sale of this butter printed into bricks or pats. As it is a more convenient way of handling the butter and makes it more attractive to consumers, some of the dealers in the state practiced the printing of Western tub butter into bricks or pats. To this there was no objection until they began wrapping it in paper upon which some attractive creamery name was stamped.

Undoubtedly many consumers were misled by this, thinking that they were using some regular creamery butter. The law is given under its proper head in the first part of this report.

"GOLD COAST SIENITE." OWNED BY C. L. TUTTLE.

The amount of tub butter printed in the state at the present time is not large, and dealers, we believe, are all complying with the provisions of the law, There is undoubtedly quite an amount of tub butter which has been printed into bricks or pats, brought into the markets of Connecticut from outside of the state, and while those dealers who are handling these goods may be liable under the law, it is very hard to get proof which would substantiate any prosecution.

The term, "Tub Butter," as used in this law, according to the ruling of this department, means such butter as has been fully prepared for market, packed in tubs, and has passed into the hands of wholesale or retail dealers ready for consumption, and should not apply to butter that may be packed in tubs or boxes simply for the purpose of transportation.

VINEGAR.

The following list shows the number of samples of vinegar taken by this department the last year for analysis. The kind of vinegar, where taken, and the result of analysis. Some of the samples show a slight falling off from the standard required by law. Most of these cases have been found to be pure vinegar, and no attempt at fraud has been found. In the case of cider vinegar a little more age was all that was required. In all cases where the analysis has shown it to be decidedly below standard the parties have at once been notified, and if selling the same continues the parties will be prosecuted. We would call particular attention to that part of the law in regard to branding. It is required that all makers of vinegar shall conspicuously brand, stencil, or paint upon the head of any barrel or cask containing the same the name of the maker, his residence, or place of manufactuare, and the true name of the kind of vinegar. We find some cases where parties had neglected to do this. We shall insist that all manufacturers of vinegar must comply with this provision.

This law is one of great importance to all manufacturers of vinegar in the state and to farmers who are growing apples. It is also of importance to all consumers, for they do not wish to pay for cider vinegar and get an article which has been manufactured with help of acid and can be put upon the market at a very low price.

Careful investigation has been made in every part of the state to see that the provisions of this law are sustained.

ANALYSIS OF VINEGAR.

No.	Brand.	Solids Per Cent.	Acidity Per Cent.	County.
1	Cider,	1.85	4.38	Hartford.
2	Cider,	2.03	6.97	"
3	Cider,	2.07	4.01	"
4	Malt,	.21	4.60	"
5	Cider,	2 11	4.02	"
6	Cider,	3.62	3.94	"
7	Cider,	2.38	4.51	"
8	White Wine,	.25	5 61	"
9	Cider,	1.38	4.62	"
10	Cider,	2.25	4.20	"
11	Cider,	2.00	4.83	"
12	Cider,	2.19	3.97	"
13	Cider,	1.95	4.64	"
14	Cider,	2.10	4.85	"
15	Cider,	2.36	3.68	"
16	Cider,	2.86	4.73	"
17	White Wine,	36	3.81	"
18	Cider,	2.77	4 79	"
19	Cider,	2.28	4.25	"
20	White Wine,	.14	4.10	"
21	Cider,	2.22	5.24	"
22	Cider,	1.76	4.82	"
23	Cider,	1.97	5.36	"
24	Cider,	2.10	4.90	"
25	Cider,	2 75	4.31	New Haven.
26	Cider,	2.11	4.00	"
27	Cider,	3.11	4.14	"
28	White Wine,	.20	4.12	"
29	Malt,	.21	4.63	"
30	Cider,	2.75	3.95	"
31	Malt,	.32	6.28	"
32	Cider,	2.74	4.67	"
33	Malt,	.30	4.56	"
34	Cider,	2.64	4.20	"
35	Malt,	1.54	3.88	"
36	Malt,	.39	4.18	"
37	Cider,	1.94	2 32	"
38	Malt,	.27	3.80	"
39	Cider,	2.07	4.30	"
40	Malt,	.17	3.38	"

No.	Brand.	Solids Per Cent.	Acidity Per Cent.	County.
41	Cider,	3.13	4.12	New Haven.
42	Malt,	.30	4.10	"
43	Cider,	2.86	4.92	"
44	Cider,	2.07	3.15	"
45	Cider,	2.93	4.39	"
46	Cider,	2.30	4.41	"
47	Cider,	2 95	4.96	"
48	Cider,	2.56	1.51	"
49	Malt,	.52	3.63	"
50	Cider,	2.54	4.20	"
51	Cider,	2.71	4.85	"
52	Cider,	2.16	4.94	"
53	White Wine,	.14	4.24	"
54	Cider,	2.55	4.38	"
55	Cider,	2.42	4.10	"
56	Cider,	2.84	4.10	"
57	Cider,	2.32	4.11	"
58	Wine,	1.70	3 14	"
59	Malt,	.25	4.00	"
60	Malt,	.18	4.59	"
61	Cider,	3.05	4.35	"
62	Cider,	2.34	4.17	"
63	Cider,	3.16	4.11	"
64	Malt,	.24	4.18	"
65	Malt,	.27	4.06	"
66	Cider,	1.84	4.24	Tolland.
67	Cider,	1.70	4.18	"
68	Cider,	1.81	4.58	"
69	White Wine,	.27	6.58	"
70	Cider,	2.28	4 07	"
71	Cider,	2.27	4 54	"
72	Cider,	2.72	4.25	"
73	Cider,	1.81	4.60	"
74	Cider,	2,06	4.86	"
75	Cider,	2.10	4.44	"
76	Cider,	1 96	4.87	"
77	Cider,	1.93	4.81	"
78	Cider,	2.82	4.31	Windham.
79	Cider,	3.33	4 62	"
80	Malt,	.26	4.47	"
81	Cider,	1.69	2.64	"

No.	Brand.	Solids Per Cent.	Acidity Per Cent.	County.
82	Cider,	1.95	4.06	Windham.
83	Cider,	2.79	3.27	"
84	White Wine,	.18	4.48	"
85	Cider,	2.25	4.90	"
86	Cider,	2.73	3.50	"
87	Cider,	2.24	5.16	"
88	White Wine,	.17	5.44	"
89	Cider,	2.71	4.38	"
90	Cider,	2.50	3.17	"
91	Malt,	.26	4.58	"
92	Cider,	1.99	3.89	"
93	Malt,	.34	4.11	"
94	Cider,	.93	4.68	"
95	Cider,	1.81	3.23	Middlesex.
96	Cider,	2.02	5.82	"
97	Cider,	2.18	5.39	"
98	Cider,	1 54	4.74	"
99	Cider,	1.67	4.79	"
100	Cider,	1.70	3.82	"
101	Malt,	.27	3.13	"
102	White Wine,	.26	4.85	"
103	Cider,	3.27	4.82	"
104	Cider,	2.36	5.03	"
105	Malt,	.48	3.77	"
106	Cider,	1.79	3.93	"
107	Malt,	.26	3.97	"
108	Cider,	2.72	4.37	"
109	Cider,	1.88	5.16	"
110	Cider,	2.24	5.28	"
111	Cider,	1.89	5.66	"
112	Cider,	2.44	4.44	"
113	Cider,	1.45	2.85	"
114	Malt,	.27	4.17	"
115	Malt,	1.19	4.64	"
116	Malt,	.28	4.31	"
117	Cider,	2.10	5.41	New Haven.
118	Cider,	1.65	5.90	"
119	Cider,	1.71	5.68	"
120	Cider,	3.07	5.16	"
121	Malt,	1.37	5.03	"
122	Cider,	1.57	5.94	"

No.	Brand.	Solids Per Cent.	Acidity Per Cent.	County.
123	Cider,	1.70	4.27	New London.
124	Cider,	1.62	5.26	"
125	Cider,	2.48	4.30	"
126	Cider,	1.88	4.97	"
127	Cider,	2.31	4.86	"
128	Cider,	2.50	4.58	"
129	Cider,	1.84	4.06	"
130	Cider,	1.86	3.51	"
131	White Wine,	.25	8.85	"
132	Cider,	2.61	3.67	"
133	Cider,	2.09	6.19	"
134	Malt,	4.19	6.32	"
135	White Wine,	.23	4.14	"
136	Cider,	2.22	4.02	"
137	Cider,	2.52	4.44	"
138	Malt,	.22	4 36	"
139	Cider,	2.02	3.99	"
140	Cider,	2.95	4.39	"
141	White Wine,	.20	5.31	"
142	Cider,	1.93	4.00	"
143	Cider,	1.44	3.72	"
144	Malt,	2.07	4 64	"
145	Malt,	.55	4.54	"
146	•Cider,	2.13	3 97	"
147	Cider,	3.15	4.37	"
148	White Wine,	.22	5.57	"
149	White Wine,	.26	4.72	"
151	Malt,	1.35	4.90	New Haven.
152	Cider,	2.24	4.95	"
153	Malt,	.31	4.91	"
154	Cider,	2.22	5.57	"
155	White Wine,	.15	5.07	"
156	Cider,	2.71	4.23	"
157	Malt,	.27	4.52	"
158	Malt,	1 29	4.65	"
159	Cider,	2.89	4.44	"
160	Cider,	2.07	5.24	"
161	Cider,	2.62	3.84	"
162	Cider,	1.73	4.84	"
163	Cider,	3.15	5.20	"
164	Cider,	2.35	5.12	"

No.	Brand.	Solids Per Cent.	Acidity Per Cent.	County.
165	Malt,	.37	2.97	New Haven.
166	Malt,	.22	4.35	"
167	Cider,	3.22	4.60	"
168	Malt,	.18	4.67	"
169	Cider,	2.92	4.10	"
170	Cider,	2.23	4.32	"
171	Cider,	2.28	4.38	"
172	Cider,	3.05	4.74	"
173	Cider,	2.84	7.68	"
174	Cider,	1.58	6.01	"
175	Cider,	2.02	4.18	"
176	Cider,	3.53	3.56	"
177	Cider,	2.03	4.08	"
178	Cider,	2.14	4.77	"
179	Cider,	1.87	5.89	"
180	Cider,	2.35	4.48	"
181	Malt,	1.47	4.88	"
182	Cider,	2.07	4.23	"
183	Malt,	1.40	4.20	"
184	Malt,	1.45	4.82	"
185	Cider,	2.03	6.72	"
186	Cider,	2.18	5.09	"
187	Cider,	2.13	4 00	"
188	Cider,	3.77	4.91	"
189	Malt,	.31	4.67	"
190	Cider,	2.66	3.96	Fairfield.
191	Cider,	2.33	4.82	"
192	Malt,	1.13	2.61	"
193	Cider.	1.76	4.98	"
194	Cider,	3.50	4.51	"
195	Cider,	1.98	4.80	"
196	Cider,	2.08	3.23	"
197	Cider,	2.89	5.20	"
198	Cider,	2.66	6.49	"
199	Malt,	.24	4.65	"
200	Cider,	1.56	3.72	"
201	Cider,	2.69	4.80	"
202	Cider,	3.65	7.31	"
203	Malt,	1.49	5.12	"
204	Cider,	2.97	4.54	"
205	Cider,	2.80	4.77	"

No.	Brand.	Solids Per Cent.	Acidity Per Cent.	County.
206	Cider,	2.41	4.88	Fairfield.
207	Cider,	2.90	4.65	"
208	Malt,	.21	4.32	"
209	White Wine,	.13	4.43	"
210	Red Wine,	1.01	3.73	"
211	Cider,	3.74	4.61	"
212	Cider,	2.18	3.53	"
213	Cider,	2.33	4.37	"
214	Malt,	.33	4.62	"
215	Cider,	2.40	5.79	"
216	Cider,	2.40	3.18	"
217	Cider,	2.00	3.65	"

MOLASSES.

The law regulating the sale of molasses prohibits its adulteration or the selling of molasses that has been adulterated with salts of tin, terra alba, glucose, dextrose, starch, sugar, corn syrup, or other preparations of or from starch.

The following list shows the samples which have been taken the past year from all parts of the state.

The analysis shows great improvement over what we have had in past years. In all cases that have shown decided adulteration the parties were notified, goods condemned and the sales stopped. If any sales were continued after notification the parties were prosecuted.

Very careful investigation has been made of all wholesale and retail dealers in this state. A large portion of these dealers are very desirous to have their goods all right and pure, having made their purchases in good faith with the understanding that there was no adulteration. They stopped the sale at once of any goods that the analysis showed were adulterated.

Very little adulteration has been found among the wholesale dealers of the state. They make their purchases very carefully and oftentimes have them analyzed before putting them on the market.

Retail dealers are also very much more particular than they were a few years ago. The working of this law has proved very satisfactory in clearing the state of a great deal of cheap adulterated molasses. There is still a large qu ,' of adulterated molasses in the larger markets of the country and we would warn all dealers in Connecticut to be very careful in their purchases, as under this law they will be liable to prosecution if they are found selling any molasses which is found to be adulterated.

We take great pleasure in stating that dealers with whom we have come in contact throughout the state are in sympathy with this law, as they wish to provide their customers with those goods which are pure and satisfactory.

No.	Direct Polarization Sugar Degrees.	Polarization After Inversion Sugar Degrees.	At Temp. of	At 86° C.	Kind.	County.
1	39.0	....	....	...	New Orleans,	Windham.
2	40.4	....	....	....	Porto Rico,	"
3	103.0	86.4	24	86.0	Porto Rico,	"
4	105.5	88.0	24	87.4	Porto Rico,	"
5	50.5	....	....	....	New Orleans,	New London.
6	60.4	9.6	22	24.4	Porto Rico,	"
7	70.0	25.6	24	35.0	New Orleans,	"
8	42.6	....	....	....	Porto Rico,	"
9	38.0	....	....	....	New Orleans,	"
10	41.4	....	....	....	New Orleans,	"
11	41.4	....	....	....	New Orleans,	"
12	39.4	....	....	....	Porto Rico,	"
13	46.8	....	....	....	New Orleans,	"
14	38.0	....	....	....	Porto Rico,	"
15	42.6	....	....	....	New Orleans,	"
16	41.4	....	....	....	Porto Rico,	"
17	46.0	....	....	....	New Orleans,	"
18	42.0	....	....	....	Porto Rico,	"
19	51.0	8.0	24	9.0	New Orleans,	Windham.
20	43.8	....	....	....	Porto Rico.	"
21	88.8	60.2	20	62.0	Porto Rico,	"
22	118.4	110.0	20	115.0	New Orleans,	"
23	37.4	....	....	...	Porto Rico,	"
24	42.2	....	....	....	Porto Rico,	"
25	36.6	....	....	....	New Orleans,	"
26	44.0	....	....	....	New Orleans,	"
27	48.0	....	....	....	Porto Rico,	"
28	50.8	9.0	24	9.6	New Orleans,	"
29	43.2	....	....	....	Porto Rico,	"
30	79.6	44.0	24	58.0	Porto Rico,	"
31	112.6	94.0	22	94.0	New Orleans,	Hartford.
32	42.8	....	....	....	New Orleans,	"

No.	Direct Polarization Sugar Degrees.	Polarization After Inversion Sugar Degrees.	At Temp. of	At 86° C.	Kind.	County.
33	48.6	....	....	....	Porto Rico,	Hartford.
34	49.6	....	....	....	New Orleans,	"
35	59.0	14.0	22	29.4	Porto Rico,	"
36	39.0	....	....	....	New Orleans,	"
37	32.0	....	....	....	Porto Rico,	"
38	44.4	....	....	....	New Orleans,	"
39	32 4	....	....	....	Porto Rico,	"
40	32 0	....	....	....	New Orleans,	"
41	32.0	....	....	....	Porto Rico,	"
42	40.4	....	....	....	New Orleans,	"
43	40.0	....	....	....	New Orleans,	"
44	37.6	....	....	....	New Orleans,	"
45	26.8	....	....	....	New Orleans,	"
46	24.4	....	....	....	New Orleans,	"
47	60.0	7.2	20	22.0	New Orleans,	"
48	46.8	....	....	....	Porto Rico,	"
49	113.4	94.0	20	94.0	New Orleans,	"
50	37.0	....	....	....	Porto Rico,	"
51	42.2	....	....	....	New Orleans,	"
52	51.2	9.2	20	10.0	Porto Rico,	"
53	34.6	....	....	....	New Orleans,	"
54	36.6	....	....	....	Porto Rico,	"
55	46.8	....	....	....	New Orleans,	"
56	29.6	....	....	....	Porto Rico,	"
57	42.2	....	....	....	New Orleans,	"
58	43.4	....	....	....	Porto Rico,	"
59	40.0		....	....	New Orleans,	"
60	35.2	....	....	....	Porto Rico,	"
61	45.6	....	....	....	New Orleans,	"
62	33.8	....	....	....	Porto Rico,	"
63	42.8	....	....	....	New Orleans,	"
64	51.2	9.4	20	9.0	Porto Rico,	"
65	38.6	....	....	....	New Orleans,	"
66	40.6	....	....	....	Porto Rico,	"
67	43 8	....	....	....	New Orleans,	"
68	41.6	....	....	....	New Orleans,	"
69	40.0	....	....	....	Porto Rico,	"
70	40.4	....	....	....	New Orleans,	"
71	35.2	....	....	....	Porto Rico,	"

No.	Direct Polarization Sugar Degrees.	Polarization After Inversion Sugar Degrees.	At Temp. of	At 86° C.	Kind.	County.
72	42.2	....	....	....	New Orleans,	Hartford.
73	46 4	....	....	....	Porto Rico,	"
74	35.0	....	....	....	Porto Rico,	"
75	45.2	....	....	....	New Orleans,	"
76	32.8	....	....	...	Porto Rico,	"
77	42 2	....	....	....	New Orleans,	"
78	58.2	26.0	22	35.0	Porto Rico,	"
79	42.0	....	....	....	New Orleans.	"
80	45.6	....	....	....	Porto Rico.	"
81	43.4	....	....	....	New Orleans,	"
82	37 0	....	....	....	Porto Rico,	"
83	25.6	....	....	....	Porto Rico,	Fairfield.
84	44.6	....	....	....	New Orleans,	"
85	43.2	...	....	....	Porto Rico,	"
86	28.4	....	....	....	Porto Rico,	"
87	140.8	136.6	20	128.2	New Orleans,	"
88	140 6	136.6	20	128.0	New Orleans,	"
89	51.0	-11.2	22	7.0	New Orleans,	"
90	42.2	....	....	....	Porto Rico,	"
91	87.6	49.0	23	56.4	New Orleans,	"
92	37.0	....	....	....	Porto Rico,	"
93	44.8	....	....	....	New Orleans,	"
94	38.2	....	....	....	Porto Rico,	"
95	126.0	126.6	22	117.0	New Orleans,	"
96	129.2	116.6	22	112.6	New Orleans,	"
97	46.0	....	....	....	New Orleans,	"
98	41.0	....	....	....	Porto Rico,	"
99	24.4	....	....	....	New Orleans,	"
100	21.6	....	....	....	Porto Rico,	"
101	44.0	....	....	....	New Orleans,	Windham.
102	50.0	-12.8	24	4.0	Ponce,	"
103	49.0	....	....	....	Ponce,	"
104	46.0	....	....	....	New Orleans,	"
105	29.0	....	....	....	Ponce,	"
106	47.2	....	....	....	Ponce.	"
107	40.0	....	....	....	New Orleans,	"
108	47.6	....	....	....	Ponce.	"
109	43.6	....	....	....	New Orleans,	"
110	43.8	....	....	....	Ponce,	"

No.	Direct Polarization Sugar Degrees.	Polarization After Inversion Sugar Degrees.	At Temp. of	At 86° C.	Kind.	County.
111	60.8	8.4	22	22.8	New Orleans,	Windham.
112	85.0	53.6	22	71.0	Ponce,	"
113	47.8	....	....	....	New Orleans,	"
114	41.4	....	....	....	Ponce,	"
115	45.4	....	....	....	New Orleans,	"
116	39.6	....	....	....	Ponce,	"
117	43.0	....	....	....	Porto Rico,	"
118	43.2	....	....	....	New Orleans,	"
119	75.0	37.6	22	45.0	Ponce,	"
120	38.0	....	....	....	Porto Rico,	"
121	44.2	....	....	....	New Orleans,	"
122	51.4	-7.2	22	12.4	Ponce,	"
123	40.6	....	....	....	New Orleans,	"
124	43.0	....	....	....	New Orleans,	"
125	54.8	-10.8	22	9.0	Ponce,	"
126	100.0	77.0	22	80.0	New Orleans,	"
127	52 8	-4.8	22	12.4	Ponce,	"
128	39.6	....	....	....	New Orleans,	"
129	45.0	....	....	....	New Orleans,	New Haven.
130	33.4	....	....	....	Ponce,	"
131	45.8	....	....	....	Ponce,	"
132	42.0	....	....	....	New Orleans,	"
133	45.2	....	....	....	Ponce,	"
134	45.6	....	....	....	New Orleans,	"
135	39.0	....	....	....	New Orleans,	"
136	46.0	....	....	....	Ponce,	"
137	49.6	....	....	....	Ponce,	"
138	47.2	....	....	....	Ponce,	"
139	39.0	....	....	....	New Orleans,	"
140	43.0	....	....	....	Ponce,	"
141	41.0	....	....	....	New Orleans,	"
142	78.6	47.6	22	49.0	Ponce,	"
143	32.4	....	....	....	New Orleans,	"
144	36.0	....	....	....	Ponce,	"
145	43.2	....	....	....	New Orleans,	"
146	36.8	....	....	....	Ponce,	"
147	44.6	....	....	....	New Orleans,	"
148	32.8	....	....	....	Ponce,	"
149	43.6	....	....	....	Ponce,	"

No.	Direct Polarization Sugar Degrees.	Polarization After Inversion Sugar Degrees.	At Temp. of	At 86° C.	Kind.	County.
150	36 8	....	....	....	Ponce,	New Haven.
151	29.2	....	....	....	New Orleans,	"
152	25.0	....	....	....	Ponce,	"
153	38.4	....	....	....	Ponce,	"
154	43.0	....	....	....	New Orleans,	"
155	45.0	....	....	....	Ponce,	"
156	38 0	....	....	....	New Orleans,	"
157	43.2	....	....	....	Ponce,	"
158	44.0	....	...	....	New Orleans,	"
159	32 8	....	....	....	Ponce,	"
160	46.0	....	.. .	....	Ponce,	"
161	33.0	....	....	....	Ponce,	"
162	118.2	101.0	23	100 0	New Orleans,	"
163	33.2	....	....	....	Porto Rico,	"
164	38.8	....	....	....	New Orleans,	Fairfield.
165	39.6	....	....	....	Porto Rico,	"
166	37.2	....	....	....	New Orleans,	"
167	28 0	....	....	....	Ponce,	"
168	42.2	....	.. .	....	New Orleans,	"
169	36 6	....	....	....	Ponce,	"
170	93.2	70.0	20	74.0	New Orleans,	"
171	48.2	....	....	....	New Orleans,	"
172	43.0	....	....	....	Porto Rico,	"
173	86.8	47.4	18	56.0	New Orleans,	"
174	41.0	....	....	....	New Orleans,	"
175	87.2	47.6	18	56.8	New Orleans,	"
176	19.2	....	....	....	Ponce,	"
177	39.6	....	...	....	New Orleans,	"
178	58.4	28	18	19.2	Ponce,	"
179	43.8	....	....	....	Compound,	"
180	36.8	....	....	....	New Orleans,	"
181	43.4	....	....	....	Porto Rico,	"
182	113.2	99.6	8	99.6	New Orleans,	"
183	38.4	....	....	....	New Orleans,	"
184	48.6	....	....	....	New Orleans,	"
185	46.8	....	....	....	Porto Rico,	"
186	44.4	....	....	....	New Orleans,	"
187	30.4	....	....	....	Ponce,	"
188	86 6	48.0	20	58.6	New Orleans,	"

No.	Direct Polarization Sugar Degrees.	Polarization After Inversion Sugar Degrees.	At Temp. of	At. 86° C.	Kind.	County.
189	43.0	....	....	....	Compound,	Fairfield.
190	42.8	....	....	....	New Orleans,	"
191	106.4	87.4	20	89.2	New Orleans,	New London.
192	54.6	-7.4	24	11.4	New Orleans,	"
193	49-6	-13.2	24	4.0	Ponce,	"
194	51.0	-12.4	24	6.4	New Orleans,	"
195	50.6	-12.6	24	4.6	Porto Rico,	"
196	37.0	....	....	....	New Orleans,	"
197	52.2	-8.0	24	10.0	New Orleans,	"
198	40 6	....	....	....	New Orleans,	"
199	42.0	....	....	....	Porto Rico,	"
200	111.0	96.0	24	95.6	Porto Rico,	"
201A	52.8	-8.4	26	9.8	New Orleans,	"
202B	52.0	-11.2	26	4.0	New Orleans,	"
203C	50.6	-4.0	23	11.0	Porto Rico,	"
204D	55.4	-7.4	24	10.0	New Orleans,	"
205E	52 6	-4.0	24	12.6	Porto Rico,	"
206F	45.4	....	....	....	New Orleans,	"
207G	47.6	....	....	....	Porto Rico,	"
208H	40.8	....	....	....	New Orleans,	"
209I	105.6	90.6	23	90.6	Porto Rico,	"
210J	41.8	....	....	....	New Orleans,	"
211K	50.4	....	...	....	Porto Rico,	"
212L	30.0	....	....	....	New Orleans,	"
213M	36.0	....	....	....	New Orleans,	"
214N	43.4	....	....	....	New Orleans,	"
215O	35.4	....	....	....	Ponce,	"
216P	38.2	....	....	....	New Orleans,	"
217Q	41.0	....	....	....	New Orleans,	"
218R	103.6	84.0	23	85.4	New Orleans,	"
219S	36.8	...	....	....	New Orleans,	"
220T	42.8	....	....	....	New Orleans,	Middlesex.
221U	37 4	....	....	....	Porto Rico,	"
222V	117.4	106.4	23	102.0	Compound,	"
223W	44.8	....	....	....	New Orleans,	"
224X	48.8	....	....	....	Porto Rico,	"
225Y	44.4	....	....	....	New Orleans,	"
226Z	40 6	....	....	....	Porto Rico,	"
227I	41.0	....	....	....	Porto Rico,	"

No.	Direct Polarization Sugar Degrees.	Polarization After Inversion Sugar Degrees.	At Temp. of	At 86° C.	Kind.	County.
228II	42.2	....	....	...	New Orleans,	Middlesex.
229III	37 4	....	....	....	Porto Rico,	"
230IV	40.4	....	....	....	New Orleans,	"
231V	40.0	...	....	....	Porto Rico,	"
232VI	44.6	....	....	....	New Orleans,	"
233VII	30.6	....	....	....	Porto Rico,	"
234VIII	45.4	....	....	....	New Orleans,	"
235IX	38.8	....	....	....	Porto Rico,	"
236X	41.2	....	....	....	New Orleans,	"
237XI	47.2	....	....	....	Porto Rico,	"
238XII	39 2	....	....	....	New Orleans,	"
239XIII	38.0	....	....	....	Porto Rico,	"
260	102.4	86.6	20	86.6	New Orleans,	Litchfield.
261	95 0	76.0	20	80.6	Porto Rico,	"
262	48.4	....	....	....	Porto Rico,	"
263	34.6	....	....	....	Porto Rico,	"
264	42.4	....	....	....	New Orleans,	"
265	42.8	....	....	....	New Orleans,	"
266	34.4	....	....	....	Ponce,	"
267	40.0	....	....	....	Porto Rico,	"
268	38.2	....	....	....	New Orleans,	"
269	48.8	....	....	....	Ponce,	"
270	97.0	72.0	22	75.0	Ponce,	"
271	36.6	....	....	....	Ponce,	"
272	38.0	....	....	....	New Orleans,	"
273	46.4	....	....	....	New Orleans,	"
274	37.6	....	....	...	New Orleans,	"
275	47.0	....	....	....	Ponce,	"
276	36.4	....	....	....	New Orleans,	"
277	42.8	....	....	....	Ponce,	"
278	37.6	....	....	....	New Orleans,	"
279	40.6	....	...	....	Ponce,	"
280	38.8	....	....	....	New Orleans,	"
281	48 0	....	....	....	Ponce,	"
282	38.0	....	....	....	Ponce,	"
283	112.0	88.0	21	88.0	Sugar House Syrup,	"
284	44.0	....	....	....	New Orleans,	Fairfield.
285	43.0	....	....	....	Ponce,	"
286	42.4	....	....	....	New Orleans,	"

No.	Direct Polarization Sugar Degrees.	Polarization After Inversion Sugar Degrees.	At Temp. of	At 86° C.	Kind.	County.
287	34.6	....	....	....	Ponce,	Fairfield.
288	100.2	77.2	22	79.2	New Orleans,	"
289	44.0	....	....	....	Ponce,	"
290	31.4	....	....	....	New Orleans,	"
291	42.2	....	....	....	Ponce,	"
292	45.4	....	....	....	New Orleans,	"
293	38.0	....	....	....	Porto Rico,	"
301	40.8	....	....	....	New Orleans,	"
302	35.2	....	....	....	Porto Rico,	"
303	84.6	62.6	20	64.6	Porto Rico,	"
304	40.0	....	....	....	New Orleans,	"
305	48.0	-14.0	23	4.0	Porto Rico,	"
306	132.0	123.4	23	118.6	Porto Rico,	"
307	38.8	....	....	....	Porto Rico,	Hartford.
308	26.8	....	....	....	Porto Rico,	"
309	42.0	....	....	....	New Orleans,	"
310	29.4	....	....	....	Porto Rico,	"
311	39.0	....	....	....	Porto Rico,	"
312	47.2	....	....	....	New Orleans,	"
313	49.8	....	....	....	Porto Rico,	"
314	43.6	....	....	....	New Orleans,	"
315	45.2	....	....	....	Porto Rico,	"
316	41.2	....	....	....	New Orleans,	New Haven.
317	36.0	....	....	....	New Orleans,	"
318	43.2	....	....	....	Porto Rico,	"
319	109.4	91.6	21	91.0	Porto Rico,	"
320	28.8	....	....	....	Porto Rico,	"
321	42.4	....	....	....	Porto Rico,	"
322	46.8	....	....	....	Porto Rico,	"
323	42.4	....	....	....	Porto Rico,	"
324	47.0	....	....	....	Porto Rico,	"
325	43.0	....	....	....	New Orleans,	"
326	42.2	....	....	....	Porto Rico,	"
327	45.4	....	....	....	Ponce,	"
328	17.2	....	....	....	New Orleans,	"
329	42.4	....	....	....	New Orleans,	"
330	47.2	....	....	....	Porto Rico,	"
331	33.2	....	....	....	Porto Rico,	"
332	39.6	....	....	....	New Orleans.	"

No.	Direct Polarization Sugar Degrees.	Polarization After Inversion Sugar Degrees.	At Temp. of	At 86° C.	Kind.	County.
333	47.0	....	....	....	Porto Rico,	New Haven.
334	112.8	94.0	21.0	95.0	New Orleans,	"
335	33.2	....	....	....	Porto Rico,	"
336	44.4	....	....	....	New Orleans,	"
337	41.2	....	.. .	....	Porto Rico,	"
338	39.4	....	....	....	Porto Rico,	"
339	31.0	....	....	....	New Orleans,	"
340	46.2	....	....	...	Porto Rico,	"
341	47.4	....	....	....	Porto Rico,	"
342	39.2	....	....	....	New Orleans,	"
343	42.8	....	....	....	Porto Rico,	"
344	37.4	....	....	....	New Orleans,	"
346	47.0	....	....	....	New Orleans,	"
347	39 0	....	....	....	Porto Rico,	"
348	37.0	....	....	....	Porto Rico,	"
349	38.6	....	....	....	Porto Rico,	"
350	37.4	....	....	.....	Porto Rico,	"
351	35.4	....	....	....	New Orleans,	"
352	32.0	....	....	....	Porto Rico,	"
353	49.2	.....	....	....	New Orleans,	Windham.
354	84.0	53.0	23	60.0	Porto Rico,	"
355	86.0	58.8	22	62.8	New Orleans,	"
356	31.2	....	....	....	Porto Rico,	"
357	43.4	....	....	....	New Orleans,	"
358	105.2	88.4	21	88.6	Porto Rico,	"
359	53.6	–20.0	22	–0.0	New Orleans,	"
360	48.0	....	....	....	Porto Rico,	"
361	37.2	....	....	....	Porto Rico,	"
362	41.6	....	....	...	New Orleans,	"
363	37.0	....	....	....	Porto Rico,	"
364	51.4	....	....	....	New Orleans,	"
365	45.6	.	....	....	Porto Rico,	"
366	31.0	....	....	....	New Orleans,	"
367	42.0	....	....	....	New Orleans,	"
368	38.2	....	....	....	New Orleans,	"
369	23 0	....	....	....	Porto Rico,	"
370	48.0	....	....	....	New Orleans,	Tolland.
371	47.2	....	....	....	Porto Rico,	"
372	35.4	....	....	....	Porto Rico,	"

No.	Direct Polarization Sugar Degrees.	Polarization After Inversion Sugar Degrees.	At Temp. of	At 86° C.	Kind.	County.
373	44.0	....	....	....	New Orleans,	Tolland.
374	46.0	....	....	....	Porto Rico,	"
375	26.0	....	...	....	New Orleans,	"
376	30.0	....	....	....	Porto Rico,	"
377	34.8	....	....	....	Porto Rico,	"
378	49.0	....	....	....	Porto Rico,	"
379	22.8	....	....	....	Porto Rico,	"
380	38.0	....	....	....	New Orleans,	"
381 Ap'l	43.6	....	....	....	New Orleans,	Hartford.
382	35.6	....	....	....	New Orleans,	"
383	35.6	....	....	....	Porto Rico,	"
381 July	48 0	....	....	....	Porto Bico,	"
382	40.8	....	....	....	Porto Rico,	"
383	33.0	....	....	....	New Orleans,	"
384	43.0	....	....	...	New Orleans,	"
385	·52.0	−17.0	25.	2.0	New Orleans,	"
230	43.6	....	....	....	New Orleans,	Middlesex.
231	46.0	....	....	....	Porto Rico,	"
232	44.8	....	....	....	New Orleans,	"
233	44.0	....	....	....	Porto Rico,	"

THE LAW RELATING TO COMMERCIAL FEEDING STUFFS.

The necessity for such a law as we have has largely grown up under the conditions which have existed for the last three years. There has been a great variety of human food products manufactured in late years, the aggregate quantity of which is very large. There are enormous quantities of by-products left over from the grains used in the manufacture of the above foods, and many of these possess a high nutritive value for the feeding of domestic animals. Most of the farmers and other consumers are unacquainted with the constituent parts of these new feeds. Protein, carbo-hydrates and fat are the principal parts of foods necessary for the sustenance and growth of animals, also for the production of milk.

Protein, that part which is necessary for the formation of milk, is the most expensive porticn of all animal feeds, and as the ordinary feeds grown in Connecticut contain very little protein it generally represents so much cash.

Carbo-hydrates represent the coarser portion of the feed used for sustaining animal heat and muscular energy. These portions are usually grown largely on our farms.

While the amount of animal feeds grown in the state is quite large, it is necessary for the successful production of milk and cream to purchase large quantities of those concentrated feeds which are rich in protein, and for the protection of dairymen and others who are purchasing these feeds there should be some guarantee as to the relative amount of protein, carbo-hydrates which these feeds contain.

Corn meal, the principal grain grown in Connecticut contains a large amount of carbo-hydrates, but is quite low in protein, and in order to have the most economical rations provided for their cows some feeds rich in protein must be added.

This law is a great help to all purchasers, as it enables them to know the constituent parts of the feeds purchased. Without this they have no data beyond what they learned from the different advertisements of the feed sold or by taking samples themselves and having them analyzed, but cases arise where feeding stuffs differ very largely in value although sold under the same name. Since the passage of this law a large portion of the concentrated feeds are sold with analysis and under a guarantee.

The following list of feeds show those which are rich in protein:

Feeds.	Protein.	Carbo-Hydrates.
Corn Meal	7.0	64.2
Oats	9.3	56.2
Wheat	10.2	63.5
Cotton Seed Meal	37.2	16.9
Linseed Meal	28.8	32.7
Cream Gluten Meal	33.3	35.4
Buffalo Gluten Meal	24.2	44.7

THE LAW RELATING TO THE MANUFACTURE AND SALE OF FOOD PRODUCTS.

The report of the Experiment Station in New Haven on food products shows the good work which has been accomplished under this law in sampling and analyzing the different food products of the state, and thereby showing to the public those which are adulterated.

The results obtained show most conclusively the need of such law and fully justifies its passage. The reports from the Station can be obtained by sending name and address to the Agricultural Experiment Station, New Haven, Conn.

This law was amended in 1899 so as to empower the dairy commissioner or his deputy to take samples of all food products in connection with the agent of the Experiment Station. It also provides that all prosecutions shall be brought by the dairy commissioner, but under this law no one can be prosecuted unless he is found selling adulterated goods knowingly.

So on all returns of the analysis sent to the commissioner by the Experiment Station showing any food product to be adulterated notice is at once sent to the parties selling such goods, and if the parties are found to continue selling after such notice prosecution will follow.

The subject of pure foods is engaging the attention of people throughout the different states more and more each year, and a large number of states have already enacted laws governing the manufacture and sale of the different food products within their state.

There have also been several bills presented to Congress for a national law on this subject. This would be of great help to all the states as it would be very likely to lead to more uniform laws in the different states.

The sale of quite a number of adulterated articles has been stopped during the year. Samples of "Sweetheart Baking Powder" were taken by the agent of the Station from a store in New Haven. This was found to be very badly adulterated. Notice was at once sent to the parties and the store was soon after visited by the Commissioner, and if any had been found on sale the party would have been prosecuted, but the sale of it was stopped as soon as they knew it was adulterated.

Coal tar dyes have been found to be used quite extensively in syrups, etc.

The following is a list of the syrups which have been found adulterated. Notices have been sent to all the parties from this department with the analysis.

Sample.	No.	Adulterated with
Strawberry soda water syrup	5113	Coal-tar color, salicylic acid, and artificial flavor.
Strawberry soda water syrup	5115	Coal-tar color and salicylic acid.
Strawberry syrup	5116	Salicylic acid.
Orangeade	5119	Coal-tar color and benzoic acid.

Sample.	No.	Adulterated with
Strawberry soda	5121	Coal-tar color and artificial flavor.
Orange cider..	5122	Coal-tar color.
Strawberry syrup	5127	Coal-tar color and benzoic acid.
Raspberry soda water syrup	5128	Cochineal and glucose.
Cherry soda water syrup ...	5130	Coal-tar color and artificial flavor.
Raspberry soda water syrup	5131	Coal-tar color and benzoic acid.
Strawberry soda water syrup	5132	Coal-tar color and artificial flavor.
C. & M. strawberry fruit syrup....................	5133	Coal-tar color and benzoic acid.
C. & M. fruit syrup raspberry shrub..............	5134	Benzoic acid.
Strawberry soda water syrup	5136	Coal-tar color.
Pureoxia high-grade ginger ale.........	5137	Salicylic acid.
Strawberry soda water syrup	5138	Cochineal and artificial color.
Orange soda water syrup ...	5140	Coal-tar color.
Raspberry soda water syrup	5144	Salicylic acid.
Soda water syrup...........	5146	Coal-tar dye.
Raspberry soda water syrup	5145	Salicylic acid and glucose.
Strawberry soda water syrup	5148	Salicylic acid,
Strawberry soda water syrup	5149	Coal-tar color and artificial flavor.
Raspberry soda water syrup	5150	Benzoic acid.
Clicquot Club blood orange..	5153	Coal-tar color
Strawberry soda	5155	Coal-tar color and artificial flavor.
Non-alcoholic orange cider..	5156	Coal-tar color.
Raspberry syrup	5159	Coal-tar color and glucose.
Raspberry syrup	5160	Salicylic acid.
Naugatuck Diamond ginger ale	5161	Salicylic acid.
Pureoxia high-grade blood orange...................	5162	Coal-tar color and salicylic acid.
U. S. Club ginger ale	5163	Salicylic acid.
Strawberry soda	5166	Coal-tar color and artificial flavor.
Orange phosphate..........	5167	Coal-tar color.
Strawberry soda water syrup	5168	Salicylic acid.
Raspberry soda water syrup	5169	Coal-tar color and salicylic acid.
Strawberry soda water syrup	5172	Cochineal and salicylic acid.
Pure New Jersey fruit syrup	5178	Salicylic acid.
Pan-American orangeade....	5179	Coal-tar color.
Palisade fruit syrup	5180	Artificial color.
Raspberry shrub	5182	Artificial color and salicylic acid.
Strawberry soda water syrup	5186	Coal-tar dye and salicylic acid.

Sample.	No.	Adulterated with
Orange soda	5191	Coal-tar color.
Strawberry soda	5193	Coal-tar color and artificial flavor.
Raspberry soda	5194	Coal-tar color and artificial flavor.
Raspberry syrup	5195	Artificial color.
Blood orange soda water syrup	5198	Coal-tar color and salicylic acid.
Strawberry soda water syrup	5202	Coal-tar color and salicylic acid.
Strawberry soda water syrup	5204	Coal-tar color.
Soda water syrup	5206	Benzoic acid.
Strawberry soda water syrup	5207	Coal-tar color and salicylic acid.
Strawberry soda water syrup	5208	Coal-tar colorand salicylic acid.
Pure California cherry cider	5209	Coal-tar dye and salicylic acid.
Birch beer	5210	Coal-tar color.
Birch beer	5211	Coal-tar color.
Strawberry soda	5215	Coal-tar color and artificial flavor.
Soda water syrup	5219	Coal-tar dye.
Raspberry soda water syrup	5221	Coal-tar color and artificial flavor.
Strawberry soda water syrup	5222	Coal-tar color and benzoic acid.
Raspberry soda water syrup	5223	Salicylic acid.
Raspberry soda water syrup	5224	Salicylic acid.
Strawberry soda water syrup	5226	Salicylic acid.
Strawberry soda water syrup	5228	Salicylic acid.
Raspberry soda water syrup	5231	Salicylic acid.
Raspberry soda water syrup	5232	Salicylic acid.
Strawberry soda water syrup	5233	Coal-tar color.
Strawberry soda water syrup	5234	Coal-tar color and artificial flavor.
Strawberry soda water syrup	5236	Cochineal and salicylic acid.
Strawberry soda	5240	Coal-tar color.
Hygienic grape juice	5242	Salicylic acid.
Lime juice	5243	Salicylic acid.
Strawberry soda water syrup	5246	Salicylic acid.
Strawberry soda water syrup	5247	Cochineal.
Strawberry soda water syrup	5248	Coal-tar color and benzoic acid.
Orange phosphate	5250	Coal-tar color.
Strawberry soda	5251	Coal-tar color and artificial flavor.
Orange phosphate	5252	Coal-tar color.
Raspberry soda water syrup	5254	Artificial color and salicylic acid.
Raspberry soda water syrup	5256	Salicylic acid.
Ginger ale	5257	Salicylic acid.
Strawberry soda water syrup	5258	Coal-tar color and artificial flavor.
Strawberry soda water syrup	5259	Salicylic acid.
Strawberry soda water syrup	5260	Coal-tar color and artificial flavor.

Sample.	No.	Adulterated with
Strawberry soda water syrup	5261	Benzoic acid.
Strawberry soda water syrup	5262	Coal-tar color, salicylic acid, and artificial flavor.
Strawberry soda water syrup	5264	Salicylic acid.
Raspberry soda water syrup	5265	Cochineal.
Strawberry soda water syrup	5266	Coal-tar color and artificial flavor
Raspberry soda water syrup	5267	Coal-tar color and artificial flavor.
Raspberry soda water syrup	5268	Coal-tar color.
Raspberry soda water syrup	5269	Coal-tar color.
Strawberry soda water syrup	5270	Coal-tar color and salicylic acid.
Strawberry soda	5274	Coal-tar color and artificial flavor.
Raspberry soda	5275	Coal-tar color.
Strawberry soda	5276	Coal-tar dye and artificial flavor.
Strawberry soda water syrup	5279	Coal-tar color.
Raspberry soda water syrup	5280	Coal-tar color.
Strawberry soda water syrnp	5281	Benzoic acid and glucose.
Raspberry soda water syrup	5282	Benzoic acid.
Iced mint soda water syrup	5283	Coal-tar dye.
Strawberry soda water syrup	5284	Coal-tar color, salicylic acid, and artificial flavor.
Lime juice	5287	Salicylic acid.
Blood orange soda..........	5289	Coal-tar dye.
Strawberry soda water syrup	5292	Benzoic acid.
Raspberry soda water syrup	5293	Benzoic acid.
Strawberry soda water syrup	5295	Coal-tar color and artificial flavor.
Orange soda water syrup ...	5296	Coal-tar color.
Strawberry soda	5299	Coal-tar color.
Strawberry soda water syrup	5300	Coal-tar color.
Raspberry soda water syrup	5301	Salicylic acid.
Strawberry soda water syrup	5303	Salicylic acid.
Concord grape juice........	5306	Salicylic acid.
Strawberry soda water syrup	5307	Coal-tar color and benzoic acid.
Strawberry soda water syrup	5310	Coal-tar color and artificial flavor.
Raspberry soda water syrup	5311	Salicylic acid.
Raspberry soda	5316	Coal-tar color and salicylic acid.
Grape juice	5321	Coal-tar color and benzoic acid.
Raspberry pure fruit syrups	5322	Coal-tar color.
Lemon sour	5324	Artificial color.
Pineapple fruit syrup.......	5327	Salicylic acid.
Orange phosphate	5331	Coal-tar dye.

UNITED STATES DEPARTMENT OF AGRICULTURE, 1902.

Secretary, James Wilson.
Assistant Secretary, J. H. Brigham.

Bureau of Animal Industry:
Chief, D. E. Salmon.
Assistant Chief, A. D. Melvin.

Dairy Division:
Chief, Henry E. Alvord.
Assistant Chief, R. A. Pearson.

STATE DAIRY OFFICIALS, 1902.

California—Agent and Secretary of the State Dairy Bureau, William Vanderbilt, San Francisco. Assistant Agent, William H. Saylor.

Colorado—State Dairy Commissioner, T. L. Monson, Denver. Deputy Commissioner, B. S. Newland.

Connecticut—Dairy Commissioner, J. B. Noble, Hartford. Assistant Commissioner, R. O. Eaton.

Illinois—State Food Commissioner, Alfred H. Jones, Room 1623, Manhattan Building, Chicago. Assistant Commissioner, R. M. Patterson.

Indiana—Secretary of the State Board of Health, J. N. Hurty, Indianapolis.

Iowa—Dairy Commissioner, H. R. Wright, Des Moines. Deputy Commissioner, W. E. Smith.

Massachusetts—General Agent State Dairy Bureau, George M. Whitaker, Box 1332, Boston.

Michigan—Dairy and Food Commissioner, W. B. Snow, Lansing. Deputy Commissioner, George H. Bussey.

Minnesota—State Dairy and Food Commissioner, W. W. P. McConnell, St. Paul. Assistant Commissioner, G. L. Dingman.

Nebraska—Food Commissioner, the Governor of the State. Deputy Commissiner, F. B. Hubbard, Lincoln.

New Jersey—State Dairy Commissioner, George W. MacGuire, Trenton.

New York—Commissioner of the Department of Agriculture (including dairy), Charles A. Weiting, Albany. Assistant Commissioners, G. L. Flanders, Albany; F. J. H. Kracke, No. 23 Park Row, New York City.

NORTH DAKOTA—Ex-officio State Dairy Commissioner, the State Commissioner of Agriculture and Labor. Assistant Dairy and Food Commissioner, E. E. Kaufman, Fargo.

OHIO—Dairy and Food Commissioner, Joseph E. Blackburn, Columbus.

OREGON—Dairy and Food Commissioner, J. W. Bailey, Portland.

PENNSYLVANIA—Dairy and Food Commissioner of the Department of Agriculture, Jesse K. Cope, Harrisburg.

UTAH—Dairy and Food Commissioner, H. J. Faust, Jr., Salt Lake City.

WASHINGTON—State Dairy and Food Commissioner, E. A. McDonald, Seattle.

WISCONSIN—Dairy and Food Commissioner, H. C. Adams, Madison. Assistant Commissioner, C. W. Sweeting.

CANADA—Commissioner of Agriculture and Dairying, James W. Robertson, Ottawa.

DAIRY ASSOCIATIONS, 1902.

National Association of State Dairy and Food Departments—Organized 1897. Membership 30. President, J. W. Bailey, Portland, Oregon. Secretary, B. M. Allen, Lexington, Kentucky Annual meeting: Portland, Oregon, 1902.

National Creamery Buttermakers' Association—Organized 1901. Membership 1,300. President, H. J. Nestret, Walker, Ia. Secretary, E. Sudendorf, Elgin, Ill. Annual meeting: Milwaukee, Wis., 1902.

National Dairy Union—Organized 1894. President, W. D. Hoard, Fort Atkinson, Wis. Secretary, Charles Y. Knight, 188 S. Water street, Chicago, Ill. Annual meeting: St. Paul, Minn., 1902.

New England Milk Producers' Union—Organized 1886. Membership over 3,000. President, A. B. Ward, Westboro, Mass. Secretary, W. A. Hunter, Rutland, Mass. Annual meetings: Boston, Mass., 1902; Boston, Mass., 1903.

Five States Milk Producers' Association—Organized 1898. Membership 6,893. President, Frank B. Aiken, Trumansburg, N. Y. Secretary, H. T. Coon, Little York, N. Y. Annual meetings: Binghamton, N. Y., October 16, 1900; New York City, October 15, 1901.

Columbia River Dairy Association—Organized 1898. President, W. J. Spillman, Pullman, Wash. Secretary, D. C. Dilworth, Spokane, Wash. Annual meetings: Moscow, Idaho, March, 1900; (probably) Pullman, Wash., March, 1901.

EXPENSES.

For the Year Ending September 30, 1902.

Salary of Commissioner	$1,500 00
Office and traveling expenses	827 03
Salary of Deputy Commissioner	1,200 00
Traveling expenses of Deputy	859 98
Total	$4 387 01

CONCLUSION.

The various laws under which this department is working represent not only a large financial interest in the state but also those questions which enter largely into the health and good citizenship of the people.

Our dairy interests, representing a large amount of invested capital, are brought into close touch with all those matters relating to the manufacture and sale of imitation butter and in fact with all that pertains to the butter trade in the state.

We have no state law governing the manufacture and sale of renovated butter and we would respectfully suggest that the incoming legislature should pass some law in conformity to the new United States law passed at the last session of Congress requiring this class of butter to be marked or stamped in such a way as to plainly show to all consumers just what they are purchasing.

The special and general pure food laws of the state are of great importance to all persons, and it is with pleasure that we note that a majority of dealers in the state and all consumers are in hearty sympathy with all of their regulations.

In making the careful investigations which your Commissioner and the Assistant Commissioner have made several times during the year in all parts of the state to see that the provisions of these laws are sustained, they have found that dealers are very generally desirous of knowing if the food products which they have on sale are pure and unadulterated and are sold in conformity with the law. Many times they have purchased articles supposing them to be all right, but investigation has proved that they were quite badly adulterated and consumers thereby deceived.

I take pleasure at this time in congratulating the state upon the thorough and efficient work done at the Connecticut Agricultural Station under the pure food law, and I wish to thank the officers of the Station for the hearty coöperation with which they have always entered into the work of this department. I also desire to thank the Dairymen's Association and Creamery Association for the hearty support which they have rendered, and the many court officers of the state for the many courtesies they have shown.

Respectfully submitted,

JOHN B. NOBLE,

Dairy Commissioner.

State of Connecticut.

PUBLIC DOCUMENT NO. 38.

ANNUAL REPORT

OF

COMMISSIONER ON DOMESTIC ANIMALS.

TO

THE GOVERNOR,

For the Year Ended September 30, 1902.

PRINTED BY ORDER OF THE LEGISLATURE.

PRESS OF
CONN. INSTITUTE FOR THE BLIND,
HARTFORD, CONN.

STATE OF CONNECTICUT.

OFFICE OF THE

COMMISSIONER ON DOMESTIC ANIMALS.

ROOM 54, CAPITOL, HARTFORD.

Telephone Connections { Hartford Division 1651. Washington Division 17-4.

HEMAN O. AVERILL, *Commissioner.*
WASHINGTON DEPOT, CONN.

B. WINONA PAGE,
Clerk and Stenog.

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

Sir: In compliance with the requirements of the law creating this department, I hereby present the fifth annual report containing a general synopsis of the work accomplished during the fiscal year ending September 30, 1902, with such conclusions and suggestions as the experience gained in the administration of its duties during the past three years prompts me to offer in the hope that they will prove of some service and encouragement in the private and public efforts that are being put forth to check and suppress the ravages of bovine tuberculosis in this state.

During the year no case of any animal infected with contagious disease has been reported to the Commissioner by any selectman in the state, under Section 4377. With the exception of a few notifications received from town health officers and from Mr. Thrall, agent of the Connecticut Humane Society, the calls for inspection and examination have come directly from the owners of cattle.

Bovine tuberculosis is the only contagious disease dangerous to public health that has been found by the Commissioner to exist among the domestic animals of the state. Farmers and cattle owners are becoming more familiar with the earlier symptoms of tuberculosis and realizing the danger in permitting animals suffering with this dread disease to remain in their herds, are coming more and more to seek the co-operation of the state in their efforts to weed out all tuberculous animals if possible before the disease gains a foothold in their herds.

The following are extracts from a few of the letters received during the year:

"I have one cow I suspicion has tuberulosis, would like to have you see her quite soon."

"I have a cow and something seems to be the matter with her, am afraid she may have tuberculosis. I wish you would come and see her as soon as possible."

"I have a yearling which does not seem to be doing well and think you had better look it over as soon as you can as I do not want to put it into the barn for the winter if not right."

"Please give me as early a date as possible when you can come and examine all my cows. I killed a nice fat cow the other day that was badly affected. After this I though I had better have them all examined."

"I have a sick cow and my neighbors advised me to write to you, etc., etc."

"I have a young cow that I have had two years that is growing poor. She eats well. I do not know what is the matter with her. Would like to have you see her."

"I have a herd of several cows. I have a family of children who inherit strong constitutions on their mother's side as well as on my own. Within the past two years three of my children have had trouble which the physicians have pronounced tubercular in its origin and they are at a loss to know the source. Will you kindly inform me what provision is made for the examination of cows by the tuberculin test or otherwise."

"The cow I got in the place of the one you killed has developed suspicious symptoms. She is giving about twelve quarts of milk a day and as our large family consumes this in milk, cream, and butter, I am a little alarmed lest she should have tuberculosis. I should be glad to have your opinion about her."

The foregoing are fair types of the many calls which have been received during the year from cattle owners who had suspicious cases of bovine tuberculosis in their herds which they wished to have examined. In response to these calls the Commissioner has either made a personal examination of the cattle or deputized competent local veterinarians to do the work when it was apparent that his fee would be less than the traveling expenses of the Commissioner.

APPRAISALS.

In every case when a physical examination has diagnosed tuberculosis the animal has been condemned and its value appraised by mutual agreement between the Commissioner or his deputy, as the case might have been, and the owner. The matter of appraisal of condemned animals has not been found to be a very difficult one. While occasionally a man is found who seems to think the state should pay him as much for a diseased farrow cow as she was worth when she freshened or before she commenced to run down with tuberculosis, the great majority approach the subject in a fair minded way. They realize that the object and intention of the law is to prevent the spread of bovine tuberculosis among the cattle of the state and to protect the public health and that he cattle owner himself secures the greatest benefit by the removal of what was a menace to the health of his herd and a source of danger to himself and his family. These men are willing to share the loss with the state and accept a reasonable compensation for their condemned cattle.

The prices allowed for cattle during the year have ranged from nothing to $25, the average being $13.26.

Letters are occasionally received inquiring if the state will pay for cattle that have been slaughtered for beef and found diseased to such an extent that the carcass was unfit for food. As the state is not a charity bureau such requests must of necessity be refused, the town health officer alone having jurisdiction over such cases.

The following are summaries of records of this department for the years ending respectively September 30, 1901–1902:

	1901	1902
No. of calls to examine suspicious cases of bovine tuberculosis	279	289
No. of towns from which these calls came	102	102
No. cattle examined in response to these calls	825	1127
No. herds inspected furnishing milk to Norwalk and South Norwalk markets	71	33
No. cattle inspected furnishing milk to Norwalk and South Norwalk markets	635	304
No. of cattle condemned in the state	217	215

	1901	1902
Average price allowed	$ 15 18	$ 13 26
Total allowed for cattle	3294 50	2851 50
Office and traveling expenses and clerk	1001 93	847 78
Veterinarians and expenses	364 58	396 47
TOTALS	$4676 19	$4109 01

The calls were received during the year as follows:

	1900	1901
October	20	23
November	23	22
December	31	31
	1901	1902
January	27	20
February	16	15
March	25	28
April	30	24
May	31	29
June	22	23
July	22	24
August	22	24
September	10	26
TOTALS	279	289

As to localities the calls were received as follows by counties:

	1901	1902
Hartford	53	41
New Haven	11	17
New London	61	51
Fairfield	19	15
Windham	47	63
Litchfield	39	49
Middlesex	21	33
Tolland	28	20
TOTALS	279	289

If the size of the counties and the number of neat cattle kept in each county are taken into consideration it will readily be seen that no county by reason of locality can claim any appreciable freedom from the disease.

Cattle reported to this office as having been brought into this state.

	1901	1902
Cows	724	959
Heifers	278	241
Oxen	18	31
Steers	428	476
Bulls	48	143
Calves	142	149
TOTALS	1638	1999

PREVENTION.

The tubercle bacilli will retain their vitality only a very short time when exposed to the direct rays of the sun. The germs cannot retain their power to do harm for any great length of time in diffused or reflected light. This shows the importance of securing as much light in the stable as possible. Windows to admit light and whitewashed walls to reflect it would turn many a dark and unhealthy den into light, cheerful, and wholesome stables, thereby adding greatly to the comfort, pleasure, and healthfulness of both owner and cattle. Stables should be whitewashed every year because lime in addition to being a good reflector is a disinfectant. "Cleanliness is next to Godliness." This trite saying applies to the stable and its occupants as forcibly as to the home and the home makers. There is far more danger to the public health in filthy stables, dirty cows, and untidy milkers than from tuberculous cows.

The records of this department for the past six years warrant the Commissioner in making the broad statement that probably no town in the state is absolutely free from bovine tuberculosis. If cattle housed in dark, damp, and filthy stables are free from the disease they will undoubtedly continue so until the disease is brought in from outside, but if by purchase a tuberculous animal is placed in a herd in such an environment the spread of the disease is just as sure to follow as the harvest is sure to follow the sowing of the seed.

It is an insiduous disease and in many cases its presence in a herd is not suspected by the owner until revealed by the slaughter of a fat animal which has been selected and fed by the farmer for his own beef. It is often difficult and sometimes impossible for the most expert veterinarian to recognize even advanced cases during life. Much can be done, however, by every farmer and dairyman by his own labor and a very small outlay of money to reduce the danger of infection in his stables to the minimum. Dark, damp and filthy stables furnish an ideal environment for the spread of the disease in its most virulent form. While it is unquestionably true that cows stabled in barns that from a hygienic and sanitary standpoint are as nearly ideal as it is possible to make them, may become infected with the disease if exposed to the tubercle bacilli by the presence in the herd of a badly diseased animal, it is equally true that under such conditions there is far less danger of the healthy animals contracting the disease, and if contracted the ravages of the disease will be far less rapid.

Additional windows in the barns to admit more sunlight, more whitewashed walls and ceilings to reflect the light, better ventilation and greater cleanliness in the stables to provide a sufficiency of pure air for the cattle confined therein will do more to keep them healthy and make them profitable than all the patent feeds and medicines in the market.

Dr. Theobald Smith, chief of the division of animal pathology, Bureau of Animal Industry, U. S. Department of Agriculture, Washington, D. C., in Bulletin No. 7, while tacitly admitting that a herd of cattle can live and thrive when tuberculosis is present, says: "It is a fact experimentally demonstrated that the introduction into the body of the very susceptible guinea pig of different numbers of tubercle bacilli is followed by a rapidly or a very slowly progressive disease according to the quantity of virus. Hence if, even where tuberculosis is present and not recognizable, all precautions are taken to reduce in every way the number of tubercle bacilli inthe air, the food, and the milk, it is evident that if the experimental data are accurate, the amount and intensity of the disease may be reduced and possibly the unavoidable slight infections become healed.

It is not the purpose of the writer to make the neglect of the tuberculin test justifiable, but it is evident that, with the present great prevalence of tuberculosis, all means must be resorted to to keep the disease from making still further inroads.

The more conservative such means the more likely they are to find favor.

The amount of disease to be combated, the large financial resources required by more radical measures, makes it probable that the conservative measures suggested will have to be kept in operation for an indefinite time to come.

Another phase of this question which should not be overlooked is the relative danger of the air of the cow stables to human beings. If more than three-fourths of all tuberculous cattle have been infected through the air of cow stables why is not the air of cow stables equally dangerous to human beings frequenting them? It would certainly be of interest for public health officers to look into the matter more carefully.

IS TUBERCULOSIS COMMUNICABLE FROM ANIMAL TO MAN?

Dr. Robert Koch of Berlin, the celebrated scientist who first discovered the tubercle bacillus in 1882, thereby proving tuberculosis to be a contagious disease, has again startled the scientific world. In a paper which he read before the tuberculosis congress in London one year ago last July he made the statement that he had satisfied his own mind that tuberculosis was not communicable from man to animal and that he did not believe that it was communicable from animal to man.

Other scientists in other parts of the world either disagree with Dr. Koch openly or at least say that the statement made by him is a theory, the truth of which has not yet been demonstrated.

The following are extracts from the report of the Committee of Animal Diseases and Animal Food read before the American Public Health Association held in Buffalo September 16, 1901, by D. E. Salmon, D. V. M., Chief of Bureau of Animal Industry, U. S. Department of Agriculture, Washington, D. C., Chairman of the Committee:—

"While it may still be said that it cannot be absolutely proved that any given case of tuberculosis in man was caused by bovine bacilli, the evidence is about as strong as we can expect in the case of human subjects. It is generally admitted that the great majority of cases of pulmonary tuberculosis in man are caused by the inhalation of bacilli from human sources, and very likely this conclusion is correct, but when we ask for direct and absolute evidence of the fact we find it is about as difficult to produce as in the case of infection by bovine bacilli."

"That the diseases are not absolutely distinct is indicated by the fact that tuberculin made from human bacilli causes a reaction in cattle affected with bovine tuberculosis. The Bureau of Animal Industry has distributed hundreds of thousands of doses of tuberculin made from human bacilli, and this tuberculin has been used by State authorities in various parts of the United States for diagnosing the disease in cattle, and has been found extremely reliable and satisfactory for this purpose. This fact would clearly indicate that if there is a difference between bacilli from human and bovine sources, and your committee is inclined provisionally to admit such a difference—it consists in minor biological variations and not in the germ being specifically distinct."

"Many experiments are now in progress in various parts of the world which will bring additional evidence to bear upon the questions herein discussed. Until these are concluded it is the duty of all to use every precaution which would be required in case the identity of human and bovine tuberculosis were universally conceded. There are few consumers who, after an examination of the facts collected in this report, would knowingly partake of food contaminated with the germs of bovine tuberculosis; still fewer would wish to provide such food for their young and susceptible children. Under these circumstances should not the producer deliver articles of food which in this respect are above reproach?"

"It is reassuring to find that the British Congress on Tuberculosis," before which body Dr. Koch read his paper, in July, 1901, "not only did not accept the doctrine, but declared that 'medical officers of health should continue to use all the powers at their disposal, and relax no effort to prevent the spread of tuberculosis by milk and meat.' In this conclusion your committee most emphatically concurs."

While Dr. Koch's statement seems "too good to be true," still his world wide reputation as a pathologist should entitle his opinion to respectful consideration and should certainly prove to the timid consumer that the free indulgence in milk, butter, cheese and beef is attended with very little, if any, danger of contracting tuberculosis. While it is still an unsettled question whether tuberculosis is reciprocally infectious between men and animals, all scientific men are agreed: First, that human tuberculosis is transmissable from one person to another; and, Second, that bovine tubeculosis is transmissable from one animal to another. There is then absolutely no reason why any farmer or cattle owner should not continue to wage a relentless warfare of extermination of the disease when once he finds he has it in his herd, and every man whose herd is free from contagion should persist in those simple precautionary measures which will most surely insure continued freedom from the dread scourge.

YOUNG ANIMALS MOST SUSCEPTIBLE TO TUBERCULOSIS.

A common, yet, I believe, erroneous opinion seems to prevail that a majority of the cattle suffering with tuberculosis are old. The observations of the Commissioner during the past three years would seem to indicate that a large majority of the worst and most aggravating cases are found in comparatively young animls. The reason for this is not hard to find. It is an exemplification of the law of the "survival of the fittest." Such animals as inherit weak lungs are particularly susceptible to the disease and having the least power of resistance easily become victims to its ravages when exposed to the virus under favorable conditions.

A WORD OF WARNING TO CATTLE BUYERS.

The state law or sanitary regulations of state boards of cattle commissioners or state boards of agriculture of many states require that all persons shipping cattle into those states shall furnish a certificate signed by some competent authority, to the effect that said described cattle are free from tuberculosis as far as may be determined by physical examination and the tuberculin test. In order to comply with these requirements thousands of cattle are annually being tested for parties who wish to ship cattle into the several states. That many are found to respond to the test admits of no doubt.

What becomes of the tuberculous cattle that react? They are not slaughtered and they are not shipped into those states that reuire a clean bill of health. The only markets open to them are in the states like Connecticut that have no restrictions against their entrance and sale.

Farmers buying cows that have been shipped from any of the large cattle markets are advised to be on their guard and to use every precaution to protect their own herds from the introduction of any diseased animals.

FARMERS SHOULD KEEP BETTER COWS.

The farmers of this state are a progressive and intelligent class of men as is evidenced by the many new silos that are being built in every part of the state; by their improved system of feeding and caring for their cattle, and by the larger average annual production of their cows.

The census of 1890 shows the average yield of milk per cow in the state during the year 1889 to have been I,702 quarts, the census of 1900 shows the average to have been 2,276 quarts during the year 1899, an increased annual yield per cow of 574 quarts during the decade.

Computing this at two and one-half cents per quart as the average price which the farmer receives for milk during the year, it is found that the average cow to-day produces during the year $14.35 more than she did ten years ago, or a total increase to the owners of the 120,000 cows in the state of $1,722,000.This rate of increase should be kept up during the present decade and most certainly will be if the farmers of the state will only provide themselves with spring scales and weigh every cow's milk at least two days in every week and with the lead pencil compute the total value of each cow's product for the year. The difference in every herd of any size between the best and the poorest cow will be so striking, if there any good cows in the herd, that the owners will surely weed out their poorest cows for whatever they can get for them and replace them with better ones. They will find indeed that this is a "condition and not a theory" that confronts them.

If, in purchasing cows the farmers of the state will judge them carefully by the following score card used at The Connecticut Agricultural College, they will find it of great assistance to them in their efforts to secure cows that will yield a large flow of milk.

Connecticut Agricultural College,

STORRS, CONNECTICUT.

SCORE CARD

For Judging Dairy Cows.

1.	DIGESTIVE CAPACITY........................	15	....
	Barrel long, and deep through the middle, with well sprung ribs.		
2.	UDDER FORMATION........................	25	....
	1. Udder full in front........................8		
	2. Udder full and well up behind...........8		
	3. Udder of large size and capacity..........4		
	4. Teats well apart, squarely placed and of good and even size.....................5		
3	NERVE SYSTEM................................	15	....
	Well developed nerve system; bright, prominent eye, with quiet and gentle expression; forehead long and broad with dished face; backbone rising well between the shoulder-blades, large, rugged spinal processes, indicating good development of spinal cord, ribs and vertebra wide apart; long tail...........		
4.	MATERNAL ORGANS..........................	5	....
	Wide over hips; roomy pelvis and high pelvis arch.		
5.	MILKING MARKS..............................	10	....
	1. Quantity of flow—milk veins long, crooked, and branching, with large or deep wells.		
	2. Color of milk—skin of deep yellow.		
	3. Quality of flow—Udder showing plenty of substance, but not too meaty.		
6.	INDICATION OF ECONOMIC PRODUCTION...	30	....
	Spare form with an absence of all superfluous flesh, as shown by: clean cut, lean face; long thin neck; light front quarters; sharp withers; brisket fine; crops scant; in hollowing hind quarters with thin, incurved thighs; high, arching flank.		
		100	....

THE TUBERCULIN TEST.

The use of the tuberculin test to diagnose tuberculosis is not resorted to by the Commissioner, as Sec. 4374, General Statutes, Revision 1902, says:

"No animal shall be quarantined that does not give evidence of disease upon competent physical examination;" but as farmers are frequently using the test throughout the state when buying or selling cattle or in efforts to stamp the disease out of their herds when once established, a few words relative to the test and a word of caution concerning its use may not be out of place here.

The tuberculin test when applied by a very careful expert is the only safe and practically sure way to diagnose incipient bovine tuberculosis. The claim that has been made that tuberculin injected into cattle sometimes causes tuberculosis does not seem to have the approval of any scientist or practical dairyman who is familiar with the test. It must be conceded, however, that tuberculin is capable of doing incalculable damage in a herd if improperly administered or if the temperatures are inaccurately read or if the herd is subjected to but a single test.

The philosophy of the test is very simple. The tuberculin is injected into the circulation of the bovine and after a certain length of time if tuberculosis is present in the animal's system the tuberculin will excite the disease into activity, thereby creating more or less systemic disturbance and consequent rise of temperature which is determined by the clinical thermometer in the hands of the veterinarian. If through any error in reading the temperature or if the germs had been so recently taken into the animal's system that the disease was not sufficiently developed to produce fever enough to cause a rise of temperature that would warrant the veterinarian in condemning the animal, and such an animal is allowed to remain in the herd, the mischief has been done. The disease possibly in its very earliest stages or perhaps in an encysted and dormant condition has been started into activity and will under favorable conditions continue its ravages in the animal's system until it reaches the advanced and contagious stage when it becomes a menace to its flockmates and a source of danger in the community.

If, in testing a herd of cows, a single animal responds and the autopsy verifies the diagnosis, it would most certainly be necessary to have the herd re-tested after the lapse of several months to warrant any assurance that every animal in the herd was free from the disease. The tuberculin test should always be accompanied by a thorough physical examination by a skillful veterinarian. The tuberculin test occasionally fails to cause a reaction in an animal suffering with generalized tuberculosis in the advanced stage of the disease. The reason for this is that there is so much toxin or poison present in the animal's system that the small amount of tuberculin that is injected fails to create sufficient fever to cause the necessary rise of temperature to be read by the veterinarian.

They are the very worst cases that the test fails to point out, but fortunately such cases are usually the easiest to diagnose by a competent physical examination.

It should be thoroughly understood that tuberculin is not a curative agent but it is a diagnostic agent that will inform the veterinarian whether tuberculosis is present in the animal's system or not. If the tested animal's temperature rises two degrees or more it is almost assured that the animal has bovine tuberculosis. The test unfortunately gives no indication whether the disease is in an embryonic or advanced stage as the greatest reaction frequently occurs where there is the least disease present in the animal's system.

The United States government inspection of beef conducted under the direction of the highest and most advanced scientific authority on bovine tuberculosis in this country does not reject as unwholesome or dangerous the beef from cattle having incipient tuberculosis, when there is no emaciation noticeable in the animal and where the disease is "localized to a single organ in small areas; that is to say, if there are only two or three small tubercles in a lymphatic gland or in one lung or along the intestinal canal."

It is the consensus of opinion among scientists that only a small percentage of tuberculous animals have the disease in a contagious form. Cows having tuberculous udders or suffering with advanced generalized tuberculosis are a menace not only to their flockmates and the person who cares for them and milks them, but they unquestionably yield milk that contains the dread tubercle bacilli in large numbers. That the owner and his herd and the general public who consume meat and milk and who own cattle should be protected against the dire effects that are possible to result from permitting such animals to live indefinitely is a proposition so simple and so self evident as to require no argument to convince the public of its truth.

Admitting what is unquestionably true that the speediest and the surest way to eliminate bovine tuberculosis from the state and the country would be to have every bovine subjected to the tuberculin test and every animal showing a reaction condemned and destroyed, it is equally true that such a course would cause untold hardships and loss to the farmer and the consumer, and unlimited expense to the state and to the nation by consigning to the grave many thousands of cattle that otherwise would be a source of profit to their owners by furnishing a generous supply of milk and finally yielding up their innocent and harmless lives to provide wholesome meat for our own tables.

WEAK POINTS IN THE LAW.

While your Commissioner would not think for a moment of recommending the indiscriminate use of the tuberculin test, his observations and experience during the three and one-half years he has served the state as Commissioner on Domestic Animals leads him to suggest that it would be wisdom on the part of the General Assembly to amend the law by giving to the Commissioner discretionary power and authority to use the tuberculin test with the consent of the owners in herds where physical examinations have condemned one or more animals, the post mortem examinations of which have proved them to have been suffering with advanced generalized tuberculosis in an unquestionably contagious form.

The present law is weak in not giving the commissioner authority to require the disinfection of even the stall and manger that have been occupied by an animal suffering with contagious tuberculosis.

If, after an animal has been condemned and paid for by the state, a healthy animal is immediately placed in the vacant stall and kept there it is almost certain to contract the disease.

Whenever the Commissioner has condemned an animal suffering with tuberculosis he has endeavored to impress this fact on the mind of the owner and explain to him the importance and necessity of thoroughly cleansing and disinfecting the stall and manger.

It is to be hoped that a single experience of selling diseased cattle to the state will be sufficient to convince the most ignorant and skeptical that it is at best a losing business and that for his own protection it will be wisdom and economy for him to take the simple and inexpensive precautionary measures recommended.

Under the law of this state the commissioner has authority to quarantine only such animals as give evidence of disease upon competent physical examination.

If a highly contagious disease such as pleura-pneumonia should make its appearance in a single animal in a herd of cows in this state, this limitation in the authority of the commissioner would permit him to quarantine only the animal that was actually affected, notwithstanding every animal in that herd had been exposed to the contagion and were likely to be sold and carry the disease to every section of the state. In the face of such an emergency as this if the commissioner is to accomplish anything in preventing the spread of the disease, he should have the authority to quarantine not only the diseased animal itself but the entire herd in which it is found and every other animal that he has reason to believe has been exposed to the disease.

While a great deal can be accomplished by preventing the spread of contagious disease after it is brought into the state it would be much better and safer to prevent if possible its introduction into the state in the first place. In order to do this it would be necessary that the governor or the commissioner should be vested with the necessary authority to prevent cattle or other domestic animals being brought into this state from any other state in which a highly contagious disease was known to be prevalent among such animals.

SUMMARY OF RECOMMENDATIONS TO THE GENERAL ASSEMBLY.

Amend the law so as to give the Commissioner additional authority as follows:

To quarantine all animals that have been exposed to a disease of a highly contagious character.

To prevent domestic animals coming into this state from a state in which a highly contagious disease is known to exist among such animals.

To order the disinfection of the stall and manger that have been occupied by an animal that was known to have been afflicted with a contagious disease.

To use tuberculin with the consent of the owner if an animal previously condemned by him in a herd had been found affected with advanced tuberculosis.

RECOMMENDATIONS.

We cannot close this report without condensing the foregoing remarks into the following suggestions and advice to farmers and herdsmen:

Admit as much sunlight as possible into the stable.

Whitewash the walls, ceilings, and stanchious at least once every year.

Make every cow in the herd occupy the same stall every time.

Use common sense about turning cows out from a warm barn to stay out in inclement weather.

When you discover symptoms of tuberculosis in any animal in your herd promptly call a veterinarian or report the case to the commissioner and have the animal examined.

Thoroughly cleanse and disinfect after removing a tuberculosis animal

In closing this report I desire to express my appreciation of the courtesy and co-operation which have so universally been extended to me by all with whom I have had official relations.

Respectfully submitted,

HEMAN O. AVERILL,

Commissioner on Domestic Animals.

APPENDIX.

The following forms are used by the Commissioner in carrying on the work of this department:

Form 1.

State of Connecticut.

Cattle Commissioner's Office.

General Statutes Relating to Domestic Animals.

Revision of 1902.

Section 4372. The governor shall biennially appoint a commissioner on domestic animals, who shall be a practical farmer and stock breeder of at least ten years' experience. Said commissioner shall hold his office for two years from and after the date of his appointment, and he may, with the approval of the governor, employ such assistants as may be necessary, and any expense so incurred shall be paid by the state upon the approval of the governor. Said commissioner shall annually report to the governor concerning his acts and expenses.

Section 4373. When any person shall bring any cattle from adjoining state into this state he shall, within six days thereafter, notify the commissioner on domestic animals, and such notice shall state the number and sex of such cattle and their actual physical condition. Every person who shall violate any provision of this section shall be fined not more than fifty dollars.

Sec. 4374. Said commissioner may quarantine all animals infected with a contagious disease and prohibit the sale of all the products thereof; but no animal shall be quarantined that does not give evidence of disease upon competent physical examination, and no animal shall be quarantined for more than thirty days.

Sec. 4375. If said commissioner finds that it will be for the good of the state, he may cause said animals so quarantined to be killed, but no animal so quarantined shall be killed until its value has been adjudged by the owner and the commissioner, and if they cannot agree each shall choose a representative who shall choose a third, and the three so chosen shall determine the value of the animal, and the value thus determined shall, when approved by the commissioner, be paid to said owner by the state upon the order of the comptroller; but no animal whose physical condition indicates that it is of no real value, and no animal that has not been in this state during the six months next prior to its quarantine, shall be paid for by the state. This section shall not apply to horses.

Sec. 4376. The commissioner shall, at the request of the owner of any domestic animal in this state, inspect the same by physical examination, and if he find it free from disease dangerous to the public health he shall so certify to the owner.

Sec. 4377. The selectmen in each town shall report to the commissioner any animals infected with contagious disease.

Sec. 2591. Every person who shall knowingly sell, or expose for sale, milk, or any product of milk, from a cow which shall have been adjudged by the commissioner of domestic animals affected with tuberculosis or other blood disease shall be fined not more than seven dollars, or imprisoned not more than thirty days, or both.

Form 2.

State of Connecticut,

Cattle Commissioner's Office,

HEMAN O. AVERILL,
COMMISSIONER.

Room 54, Capitol, Hartford.

SEC. 4373 OF THE GENERAL STATUTES. *Revision 1902.* When any person shall bring any cattle from an adjoining state into this state he shall, within six days thereafter, notify the commissioner on domestic animals, and such notice shall state the number and sex of such cattle and their actual physical condition. Every person who shall violate any provision of this section shall be fined not more than fifty dollars.

.... 190.....

....Post Office,

Commissioner on Domestic Animals,
Hartford, Conn.

Dear Sir: In compliance with the law I hereby notify you that on the .... day of ...., 190 , I brought into the town of ....from the State of ...., the following described cattle, to wit:

..................Cows, ...Heifers, ...Oxen,

..................Steers, ...Bulls, ...Calves,

Total number ...., and that their physical condition is

....

....

Blanks and envelopes will be furnished on application to this office.

Form 3.

State of Connecticut.

COMMISSIONER ON DOMESTIC ANIMALS.

Adjudged Value of Cattle to be Killed.

Whereas, *the Commissioner on Domestic Animals for the State of Connecticut has this day made a physical examination of certain cattle said to be owned by* .... *of the town of* ...., *and Whereas, it appears to said commissioner that it would be for the good of the State that the following animals should be destroyed, to wit:* ....*Cows,* ....*Heifers,* ....*Oxen,* ....*Steers,* ....*Bulls,* ....*Calves. Total number,*..............................

Now Therefore, *we, the said Commissioner and*.., *the said owner, do hereby adjudge the value of said animals, to be as follows: Cows, value,* $............; *Heifers, value,* $............; *Oxen, value,* $............; *Steers, value,* $............; *Calves, valne,* $............; *Bulls value,* $............ *Total value,* $............ *The said owner hereby agrees to bury said animals as soon as killed, and comply with all requirements of publtc Health Officer in said town at his expense. And the said Commissioner agrees to approve the above total value to the Comptroller after said animals have been killed.*

.... } *Commissioner on Domestic Animals.*

.... } *Owner.*

Dated at..., *this*..................*day of*.........................., *190* .

Form 4.

...................................., *Conn.,* .... *190* .

State of Connecticut

To .... *Dr.*

To cattle killed by order of the Commissioner on Domestic Animals, on the .... *day of* ...., *190* , *to wit:*

Cows, valued $..............; *Heifers, valued* $..............; *Oxen, valued* $..............;

Steers, valued $..............; *Calves, valued* $..............; *Bulls, valued* $..............

Total Value, $..................

I hereby certify that the above named animals have been owned and kept in this State six months continuously, prior to the time they were killed

.... *Owner.*

Subscribed and sworn to before me this .... *day of* ...., *190* ,

.... *Notary Public.*

Approved

....

Commissioner.

Received Payment, ... *Owner.*

State of Connecticut

PUBLIC DOCUMENT No. 29

ANNUAL REPORT OF THE TRUSTEES

OF THE

CONNECTICUT AGRICULTURAL COLLEGE

AT

STORRS, CONN.

For the period embraced within the first day of December, 1901, and November 30, 1902

PRINTED BY ORDER OF THE LEGISLATURE

Hartford Press
The Case, Lockwood & Brainard Company
1902

ANNUAL REPORTS OF COLLEGE OFFICERS

THE

CONNECTICUT AGRICULTURAL COLLEGE

EXECUTIVE COMMITTEE

GEORGE A. HOPSON
GEORGE S. PALMER
B. C. PATTERSON

FARM COMMITTEE

WILLIAM E. SIMONDS
*WILLIAM D. HOLMAN
†WILLIAM H. HALL
B. C. PATTERSON

COMMITTEE ON HORTICULTURE

GEORGE A. HOPSON
MARTIN M. FRISBIE
ALFRED G. GULLEY

AUDITORS OF ACCOUNTS

GEORGE A. HOPSON
MARTIN M. FRISBIE

SECRETARY OF THE BOARD

GEORGE A. HOPSON

TREASURER

*WILLIAM D. HOLMAN
†WILLIAM H. HALL

---

* Died March 21, 1902.

† Appointed by the Board of Trustees to fill the vacancy occasioned by Mr. Holman's death.

To His Excellency GEORGE P. MCLEAN,

Governor of the State of Connecticut:

I have the honor to submit herewith the Report of the Board of Trustees of The Connecticut Agricultural College for the fiscal year ended September 30, and for the year in other matters ended November 30, 1902.

Very respectfully,

GEORGE A. HOPSON,

Secretary of the Board of Trustees.

REPORT OF THE PRESIDENT.

To the Trustees of the Connecticut Agricultural College:

It is gratifying to be able to record a most successful year in the development and work of the College.

From various causes, but principally, it is thought, from the reorganization of our courses of study and the additions to them which you have been pleased to sanction, the usefulness of the College has been increased and its influence greatly broadened. In addition to our old students, forty-four new students presented themselves for enrollment on the opening of the present term, and during the calendar year covered by this report our students in the College proper, in the Winter School and in the Summer School, have reached the unprecedented number of one hundred and fifty-two.

The advantages we now offer and the names of those who have come here for our assistance will be found fully set forth in the catalogue for 1902-1903, which forms part of this annual record.

Accompanying the catalogue, you will please find the reports of individual College officers, including the Treasurer's report and the certificate of the State Auditors approving it.

At a later date the needs of the Institution for the ensuing two years will be presented for your consideration and action, in anticipation of the meeting of the next General Assembly.

The activities of the Faculty have not been confined to their College duties the past year, though in their several reports it is chiefly of these that they speak. Interesting and instructive exhibits have been made at various agricultural fairs, and our men have responded to an increasing number of calls for lectures and addresses at agricultural meetings both in and out of the State. And the work of the Storrs Experiment Station, now located here, is arousing the interest and enlisting the hearty coöperation of our scientific men, thanks to the wise directorship of our new Professor of Agriculture.

The past year will always be full of the pleasantest memories; for I am sure you will permit me to say that little or nothing of all that has been accomplished in advancing the interests of the College could have been done but for your kindly counsel and unfailing support, coupled with the hearty loyalty and untiring labors of our teaching and administrative force.

Only one dark shadow has fallen across our path, the death of your friend and colleague, and our honored superior officer, Treasurer William D. Holman, whose modesty, courtesy, and broad intelligence will long be remembered among us.

Very respectfully submitted,
RUFUS WHITTAKER STIMSON.

REPORT OF B. F. KOONS, Ph.D.,

Professor of Natural History and Curator of the Museum.

To Rufus Whittaker Stimson, President:

It has been my privilege to give instruction the past year in the following subjects: embryology, zoölogy, entomology, ornithology, geology, mineralogy, and physical geography.

During the winter term I gave the second year class a course of lectures on the embryology of the chick, accompanied by demonstrations, following the development through each twenty-four hours, from the beginning of the incubation of the egg up to the fully formed chick.

During the same term the different groups of special students had a course in practical bee-keeping, a course in economic entomology, and a course in elementary zoölogy.

During the spring term the third year class had a course of lectures and laboratory work upon the principal groups of the animal kingdom.

During the summer term the incoming fourth year class took a course in entomology, including lectures, laboratory work and collections, with the study of the habits, particularly, of the destructive insect pests and the methods of checking their ravages. This term, also, the class took a course in ornithology,— our common birds, their food habits and economical relations to man, with identification of species, etc. And, during the same term, the teachers here for the Summer School had two extensive courses of lectures, one upon entomology, the other upon ornithology.

In the fall term the fourth year class, with the aid of Dana's Revised Text-book of Geology, studied the general principles of geology, including the more common minerals, origin of soils, coal, peat, causes of volcanoes, earthquakes, and glaciers. The same term I had a special class doing more extensive work in the same subject.

Finally, during the fall term I had another special class in physical geography, using Davis's admirable text-book.

Respectfully submitted,

B. F. KOONS.

REPORT OF L. A. CLINTON, M.S.,

Professor of Agriculture.

To Rufus Whittaker Stimson, President:

As my duties as Professor of Agriculture began September 1st, I have but little to report in the way of work accomplished.

The Class-room instruction in agriculture which comes under my immediate charge is, in the fall term, Agricultural Physics and Fertilizers; in the winter term, Rural Economics; and, in the spring term, Farm Crops. The work in Agricultural Physics and Fertilizers is given to third year students, while the other two subjects mentioned are in the fourth year. Nearly all of the instruction is given by lectures, various books being used for reference.

Laboratory work in Agriculture begins in the spring term of the second year, one afternoon per week being required. This work comes before any class-room instruction in the subject has been given. At the end of the second year the students elect their course for the succeeding two years. The object in putting laboratory work in Agriculture in this year was that all students might become familiar with some of the practical farm operations. While not much time is required, yet it is sufficient to teach something of the art of Agriculture. Many of the students who will enter here have had no experience in practical farm operations, and it was thought that in selecting their course for the next two years they could select more intelligently after having had some laboratory work in Agriculture.

Laboratory work in the third year in the fall term is in connection with the class-room instruction in Agricultural Physics. When the room which is to be equipped as a Soil Physics laboratory is ready, it will greatly add to the efficiency of this work. The College Farm furnishes excellent opportunity to study soil formation and the effect of soil manipulation, and will always be our main laboratory for work in Agriculture. During the winter term the third year men will spend one afternoon per week in laboratory work. This will consist of testing seeds for vitality, purity, and quality, and the identification of weed and agricultural seeds. In addition to this work, instruction will be given in various practical farm operations, as rope splicing, care of farm tools, arrangement of farm buildings, etc. In the spring of the fourth year, laboratory work will be given in connection with the class-room instruction in Farm Crops. The laboratory work, as far as possible, will supplement the class-room work. Illustrations will be given of the various principles which are involved in growing crops. Soil preparation, fertilization, seeding, and cultivation will be illustrated by practical work in the field.

The College Farm is hilly, rocky, and generally fertile. It is typical of the farms throughout a large section of the State. While it does not furnish ideal conditions for experimental purposes, yet it serves well for purposes of illustration. Many fields at present are unimproved and unsightly. These should be brought under cultivation as fast as practicable. Even though the cost of improvements may be more than the value of the land for agricultural purposes, this should not deter us from making them. We have the land, it is subject to inspection, and we should make it presentable and productive. In this way we can make the College Farm best serve its true purpose, namely, that of a laboratory for instruction in agricultural methods.

Respectfully submitted,

L. A. CLINTON.

REPORT OF A. G. GULLEY, M.S.,

Professor of Horticulture.

To Rufus Whittaker Stimson, President:

Very few changes in the methods of the horticultural department have been made during the year. The recent division of the courses of study has made the classes in horticulture smaller than before. It will need some time to determine if the change is favorable.

Mention was made in the report of last year of the need of a laboratory for the department. This need grows much more urgent with the prospect of students in advanced work. There is at present no place where much of such work can be carried on. With this building must also be considered a new greenhouse for specimen plants and instruction in floriculture. Our present house is too small for such purposes, being fully occupied at present. More than that, the old house will very soon have to be largely replaced, as ten years is about the limit of life of such a building. Another call for room in both buildings mentioned is that of the experiment station recently established at this place.

The results of continued work in care of orchards were well demonstrated by the great crop borne the past season by the College trees, the yield being noticeably heavy, even for this year of full crops of fruit. The value of the processes used in defense against insects and diseases was evident to all who visited the orchards while in fruit. The great value of thinning apples in full bearing years was plainly shown. For the first time, nearly all varieties in the trial orchard produced fruit, and the value of some of the newer kinds was thus partly determined. This was particularly the case among the peaches, of which over forty kinds were fruited. From this crop, and by the aid of the cold storage plant recently completed, the department is testing the keeping qualities of many kinds, a matter now of much importance. Of this the result will be published later.

This department, in connection with the agricultural, made large displays of its products at various local fairs during the fall which attracted much attention. At the fruit show of the State Pomological Society it placed upon the tables a collection of over 125 varieties, probably the most extensive exhibit ever shown in Connecticut.

The experiment station, referred to earlier in this report, will add very much to the importance of the department, both in amount of labor and value of results. The material already prepared will permit of extended operations at once, and make some of the results the sooner available. This branch of the department will also be another valuable source of information for the students.

To my assistants, Mr. Walter A. Warren and Mr. Geo. H. Hollister, I am greatly indebted for relief from much of the detail work and for their help in the general operations of the department.

All of which is respectfully submitted.

A. G. GULLEY.

REPORT OF CHARLES LEWIS BEACH, B.Agr., B.S., Professor of Dairying.

To Rufus Whittaker Stimson, President:

My work of instruction is confined to the following subjects: Feeding of Farm Animals, History of Dairy Breeds and Judging of Dairy Cattle, Animal Breeding, and Dairying. A synopsis of the ground covered in each study may be found in the catalogue.

Dairy School.— The short course in dairying is designed to meet the wants of young men expecting to engage in private dairying or creamery practice. This course begins the first week in January and continues twelve weeks. No entrance examinations are required of these students, and the lowest age limit is placed at sixteen years. An outline of this course, also, may be found in the catalogue.

My work with these students includes the subjects of Feeding Farm Animals, Dairy Breeds, Breeding of Animals, and Dairying. The class work and practicums outlined for regular students will apply to work done by these students.

The time given to each subject is somewhat shorter, and the subject matter more condensed.

In addition to these subjects, Dairy Bacteriology, Diseases of the Dairy Cow, Crops and Crop Production, Farm Accounts, and Construction of Barns and Silos, are presented by other instructors.

Dairy Herd.— The herd now numbers about fifty head of cows and young cattle. Two Advanced Registry Holstein cows have recently been purchased from the herd of Averill & Gregory of Syracuse, New York; two imported Ayrshire cows from the herd of Robert Redford of St. Anne de Bellevue, Quebec; and two Guernseys from the herd of E. T. Gill of Haddonfield, N. J.

Creamery.— During the past year a cold storage plant was installed in the dairy building by the A. H. Barber Mfg. Co. of Chicago. This plant has been in operation since June, and has given the best of satisfaction. Brine from this plant is used to cool the milk, cream, and storage boxes. Some of the refrigerator space is used by other departments.

The creamery works up the product of the College herd, and in addition the product of the herd of Messrs. C. H. Savage and A. M. Grant. This has supplied the Boarding Club and families of the Faculty with butter, cream, and milk, and, during the past year, an additional surplus of only five hundred pounds of butter.

Experiment Station.— The removal of the experiment station from Middletown to the College, and the assignment of the head of this department to a position upon the staff, calls upon, and will enable, the dairy department to carry on some experimental work.

The following experiments are under way: Feeding Milk Substitutes to Calves; The Food Value of Milk containing various per cents of Fat; The Efficiency of Rations containing more or less Protein for Milk Production.

Needs of the Department.— This department is greatly in need of a better lighted, better ventilated, and better equipped dairy barn.

Respectfully submitted,
C. L. BEACH.

REPORT OF E. H. LEHNERT, B. S., D.V.S.,

Professor of Veterinary Science, Physiology, and Animal Husbandry.

To Rufus Whittaker Stimson, President:

I herewith present the report of the department of Veterinary Science, Physiology, and Animal Husbandry for the year ending September 30, 1902.

Veterinary Science.— Since making my last report, changes in the College curriculum have been made which have materially altered the course in veterinary science for the regular four year students. This subject is taught during the fourth year to those students who elect Agriculture; five hours a week during the fall term and three hours a week during the winter are devoted to the work. The course has been shortened to such an extent that the work of necessity is of an elementary nature. The time during the fall term is taken up with a course in Veterinary Anatomy and Physiology, an outline of General Pathology and Materia Medica, with Dissection afternoons and evenings after the Thanksgiving recess. Diseases and treatment receive attention during the winter term.

Instruction in this subject is given by means of lectures, supplemented by demonstrations with models and specimens — of which we have a very good equipment — also by operations on living animals. It is intended, so far as possible with the limited time at our disposal, to give the students a thorough practical knowledge of the common diseases and accidents of farm animals, with the principles of nursing and the administration of the proper medicines. They are given every opportunity to witness ordinary operations and assist when possible. As soon as suitable quarters are available for this department, it is intended to establish a Free Clinic, which will be of inestimable value to the students and at the same time an accommodation to the farmers in this vicinity.

For the students in the B. S. course who elect this subject we are allowed five hours per week for a full year. This enables us to go more deeply into the different branches of the subject and add lectures on Stable Construction, including ventilation, drainage, etc., with work in Pathogenic Bacteriology in the spring term.

Physiology.— This subject is given during the spring term of the third year to all students. A standard text-book is used and is supplemented by lectures and practical work in the laboratory, illustrating the principles and processes of physiology, *i. e.*, digestion, power of muscles, etc. A short time is devoted to the study of normal body tissues under the microscope (Histology), and dissections of the smaller animals.

The time given to this subject is four hours in the class-room and one afternoon in the laboratory each week. For class-room work we have models, including those of the ear and the eye, and we also possess an articulated human skeleton and a Dissecting Manikin.

Animal Husbandry (Breeds).— To the study of Breeds we devote three hours a week in the class-room, and two afternoons a week are utilized for practical work. This subject is taught the third year men of the Agricultural courses during the fall term. Our work is accomplished by the use of a text-book in the class-room, supplemented by actual study of representative animals of the different breeds, comparing the specimen at hand with the ideal of type. All species of farm animals receive attention,— horses, cattle, sheep, and swine. It is our endeavor to bring before the class the best specimens possible, hence it happens occasionally that it is necessary to visit farms in other parts of the State.

For practical work the student is required to score different animals from the standpoint of the judge. This work makes him familiar with the various breeds of horses, cattle, etc., and gives him a knowledge of the conditions to which each is best suited.

Respectfully submitted,
E. H. LEHNERT.

REPORT OF C. A. WHEELER, B.A.,
Professor of Mathematics.

To Rufus Whittaker Stimson, President:

My instruction covers all courses in mathematics, except Arithmetic, which is taught by Professor Yerex; also Surveying and Free-hand Drawing. The courses, as an examination of the catalogue will show, are about the same as they were last year. The introduction of elective schedules into third year work has made Solid Geometry a required study for General Science students only. This course is given during the fall term. For the rest of the year the mathematical work is identical in the two schedules.

A new course for agricultural and horticultural students of the fourth year was planned and given during the spring term of this year (1902) and will be a part of these courses hereafter. It appears under the heading Farm Engineering. As few and as simple instruments as possible are used, the course being thoroughly practical. Some of the subjects considered are the construction and improvement of country roads, drainage of fields and drainage of cellars, with estimates of cost.

The incoming first year class is so large that my classrooms are crowded. For the recitations in Algebra the seating capacity of my room can be sufficiently increased, but for the work in Free-hand Drawing the basement of the Old Dormitory is too small. Since this subject is, and is likely to remain, a part of our first year course, it is desirable that a room of ample size and with proper light be provided. Drawing from casts is now impracticable, owing to our crowded condition and the demands upon the room for other purposes.

Our library of pure mathematics, which in previous years has been comparatively small and has consisted chiefly of textbooks contributed by their publishers, has been substantially increased recently by the purchase of some of the best and most helpful of mathematical works. A good library in this department, as well as in other lines, is essential. There are always some students who are especially interested in mathematical subjects in their higher branches, and the inspiration and help which good books afford the teacher are by no means inconsiderable.

Respectfully submitted,
CHARLES AUGUSTUS WHEELER.

REPORT OF H. S. PATTERSON,

Professor of Shop Work and Mechanical Drawing.

To Rufus Whittaker Stimson, President:

In this my eighth annual report I will not weary you with a long recital of the results or needs of the mechanical department. I would again affirm that a large part of the wealth and prestige of our commonwealth is the result of the inventive genius and mechanical skill of our people. If this prestige is to be maintained, the importance of facilities for instruction is evident. During the past year an unusual amount of labor and materials have been applied to minor improvements, changes and repairs, and the year closes with none of the large improvements which should mark our progress. Instruction in this department has been diverted to the needs of Agriculture — so that the farmers of Connecticut need have no fear that any part of the funds so generously furnished by our government for the education of the industrial classes will be applied to any line of industry except that of tilling the soil.

Respectfully submitted,

H. S. PATTERSON.

REPORT OF H. R. MONTEITH, B.A.,

Professor of History, Civics, Latin, and English.

To Rufus Whittaker Stimson, President:

The work of the English department as carried on during the year just ended calls for little comment. The ground covered was essentially that laid out under your own supervision, when professor of English. The character of our work in this department and the method of instruction are fairly determined by the experience of previous years and by the special needs of our students. There appears, therefore, little need of essential change, at least for the present. The recent strengthening of this department in the first and second years will, no doubt, enable us hereafter to accomplish more in the third and fourth years. With the remark that the fourth year work of last year may have suffered somewhat from the sudden change of instructors at the beginning of the winter term, I pass on to the subject of History. This, perhaps, requires a word of explanation.

The study of History is intended to be fairly complete for those students electing the courses containing it. At the same time it is intended that those who elect the more purely technical courses shall have the opportunity to gain a fair understanding of this most interesting and profitable subject. It has, therefore, been deemed wise to transfer the study of Civics from the third to the first year. Although this compels work of a more elementary character in Civics, yet, accompanied and enforced as it is by the parallel study of History, the general result, especially in the latter branch, seems to justify the change.

It will be noted in the catalogue that the study of Civics, two periods per week, is accompanied by the study, during the first twenty weeks, of Greek History, the same number of periods. Greek History was selected mainly for the purpose of illustrating the development of certain institutions to their finality, and for this purpose, and to accustom the student to the study of the constitutional side of History, no better example exists.

It is intended that the student shall reach the study of the United States at a time when he shall have reached some maturity of judgment, and something like a mastery of method in historical research. It is hoped that he will thus begin to understand and appreciate the really simple, though apparently complex, system embodied in our government; and that he will be prepared to take an intelligent interest in the questions of the day. Such study, with the enlarged course in Economics (which I am heartily glad to see provided for), will go far toward making our students useful citizens in their own towns, and hence useful citizens in the State and Nation.

Respectfully submitted,

H. R. MONTEITH.

REPORT OF C. A. MESERVE, B.S., Ph.D.,

Professor of Chemistry and Military Science.

To Rufus Whittaker Stimson, President:

I have the honor of presenting you my second annual report.

Chemistry.— During the past year there have been classes in general inorganic chemistry, qualitative analysis and quantitative analysis under my instruction. The third year students also during one term had instruction and laboratory work in Physics.

The equipment of the laboratory is practically the same as when I first took charge of it. Among the few minor changes and additions may be mentioned the following: Two of the work benches have been equipped with water and gas so that distillations may now be carried on without regard to the ordinary sinks. The high partitions between the work benches have been removed, giving the students much better light. A copper tank holding 200 gallons has been placed in one corner of the laboratory, and over it, with all connections of iron piping so that it may be left in operation over night without any danger, a large size Jewell Still has been bolted to the wall. The gas plant has been improved by the addition of a Walworth Mixer.

Military Department.— The instruction in this department has been mainly practical, although written exercises have been held at stated intervals during the year. A feature new to this institution, and I think to most institutions of our class, has been the instruction and practice in outpost and in advance and rear guard duties. We could only use " indicated " forces, but the work was not only highly interesting, but very instructive. I will describe one of these exercises very briefly.

College Hill was supposed to cover the entrance to a valley through which was a railroad, and behind which was an army advancing to fortify this hill. On the evening of this exercise the hill had been occupied by the advance guard of this army, and several strong outposts had been posted. They were supported by the main body of this advance guard, who had occupied two positions some distance apart on the crest of the hill. The advance guard of the enemy had been sent out several hours before this, with the information that the hill had been occupied. Their instructions were to feel out the entire position of their opponents' forces, cause as much confusion and damage as possible, and drive them back if they could obtain the advantage over them due to a surprise before they were themselves discovered and driven back.

More of these exercises will be undertaken in the future, for they not only serve as valuable training for the company officers, who are pitted against each other, but also arouse interest and enthusiasm among the cadets. This was well shown by a petition made out by the cadets asking that they be allowed a half holiday on Lincoln's birthday, provided that they spend it in military exercises.

Respectfully submitted,
CHARLES A. MESERVE.

REPORT OF ALBERTA TULLIA THOMAS,

Professor of Domestic Science and Art, and Lady Principal.

To Rufus Whittaker Stimson, President:

I take pleasure in making to you the following reports:

I. *Care of Grove Cottage.*— During the past year as much as possible has been done to make the cottage homelike. Inexpensive muslin and net curtains have been placed at the windows of the living rooms. Cushions for the benches and window seats, sofa pillows and table covers have been made. These, together with donations from the horticultural department in the shape of potted plants and window boxes, aid greatly in carrying out this idea. A thorough daily inspection is made of each student's room, and a high standard of cleanliness and order is thereby maintained.

II. *Care of the Young Ladies.*— The young ladies entrusted to our care have such rules and restrictions placed upon them as will tend to foster in them a due regard for the conventionalities and proprieties of life, maintain the order and dignity of the College, and make the halls and rooms sufficiently quiet for hard study.

In the various social functions at the Cottage, such responsibilities are required of the young ladies as will have a tendency to make them thoughtful, gracious hostesses in their homes, as well as to increase the pleasures of our life here.

No sickness worthy of mention has occurred during the past year, except the various complications usually arising from vaccination. A well stocked medicine closet forms the necessary ounce of prevention.

III. *Domestic Science and Art.*— The aim and scope of the work in this department is described in detail in the accompanying catalogue, and the time allotted to it definitely specified in Schedules 8, 9, and 10. Courses 8 and 9 fit the High and Country School graduate for housekeeping and home-making in two and four years respectively. These courses include instruction in hand and machine sewing, dressmaking, cookery, food values, waitress work, laundry, hygiene, emergencies, home nursing, invalid diet, sanitation, household economy, and accounts. In addition to this the graduate may elect to prepare for the teaching of Domestic Science by taking the following studies: Production and Manufacture of Foods; Chemistry of Foods; Food Experimentation; Psychology; Theory and Practice of Teaching. This preparation is described in Course 10, and covers two years.

The above courses have been followed for nearly a year, in every instance where the student was prepared to take the work as scheduled. Last spring the senior class made their graduating dresses.

The Domestic Science laboratory is located in the basement of Grove Cottage. This location is not ideal, and the entrance to it is objectionable. Such a laboratory should be on the top floor, and in a wing as far removed from the rest of the rooms as possible. However, the floor, walls, and ceiling of the present laboratory have been painted and the sinks enameled, and it has thus been made much more attractive and cleanly than formerly. Blue flame oil and gasoline stoves have been added to our equipment, greatly increasing the facilities for individual class-work and laboratory methods.

Respectfully submitted,
ALBERTA TULLIA THOMAS.

REPORT OF E. O. SMITH, B.S.,
Assistant Professor of English and Economics.

To Rufus Whittaker Stimson, President:

During the College year of 1901-1902 my class-room work was with the first year students, in English. This year two additional courses have fallen to me; namely, second year English, and economics.

The English of the first year is a course in grammar. It may be thought that, since an entrance examination in grammar is required, there can be no need of giving further time to the subject. But the knowledge of grammar that we demand for entrance can be only the average acquirement in the district schools of the State. This is a modicum that must be increased materially before courses in higher English can be undertaken with profit; and the first year course in English is designed to furnish the necessary increment.

The second year course covers a study of punctuation, the sentence, the paragraph, and figures of speech, and includes exercises in composition running through the year. It is expected to lead up to the further study of rhetoric and to work in argumentation in the third year.

The time devoted to economics has been fixed at two hours a week for third year students in all courses. This seems a meager allowance to an important subject; but the schedules of the courses in agriculture are full, and an opportunity for continued study in this department is offered in the form of an elective course.

A word as to outdoor athletics, which are in my charge. During the year the athletic field has been graded and put in good playing condition, and new shower baths and a locker room have added greatly to the comfort of those engaged in out-of-door sports. Creditable teams in baseball and football have been organized. With our present number of students, their requirements of self-support, and the exacting schedules in force, it is not to be expected that teams of great efficiency will be developed. The benefits and pleasure of athletics, however, lie in the sports themselves, and are not dependent upon winning games from rival organizations. The members of the teams have enjoyed playing, have strengthened mind and body by contest, and have shown a satisfactory development of team play.

Respectfully submitted,

EDWIN O. SMITH.

REPORT OF E. A. WHITE, B.S.,

Assistant Professor of Botany, Forestry, and Landscape Architecture.

To Rufus Whittaker Stimson, President:

I take pleasure in submitting to you a report of the work of the departments under my direction since I assumed charge last July.

During the month of July lectures on Botany were delivered before the teachers attending the Summer School. Special attention was given to structural and systematic botany, as it was thought that these topics would best prepare the teachers for their work in nature study in the public schools. Thirty-two teachers attended these lectures, and the interest manifested was very satisfactory. It is the intention to offer a similar course during the coming summer; also an advanced course will be scheduled to benefit those who attended the lectures of the past summer. During the regular students' summer term of six weeks, this department gave instruction to the incoming fourth year class in agricultural grasses and forage crops, because of the absence of instructors in the agricultural department.

The work of the second year class during the fall term has included the study of the fundamental principles of botany, both structural and physiological, and this will prepare them for the study of systematic botany, which they will take up during the winter and spring terms.

One member of the third year class has taken botany in the elective course, and instruction has been given in advanced analytical and microscopical work.

The work in forestry has demanded much time. One candidate for the degree of Bachelor of Science has elected forestry as his major subject, and a course has been scheduled, covering two years, similar to those given by the several forestry schools in the United States. It is the intention to offer such instruction in this subject that men completing the fifth and sixth year work here may be ably fitted to fill positions on the State or the United States government preserves, in the woodlands of private individuals or corporations, or to enter any of the special forestry schools, complete the scheduled curriculum, and receive in one year the degree of Master of Forestry, which most of these schools offer.

Aside from the theoretical work of the class-room, as much practical work as possible is given in silvicultural operations in the forest and forest nursery. Work in the propagation of forest trees has already been taken up, and this work will be followed later in the course by work in transplanting and thinning. The forest lands belonging to the College offer admirable facilities for this work.

Special lectures in forestry are scheduled for the fourth year and short course students during the coming winter term.

The subject of landscape architecture, in its relation to the beautifying of the farm dwelling and its surroundings, is a topic of interest to the rural population of the State, and it is the intention to give every student a thorough knowledge of the principles involved in beautifying the home grounds, the village green, or town parks and cemeteries. With this point in view, it is hoped that sufficient funds may be available for making our campus an object lesson to our students in landscape art.

Considerable work has been accomplished about the grounds during the past year. A much needed athletic field has been drained and graded. This is now used for the athletic sports of the students and also by the military company for drill.

Several unsightly areas, which have been prominent features detrimental to the beauty of the campus, have been cleared of rocks, graded, and brought into suitable condition for lawn mowing. Drives have been graded and graveled, or covered with broken stone; and arrangements have been made by which the water from heavy rains may be disposed of without washing out the drives already constructed. Planting of trees and shrubs about the lawns and buildings is now in progress.

The need of a laboratory specially designed for botanical teaching is greatly in evidence. At present the room assigned for this work is used also by the professors of entomology, geology, and zoölogy, and of mechanical drawing, to the great inconvenience of all. Appropriations are also needed for the purchase of nursery stock, for both landscape and forestry work.

Respectfully submitted,

E. A. WHITE.

REPORT OF W. A. STOCKING, Jr., B.S.A.,

Instructor of Agriculture and Physics.

To Rufus Whittaker Stimson, President:

Agricultural Bacteriology.— Last year the work in Agricultural Bacteriology was introduced into our curriculum for the first time, and consisted of a lecture course of one hour per week given to the fourth year students in Agriculture by Dr. H. W. Conn of Wesleyan University. The College is very fortunate in that this course is being given again this year by a man so prominent in Agricultural Bacteriology. The work this year has been extended by the introduction of the two courses mentioned in this report.

One of these new courses consists of four hours per week during the spring term for third year students in Agriculture and Horticulture. It considers some of the more important bacteriological problems relating to soils, manures, and crops, a knowledge of which is of value to all concerned in the management of the soil or its vegetable products.

The second new course covers four hours per week, and is given in the spring term to the fourth year students of Agriculture. The work here is confined to dairy problems in which bacteria play an important part. One of the rooms in Agricultural Hall is used for the work in Agricultural Bacteriology, in connection with the bacteriological work of the Veterinary department. This room is rather small, but is fairly well supplied with apparatus, and it is hoped that it will soon be made more efficient by the addition of gas for the laboratory work.

Meteorology.— This course is given during the fall term to the third year students in Agriculture and Horticulture. This year it covered the more practical problems in connection with Meteorology and Climatology with which the farmer should be familiar.

Physics.— This department occupies a room on the second floor of the chemical laboratory. The room is not well suited for the work, since it is small and is lighted only by small windows near the ceiling and by skylights. It is fitted with side cupboards in which to store apparatus. The room has been improved this year by the addition of a permanent desk, fitted with running water and gas, for the use of the instructor in demonstration. Three hours per week for two terms with the third year students are given to instruction in general physics. The work is based on Gage's Introduction to Physical Science (Revised Edition), aided by class demonstrations and laboratory work. The department has a considerable amount of apparatus, but some of it was found broken and unfit for use, and some is not suited to the needs of this course, so that the amount really available for use is not large. Next year a course in advanced physics will be offered, and more of the apparatus will then be used.

In the catalogue, under "Courses of Study Fully Described," will be found outlines and descriptive matter giving something of the subject matter and methods of instruction found in the work here dealt with.

Respectfully submitted,

W. A. STOCKING, Jr.

REPORT OF F. H. STONEBURN,

Instructor in Poultry Industry and Poultry Manager.

To Rufus Whittaker Stimson, President:

No radical change has been made in the work of the Poultry department since the appointment of the writer last January. The recitation schedule as prepared by your committee on courses of study was carefully followed, while the practical operations at the poultry plant have been carried on in much the same manner as formerly. In fact it is evident that my predecessor made the best possible use of the facilities afforded by our plant.

Class-room instruction in poultry culture was given the second year class during the winter term. The theory of the subject was covered by lecture work as far as the time assigned would permit, and this was supplemented by practical work at the poultry plant. Most of the students manifested a decided interest, and it is evident that this feature may be made a valuable part of the agricultural course.

A special course in poultry culture was given for the first time during the winter term. The instruction was divided between theory and practice, and all of the phases of the industry were touched upon. All of the special students were enthusiastic in their work, and from the results obtained it is safe to say that this course may also be made of great value to the citizens of the State. The success of this special course was due in no small measure to the hearty coöperation of other members of the Faculty.

The practical work of the Poultry department is to supply the College table with fresh poultry products, and also to furnish the farmers of the State with eggs for hatching and reliable breeding stock at reasonable rates. The latter feature is resulting in the wider distribution of thoroughbred poultry throughout the State, and hence in an increased interest in the industry. The large and growing correspondence of the department also indicates much interest in our work.

There have been some accessions to the equipment of the department during the past year, notably in the line of incubators and brooders. Some fine stock has also been added. At present a " working exhibit " of poultry supplies and foods is in preparation. The equipment of the poultry plant as a whole is excellent, both for purposes of instruction and for practical work. The average quality of the stock is very high, certainly much above that usually found upon poultry farms. The apparatus includes different forms of incubators and brooders, a steam cooker, and a power bone cutter.

The great need of the department now is new buildings. The present structures are old and do not embody modern ideas, and they are also uncomfortable and unsightly. In addition, their arrangement and location are such as to prevent economical operation of the plant. The increasing interest manifested by all classes of citizens in this branch of agriculture now seems to demand that the field of this department be broadened; but before much more can be done, some decided improvement over existing conditions will have to be made. In view of these facts it seems that this institution would be justified in expending the funds necessary to erect a modern, up-to-date poultry plant.

Respectfully submitted,

FREDERIC H. STONEBURN.

REPORT OF J. W. YEREX,

Instructor in Business Studies.

To Rufus Whittaker Stimson, President:

Herewith I present my second annual report of the Business department of the Connecticut Agricultural College.

In 1901 the classes in this department were late in being formed, and not until about the middle of December were they thoroughly organized, yet in some of the branches I think a very creditable showing was made.

The classes in Bookkeeping did very well, and a number of those taking this branch got a good knowledge of the principles of double entry bookkeeping. Some of those who took up the course in Stenography were also quite successful, and at the close of the school year in June were nearly qualified to do the office work of a shorthand amanuensis. Business Arithmetic received its due share of attention, and though the work done was not altogether satisfactory, yet under the circumstances I was fairly well pleased. The class in Typewriting was small, being composed of only three members during the term. In Penmanship and Spelling marked improvement was made by nearly every member of the class. One of the most interesting classes in the Business department was the class in Commercial Geography. It took up the geography of nearly all the leading nations of the world from a commercial standpoint, noting the manufacturing, agricultural, mineral, and in fact all the chief industries of each country.

The class-room equipment last year was very unsatisfactory. This year it is much improved, therefore much better results are looked for.

Respectfully submitted,

J. W. YEREX.

REPORT OF EDWINA MAUD WHITNEY, PH.B.,

Instructor in German and Librarian.

To Rufus Whittaker Stimson, President:

Library.— The few changes which I have to record in the library work and equipment of the past year have been decidedly for the better.

At the beginning of the winter term our heavy stacks were removed to the rear, and our main room, with the addition of new racks and tables, has been changed to a reading and reference room. This is of great advantage to the students, giving them better light and air, and bringing them more directly under the supervision of the Librarian. As a result the library is more patronized than ever before, and is sometimes so crowded that there is not room at the tables for all the readers.

Another important change is an increase in the number of hours in which the library is open. With the aid of a student assistant we have been able to keep open until ten in the evening, and in this way give a chance for all to spend at least a part of their day in reading or reference work.

We have accessioned during the year 520 books, a smaller number than in recent years, but as many as we could find convenient space for in our alcoves. Our total number of volumes now reaches 9,300. We have, also, about 1,000 pamphlets, mostly of an agricultural nature, which are being arranged and bound as rapidly as possible.

German.— The course in German was introduced at the beginning of the College year, 1901-1902. As might have been anticipated, the study being elective, the class at first was small. At the opening of the current year, however, there has been a large increase both in numbers and interest, with a promise of even better things for the future.

A knowledge of German is without doubt necessary for advanced scientific work. The aim of the instruction is, therefore, to give sufficient knowledge of the language to enable the ambitious student to read scientific German. Little time is spent in conversation, derivation, or the strictly literary side of the language. The necessary grammatical details are mastered as soon as possible, and by means of a scientific reader the student becomes familiar with the technical vocabulary.

The introduction of German into the College curriculum is too recent to enable us to foretell with certainty what will be the result, but all present indications show that the course is both needed and desired.

Respectfully submitted,
EDWINA WHITNEY.

REPORT OF GRACE LYON GEER,

Instructor in Music, Elocution, and Gymnastics, and Assistant to the Lady Principal.

To Rufus Whittaker Stimson, President:

Music.—The opening of the year 1902-1903 is very promising in this department. The majority of the pupils are beginners. At present there are thirty-five private lessons given each week.

In the Pianoforte department the course as laid out includes a constant and thorough drill in Hand-culture and Finger-training, and studies of Czerny, Köhler, Berens, and Lecouppey. Sonatinas and pieces suited to the grade supplement this work.

In the Vocal department the work is largely in voice placing and building. Vocalizes and studies of Lamperti, Nava, Abt, Sieber, and Concone are used with songs suited to the grade.

The Freshmen meet twice a week for Sight-singing. The "Normal Music Course" is used for their instruction.

A pleasant and profitable result of this training will be the development of a school chorus.

Elocution.— No important change has been made in the work of this department. One declamation each term is required of each member of the Freshman, Sophomore, and Junior classes. Private instruction is given the students in every case.

The object of this course is to train the speaking voice of the student to be smooth, clear, well-placed and properly modulated; to enable the pupil to attain clear enunciation and correct pronunciation; to interpret with feeling and expression the best productions of standard authors; and to appear before an audience with ease of manner and dignity of bearing.

I share with the Lady Principal the pleasant duties of hostess of Grove Cottage, and the chaperoning of the young ladies on their walks, drives, excursions, picnics, and shopping trips.

Respectfully submitted,
GRACE LYON GEER.

INVENTORIES

Sept. 30, 1902

FARM DEPARTMENT

Live stock,	$3,690.00	
Farm products and feed,	2,572.80	
Implements and tools,	1,919.05	
		$8,181.85

CREAMERY DEPARTMENT

Equipment,	$3,246.17	
Permanent fixtures,	800.00	
Office furniture,	140.00	
Supplies and stock,	219.50	
Cold storage plant,	3,500.00	
		$7,905.67

POULTRY DEPARTMENT

Old stock,	$318.00	
Young stock,	627.57	
Office furniture,	61.70	
Supplies,	149.30	
Equipment,	335.50	
		$1,492.07

HORTICULTURAL DEPARTMENT

Tools,	$460.70	
Fruit and vegetables,	143.50	
Nursery stock,	50.00	
Greenhouse stock,	257.55	
		$911.75

BOTANY, FORESTRY, AND LANDSCAPE ARCHITECTURE

Apparatus, tools, and supplies,	$587.85

BOARDING DEPARTMENT

Equipment and supplies,	$862 01

HORSE-BARN DEPARTMENT

Horses,	$820.00	
Wagons and sleighs,	379.00	
Feed,	74.00	
Harness and general equipment,	285.75	
		$1,558.75

MECHANICAL DEPARTMENT

Stock,	$211.00	
Equipment for woodworking,	462.00	
Equipment for ironworking,	350.00	
		$1,023.00

NATURAL HISTORY DEPARTMENT

Apparatus,	$1,115.00	
Museum,	1,000.00	
		$2,115.00

MATHEMATICS

Instruments, models, etc.,	$1,000.79

VETERINARY SCIENCE, PHYSIOLOGY, AND BACTERIOLOGY

Instruments, apparatus, models, etc.,	$2,357.08

CHEMISTRY AND PHYSICS

Apparatus, supplies, etc.,	$2,121.18

MILITARY EQUIPMENT

Arms and other equipment,	$436.45

GROVE COTTAGE

General equipment,	$2,313.00	
Kitchen and dining-room equipment,	200.00	
Kitchen laboratory equipment,	275.00	
		$2,788.00

LIBRARY

Books, card catalogues, shelving,	$21,603.00

GENERAL EQUIPMENT

Office furniture and supplies,	$650.00	
Local telephones,	350.00	
Wagon scales,	150.00	
Miscellaneous,	2,250.00	
		$3,400.00
Dormitory furniture,		1,283.80
Janitor's supplies,		111.29
Main building, household equipment,		684.95
Lands, 300 acres,		15,000.00
Buildings,		112,000.00
		$187,424.49

TREASURER'S REPORT

REPORT OF W. H. HALL, TREASURER OF THE CONNECTICUT AGRICULTURAL COLLEGE, FOR THE FISCAL YEAR ENDING SEPTEMBER 30, 1902.

Balance of the State Fund September 30, 1901,	$6,495.75	
Due from the First National Bank of Willimantic (suspended), September 30, 1901,	679.98	
Correct balance of the State Fund Sept. 30, 1901,		$7,875.73
Balance of the Land Grant Fund Sept. 30, 1901,		6,668.98
Balance of the Morrill Fund Sept. 30, 1901,	13,043.95	
Due from the State Treasurer,	1,000.00	
Correct balance of the Morrill Fund Sept. 30, 1901,		14,043.95
Balance of the Hicks Prize Fund Sept. 30, 1901,		37.00
Total,		$27,925.66

		Disbursements.	*Receipts.*
Cash balance, September 30, 1901:			
Subject to check,	$26,245.68		
Due from First Nat'l Bank of Willimantic (suspended),	679.98		
Due from State Treasurer,	1,000.00		$27,925.66
Annual State appropriation (State Fund),			15,000.00
Endowment income (Land Grant Fund),			6,700.00
Annual Federal appropriation (Morrill Fund), $25,000 being the appropriation advanced for 1902–1903,			50,000.00
Hicks Prize Fund,		$48.00	60.00
Doubtful accounts collected,			20.00
Interest,			620.26
Fees: Breakage,	130.97		
Diploma,	24.00		154.97
Salaries: Officers,	$5,277.69		
Instructors,	22,633.29		
Lecturers,	679.54	28,590.52	

		Disbursements.	Receipts.
Departments:			
Library and Reading Room.			
New books,	$693.48		
Periodicals,	213.20		
Other items,	86.72	$993.40	
Farm,		7,653.83	5,405.70
Creamery,		4,033.71	3,417.11
Poultry,		1,272.41	1,142.47
Horticulture,		2,544.33	1,231.13
Forestry, Landscape Architecture, and Botany, including care and permanent improvement of grounds,		2,828.14	119.65
Horse Barn,		2,550.61	1,235.43
Boarding,		10,271.91	7,547.65
Extension,		138.49	50.18
Military,		491.14	
Buildings: Repairs, additions, and improvements not elsewhere included,		6,334.60	
Rent,		600.00	1,053.67
Fuel and Light (material),		615.34	1,699.96
Equipment:			
Cold Storage Rooms and Machinery,		3,766.75	
Safes,		683.00	
Repairs, additions, and improvements not elsewhere included,		2,150.31	
Facilities for instruction: Supplies and incidental service not elsewhere included,		1.710.19	
Insurance,		1,042.21	12.00
Students' Stationery and Supplies,		1,555.01	1,742.48
Students' Laundry,		940.28	1,138.34
Medicines,		38.80	10.00
Pew Rent for Students,		399.96	
Administration, general:			
Freight and Express,		215.51	
Cartage and Transportation,		759.38	
Entertainment of Guests,		130.07	
Commencement,		223.68	
Telephone and Telegraph,		162.92	53.12
Traveling expenses, including attendance at agricultural fairs, farmers' meetings, educational conventions, and meetings of the Trustees,		1,351.31	
Printing,		446.60	

		Disbursements.	Receipts.
Postage,		$602 54	
Office Stationery and Supplies,		395.26	
Advertising,		202.91	
Grove Cottage Laundry and Supplies,		41.78	
Janitor Work and Supplies,		1,186.54	
Engineer and Fireman,		570.00	
Board allowances,		525.11	
Unclassified items,		765.70	$209.78
Balances September 30, 1902:			
State Fund,	$8,068.97		
Land Grant Fund,	874.33		
Morrill Fund,	28,725.01		
Hicks Prize Fund,	49.00		
	$37,717.31		
Cash balance, September 30, 1902:			
Subject to check,	$36,037.33		
Due from First National Bank of Willimantic (suspended),	679.98		
Due from State Treasurer,	1,000.00	37,717.31	
		*$126,549.56	*$126,549.56

Amounts paid to officers and employees from the Morrill Fund (United States Government grant of 1890):

Rufus W. Stimson,	$1,510.39
Benjamin F. Koons,	2,000.00
Alfred G. Gulley,	2,000.00
Charles S. Phelps,	1,500.00
Eugene H. Lehnert,	1,500.00
Charles A. Wheeler,	1,500.00
Henry R. Monteith,	1,500.00
Charles A. Meserve,	1,500.00
Charles L. Beach,	1,200.00
Henry S. Patterson,	1,200.00
Edwin O. Smith,	633.35
Edward L. Raymond,	1,000.00
Frederic H. Stoneburn,	1,000.00
James W. Yerex,	1,000.00
Marcia G. Greenough,	824.96
Alberta T. Thomas,	800.00
Herbert W. Conn,	500.00
M. P. Colman,	10.00
George W. Flint,	625.00

*The totals of the receipts and disbursements include transfers which are not cash items but are for material and service furnished one department by another.

From the Land Grant Fund (United States Government grant of 1862):

Rufus W. Stimson,	$989.58
*William D. Holman, Treasurer,	262.50
†William H. Hall, Treasurer,	262.50
George A. Hopson, Secretary,	400.00
Edwin O. Smith,	516.66
Ernest D. Proudman,	900.00
Edwina M. Whitney,	650.00
Lena M. Gardner,	528.61
Harry L. Garrigus,	350.00
W. A. Warren,	330.00

From the annual State appropriation:

Edwin O. Smith,	$50.00
Lucius P. Chamberlain,	600.00
W. A. Warren,	330.00
Harry L. Garrigus,	250.00
Julius Hauschild,	702.13
M. P. Colman,	636.25
Joseph Brown,	570.00
Charles H. Copeland,	480.00
George W. Flint,	1,452.38

CHAPTER XXXV.

An Act concerning Reports of State Institutions.

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

SECTION 1. It shall be the duty of the officers of each institution and commission of this State, who are required by law to report to the Governor or to the General Assembly, to give, in the financial statement of receipts and expenditures contained in their respective reports, a detailed statement of the salaries paid to each and every officer and employee for the year ending with the 30th day of September next preceding.

SEC. 2. This act shall not apply to any officer or employee whose compensation is less than four hundred and fifty dollars per annum.

Approved March 17, 1897.

* Died March 21, 1902.

† Appointed by His Excellency the Governor to fill out the term of William D. Holman, deceased.

HARTFORD, CONN., Dec. 3, 1902.

This certifies that we have examined the accounts of W. D. Holman, Treasurer of the Connecticut Agricultural College for the period from September 30, 1901, to April 7, 1902, compared said accounts with the vouchers therefor, and found them correct.

We further certify that we have examined the accounts of W. H. Hall, Treasurer of said College from April 7, 1902, to September 30, 1902, inclusive, compared said accounts with the vouchers therefor, and found them correct. The amount of cash in the hands of said Treasurer, belonging to the State Fund, was, at the close of business on September 30, 1902, twenty-two and two one-hundredths dollars ($22.02). We find, however, that said Treasurer has received since said last-mentioned date, and prior to this audit, from the President of said College the further sum of seventy-four hundred fifteen and ninety-seven hundredths dollars ($7,415.97), this being the amount collected by said President in the fiscal year preceding its payment.

The balance of the Morrill Fund in the hands of said Hall, as Treasurer, on September 30, 1902, was twenty-seven thousand seven hundred twenty-five and one one-hundredth dollars ($27,725.01).

The balance of the Land-Grant Fund in the hands of said Hall, as Treasurer, aforesaid, on said last-mentioned date, was eight hundred seventy-four and thirty-three one-hundredths dollars ($874.33).

WALTER A. RILEY,
JAMES P. BREE,
Auditors of Public Accounts.

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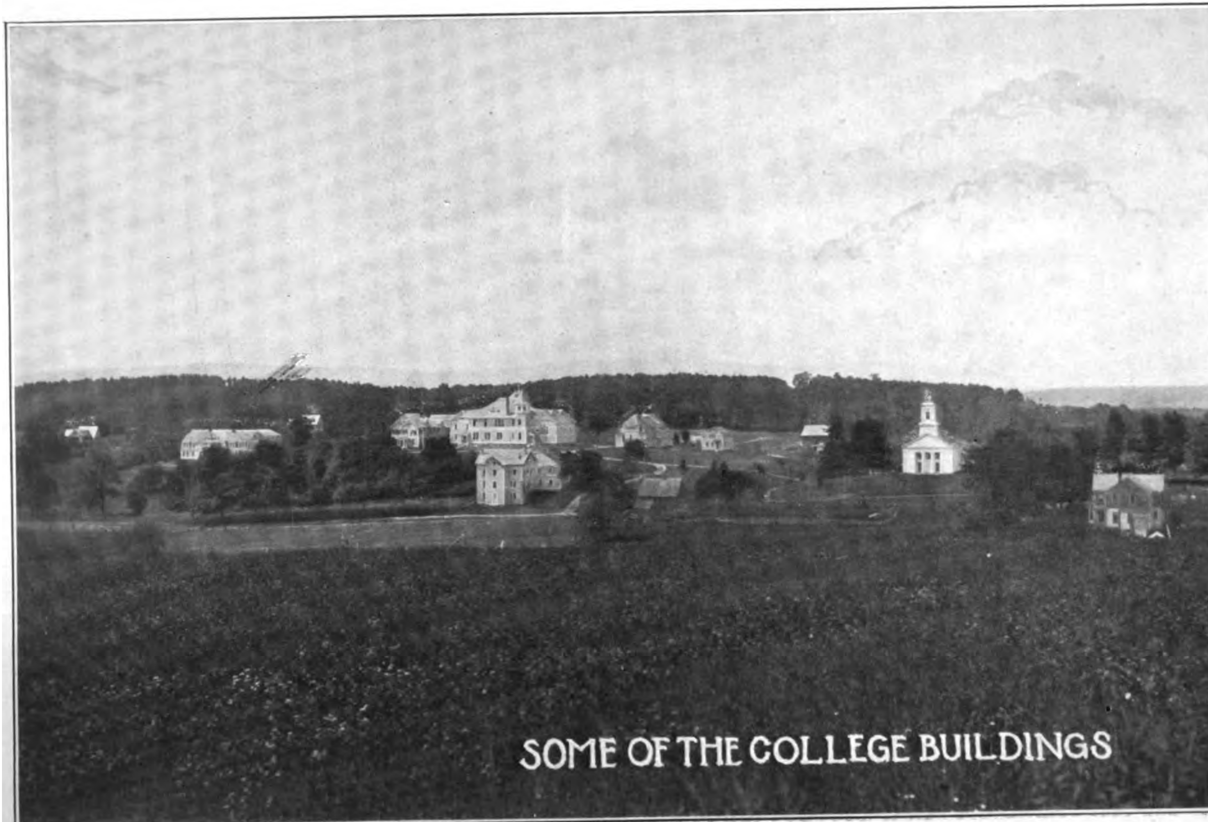
COLLEGE CATALOGUE, 1902–1903


SOME OF THE COLLEGE BUILDINGS

THE

CONNECTICUT AGRICULTURAL COLLEGE

CATALOGUE

1902–1903

STORRS, CONNECTICUT

Hartford Press
THE CASE, LOCKWOOD & BRAINARD COMPANY
1903

THE

CONNECTICUT AGRICULTURAL COLLEGE

BOARD OF TRUSTEES

* Died March 21, 1902.

† Appointed by the Board of Trustees to fill the vacancy occasioned by Mr. Holman's death.

OFFICERS OF INSTRUCTION AND ADMINISTRATION

RUFUS WHITTAKER STIMSON, A.M., B.D.
President

BENJAMIN FRANKLIN KOONS, Ph.D.
Professor of Natural History and Curator of the Museum

LOUIS ADELBERT CLINTON, M.S.
Professor of Agriculture

ALFRED GURDON GULLEY, M.S.
Professor of Horticulture

CHARLES LEWIS BEACH, B.Agr., B.S.
Professor of Dairying

EUGENE HUGO LEHNERT, B.S., D.V.S.
Professor of Animal Husbandry, Physiology, and Veterinary Science

CHARLES AUGUSTUS WHEELER, B.A.
Professor of Mathematics and Civil Engineering

HENRY SHERMAN PATTERSON
Professor of Shop Work and Mechanical Drawing

HENRY RUTHVEN MONTEITH, B.A.
Professor of History, Civics, Latin, and English

CHARLES ARTHUR MESERVE, B.S., Ph.D.
Professor of Chemistry and Military Science

ALBERTA TULLIA THOMAS
Professor of Home Economics and Lady Principal

EDWIN OSCAR SMITH, B.S.
Assistant Professor of English and Political Economy, and Secretary of the Faculty

EDWARD ALBERT WHITE, B.S.
Assistant Professor of Botany, Forestry, and Landscape Architecture

WILLIAM ALONZO STOCKING, Jr., B.S.A.
Instructor in Agriculture and Physics

FREDERIC HENRY STONEBURN
Instructor in Poultry Industry and Poultry Manager

JAMES WELLINGTON YEREX
Instructor in Commercial Subjects, including Bookkeeping, Stenography, and Typewriting

EDWINA MAUD WHITNEY, PH.B.
Instructor in German and Librarian

GRACE LYON GEER
Instructor in Music, Elocution, and Gymnastics, and Assistant to the Lady Principal

WALTER ARNOLD WARREN, B. AGR.
Instructor in Greenhouse and Garden Work

HARRY LUCIAN GARRIGUS, B.AGR.
Instructor in Field Work and Farm Superintendent

HERBERT WILLIAM CONN, PH.D.
Lecturer on Dairy Bacteriology

COMMITTEE ON COURSES OF STUDY

BENJAMIN FRANKLIN KOONS
LOUIS ADELBERT CLINTON
ALFRED GURDON GULLEY
CHARLES AUGUSTUS WHEELER
CHARLES ARTHUR MESERVE

COMMITTEE ON DISCIPLINE

HENRY RUTHVEN MONTEITH
HENRY SHERMAN PATTERSON
CHARLES LEWIS BEACH
CHARLES ARTHUR MESERVE
EUGENE HUGO LEHNERT

LUCIUS PHELPS CHAMBERLAIN
Steward

ERNEST DAVIS PROUDMAN
Chief Clerk

THE STORRS EXPERIMENT STATION

A DEPARTMENT OF THE

CONNECTICUT AGRICULTURAL COLLEGE

Station Council

R. W. STIMSON	*ex officio*, as President of Connecticut Agricultural College
G. A. HOPSON	Appointed by the Board of Trustees
L. A. CLINTON	*ex officio*, as Acting Director
A. G. GULLEY	Appointed by the Station Staff
C. L. BEACH	Appointed by the Station Staff

Station Staff

L. A. CLINTON	Acting Director
W. O. ATWATER	Supervisor Nutrition Investigation
H. W. CONN	Supervisor Dairy Bacteriology
A. G. GULLEY	Horticulturist
C. L. BEACH	Dairy Husbandman
W. A. STOCKING, JR.	Assistant Bacteriologist
F. H. STONEBURN	Poultryman
E. R. BENNETT	Assistant Horticulturist
H. L. GARRIGUS	Assistant Field Experimenter
W. M. ESTEN	Laboratory Assistant
B. F. KOONS	Consulting Entomologist
C. A. MESERVE	Consulting Chemist
E. H. LEHNERT	Consulting Veterinarian
E. A. WHITE	Consulting Botanist

The bulletins of this Station will be mailed free of charge to all residents of the State who request them. Address Agricultural Experiment Station, Storrs, Conn.

1902

JULY

Su	Mo	Tu	We	Th	F	Sa
..	..	1	2	3	4	5
6	7	8	9	10	11	12
13	14	15	16	17	18	19
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27	28	29	30	31	..	..
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AUGUST

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24	25	26	27	28	29	30
31	..	..	..	..	..	..

SEPTEMBER

Su	Mo	Tu	We	Th	F	Sa
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OCTOBER

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12	13	14	15	16	17	18
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26	27	28	29	30	31	..
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NOVEMBER

Su	Mo	Tu	We	Th	F	Sa
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23	24	25	26	27	28	29
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DECEMBER

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1903

JANUARY

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25	26	27	28	29	30	31
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FEBRUARY

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MARCH

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APRIL

Su	Mo	Tu	We	Th	Fr	Sa
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26	27	28	29	30	..	..
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MAY

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24	25	26	27	28	29	30
31	..	..	..	..	..	..

JUNE

Su	Mo	Tu	We	Th	Fr	Sa
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14	15	16	17	18	19	20
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28	29	30	..	..	..	..
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JULY

Su	Mo	Tu	We	Th	Fr	Sa
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12	13	14	15	16	17	18
19	20	21	22	23	24	25
26	27	28	29	30	31	..
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AUGUST

Su	Mo	Tu	We	Th	Fr	Sa
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16	17	18	19	20	21	22
23	24	25	26	27	28	29
30	31	..	..	..	..	..

SEPTEMBER

Su	Mo	Tu	We	Th	Fr	Sa
..	..	1	2	3	4	5
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20	21	22	23	24	25	26
27	28	29	30	..	..	..
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OCTOBER

Su	Mo	Tu	We	Th	Fr	Sa
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11	12	13	14	15	16	17
18	19	20	21	22	23	24
25	26	27	28	29	30	31
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NOVEMBER

Su	Mo	Tu	We	Th	Fr	Sa
1	2	3	4	5	6	7
8	9	10	11	12	13	14
15	16	17	18	19	20	21
22	23	24	25	26	27	28
29	30	..	..	..	..	..
..	..	..	..	..	..	..

DECEMBER

Su	Mo	Tu	We	Th	Fr	Sa
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6	7	8	9	10	11	12
13	14	15	16	17	18	19
20	21	22	23	24	25	26
27	28	29	30	31	..	..
..	..	..	..	..	..	..

CALENDAR

1902–1903

The full college year is forty-two weeks, and is divided into terms of thirteen, twelve, eleven, and six weeks respectively.

FALL TERM

1902			
September	23,	Tuesday,	Fall term begins with the vesper chapel service at 5.45.
October	1,	Wednesday,	Inventories of all departments due.
"	14,	Tuesday,	Meeting of the Board of Trustees.
November	1,	Saturday,	Reports of all departments due.
"	14,	Friday,	First Year Rhetoricals.
"	25,	Tuesday,	Second Year Rhetoricals.
"	26,	Wednesday,	Thanksgiving Recess.
December	1,	Monday,	Thanksgiving Recess.
"	12,	Friday,	Third Year Rhetoricals.
"	19,	"	Examinations begin.
"	23,	Tuesday,	Fall term ends.

Winter Vacation, twelve days.

WINTER TERM

1903			
January	5,	Monday,	Winter term begins with the vesper chapel service at 5.45.
February	11,	Wednesday,	First Year Rhetoricals.
"	22,	Sunday,	Washington's Birthday.
"	25,	Wednesday,	Second Year Rhetoricals.
March	11,	"	Third Year Rhetoricals.
"	25,	"	Examinations begin.
"	27,	Friday,	Winter term ends.

Spring Vacation, nine days.

SPRING TERM

1903			
April	6,	Monday,	Spring term begins with the vesper chapel service at 5.45.
"	8,	Wednesday,	Hicks Prize Essays due at 12 o'clock, noon.
May	1,	Friday,	First Year Rhetoricals.
"	8,	"	Hicks Prize Essays delivered in public.
"	13,	Wednesday,	Second Year Rhetoricals.
"	27,	"	Third Year Rhetoricals.
"	30,	Saturday,	Memorial Day: a holiday.
June	3,	Wednesday,	Fourth Year Examinations begin.
"	5,	Friday,	Prize Readings and Declamations.
"	10,	Wednesday,	Final Examinations begin.
"	12,	Friday,	President's Reception.
"	14,	Sunday,	Baccalaureate Sermon.
"	15,	Monday,	Society Banquets.
"	16,	Tuesday,	Class Day.
"	17,	Wednesday,	Commencement.
"	17,	"	Meeting of the Board of Trustees.
"	17,	"	Meeting of the Alumni, and the Alumni Reception.

Summer Vacations for fourth year students, June 18 to July 6, and August 19 to September 21 inclusive; Summer Vacation for other students, June 18 to September 21 inclusive.

SUMMER TERM FOR FOURTH YEAR STUDENTS

July	7,	Tuesday,	Summer term for fourth year students begins at 8 o'clock in the morning.
August	18,	"	Examinations close, and term ends.

SUMMER SCHOOL FOR TEACHERS AND OTHERS IN NATURE AND COUNTRY LIFE

July	6,	Monday,	Summer School begins in the evening at 8 o'clock with a meeting of all members of the school for brief opening addresses.
"	7,	Tuesday,	Regular Exercises begin as scheduled upon the bulletin board.
"	28,	"	Summer School ends.

FALL TERM

1903

September	22,	Tuesday,	Fall term begins with the vesper chapel service at 5.45.
October	1,	Thursday,	Inventories of all departments due.
"	13,	Tuesday,	Meeting of the Board of Trustees.
November	2,	Monday,	Reports of all departments due.
"	13,	Friday,	First Year Rhetoricals.
"	24,	Tuesday,	Second Year Rhetoricals.
"	25,	Wednesday,	Thanksgiving Recess.
"	30,	Monday,	
December	11,	Friday,	Third Year Rhetoricals.
"	21,	Monday,	Examinations begin.
"	23,	Wednesday,	Fall term ends.

Winter Vacation, eleven days.

WINTER TERM

1904

January	4,	Monday,	Winter term begins with the vesper chapel service at 5.45.

ENTRANCE EXAMINATIONS, 1903

WILL BE HELD AT THE TIMES AND IN THE PLACES HERE INDICATED

June	20,	Saturday,	At the College.
August	28,	Friday,	Danbury, City Hall, Selectmen's Room.
"	28,	"	Norwich, City Hall, Council Chamber.
"	28,	"	New Haven, Agricultural Experiment Station.
"	29,	Saturday,	Hartford, Capitol, Room 50.
"	29,	"	At the College.
September	19,	"	At the College.

ALL AT 9 A. M.

SCENE ON THE CAMPUS — LOOKING WEST

CONNECTICUT AGRICULTURAL COLLEGE

The Connecticut Agricultural College

Historical Sketch

Twenty-three years ago the Connecticut General Assembly established The Storrs Agricultural School, an institution which had its beginnings in the public spirit of Mr. Augustus Storrs and Mr. Charles Storrs, his brother, natives of the town of Mansfield, where the school was located. The object of the school, as stated in the act establishing it, was the "education of boys whose parents are citizens of this state in such branches of scientific knowledge as shall tend to increase their proficiency in the business of agriculture."

A period of growth and development followed, in which the name of the institution was changed to The Storrs Agricultural College, and in which the Board of Trustees admitted young women, providing for them education in such branches of knowledge as tend to increase proficiency in the art of housekeeping and home-making.

As a college, this institution fell heir to a large amount of federal income, proceeds from the Land-grant Act of 1862 and the Morrill Act of 1890, became responsible for half the agricultural experiment station work in this state, for which annual provision had been made by the Hatch Act of 1887, and found itself under moral and legal obligations to maintain the standard and the scope of education appropriate to the land-grant colleges, one of which by the acceptance of this federal support it had become.

The name "The Storrs Agricultural College" was believed to be misleading. It seemed to designate a private institution. Therefore, to make manifest to all who might see or hear its name that this is a state institution, maintained by, and designed and conducted for the benefit of all citizens, it was decided by the General Assembly, four years ago, to change its name to The Connecticut Agricultural College, the name it now bears.

That the College is in fact a State institution has become somewhat better known. It yet remains to be discovered by most citizens that this is a national college as well, deriving by far the greater proportion of its income from federal sources.

From the State the Trustees at present receive for the College proper but $15,000, and for the Storrs Experiment Station but $1,800 a year. From the National Government it now has the following fixed annual income: under the Land-grant Act of 1862, $6,750; under the Morrill Act of 1890, $25,000; and under the Hatch Act of 1887, providing for agricultural experiment stations, $7,500. The use of the federal funds is limited to certain specified objects, — none of the first two amounts and only a small percentage of the last can be used for the construction or repair of buildings or for the purchase of land. The State is required to coöperate at least to the extent of providing and maintaining a suitable home for the College. Such a home has been furnished; and the annual income from the State is now devoted to its support and improvement. From the federal funds are paid the salaries of the officers of instruction and administration.

System of Control

The control of the institution is vested in a Board of Trustees consisting of ten members including the Governor, — six appointed by the Senate for periods of four years each, one elected by the alumni of the College for two years, one elected annually by the Board of Agriculture, and the Director of the Connecticut Agricultural Experiment Station *ex officio* a member. The Governor is *ex officio* President of the Board. The Trustees elect their own officers, with the exception of their president. They also elect the College officers.

The President of the College, subject to the direction of the Trustees, is its executive officer. He has the immediate supervision of all departments, and direction of all matters pertaining to the welfare of the College. He has the power of outlining the duties of each member of the institution. He may delegate this power to the heads of departments. All are responsible to him, or to those appointed by him, for the faithful discharge of their duties. The President of the College, furthermore, is charged by the Trustees with the duty of nominating for election by them, if approved, professors and instructors to fill vacancies in all departments, and, upon approval by the Trustees, has the power of asking for the resignation of the same for the neglect or non-performance of duties assigned, or when in his judgment the best welfare of the College demands a change. Finally, the President of the College is expected to be present at all meetings of the Board of Trustees, except when requested otherwise by them, and has the privilege of participating in all discussions.

The Faculty of the College is made up of officers of instruction. It holds meetings, when called by the College President, for the consideration of courses of study, cases of discipline, and such other matters as pertain to the internal well-being of the College; and in such matters is advisory to the President. All business, or any communication of the Faculty touching the College or its departments, which requires such action, is presented to the Board of Trustees by the President of the College; it being provided that if he refuses to place such business or communication before the Trustees within reasonable time, those concerned have the power of petitioning direct to the Board.

The Board of Trustees, as a body and through special committees of their own number, are thus able to keep themselves closely cognizant at all times of the affairs of the institution, and constitute a responsible and effective board of control.

Present Purpose

As a land-grant college the original purpose of this institution, as defined by the act establishing The Storrs Agricultural School, has been enlarged.

In accordance with the first act of Congress, named above in speaking of its annual income, this institution is a college where the leading object is, in the precise words of Congress, "without excluding other scientific and classical studies, and including military tactics, to teach such branches of learning as are related to agriculture and the mechanic arts, in order to promote the liberal and practical education of the industrial classes in the several pursuits and professions of life."

Its aim, in applying the $25,000 a year received under the Act of 1890, is the provision of instruction in the following subjects, specifically mentioned by that act: "Agriculture, the mechanic arts, the English language, and the various branches of mathematical, physical, natural, and economic science, with special reference to their application in the industries of life."

Its purpose, finally, is to provide a liberal and practical education of a degree of excellence so high as to warrant its being chosen by young men and women with the brightest minds and loftiest aspirations, yet at so low a cost as to bring it within the grasp of the poorest boy or girl who is strong and willing to work.

How far and in exactly what manner these statements are true will appear from an examination of the courses of study offered in this catalogue and the terms upon which they are available, — courses which range in length from ten days to six years, which lead to graduation with certificates or diplomas, or the degree B. S., and which are open in part to those who have had a high school, and in part to those who have had only a common school education. It will be observed that the regular college courses are supplemented by special courses designed for the benefit of those who desire to improve their proficiency in any one of several pursuits and professions, but who find it impossible to secure a full college education.

And for the best accomplishment of its purpose the College Faculty is made up of specialists in their several fields trained at this institution, at the agricultural colleges of Massachusetts, Michigan, Wisconsin, and Cornell, and at other colleges, as follows: Oberlin, the Institute of Technology at Boston, McGill University, Wesleyan, Dartmouth, Yale, and Harvard.

Location, Railway Stations, Telephone, Telegraph, and Mails

The Connecticut Agricultural College is located at Storrs, in the town of Mansfield, Tolland County. It is rather more than six hundred feet above sea level, therefore, and in the midst of the pleasant scenery and healthful surroundings for which this part of the State is known. Without the College, Storrs would consist of but a few scattered farm houses. The community, consequently, centers in the College — the whole being a little world by itself and remarkably free from those things which at many colleges are wont to distract the attention of students and to dissipate their energies to no good educational purpose.

The College railway station for freight and express is Eagleville, seven miles north of Willimantic, on the Central

Vermont Railway. Trains connect at New London and Willimantic with trains for this station.

Passengers for the College may leave the cars either at Willimantic or at Eagleville. The drive from Willimantic to the College is but eight miles, and the livery stable rates are reasonable. Eagleville is three miles west of the College. Students on the opening of terms generally arrive at Eagleville, and are met there by college teams — due notice of their arrival having been sent in advance.

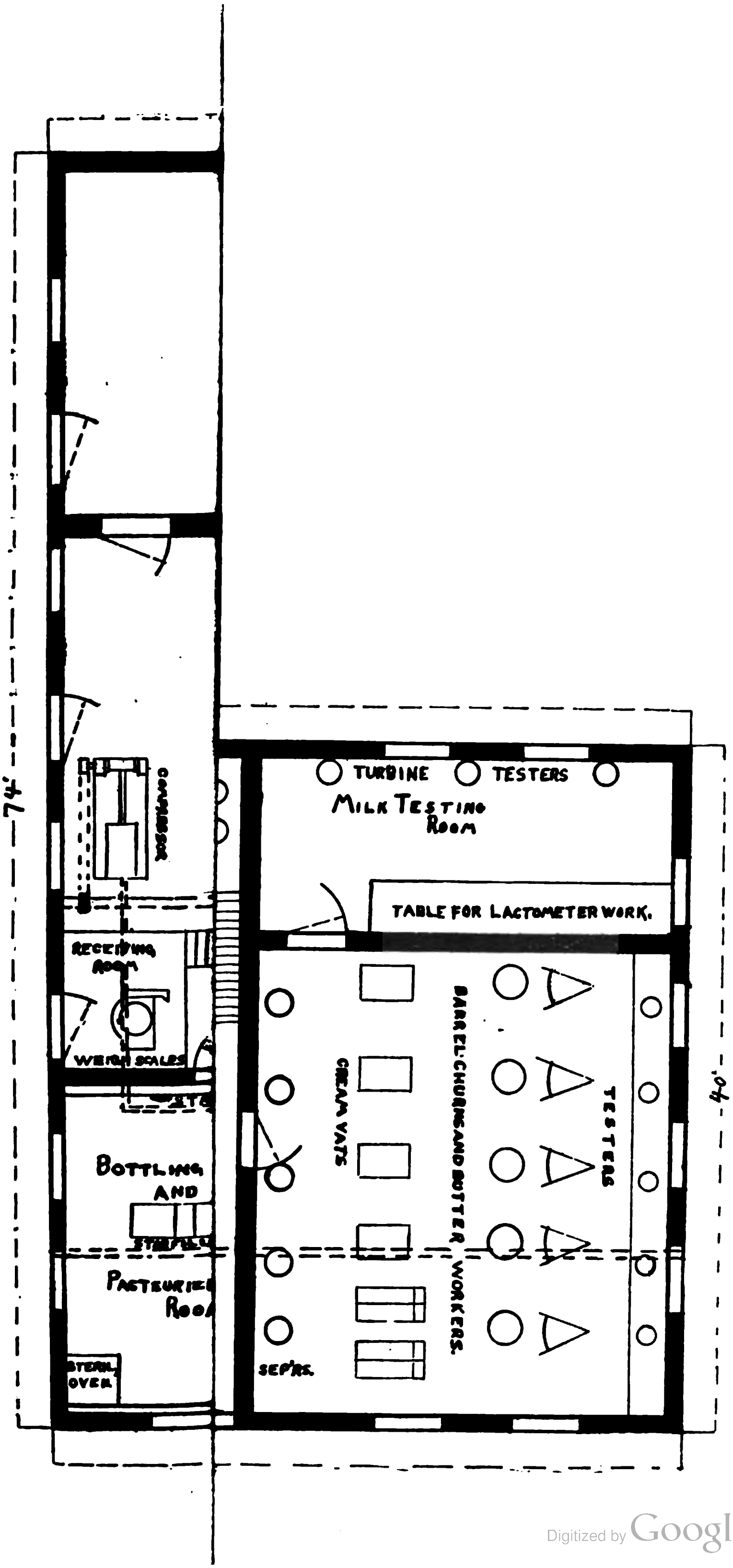
Communication with the College is made easy by the long-distance telephone, by telegraph, and by the free rural-delivery system, which brings three mails a day.

An electric car line from Willimantic is being considered, and when built will add greatly to the convenience of those coming to and going from the College.

Buildings and Equipment

Main Building — All the buildings, with one exception, are wooden structures. The main building was erected in 1890, is a two-story edifice with a basement, and contains a chapel, offices, a mathematical recitation room, the library and reading room, a dining hall, and the steward's rooms, on the first floor; and on the second floor contains a recitation room for English literature, a horticultural room, a room for botany and mechanical drawing, and a second recitation room for English and mathematics.

Agricultural Hall — By skillful management and economical expenditure of the College funds the Trustees were able to erect a fine building sixty by forty feet and three stories high, constructed of stone and brick. The basement of this building, connected with the College creamery, contains the dairy apparatus, laboratory, and samples of machinery. This is said to be the best equipped dairy laboratory in New England,



74'
40'
TURBINE TESTERS
MILK TESTING ROOM
TABLE FOR LACTOMETER WORK.
COMPRESSOR
RECEIVING ROOM
WEIGH SCALES
BOTTLING AND
PASTEURIZ
ROO
STERIL. OVEN
CREAM VATS
BARREL CHURNS AND BUTTER WORKERS.
TESTERS
SEP'RS.

GROVE COTTAGE — ENTRANCE HALL

GROVE COTTAGE. PRESIDENT'S HOUSE. MAIN BUILDING. CHEMICAL LABORATORY. EXPERIMENT STATION.

and was in readiness for the 1902 Dairy and Creamery Short Courses of the Winter School. The second floor is devoted to the veterinary laboratory and class-room, and the agricultural laboratory and class-room. The third floor will be given to the work of the Storrs Experiment Station. Agricultural Hall does credit to its designer and builder, Professor Henry S. Patterson, master mechanic of the College, and is an excellent addition to the College buildings as well as to the agricultural department.

Dormitories — The east building for men, called "The Old Dormitory," contains fifteen rooms, used by the male students of the lower classes. It contains, also, six living rooms for an instructor. The building is heated by steam. "The New Dormitory" for men was built in 1890, with a dwelling house for the President connected at the front. This building is steam heated, and has modern shower and tub baths, and a dressing room fitted with lockers. "Grove Cottage," the dormitory for young women, is one of the most attractive buildings on the campus. Airy rooms, spacious halls, reception parlors, dining hall, and gymnasium, a sewing room for work in domestic science and art, and rooms for the Lady Principal, comprise the first and second floors. A laboratory for instruction in cooking has been fitted up in the south basement, and one has been provided in the north basement for instruction in laundering.

Other Buildings — Besides the buildings described, there is one containing excellent chemical and physical laboratories, well equipped with appropriate apparatus; there is a greenhouse for instruction in the growing and storing of plants; there are barns and sheds for the horses, dairy herd, sheep, and swine; a building for a poultry class room with a basement for incubators, and different types of poultry houses; and there are three well-built and attractive houses for professors.

The Valentine Estate — The Valentine estate has been rented by the College, and furnishes additional land of about one hundred acres and a dwelling house which accommodates three families.

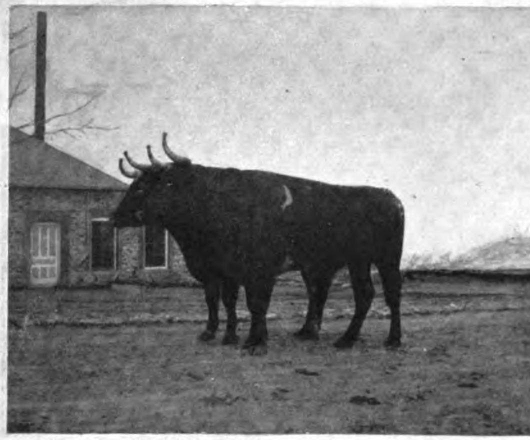
Live Stock and Apparatus — The College is well equipped with farm animals, including model farm horses and oxen; a dairy herd of thoroughbred and grade Jerseys, Ayrshires, Holsteins, and Guernseys; Horned Dorset sheep; Berkshire and Chester White swine; White and Barred Plymouth Rock, White Wyandotte, Rose Combed Brown Leghorn, Rose Combed Black Minorca, Black Langshan, Light Brahma, and Rhode Island Red Poultry; and Pekin Ducks.

It also has a good variety of farm, garden, and orchard tools and machines of the most useful and economic makes.

Fields, Orchards, Gardens, Vineyards, and Nurseries — The College farm and campus contain about 300 acres of well diversified kinds of soil. The tillage land is divided between the farm and horticultural departments, and is manipulated in such a manner as to illustrate the principles and processes of both general and specialized agriculture, including crop rotation, vegetable production, and fruit growing. And the campus and wooded reservations furnish good facilities for scientific and practical instruction in landscape architecture, floriculture, road making, and forestry.

Military Equipment — For instruction in military drill the College has a full complement of Springfield rifles. It has also two 30-30 United States Government Winchester rifles, two Colt 38 United States Army revolvers, and a large pit of earth and masonry, properly drained and provided with drop targets. The pit furnishes perfect protection to the target tenders, and with flags, drums, and a bugle, the College has complete facilities for both military drill and target practice.

Library — By no means least important, though mentioned last, the College has an excellent library of more than



DURHAMS 5 YEARS OLD. DARK RED AND WHITE.

C. A. C. MODEL FARM TEAMS.

"IKY" AND HIS MATE.

JERSEY COW "BUTTERFLY MAID"
RECORD FOR A YEAR, BUTTER, 392 Lbs. MILK, 6,654 Lbs.

AN AYRSHIRE YOUNGSTER
"BEN ARDEN 2nd."

GUERNSEY FOUR-YEAR OLD.
PRESENTED BY MR. H. G. CHENEY
OF SOUTH MANCHESTER.

JERSEY BULL
"COPPER STORRS."

9,000 books and above 1,000 pamphlets, all carefully indexed and classified. In the library, in addition to standard reference books on scientific and general subjects, and besides the works of the leading authors in the field of English and American literature, there is a reading room provided with most of the current magazines and a good assortment of daily and weekly newspapers of national and local interest. This is open during term-time from 8 to 12 A. M., and from 3 to 5.45 and 6.30 to 10 P. M., except Saturday, when it is open only in the forenoon, and Sunday, when it is open only part of the afternoon.

Student Expenses

The College gives free tuition and free rent of rooms.

Old and New Dormitories — Each room contains a bed, mattress, table, washstand, bureau, and chairs. All other furniture the students furnish for themselves. Each student, accordingly, should provide himself with the following necessary articles of household furnishings: 1 lamp, 1 oil can, 1 broom, 1 dust-pan, 1 washbowl and pitcher, 1 looking-glass, 1 slop-pail, 6 towels, 3 sheets for double bed, — these can be used on a single bed, — 3 pillow cases, pillows, and the blankets or comfortables to which he has been accustomed. It is advisable for students to bring from home such things as pictures, curtains, and rugs or carpets, with which to make their rooms cheerful and homelike. The students provide themselves with kerosene oil at the village store.

Grove Cottage — The rooms in the dormitory for the young lady students are well furnished with chairs, tables, bureaus, iron beds, mattresses, washstands, and bowls and pitchers. Each student should provide herself with the following articles: 1 lamp, 1 rocking chair, if desired, 6 towels, 3 sheets for single bed, 4 pillow cases, and such pillows and blankets or bed-quilts as she may require for comfort.

Further Details — The College furnishes fuel, books, and stationery at cost; the charge for heating is about $16 a year, and that for the other items is variable.

Board is furnished at cost, — $2.75 a week for regular students, $5 for ten-day periods, and $4 a week for the Summer School. No reduction is allowed for less than three days of continuous absence, and then only when notice is given in advance to the College steward.

A laundryman calls twice a week, and gives special rates to students.

All breakage of tools and apparatus, and all damage to rooms, furniture, or other College property is chargeable to the students at fault.

There is a fixed annual "breakage" charge of $3 to cover general wear and tear.

The military uniform is furnished at cost, — about $15.

A student may work at paid manual labor, *if his general conduct is good, and he maintains a good stand in his studies, provided there is such labor to be performed;* and in such cases his labor is governed by business principles and is paid for at business rates. In all laboratory, shop, and class work, and in instructive labor, system and promptness are indispensable. Professors give their classes notice daily of time and place for laboratory work and instructive labor. The daily schedule has been so revised as to give sufficient time for study and class work. The recitation and lecture periods are from 8 A. M. to 12, and from 1 P. M. to 4, including afternoon laboratory exercises and instructive labor. Students who desire to work at paid labor should make application to the various officers of the institution in whose departments they are interested.

It should be noted that, while it is the policy of the College to pay for uninstructive labor according to its value to the institution, a student should not expect to pay all expenses by this means. The student's *time is needed first of all for his studies*, if he is to succeed best in his college course. Those who depend for the most part upon their own earnings must expect to forego the sports and leisure in which those able to pay their way may more often indulge. Students who receive aid from the College through uninstructive labor must be *worthy* and *industrious*. No student whose conduct requires frequent inspection will be employed at paid labor, either in term time or during vacations.

Occasionally a young woman finds work in the family of a professor or instructor by which she is able to earn her board.

Expenses in College, as elsewhere, vary with individuals. A few students have been charged on the College books a little over $200 a year; some less than $125. Any economical student may reduce to a minimum his yearly expenditures. A few students have paid their entire expenses by their own efforts, working about the College farm, campus, and buildings; but the College does not guarantee to furnish any student enough work to enable him to do this.

All bills are payable monthly.

Deposits

Every student who intends to reside three weeks or more at the College is required to make a deposit of $25 at the Chief Clerk's office upon the date of registration. This sum may not be drawn upon until the end of the term or year; but it may then be applied to the payment of the bill for the last month, and any balance remaining will be returned to the student.

Ten-day-course students are required to deposit $10 upon the date of registration, any balance to be refunded at the end of the period.

Day students who reside away from the College are not required to make deposits upon registration, but must pay cash for all stationery and supplies.

The making of these deposits, together with the prompt payment of bills at the end of each ten days, or of each month, obviates the necessity on the student's part of furnishing bondsmen, and puts each student upon a footing of self-respect. It also enables the College to do its business in accordance with sound financial principles.

Prizes and Honors

Hicks Prizes for English Composition and Public Address—Third and fourth year students of the four-year course for farming, all students in the regular (not "associate") two-year course for farming, and all other regular students who are studying English, rhetoric, literature, or composition, may contend for the Ratcliffe Hicks Prizes.

Those who write for these prizes must deliver their essays, typewritten, to the President on or before the second Wednesday in April; and no essay will be received after 12 o'clock noon of that day.

Each essay must contain at least fifteen hundred words, and be approved by a committee of the Faculty appointed by the President.

Such essays as are not approved are returned to the writers; and the successful contestants are notified at once, in order that they may prepare themselves for the delivery of their essays the second Friday evening in May, in College Hall, before three judges,—these judges to decide on the best delivery.

The award is determined by the marks for composition and delivery reckoned together.

The first prize of $30 in 1902 was awarded to Mr. Alfred Byron Clark, '02. No second prize was assigned.

Hicks Prizes for Reading and Declamation — Three prizes are given for excellence in elocution. These may be competed for by all regular students who are required to participate in public "rhetoricals." Four speakers from each class are chosen at preliminary trials, and those selected speak in a public contest, held the first Friday evening in June, before three judges.

The prizes in 1902 were awarded as follows: First, $10, to Miss Rosa Warner Dimock, '04; second, $5, to Mr. Allen Wilbur Manchester, '03; third, $3, to Mr. David Hirsch Rosenfeld, '04.

The judges were Mr. A. E. Peterson, Mr. Allen B. Lincoln, and Miss Sarah J. Walter, all of Willimantic.

Cadet Appointments and Awards — The officers of the College Military Company are appointed and promoted according to their relative proficiency in military science and drill, their soldierly bearing, and their good conduct.

Three of the highest officers, in recognition of their excellent standing, receive at the end of a year of successful service the following prizes: Captain, $25, First Lieutenant, $20, and Second Lieutenant, $15. No officer degraded to the ranks for breach of discipline is awarded either the whole or any portion of one of these prizes.

The following officers were appointed in 1902: Captain, A. W. Manchester, '03; First Lieutenant, Mr. A. C. Hauck, '03; Second Lieutenant, Mr. R. J. Averill, '03.

At a public contest in military drill the cadet who wins the award of first place is made color-bearer.

Commencement Honors — The two honor positions on the Commencement programme are the first and the last. The student who maintains the highest rank is awarded the last position, and the student next in rank the first.

In 1902 Miss Vera Estelle Freeman stood first, and Mr. Lester Ford Harvey second.

Lectures

Lectures are delivered before the student body during the College year. The following were given during the year 1901-1902:

Mr. Edward F. Bigelow, editor of Nature and Science for Young Folks' department of *St. Nicholas*, Stamford, " Roadsides, Fields, and Forests."

Mr. Edwin H. Forbes, Superintendent of Schools. Torrington, " The Moon."

The Rev. Nestor Light, South Coventry, "A Trip to the Philippines."

Mr. T. F. McGrew, editor Poultry department of *The Country Gentleman*, New York, " Types of Poultry and Game Birds."

The Hon. William Edgar Simonds, Hartford, " The Age of Inventions."

Professor Edward B. Voorhees, Director of New Jersey Experiment Station, Brunswick, N. J., " High Grade Market Milk."

Recreation

Just to be at the College is, during a considerable portion of the year, a sheer delight for one who loves the country, with all its pleasant sights and sounds, fresh air, pure water, cool woods, fragrant orchards and meadows, and familiar domestic animals. Storrs is a beautiful spot.

Add to this the outdoor pleasures of walking, bicycling, tennis, baseball, football, ice-polo, and coasting, and indoor basketball, receptions, games, dances, good reading, interesting lectures and entertainments, society meetings, and dormitory good-fellowship, and students find few dull moments in their leisure between classes and study hours. A term is scarcely begun before it is over and gone.

JUNIORS COASTING

DAIRY BACTERIOLOGY.

VETERINARY CORNER

CHEMISTRY

For many students there is sufficient recreation in the diversified class-room and field work provided by the College curriculum, especially when the manifold opportunities for self-improvement here are contrasted with the deprivations of a previous less fortunate condition.

To feel well is to find extreme enjoyment, and no locality can be more healthful and invigorating than that occupied by the College.

College life has a charm and worth peculiar to itself, and not a few have gone from the Connecticut Agricultural College with the bravest, tenderest, and pleasantest memories.

Student Rules and Regulations

A college, however proud its past, its equipments, or its attractions, is like a nation. It must have its laws, unwritten and written. The following written rules and regulations will indicate, with some degree of adequacy, the constitution to which this Institution, in the interest of pleasant relationships and thorough education, has by degrees come to conform. There are others, doubtless, of no less importance, but these here published should be marked well and carefully digested. Some of these relate to the appearance, some to the heart, of our college life.

1. Students are expected to keep their rooms and closets in tidy condition at all times.

2. All dirt and litter is to be put in boxes provided by the janitor.

3. Students are advised not to paste or tack anything upon the walls or woodwork of their rooms, as each will be held responsible for any damage which may be done to his or her apartment.

4. Students are forbidden to suspend from windows, or to display on the outer walls or in the halls of dormitories,

signs, or posters, or wearing apparel of any description, or other articles unsightly or improper to be so exposed. This rule is not held to include the proper airing of bedding during the forenoon.

5. Study hours are kept at Grove Cottage from 7.30 to 9.30, and in the dormitories of the young men from 7.30 until the hour of retiring; except Friday and Saturday evenings. Failure to do satisfactory class work during the day is reported immediately at the President's office, and delinquents are required to study that evening from 7.30 to 9.30 in a class-room under the eyes of a master.

6. Military inspection of the College cadets and their quarters is conducted regularly Sunday mornings, and at such other times as the President or Commandant may choose; and the young men conform to the inspection regulations made by the Commandant.

7. The cadets are required to wear the prescribed military uniform at all times, except when the Commandant shall order otherwise.

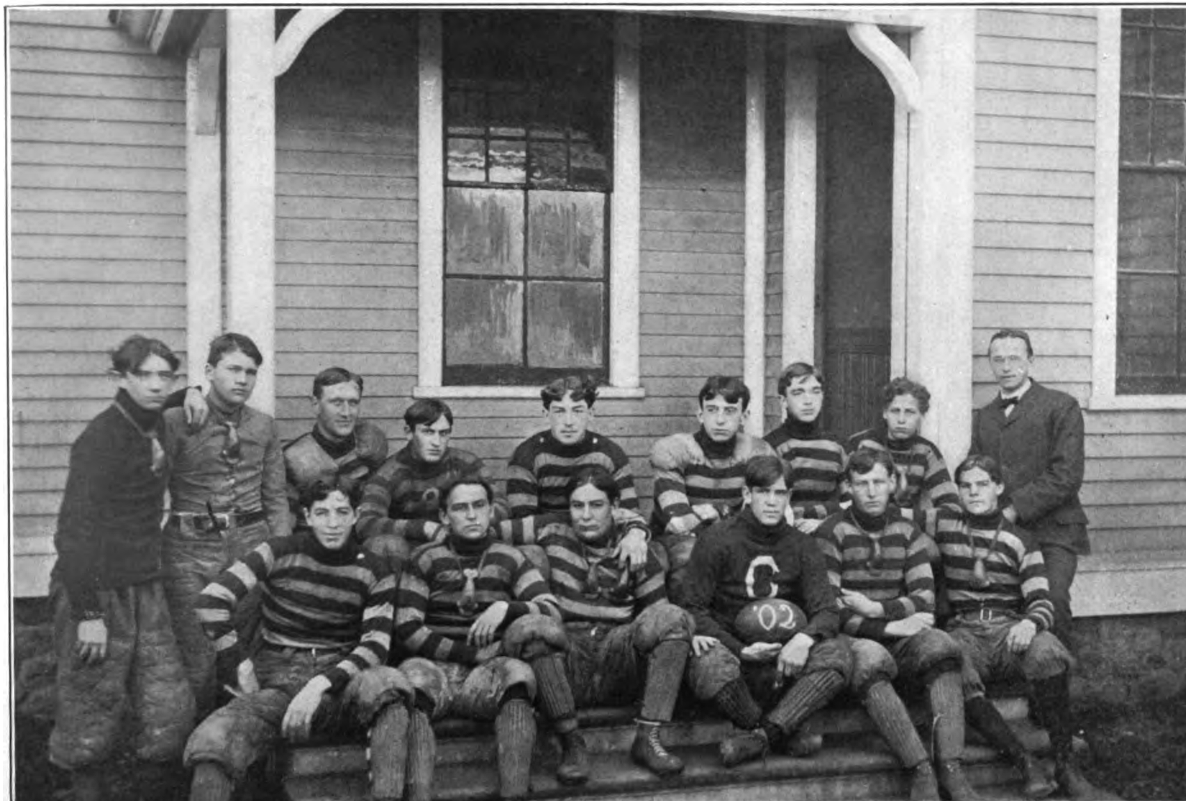
8. A cadet officer for breach of discipline may be degraded to the ranks.

9. The young women are expected to conform to the rules made by the Lady Principal.

10. Attendance upon a vesper chapel service in College Hall each week day except Saturday and Sunday, and attendance upon a religious service on Sunday, are required of all students, except upon written petition to the contrary from a parent or guardian filed at the President's office, or except upon the presentation of some other good reason. The chapel services are nonsectarian, and devoted to topics relating to public and private morals, or to the welfare of the College and student body.

11. Most of the students prefer to attend a neighboring Congregational Church, which has assigned desirable seats

GIRLS' BASKETBALL TEAM



FOOTBALL TEAM

for their use; and the cadets who choose to attend this church march there Sunday mornings and sit in a body, when ordered to do so by the Commandant. This is the church attended by most of the College Faculty.

12. Promotion from one class to the next higher occurs at the end of the college year. Grades are reported regularly at the President's office upon the completion of the work of each term, and the following letters are used for this purpose: A, meaning *excellent;* B, meaning *good;* C, meaning *fair;* D, meaning *failure*, and, therefore, *a condition* in the subject indicated. The grades attained are reported, also, to parents or guardians.

13. A failure in two subjects allows a student to pass, upon the condition that the deficiency be satisfactorily made up.

14. The Faculty reserves the right of dropping a delinquent student to a lower class, or of making other disposition of his case, at any time during the year.

15. A student failing in more than two studies is not promoted to a higher class, but is required to take over again the studies of the year in which he has failed.

16. Special students are required to submit schedules of study which meet the approval of the Committee on Courses of Study or the President.

17. Examinations are given in all classes at the end of each term. But class officers keep a daily record of the standing of each student, and are at liberty to give tests at any time they may deem it necessary. Fees for special examinations are charged at the discretion of the President or Committee on Courses of Study.

18. All students must maintain in their studies a daily standing satisfactory to their instructors. Inability or disinclination to do this renders a student liable to instant suspension from the class.

19. Students who are behind in their classwork may be debarred from taking part in athletics.

20. Where certificates, diplomas, or degrees are expected, all deficiencies must be made up before the spring term of the year of graduation.

21. Excuses for absences from church, chapel, or class must be offered before the absences occur, except in cases of protracted illness, or when the roads are impassable. An excuse for leave of absence from College, to be valid, must be signed by the class officers and approved at the President's office before the departure of the student.

22. Quiet is expected to be preserved in the dormitories during class and study hours, and in other college buildings at all times.

23. The use of tobacco on the campus is forbidden.

24. It should go without saying that such gross offenses as lying, stealing, drinking intoxicating liquors, or bringing upon the college grounds any fermented or intoxicating liquors are punishable by the summary expulsion of the student found guilty.

25. The discharge of firearms in or about the dormitories or elsewhere upon the campus, except by order of the Commandant, is prohibited.

26. Ball-playing and snow-balling are not permitted within a hundred feet of any College building.

27. Students under age are not permitted to purchase from the College on credit anything but books, stationery, and similar supplies, without written permission from parents or guardians addressed to the College and left at the Chief Clerk's office.

28. No money is paid to any minor for labor, or otherwise, without a written order from a parent or guardian. Such orders must be addressed to the Connecticut Agricultu-

BOARD OF EDITORS—*C. A. C. Lookout*

C. A. C. CADET OFFICERS

ral College, and should state specifically whether any and all money earned is to be paid, or only such part, and for such a period, as may be stated in the order.

29. No money can be advanced to any student whose account is not settled. And all earnings at paid labor must be applied to the payment of current expenses until the amounts due have been paid in full, unless their prompt payment has been otherwise provided for.

30. No student is entitled to a certificate or diploma until the payment of his last College bill has been secured.

31. The Lady Principal and young women at Grove Cottage hold a reception the third Friday evening of each month during term time. Dancing is permitted, and other forms of pleasant amusement. These receptions close at ten o'clock.

32. The young men are permitted to call at Grove Cottage at times fixed by the Lady Principal.

33. The young men are expected cheerfully to conform to the rules of the Lady Principal which concern them,— rules according joint privileges to the young women and to them, or establishing restrictions; and they are held severely accountable for participation in any misconduct.

34. All entertainments given by the students on the College grounds are under the control of the Faculty, and allowed at their discretion.

35. All matters pertaining to Commencement are arranged in consultation with, and upon the approval of, the President or Committees of the Faculty.

36. The exercises of Class-Day evening are closed at ten o'clock, whether these consist of a senior or of an alumni reception, hop, or banquet.

37. If students at any time decide to withdraw from the Institution, they are expected to call at the President's

office for making their final arrangements. Their accounts will then be properly adjusted, all money due from their deposits refunded, their work recorded, and an honorable discharge granted. Students leaving College without such adjustment will not be entitled to an honorable dismissal.

Admission Requirements

Citizens of Connecticut fifteen years old or older are eligible as candidates for admission to the College.

Satisfactory testimonials in respect of good character and previous scholarship from a former teacher, pastor, or reputable neighbor, are required of each candidate.

All candidates are advised to take examinations.

Candidates are admitted on certificate from teachers of properly accredited high and common schools; but students so admitted are considered on probation until they have demonstrated their ability to do the work of the classes to which they have sought entrance.

Those who enter College under conditions are required to make up such conditions before advancing to the course of study of the next year.

Candidates may enter an advanced class, if, on examination or proper certificate, they are found qualified.

New classes are formed at the beginning of the College year, but students may be admitted at any time by special examination.

Special students, who for good reason find themselves unable to take a regular course, are permitted to choose courses of study in subjects they are prepared to pursue; but are held in all other matters by the same restrictions as regular students.

Candidates for the short courses of the Winter School or the Summer School are admitted without examination.

A good preparation enhances a college course tenfold. The following subjects are required for entrance to the lowest regular classes:

Arithmetic —A thorough knowledge of fractions, denominate numbers, mensuration, percentage, discount, interest, bonds and stocks, square and cube root.

Geography — What is usually required in a common school course.

History — Montgomery's "Leading Facts in American History," or its equivalent.

English Grammar — A knowledge of the parts of speech, the construction of sentences, punctuation, the use of capitals, and the ability to analyze sentences and parse the words composing them. The applicant's speech should be free from flagrant errors, and he should be able to express himself in writing with grammatical correctness and ease.

Reading — The course prescribed by the New England colleges is recommended to candidates here.

All examinations must be written, and the candidate's handwriting will be carefully noted.

Specimen Entrance Examinations for Admission to the Lowest Class

ARITHMETIC

1. Add 1256.
   3482.
   9783.
   6145.
   9319.
   2864.
   5873.
   9451.
   2439.
   5349.

2. Add $\frac{1}{2}$, $\frac{1}{4}$, $\frac{1}{3}$, and $\frac{1}{6}$.
3. Subtract 45° 25′ 25″ from 50° 20′ 45″.
4. Multiply 493.62 by 64.93.
5. Divide 105 by 254 to five places.
6. Find the square root of 5 to four places.
7. Find the cube root of 17,576.
8. Flint glass contains by weight 72% sand, 14% soda, 12% lime, and 2% aluminum. Find the number of pounds of each of these substances in 125 lbs. of flint glass.
9. Find the number of feet board measure in 6 beams 16 ft. long and 16 in. square at the ends.
10. Define *numerator*, *prime number*, *product*, *decimal*, *simple interest*, *compound interest*, *premium*.

GEOGRAPHY

1. Define latitude ; longitude ; parallels ; meridians.
2. What island is at the southern extremity of British India?
3. What strait separates Spain from Morocco?
4. Locate the following cities: Copenhagen, Hamburg, Moscow, Kansas City, Winnipeg, Seattle.
5. Locate the following islands: Hawaii, St. Helena, Fiji, Porto Rico; and state to what country each belongs.
6. Bound the following states: Idaho, Utah, Tennessee; and give their capitals.
7. What lake is immediately north of Minnesota?
8. Into what body of water does the Mississippi River flow?
9. What mountains separate France from Spain?
10. Where are the great maize producing states of the Union situated?
11. Which are the great wheat producing states?

UNITED STATES HISTORY

1. (*a*) Name the thirteen original states.
   (*b*) Mention the principal accessions of territory since the foundation of the government, noting the administration under which each was made.
   (*c*) Name the accessions of territory made by purchase and those made as a result of war.
2. (*a*) Mention some of the causes that led to the French and Indian War.
   (*b*) Name some of the causes that led to the Revolution.
   (*c*) Describe the movements that led up to the battle of Trenton.

3. (*a*) For what reason is the capture of Quebec by Wolfe regarded as an event of great importance in American History?
(*b*) What battle is regarded as the turning point in the American Revolution?
(*c*) State the reason for your selection.

4. Name some act, some event, or some famous state paper associated in your mind with the following names: Franklin, Jefferson, John Jay, Monroe, John Brown, Abraham Lincoln, William McKinley.

5. (*a*) What invention or improvement either in means of communication, manufacture, transportation, or ease of living is associated in your mind with the following names: Morse, Whitney, De Witt Clinton, Edison, Ericsson, Elias Howe, Marconi, Alexander Bell?
(*b*) Name some of the earliest institutions of learning founded in this country.
(*c*) Name some of the earliest newspapers.
(*d*) What paper in Connecticut is among the oldest in the country?

6. (*a*) What political struggle led up to the Civil War?
(*b*) On what date and by what act did the Civil War begin?
(*c*) Where and by what act was the Civil War brought to an end?
(*d*) What battle is generally regarded as the turning point in the Civil War?

ENGLISH GRAMMAR

1. Name the parts of speech, and give an example of each.
2. Name the classes of nouns, and give an example of each.
3. Give the feminine of *boy*, *lion*, *man-servant*.
   Give the plural of *wind*, *dish*, *loaf*, *army*, *ox*, *radius*.
   Give the possessive of *princess*, *man-of-war*, *oxen*, *horses*.
4. What are the different classes of pronouns? Give examples of each class. Decline *he*.
5. Compare *good*, *bad*, *much*, *old*.
6. What is a transitive verb? An intransitive verb? Give examples in sentences.
7. Name the different moods and tenses. Give the principal parts of *rise*, *sing*, *know*, *call*, *buy*, *bend*.
   Give the passive, indicative, future perfect, third singular of the verb *throw*.
8. What is a simple sentence? A complex sentence? A compound sentence?
9. Analyze and parse: "*Smooth runs the water where the brook is deep.*"

10. Correct the following:

I had intended to have done it.
Can I go tomorrow?
I do not want those kind.
Everyone went their way rejoicing.
The fields look beautifully in the sunlight.
It will not rain today, I don't think.
He has not said nothing for an hour
There is a boy whom everyone thinks will become a great artist.

Those who are unwilling to pledge themselves to cheerful conformity to all College rules and regulations, and to the industrious performance of such tasks as are called for by the courses of study offered, are requested not to present themselves as candidates for admission.

INSTRUCTIONS TO CANDIDATES

Those desirous of becoming students in College should carefully examine this catalogue, especially the sections found under the headings: "Expenses," "Deposits," "Rules and Regulations," and "Admission Requirements."

In addition to the parts indicated, the following advice and directions may be found serviceable and should be observed:

1. Write for "Questions to Prospective Students"; answer the questions, and mail the sheet to the President of the College.

2. When you present yourself for an entrance examination, bring a letter of recommendation from your former teacher or pastor, certifying as to your *moral character* and *previous scholarship*. If from a high school or another college, an honorable discharge and recommendation will also be required. No examination of any candidate will be conducted until such credentials have been furnished.

3. As soon as convenient after the examination you will be notified of the result.

4. There is no hotel at Storrs. Therefore, if you are intending to take advantage of any of the courses offered, you are requested to make application at your earliest convenience in order to facilitate preliminary dining-room and dormitory arrangements.

5. Address all inquiries about rooms to Mr. E. O. Smith, *Secretary*.

6. Check all baggage and send all freight and express to Eagleville. Tag with your name and destination all trunks, bags, or boxes.

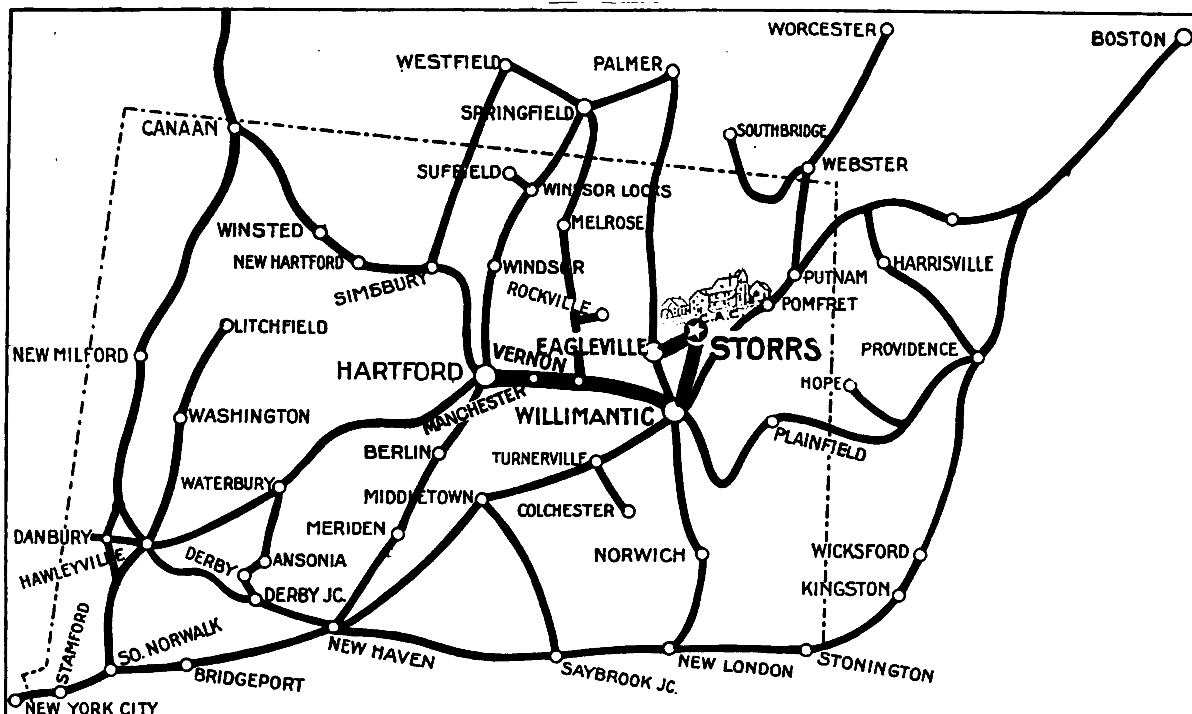
7. Drive out to the College from Willimantic. The livery stable charge for one person is $1.50; for two or more a cheaper rate is made.

8. Or, take the train from Willimantic to Eagleville. The fare is only 25 cents, but close connections cannot be made at all times of the day.

9. If you mean to come to Eagleville, send notice several days in advance, indicating the time at which your train will arrive, in order that the College may meet you and deliver your baggage promptly. Students frequently find it convenient to walk up from Eagleville.

10. Call at the President's Office for registration, for making your deposit, and for the assignment of a room.

11. Examine the College bulletin board daily for schedules of classes and other important notices.



RAILWAY CONNECTIONS:—Students arrive at Willimantic, on the N. Y., N. H. & H. Railway; or at Eagleville, on the Central Vermont Railway.

HIGHWAYS:—Students drive out to the College from Willimantic: or are met by College teams at Eagleville, if due notice is sent.

CONNECTICUT AGRICULTURAL COLLEGE — REAR VIEW

COURSES OF STUDY

The liberal, scientific, and practical education provided by The Connecticut Agricultural College may be in some measure suggested by the headings of the courses of study, which will be open for choice in 1902-1903.

These courses embrace the sciences that bear directly upon practical agriculture: Botany, Chemistry, Geology, Zoölogy, Veterinary Science, Physics, Entomology, and Meteorology. Also it will be seen that they include culture and mental discipline studies, such as Mathematics, English Composition, Rhetoric and Literature, Latin, German, History, Ethics, Political Economy, Civics, Drawing, Business Studies, and Home Economics.

Large latitude is given in the choice of a course. And the provision of these various courses makes possible the most thorough and enthusiastic work, inasmuch as each student may turn to the group of studies for which he has special liking or aptitude, and inasmuch as each, thus, may expect to be associated with students as earnest as himself.

These courses tend to specialization and increased efficiency; but the students who choose them are guarded against narrowness by being thrown together in those broadening, general culture studies which are fundamental to good citizenship, and which are required of all students.

Provision has been made for the young men and young women who desire to return to the farms; and for those, also, who desire to go into civil engineering, business, teaching, or some one of the other leading pursuits or professions.

Courses of Study in Briefest Outline

1. Four Years of Preparation for Farming. — Open to graduates of the common schools. Diploma on graduation.

2. Two Years of Preparation for Farming. — Open to graduates of high schools. Diploma on graduation.

3. Associate Two Years of Preparation for Farming. — Open to men twenty years old, or older, who have not had a high school education. No diploma. Certificate, if desired, covering work done.

4. Two Years of Preparation for Business. — Open to those who have had the first two years of course No. 1 or No. 8, and open to graduates of high schools. Certificate or diploma.

5. Two Years of Preparation for Mechanical Work, Surveying, or Drafting. — Open to those who have had the first two years of course No. 1, and open to graduates of high schools. Certificate or diploma.

6. Four Years of Preparation for Agricultural Teaching, Experiment Station Work, or Work in the Department of Agriculture at Washington, D. C., under Civil Service Rules. — Open to those who have had the first two years of course No. 1, and open to graduates of high schools. Graduation with degree, B.S.

7. Four Years of Training in Mathematics, Sciences, Civil Engineering, History, Ethics, Political Economy, Literature, and Three Languages — Latin, German, and English. — Open to those who have had the first two years of course No. 1 or No. 8, and open to graduates of high schools. Degree, B.S.

8. Four Years of Preparationf or Housekeeping or Home-Making. — Open to graduates of common schools. Diploma or certificate on graduation.

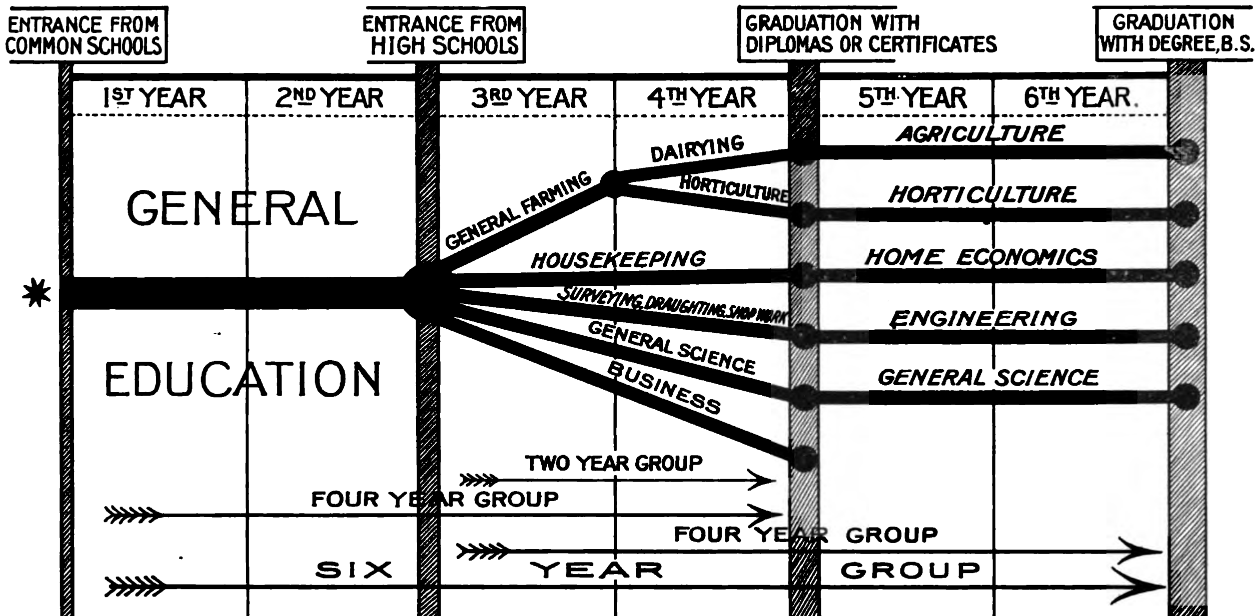
9. Two Years of Preparation for Housekeeping or Home-making.— Open to graduates of high schools. Diploma or certificate.

10. Four Years of Preparation for Teaching Home Economics. — Open to those who have had the first two years of course No. 8, and open to graduates of high schools. This, if taken in connection with two different branches selected from other courses, will lead to graduation with the degree, B.S.

Note. — Certain of the above courses overlap others. For example, the last two years of Course 1 and Courses 2 and 3 cover the same group of studies. In some classes students from several different courses may be associated. The main purpose of this classification is to show that education is provided by the College to meet the needs of students of different grades of preliminary training and of distinctly different prospective callings.

For the shorter courses offered, see pages (79–87).

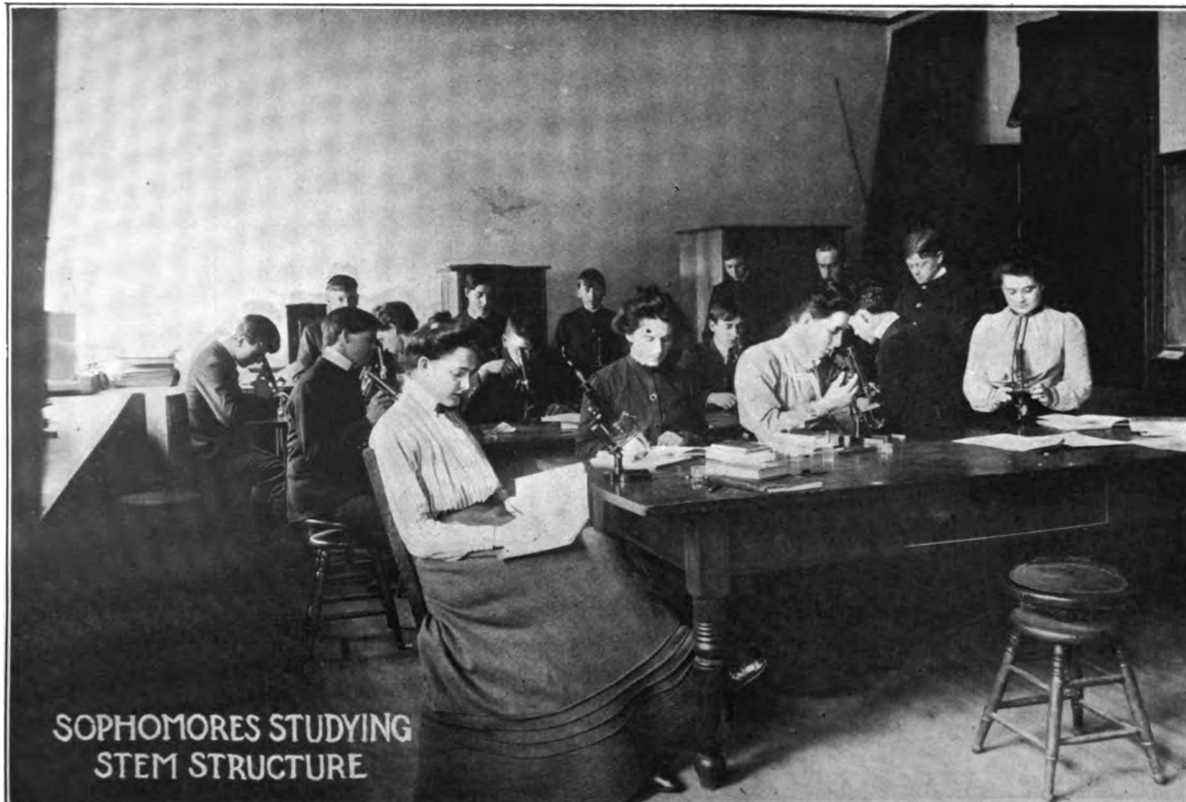
Six years of Education provided at the Connecticut Agricultural College.



✱ Studies of first and second years, prescribed; courses of years three to four, or three to six, inclusive, are elective, as above shown. Special Students admitted.

ADDITIONAL ADVANTAGES:—

WINTER SCHOOL, Short Courses, for Busy People.
SUMMER SCHOOL, for Teachers and Others, in Nature and Country Life.



SOPHOMORES STUDYING
STEM STRUCTURE

SCHEDULES

EXPLANATORY — The subjects on the left indicate the various studies; the figures following the subjects, the number of the course in the subject specified; the figures in the vertical columns, the number of hours a week in the different terms; and the figures in parentheses, laboratory (or instructive labor) periods. Not fewer than fifteen class hours a week may be taken; and in computing the number of hours, two laboratory hours will be counted equivalent to one class hour. The schedule chosen must be approved by the Committee on Courses of Study, or by the President, previous to entrance upon it.

For synopses of the subjects in the following schedules see Courses of Study Fully Described, p. 59.

Schedule of Course No. 1

PREPARATION FOR FARMING — 4 YEARS

OPEN TO STUDENTS FROM THE COMMON SCHOOLS — DIPLOMA ON GRADUATION

First Year

Subjects	Fall term	Winter term	Spring term
English, 1,	4	4	4
Algebra,	4	4	4
Arithmetic and Penmanship,	..	5	5
Physical Geography,	5	..	..
Free-hand Drawing,	(2)	..	(2)
History and Civics, 1,	4	4	4
Drill,	(3)	(3)	(3)

Second Year

Subjects	Fall term	Winter term	Spring term
English, 2,	4	4	4
Geometry,	4	4	4
Chemistry, 1,	4	4	4
Botany, 1,	3 (2)	3	2 (3)
Physics, 1,	2	2	2
History, 2,	3	4	3
Drill,	(3)	(3)	(3)
Agricultural Laboratory, 1,	..	..	(3)
Horticultural Laboratory, 1,	..	..	(3)

Third Year

English, 3,	3	3	3
Economics, 1,	2	2	2
Drill,	(3)	(3)	(3)
Zoölogy,	..	..	3
Physiology,	..	..	4 (2)
Agricultural Physics and Fertilizers,	5 (3)	..	..
Agricultural Bacteriology,	1 (4)	1	1
Surveying,	..	..	(3)
Wood Work,	..	(6)	..
Mechanical Drawing, 1,	.. (6)	..	..
Iron Work,	..	..	(6)
Poultry,	..	3	10 *
Trigonometry,	..	3	..
Horticulture, 2,	3 (3)	5 (3)	(3)
Meteorology,	2	..	..
Agricultural Laboratory, 3,	..	(3)	..
Horse Barn,	..	(3)	..

Summer term: Economic Entomology, Horticulture, and Agriculture.

Fourth Year

REQUIRED OF ALL

Drill,	(3)	(3)	(3)
Forestry, 4,	..	3	..
Rural Economics,	..	5	..
Farm Engineering,	..	..	3
Geology,	..	..	3

THREE ADDRESSES, ONE EACH TERM

In addition to these required studies, each student will elect either the following studies in Horticulture or those in Agriculture.

* First 6 weeks.

For those who prefer Agriculture

Subjects	Fall term	Winter term	Spring term
Breeding of Animals,	..	4	..
Feeding,	5 (3)	(15)	..
Breeds and Stockjudging,	3 (6)	..	..
Dairy Breeds,	2 (6)	..	..
Veterinary Science, 1,	5	3	..
Dairying, 4,	..	..	5 (9)
Crop Production,	..	..	5 (3)
Dairy Bacteriology,	..	..	(4)

For those who prefer Horticulture

Greenhouse Construction,	2	..	..
Plant Diseases,	4 (6)	..	..
Botanic Horticulture,	..	3 (3)	..
Plant Breeding,	1	..	..
Commercial Horticulture,	5 (6)	(3)	..
Special Investigation and Thesis,	(3)	3 (6)	3 (15)

Schedule of Course No. 2

PREPARATION FOR FARMING—2 YEARS

OPEN TO GRADUATES OF HIGH SCHOOLS—DIPLOMA ON GRADUATION

All courses taken into account, students in the first year of this course rank as third year students in the College.

First Year

English, 3,	3	3	3
Economics, 1,		2	2
Drill,	(3)	(3)	(3)
Zoölogy,	..	..	3
Physiology,	.	..	4 (2)
Agricultural Physics and Fertilizers,	5 (3)	..	..
Agricultural Bacteriology,	1 (4)	1	1
Surveying,	..	..	(3)
Wood Work,	..	(6)	..
Mechanical Drawing, 1,	(6)	..	..
Iron Work,	..	..	(6)
Poultry,	..	3	(10)*
Trigonometry,	..	3	..
Horticulture, 2,	3 (3)	5 (3)	(3)
Meteorology,	2	..	..
Agricultural Laboratory, 3,	..	(3)	..
Horse Barn,	..	(3)	..

Summer term: Economic Entomology, Horticulture, and Agriculture.

* First 6 weeks.

Second Year

Required of All

Subjects	Fall term	Winter term	Spring term
Drill,	(3)	(3)	(3)
Forestry, 4,	..	3	..
Rural Economics,	..	5	..
Farm Engineering,	..	..	3
Geology,	..	..	3

Three Addresses, one each term

In addition to these required studies, each student will elect either the following studies in Horticulture or those in Agriculture.

For those who prefer Agriculture

Breeding of Animals,	..	4	..
Feeding,	5 (3)	(15)	..
Breeds and Stockjudging,	3 (6)	..	..
Dairy Breeds,	2 (6)	..	..
Veterinary Science, 1,	5	3	..
Dairying, 4,	..	..	5 (9)
Crop Production,	..	..	5 (3)
Dairy Bacteriology,	..	..	(4)

For those who prefer Horticulture

Greenhouse Construction,	2	..	..
Plant Diseases,	4 (6)	..	..
Botanic Horticulture,	..	3 (3)	..
Plant Breeding,	1	..	..
Commercial Horticulture,	5 (6)	(3)	..
Special Investigation and Thesis,	(3)	3 (6)	3 (15)

Schedule of Course No. 3

PREPARATION FOR FARMING — ASSOCIATE 2 YEARS

Open to Men twenty years old, or older, who have not had a High School Education — No Diploma — A Certificate if desired, covering work done

All courses taken into account, students in the first year of this course rank as third year students in the College.

First Year

Subjects	Fall term	Winter term	Spring term
English, 3,	3	3	3
Economics, 1,	2	2	2
Drill,	(3)	(3)	(3)
Zoölogy,	..	..	3
Physiology,	..	..	4 (2)
Agricultural Physics and Fertilizers,	5 (3)	..	..
Agricultural Bacteriology,	1 (4)	1	1
Surveying,	..	..	(3)
Wood Work,	..	(6)	..
Mechanical Drawing, 1,	(6)	..	..
Iron Work,	..	..	(6)
Poultry,	..	3	(10)*
Trigonometry,	..	3	..
Horticulture, 2,	3 (3)	5 (3)	(3)
Meteorology,	2	..	..
Agricultural Laboratory, 3,	..	(3)	..
Horse Barn,	..	(3)	..

Summer term: Economic Entomology, Horticulture, and Agriculture.

Second Year

REQUIRED OF ALL

Drill,	(3)	(3)	(3)
Forestry, 4,	..	3	..
Rural Economics,	..	5	..
Farm Engineering,	..	..	3
Geology,	..	..	3

THREE ADDRESSES, ONE EACH TERM

In addition to these required studies, each student will elect either the following studies in Horticulture or those in Agriculture.

For those who prefer Agriculture

Breeding of Animals,	..	4	..
Feeding,	5 (3)	(15)	..
Breeds and Stockjudging,	3 (6)	..	..
Dairy Breeds,	2 (6)	..	..
Veterinary Science, 1,	5	3	..
Dairying, 4,	..	..	5 (9)
Crop Production,	..	..	5 (3)
Dairy Bacteriology,	..	..	(4)

* First 6 weeks.

For those who prefer Horticulture

Subjects	Fall term	Winter term	Spring term
Greenhouse Construction,	2	..	..
Plant Diseases,	4 (6)	..	..
Botanic Horticulture,	..	3 (3)	..
Plant Breeding,	1	..	..
Commercial Horticulture,	5 (6)	(3)	..
Special Investigation and Thesis,	(3)	3 (6)	3 (15)

Schedule of Course No. 4

PREPARATION FOR BUSINESS—2 YEARS

OPEN TO GRADUATES OF HIGH SCHOOLS, OR TO THOSE WHO HAVE HAD YEARS 1 AND 2 OF THE FOUR YEARS' COURSE FOR FARMING—DIPLOMA ON GRADUATION

All courses taken into account, students in the first year of this course rank as third year students in the College.

First Year

Drill,	(3)	(3)	(3)
English, 3,	3	3	3
Economics, 1,	2	2	2
Bookkeeping,	5	5	5
Correspondence,	3	3	..
Stenography,	5	5	5
Typewriting,	3	3	3
Commercial Geography,	..	..	3

Second Year

Drill,	(3)	(3)	(3)
English and Ethics, 4,	4	4	4
Economics, 2,	3	3	3
Commercial Law,	3	3	3
Stenography,	3	3	3
Business Forms,	3	3	3
Typewriting,	3	3	3

THREE ADDRESSES, ONE EACH TERM

Schedule of Course No. 5

PREPARATION FOR MECHANICAL WORK, SURVEYING, OR DRAFTING—2 YEARS

OPEN TO THOSE WHO HAVE HAD YEARS 1 AND 2 OF COURSE NO. 1, AND OPEN TO GRADUATES OF HIGH SCHOOLS—CERTIFICATE OR DIPLOMA

All courses taken into account, students in the first year of this course rank as third year students in the College.

First Year

REQUIRED OF ALL

Subjects	Fall term	Winter term	Spring term
English, 3,	3	3	3
Economics, 1,	2	2	2
Mathematics, 4,	3	3	3
Physics, 2,	3	3	..
Physiology,	..	..	4 (2)
Drill,	(3)	(3)	(3)

Choose two of the following:

Chemistry, 2,	1 (4)	1 (4)	1 (4)
German, 1, or Latin, 1,	3	3	3
Botany, 2,	3	3	3
History, 3,	3	3	3
Mechanical Drawing and Shopwork in Wood and Iron, 1,	(6)	(6)	(6)
Geology,	3	3	3
Zoölogy,	3	3	3

Second Year

REQUIRED OF ALL

English and Ethics, 4,	4	4	4
Mathematics, 6, and 7 or 10,	3	3	3
Drill,	(3)	(3)	(3)

THREE ADDRESSES, ONE EACH TERM

Choose three of the following:

Subjects	Fall term	Winter term	Spring term
Chemistry, 3,	1 (4)	1 (4)	1 (4)
German, 2, or Latin, 2,	3	3	3
Botany, 3,	3	3	3
History, 4,	3	3	3
Mechanical Drawing, 2,	(6)	(6)	(6)
Economics, 2,	3	3	3
Entomology,	3	3	3
Ornithology,	3	3	3

Schedule of Course No. 6

PREPARATION FOR AGRICULTURAL TEACHING, EXPERIMENT STATION WORK, OR WORK IN THE DEPARTMENT OF AGRICULTURE AT WASHINGTON, D. C., UNDER CIVIL SERVICE RULES—4 YEARS

OPEN TO THOSE WHO HAVE HAD THE FIRST TWO YEARS OF COURSE NO. 1, AND OPEN TO GRADUATES OF HIGH SCHOOLS—GRADUATION WITH DEGREE, B. S.

All courses taken into account, students in the first year of this course rank as third year students in the College.

First Year

English, 3,	3	3	3
Economics, 1,	2	2	2
Drill,	(3)	(3)	(3)
Zoölogy,	..	..	3
Physiology,	..	..	4 (2)
Agricultural Physics and Fertilizers,	5 (3)	..	..
Agricultural Bacteriology,	1 (4)	1	1
Surveying,	..	..	(3)
Woodwork,	..	(6)	..
Mechanical Drawing, 1,	(6)	..	..
Iron Work,	..	..	(6)
Poultry,	..	3	(10)*
Trigonometry,	..	3	..
Horticulture, 2,	3 (3)	5 (3)	(3)
Meteorology,	2	..	..
Agricultural laboratory, 3,	..	(3)	..
Horse Barn,	..	(3)	..

Summer term: Economic Entomology, Horticulture, Agriculture, and Botany.

* First 6 weeks.

Second Year

Required of All

Subjects	Fall term	Winter term	Spring term
Drill,	(3)	(3)	(3)
Forestry, 4,	..	3	..
Rural Economics,	..	5	..
Farm Engineering,	..	..	3
Geology,	..	..	3

Three Addresses, one each term

In addition to these required studies, each student will elect either the following studies in Horticulture or those in Agriculture.

For those who prefer Agriculture

Breeding of Animals,	..	4	..
Feeding,	5 (3)	(15)	..
Breeds and Stockjudging,	3 (6)	..	..
Dairy Breeds,	2 (6)	..	..
Veterinary Science, 1,	5	3	..
Dairying, 4,	..	..	5 (9)
Crop Production,	..	..	5
Dairy Bacteriology,	..	..	(4)

For those who prefer Horticulture

Greenhouse Construction,	2	..	..
Plant Diseases,	4 (6)	..	..
Botanic Horticulture,	..	3 (3)	..
Plant Breeding,	1	..	..
Commercial Horticulture,	5 (6)	(3)	..
Special Investigation and Thesis,	(3)	3 (3)	3 (15)

Third Year

English and Ethics, three terms, four hours a week.

One other language required three terms, three hours a week, of those who have not had two years of German or Latin.

Other studies elective, except that, in the schedule as a whole, studies in three distinct branches must be taken.

4

Fourth Year

One foreign language required three terms, three hours a week, of those who have not had two years of German or Latin.

All other studies elective, except that, in the schedule as a whole, studies in three distinct branches must be taken.

NOTE: In making out the schedule desired, the section of the catalogue named "Elective Studies," p. 55, should be consulted.

Schedule of Course No. 7

GENERAL SCIENCE COURSE—4 YEARS

OPEN TO THOSE WHO HAVE HAD THE FIRST TWO YEARS OF COURSES No. 1 OR No. 8, AND OPEN TO GRADUATES OF HIGH SCHOOLS—DEGREE OF B. S.

All courses taken into account, students in the first year of this course rank as third year students in the College.

First Year

REQUIRED OF ALL

Subjects	Fall term	Winter term	Spring term
English, 3,	3	3	3
Economics, 1,	2	2	2
Mathematics, 4,	3	3	3
Physics, 2,	3	3	..
Physiology,	..	..	4 (2)
Drill,	(3)	(3)	(3)

Choose two of the following:

Chemistry, 2,	1 (4)	1 (4)	1 (4)
German, 1, or Latin, 1,	3	3	3
Botany, 2,	3	3	3
History, 3,	3	3	3
Mechanical Drawing and Shopwork in Wood and Iron, 1,	(6)	(6)	(6)
Geology;	3	3	3
Zoölogy,	3	3	3

Second Year

REQUIRED OF ALL

English and Ethics, 4,	4	4	4
Mathematics, 6, and 7 or 10,	3	3	3
Drill,	(3)	(3)	(3)

THREE ADDRESSES, ONE EACH TERM

Choose three of the following:

Subjects	Fall term	Winter term	Spring term
Chemistry, 3,	1 (4)	1 (4)	1 (4)
German, 2, or Latin, 2,	3	3	3
Botany, 3,	3	3	3
History, 4,	3	3	3
Mechanical Drawing, 2,	(6)	(6)	(6)
Economics, 2,	3	3	3
Entomology,	3	3	3
Ornithology,	3	3	3

Third and Fourth Years

Before the end of this course, two years of Latin and two years of German must be completed; and any language deficiencies existing after the completion of the first two years must be made up by proper elective language studies in the third and fourth years.

All other studies freely elective: subject in the case of each course to the approval of the instructor who offers it.

For a list of studies which may be chosen, consult "Elective Studies," p. 55.

Schedule of Course No. 8

PREPARATION FOR HOUSEKEEPING OR HOME-MAKING — 4 YEARS

OPEN TO GRADUATES OF COMMON SCHOOLS—DIPLOMA OR CERTIFICATE ON GRADUATION

First Year

English, 1,	4	4	4
Algebra,	4	4	4
Arithmetic and Penmanship,	..	5	5
Physical Geography,	5	..	..
Drawing,	(2)	..	(2)
History and Civics, 1,	4	4	4
Gymnastics,	(3)	(3)	(3)

Second Year

Chemistry, 1,	4	4	4
English, 2,	4	4	4
Geometry,	4	4	4
Botany, 1,	3 (2)	3	2 (3)
Physics, 1,	2	2	2
History, 2,	3	4	3
Gymnastics,	(3)	(3)	(3)
Sewing,	..	..	(6)

Third Year

Subjects	Fall term	Winter term	Spring term
English, 3,	3	3	3
Economics, 1,	2	2	2
Physiology,	..	..	4 (2)
Gymnastics,	(3)	(3)	(3)
Chemistry, 2,	1 (4)	1 (4)	1 (4)
Cookery,	1 (5)	1 (5)	1 (5)
Dressmaking, Elementary,	..	..	(6)
Sewing,	(6)	(6)	..
Bacteriology, 1,	1	1	1

Fourth Year

English and Ethics, 4,	4	4	4
Chemistry, 3,	1 (4)	1 (4)	1 (4)
Dressmaking,	(6)	(6)	(6)
Sanitation, Chemistry of Cleaning, Household Economy, and Marketing Accounts,	2	2	2
Laundry,	..	1 (2)	..
Gymnastics,	(3)	(3)	(3)
Hygiene,	..	..	1
Invalid Diet,	..	..	2 (4)
Emergencies and Home Nursing,	2	..	2
Cookery, and Waitress Course,	1 (5)	1 (5)	..

Schedule of Course No. 9

PREPARATION FOR HOUSE KEEPING OR HOME-MAKING — 2 YEARS

OPEN TO GRADUATES OF HIGH SCHOOLS — DIPLOMA OR CERTIFICATE

All courses taken into account, students in the first year of this course rank as third year students in the College.

First Year

English, 3,	3	3	3
Economics, 1,	2	2	2
Physiology,	..	..	4 (2)
Gymnastics,	(3)	(3)	(3)
Chemistry, 2,	1 (4)	1 (4)	1 (4)
Cookery,	1 (5)	1 (5)	1 (5)
Dressmaking, Elementary,	..	..	(6)
Sewing,	(6)	(6)	..
Bacteriology, 1,	1	1	1

Second Year

Subjects	Fall term	Winter term	Spring term
English and Ethics, 4,	4	4	4
Chemistry, 3,	1 (4)	1 (4)	1 (4)
Dressmaking,	(6)	(6)	(6)
Sanitation, Chemistry of Cleaning, Household Economy, and Marketing Accounts,	2	2	2
Laundry,	..	1 (2)	..
Gymnastics,	(3)	(3)	(3)
Hygiene,	..	..	1
Invalid Diet,	..	..	2 (4)
Emergencies and Home Nursing,	..	..	2
Cookery, and Waitress Course,	1 (5)	1 (5)	..

Schedule of Course No. 10

PREPARATION FOR TEACHING HOME ECONOMICS — 4 YEARS

A course elsewhere sometimes called Domestic Economy, Domestic Science and Art, or Household Economy.

OPEN TO THOSE WHO HAVE HAD THE FIRST TWO YEARS OF COURSE No. 8, AND OPEN TO GRADUATES OF HIGH SCHOOLS — DEGREE OF B. S.

All courses taken into account, students in the first year of this course rank as third year students in the College.

First Year

English, 3,	3	3	3
Economics, 1,	2	2	2
Physiology,	..	..	4 (2)
Gymnastics,	(3)	(3)	(3)
Chemistry, 2,	1 (4)	1 (4)	1 (4)
Cookery,	1 (5)	1 (5)	1 (5)
Dressmaking, Elementary,	..	..	(6)
Sewing,	(6)	(6)	..
Bacteriology, 1,	1	1	1

Second Year

Subjects	Fall term	Winter term	Spring term
English and Ethics, 4,	4	4	4
Chemistry, 3,	1 (4)	1 (4)	1 (4)
Dressmaking,	(6)	(6)	(6)
Sanitation, Chemistry of Cleaning, Household Economy, and Marketing Accounts,	2	2	2
Laundry,	..	1 (2)	..
Gymnastics,	(3)	(3)	(3)
Hygiene,	..	..	1
Invalid Diet,	..	..	2 (4)
Emergencies and Home Nursing,	2	..	2
Cookery, and Waitress Course,	1 (5)	1 (5)	..

Third Year*

Food Experimentation,	1 (6)	1 (6)	1 (6)
Production and Manufacture of Foods,	..	(2)	..
Chemistry of Foods,	(6)	(6)	(6)
Physiology of Digestion,	..	..	(2)
Psychology,	2	2	2
Theory and Practice of Teaching Domestic Science and Art, and Planning of Courses,	2 (4)	2 (4)	2 (4)

Fourth Year*

Food Experimentation, continued,	1 (6)	1 (6)	1 (6)
Bacteriology,	..	..	(4)
Theory and Practice in Teaching Domestic Science and Art,	6	6	6
Pedagogy,	2	2	2
Dietaries,	2	..	..
Household Decoration and Art,	..	2	.

Practical Application of Dietaries, see page 77.

* Students in this course who are candidates for the degree B.S. must elect, in addition to the subjects scheduled for the third and fourth years of the course, two subjects each year from other departments. See p. 55.

ELECTIVE STUDIES

For Fifth-year and Sixth-year Students

Agriculture

6. Soils. Special soil investigations in laboratory and field. Soil fertility; soil exhaustion and restoration; original investigations in soil management. Supplemental to Agriculture 2. 1 year.

PROFESSOR CLINTON.

7. Farm Crops. Special study of agricultural seeds, their varieties and purity; plant variation on the farm; habits of growth and principles of tillage; original investigations in laboratory and field. Supplemental to Agriculture 5. 1 year.

PROFESSOR CLINTON.

Dairying

6. Dairy-Animal Husbandry. 1 year.

PROFESSOR BEACH.

7. Dairying and Dairy Bacteriology. 1 year.

PROFESSOR BEACH and MR. STOCKING.

Poultry Industry

2. A thorough course made up of topics selected from the following list: Domestic fowls, breeds and breeding; buildings, location, arrangement, construction, and furnishing; ventilation; yards; care and management; foods and feeding; production of flesh and eggs; dressing and packing; marketing; incubators and brooders; incubation and rearing, both natural and artificial; caponizing; care of turkeys, ducks, geese, pigeons; diseases and enemies; records and accounts. 1 year.

MR. STONEBURN.

Horticulture

4. Original work under the direction of the Professor of Horticulture. The student's desires will be consulted, and his particular interests promoted. Years 3 and 4 of course No. 1, or course No. 2 entire, must have been completed by the applicant. Original investigations in plant diseases and in the effects of pollenization are suggested as highly important and as promising valuable training and results. A thesis. 1 year or 2 years.

PROFESSOR GULLEY.

History

5. (*a*) Origin and growth of parliamentary institutions in England. One hour a week, 1st term.

(*b*) Constitutional History of the United States, tracing the sources of the constitution in the Colonial period. Two hours a week, 1st term. Parallel with course (*a*). Also, the formation of the constitution; and the development of the constitution in the National period. Two hours a week, 2d and 3d terms. Parallel with (*c*).

(*c*) History of Modern Europe to the Napoleonic era; the growth of the European states, and the colonization of America. One hour a week, 2d and 3d terms.

The method of instruction will be by text and lecture, by reference to such contemporaneous sources of information as may be available, and by reading on specially assigned topics. 1 year.

6. There will be offered, also, a course on the History of Connecticut, with especial reference to its settlement and early history. This course will be mainly by lecture and assigned reading. 1 year.

Courses 5 and 6 will be given in alternate years, and will be elective to students who have had courses 1-4.

PROFESSOR MONTEITH.

Mathematics

11. Railway Curves; Embankments; Higher Surveying; Use, Care, and Adjustment of Instruments; Field Work. 1 year.

12. Theory of Equations (open only to those who have taken Mathematics 6 and 7). Curve Tracing, and History of Mathematics. 1 year.

13. For those who take 12 the first year, a second year's work in advanced Calculus, or the higher subject of Plane Trigonometry, or Quaternions, or reading in French Mathematics may be expected.

PROFESSOR WHEELER.

Chemistry

See Chemistry 3, p. 72.

Veterinary Science

4. Hygiene, anatomy, and veterinary physiology in the fall term; dissection, pathology (gross), and materia medica, in the winter term; and diseases and their treatment, in the spring term. Extra hours, if available, in bacteriology and micro-pathology. Five hours a week. 1 year.

PROFESSOR LEHNERT.

Forestry and Landscape Architecture

5. A two-year course in forestry has been arranged for students who have had the preliminary courses in botany here, or their equivalent elsewhere. The departments of mathematics, entomology, geology, and German have coöperated, giving a thorough course in forestry and the allied sciences. Lectures are given on silviculture, the fundamental principles of forestry, propagation of forest trees, forest planting, timber measurements, timber physics, treatment of farm forests, United States and state reservations, and kindred subjects.

ASSISTANT PROFESSOR WHITE.

6. Landscape Architecture. Lectures on the propagation of shrubs and trees, methods for planting and grouping, ornamental trees, shrubs, and hardy perennials adapted to the Connecticut climate, improvements about farm buildings, grading, construction of farm roads, and other subjects connected with home and town ornamentation. Three hours a week. 1 year.

ASSISTANT PROFESSOR WHITE.

Other Elective Studies

Mathematics, 4, 6 (with 7 or 10).
Chemistry, 2, 3.
German, 1, 2.
Latin, 1, 2.
Botany, 2, 3.
History, 3, 4.
Mechanical Drawing, 1, 2.
Geology.
Zoölogy.
Economics, 2.
Entomology.
Ornithology.

NOTE :—Schedules involving elective studies cannot be made up until the schedules of required courses have been posted on the bulletin board; and then only after consultation with the individual instructors offering the studies desired, for ascertaining the number of hours required in each case and the times which they can be had. The greatest care must be taken that no conflict of hours occur.

COURSES OF STUDY FULLY DESCRIBED

Agriculture

1. **Laboratory Work** — Second year, spring term, three hours a week. Field work in planting and caring for various farm crops; the purpose being to familiarize students with the practice, rather than with the principles, of agriculture.

PROFESSOR CLINTON.

2. **Agricultural Physics** — Third year, fall term, five hours a week. Soil formation, transportation, and classification; physical characteristics of soils; modification of soils by tillage and use of cover crops and manures; adaptation of various soils to the production of crops; the conservation of moisture by tillage; under drains and surface drains, and their physical effects upon soils; commercial fertilizers, their purchase and use; soil amendments, and where valuable. Instruction given by text-book and lectures.

Laboratory Work — Three hours a week. A study of various soils under field conditions; erosion of fields and means of prevention; the effect of plant roots upon soils; tests of various soils to determine their plasticity and power of absorbing and retaining moisture; capillary power, and how the same may be increased and diminished; microscopic examination of various types of soils.

PROFESSOR CLINTON.

3. **Laboratory Work** — Third year, winter term, three hours a week. Rope splicing; care of farm tools; various farm conveniences; testing agricultural seeds for purity, germination, and quality; identification of agricultural and weed seeds.

PROFESSOR CLINTON.

4. **Rural Economics** — Fourth year, winter term, five hours a week. Choosing a profession; agriculture as a profession; selection and purchase of a farm; the farm as an investment and a source of income; factors which determine the crop to be raised, as nearness to market, market demands, climatic conditions, and soil; general and special farming; extensive and intensive farming; the effect of various systems of farming upon the fertility of the land; arrangement of farm buildings for economy and efficiency; farm accounts and business principles; marketing farm produce

and purchasing supplies. Instruction given by lectures, and especially adapted to New England conditions.

PROFESSOR CLINTON.

5. **Farm Crops** — Fourth year, spring term, five hours a week. Crops adapted to Connecticut. Corn — varieties, preparation of soil, seeding, cultivation, harvesting, and ensilage; potatoes — principles relating to growth, selection of seed, soil conditions favorable, varieties, fungous and insect enemies and means of combating them, harvesting, marketing, storing; tobacco, rye, wheat, oats, barley, buckwheat, soy beans, cow peas, hay and pastures, clovers and alfalfa, mangolds, sugar beets, and various forage crops, all receive attention according to the importance of the crop in the State.

Laboratory Work — Three hours a week. This work is designed to familiarize the students with actual field conditions in relation to the crops studied. All are given practice in preparing the soil, in planting seeds, and in caring for crops. Principles and practices are illustrated by field work. Students are required to use the various farm tools, and in this way learn to handle teams and adjust machinery.

PROFESSOR CLINTON.

Dairying, Breeds, and Stock Judging

1. **Feeding Farm Animals** — Fourth year, fall term, five hours a week. This subject treats of: (1) The growth of the plant and its elaboration of food for the animal; the composition of the plant; the digestion and assimilation of the plant by the animal; the source of lean meat, fat, wool, milk, and muscular energy; discussion of feeding standards; and methods of calculating rations for farm animals. (2) Composition and characteristics of cereal and leguminous seeds; composition and characteristics of forage crops; preparation of feeding stuffs; the ensilage of fodders; and the manurial value of feeding stuffs. (3) Feeds for, care of, and investigations concerning the horse, steer, cow, and pig. Text-book, Henry's "Feeds and Feeding."

Laboratory Work — Fall term, three hours a week; winter term, fifteen hours a week. In the fall term practice will be given in formulating rations for farm animals, a study of the rations fed different classes of animals on the College Farm, and a discussion of their efficiency and economy. In the winter term several feeding experiments will be in operation. Students will become familiar with the object of these experiments, and, as far as possible, will conduct them.

PROFESSOR BEACH.

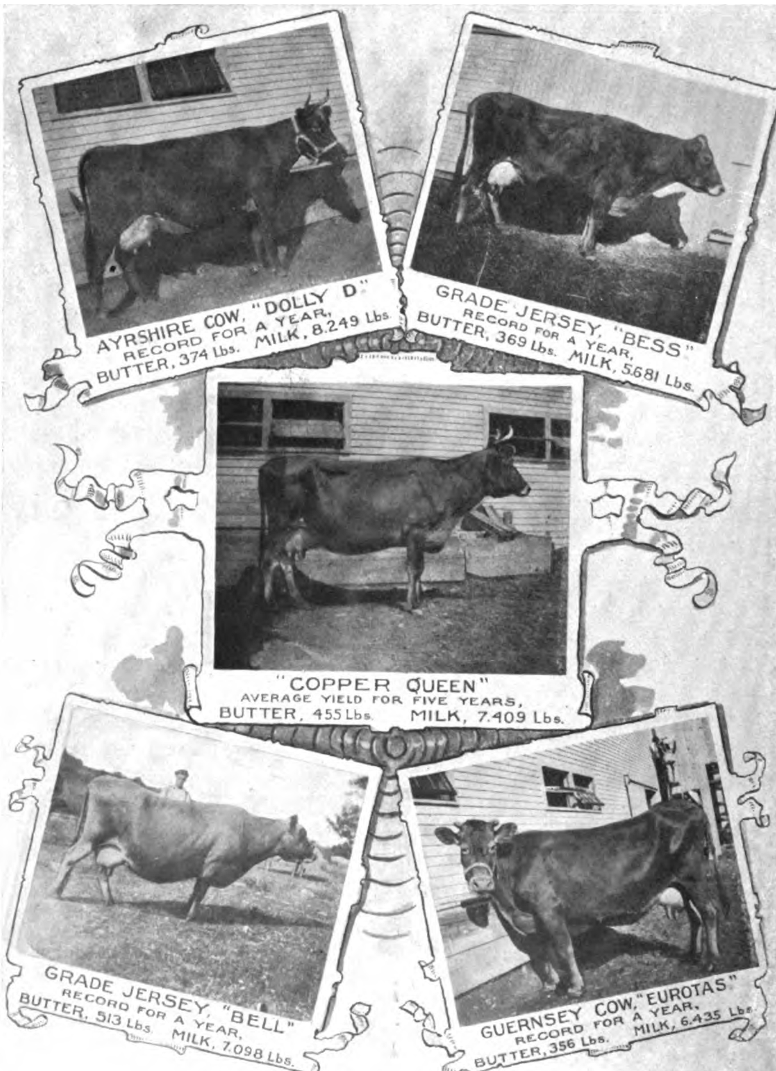
BOTTLING MILK

MILK STRAINING

C.A.C DAIRY SCHOOL.

SCORING DAIRY COWS

SANITARY MILKING


AYRSHIRE COW, "DOLLY D"
RECORD FOR A YEAR,
BUTTER, 374 Lbs. MILK, 8.249 Lbs.
GRADE JERSEY, "BESS"
RECORD FOR A YEAR,
BUTTER, 369 Lbs. MILK, 5.681 Lbs.
"COPPER QUEEN"
AVERAGE YIELD FOR FIVE YEARS,
BUTTER, 455 Lbs. MILK, 7.409 Lbs.
GRADE JERSEY, "BELL"
RECORD FOR A YEAR,
BUTTER, 513 Lbs. MILK, 7.098 Lbs.
GUERNSEY COW, "EUROTAS"
RECORD FOR A YEAR,
BUTTER, 356 Lbs. MILK, 6.435 Lbs.

2. **Breeding of Animals** — Fourth year, winter term, four hours a week. This course deals with the principles of breeding — the laws relating to heredity, reversion, in-and-in breeding, cross breeding, prepotency, and the selection and mating of animals. Text-book, Shaw's "Animal Breeding."

PROFESSOR BEACH.

3. **Dairy Breeds** — Fourth year, fall term, two hours a week. This course covers the origin, history of the development, and characteristics of the breeds of dairy cattle; study of the score cards of the various breeds, and practice in tabulating pedigrees; a study of the performance requirements for advanced registry with each breed, and the value and method of making official records; a study of the type of different breeds, and a comparison with "dairy type," both theoretically and with living specimens. Lectures.

Laboratory Work — Six hours a week. Practice given in judging animals from the dairyman's standpoint; practice given in the use of the score cards of the different breeds.

PROFESSOR BEACH.

4. **Dairying** — Fourth year, spring term, five hours a week. This subject deals with milk — its secretion, nature, and composition; causes and conditions influencing the quality and quantity of milk; handling of milk for the market and for butter making; production of market milk, including milking, straining, aerating, cooling, and shipping; pasteurization and sterilization of milk; creaming of milk by gravity methods and by the separator; cream ripening and churning; washing, salting, working, packing, and marketing butter. Text-book, Wing's "Milk and Its Products."

Laboratory Work — Nine hours a week. Practice in use of Babcock test; in the care and handling of milk for market; in the use of hand and power separators; in the ripening of cream; in churning; in working, washing, and preparing butter for market; in care and handling of boiler and engine.

PROFESSOR BEACH.

5. **Breeds and Stock Judging** — Fourth year, fall term, three hours a week. The various breeds of domestic animals are studied with reference to their appearance, character, and utility. Text-book, Curtis' "Horses, Cattle, Sheep, and Swine."

Laboratory Work — Six hours a week. Specimens of breeds are brought before the class and scored from the standpoint of the judge.

PROFESSOR LEHNERT.

Poultry Industry

1. Third year, winter term, three hours a week. Some of the topics considered in the classroom are: Principles of breeding; breeds of fowls, ducks, geese, and pigeons, their origin and development; selecting and mating; general care; incubating and brooding, both natural and artificial; rearing; marketing; preparing for the show room; scoring; foods and feeding; poultry buildings, their location, arrangement, construction, and furnishing; drawing of plans and making of estimates; building materials; yards and fences; preservation and use of poultry manure; embryology; anatomy of fowls; diseases and parasites of fowls; records.

Laboratory Work — Spring term, first six weeks, ten hours a week. This work includes feeding and general care of the stock, operating incubators and brooders of different types, killing and dressing for general and special markets, caponizing, packing hatching eggs and breeding stock for shipment, and other incidental details necessary for successful poultry farming.

MR. STONEBURN.

Horticulture

1. **Second-Year Course** — Spring term, laboratory work, three hours a week. Handling seeds, methods of cultivation, transplanting plants and trees, pruning.

PROFESSOR GULLEY.

2. **Third-Year Course** — Fall term, three hours a week, and three hours a week of laboratory work. Harvesting and handling fruits and vegetables, storing, seeds, winter preparations.

Winter term, five hours a week, and three hours a week of laboratory work. Forcing, handling greenhouse plants, grafting and other methods of propagation.

Spring term, laboratory work, three hours a week. Pruning, nursery work, spraying, and treatment of insects.

Summer term. Thinning fruit, study of weeds, summer care for orchards and plants, budding.

PROFESSOR GULLEY.

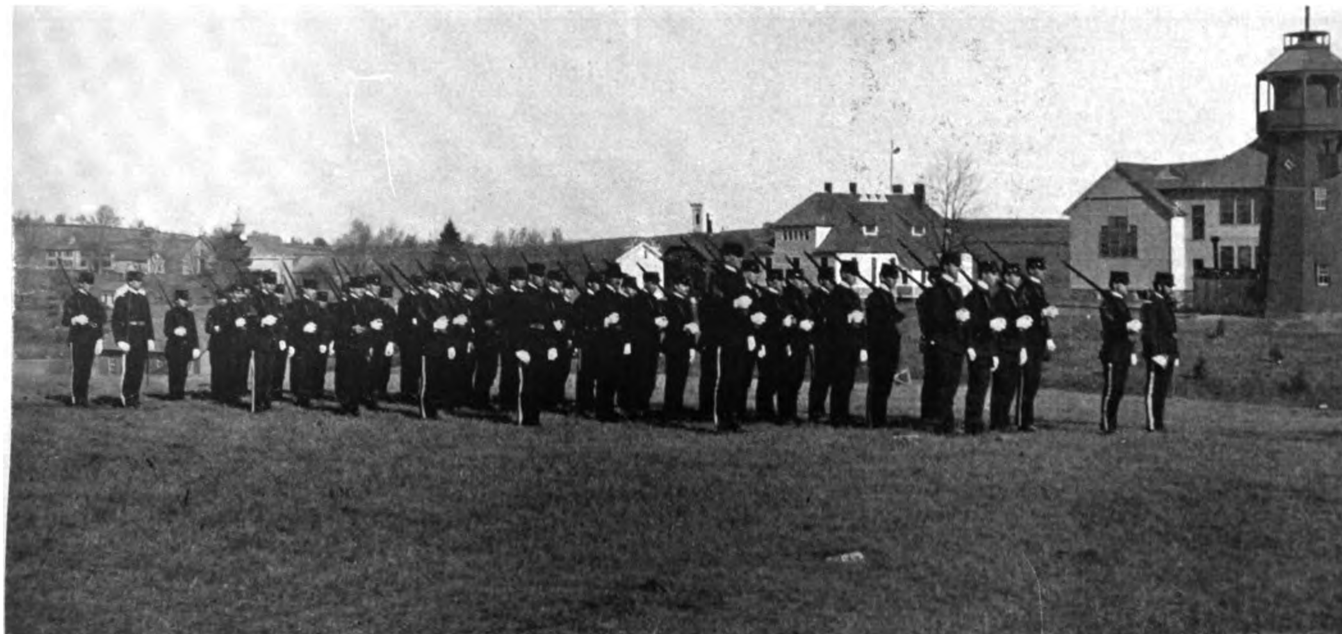
3. **Fourth-Year Course — (a) Greenhouse Construction** — Fall term, two hours a week. Planning, heating, and interior appliances.

(b) Plant Diseases — Fall term, four hours a week, and six hours a week of laboratory work. A study of plant diseases and of methods of treatment.

OUR CHRYSANTHEMUMS

IN THE GREENHOUSE

CARNATIONS



COLLEGE CADETS

(c) **Botanic Horticulture** — Winter term, three hours a week, and three hours a week of laboratory work. The sources and relations of our cultivated plants and plant products; the derivation of plant pests of various kinds.

(d) **Plant Breeding** — Fall term, one hour a week. The sources of new varieties, and methods used in producing them.

(e) **Commercial Horticulture** — Fall term, five hours a week, laboratory work six hours a week; winter term, laboratory work three hours a week. Study in pomology, floriculture, nursery growing, or vegetable growing and forcing, as desired.

(f) **Special Investigation and Thesis** — An arrangement will be made with each student for the work of this course.

PROFESSOR GULLEY.

Veterinary Science and Physiology

1. **Veterinary Science** — Fourth year, fall term, five hours a week. **Anatomy and physiology (comparative):** Skeleton, separate bones, muscles of locomotion, digestive system, teeth as an indication of age, respiratory system. **Pathology (general):** Inflammation, healing of wounds. **Materia medica (general):** Classes of drugs, with class characters and dosage; administration of medicines.

Winter term, three hours a week. **Diseases and treatment:** Asepsis and antisepsis, treatment of wounds, minor surgical operations, castration and spaying, obstetrics, lameness, bone diseases, and diseases of the foot (horse), diseases of the digestive system, diseases of the respiratory system, constitutional and specific diseases.

PROFESSOR LEHNERT.

2. **Horse Barn** — Third year, winter term, laboratory work three hours a week. Care of horses in the stable, of harnesses and wagons; hitching and unhitching; nursing, bandaging, etc.

PROFESSOR LEHNERT.

3. **Physiology** — Third year, spring term, four hours a week. Bones, muscles, physical exercise, food and drink, digestion, blood and its circulation, respiration, skin and kidneys, nervous system, special senses, throat and voice, accidents and emergencies.

Laboratory Work — Two hours a week. Dissections of the smaller animals, and experiments illustrating the physiological processes going on in the animal body.

PROFESSOR LEHNERT.

Meteorology and Climatology

1. Third year, fall term, two hours a week. This work includes the study of the following: The atmosphere, its origin, composition, and functions; temperature, source and effect upon atmosphere and ground, relation to crops and animals; atmospheric pressure; the use of the barometer; atmospheric circulations, general winds, local winds, force and velocity of winds, beneficial and destructive winds; atmospheric moisture; evaporation; absolute and relative humidity; conditions for the formation of dew and frost; prediction of frosts; protection against frosts; causes and conditions of rainfall, snow, and hail; weather observations and predictions; methods of forecasting weather conditions; relation of climate to various branches of agriculture; work of the U. S. Weather Bureau.

MR. STOCKING.

Bacteriology

1. **Agricultural Bacteriology** — Third year, three terms, one hour a week. Fall term, bacteria in general; fermentation; bacteria in soil, with special reference to the problem of nitrogen supply; bacteria in manure, sewage, water, silage, and in vinegar making; food preservation from bacterial action. Winter term, bacteria in the dairy. Spring term, bacteria in their relation to diseases of men and animals. In this discussion, special attention is given to the phases of the subject which are related to problems of agriculture and domestic science.

DR. CONN.

Laboratory Work — Fall term, four hours a week. This work includes: Methods of studying bacteria; making culture media; sterilization; bacteria in relation to farm manures, to fruits, vegetables, and other farm products; work of bacteria in the soil, and their importance in connection with legumes; investigation of subjects of special interest to the individual student.

MR. STOCKING.

2. **Dairy Bacteriology** — Fourth year, spring term, laboratory work four hours a week. Methods of studying dairy bacteria; preparation of special culture media; effects of bacteria on milk, butter, and cheese; sources of contamination and methods of exclusion; investigation of subjects of special interest to the individual student.

MR. STOCKING.

Mechanical Drawing and Shop Work

1. **Third-Year Course** — Three terms, laboratory work six hours a week. Fall term, **Mechanical Drawing:** plans for farm and other buildings. Winter term, **Wood Work:** general shop and repair work. Spring term, **Iron Work:** general forging, including the making of chains, bolts, drills, and work in forging and tempering steel.

PROFESSOR PATTERSON.

2. **Fourth-Year Course** — Elective, three terms, laboratory work six hours a week. **Mechanical Drawing:** architecture; plane and perspective drawing; principles of construction in wood, brick, stone, and concrete, including stereotomy.

PROFESSOR PATTERSON.

Physics

1. **General Physics** — Second year, three terms, two hours a week. This course includes a study of properties of matter, composition and resolution of forces and motions, the pendulum, gravitation, machines, work, energy and power, fluids and gases, heat, sound, light, magnetism, and electricity.

MR. STOCKING.

2. **Advanced Physics** — Third year, fall and winter terms, three hours a week. A continuation of course 1.

MR. STOCKING.

Botany, Forestry, and Landscape Architecture

1. **Elementary Botany** — Second year, three terms. Fall term, three hours a week, and two hours a week of laboratory work. Plant morphology and physiology. Winter term, three hours a week. Plant ecology and cryptogamic botany. Spring term, two hours a week, and three hours a week of laboratory work. Plant analysis; a study of the local flora, with characteristics of the different orders.

ASSISTANT PROFESSOR WHITE.

2. **Advanced Botany** — Elective, third year, three terms, three hours a week. Fall term, analytical study of the fall flora, lectures, and microscopic study of the morphology of plants. Winter term, advanced plant physiology. Spring term, study of the local flora, especially trees and shrubs.

ASSISTANT PROFESSOR WHITE.

5

3. **Fourth-Year Botany** — Elective, three terms, three hours a week. Fall term, study of the ferns and mosses. Winter term, advanced cryptogamic botany, a study of the rusts, smuts, mildews, and mushrooms. Spring term, economic botany and original thesis work.

ASSISTANT PROFESSOR WHITE.

4. **Forestry** — Fourth year, winter term, three hours a week; also for short-course students. The study of practical forest management; the reproduction, growth, and maturity of forest trees; destructive agencies in the forests; care of farm forests; study of our native forest trees.

ASSISTANT PROFESSOR WHITE.

Natural History

1. **Physical Geography** — First year, fall term, five hours a week. An elementary course.

PROFESSOR KOONS.

2. **Zoology** — Third year, spring term, three hours a week. Lectures and laboratory work covering the more important groups of the animal kingdom.

PROFESSOR KOONS.

3. **Entomology** — Fourth year, summer term. Lectures, laboratory work, and collecting, both in general entomology and those species destructive to man's interests; with methods of checking their ravages.

PROFESSOR KOONS.

4. **Ornithology** — Fourth year, summer term. Our common birds, with a study of their foods and their relations to man.

PROFESSOR KOONS.

5. **Geology and Mineralogy** — Fourth year, spring term, three hours a week. The general principles of these subjects: Soil formation, the common minerals, volcanoes, earthquakes, glaciers, caves, etc. Dana's Revised Text-book of Geology is used as the basis of the term's work, with excursions to places of geological interest in the vicinity.

PROFESSOR KOONS.

6. **Geology** — Elective, third year, three terms, three hours a week. An extended course in dynamical, historical, and economical geology; also in crystallography and mineralogy.

PROFESSOR KOONS.

7. **Zoology** — Elective, third year, three terms, three hours a week. Lecture, text-book, and laboratory work on representative forms in all the important classes of the animal kingdom, including systematic work on the principal groups.

PROFESSOR KOONS.

8. **Entomology** — Elective, fourth year, three terms, three hours a week. Economic and systematic entomology: including both the external and the internal anatomy of the principal groups; their physiology, embryology, classification; the economical relations of insects to man and to each other; methods of combating injurious species; the honey bee and apiculture; collecting, preserving, mounting, care, and use of collections.

PROFESSOR KOONS.

9. **Ornithology** — Elective, fourth year, three terms, three hours a week. Beginning with the embryology of birds. This course will include their anatomy, physiology, classification, distribution, migration, and economical relations to man.

PROFESSOR KOONS.

Courses 6-9 include a large amount of field work and outdoor study.

Mathematics

1. **Arithmetic** — First year, winter and spring terms, three hours a week. Short methods for business calculations; drills in addition, fractions, and decimals; working denominate numbers, percentage, interest, discount, and partial payments.

MR. YEREX.

2. **Algebra** — First year, three terms, four hours a week. The subjects included in this course are the fundamental processes of algebra, equations, involution of monomials and polynomials, evolution of the higher roots of polynomials, rules for extracting the roots of numbers based on the algebraic methods, radicals, solution of radical equations, pure and affected quadratics, simultaneous equations, progressions, binomial theorem, logarithms, etc. The relation between an equation and its locus is introduced early into the mathematical course. The various forms of equations of elementary algebra are plotted and discussed. Approximately two thousand examples are worked during the year.

PROFESSOR WHEELER.

3. **Plane Geometry** — Second year, three terms, four hours a week. The text-book used in this subject is Pettee's Plane Geometry. A thorough knowledge of algebra is a necessary preparation for this work. Basic definitions and axioms; the theory of limits and proportion; similar figures, and the laws relating to them; propositions demonstrated in concise, geometric language; original exercises showing the application of geometric principles.

Two hours a week, when the weather permits, during the spring term, are employed in out-of-door exercises, in pacing the sides and diagonals of fields for determining their areas, and in simple leveling. This course, therefore, is a brief introduction to the surveying of the third year. Students here gain a knowledge of the theory of leveling and of the form of notes, and learn how to plot profiles and to compute cuts and fills.

PROFESSOR WHEELER.

4. **Solid Geometry** — Elective, third year, fall term, three hours a week. In beginning, no text-book is employed. Fundamental definitions are dictated by the teacher, the student is taught to make correct drawings, and step by step to prove the theorems of lines and planes in space. The use of models assists the geometric conception. Wentworth's Revised Text-book is used for a more rapid treatment of the cylinder, pyramid, cone, and sphere. Computations of the volumes and areas of these figures are made, and several models, some from original estimates, are constructed by each student.

PROFESSOR WHEELER.

5. **Trigonometry** — Third year, winter term, three hours a week. Some of the principles investigated are: Functions of angles, measurement of angles, derivation and reduction of trigonometric formulæ, solution of right and oblique triangles. Proficiency in the use of logarithmic tables is acquired in the solution of twenty individual examples. Text-book, Wentworth.

PROFESSOR WHEELER.

6. **Analytic Geometry** — Elective, fourth year, fall term, three hours a week. The student finds his way to this subject through algebra, geometry, and trigonometry; geometric lines and curves are represented by equations, their relations understood by an investigation of such equations. The solution of examples and the knowledge of particular principles lead to the demonstration of general theorems, and furnish excellent practice in reasoning, both inductive and deductive. Text-book, Wentworth.

PROFESSOR WHEELER.

7. **Differential and Integral Calculus** — Elective, fourth year, winter and spring terms, three hours a week. This course is intended for those who wish a good foundation for further study in physics or engineering, for those who are specializing in pure mathematics, and for those who wish the mental discipline afforded by so fine an instrument. Differentiation, derivatives, maxima and minima, infinite series, Maclaurin's theorem, partial derivatives, integration, applications to areas and volumes, moments, etc. Text-book, Osborne.

PROFESSOR WHEELER.

8. **Surveying** — Third year, spring term, three hours a week. Leveling is continued from second year with the wye level. Farm surveying by the method of latitudes and departure, using the compass and chain; practice in setting up and operating the transit; plotting. Wentworth's Surveying.

PROFESSOR WHEELER.

9. **Farm Engineering** — Fourth year, spring term, three hours a week. The laying out of farm roads, drainage of a house, field drainage, etc.

PROFESSOR WHEELER.

10. **Plane Surveying** — Elective, fourth year, winter and spring terms, three hours a week. Theory and practice, the use and care of surveying instruments, problems in surveying, railroad surveys and curves, methods of field work, computing of earthwork excavations, etc. Searle's Field Engineering; Raymond.

PROFESSOR WHEELER.

Drawing

Freehand Drawing — First year, fall and spring terms, two hours a week. In this course it is expected that the student will learn to reproduce a form correctly with the pencil or pen. Drawing plates are copied. The aim is not to make artists, nor primarily to cultivate a taste for the beauty of lines and shades, but to train the eye to see and the fingers to form again what is seen; thus the course is an aid to subsequent study in botany, entomology, horticulture, mechanical drawing, mapping, and other subjects.

PROFESSOR WHEELER.

English and Ethics

1. **Grammar** — First year, three terms, four hours a week. Parts of speech; inflection; analysis of sentences; syntax, a course designed to insure a knowledge of grammar as a foundation for the courses in English that follow.

ASSISTANT PROFESSOR SMITH.

2. **Composition and Rhetoric** — Second year, three terms, four hours a week. Punctuation; the paragraph; the sentence; diction; figures of speech; exercises in composition.

ASSISTANT PROFESSOR SMITH.

3. **Third-Year English** — Three terms, three hours a week. This course is devoted mainly to the study of rhetoric. Three formal essays are required; constant practice in composition. The text-book in use is Lockwood and Emerson's Rhetoric; references, Hill's Foundations and Waddy's Rhetoric.

PROFESSOR MONTEITH.

4. **Fourth-Year English** — Three terms, four hours a week. Painter's History of English Literature; Matthews' Introduction to American Authors. The course includes, besides the regular classroom work, the reading and discussion of masterpieces, lectures, and the preparation of one finished and elaborate essay.

Ethics. Formerly the plan was to give to this subject three hours a week in the spring term. Last year a change was made by which the subject is carried through the entire year, allowing one hour per week to it. The latter seems the better course, and will be continued for the present.

Addresses — During the fourth year three addresses, to be delivered in public, are required of each student. Special students are not excused from this exercise. These addresses are carefully prepared under the direction of the professor, and are, of course, delivered without notes. During the year practice is given in class in extemporaneous speaking. At least one extemporaneous address before the College is required of each member of the fourth-year class.

PROFESSOR MONTEITH.

History and Civics

1. **History and Civics** — First year, three terms, four hours a week. **Civics:** two hours a week (40 weeks). **History:** ancient Greece, twenty weeks, two hours a week; geography, climate, pro-

ductions, racial connections, government, religion, education; Sparta, Athens to close of Peloponnesian War. Rome, twenty weeks, two hours a week. Italy, geography, climate, productions, races, Latium, Rome, government, religion, education, down to the empire.

PROFESSOR MONTEITH.

2. **Roman History** — Second year, three hours a week in the fall and spring terms, four hours a week in the winter term. Rome: Empire, introduction and growth of Christianity, invasion of barbarians. Mediæval Europe: France, rise of modern nations.

PROFESSOR MONTEITH.

3. **English History** — Elective, third year, three terms, three hours a week. England from Saxon invasion, growth of parliamentary institutions; the Puritan movement, and the colonization of America.

PROFESSOR MONTEITH.

4. **United States History** — Elective, fourth year, three terms, three hours a week. The United States from the Revolution. This is intended as an intensive study of the development of American institutions.

PROFESSOR MONTEITH.

Chemistry

1. **Elementary Chemistry** — Second year, three terms, three hours recitation and two hours laboratory a week. Text-book, Williams' Elements of Chemistry. Object, to obtain a good general knowledge of the occurrence and properties of the commoner elements, acids, bases, and salts, and to learn their value to mankind in daily life. Special emphasis is laid upon those substances of most importance to the farmer, although it is also intended to furnish those who wish to continue this subject a good foundation for future work.

PROFESSOR MESERVE.

2. **Advanced Chemistry** — Elective, third year, three terms, three hours a week (six hours laboratory work). Text-book, Noyes' Notes on Qualitative Analysis. The first few weeks of the first term will be spent in a brief review of the work of the previous year, that those students who have just entered College in the third year may attain the same view of the subject that the others have received, and also to take up those theories that were omitted in the preceding year. Most of the year is spent in ac-

quiring the necessary skill in qualitative analysis and laboratory practice which will fit students for the more careful and exact work of the following year. A few of the simpler determinations in acidimetry and alkalinity will be undertaken by the more apt students, as well as one or two simple gravimetric determinations.

PROFESSOR MESERVE.

3. **Fourth-Year Chemistry** — Elective, three terms, three hours a week. The work of this year is purely elective, and will be arranged to meet the needs of the students concerned. The work will be mainly in analytical methods. Those preparing for Experiment Station work and domestic economy will pay especial attention to foods and their analysis, and to the methods of the Society of Official Agricultural Chemists. Organic chemistry, including laboratory, recitations, and organic preparations, will be required of those specializing in chemistry, as well as German. Simple methods of gas, air, and water analysis, and the saccharimeter will be studied by students who are interested in these lines of work.

Course 3 will be extended to two years or three years for fifth and sixth-year students who have had three years of chemistry, and who elect further work in the subject.

PROFESSOR MESERVE.

Economics

1. **Elementary Economics** — Third year, three terms, two hours a week. An introductory course, covering production, consumption, exchange, money, distribution, trade, wages, and land.

ASSISTANT PROFESSOR SMITH.

2. **Fourth-Year Economics** — Elective, three terms, three hours a week. Students who elect this course will choose one or more of the following topics, after conferring with the instructor:

Advanced Economics. Critical study of theories of value, distribution, etc.

Public Finance. Taxation, government industries, public debt, government expenditures and their effects.

Money and Banking — The Trust Problem. General principles and history of banking. Present monetary situation and schemes for reform. Suggested methods of control of industrial combinations and monopolies.

The General Labor Problem. Nature and cause of present social discontent. Discussion of proposed remedies.

ASSISTANT PROFESSOR SMITH.

German

1. **Beginner's German** — Elective, third year, three terms, three hours a week. Fall term, Joynes-Meissner, German Grammar; winter term, Grammar, and Joynes' German Reader; spring term, reading of easy German texts.

MISS WHITNEY.

2. **Advanced German** — Elective, fourth year, three terms, three hours a week. Part Second of Joynes-Meissner, German Grammar, Dippold's Scientific German Reader, and reading of elementary German texts.

MISS WHITNEY.

Latin

1. **Beginner's Latin** — Elective, third year, three terms, three hours a week. The course of study in Latin is intended to meet the requirements of those students intending to follow the courses leading to the degree of Bachelor of Science. It is not recommended to any student who cannot give two years to it. The first year is devoted to the mastery of the forms and ordinary constructions, including the subjunctive and the ordinary forms of indirect discourse. In short, it is intended to build up, as rapidly as possible, an ability to read continuous Latin. For this purpose a book for beginners is used, accompanied by the Grammar.

PROFESSOR MONTEITH.

2. **Advanced Latin** — Elective, fourth year, three terms, three hours a week. The second year is intended to give an ability to read the ordinary Latin (except poetry) required for admission to college. For this purpose, Cæsar's Commentaries will be used. It is not designed to extend this course beyond the point indicated.

PROFESSOR MONTEITH.

Home Economics

COURSE NO. 8

This course is open to students from the district or grammar schools, and covers four years. It can be completed in two years by a student who is a graduate of a good high school. It is designed to meet the needs of those who wish to learn the theory and practice of housekeeping and home-making. This work is not intended to supplant the training of the young woman in the home kitchen, but to supplement that work by further study and practice which will enable her to get desired results at the least expenditure of energy, time, and money.

This training is designed to make the future home-maker feel that it is just as necessary to plan the home on a scientific basis as the farm; to bring to her the realization that upon her shoulders rests the decision of the problem of whether or not the home shall be the place wherein each member shall reach his or her highest physical, intellectual, and spiritual development.

The preparation of foods, their uses, cost, and service; the purchase, making, and cleansing of clothing; the care of the house and its belongings, and the judicious management of a family income are all studied in detail.

1. **Sewing** — (1) A course in plain needle work upon samples and useful articles. Special attention is paid to practical repairing and mending, darning of stockings and flannels, patching, and buttonholes. (2) The use and care of machines — models illustrating the varieties of machine work; drafting by simple measurements. A white skirt, drawers, corset cover, and nightdress are made. Talks are given on weaving and manufacture of the various materials used, the durability of different fabrics, the uses of patterns, and economy of material.

Miss Thomas.

2. **Dressmaking** — Simple drafting by means of a table of measurements, tape measure, and a rule is taught. A dressing sacque, shirtwaist, and unlined skirt are made; also samplers illustrating the making of blind hems, milliner's folds, pipings, pockets, bone and seam coverings, blind laps, buttonholes, and the placing of braids, facings, hooks and eyes. A system of dressmaking by a chart is practiced. Pupils practice in measuring, drafting, cutting, and fitting linings to each other. A lined, boned, and trimmed dress is made. A study of textiles, materials suitable for different occasions, and styles for different figures is continued throughout the course. Designs are made for all of the garments. A muslin gown suitable for graduation is also made.

Miss Thomas.

3. **Cooking** — This work consists of courses of cookery of a strictly economical character. Correlated with it is a brief study of the composition of foods. The foods cooked are taken up with regard to the food principles they represent. The comparative food and market value and the effect of heat and moisture are noted; also the uses of foods in the body and their digestion and assimilation. The combination of food materials is discussed, es-

pecially those most easily obtained upon a farm. The food principles, taken in their natural sequences, are illustrated by the cooking of cereals, vegetables, eggs, meat, fish, peas, and beans. The various methods of making batters and doughs light are discussed. Biscuits, muffins, breads, cakes, and pastry are made. Later comes the more advanced work of salads, desserts, and other made dishes, canning, pickling, and preserving. The economy of material, time, labor, and fuel is brought before the pupil, as is accuracy of measurement, neatness, method, and system.

MISS THOMAS.

4. **Waitress Course** — The various topics are as follows: The equipment and care of the dining-room, china closet, and pantry; the care of silver, glass, china, and steel; the arrangement of a table at different meals and teas, and the duties of a waitress at each; the preparation of sandwiches and packing of lunch boxes.

MISS THOMAS.

5. **Invalid Diet** — The varieties of liquid diets are here discussed, and their uses in different diseases; peptonized milk, broths, and teas; nutritious, cooling, and stimulating drinks; convalescent diet; the equipment and preparation of an invalid's tray.

MISS THOMAS.

6. **Emergencies and Home Nursing** — (1) This course consists of lectures, recitations, and practice work; the treatment of cuts, burns, scalds, sprains, dislocations, fractures, and unconscious conditions; the methods of utilizing material at hand for improvised splints, bandages, slings, pads, and stretchers; the use of emergency and roller bandages. (2) Home nursing treats of the best methods of caring for patients in the home; precaution against contagion; disinfection, bed-making, and handling of helpless patients; the preparation of steeps and poultices.

MISS THOMAS.

7. **Sanitation and Chemistry of Cleaning** — Under this subject are considered: the location of the country home; the relative position of drains, wells, closets, and stables; the dangers of contaminated water supply and improper cellars; heating, lighting, and ventilation; the sanitary care of food; the principles of cleaning wood, metal, iron, tin, copper, and brass.

MISS THOMAS.

8. **Laundry** — The course in laundering aims to give the student an intelligent understanding of the general principles on which cleansing processes are based; the value and economy of materials used; the removal of stains; the setting and restoring of colors; the cleansing of flannels, laces, and embroideries.

MISS THOMAS.

9. **Household Economy, Accounts, and Marketing** — The general care of a house and its expenditures are here considered; the distribution of income; the use and disposal of farm products; the purchase of clothing, food, and house furnishing; the importance of household accounts.

MISS THOMAS.

10. **Hygiene** — This course is designed to show the importance of a correct knowledge of the laws of nature, of personal cleanliness, and of proper habits. Lectures upon maidenhood, maternity, motherhood, infancy, and related subjects are included in this course.

MISS THOMAS.

COURSE NO. 10

This course is designed for the student who has completed course 9, who shows natural aptitude for its subjects, and wishes to fit herself to teach sewing and cookery in the public schools of Connecticut or other institutions where such work is required.

11. **Food Experimentation** — In this course the composition and nutritive value of foods are considered; the principles and processes of cookery; the study of fuels and equipment. The aim is to give a thorough knowledge in the theory and practice of cookery, and aid in the preparation of subject-matter for teaching. Laboratory methods and their adaptation to school kitchens are considered.

MISS THOMAS.

12. **Dietaries** — The value of foods is studied more in detail than in the other courses. The food value of rations at a limited cost is estimated, to meet the needs of persons of different ages and occupations.

MISS THOMAS.

13. **Practical Application of Dietaries** — This course will occupy from four to six weeks. It will consist of planning, purchasing, cooking, and serving meals; arrangements to be made with individual students as to time.

MISS THOMAS.

Music, Elocution, Gymnastics

1. **General Course** — First year, three terms, two hours a week. Normal Music Course.

MISS GEER.

2. **Chorus** — Forty voices, selected from all classes. Practice, one hour a week.

MISS GEER.

3. **Piano Forte** — Elective, two half-hour private lessons a week. Practice, from one to three hours a day.

MISS GEER.

4. **Voice** — Elective, two half-hour private lessons a week. Practice, from forty minutes to one hour a day.

MISS GEER.

5. **Elocution** — First, second, and third years, private instruction. Public speaking once each term.

MISS GEER.

6. **Gymnastics** — All classes (girls), three hours a week. Free gymnastics; marching; wand and dumb-bell drill.

MISS GEER.

Commercial Studies

1. **Penmanship** — First year, winter term, two hours a week. Formation and analysis of letters, and drills in movement.

MR. YEREX.

2. **Spelling** — First year, spring term, two hours a week.

MR. YEREX.

BUSINESS COURSE

3. **Bookkeeping** — Three terms, five hours a week. Journalizing daybook entries, posting, making trial balances, closing accounts, single to double entry, bank bookkeeping, shipping and commission business, joint stock and corporation accounts.

MR. YEREX.

4. **Correspondence** — Fall and winter terms, three hours a week. Williams and Rogers' Business and Social Correspondence.

MR. YEREX.

5. **Stenography** — Three terms, two years, five hours and three hours a week. Isaac Pitman's Shorthand Instructor. Theory of shorthand, and speed practice.

MR. YEREX.

6. **Typewriting** — Three terms, two years, three hours a week. Practice, from three to five hours a week.

MR. YEREX.

7. **Commercial Geography** — Spring term, three hours a week. The climatic and soil factors in production. The resources and manufactures of the countries of the world. Transportation and exchange of commodities.

MR. YEREX.

8. **Commercial Law and Business Forms** — Three terms, six hours a week. Contracts, negotiable paper, usury, personal property, partnerships, insurance, patents, conveyance of real estate.

MR. YEREX.

SHORT WINTER COURSES

Supplementary to its longer courses, the College provides short courses varying from ten days to twelve weeks. The expenses for these are uniform with those in the longer courses, but vary with the length of time covered by the several periods. Those who desire to avail themselves of the advantages thus provided are expected to conform to the requirements fixed for other students. They also, therefore, are requested to read this catalogue carefully, especially those parts entitled "Expenses," "Deposits," "Rules and Regulations," "Admission Requirements," and "Instructions to Candidates."

These courses, excepting part of the ten-day courses, will begin January 6, 1903; and, except when stated to the contrary, will be open to men and women, boys and girls, fifteen years old or older.

DAIRY AND CREAMERY SHORT COURSES

The Connecticut Agricultural College offers short winter courses of twelve weeks in farm-dairy and in creamery practice and management.

Requirements for Admission

Short dairy and creamery courses generally prove of most value to students of mature years, who have a clear understanding of the kind of training they need in view of their present circumstances and their plans for the future. No students under sixteen years of age will be accepted. Other requirements are good character and a determination to work.

General Advertisement

A knowledge of certain subjects connected with dairying must be considered of value both to the producer and to the manufacturer of dairy products — to the producer to aid him in the selection and management of his herd, and to the creamery manager in order that he may wisely advise his patrons in regard to the selection of cows, their care and management. Certain subjects of common interest and value will, therefore, be required of both dairy and creamery students. The rest of the work will be divided into two sections, one or the other to be taken according as the student may elect.

Studies Required of All Students

Crops for the dairy herd.
Feeding the dairy herd.
Dairy breeds and the dairy type.
Principles of breeding.
Dairy bacteriology.
Lectures on such subjects as composition of milk and butter making.
Diseases of the dairy cow.

Special Work of Farm-Dairy Students

Practice separating milk.
Babcock testing.
Ripening cream and acid testing.
Churning and butter making.
Producing milk for market.
Judging and scoring dairy cattle.
Construction of barns and silos.
Dairy herd records and accounts.

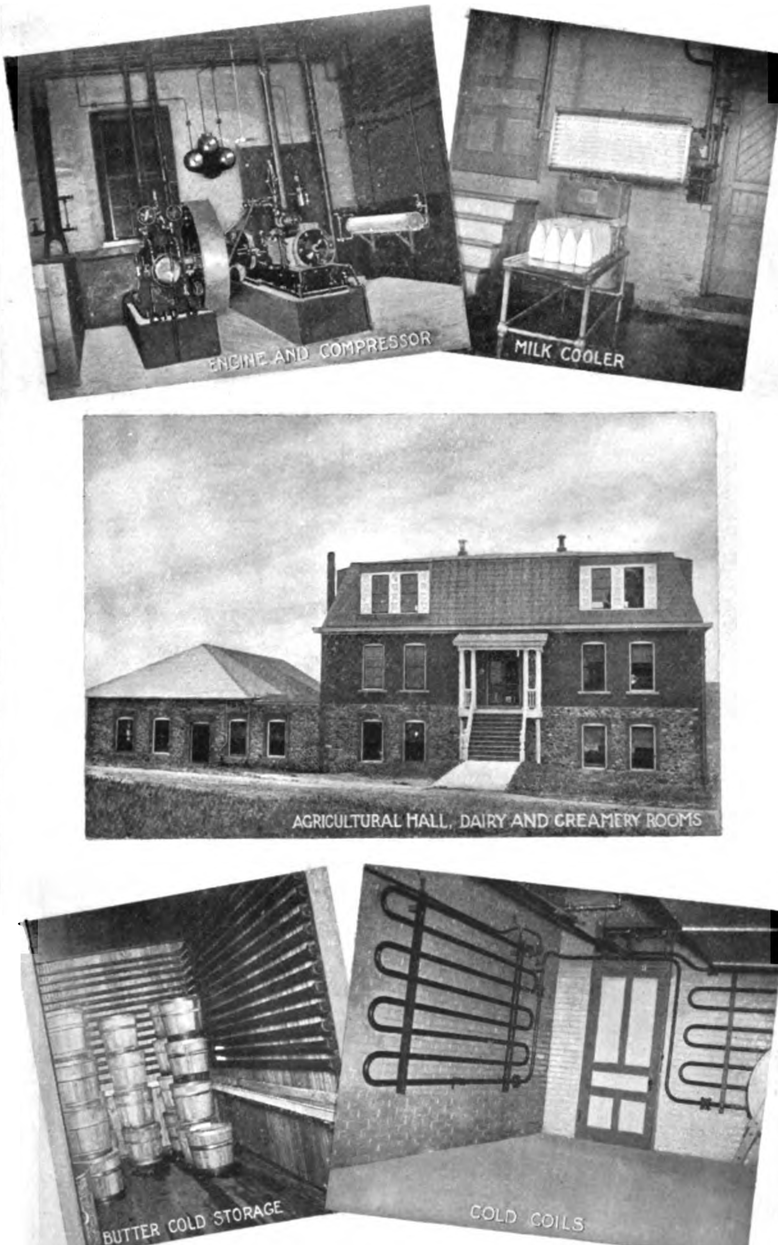
Special Work of Creamery Students

Practice separating milk.
Babcock testing.
Ripening cream and acid testing.
Churning and butter making.
Care of engine and boiler.
Construction and equipment of creameries.
Creamery bookkeeping.

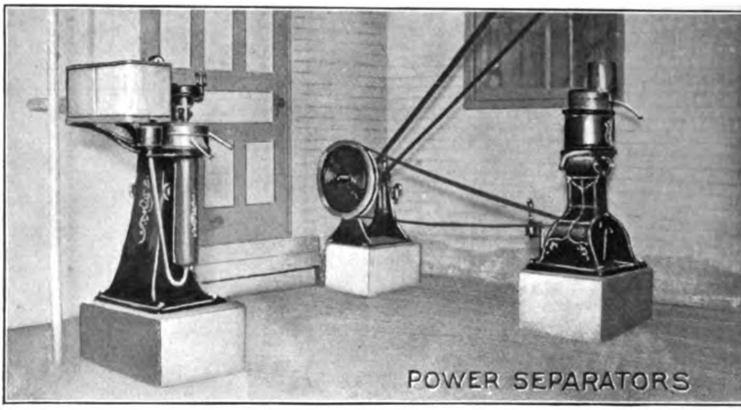
DR. H. W. CONN, Special Lecturer on Bacteriology.

Certificates

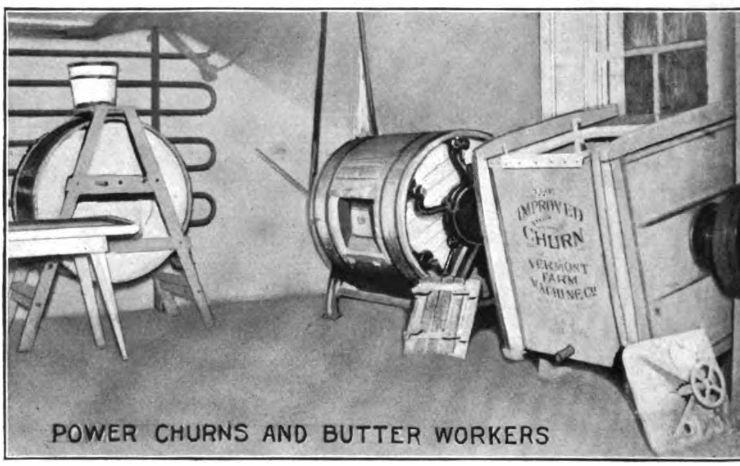
At the completion of these short courses, record blanks will be furnished to the students who intend to continue the dairy business. On these they will be required to keep an accurate record of their



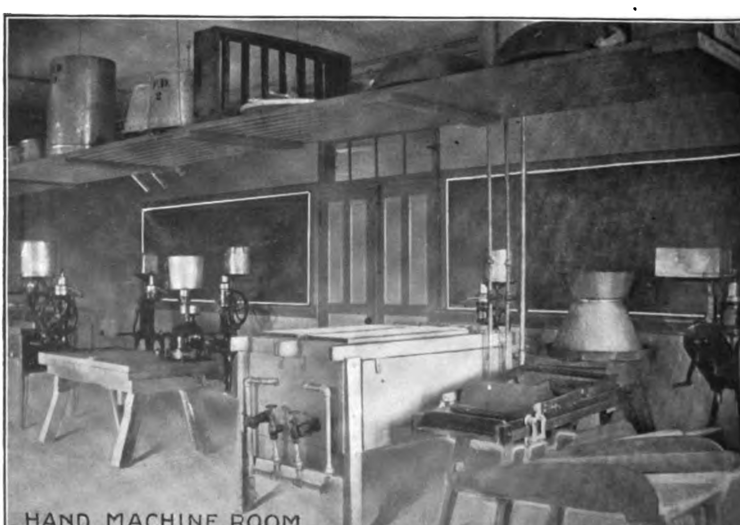
ARTIFICIAL REFRIGERATION INSTRUCTION.



POWER SEPARATORS



POWER CHURNS AND BUTTER WORKERS



HAND MACHINE ROOM

work, and report to the dairy department of the College every month. This work, carefully and systematically pursued, will, in due time, be rewarded by a certificate issued by the College and approved by the department.

Come to see our new model Farm-Dairy and Creamery Building.

POMOLOGY SHORT COURSE

12 Weeks

For Fruit Growers, Busy Men, Twenty Years Old or Older.

Classroom and Field Particulars.

This short course consists of lectures, and of illustrations in the field when the weather permits.

Some of the subjects treated are: The propagation of fruit trees; location and laying out of orchards; methods of protection, cultivation, pruning, and spraying; insects and special diseases.

Time is given to the various important fruits and their individual needs.

The course is varied to suit the students applying, their previous knowledge having been taken into careful consideration.

A thoroughly good course is guaranteed, and studies in other departments may be taken.

POULTRY SHORT COURSE

6 Weeks

For men who desire to gain a knowledge of the broad general principles underlying the poultry industry and of modern methods of conducting operations upon a poultry farm, a special short course is offered. It opens January 6th and continues six weeks, thus terminating early enough to permit students to begin their own poultry operations at the proper season.

No special examination is required for entrance to this course. It is open to all men of good character above fifteen years of age.

Important Features

Instruction is divided between classroom and practical work, and touches upon practically every phase of the industry. In addition to specialists from the College faculty, leading experts in the poultry industry are secured to lecture before the class. At lectures there is opportunity for valuable discussion — the students are permitted to ask questions, and information suited to the needs of each individual is thus had.

When desired, observation excursions are made to leading poultry plants and shows, for clinching facts brought out in the classroom. Available poultry literature is examined, and courses of reading are outlined upon request.

The schedule is full, but other studies may be taken where hours do not conflict. The regular evening lectures are open to all.

Poultry Course Graduates in Demand

From this short course it is impossible to turn out a finished poultryman. Each earnest student, however, is given a foundation upon which to build a successful career. The poultry business is worthy of more attention, particularly among those engaged in other branches of agriculture. It is elastic in its application, and can be made a source of profit, either as a specialty or as a side line, upon the farm or upon the village acre. It offers advantages in this respect possessed by no other branch of farm work. This fact is daily becoming more and more apparent, and the business is being rapidly enlarged. As a result, young men qualified to manage poultry farms are in great demand. At present this demand far exceeds the supply. This College alone has been compelled to return several applications for such men during the past season, and the same condition exists in other states.

For the poultry short-course graduate the outlook is bright.

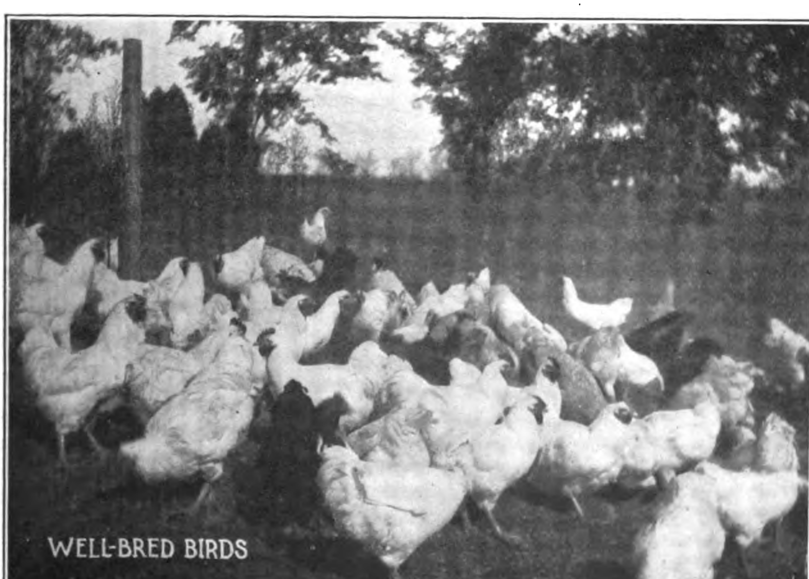
Poultry Class-Room Topics

Some of the topics considered in the classroom are: Principles of breeding; breeds of fowls, ducks, geese, and pigeons, their origin and development; selecting and mating; general care; incubating and brooding, both natural and artificial; rearing; marketing; preparing for the show room; scoring; elementary chemistry of food; foods and feeding; poultry buildings, their location, arrangement, construction, and furnishing; drawing of plans and making of estimates; building materials; yards and fences; growing of special crops for poultry; preservation and use of poultry manure; trees, shrubs, and vines for fruit and protection; elementary zoölogy and embryology; anatomy of fowls; physiology; sanitation; diseases and parasites of fowls; business methods; records.

Practical Poultry Work

The College poultry plant has accommodations for about 400 head of breeding birds, and is stocked with thoroughbred fowls of several of the leading varieties. This stock includes some very


PEKIN DUCKS


WELL-BRED BIRDS

TYPES OF POULTRY HOUSES.

POULTRY DEP'T OFFICE.
BASEMENT INCUBATOR ROOM.

fine specimens, while the average quality is high. The equipment consists of incubators, brooders, a bone cutter, a steam cooker, and other apparatus necessary to care for this amount of breeding stock and rear a large number of young annually. Here the "laboratory practice," or practical work, of the class is carried on. This includes feeding and general care of the stock, operating incubators and brooders of different types, killing and dressing for general and special markets, caponizing, packing hatching eggs and breeding stock for shipment, the use and care of ordinary carpenter tools, and many other incidental details necessary for successful poultry farming.

BUSINESS SHORT COURSE

12 Weeks

IN ANY OR ALL OF THE FOLLOWING SUBJECTS THE CANDIDATE IS PREPARED TO STUDY:

Spelling,	Bookkeeping,
Penmanship,	Shorthand,
Business Arithmetic,	Typewriting,
Business Geography,	Business Laws
Business Correspondence,	and Methods.

STUDENTS MAY ENTER THIS COURSE AT ANY TIME

FORESTRY

12 Weeks to Study

The fitness of certain trees for certain soils.

SAFETY

Planting and Replanting

BEAUTY

The Woodland

ECONOMY

Thinning and Cutting

PROFIT

The practicability of each land proprietor's having his own nursery.

OTHER STUDIES MAY BE TAKEN WITH THIS.

FORESTRY

TEN DAYS IN COLLEGE

WORKERS over 15 years of age who have been or must be deprived of a full college course or of a full term of such a course, but who want to learn and can plan to leave home for a few days this winter, are invited to consider the rare opportunities here presented.

The following ten-day courses of study will be provided at the periods indicated:

January 6-16

1. **Practice** with hand separators, and Babcock testing of milk and cream.

2. **General Entomology:** Including insect anatomy, physiology, and classification; together with methods of collecting, preserving, and mounting insects.

3. **Blacksmithing:** Value of a forge on the farm; work at the forge making bolts, mending chains, and sharpening and tempering tools.

4. **Stable Construction:** Ventilation, drainage, and general stable hygiene.

5. **Library Use and Management:** Reference books, classification and card cataloguing; help for the custodian of the home or village library.

6. **Economic History of the United States:** Westward expansion, systems of land tenure, disposal of the public domain; transportation, monetary system, and industrial revolution.

7. **Injurious Insects and Plant Diseases:** Methods of protection, embracing implements and formulas for spraying and fumigating.

8. **Commercial Fertilizers:** Their purchase, home mixing and use; materials available and their adaptation to various soils and crops. This course is designed for mature men.

9. **Shirtwaists:** The taking of accurate measurements; drafting by simple measurements; economical cutting of material; fitting; the making of waists, stocks, and ties.

10. **Cooking:** Lectures and demonstrations, and practice on the following topics: The use of left-overs, and the most attractive

and palatable ways of preparing and serving the various substitutes for fresh meat and fish; *i. e.*, codfish, dried beef, macaroni, beans, peas, and cheese.

January 20-30

1. **Practice in Cream Ripening.**

2. **Judging and Scoring** dairy cattle and other farm animals.

3. **Economic Entomology:** Life history of our most destructive pests; stages at which insects do their harm; what insects destroy, and how to check insect ravages.

4. **Carpentry:** Principles and rules of building, shop work, and the use and care of carpenter's tools.

5. **Diseases** of the digestive system of the horse, including diseases of the teeth and of the stomach and intestines, such as the different forms of colic; and their treatment.

6. **Road Construction:** The making, improvement, and maintenance of highways.

7. **Vegetable Forcing,** covering houses, heating, soils and plants used.

8. **Summer Dresses:** The principles of dressmaking, simple methods of drafting gored and circular skirts and unlined waists, the placing of laces by machine, the making of a muslin or dimity dress, the making of bows.

9. **Cooking — Yeast Breads:** This course will cover all varieties of breads made with yeast, graham, entire wheat, oatmeal, and white breads, rolls, biscuits, and rusks.

10. **Table Service:** This course will consist of lectures and of practice in planning and serving meals.

February 3-13

1. **Practice in Churning, Working, and Packing Butter.**

2. **Common Diseases of the Cow,** such as milk fever, garget, and bloat, with ordinary treatment.

3. **Bee Keeping:** Kinds of bees, their habits, customs, and methods of work; selection of strains and their propagation; standard hives; and marketing honey.

4. **Mechanical Drawing:** Geometrical drawing and the designing of buildings.

5. **Surveying:** Practice in setting up and in using the transit and the level, and in note keeping. A course for foremen and inspectors on construction work.

6. **Drafting:** Instruction in the use of a dressmaking system, and practice in drafting, cutting, and fitting.

7. **Needlework Pertaining to Dressmaking:** A systematic series of models illustrating the making of blind hems, milliner's folds, pipings, pockets, bone and seam coverings, blind loops, buttonholes, and the placing of braids, facings, and hooks and eyes.

February 17-27

1. **Lectures on Feeding Animals.**
2. **Pomology:** Propagating and pruning fruit trees; insects.
3. **Unsoundness in the Horse.**
4. **Poultry Production,** including judging, selecting and mating fowls.

March 3-13

1. **Dairy Herd Records and Accounts, and Creamery Bookkeeping.**
2. **Obstetrics, especially of the Cow.**

To Candidates

Students applying for admission to any of the ten-day courses may come Monday night and go a week from the next Saturday morning.

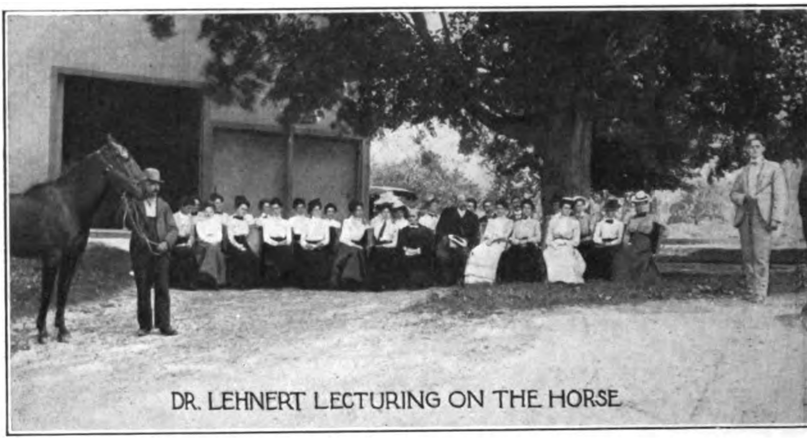
Applicants must be over fifteen years of age.

No other entrance requirements are made except good character and eagerness to learn.

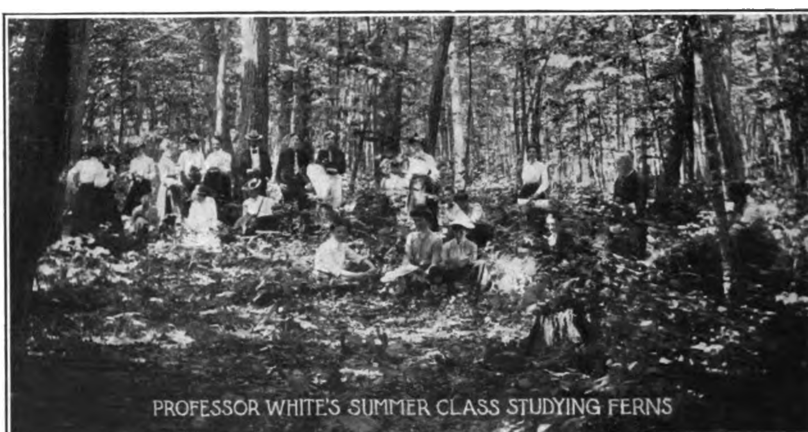
Cooking, table service, and dressmaking courses are expected to be of most interest to those who are beyond the schoolgirl age.

Two or more of the courses in any period may be taken, if the hours do not conflict.

SUMMER SCHOOL



DR. LEHNERT LECTURING ON THE HORSE



PROFESSOR WHITE'S SUMMER CLASS STUDYING FERNS

WITH PROFESSOR KOONS
TEACHERS STUDYING THE HONEY BEES

SUMMER SCHOOL

TEXT-BOOK LIST

Academic Algebra, Milne.
American Fruit Culturist, Thomas.
Analytic Geometry, Wentworth.
Animal Breeding, Shaw.
Business and Social Correspondence, Williams and Rogers.
Business Arithmetic, Williams and Rogers.
Cæsar's Commentaries, Kittridge.
Civil Government, Martin.
Commercial Geography, Adams.
Commercial Law, Fitch.
Complete Bookkeeping, Williams and Rogers.
Composition and Rhetoric, Lockwood and Emerson.
Composition and Rhetoric, Waddy.
Computation Tables, Crandall.
Dairy Bacteriology, Russell.
Differential and Integral Calculus, Osborne.
Elements of Chemistry, Newell.
Elements of Morals, Janét.
Elements of Physics, Gage.
Elements of the Theory and Practice of Cookery, Williams and Fisher.
English History, Montgomery.
Farm Poultry, Watson.
Feeds and Feeding, Henry.
Fertility of the Land, Roberts.
Field Surveying, Searles.
Foundations of Botany, Bergen.
Foundations of Rhetoric, Hill.
Gardening for Profit, Henderson.
German Grammar, Joynes-Meissner.
German Reader, Joynes.
German Texts, Storm's Immensee.
Von Hillern's Höher als die Kirche.
History of English Literature, Painter.
History of Greece, Fyffe.
History of Rome, Creighton.

Horses, Cattle, Sheep, and Swine, Curtis.
Introduction to American Literature, Matthews.
Introduction to the Study of Economics, Bullock.
Latin Grammar, Allen and Greenough.
Lessons and Manual of Botany, Gray.
Micro-Biology, Dinwiddie.
Milk and Its Products, Wing.
Normal Music Course.
Organic Chemistry, Remsen.
Physics of Agriculture, King.
Physical Geography, Davis.
Physiological Botany, Goodale.
Physiology, Martin-Fitz.
Plane Geometry, Pettee.
Plane Surveying, Raymond.
Plant Dissection, Barnes and Coulter.
Practical Exercises in English, Buehler.
Practical Floriculture, Henderson.
Practical Physiology, Blaisdell.
Principles of Fruit Growing, Bailey.
Qualitative Analysis, Noyes.
School Grammar of the English Language, Allen.
Seventy Lessons in Spelling, Williams and Rogers.
Shorthand, Pitman.
Solid Geometry, Wentworth.
Text-book of Geology, Dana-Rice.
The Forester, Brown and Nisbet.
The Soil, King.
The Transition Curve, Crandall.
Trigonometry, Wentworth.
United States History, Montgomery.
U. S. Army and Infantry Drill Regulations.
Veterinary Elements, Hopkins.

COMMENCEMENT EXERCISES

WEDNESDAY, JUNE 18, 1902

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10 o'clock A.M., on the College Campus

PROGRAMME

1. MUSIC: Orchestra, Overture, "Morning, Noon and Night," *F. von Suppe*
2. PRAYER.
3. MUSIC: Orchestra, "The Merry Mandarin," *Theo. Morse*
4. LESTER FORD HARVEY, "The Citizen and the State College"
5. ELIZABETH EMILY GOODRICH, "Commencement Day"
6. GEORGE HUBERT HOLLISTER, "The Diseases of Fruit Trees"
7. GEORGE HERBERT LAMSON, JR., "Obstacles as Incentives to Success"
8. MUSIC: Orchestra, "Fairies' Flirtation," *F. H. Losey*
9. ALFRED BYRON CLARK, "Five Years in Cuban History"
10. LAURA JOSEPHINE WHEELER, "The Public School"
11. *JAMES BYRON TWING, "Tendencies of Modern Education"
12. MUSIC: Orchestra, "Harmony of Love," *E. Brooks*
13. STEPHEN MILLER CROWELL, "The Army of the United States"
14. JENNIE MAUDE OLIN, "The Class in College"
15. JOHN SKINNER CARPENTER, "The Student"
16. MUSIC: Orchestra, "Blissful Moments," *R. Gruenwald*
17. HOWARD LINDEN BUSHNELL, "Improvement and Development of Roads in Connecticut"
18. †JOHN JOSEPH FARRELL, "Selecting an Occupation"
19. VERA ESTELLE FREEMAN, "A Dream of Fair Women"
20. MUSIC: Orchestra, March, "Bombasto," *O. R. Farrar*

Honor positions on the programme given for the highest standing during the college course, 1st — Vera Estelle Freeman; 2d — Lester Ford Harvey

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* Diploma withheld, until a slight deficiency in horticulture has been made up.
† Diploma withheld, until a deficiency in chemistry has been made up.

Afternoon Exercises

2.30 o'clock

MUSIC

Orchestra, "Maid Marian," . . . *Reginald de Koven*

COMMENCEMENT ADDRESS

"The Harper and the Harp," *The Rev. R. G. S. McNeille, D.D.*

MUSIC

Orchestra, "Moon Moths," . . . . *F. Kussner*

CONFERRING DIPLOMAS

AWARD OF PRIZES

MUSIC

Orchestra, "Prince Charming," . . . *F. N. Innes*

CLASS MOTTO, ... "*Labore et Honore*"

CLASS COLORS, ... Orange and Black

STUDENTS

The following students have been in attendance during all or a part of the calendar year from December first, 1901, to November thirtieth, 1902. Names preceded by an asterisk are those of students who did not return to college during the fall term of 1902.

Class of 1902

Name	Town	County
* Bushnell, Howard Linden,	Danielson,	Windham.
* Carpenter, John Skinner,	East Hampton,	Middlesex.
* Clark, Alfred Byron,	Beacon Falls,	New Haven.
Crowell, Stephen Miller,	Middletown,	Middlesex.
† * Farrell, John Joseph,	Storrs,	Tolland.
* Freeman, Vera Estelle,	Spring Hill,	Tolland.
* Goodrich, Elizabeth Emily,	East Hampton,	Middlesex.
* Harvey, Lester Ford,	Minortown,	Litchfield.
* Hollister, George Hubert,	Washington,	Litchfield.
* Lamson, George Herbert, Jr.,	East Hampton,	Middlesex.
* Olin, Jennie Maude,	Plainfield,	Windham.
* Twing, James Byron,	Wallingford,	New Haven.
* Wheeler, Laura Josephine,	Trumbull,	Fairfield.
Total,	13	

Fifth Year Students

Crowell, Stephen Miller,	Middletown,	Middlesex.
Edmond, Herman Deane,	Westminster,	Windham.
Total,	2	

Fourth Year Students

1903

Averill, Ralph Johnson,	Washington,	Litchfield.
Baxter, Ernest Winslow,	Pawtucket,	Rhode Island.
Hauck, Arthur Charles,	Spring Hill,	Tolland.

† Did not complete the course.

Name	Town	County
Manchester, Allen Wilbur,	Bristol,	Hartford.
Pierpont, Morton Elbert,	Waterbury,	New Haven.
Stocking, Wilbur Foshay,	Weatogue,	Hartford.
*Dewey, Charles Wheeler,	Wapping,	Hartford.
*McLean, Samuel George,	So. Glastonbury,	Hartford.
Total,	8	

Third Year Students

1904

Akers, Ella Margaret,	Storrs,	Tolland.
Chandler, Herman Brown,	East Woodstock,	Windham.
Comstock, Herbert Spencer,	Norwalk,	Fairfield.
Dewell, Robert Treat,	Orange,	New Haven.
Dimock, Rosa Warner,	Merrow,	Tolland.
Ford, Frederic Jerome,	Washington,	Litchfield.
Rosenfeld, David Hirsch,	Woodbine,	New Jersey.
Shurtleff, Dwight Knowlton,	West Ashford,	Tolland.
*Palmer, Harry Edwin,	Danielson,	Windham.
Total,	9	

Second Year Students

1905

Colman, Edith,	So. Coventry,	Tolland.
Donovan, Bessie,	Eagleville,	Tolland.
Garlick, Herbert Middleton,	Bridgeport,	Fairfield.
Graff, Paul Weidemeyer,	Bridgeport,	Fairfield.
Gulley, Roy Clinton,	Storrs,	Tolland.
Hollister, Sherman Preston,	Washington,	Litchfield.
Jennings, Henry,	Southold,	New York.
Koons, Frank Stevenson,	Storrs,	Tolland.
Miller, Clyde Sawyer,	Moosup,	Windham.
Patterson, Irving Wooster,	Storrs,	Tolland.
Snow, John Collins,	Mansfield Depot,	Tolland.
Tuller, Oliver Dibble,	West Simsbury,	Hartford.
*Champlion, Louisa,	Eagleville,	Tolland.
*Storrs, Gilbert Holland,	Spring Hill,	Tolland.
Total,	14	

First Year Students

1906

Name	Town	County
Andrews, Nathan,	East Haven,	New Haven.
Baldwin, Harold Tolles,	Beacon Falls,	New Haven.
Barnes, Erva Lyon,	Preston,	New London.
Bass, Eben Lucian,	Scotland,	Windham.
Braski, Leon John,	Storrs,	Tolland.
Camp, Leroy James,	Waterbury,	New Haven.
Clark, Frank Truman,	Beacon Falls,	New Haven.
Cooke, Bertha Adelaide,	New Haven,	New Haven.
Cornelis, Clement Eugene,	Wolcott,	New Haven.
Davis, Walter Olds,	So. Willington,	Tolland.
Doane, Abram Justus,	Essex,	Middlesex.
Fuller, Irving Washington,	Mansfield,	Tolland.
Gibney, John Edward,	East Granby,	Hartford.
Hanks, Harrie Gordon,	Gurleyville,	Tolland.
Hibbard, Harold Chandler,	No. Woodstock,	Windham.
Laubscher, Martin Paul,	Rockville,	Tolland.
Lincoln, George Austin,	Merrow,	Tolland.
Miller, Frederick August,	Millbury,	Massachusetts.
Minor, Dwight Junius,	Bristol,	Hartford.
Pender, Herbert Lawrence,	Somersville,	Tolland.
Risley, Harry Brainard,	Wethersfield,	Hartford.
Rose, Frank Howard,	Ivoryton,	Middlesex.
Shurtleff, Goldie Adaline,	West Ashford,	Windham.
Shurtleff, Nora Iola,	West Ashford,	Windham.
Spalding, Madge Ernestine,	Portland,	Middlesex.
Stockwell, Lucy Frances,	West Simsbury,	Hartford.
Swift, Theron Dunham,	Mansfield Center,	Tolland.
Tryon, Ralph Goodrich,	So. Glastonbury,	Hartford.
Waters, Theodore Charles,	Wolcott,	New Haven.
Welton, Walter Roger,	Warren,	Litchfield.
Wilbur, Alice Roxana,	Abington,	Windham.
Total,	31	

Special Students

Bassett, Lucian Nichols,	Putnam,	Windham.
Clark, Annie Eliza,	Beacon Falls,	New Haven.
Conger, Anna Martha,	Storrs,	Tolland.
Holcomb, Ruth Angeline,	Simsbury,	Hartford.
Huntington, Maude Leone,	Mansfield Center,	Tolland.

Name	Town	County
Koenig, Fred,	Rockville,	Tolland.
Monteith, Marjorie Ruthven,	Unionville,	Hartford.
Pattison, Charles Nelson,	Norwich,	New London.
Pearl, Arthur Eugene,	Hampton,	Windham.
Ritch, William Edgar, Jr.,	Bridgeport,	Fairfield.
Rogers, Lillian Elizabeth,	New York,	New York.
Von Tobel, Emma Louise,	Torrington,	Litchfield.
Waters, Gertrude Starr,	Wolcott,	New Haven.
Welton, Clark Hubbard,	Waterville,	New Haven.
Witt, Bertha Abbie,	Stafford Springs,	Tolland.
†*Clark, Arthur Nathaniel,	Old Saybrook,	Middlesex.
*Dallas, Bertha,	Storrs,	Tolland.
*Koons, Grace Elizabeth,	Storrs,	Tolland.
*Mallard, Samuel George,	East Manchester,	N. H.
*Moriarity, Edward Henry,	East Hampton,	Middlesex.
*Morse, Charles Taylor,	Shelton,	Fairfield.
*Parkhurst, Herbert Roy,	Westminster,	Windham.
†*Rust, May Alice,	Farmington,	Hartford.
*Stevens, Edward Le Roy,	Stockbridge,	Massachusetts.
*Thorpe, Gertrude Leila,	North Haven,	New Haven.
*Willard, Edward Wells,	Wethersfield,	Hartford.
*Woodward, Sherman Prindle,	Bethany,	New Haven.
Total,	27	

Short Course Students

1902

DAIRY

Dewey, Roger P.,	Buckland,	Hartford.
Holt, Roy S.,	Chestnut Hill,	Tolland.
Jarman, Charles E.,	Burnside,	Hartford.
Patchen, Howard C.,	Danbury,	Fairfield.
Schaller, Frederick A.,	Norwalk,	Fairfield.

POULTRY

Baldwin, Harry H.,	Thomaston,	Litchfield.
Copeland, John,	Middletown,	Middlesex.
Messenger, Frederic B.,	West Granby,	Hartford.
Palmer, Frank H.,	Greeneville,	New London.
Parkhurst. Herbert R.	Westminster,	Windham.

† Expelled.

SHOP WORK

Name	Town	County
Goodwin, Henry E., . . .	Cheshire,	New Haven.

BEE KEEPING

Stanton, Mary A., ...	Bridgeport,	Fairfield.

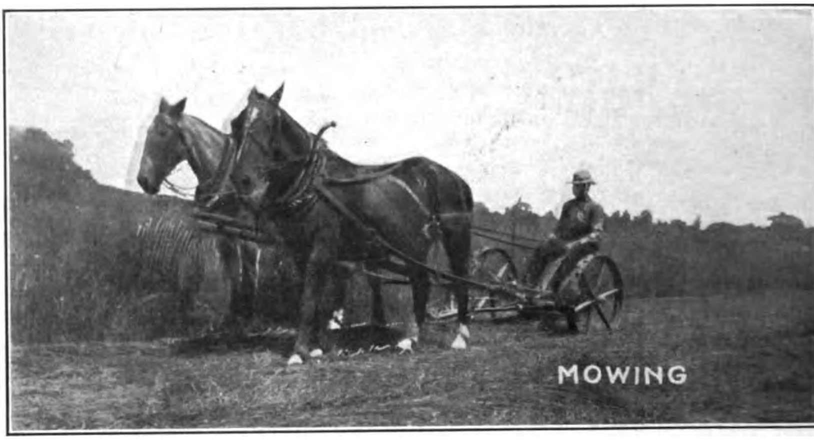
VETERINARY SCIENCE AND ENTOMOLOGY

Frost, Willis E., ...	Bridgewater,	Litchfield.

FORESTRY

Mallard, Samuel G., . . .	East Manchester,	N. H.
Total, ...	14	

SUMMER SCHOOL'



SUMMER SCHOOL

SUMMER SCHOOL

1902

Names preceded by an asterisk are of those who received certificates of attendance at the exercises of the entire course.

*Arthur, Janet E.,	Waterbury,	Conn.
Buffington, Eva M.,	Hartford,	"
Burlingame, Ada M.,	Killingly,	"
Burnett, Cora B.,	New Milford,	"
*Chedsey, Mary C.,	Park Hill, Yonkers,	N. Y.
Cleasby, Elizabeth,	Hartford,	Conn.
*Cleaveland, Almira,	Lakeville,	"
*Conklyn, Harriet W.,	Salisbury,	"
Daniels, Ella,	Meriden,	"
English, Alice,	New Britain,	"
*Greene, Ruth R.,	Goshen,	"
Hall, Anna E.,	Mansfield Depot,	"
*Hanrahan, Minnie E.,	Stamford,	"
*Harrison, Margaret L.,	Stamford,	"
Hatch, Mildred D.,	New Milford,	"
*Hawley, Mrs. J. S.,	Nutley,	N. J.
*Hawley, Mary W.,	Nutley,	"
*Hill, Mamie E.,	New Milford,	Conn.
Hornbeck, H. F.,	Chester,	"
Huntington, Mary L.,	Mansfield,	"
*Lewis, Carrie E.,	Watertown,	"
Marsh, Ida J.,	New Milford,	"
Mason, Christie J.,	Mansfield,	"
Mason, Dasie M.,	Mansfield,	"
Mason, Eva B.,	Mansfield,	"
Roeth, Mrs. I. S.,	Meriden,	"
Roeth, Natalie S.,	Meriden,	"
*Rozelle, Lida A.,	Plymouth,	"
Shute, J. M.,	Waterbury,	"
*Starkweather, Annie,	Mansfield Depot,	"
Stevenson, Lizzie,	Storrs,	"

*Stillman, Clara M., ...	Rocky Hill,	Conn.
*Weed, Susan M., ...	Long Ridge, Stamford,	"
Wiley, Clarence H., ...	Hartford,	"
*Wilkinson, Ellen, ...	South Manchester,	"
*Wilkinson, Minna, ...	South Manchester,	"
Zug, Lola, ...	Lancaster,	Pa.
Total, ...	37.	

Summary

Class of 1902, ...	13
Fifth Year Students, ...	2
Fourth Year Students, ...	8
Third Year Students, ...	9
Second Year Students, ...	14
First Year Students, ...	31
Special Students, ...	27
Short Course Students, ...	14
Summer School, ...	37
Total, counting none twice, 152	

COLLEGE ORGANIZATIONS

Students' Organization

R. J. Averill, ...	President.
M. E. Pierpont, . . .	First Vice-President.
H. S. Comstock, . . .	Second Vice-President.
D. H. Rosenfeld, . . .	Secretary.
F. S. Koons, ...	Treasurer.

C. A. C. Athletic Association

M. E. Pierpont, . . .	President.
D. K. Shurtleff, . . .	Vice-President.
S. P. Hollister, ...	Secretary and Treasurer.

Baseball Team, 1902

R. J. Averill, ...	Pitcher.
C. N. Pattison, ...	Catcher.
J. S. Carpenter, *Manager*, . .	First Base.
S. M. Crowell, ...	Second Base.
G. H. Lamson, Jr., . . .	Short Stop.
L. F. Harvey, *Captain*, . .	Third Base.
H. S. Comstock, . . .	Right Field.
D. K. Shurtleff, . . .	Center Field.
J. B. Twing, ...	Left Field.
S. G. Mallard, ...	Substitute.

Basketball Team, 1902

S. G. McLean, ...	Right Forward.
M. E. Pierpont, *Captain*, . .	Left Forward.
J. B. Twing, R. J. Averill, ...	Center.
*S. M. Crowell, *Captain*, L. F. Harvey, . .	Right Guard.
A. W. Manchester, E. H. Moriarity, . . .	Left Guard.

* Resigned.

Girls' Basketball Team, 1902

Anna M. Conger,	Right Forward.
Grace E. Koons,	Left Forward.
Marjorie R. Monteith, *Captain*,	Center.
Rosa W. Dimock,	Right Guard.
Gertrude L. Thorpe,	Left Guard.
Elizabeth E. Goodrich, Bessie Donovan,	Substitutes.

Football Team, 1902

H. S. Comstock,	Right End.
M. E. Pierpont, *Manager*,	Right Tackle.
H. D. Edmond,	Right Guard.
R. T. Dewell,	Center.
H. B. Risley,	Left Guard.
D. K. Shurtleff,	Left Tackle.
W. E. Ritch,	Left End.
A. W. Manchester,	Right Half Back.
C. H. Welton,	Quarter Back.
R. J. Averill, *Captain*,	Left Half Back.
S. M. Crowell,	Full Back.
C. N. Pattison, I. W. Patterson, J. C. Snow,	Substitutes.

College Paper

C. A. C. LOOKOUT

(Published Monthly)

A. W. Manchester,	Editor-in-Chief.
R. J. Averill,	Business Manager.
R. T. Dewell,	Assistant Manager.
Prof. H. R. Monteith,	Treasurer.
M. E. Pierpont,	College Notes.
E. W. Baxter,	Athletics.
D. K. Shurtleff,	Alumni Notes.
F. Koenig,	Exchanges.

Young Men's Christian Association

The Young Men's Christian Association is organized by the students for the promotion of Christian fellowship among its members, and for the purpose of raising a higher standard of manhood among all students.

OFFICERS

W. F. Stocking,	President.
M. E. Pierpont,	Treasurer.

Eclectic Literary Society

This society holds weekly meetings for the purpose of improvement in writing and speaking. Original papers, declamations, and *extempore* debates are the principal features of its regular programs.

OFFICERS

W. F. Stocking,	President.
S. M. Crowell,	Vice-President.
A. E. Pearl,	Secretary.
H. D. Edmond,	Corresponding Secretary.
A. C. Hauck,	Treasurer.
L. J. Braski,	Marshal.

College Shakespearean Club

The Shakespearean Club, like the above, has for its object the mental culture of its members. Weekly programs of declamations, essays, and debates afford an ample field for the exercise of literary ability and oratorical genius.

OFFICERS

R. J. Averill,	President.
H. S. Comstock,	Vice-President.
D. H. Rosenfield,	Corresponding Secretary.
D. K. Shurtleff,	Secretary.
F. J. Ford,	Treasurer.
M. E. Pierpont,	First Director.
D. H. Rosenfeld,	Second Director.
H. M. Garlick,	Third Director.

Class Officers

1903.	A. W. Manchester,	President.
1904.	H. S. Comstock,	President.
1905.	S. P. Hollister,	President.
1906.	I. W. Fuller,	President.

Military Organization

Cadet Commissioned and Noncommissioned Officers

Charles A. Meserve, Ph.D., Instructor in Military Tactics, Captain and Commandant.

A. W. Manchester,	Cadet Captain.
A. C. Hauck,	Cadet First Lieutenant.
R. J. Averill,	Cadet Second Lieutenant.
M. E. Pierpont,	Cadet First Sergeant.
W. F. Stocking,	Cadet Quartermaster Sergeant.
H. S. Comstock,	Cadet Sergeants.
R. T. Dewell,	
D. K. Shurtleff,	
C. H. Welton,	
E. W. Baxter,	Cadet Corporals.
I. W. Patterson,	
A. J. Doane,	
F. J. Ford,	
H. M. Garlick,	
F. S. Koons,	

Alumni Association

Harry L. Garrigus, '98,	President.
Charles R. Green, '95,	Secretary.
Albert C. Gilbert, '97,	Treasurer.

ALUMNI AND ALUMNAE

1883

Fred Birge Brown,	Lumber Dealer,	Mobile, Ala.
Charles Spencer Foster,	Buffer,	Terryville, Conn.
Henry Richard Hoisington, Jr.,	Farmer,	Coventry, Conn.
Burke Hough,	Groceryman,	Northampton, Mass.
Arthur Sherwood Hubbard,	Emp'd in Mfg.,	Care A. P. Smith Co., Newark, N. J.
Andrew Keith Thompson,	Express Agent,	New Haven, Conn.

1884

Clifford S. Barnes,	Liveryman,	Bristol, Conn.
Jerry Lincoln Fenn,	Asst. Clerk, Superior Court,	Hartford, Conn.
Frank S. Hubbard.*		
Andrew Hyde,	Vet. Surgeon,	Norwich, Conn.
Fred C. Leavens,	Farmer,	Wauregan, Conn.
Samuel Q. Porter,	Stock Breeder,	West Plains, Mo.

1885

Robert A. Ayer,	Lumberman,	Olympia, Wash.
Horace S. Eaton,	Farmer,	Fairfax, Vt.
Frank E. Fenner,	Merchant,	Waterbury, Conn.
Archer C. Ford,	Orchardist,	Grant's Pass, Oregon.
Royal E. Myers,	Doctor,	Baltimore, Md.
Isaac B. Wakeman,	R. E. Dealer and Broker,	149 Br'dway, N. Y. City.

1886

John H. Atkins,	Farmer,	Middletown, Conn.
Eugene A. Bailey.†		
Edgar S. Blair,		Address not known.
Wilbur L. Chamberlain,	Electrician,	172 Franklin Ave., Hartford, Conn.

* Died April, 1902, at Glastonbury, Conn.
† Died Sept. 18 1895, at Loveland, Col.

Fred T. Coe,	Bookkeeper,	Address not known.
John H. Gardner, Jr.,	Vet. Surgeon,	Norwich, Conn.
Henry R. Hayden,	Architect,	Northampton, Mass.
Selden W. Hayes,	Asst. Prin. Farm School,	Box 965, Hartford, Conn.
Bruce Hough,	Chair Mfr.,	West Gardner, Mass.
Edgar J. Leavenworth,	Farmer,	Ansonia, Conn.
John B. Perry,	Farmer,	Clark's Fall, Conn.
Arthur L. Reed,	Farmer,	North Coventry, Conn.
Fred A. Robinson,	Dentist,	Shanghai, China.
Ira B. Smith,	Salesman,	Address not known.

1887

Dexter E. Hall,	Salesman,	Box 1382, Meriden, Conn.
William J. Irwin,	Emp'd in Mfg.,	15 Oak St., Hartford, Conn.
William S. Lee,	Farmer,	Hanover, Conn.
Sidney H. Perry,	Salesman,	Danielson, Conn.
Edward F. Weed,	Supt. of R. E.,	Rowayton, Conn.
John W. Yeomans,	Emp'd in Mfg.,	Hopedale, Mass.

1888

Willette Lincoln Alley,	Butcher,	Banksville, Conn.
Wesley Roswell Coe,	Teacher,	2 Hillhouse Ave., New Haven, Conn.
Henry Bacon Hubbard,	Bookkeeper,	21 Orman Place, Brooklyn Borough, N.Y. City.
George Henry Knowles,	Gardener,	Ellington, Conn.
Keeney B. Loomis,	Farmer,	So. Manchester, Conn.
Harry Lincoln Quinlin.*		
Charles William Roberts,	Farmer,	Middletown, Conn.
Clarence Henry Savage,	Farmer,	Storrs, Conn.
Charles Augustus Wheeler,	Teacher,	Storrs, Conn.

1889

Merton Chapman,	Nurse,	Groton, Conn.
Samuel Hart Deming,	Cream Gatherer,	Box 24, Farmington, Conn.
Fred Alfred McKenzie,	Emp'd in Mfg.,	Atlantic Screw Co., Hartford, Conn.

* Died Feb. 24, 1893, at Newfield, Conn.

1890

Ernst Hamilton Brandt,	Mfg. Rub. Wks.,	13 South St., Mt. Vernon, N. Y.
Merrill Everett Brown,	Sec'y Derby-Shelton Y. M. C. A.,	Box 1049, Derby, Conn.
Charles James Gilmore,		Address not known.
Wilbur Lionel Goodenough,	Salesman,	Winchester Ctr., Conn.
Latham Hull,	Stockbreeder,	No. Stonington, Conn.
John Hunter Lacke,	Lawyer,	177 Montague St., Br'k-lyn Bor., N. Y. City.
Carlton Elbert Lane,	Grain Dealer,	Address not known.
Clarence Bronson Lane,	Asst. in Exp.Sta.,	New Brunswick, N.J.
George Neth,	Electrician,	Address not known.
Charles Backus Pomeroy, Jr.,	Farmer,	Willimantic, Conn.
Robert Garland Shepard,		Address not known.
Adolph Carl Sternberg,	Fruit Grower,	West Hartford, Conn.
Willis LeRoy Wetmore,	Farmer,	Winchester, Conn.

1891

Herbert Porch Caldwell,	Salesman,	234 Putnam St., Hartford, Conn.
Charles Vibert Chandler,	Clerk,	Olds & Whipple, Hartford, Conn.
Walter Ernest Cummings,	Hardware,	West Medway, Mass.
James Sumner Fowler,	Fruit Grower,	Florida.
John Carter Frisbie,	Civil Engineer,	Southington, Conn.
Alfred Herbert Griswold,	Mechanic,	New Britain, Conn.
Arthur Gilbert Hall,	Salesman,	104 So Colony St., Meriden, Conn.
Harry Grant Manchester,	Farmer,	Sta. A, Winsted, Conn.
George Henry Merwin,	Farmer,	Greenfield Hill, Conn.
Fred Rosebrooks,	Farmer,	Willimantic, Conn.
Walter Lyman Rosebrooks,	Hardware,	West Medway, Mass.
Charles Herbert Vibert,	Farmer,	Meriden, Conn.
Allen Rice Yale,	Farmer,	Meriden, Conn.

1892

Charles George Allen,	Bookkeeper,	Turnerville, Conn.
Seth Herbert Buell,	Student,	Yale University, New Haven, Conn.
Aaron William Fenn,	Farmer,	Plymouth, Conn.
Henry Edward French,	Salesman,	Hartford, Conn. Care C. N. Dodge.
George Henry Hall,	Printer,	76 Lexington Ave., New York City.

Walter Holden,	Electrician,	7 Cedar Court, Norwich, Conn.
Walter Francis Schultz,	Gardener,	12 Brook St., Hartford, Conn.
Herbert Edmund Warner,	Farmer,	North Haven, Conn.

1893

Ernest Treat Beard,	Farmer,	Milford, Conn.
Walter Harley Bishop,	Farmer,	North Haven, Conn.
Charles Henry Brimble.*		
Frederick William Darnstedt,	Electrician,	74 Willow St., Hartford, Conn.
William Bailey Dayton,	Farmer,	Plantsville, Conn.
Walter Morgan Dunivan,	Clerk,	268 Market St., Hartford, Conn.
Charles Wells Eddy,	Civil Engineer,	Simsbury, Conn.
Edward Blodgett Fitts,	Farm Supt.,	N. Lebanon Ctr., N. Y.
William James Frey,	Bookkeeper,	Box 306, Hartford, Conn.
Martin Moore Frisbie,	Earmer,	Southington, Conn.
Harvey Clark Harrison,	Farmer,	Northford, Conn.
Martin Hibbard Parker,	Farmer,	So. Coventry, Conn.
Frank Curtis Osborne,	Clerk,	Pier 14, East River, New York City.
Homer Gurley Sperry,	Farmer,	So. Manchester, Conn.
Walter Arnold Warren,	Asst. Hort. Dept.,	Storrs, Conn.

1894

Charles H. Brimble.†*		
Hobart James Brockett,	Farmer,	Clintonville, Conn.
Seth Herbert Buell.†		
John Carter Frisbie.†		
Harvey Clark Harrison.†		
Martin Hibbard Parker.†		
Louise Jane Rosebrooks,	Housekeeper,	So. Coventry, Conn.
Walter Francis Schultz.†		
Anna Mabel Fitts, *née* Snow,	Housekeeper,	New Lebanon Ctr., New York.
Herbert Edmund Warner.†		
Walter Arnold Warren.†		
Nellie Louise Bingham, *née* Wilson,	Housekeeper,	Mansfield, Conn.

* Died June, 1900, at Hartford, Conn.

† Graduated with an earlier class; returned and completed the four-year course established in 1893.

1895

Francis Ariel Bartlett,	Clerk,	1 Fulton Fish Market, N. Y. City.
Martin Moore Frisbie.†		
Charles Robert Green,	Asst. Librarian,	161 Seymour St., Hartford, Conn.
George Ransom Hall,	Salesman,	Hartford, Conn. Care Veeder Mfg. Co.
William App Richard Hawley,	Asst. Supt. Power Plant,	New Canaan, Conn.
Arthur Clayton James,	R. P. Clerk,	Hartford, Conn.
Arthur Joseph Pierpont,	Farmer,	Waterbury, Conn.
Arthur Edward Shedd,	Farmer,	Preston, Conn.
William Alonzo Stocking, Jr.,	Asst. in Ex. Sta.,	Storrs, Conn.
Arthur Hatch Sturdevant,	Farmer,	Bridgewater, Conn.
Albert Buckingham Tyler,	Farmer,	Address not known.

1896

Howard Grant Barber,	Teacher,	Union, Conn.
Grace Emily Eddy, *née* Blakeman,	Housekeeper,	Simsbury, Conn.
Olive Nicholson Clark,	Housekeeper,	Old Saybrook, Conn.
Albert Ernest Coles,	Farmer,	Rockfall, Conn.
Clayton Theron Curtis,	Farmer,	E. Glastonbury, Conn.
John Harry Evans,	Student,	College of P. & S., New York City.
Ethel Eugenia Freeman,	Clerk,	Chaplin, Conn.
Olcott Frederick King,	Farmer,	South Windsor, Conn.
Grace Edith Palmer, *née* Snow,	Housekeeper,	Jewett City, Conn.
Leroy Minor Tucker,	Farmer,	Middletown, Conn.
Ernest Henry Waite,	Landscape Gard.,	Address not known.

1897

Harry E. Atwood,	Farmer,	Windham, Conn.
Robert D. Beardsley,	Civil Engineer,	28 Arch Street, Waterbury, Conn.
Frederick N. Buell,	Bridge Builder,	2052 N. 14th St., Toledo, Ohio.
Fred F. Bushnell,	Vet. Surgeon,	Winsted, Conn.
Francis Comber,	Clerk,	Elmwood, Conn.
John N. Fitts,	Mechanic,	Storrs, Conn.
Charles L. Foskett,	Clerk,	Gilbert Clock Co., Winsted, Conn.

† See note on preceding page.

Erma L. Webb, *née* Fuller,	Housekeeper,	Plymouth, Conn.
Albert C. Gilbert,	Student,	Mass. Inst. Tech., Boston, Mass.
R. D. Gilbert,	Student,	Yale University, New Haven, Conn.
Arthur O. Green.*		
Grove H. Johnson,	Insurance Agent,	Winsted, Conn.
Harry B. Luce.	Farmer,	New Britain, Conn.
Victor E. Luchinni,	Farmer,	Meriden, Conn.
Benjamin S. Taylor,	Farmer,	So. Glastonbury, Conn.

1898

Dennis Julian Burgess,	Clerk,	Fall River, Mass.
Charles Sydney Chapman,	Forestry Bureau,	Washington, D. C.
Charles Stoddard Francis,	Civil Engineer,	Newington, Conn.
Harry Lucian Garrigus,	Farm Supt.,	Storrs, Conn.
Walter Stanley Gillette,	Bookkeeper,	New Haven, Conn.
Willis Nicholas Hawley.†		
Herbert Kirkpatrick,	Farm Supt.,	Spring Hill, Conn.
Edwin Shepard Mansfield,	Farmer,	North Haven, Conn.
Herman Frederick Onthrup,	Student,	Wesleyan University, Middletown, Conn.
Joseph William Pincus,	Teacher,	Woodbine, N. J.
Max Schaffrath,	Bookkeeper,	Springfield, Mass.
Clinton Gold Smith,	Forestry Bureau,	Washington, D. C.
George Ernest Smith,	Surveyor,	Derby, Conn.
Norman James Webb,	Machinist,	Plymouth, Conn.

1899

Selma Alida Carlson,	Teacher,	Mansfield, Conn.
Frank Dexter Clapp,	Salesman,	Hartford, Conn.
Roscoe Hoskins Gardner,	Florist,	Cromwell, Conn.
Irvin Edson Gilbert,	Woodworker,	Waterville, Conn.
Arthur Franklin Green,	Dairyman,	Middlebury, Conn.
George Melville Green,	Student,	Mass. Inst. Tech., Boston, Mass.
Ida Louise Hobby,	Housekeeper,	81 Hillside Ave., Arlington Hts., Mass.
Willard Whitaker James,	Surveyor,	North Windham, Conn.
Elsie Sophia Leach,	Housekeeper,	Plymouth, Conn.

* Died April, 1898, at Hartford, Conn.

† Died at Philadelphia, November 19, 1898. First Sergeant, Company H, Third Regiment, Connecticut Volunteers.

Willard Ernest Mason,	Student,	Mansfield, Conn.
Edward Francis Manchester,	Farmer,	Bristol, Conn.
George Harry Miner,	Student,	Cornell University, Ithaca, N. Y.
Willis Mills Nettleton,	Farmer,	Washington Depot, Conn.
Bertha May Garrigus, *née* Patterson,	Housekeeper,	Storrs, Conn.
Clarence Dwight Smith,	Farmer,	Westminster, Conn.
Benjamin Hovey Walden,	Asst. Exper. Stat.	Conn. Agri. Exper. Sta., New Haven, Conn.
Cassius Way,	Student,	Cornell University, Ithaca, N. Y.
Elmer Clinton Welden,	Dairyman,	Scotland, Conn.
Katherine Rosetta Luchinni, *née* Yale,	Housekeeper,	Meriden, Conn.

1900

Frederick Joseph Baldwin,	Surveyor,	Watertown, Conn.
Edwin Stanley Bishop,	Farmer,	Clintonville, Conn.
Marie Carrie Brown,	Teacher,	Rockville, Conn.
Herman Deane Edmond,	Student,	Storrs, Conn.
Harry David Emmons,	Insurance Agent,	Naugatuck, Conn.
Gertrude Eliza Grant,	Teacher,	Rocky Hill, Conn.
Hester Clarice Luce, *née* Hall,	Housekeeper,	New Britain, Conn.
Anna Christina Jacobson,	Teacher,	3349 Forbes Street, Pittsburg, Pa.
Irving Charles Karr,	Civil Engineer,	West Haven, Conn.
Edith Sara Latimer,	Supt. Y. W. C. A.,	15 Lodge Street, Albany, N. Y.
Lena Eliza Latimer,	Teacher,	North Canton, Conn.
John Bowers Lyman,	Clerk,	Middletown, Conn.
Christie Jennie Mason,	Student,	Mansfield, Conn.
Eva Belle Mason,	Teacher,	Mansfield, Conn.
Edna Mabel Nason.*		
Albert Vincent Osmun,	Student,	Amherst, Mass
Hanna Bertha Squire,	Teacher,	Mansfield City, Conn.
Horace George Williams,	Student,	Cornell University, Ithaca, N. Y.

1901

Joseph Howard Blakeslee,	Insurance Agent,	Willimantic, Conn.
Edwin Pike Brown,	Farmer,	Rockville, Conn.
*William Wallace Dimock,	Student,	Cornell University, Ithaca, N. Y.

* Died March 17, 1901.

Theodore Francis Downing,	Ins. Agent,	Willimantic, Conn.
Charles Wentworth Fairchild,	Merchant,	Nichols, Conn.
Elia Tom Kuzirian,	Gard'r & Teacher,	Cranston, R. I.
Frederick Henry Plumb,	Teacher,	Norwalk, Conn.
Frederic William Pratt,	Electrician,	32 Eagle Street, Schenectady, N.Y.
Walter Franklin Thorpe,	Student,	Cornell University, Ithaca, N. Y.
John Hamilton Vallett,	Mechanic,	Worcester, Mass.

1902

Howard Linden Bushnell,	Emp'd in Dairying,	Waterbury, Conn.
John Skinner Carpenter,	Farmer,	East Hampton, Conn.
Alfred Byron Clark,	Asst., Dairy Department,	Storrs, Conn.
Stephen Miller Crowell,	Student,	Storrs, Conn.
Vera Estelle Freeman,	Teacher,	Spring Hill, Conn.
Elizabeth Emily Goodrich,	Housekeeper,	East Hampton, Conn.
Lester Ford Harvey,	Student,	Amherst, Mass.
George Hubert Hollister,	Asst., Hort. Dept.,	Storrs, Conn.
George Herbert Lamson, Jr.,	Student,	Amherst, Mass.
Jennie Maude Olin,	Housekeeper,	Merrick, Mass.
James Byron Twing,	Agent,	Home Correspondence School, Springfield, Mass.
Laura Josephine Wheeler,	Housekeeper,	Trumbull, Conn.

SUMMARY

Total number of students graduated up to 1903, two hundred and twelve, of whom twenty-seven are women.

Farmers,	50	Manufacturers,	2
Salesmen, Clerks, and Bookkeepers,	26	Veterinary Surgeons,	3
Students,	18	Lawyer,	1
Housekeepers,	15	Architect,	1
Teachers,	14	Liveryman,	1
Merchants,	9	Printer,	1
Nurserymen, Gardeners, and Fruit Growers,	9	Doctor,	1
Mechanics,	7	Real Estate Dealer,	1
Superintendents and Agents,	8	Dentist,	1
Civil Engineers,	5	Nurse,	1
Employed in Manufacturing,	4	Y. M. C. A. Secretary,	1
Assistants in Experiment Stations and Forestry Bureau,	5	Y. W. C. A. "	1
Electricians,	5	Stockbreeders,	2
Surveyors,	3	Librarian,	1
Dairymen,	5	Landscape Gardener,	1
		Occupation not known,	3
		Deceased,	7

Graduates, upon changing their addresses, are requested to communicate with the President of the College, that the above list may be kept up to date; and the aid of class secretaries and all others is solicited, that the list may be properly revised each year.

INDEX

REAR VIEW WITH LAKE—1898

State of Connecticut.

PUBLIC DOCUMENT No. 34.

ANNUAL REPORT

OF THE

STORRS

AGRICULTURAL EXPERIMENT STATION,

STORRS, CONN.,

FOR THE YEAR ENDING JUNE 30, 1902.

PRINTED BY ORDER OF THE LEGISLATURE.

MIDDLETOWN, CONN.:
PELTON & KING, PRINTERS AND BOOKBINDERS.
1902.

OFFICERS OF THE STATION.

EXECUTIVE COMMITTEE.

G. A. HOPSON, G. S. PALMER, B. C. PATTERSON.

TREASURER.

WILLIAM D. HOLMAN,* West Willington.
WILLIAM H. HALL, West Willington.

STATION STAFF.

W. O. ATWATER,	*Director.*
C. S. PHELPS,	*Vice-Director and Agriculturist.*
F. E. SINGLETON,	*Secretary.*
H. W. CONN,	*Bacteriologist.*
W. A. STOCKING, JR.,	*Dairy Experimenter.*
R. D. MILNER,	*Chemist.*
W. M. ESTEN,	*Assistant in Dairy Bacteriology.*

The Station is located at Mansfield (P. O. Storrs), as a department of the Connecticut Agricultural College. The chemical and other more abstract research is carried out at Wesleyan University, Middletown, where the Director may be addressed.

* Died during fiscal year.

Report of the Director

For the Year Ending June 30, 1902.

The subjects of experimental investigation undertaken by the Station during the year 1901–2 were similar to those of previous years. This was in accordance with the policy of the Station since its foundation, namely, to undertake comparatively few lines of work, have these as nearly parallel as practicable, and continue them from year to year as long as circumstances should warrant. The principal inquiries conducted for a number of years had to do with the nutrition of plants, domestic animals and man, and the bacteriology of the dairy. These included experiments on the effects of fertilizers upon the growth and composition of plants, studies of rations fed to milch cows, studies of bacteria, especially those concerned in normal cream ripening, and investigations of the food and nutrition of man.

Inquiries along the various lines were taken up as usual during the year 1901–2, but the work of the Station was interrupted in several ways and part of it had to be terminated in an unfinished condition. Prof. C. S. Phelps, who had charge of all the work done at Storrs, including the investigations with plants and animals, resigned his position as vice-director and agriculturist of the Station during the middle of the year; and at the same time it was decided to transfer to Storrs as much as possible of the work that up to that time had been carried on at Middletown. The work at Storrs undertaken by Prof. Phelps during the year could not be completed, and consequently there were no results to be reported. The remainder of the work for the year 1901–2, *i. e.*, investigations in nutrition and dairy bacteriology, was carried out without interruption, but some of this, particularly that having to do with the food and nutrition of man, forms a part of consecutive inquiries extending over a number of years, and the results of the work of any one year have to be considered in connection with those from similar inquiries in other years of which they form a part.

Therefore, instead of attempting to prepare the usual annual report, which would include only such work as was completed and could be reported for the year, it seemed best to carry the results along and combine them with the work of the year 1902–3.

The feeding experiments with dairy herds that for a number of years had been carried on by the Station in coöperation with the farmers in different parts of the State, under the direction of Prof. Phelps, were not undertaken during the year 1901–2. The object of these experiments was to learn how representative dairy farmers in Connecticut fed their cows, compare the results obtained by their methods, by the results of other methods elsewhere, and to suggest improvements wherever it seemed advisable. A summary of the work in this line was given in the report of the Station for 1901.

The field and pot experiments with fertilizers upon the growth and composition of plants, including soil tests and soil improvement experiments on field plots and special nitrogen experiments both on field plots and in pots, were taken up as usual by Prof. Phelps in the spring of 1902, but owing to his resignation in June of that year these investigations were not completed.

The work upon the bacteria of milk was continued during the year by Prof. Conn, aided by Mr. W. M. Esten and Mr. W. A. Stocking, Jr. The inquiries conducted under Prof. Conn's direction were a continuation of those of preceding years and the results will be included in the reports of Prof. Conn's work for 1903.

The inquiries on the food and nutrition of man carried on by the Station in coöperation with Wesleyan University and the United States Department of Agriculture were continued during the year. These included analysis of food materials, digestion experiments with men and metabolism experiments with men in the respiration calorimeter. The results of these investigations will be given in connection with others in the same lines in the report for 1903.

The expenditures for the year 1901–2 are given on another page in the customary report of the treasurer.

W. O. Atwater, *Director.*

Report of the Treasurer

For the Fiscal Year Ending June 30, 1902.

The following summary of receipts and expenditures, made out in accordance with the form recommended by the United States Department of Agriculture, includes, first, the Government appropriation of $7,500, and, secondly, the annual appropriation of $1,800 made by the State of Connecticut, together with various supplemental receipts. These accounts have been duly audited according to law, as is shown by the Auditors' certificates, copies of which are appended.

GOVERNMENT APPROPRIATION—RECEIPTS AND EXPENDITURES.

RECEIPTS.

United States Treasury,	$7,500 00

EXPENDITURES.

Salaries,	$4,407 35
Labor,	935 95
Publications,	6 00
Postage and stationery,	329 86
Freight and express,	64 25
Heat, light, water, and power,	354 37
Chemical supplies,	140 90
Seeds, plants, and sundry supplies,	228 18
Fertilizers,	88 26
Feeding stuffs,	10 07
Tools, implements, and machinery,	27 06
Furniture and fixtures,	103 14
Scientific apparatus,	426 92
Live stock,	12 15
Traveling expenses,	91 96
Contingent expenses,	15 00
Buildings and repairs,	808 58
	$7,500 00

AUDITORS' CERTIFICATE.

We, the undersigned, duly appointed Auditors of the Corporation, do hereby certify that we have examined the books and accounts of the Storrs Agricultural Experiment Station for the fiscal year ending June 30, 1902, that we have found the same well kept and classified as above, and that the receipts for the year from the Treasurer of the United States are shown to have been $7,500 and the corresponding disbursements $7,500, for all of which proper vouchers are on file and have been by us examined and found correct, thus leaving no balance.

And we further certify that the expenditures have been solely for the purposes set forth in the act of Congress, approved March 2, 1887.

(Signed,) GEO. A. HOPSON, } *Auditors.*
M. M. FRISBIE, }

STATE APPROPRIATION AND SUPPLEMENTAL RECEIPTS—RECEIPTS AND EXPENDITURES.

RECEIPTS.

State of Connecticut,	$1,800 00
Miscellaneous receipts,	119 21
	$1,919 21

EXPENDITURES.

Salaries,	$1,111 13
Labor,	123 91
Postage and stationery,	29 75
Freight and express,	3 25
Heat, light, water, and power,	40 74
Chemical supplies,	21 50
Seeds, plants, and sundry supplies.	27 01
Bacteriological investigations,	437 86
Tools, implements, and machinery,	1 15
Furniture and fixtures,	2 90
Scientific apparatus,	93 41
Traveling expenses,	26 60
	$1,919 21

AUDITORS' CERTIFICATE.

We, the undersigned, duly appointed Auditors of the Corporation, do hereby certify that we have examined the books and accounts of the Storrs Agricultural Experiment Station for the fiscal year ending June 30, 1902, that we have found the same well kept and classified as above, and that the receipts for the year from the State of Connecticut are shown to have been $1,800 and that the receipts for the year from miscellaneous sources are shown to have been $119.21, making a total of $1,919.21 receipts, and the corresponding disbursements $1,919.21; for all of which proper vouchers are on file and have been by us examined and found correct, thus leaving no balance.

(Signed,) GEO. A. HOPSON, M. M. FRISBIE, } *Auditors.*

State of Connecticut

PUBLIC DOCUMENT No. 24.

TWENTY-SIXTH ANNUAL REPORT

OF

The Connecticut Agricultural Experiment Station

FOR THE YEAR ENDING OCTOBER 31

1902

PRINTED BY ORDER OF THE LEGISLATURE

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

NEW HAVEN, CONN.:
THE TUTTLE, MOREHOUSE & TAYLOR COMPANY
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 / Insect Pest Fund... 200.00 }		$	694.83
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 incorporated 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:

*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,	Muriate of Potash,
Nitrate of Soda,	Sulphate of Potash,
Dried Blood,	Plain Superphosphate,
Azotin,	Dry Ground Fish,
Ammonite,	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.

*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

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.

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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.

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.

Percentage amounts of	4678	4767	4871	5010	4869	4870	4677
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.
	4845	4878	4654	4877	4879
Percentage amounts of					
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.				Percentages guaranteed.		Cost per ton.	Potash costs cents per pound.
	Chlorine.	Potash Soluble in water.	Equivalent Muriate.	Equivalent Sulphate.	Muriate.	Sulphate.		
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

Station No.	Name of Brand.	Manufacturer.
	Sampled by station agents.	
4893	Ground Bone	L. T. Frisbie Co., Hartford
4890	Cooper's Pure Bone Dust	Peter Cooper's Glue Factory, N. Y.
4882	Raw Bone Flour	Rogers Mfg. Co., Rockfall
4887	Fine Ground Bone	Am'n. Agricultural Chemical Co., N. Y.
4885	Essex Bone Meal	Russia Cement Co., Gloucester, Mass.
4889	Fresh Ground Bone	Bowker Fertilizer Co., Boston
4883	Swift-Sure Bone Meal	M. L. Shoemaker & Co., Phila., Pa.
4899	Ground Bone	Plumb & Winton Co., Bridgeport
4988	Pure Ground Bone	Wilcox Fertilizer Works, Mystic
4884	Pure Bone Dust	C. M. Shay, Groton
4894	Swift's Lowell Ground Bone	Lowell Fertilizer Co., Boston
4886	Armour's Bone Meal	Armour Fertilizer Co., Baltimore, Md.
4892	Pure Ground Bone	Downs & Griffin, Derby
4900	Hubbard's Raw Knuckle Bone Flour	The Rogers & Hubbard Co., Middletown
4888	Fine Ground Bone	Berkshire Fertilizer Co., Bridgeport
4904	Self-Recommending Fertilizer	Valentine Bohl, Waterbury
4898	Ground Bone	Peck Brothers, Northfield
4902	Ground Bone	Sanderson Fertilizer and Chemical Co., New Haven
4895	Ground Bone	Lederer & Co., New Haven
5085	E. Frank Coe's XX Ground Bone	E. Frank Coe Co., New York
4897	Chittenden's Fine Ground Bone	National Fertilizer Co., Bridgeport
4903	James' Ground Bone	E. L. James, Warrenville
4891	Ground Bone	E. C. Dennis, Stafford Springs
4901	Hubbard's Strictly Pure Fine Bone	The Rogers & Hubbard Co., Middletown
4896	Ground Bone, Mad River Brand	Wm. MacCormack, Wolcott
5036	Increase Crescent Bone Dust	Listers' Agricultural Chemical Works, Newark, N. J.
	Sampled by purchasers.	
4733	Pure Bone	Berkshire Fertilizer Co., Bridgeport
4957	Sanderson's Fine Ground Bone	Sanderson Fertilizer & Chemical Co., New Haven
6120	Bone Fertilizer	Plumb & Winton Co., Bridgeport
4805	James' Ground Bone	Ernest L. James, Warrenville
6109	Bone ground from common bones	A. J. Doolittle, Westville
6110	Bone ground from selected bones	" " "
4630	Clean Bone	
4629	Soiled Bone Dust	
4628	Grinding Bone	

Valuation of Bone Manures.

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.	Mechanical Analysis. Coarser than 1-50 inch.
Manufacturer	$25.00	$28.32	11.7*	4.46	3.3	20.64	22.0	68	32
Geo. Beaumont, Wallingford	24.00	25.13	4.5*	1.15	0.9	30.41	26.7	59	41
Auguste Pouleur, Windsor	30.00								
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								
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								
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								
Bowker's Branch, Hartford	28.00	26.47	5.8	2.88	2.3	25.66	24 0	56	44
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								
Manufacturer	28.00	26.06	7.4	4.37	---	19.64	....	51	49
"	29.00	26.75	8.4	3.12	2.5	24.66	22.0	60	40
"	30.00	26.99	11.2	2.12	2.6	28.30	25.0	67	33
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								
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								
Manufacturer	30.00	26.50	13.2	2.81	4.0	26.51	28.8	51	49
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								
H. F. Childs, Woodstock	30.00	26.12	14.8	4.55	2.5	18.59	20.0	55	45
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								
W. H. Scott & Co., Pequabuck	30.00	25.81	16.2	4.43	4.0	21.98	21.0	25	75
Manufacturer	29.00								
"	28.00	24.00	16.7	2.99	2.5	21.10	20.0	63	37
R. H. Hall, East Hampton	27.00								
Manufacturer	30.00	24.76	21.2	4.25	----	21.33	----	23	77
J. P. Kingsley & Son, Plainfield	30.00	24.34	23.3	2.33	----	25.25	----	52	48
F. Hallock, Derby	32.00	25.41	25.9	2.60	2.5	24.79	20.8	61	39
John Clark, Simsbury	28.00								
Manufacturer	28.00	21.62	29.5	3.90	----	20.44	----	....	100
"	28.00	21.45	30.5	3.35	4.2	19.11	20.5	30	70
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								
Manufacturer	30.00	20.93	43.3	3.80	----	18.68	----	9	91
S. A. Billings, Meriden	25.00	14.51	72.3	2.40	2.2	12.00	11.0	36	64
Manufacturer	25.00	25.94	3.6*	4.48	2.5	18.92	20.0	52	48
O. G. Beard, Shelton†	28.00	24.29	15.3	2.29	2.5	25.83	20.0	47	53
H. A. Mayse, Bridgeport†	28.00	23.82	17.5	4.19	----	17.08	----	52	48
Manufacturer	28.00	21.99	27 3	4.06	----	20.42	----	....	100
....	----	26.15	----	4.14	----	19.65	----	61	39
....	----	26.54	----	3.15	----	24.78	----	55	45
J. H. Webb, New Haven†	----	33.27	----	4.00	----	26.99	----	87	13
" " "	----	31.17	----	3.93	----	26.06	----	73	27
" " "	----	31.15	----	4.03	----	25.52	----	74	26

* Valuation exceeds cost. † Purchaser.

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. Nitrogen Found.	Chemical Analysis. Nitrogen Guaranteed.	Chemical Analysis. Phosphoric acid. Found.	Chemical Analysis. Phosphoric acid. Guaranteed.	Mechanical Analysis. Finer than 1-50 inch.	Mechanical Analysis. Coarser than 1-50 inch.
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.

Percentage amounts of	Darling's. 4756	Swift's Lowell. 4703	Lister's. 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.

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* 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 34.00	26.34
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.		Soluble.	Reverted.	Insoluble.	Total.		Available.		Found.		Guaranteed.
					Found.	Guaranteed.				Found.	Guaranteed.	Found.	Guaranteed.	As Muriate.	Total.	
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. Mecker, 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	26.31
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	26.33
			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.					Phosphoric Acid.							Potash.		
		Nitrogen as Nitrates.	Nitrogen as Ammonia.	Nitrogen Organic.	Total Nitrogen.		Soluble.	Reverted.	Insoluble.	Total.		Available.		Found.		Guaranteed.
					Found.	Guaranteed.				Found.	Guaranteed.	Found.	Guaranteed.	As Muriate.	Total.	
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.co	
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	

* See page 40.

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.		Soluble.	Reverted.	Insoluble.	Total.		Available.		Found.		Guaranteed.
					Found.	Guaranteed.				Found.	Guaranteed.	Found.	Guaranteed.	As Muriate.	Total.	
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	

* See page 40.

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.		Soluble.	Reverted.	Insoluble.	Total.		Available.		Found.		Guaranteed.
					Found.	Guaranteed.				Found.	Guaranteed.	Found.	Guaranteed.	As Muriate.	Total.	
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. Nitrogen as Nitrates.	Nitrogen as Ammonia.	Nitrogen Organic.	Total Nitrogen. Found.	Total Nitrogen. Guaranteed.	Phosphoric Acid. Soluble.	Reverted.	Insoluble.	Total. Found.	Total. Guaranteed.	Available. Found.	Available. Guaranteed.	Potash. Found. As Muriate.	Found. Total.	Guaranteed.
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. Nitrogen as Nitrates.	Nitrogen as Ammonia.	Nitrogen Organic.	Total Nitrogen. Found.	Total Nitrogen. Guaranteed.	Phosphoric Acid. Soluble.	Reverted.	Insoluble.	Total. Found.	Total. Guaranteed.	Available. Found.	Available. Guaranteed.	Potash. Found. As Muriate.	Found. Total.	Guaranteed.
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.		Soluble.	Reverted.	Insoluble.	Total.		Available.		Found.		Guaranteed.
					Found.	Guaranteed.				Found.	Guaranteed.	Found.	Guaranteed.	As Muriate.	Total.	
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	......	25.43
				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. Nitrogen as Nitrates.	Nitrogen as Ammonia.	Nitrogen Organic.	Total Nitrogen. Found.	Total Nitrogen. Guaranteed.	Phosphoric Acid. Soluble.	Reverted.	Insoluble.	Total. Found.	Total. Guaranteed.	Available. Found.	Available. Guaranteed.	Potash. Found. As Muriate.	Found. Total.	Guaranteed.
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	
4777	Mapes' Tobacco Manure (Wrapper Brand)*	Mapes' F. & P. G. Co., N. Y.	Spencer Bros., Suffield	46.00	35.34
			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 as Ammonia.	Nitrogen Organic.	Total Nitrogen. Found.	Total Nitrogen. Guaranteed.	Phosphoric Acid. Soluble.	Reverted.	Insoluble.	Total. Found.	Total. Guaranteed.	Available. Found.	Available. Guaranteed.	Potash. Found. As Muriate.	Found. Total.	Guaranteed.
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: 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.
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
4953	Sanderson's Top Dressing Fertilizer	Sanderson's Fertilizer and Chemical Co., New Haven		36.00	
			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. Nitrogen as Nitrates.	Nitrogen as Ammonia.	Nitrogen Organic.	Total Nitrogen. Found.	Total Nitrogen. Guaranteed.	Phosphoric Acid. Soluble.	Reverted.	Insoluble.	Total. Found.	Total. Guaranteed.	Available. Found.	Available. Guaranteed.	Potash. Found. As Muriate.	Found. Total.	Guaranteed.
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.		Soluble.	Reverted.	Insoluble.	Total.		Available.		Found.		Guaranteed.
					Found.	Guaranteed.				Found.	Guaranteed.	Found.	Guaranteed.	As Muriate.	Total.	
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.		
					Total Nitrogen.					Total.		Available.		Found.		
		Nitrogen as Nitrates.	Nitrates as Ammonia.	Nitrogen Organic.	Found.	Guaranteed.	Soluble.	Reverted.	Insoluble.	Found.	Guaranteed.	Found.	Guaranteed.	As Muriate.	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. Nitrogen as Nitrates.	Nitrogen as Ammonia.	Nitrogen Organic.	Total Nitrogen. Found.	Total Nitrogen. Guaranteed.	Phosphoric Acid. Soluble.	Reverted.	Insoluble.	Total. Found.	Total. Guaranteed.	Available. Found.	Available. Guaranteed.	Potash. Found. As Muriate.	Found. Total.	Guaranteed.
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	17.7[illegible]
			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	12.93
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.					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.
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.

* In car lots.

HOME MIXTURES. FORMULAS,

Station No.	Made by	Nitrate of Soda.	Sulphate of Ammonia.	Hen Manure.	Cotton Seed Meal.	Tankage.	Acid Phosphate.	Dissolved Bone Black.	High Grade Sulphate of Potash.
		Formulas. Pounds per ton							
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.		
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.	Percentage difference between Cost and Valuation.
....	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

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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.

	4660	5031
Percentage amounts of		
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
4715	" " " Southport	Station Agent
4771	" " " Hartford	Bowker Fertilizer Co., Hartford.
4785	" " "	Conn. Valley Orchard Co., Deep River
4789	" " "	S. T. Welden, Simsbury
4847	" " "	Bowker Fertilizer Co., Hartford.
4955	" " " Hartford	P. P. Hickey, Burnside
5012	" " " "	Conn. Valley Orchard Co., Deep River
7256	" " "	Bowker Fertilizer Co., Hartford.
7257	" " "	" " " "
4808	A. N. Graves, Suffield	E. N. Austin, Suffield
4809	John Joynt, Lucknow, Ont., Can.	Walter Fawthrop, Cromwel
4786	F. W. Miller, Ont., Canada	Earl Cooley, Berlin
4826	Geo. L. Munroe, Oswego, N. Y.	R. A. Moore, Kensington
4736		A. J. Pierpont, Waterbury
4737		" " "
4844	Auguste Pouleur, Windsor	Station Agent
4827	Prentiss, Brooks & Co., Holyoke, Mass.	C. D. Cannon, Windsor Locks
4740		Warner-Miller Co., New Haven
4993		John Gardiner, Cromwell
6134	John Joynt, Lucknow, Ont., Can.	F L. Staples, Bridgeport
7927		A. J. Sherwood, Bridgeport
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	20.06	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.

Percentage amounts of	4653	5096
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.

Percentage amounts of	4990	5054	5049	5091
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.

Percentage amounts of	4753	4989	6108
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.	Cheshire.	New Milford.
	5088	5089	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.

Percentage amounts of	4668	4681	6131
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.

Percentage amounts of	4588	7933
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	14.5	---	---	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, *Gallerucella 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.	*Spiraæ 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.
"		" " "	Apple	Milford	Sprayed with kerosene. Not all dead.
"	23	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.
"	27	Forest Tent-Caterpillar, *Clisiocampa disstria* Hbn	"	Cornwall Bridge	Larval stage, two-thirds grown.
"	27	Pine Scale, *Chionaspis pinifoliæ* Fitch	Pine	So. Manchester	Eggs just hatched.
"	27	Oyster-shell Bark-Louse, *Mytilaspis pomorum* Bouché	Lilac	" "	Old shells only.
"	31	Scale on fern, *Lecanium hemisphæricum* Targ.-Tozz?	Fern	New Britain	Specimens immature.
"	31	Forest Tent-Caterpillar, *Clisiocampa disstria* Hbn.	Maple	Hartford	Larvæ three-fourths grown.
June	2	Putnam's Scale, *Aspidiotus ancylus* Putn.	Currant	Ansonia	Mostly dead.
"	3	Strawberry Saw-fly, *Emphytus maculatus* Norton	Strawberry	East Wallingford	Larvæ, partially grown.
"	3	Eight-spotted Forester, *Alypia octomaculata* Hbn.		New Haven	Adult moth.
"	3	Currant Aphis, *Myzus ribis* Linn.	Currant	Milford	Under side of leaves covered.

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 cratægi* 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.

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.
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

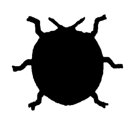

FIG. 1.—The Twice-stabbed Lady-Beetle *Chilocorus bivulnerus* Muls. Twice natural size.

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.

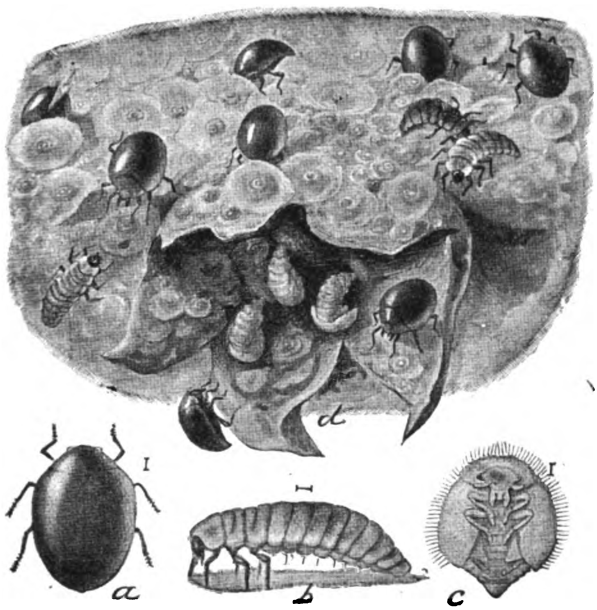

FIG. 2.—*Pentilia misella* LeC. *a*, beetle; *b*, larva; *c*, pupa; *d*, blossom end of scale-infested pear, showing beetles and their larvæ feeding upon the scales, all greatly enlarged. (After Howard & Marlatt, Bull. 3, N. S. Div. of Ent., U. S. Department of Agriculture.)

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. *Bessey*i 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.

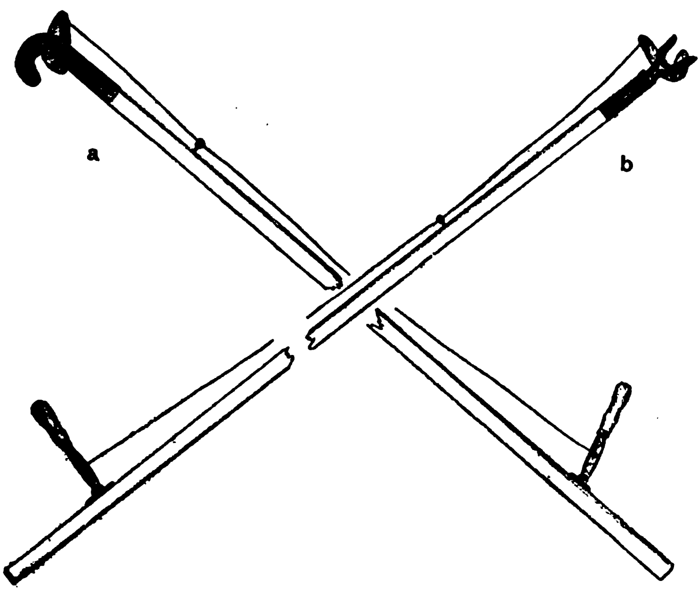

FIG. 4.—*a*, Waters' Tree Pruner; *b*, Henry's Tree Pruner.

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

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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

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* 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.

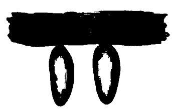

FIG. 6.—Eggs: $\times$ 36.

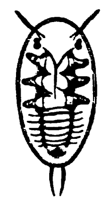

FIG. 7.—Newly-hatched nymph, ventral view: $\times$ 55.

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 ($\wedge$) 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.

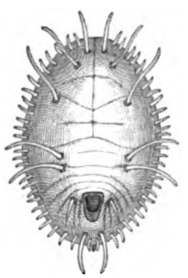

FIG. 8.—Mature nymph or pupa, dorsal view: × 36.

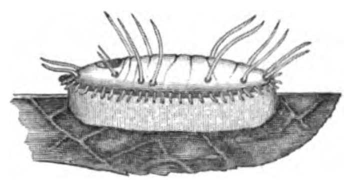

FIG. 9.—Lateral view of mature nymph: × 36.

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.

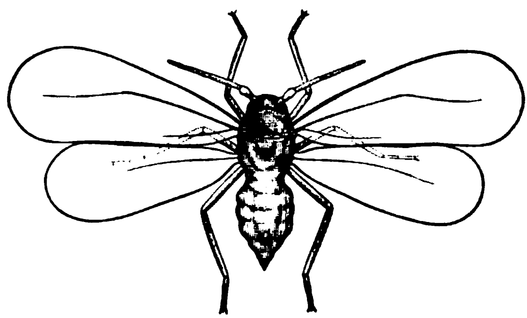

FIG. 10.—Adult female: × 36.

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.

Bibliography.

1856. Westwood. Gardeners' Chronicle, p. 852. Original description and illustrations.

1868. Signoret. Ann. de la Soc. Ent. de France, p. 387. Description.

1871. Packard. American Naturalist, Vol. 4, p. 686. Illustrated. Brief mention as attacking strawberry and tomato.

1880. Riley. Amer. Ent. (Vol. 3), n. s., Vol. I., p. 129. A brief account of Aleyrodes on Oxalis.

1889. Packard. Guide to the Study of Insects, 9th ed., p. 526. Brief account, p. 712. Fig. on Plate XIV. Found on Strawberry at Amherst, Mass.

1891. Bailey. Cornell Exp. Station, Bull. 28, p. 58. Brief mention as attacking tomatoes in greenhouse.

1890. Riley. Insect Life, Vol. II., p. 339. Mentioned.

1891. Riley. Insect Life, Vol. III., p. 394. Troublesome in greenhouses, England.

1891. Garman. Agr. Science, Vol. V., p. 264. Brief description. Same account in An. Rep. Kent. Exp. Sta., 1890, p. 37-38. Numerous on Strawberry at Lexington, Kent.

1892. Riley. Insect Life, Vol. V., 17. Found on Strawberry in Dist. of Columbia.

1893. Webster. Rep. Ohio Exp. Sta., p. xxxv. Very abundant on Strawberry, but no serious injury resulted.

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.

1897. Britton. Garden and Forest, Vol. X., p. 194. Brief account. Illustrated.

1900. Britton. Conn. Exp. Sta. Rep., p. 311. Fumigating with hydrocyanic acid gas.

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,

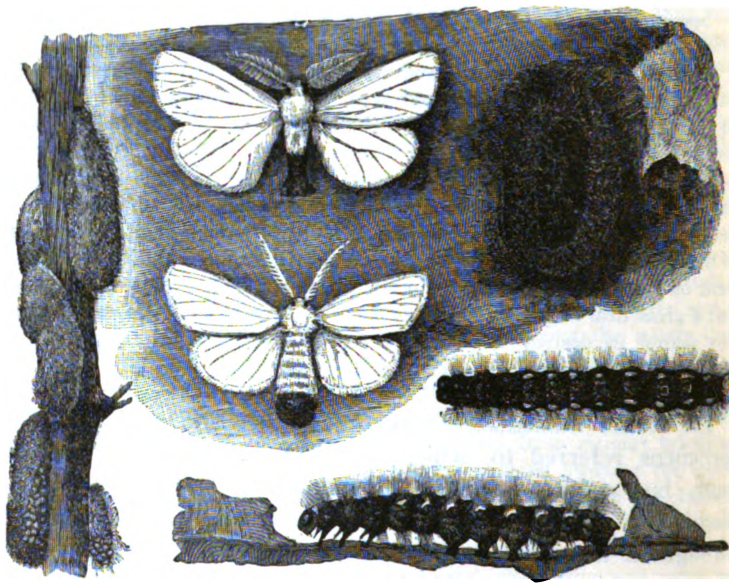

FIG. 11. The brown-tail moth *Emproctis chrysorrhea*, showing male moth above, female below, egg-masses at left, cocoon at right and caterpillars. (After Howard, Yearbook of U. S. Department of Agriculture for 1897.)

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-

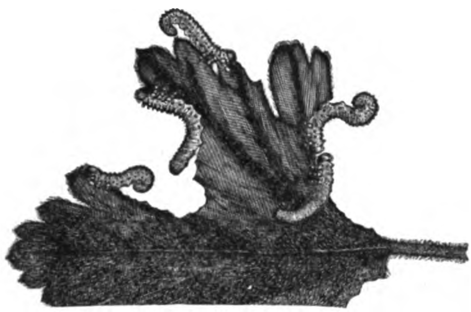

FIG. 14. The currant worm. Partially grown larvæ, twice natural size.

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

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* 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

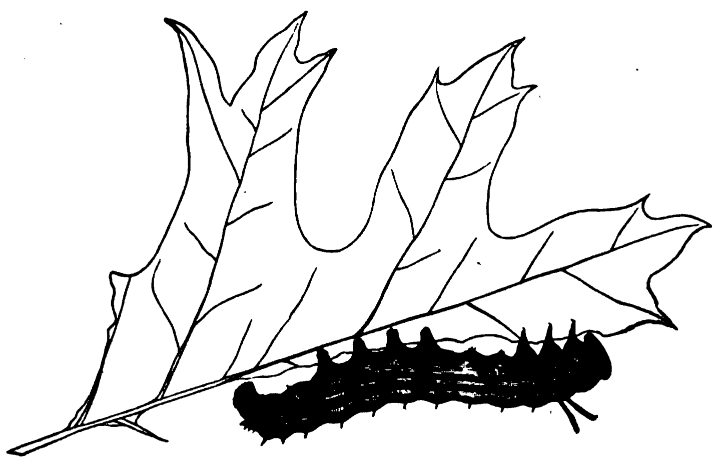


FIG. 18. The orange-striped oak-worm. *Anisota senatoria.* Larva natural size.

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:

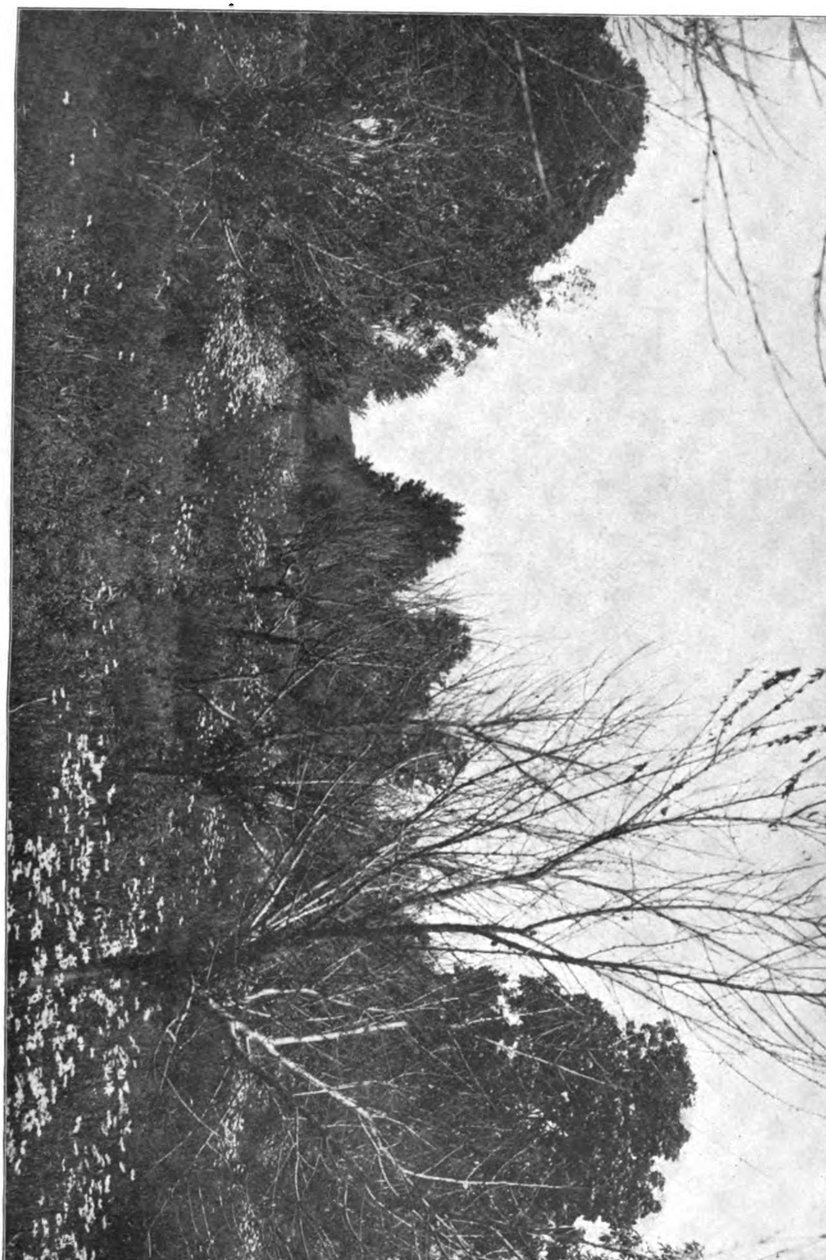
Plate XIV is herein reproduced from Bulletin 126 of the Cornell Agr. Exp. Station, by courtesy of Prof. M. V. Slingerland, Entomologist.

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.

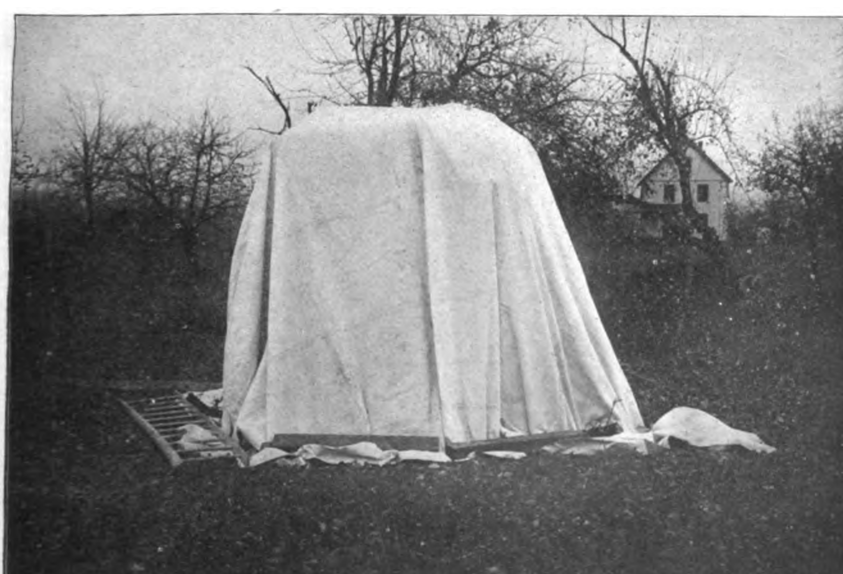
Plate I is from a photograph by the author.

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.

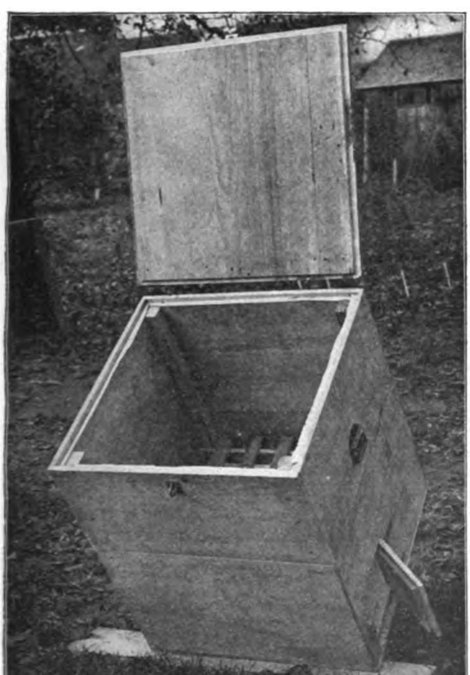
a. Tree cut back ready for treatment.



b. Tree covered by tent.

FUMIGATING LARGE TREES.

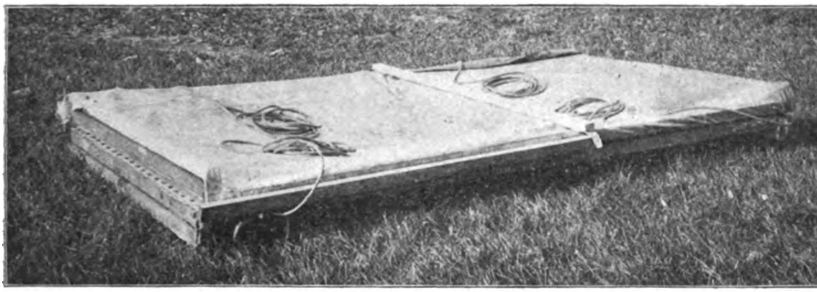
a. Barnes Bros. plant for boiling the lime, sulphur and salt mixture.



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.

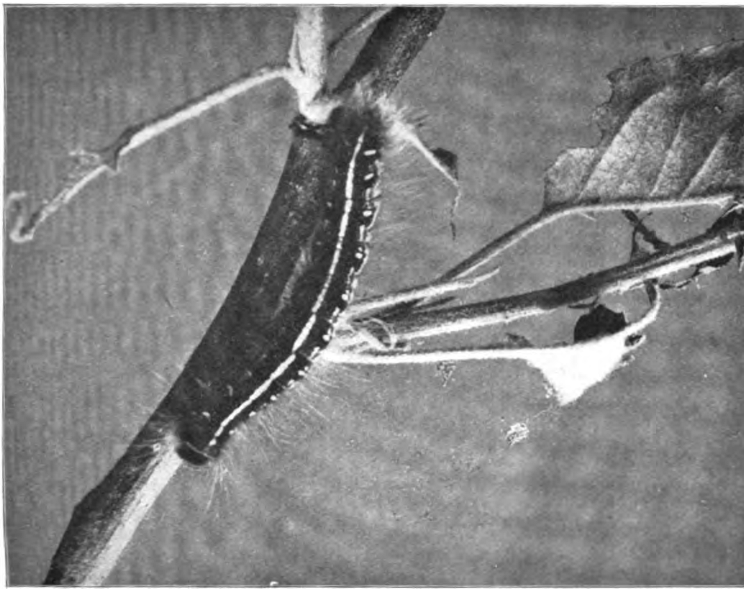
FUNGUS: FUMIGATING BOX: STEAM PLANT FOR COOKING THE LIME, SULPHUR AND SALT MIXTURE.



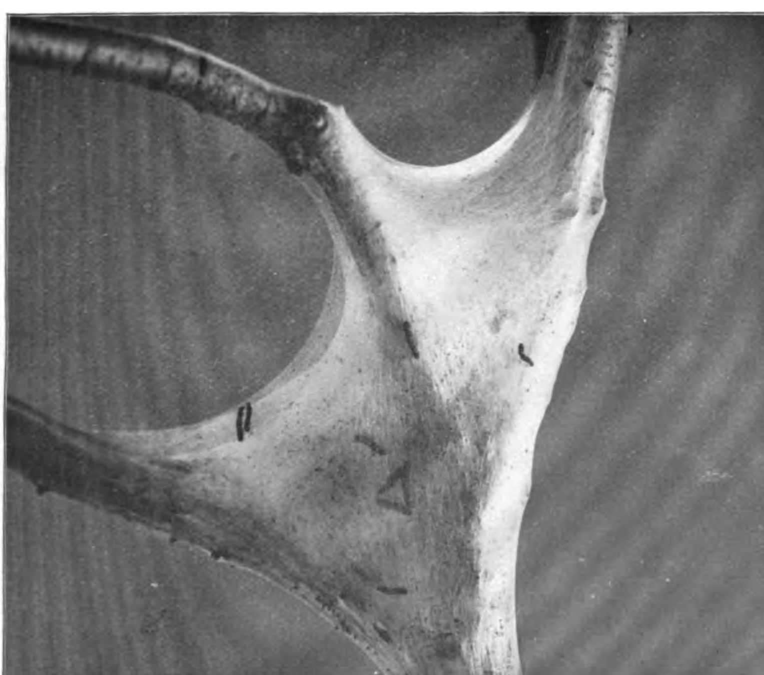
a. The tent folded.

b. The tent over a tree.

FOLDING TENT FOR FUMIGATING TREES.

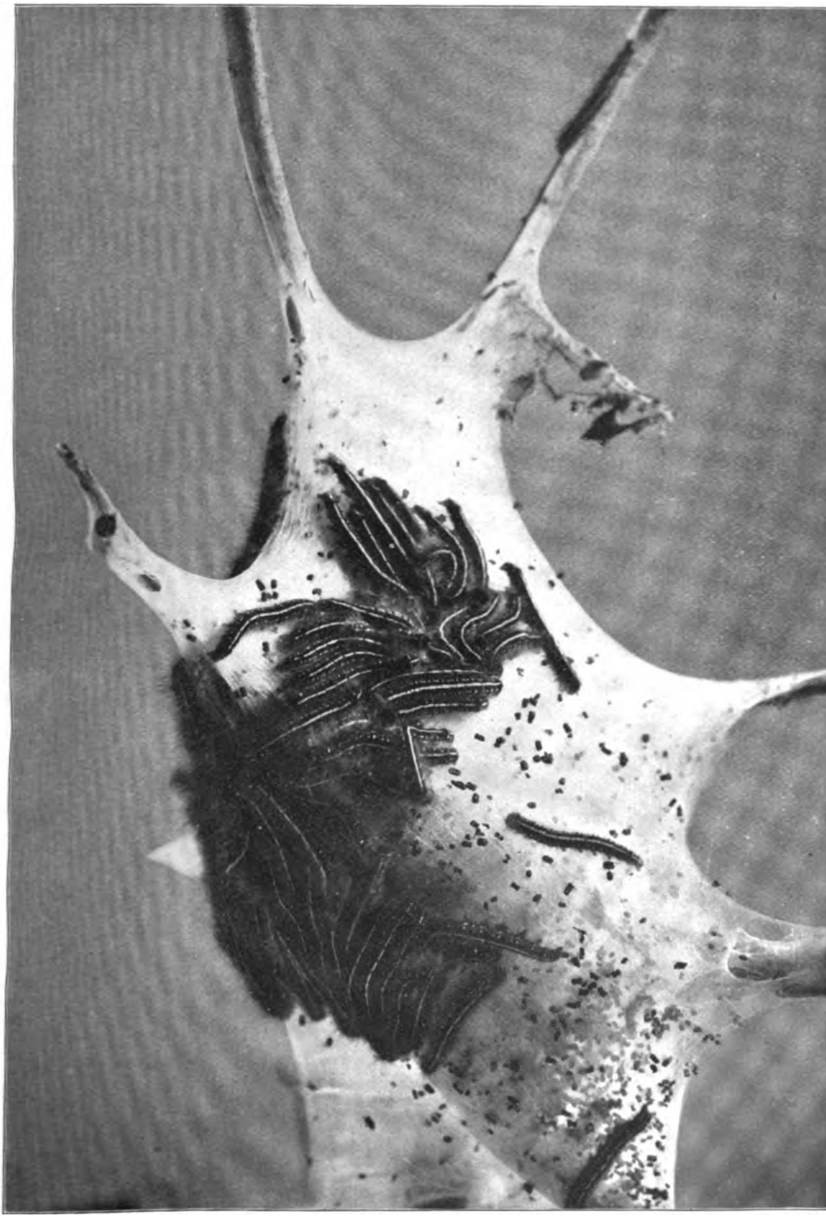


a. A full-grown Caterpillar. Natural size.



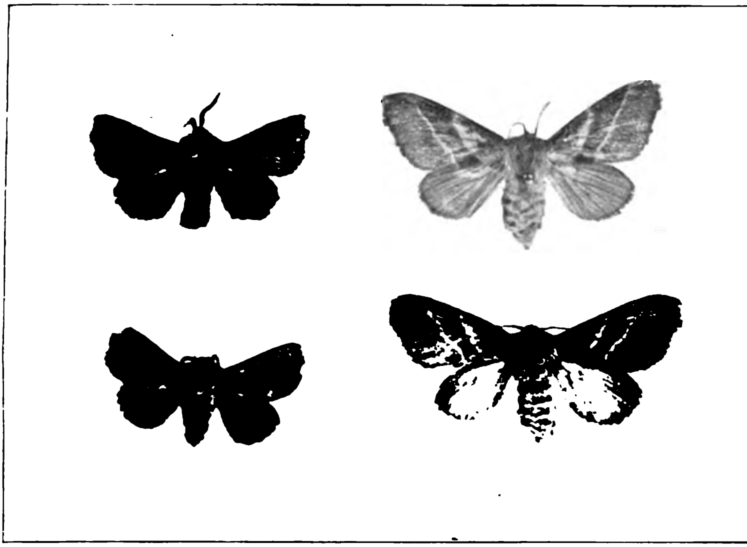
b. Young Caterpillars in nest.

THE TENT-CATERPILLAR.

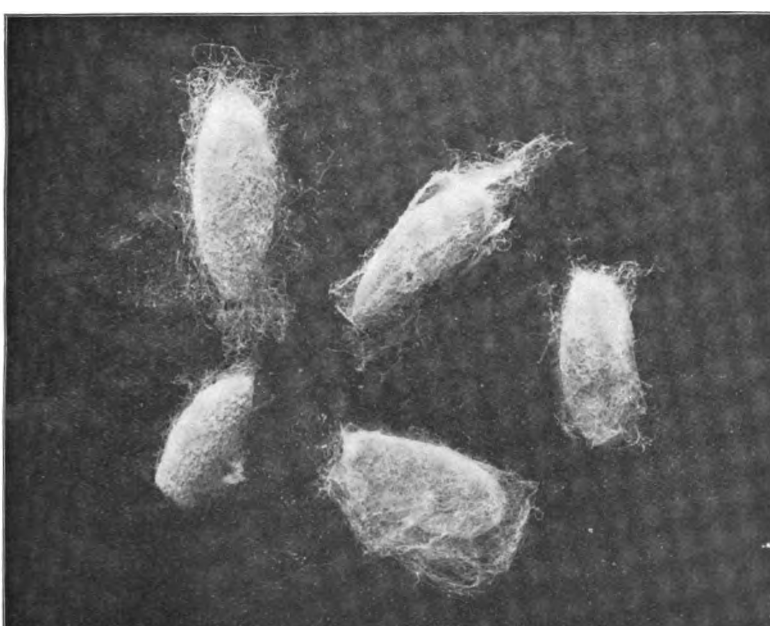


Caterpillars resting on the outside of the nest.

THE TENT-CATERPILLAR.

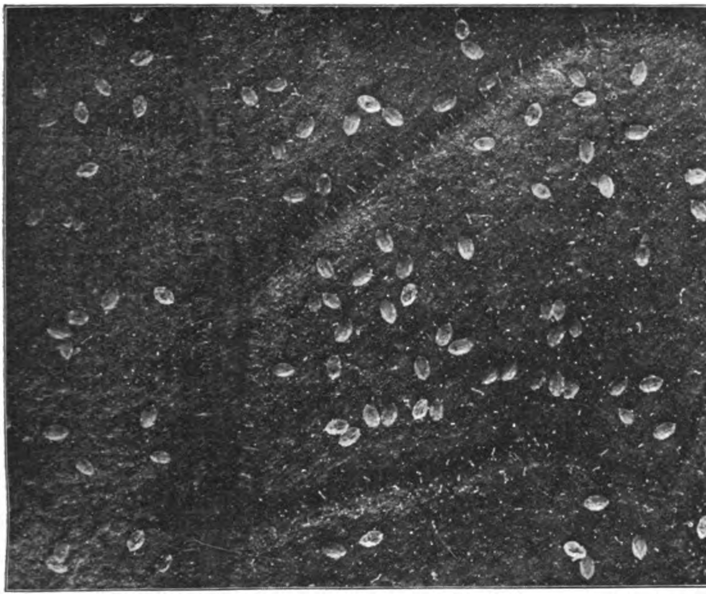


a. Male and female moths. Natural size.



b. Cocoons of the Tent-Caterpillar. Natural size.

THE TENT-CATERPILLAR.

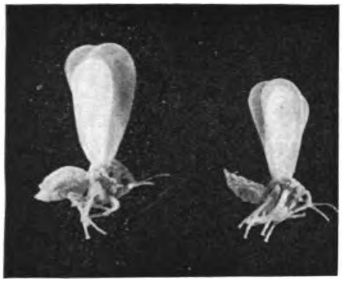


a. Nymphs: Enlarged about four times.

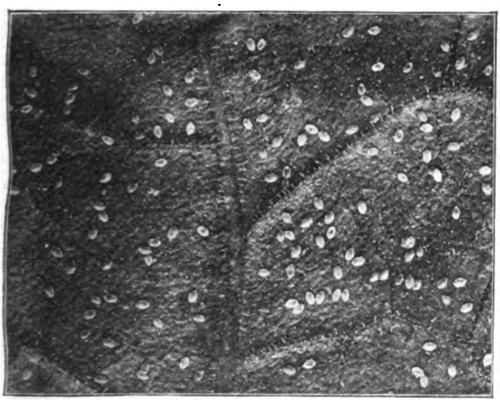
b. Adults and pupa skins. Enlarged four times.

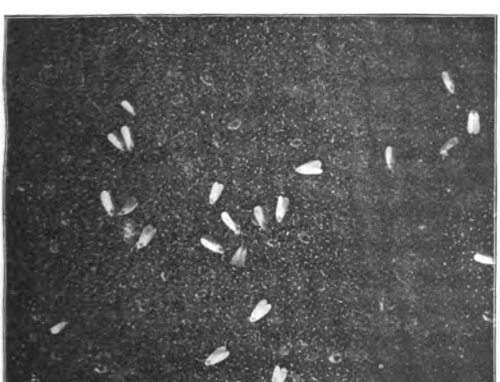
THE WHITE-FLY ON TOBACCO LEAF.

PLATE IX.

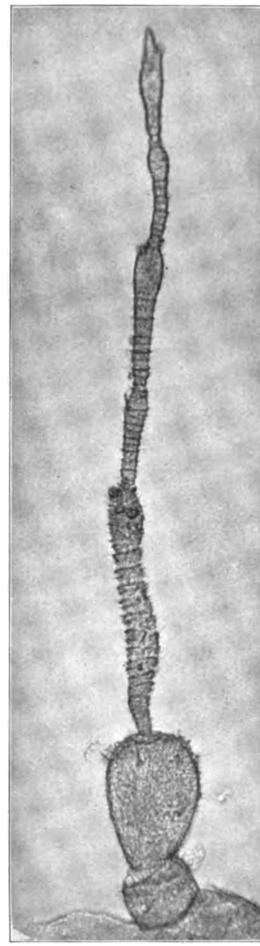


a. Female and male : much enlarged.





b. Nymphs and adults ; twice natural size.



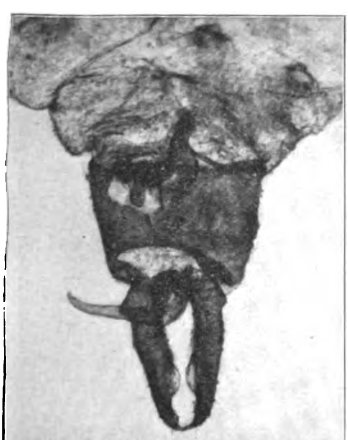
c. Antenna, showing ring-like markings : much enlarged.

THE WHITE-FLY.

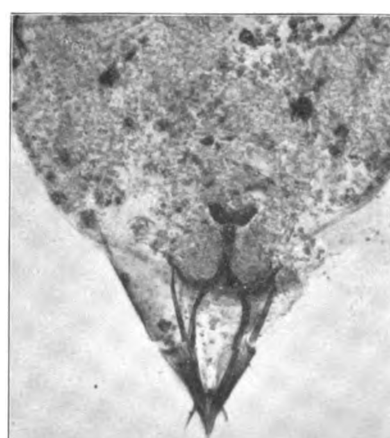
PLATE X.

a. Egg, showing stalk : much enlarged.

b. Adult female, ventral view, showing proboscis : much enlarged.

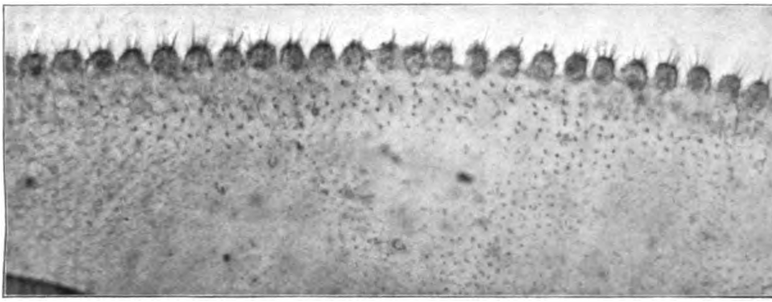


c. Genital organs of male : much enlarged.

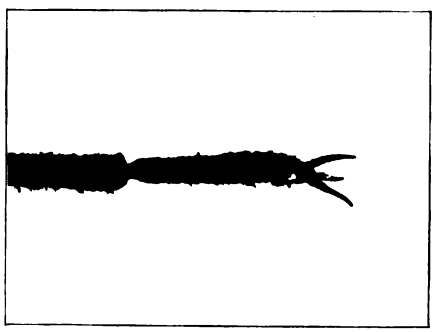


d. Ovipositor of female : much enlarged.

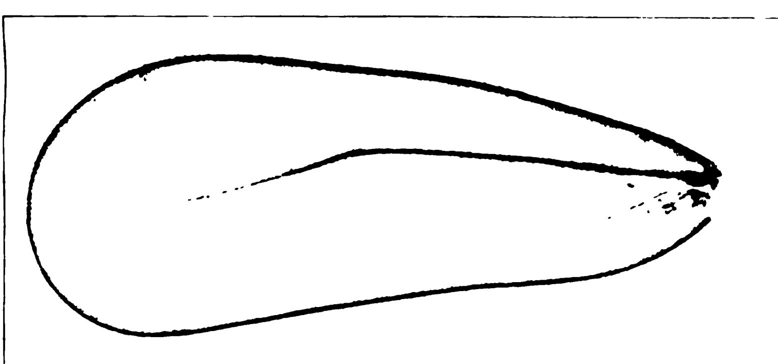
THE WHITE-FLY.



a. Edge of wing: much enlarged.

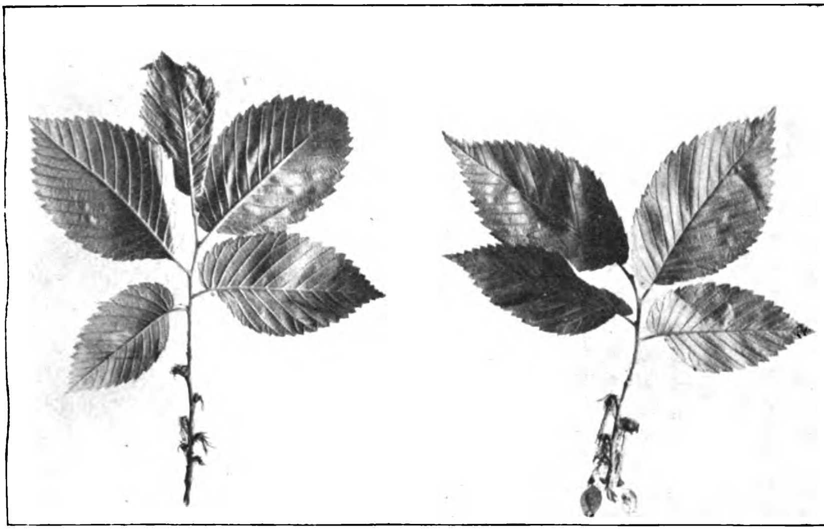


c. Foot: greatly enlarged.

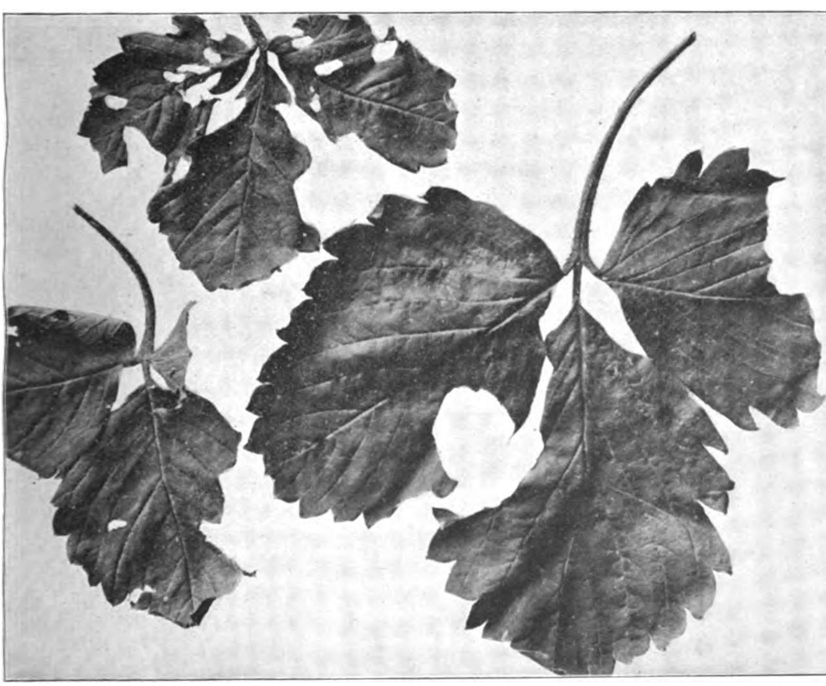


b. Fore wing: greatly enlarged.

THE WHITE-FLY.



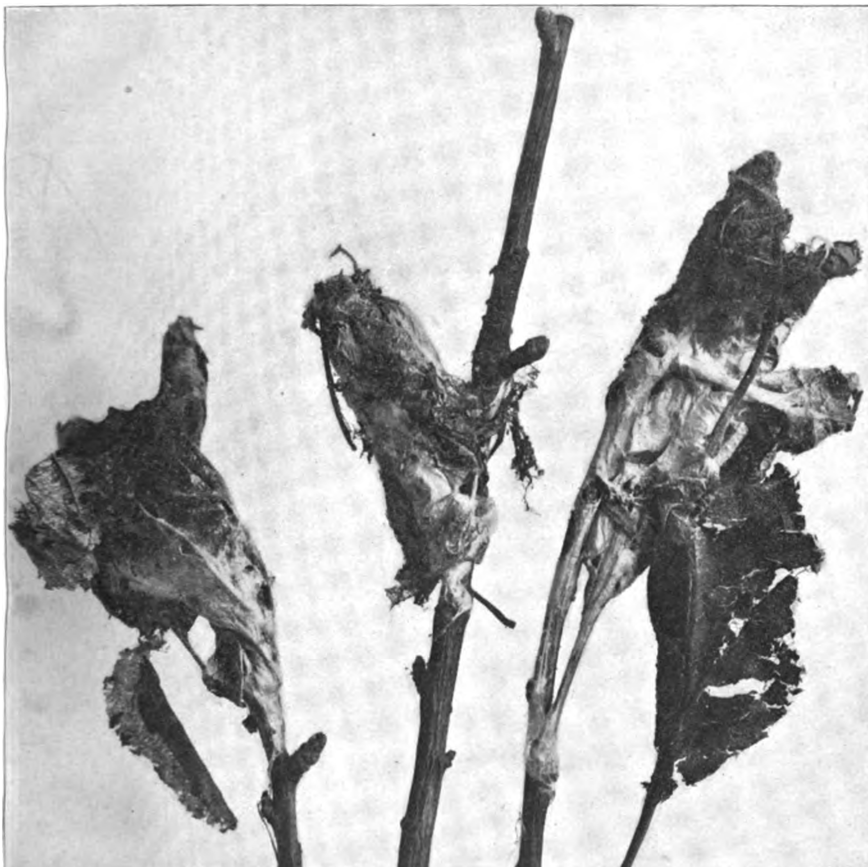
a. Elm twigs cut off by Grey Squirrels.



b. Strawberry leaves eaten by *Anomala binotata* Gyll.

ELM TWIGS AND STRAWBERRY LEAVES.

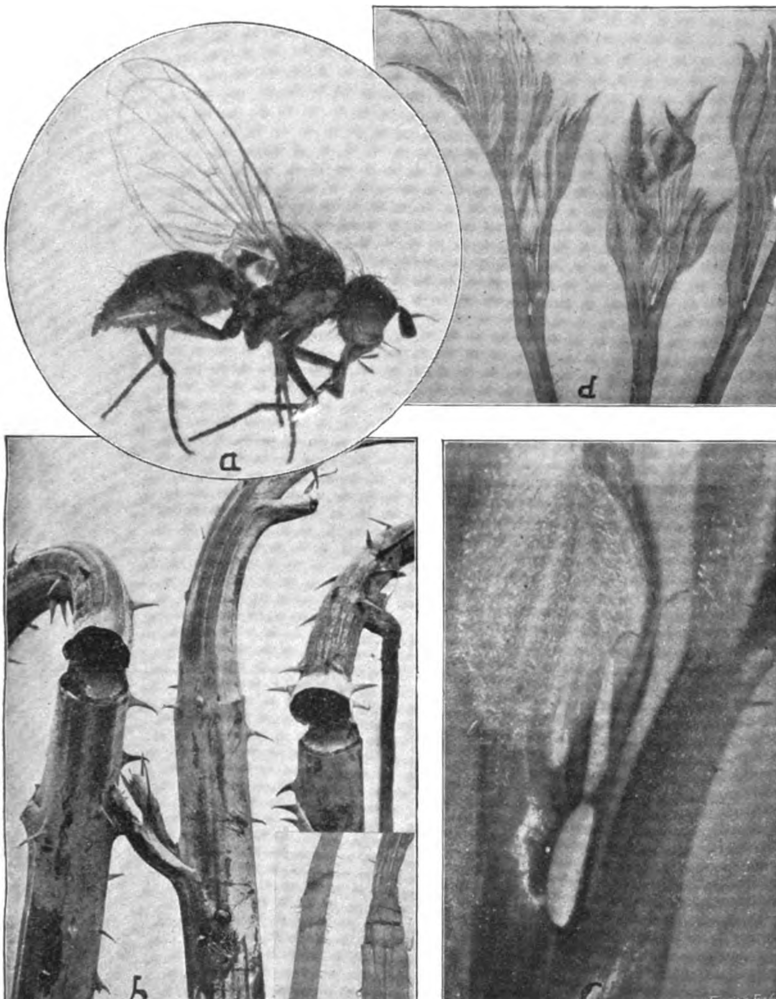
PLATE XIII.



Winter nests of the Brown-Tail Moth. Natural size.

BROWN-TAIL MOTH.

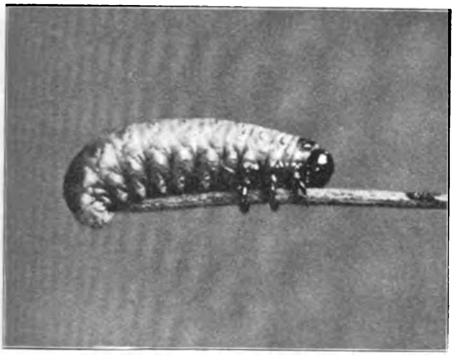
PLATE XIV.



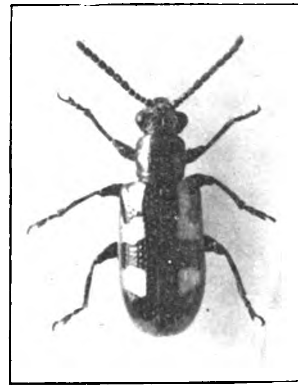
a. Adult female fly, much enlarged ; b. Raspberry shoots injured by the maggot, natural size ; c. Egg, much enlarged ; d. Tips of shoots, each bearing an egg, natural size (after Slingerland, Cornell University Experiment Station, Bulletin 126).

THE RASPBERRY CANE MAGGOT.

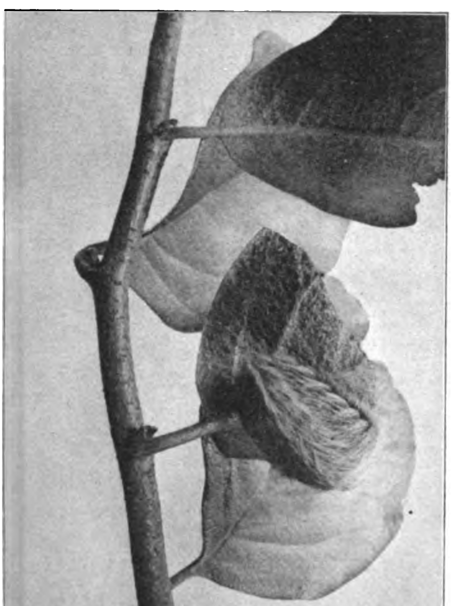
PLATE XV.



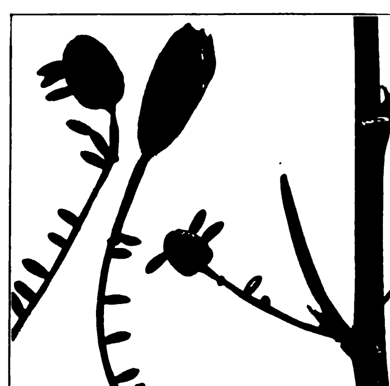
b. Larva of asparagus beetle. Much enlarged.



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.

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* 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	"	"
5875	"	G. B. Jerome	30.8	3.7	12.28	"	Annatto.
5882	"	J. W. Johnson	29.3	3 6	11.90	"	Coal-tar dye.
5877	"	S. Langel	28.2	3.8	11.92	"	Natural.
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	"
5772	2	J. H. Story, Cedar Hill Dairy	30.5	3.1	11.79	"	Annatto.
5761	"	C. E. Thatcher	30.3	3.5	12.18	"	Natural.
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	"	"
5702	"	Mt. Pleasant Dairy	31.2	4.2	13.07	Formaldehyde	"
5709	"	Rock Hill Dairy	29.9	4.2	12.95	None	"
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.

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* 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

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

FROM SODA WATER FOUNTAINS.

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

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

Beverages not Found Adulterated.

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

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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

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* 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*
6076	Sold in bulk	Osborne Bros., 629 Noble Ave.	8
6084	Silver Leaf, Swift & Co.	George Reinecke, 652 E. Main St.	45*
6077	Sold in bulk	Richards & Schmidt, 2065 Main St.	7
6082	" " "	J. A Ronan, 369 E. Main St.	7
6078	" " "	E. A. Sherwood. 679 Main St,	7
6083	" " "	Village Store Co., 746 E. Main St.	6
6089	" " "	E. E. Wheeler, 1131 Main St.	7
		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

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

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 XIII.—CHEESE CONTAINING BORAX.

Station No.	Brand.	Dealer.	Price per package.
5456	Royal Luncheon Cheese, The Gourlay Thompson Co., Detroit, Mich.	*Bridgeport.* National Grocery Co., 50 Cannon st.	.10
5491	MacLaren's Roquefort, A. F. MacLaren Cheese Co., Detroit, Mich.	*New Haven.* 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, V^{ve} 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.	*Putnam.*			
5667	Bennett, Sloan & Co., New York	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.	*Bridgeport.*			
5372	Columbia Tea Co., New York City	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 5523	E. R. Durkee & Co., New York	John Brownstein, 1314 Main 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. 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.	Fat.	Total nitrogen.	Polarization at 20° C.* Direct.	Polarization at 20° C.* 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. 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.
		%	%	%		%	%	%	%	%	%	%	%
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. 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.	Polarization at 20° C.* Direct.	Polarization at 20° C.* 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.	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.
		%	%	%		%	%	%	%	%	%	%	%
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. 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.	Polarization at 20° C.* Direct.	Polarization at 20° C.* 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.	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.
		%	%	%		%	%	%	%	%	%	%	%
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.															
			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.	Alkalinity.										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	12.41	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.

		In the Water-Free Material.															Constants of Fat, Ether Extract.			
		Ash.													Polarization at 20° C.					
Station No.		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.	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] Weig-

[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.

mann,[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.

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[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.

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[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]

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[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 sub-

[1] Apoth. Zeit., 1892, 469.
[2] Pharm. Ztg., 1898, 43, 380.

stances. 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.

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. 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.	Fat.	Total nitrogen.	Polarization at 20° C. Direct.	Polarization at 20° C. 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.												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.	Melting point, degrees C.	Zeiss refractometer reading at 40° C.	Refractive index at 40° C.	Iodine Number.
		%	%	%		%	%	%	%	%	%	%	%						
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 n the whole bean.	In the Air-Dry Material. 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.	Other nitrogen-free substances.	Fat.	Total nitrogen.	Polarization at 20° C. Direct.	Polarization at 20° C. 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	43.83	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. 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.	Polarization at 20° C. Direct.	Polarization at 20° C. 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.															
	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.
	%	%	%	%		%	%	%	%	%	%	%	%	%		
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	10.36	....	....	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-

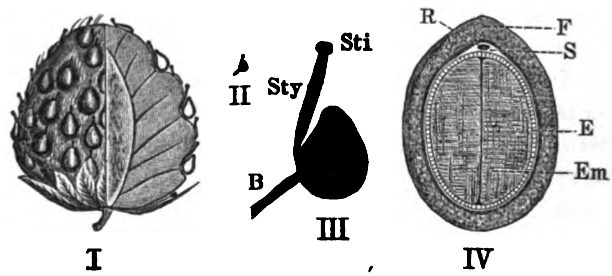

FIG. 1.—Strawberry. I Compound fruit, × 2. II Achene, × 1. III Achene, × 8. Sty, style; Sti, stigma; B, connecting bundle. IV Achene in transverse section, × 32. F, pericarp; S, testa; R, raphe; E, endosperm; Em, embryo.

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.

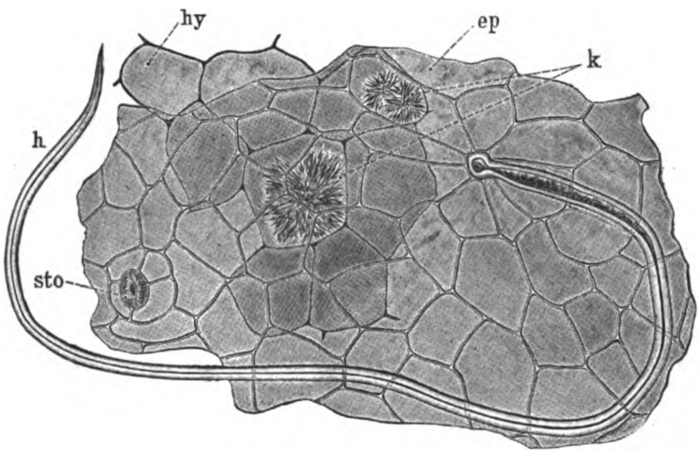

FIG. 2.—Strawberry receptacle in surface view. Ep, epidermis with h, hair and sto, stoma; hy, hypoderm; k, glucoside (?) crystals. × 160.

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

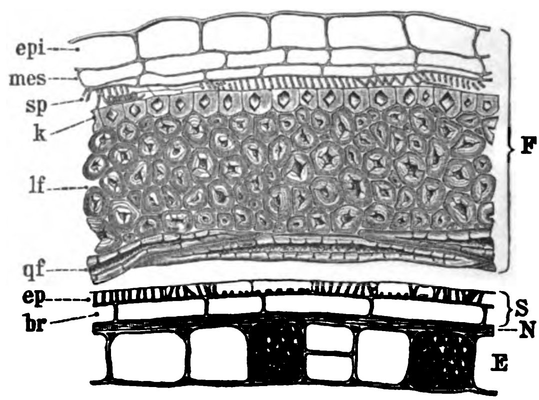

FIG. 3.—Strawberry achene in transverse section. F, pericarp consisting of epi, epicarp, mes, mesocarp, sp, spiral vessels, k, crystal layer, lf, outer endocarp with longitudinally extended fibers, and qf, inner endocarp with transversely extended fibers; S, testa consisting of ep, epidermis with reticulated 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 section quadrilateral. The cell walls are exceedingly thin, but are strengthened by thickened bands, resembling those of spiral and recticulated vessels. They differ, however, from the latter in that they do not pass completely around the cell, but are wanting on the outer surface, so that in mounting a preparation the outer wall often collapses and the side walls fall down, presenting the appearance shown in Fig. 4. This layer is difficult to make out in cross section, but is readily studied in surface view.

2. Brown Layer (Figs. 3 and 4, br). The second layer of the testa is composed of elongated brown cells which pass trans-

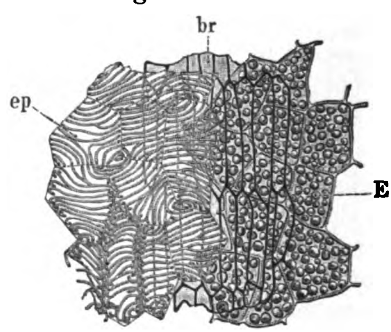

FIG. 4.—Strawberry testa and endosperm in surface view. Signification of letters same as in Fig. 3. × 300.

versely about the seed. Transverse sections of these cells are quadrilateral, with radial walls about 0.006 mm. long. As seen in surface view, they are pointed, and often are arranged side by side in rows. They vary up to 0.10 mm. in length, and usually between 0.010 and 0.015 mm. in width.

Nucellar Layer (Fig. 3, N). This coat consists for the most part of obliterated cells forming a cellulose layer from 0.002 to 0.004 mm. thick, but on the ventral side the cells are often well defined.

Endosperm (Figs. 3 and 4, E). Transverse sections show that the endosperm is but one cell thick, although here and there a cell is divided by a tangential partition forming twin cells. Seen in surface view the cells are triangular, square, or polygonal. In glycerine mounts of fresh or alcoholic materials irregularly spherical aleurone grains are evident. In nearly every point these cells resemble the aleurone layer of the cereal grains.

Embryo. Two large cotyledons, each in cross section semi-elliptical, make up the bulk of the embryo. They are built up of thin-walled cells, much the same as in the cotyledons of many other seeds, and contain protein and fat but no starch.

Style and Stigma (Figs. 5 and 6). The strawberry style is distinguished from the styles of other edible rosaceous fruits by its constricted base and the large size and transparency of the epidermal cells. The styles are about 0.3 mm. in diameter in the middle part, but taper somewhat toward the stigma, and very markedly toward the base, where they are less than 0.1 mm.

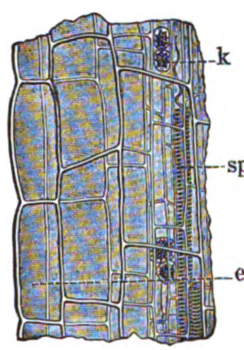

FIG. 5.—Strawberry style and stigma. × 32.
FIG. 6.—Strawberry style in surface view. ep, transparent epidermis; sp, spiral vessels; k, crystal cells. × 300.

in diameter. The epidermal cells (ep), which may be readily studied without sectioning or treatment with reagents, are for the most part about 0.04 mm. wide, 0.10–0.15 mm. long, and (as may be seen on the margins, by focusing) 0.05 mm. thick. The central core appears darker than the transparent margins, owing to the greater density of the parts as well as to the greater thickness. Treatment with potash discloses spiral and annular vessels and rows of accompanying crystal cells (k), each containing a crystal cluster. The stigmas of rosaceous fruits are studied with difficulty owing to the fungous growths, which often completely hide the papillae, even after treatment with reagents or cooking.

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

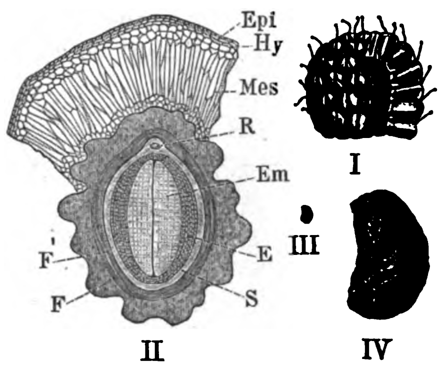

Fig. 7.—Red Raspberry. I Compound fruit, × 1. II Transverse section of a drupelet, × 32. Epi, epicarp; Hy, hypoderm; Mes, mesocarp; F, outer endocarp; F', inner endocarp; S, testa; R, raphe; E, endosperm; Em, embryo. III Stone, × 1. IV Stone, × 8.

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.

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[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.

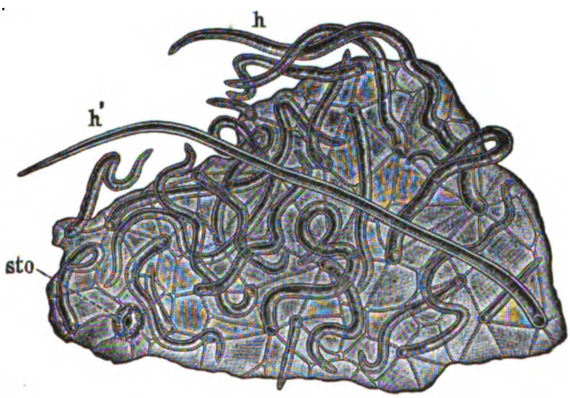

FIG. 8.—Red Raspberry epicarp with h', straight hair, h, sinuous hairs and sto, stoma. × 160.

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

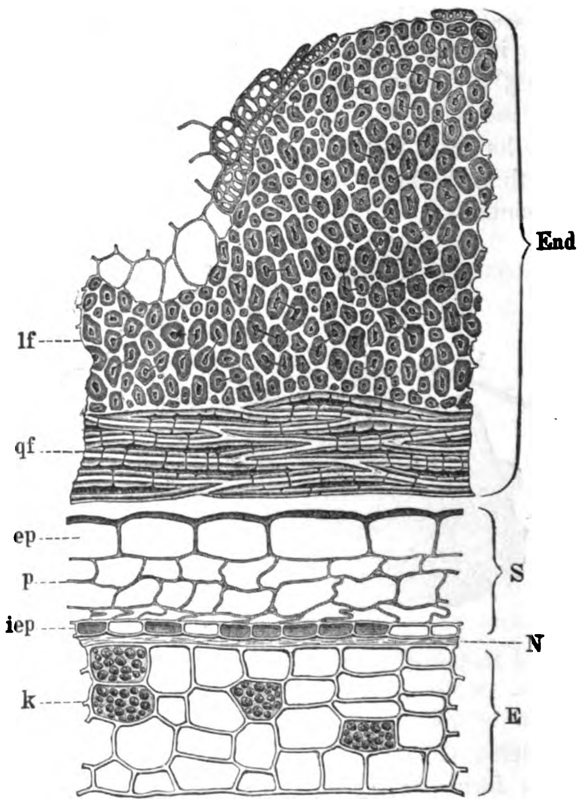

FIG. 9.—Red Raspberry. Endocarp and seed in transverse section. End, endocarp consisting of lf, longitudinally extended fibers and qf, transversely extended fibers; S, testa consisting of ep, epidermis, p, parenchyma (nutritive layer) and iep, inner epidermis; N, hyaline layer (nucellus); E, endosperm 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.

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[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.

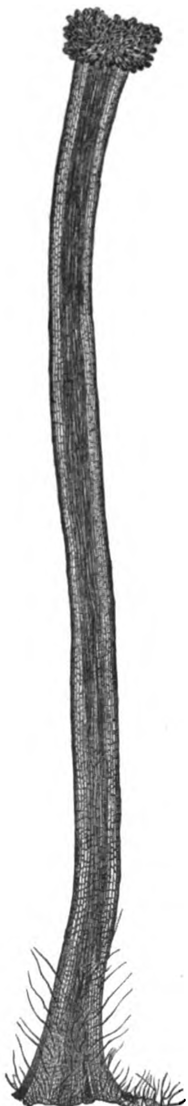

FIG. 10.—Raspberry style and stigma. × 32.

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.

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

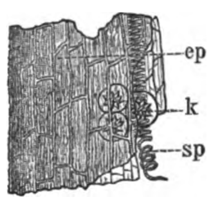

Fig. 11.—Raspberry style in surface view. ep, epidermis; sp, spiral vessels; k, crystal cells. × 300.

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

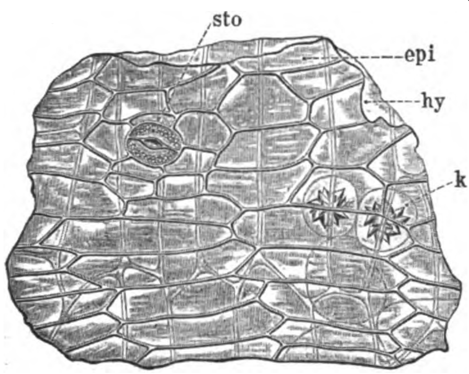

FIG. 12.—Blackberry. Outer layers of pericarp in surface view. epi, epicarp with sto, stoma; hy, hypoderm; k, crystal cells. × 160.

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.

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.

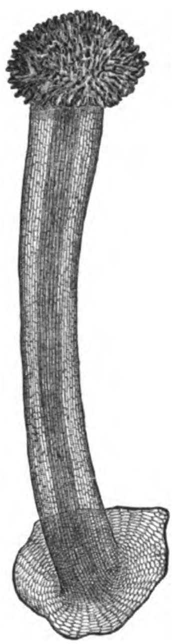

FIG. 14.—Blackberry style and stigma. × 32.

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

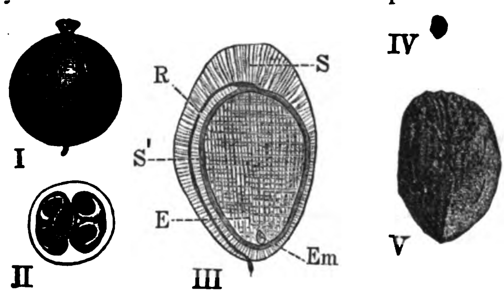

FIG. 15.—Red Currant. I Fruit, × 1. II Transverse section of fruit with seeds, × 1. III Longitudinal section of seed, × 8. S, gelatinous epidermis of testa; S′, inner testa; R, raphe; E, endosperm; Em, embryo. IV Seed deprived of gelatinous coat, × 1. V Same as IV, × 8.

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.

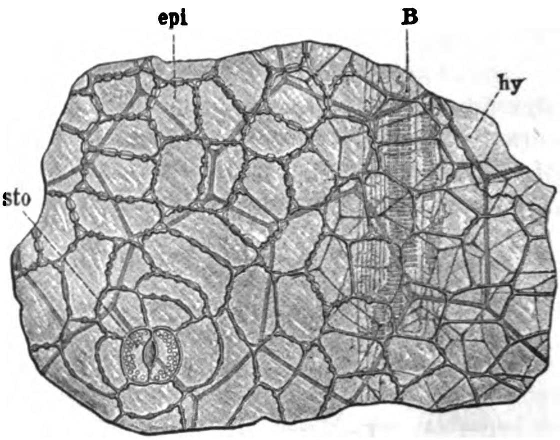

FIG. 16.—Red Currant. Outer layers of pericarp in surface view. epi, epicarp with sto, stoma; hy, hypoderm; B, vascular bundle or vein seen through the transparent outer layers of the fruit. × 160.

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.

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[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

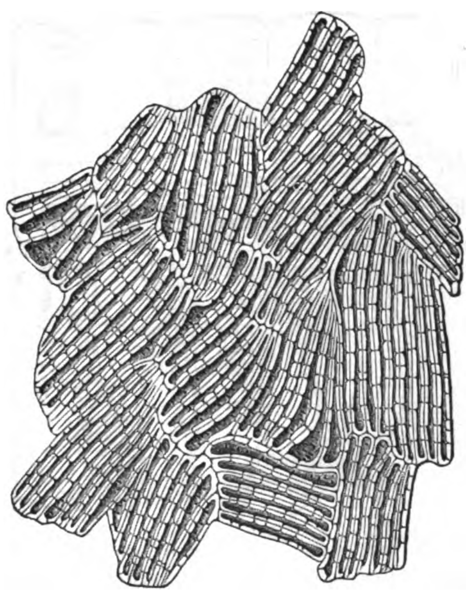


FIG. 17.—Red Currant endocarp in surface view. × 160.

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

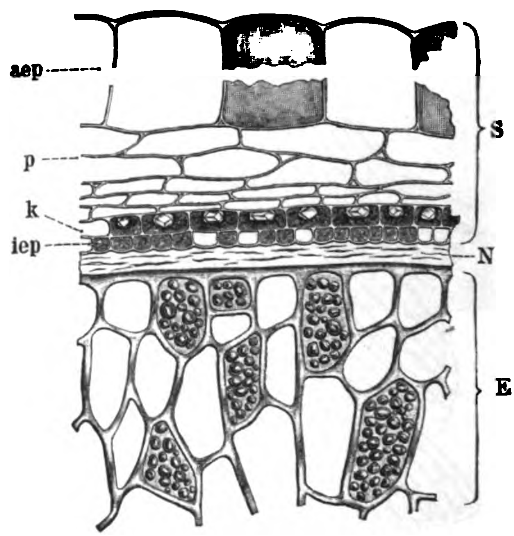


FIG. 18.—Red Currant seed in transverse section. S, testa consisting of aep, gelatinous outer epidermis, p, parenchyma (nutritive layer), k, crystal layer, iep, brown layer (inner epidermis); N, hyaline layer (nucellus); E, endosperm. × 300.

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

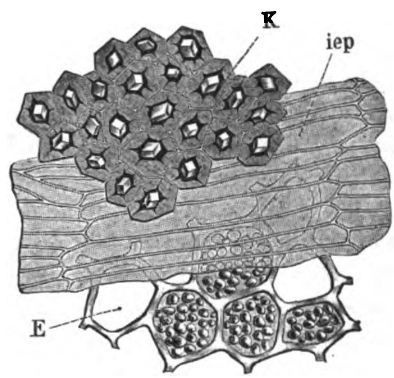


FIG. 19.—Red Currant. Transverse section of central portion of endosperm. × 300.

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 identification. 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

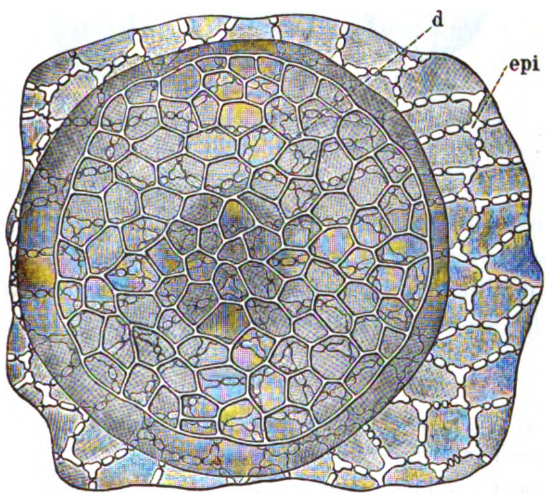


FIG. 21.—Black Currant. epi, epicarp with d, gland, in surface view. × 160.

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

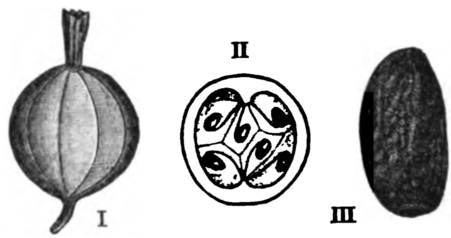


FIG. 22.—American Gooseberry (*Ribes oxyacanthoides*). I Whole fruit, × 1. II Transverse section of fruit with seeds, × 1. III Seeds deprived of gelatinous coat, × 8.

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.

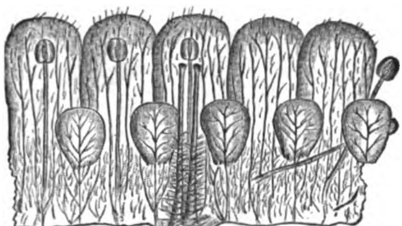
3. Mesocarp. This layer is composed of extraordinarily large cells (often 0.5 mm. in diameter), which are evident to the naked eye and are separated from each other by a network of cells hardly 0.05 mm. in diameter. In the inner layers the small cells are less numerous or entirely lacking. Crystal clusters 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



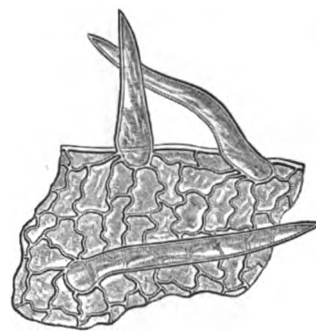


FIG. 23.—Gooseberry. Floral parts. × 5.

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

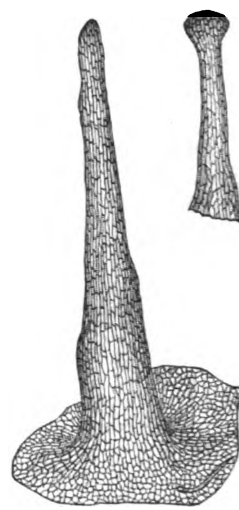


FIG. 25.—Gooseberry. Epidermis from throat of calyx, with hair. × 160.
FIG. 26.—European Gooseberry (*R. Grossularia*). Prickles with and without globular head. × 32.

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

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[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

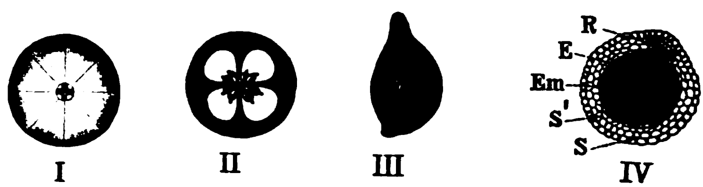


FIG. 27.—Cultivated Cranberry (*Vaccinium macrocarpum*). I Berry seen from above, × 1. II Transverse section of berry, × 1. III Seed, × 8. IV Transverse section of seed, × 15. S, epidermis of testa; S', inner testa; R, raphe; E, endosperm; Em, embryo.

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.

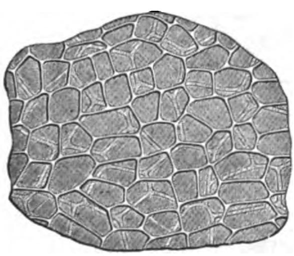
Histology.

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



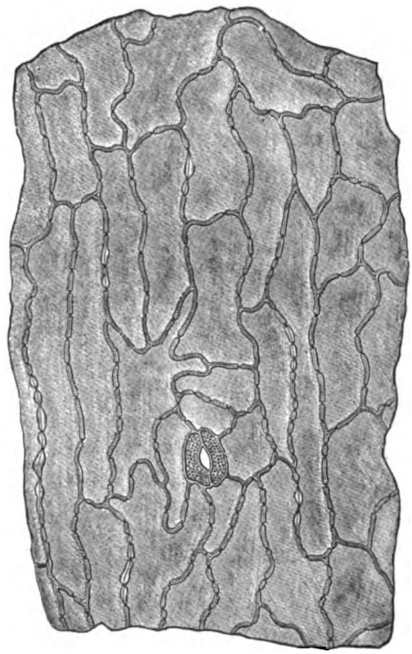


FIG. 28.—Cranberry. Epicarp and hypoderm. × 160.
FIG. 29.—Cranberry. Endocarp with stoma. × 160.

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.

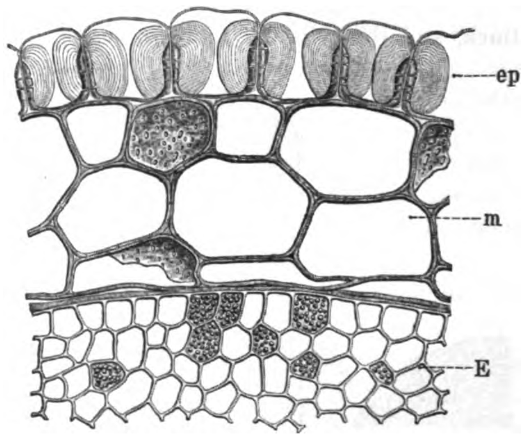


FIG. 30.—Cultivated Cranberry. Seed in transverse section. ep, epidermis of testa with sclerenchymatized and mucilaginous layers; m, inner testa; E, endosperm. × 160.

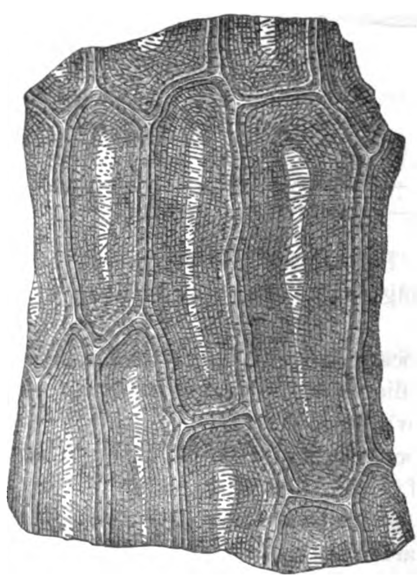


FIG. 31.—Cultivated Cranberry. Epidermis of testa in surface view. × 160.

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

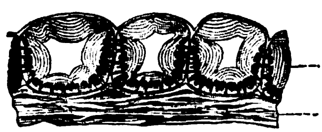


FIG. 32.—Mountain Cranberry (*Vaccinium Vitis-Idaea*). Transverse section of testa. × 160.

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.

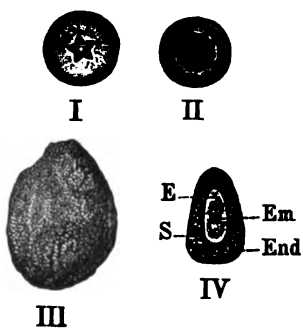
2. Inner Testa. The remainder of the testa consists of two or three layers of large thick-walled porous cells, the innermost layers being more or less collapsed. In dried or cooked specimens, all of these cells are collapsed (Fig. 30, m).

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 characteristic 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-



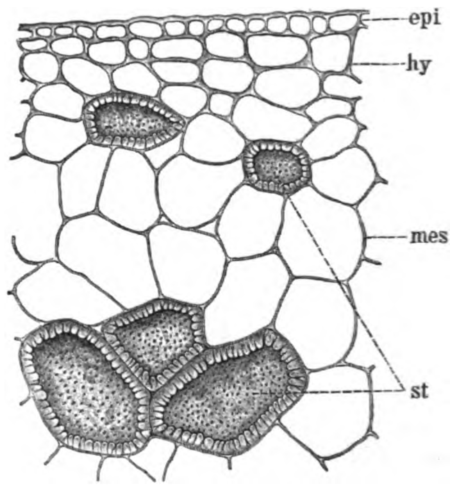


FIG. 33.—Huckleberry (*Gaylussacia resinosa*). I Fruit seen from above, × 1. II Transverse section of fruit, × 1. III Stone, × 8. IV Transverse section of stone, × 8. End, endocarp; S, testa; E, endosperm; Em, embryo.

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.

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[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.

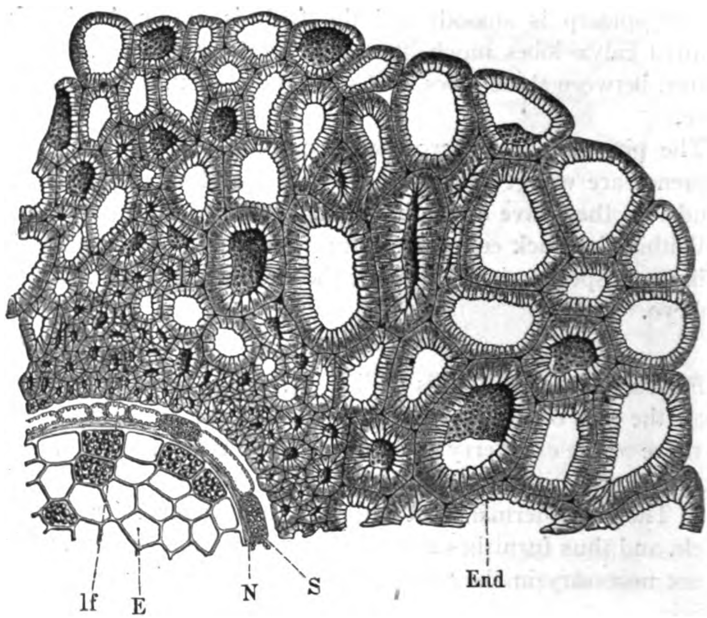

FIG. 35.—Huckleberry. Transverse section of endocarp and seed. end, endocarp with large isodiametric stone cells and lf, narrow longitudinally extended fibers; S, testa; N, hyaline layer (nucellus); E, endosperm. X 160.

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

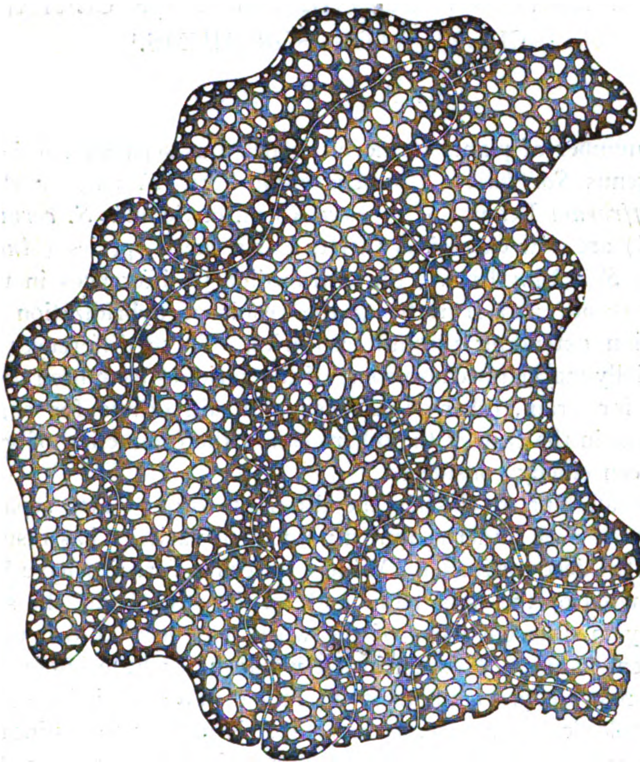

FIG. 36.—Huckleberry testa in surface view. × 300.

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.

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[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.

[1] Landw. Samenkunde, Bd. II, 1249.

[2] Mitth. aus dem Labor. f. Waarenkunde an der Wiener Handels-Akademie, 15 Jahr., 1887, 113-140; Ref. Bot. Centralbl. 1888, 17-19.

[3] 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.

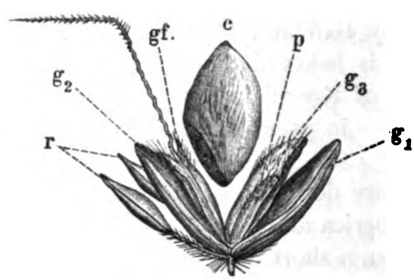


FIG. 37.—Broom-Corn. Fruit with chaff. r, two staminate spikelets; g^1, lower empty glume; g^2, upper empty glume; g^3, glume of rudimentary flower; gf, flowering glume with awn; p, palet; c, caryopsis. × 4.

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.

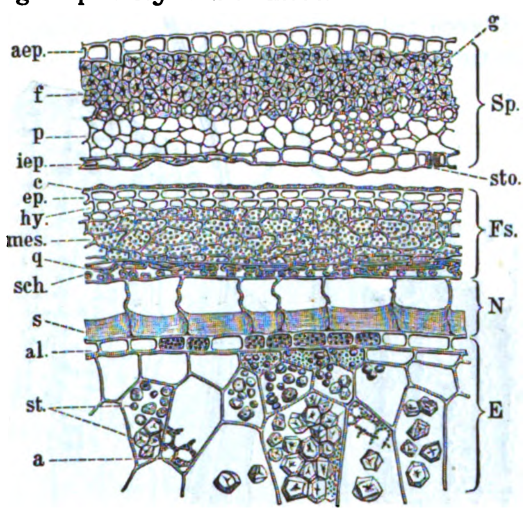


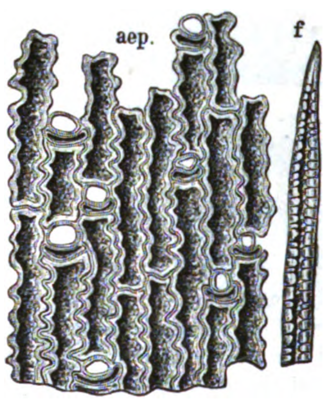
FIG. 38.—Broom-Corn. Transverse section of caryopsis and an empty glume. Sp, empty glume, consisting of the outer epidermis aep, the fiber layer f, the spongy parenchyma p, and the inner epidermis iep; g, bundel; sto, stoma; Fs, pericarp, consisting of the epidermis ep with the cuticle c, the hypoderm 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, g³). 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



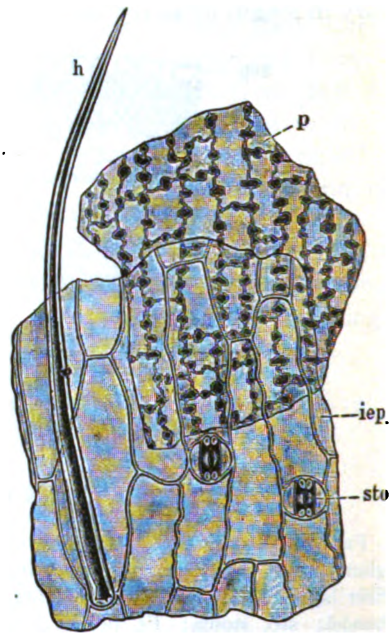


FIG. 39.—Broom-Corn. aep, outer epidermis and f, fiber of an empty glume in surface view. × 300.

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

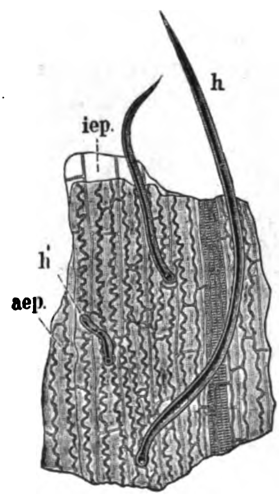


FIG. 41.—Broom-Corn. Glume of rudimentary flower (Fig. 1, g^3) in surface view. aep, outer epidermis with h, one-celled hair and h', two-celled hair; iep, inner epidermis. × 300.

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

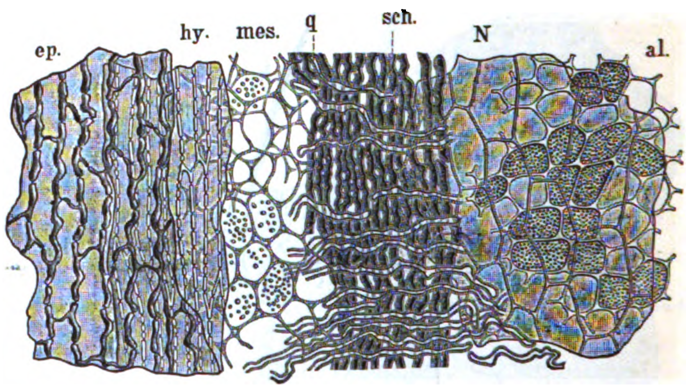


FIG. 42.—Broom-Corn. Layers of the pericarp in surface view. Significance of letters same as in Fig. 38. × 160.

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 broomcorn, 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,

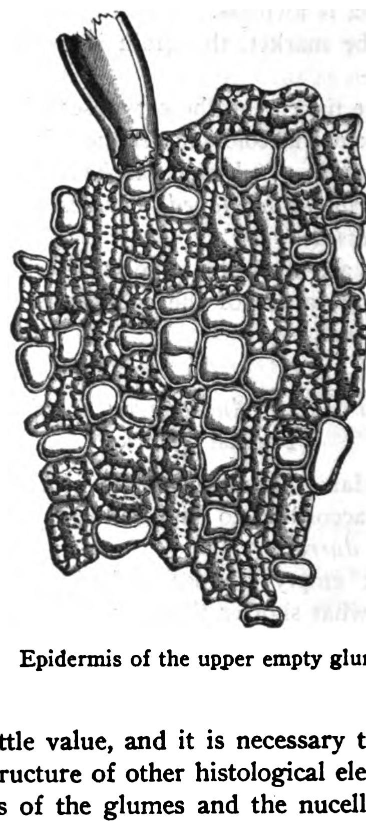


FIG. 43.—Maize. Epidermis of the upper empty glume in surface view. × 300.

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.

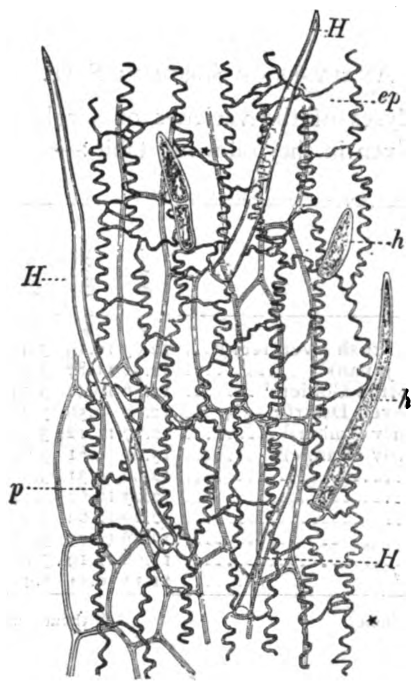


FIG. 44.—Maize. Membranaceous glume in surface view. ep, outer epidermis with the long one-celled hair H, and the short, blunt 1 to 3 celled hair h; *, hair scar; p, ground tissue. × 160. (Moeller.)

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 occur-

[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.

rence in Ohio. The aggregate production of this weed grain in the entire country must be enormous.

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.										
	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.
Station No.	7887	7889	7890	7886	7888	5109	5110	5111	5112	5158	5164	7401	7405	7403	7404	
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	100.00	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

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[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-

I II

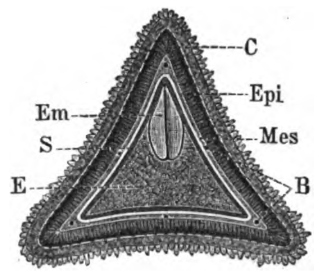


FIG. 45.—Black Bindweed. I Fruit with calyx. II Fruit without calyx. × 5.

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

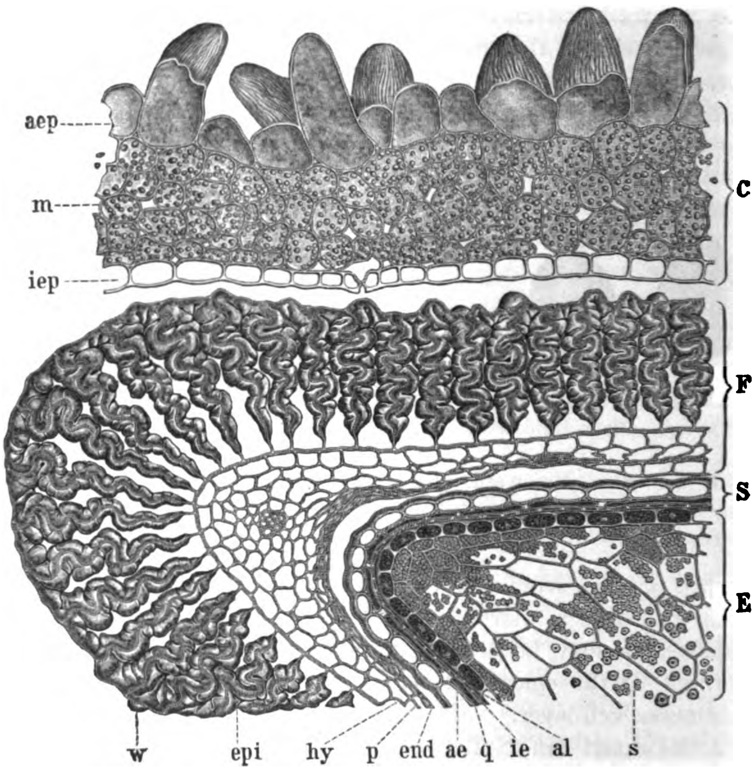
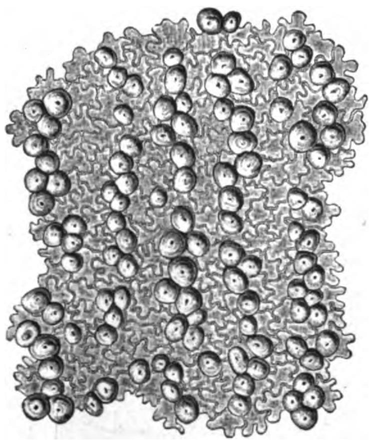


FIG. 47.—Black Bindweed. Transverse section of the fruit. C, calyx consisting of the outer epidermis aep, the mesophyll m and the inner epidermis iep; F, pericarp consisting of the epicarp epi with cuticular warts w, the mesocarp p and the endocarp end; S, testa consisting of the outer epidermis ae, 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



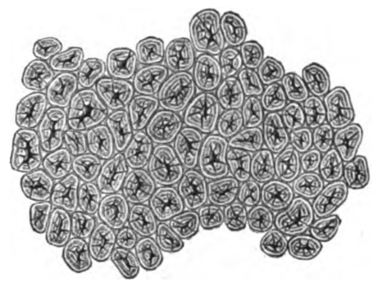


FIG. 48.—Black Bindweed. Epicarp in surface view. × 160.
FIG. 49.—Black Bindweed. Tangential section of the epicarp. × 160.

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).

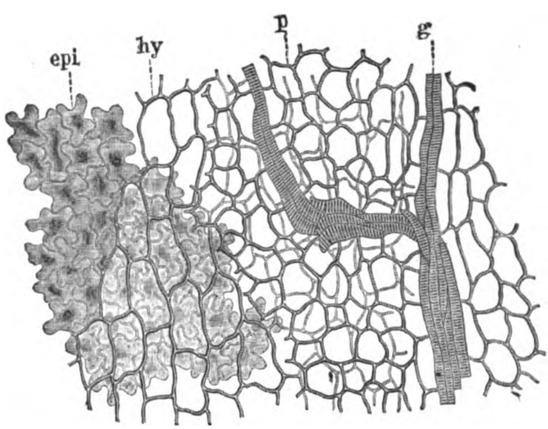


FIG. 50.—Black Bindweed. Surface view of the pericarp from below. × 160. Significance of letters same as in Fig. 47.

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.

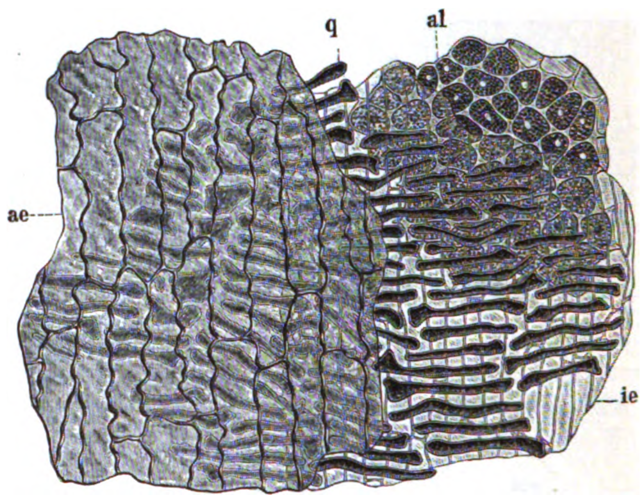


FIG. 51.—Black Bindweed. Seed in surface view. Significance of letters same as in Fig. 47.

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

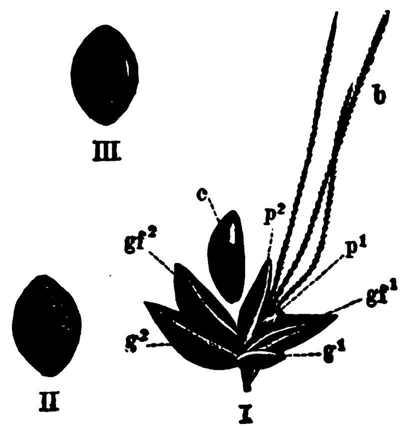


FIG. 52.—Green Foxtail. I Spikelet with ripe fruit. g^1, lower empty glume; g^2, upper empty glume; gf^1, glume, and p^1, palet of the staminate flower; gf^2, glume, and p^2, palet of fertile flower; c, caryopsis; b, bristles. II and III caryopsis enclosed by flowering glume and palet. $\times$ 8.

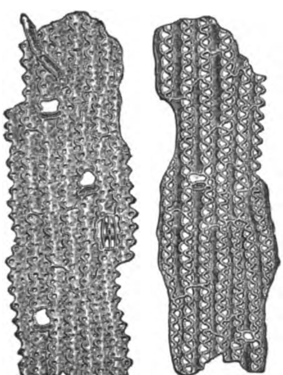
with membraneous envelopes (Fig. 52); at the base of the spikelet are from two to four upwardly barbed bristles varying in length up to 8 mm.

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.



I II

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.

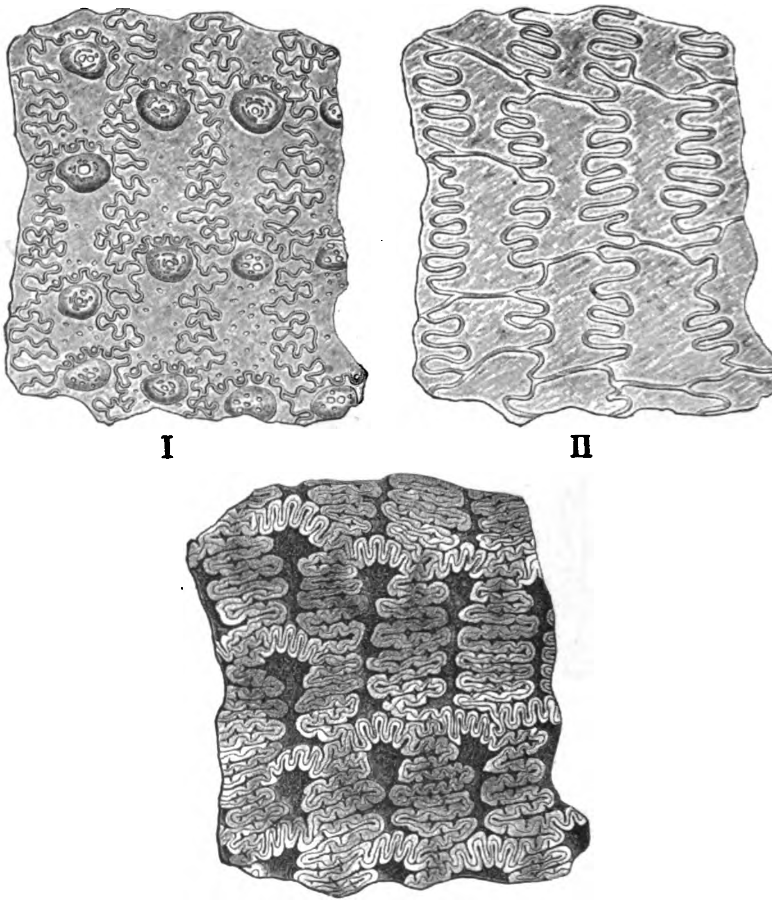


FIG. 55.—Green Foxtail. Outer epidermis from the middle of the glume of the fertile flower. I Outer surface, and II inner surface soon after blooming. III Outer surface when in fruit. × 300.

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).

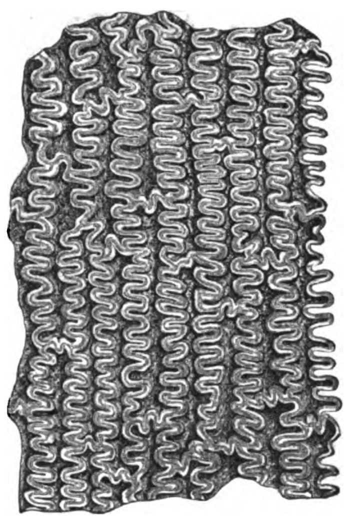


FIG. 56.—Green Foxtail. Outer epidermis from the edge of the glume of the fertile flower. ×300.

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.

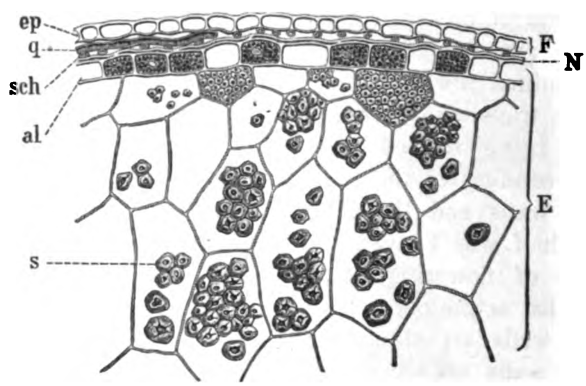


FIG. 57.—Green Foxtail. Transverse section of caryopsis. F, pericarp consisting of the epidermis ep and the tube-cells sch; N, nucellar layer; E, endosperm consisting of the aleurone-cells al and the starch-cells s. × 300.

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 miliaceum* 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.

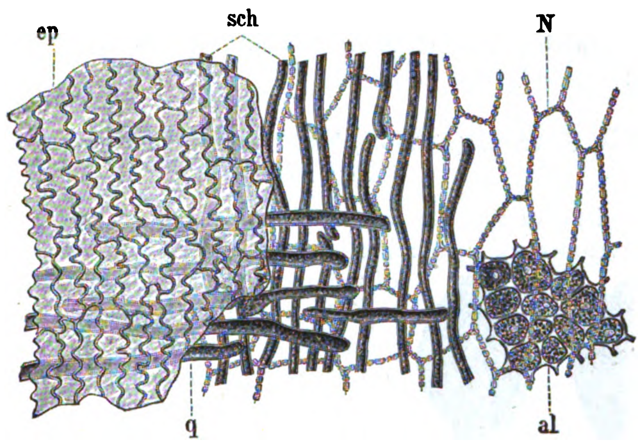


FIG. 58.—Green Foxtail. Caryopsis in surface view. Significance of letters same as in Fig. 57.

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.

the association of official agricultural chemists of the United States.

§ **4593. Statement to be filed.** Every manufacturer, importer, agent, or seller of any concentrated commercial feeding stuff shall, upon request, file with the Connecticut agricultural experiment station a certified copy of the statement prescribed in § 4592.

§ **4594. Penalty.** Every manufacturer, importer, agent, or person selling, offering, or exposing for sale any concentrated commercial feeding stuff in relation to which all the provisions of §§ 4592 and 4593 have not been complied with, shall be fined not more than one hundred dollars for the first offense, and not more than two hundred dollars for each subsequent offense.

§ **4595. Samples for analysis.** The Connecticut agricultural experiment station may collect a sample, not exceeding two pounds in weight, for analysis, from any lot, parcel, or package of concentrated commercial feeding stuff, or unmixed meals, brans, or middlings, which may be in the possession of any manufacturer, importer, agent, or dealer, but said sample shall be taken in the presence of the parties in interest, or their representatives, and taken from a number of parcels or packages which shall be not less than five per cent. of the whole lot inspected, and shall be thoroughly mixed, divided into two samples, placed in glass vessels, carefully sealed, and a label placed on each stating the name or brand of the feeding stuff or material sampled, the name of the party from whose stock the sample was taken, and the time and place of taking the same; said label shall be signed by the state chemist* or his deputy, and by the party or parties in interest or their representatives present at the taking and sealing of said sample; one of said samples shall be retained by said chemist or his deputy and the other by the party whose stock is sampled. Said station shall cause at least one sample of each brand of feeding stuff so collected to be analyzed annually by or under the direction of said chemist. Said analysis shall include determinations of crude fat and crude protein, and such other determinations as may be advisable. Said station shall cause the analysis so made to be published in station bulletins, together with such

* Amended by General Assembly of 1903 so as to read *Station* chemist.

additional information in relation to the character, composition, and use thereof as may be of importance, and issue the same annually, or more frequently if advisable.

§ **4596. Enforcement of the provisions of this chapter.** The dairy commissioner shall enforce the provisions of this chapter, and when evidence is submitted by the Connecticut agricultural experiment station that said provisions have been violated he shall make complaint to the proper prosecuting officer.

§ **4597. Term "importer" defined.** The term "importer" shall include such persons as shall bring into or offer for sale within this state concentrated commercial feeding stuffs manufactured without this state.

The statute places on this Station the duty of analyzing commercial feeds and of publishing an annual report regarding them.

In compliance with these requirements, the following report is made. The larger portion of it was published in Bulletin 141, issued in January, 1903.

To aid in understanding the analyses and discussion, the following explanations are made.

EXPLANATIONS OF ANALYSES OF FEEDING STUFFS.

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

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

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

Ash is what is left when the combustible part of a feeding stuff is burned away by heating to faint redness in a current of air 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.						Price per ton.
	Water.	Ash.	Protein.	Fiber.	Nitrogen-free Extract. (Starch, gum, etc.)	Ether Extract.	
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.						Price per ton.
	Water.	Ash.	Protein.	Fiber.	Nitrogen-free Extract. (Starch, gum, etc.)	Ether Extract.	
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.						Price per ton.
	Water.	Ash.	Protein.	Fiber.	Nitrogen-free Extract. (Starch, gum, etc.)	Ether Extract.	
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.	Water.	Ash.	Protein.	Fiber.	Nitrogen-free Extract. (Starch, gum, etc.)	Ether Extract.	Price per ton.
	ANALYSES.						
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.						Price per ton.
	Water.	Ash.	Protein.	Fiber.	Nitrogen-free Extract. (Starch, gum, etc.)	Ether Extract.	
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	2.05	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.						Price per ton.
	Water.	Ash.	Protein.	Fiber.	Nitrogen-free Extract. (Starch, gum, etc.)	Ether Extract.	
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 Stonington.

SAMPLED IN 1902.

Station No.	Analyses.						Price per ton.
	Water.	Ash.	Protein.	Fiber.	Nitrogen-free Extract. (Starch, gum, etc.)	Ether Extract.	
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.						Price per ton.
	Water.	Ash.	Protein.	Fiber.	Nitrogen-free Extract. (Starch, gum, etc.)	Ether Extract.	
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.						Price per ton.
	Water.	Ash.	Protein.	Fiber.	Nitrogen-free Extract. (Starch, gum, etc.)	Ether Extract.	
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.						Price per ton.
	Water.	Ash.	Protein.	Fiber.	Nitrogen-free Extract. (Starch, gum, etc.)	Ether Extract.	
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.						Price per ton.
	Water.	Ash.	Protein.	Fiber.	Nitrogen-free Extract. (Starch, gum, etc.)	Ether Extract.	
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. Wet.	Distillery Grains. Dry.	Distillery Grains. Dry.	Apple Pomace.	Beef Scrap.
	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	c–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. Sprouted in 14 days.	Percentage of Seeds by number. Remained hard.	Number of days within which one-half of the sprouting Seed germinated.
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. Sprouted in 14 days.	Remained hard.	Number of days within which one-half of the sprouting Seed germinated.
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	247½	198⅛	445⅝	----	----	----	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	51⅝	15⅜	67	----	----	----	85,190 "
Black "	76½	29½	106	----	----	----	136,430 "
Blackberries	53¼	6⅛	59⅜	----	----	----	110,320 "
Dewberries	10½	¾	11¼	----	----	----	15,075 "
Currants	22	7⅝	29 11/16	----	----	----	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	145½	90⅛	235⅝	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	1½	5⅝	----	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.

KINDS OF FRUIT.	Bearing.	Newly Set.	Totals.	Bearing.	Newly Set.	Totals.	Estimated Crop for 1902.
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 "	37½	34	71½	7,201	6,058	13,259	2,030 "
Grapes	16	¾	16¾	8,250	491	8,741	32,000 lbs.
Strawberries	47⅝	60¾	108⅜	----	----	----	110,644 qts.
Quinces	3	¾	3¾	563	142	705	378 bu.
Cherries	6	¼	6¼	664	50	714	10,000 qts.
Red Raspberries	15½	1¾	17¼	---	----	----	23,155 "
Black "	13⅜	3	16⅜	----	----	----	23,710 "
Blackberries	8¾	¼	9	---	----	----	13,980 "
Dewberries	2	----	2	----	----	----	2,500 "
Currants	4¾	----	4¾	----	----	----	7,000 "
Gooseberries	⅝	----	⅝	750	100	850	400 "

LITCHFIELD COUNTY.

KINDS OF FRUIT.	Bearing.	Newly Set.	Totals.	Bearing.	Newly Set.	Totals.	Estimated Crop for 1902.
Apples	710½	142¼	852¾	33,676	9,426	43,102	89,962 bu.
Pears	11¾	12⅜	24 1/16	1,342	1,924	3,266	710 "
Peaches	99½	46⅛	145⅝	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 11/16	9 7/16	25⅛	----	----	----	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	⅛	2⅛	204	50	254	26 "
Japanese "	30	18½	48½	6,173	3,673	9,846	3,011 "
Grapes	1	¾	1¾	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 "	10⅝	2	12⅝	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.

Kinds of Fruit.	Acreage: Bearing.	Acreage: Newly Set.	Acreage: Totals.	Trees and Plants: Bearing.	Trees and Plants: Newly Set.	Trees and Plants: Totals.	Estimated Crop for 1902.
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	18⅛	42⅛	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	1⅜	15⅝	----	2,600	2,600	30,535 "
Black "	27⅛	9¾	37 1/16	----	----	----	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.

Kinds of Fruit.	Acreage: Bearing.	Acreage: Newly Set.	Acreage: Totals.	Trees and Plants: Bearing.	Trees and Plants: Newly Set.	Trees and Plants: Totals.	Estimated Crop for 1902.
Apples	291½	47½	339	9,822	1,904	11,726	28,291 bu.
Pears	9¾	1¾	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	27⅛	63⅛	----	----	----	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	276¾	8,651	1,614	10,265	22,683 bu.
Pears	6½	1	7½	610	71	681	411 "
Peaches	123	33¼	156¼	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	½	----	½	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	7⅛	2⅞	10	----	----	----	24,300 qts.
Quinces	¼	¼	½	108	100	208	42 bu.
Cherries	½	----	½	50	----	50	451 qts.
Red Raspberries	¾	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	723¾	206½	930¼	26,723	8,782	35,505	59,657 "
Litchfield	710½	142¼	852¾	33,676	9,426	43,102	89,962 "
Middlesex	101	154	255	4,322	5,265	9,587	9,357 "
New Haven	682¾	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	276¾	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.

County	Bearing	Newly Set	Totals	Bearing	Newly Set	Totals	Estimated Crop
Fairfield	10⅝	20⅝	31¼	843	974	1,817	670 bu.
Hartford	18¼	3½	21¾	1,715	272	1,987	789 "
Litchfield	11¾	12⅓	24 1/12	1,342	1,924	3,266	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	9¾	1¾	11½	432	105	537	197 "
Tolland	6½	1	7½	610	71	681	411 "
Windham	13¾	8½	22¼	344	792	1,136	642 "
Totals	114⅞	83⅓	198⅜	9,404	6,669	16,073	6,370 bu.

PEACHES.

County	Bearing	Newly Set	Totals	Bearing	Newly Set	Totals	Estimated Crop
Fairfield	145¼	90⅛	235⅜	26,962	16,886	43,848	15,330 bu.
Hartford	740¾	226	966¾	122,871	44,095	166,966	78,535 "
Litchfield	99¼	46⅛	145⅜	11,164	7,545	18,709	6,800 "
Middlesex	220¼	92¼	312½	38,350	15,803	54,153	30,769 "
New Haven	1,014¾	390	1,404¾	156,828	61,540	218,368	148,240 "
New London	140¼	123¾	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.

County	Bearing	Newly Set	Totals	Bearing	Newly Set	Totals	Estimated Crop
Fairfield	1½	----	1½	206	16	222	36 bu.
Hartford	3	----	3	394	6	400	150 "
Litchfield	½	¼	¾	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	¾	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. Bearing.	ACREAGE. Newly Set.	ACREAGE. Totals.	NUMBER OF TREES AND PLANTS. Bearing.	NUMBER OF TREES AND PLANTS. Newly Set.	NUMBER OF TREES AND PLANTS. Totals.	Estimated Crop for 1902.
Fairfield	15¾	3	18¾	3,060	507	3,567	1,504 bu.
Hartford	37¼	34	71¼	7,201	6,058	13,259	2,030 "
Litchfield	19¾	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	4⅛	18	22⅛	588	2,203	2,791	169 "
Totals	139⅛	123⅛	262⅝	25,432	22,142	47,574	8,878 bu.

GRAPES.

COUNTY.	ACREAGE. Bearing.	ACREAGE. Newly Set.	ACREAGE. Totals.	NUMBER OF TREES AND PLANTS. Bearing.	NUMBER OF TREES AND PLANTS. Newly Set.	NUMBER OF TREES AND PLANTS. Totals.	Estimated Crop for 1902.
Fairfield	5	½	5½	2,466	165	2,631	9,380 lbs.
Hartford	16	⅝	16⅝	8,250	491	8,741	32,000 "
Litchfield	3¾	1¾	5½	2,226	950	3,176	15,700 "
Middlesex	1	¾	1¾	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.

COUNTY.	ACREAGE. Bearing.	ACREAGE. Newly Set.	ACREAGE. Totals.	NUMBER OF TREES AND PLANTS. Bearing.	NUMBER OF TREES AND PLANTS. Newly Set.	NUMBER OF TREES AND PLANTS. Totals.	Estimated Crop for 1902.
Fairfield	44½	36½	81	----	----	----	130,555 qts.
Hartford	47⅝	60¾	108⅜	----	----	----	110,644 "
Litchfield	15½	9¾	25¼	----	----	----	30,104 "
Middlesex	19	19½	38½	----	----	----	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	198⅛	445⅜	----	----	----	743,658 qts.

QUINCES.

COUNTY.	ACREAGE. Bearing.	ACREAGE. Newly Set.	ACREAGE. Totals.	NUMBER OF TREES AND PLANTS. Bearing.	NUMBER OF TREES AND PLANTS. Newly Set.	NUMBER OF TREES AND PLANTS. Totals.	Estimated Crop for 1902.
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	1/2	6 1/2	664	50	714	10,000 "
Litchfield	1	2 1/2	3 1/2	60	225	285	1,915 "
Middlesex	2	2	4	216	206	422	5,000 "
New Haven	2 1/2	2	4 1/2	248	192	440	7,890 "
New London	1/8	1/8	1/4	16	18	34	160 "
Tolland	1/2	----	1/2	44	5	49	320 "
Windham	1/2	----	1/2	50	----	50	451 "
Totals	14 5/8	8 1/8	22 3/4	1,491	786	2,277	28,351 qts.

RED RASPBERRIES.

County.	Bearing.	Newly Set.	Totals.	Bearing.	Newly Set.	Totals.	Estimated Crop for 1902.
Fairfield	7	2	9	----	----	----	9,200 qts.
Hartford	15 1/2	1 3/4	17 1/4	----	----	----	23,155 "
Litchfield	6 1/2	5	11 1/2	----	----	----	12,300 "
Middlesex	3 1/8	1/4	3 3/8	6,200	200	6,400	5,000 "
New Haven	14 1/4	1 3/8	15 5/8	----	2,600	----	30,535 "
New London	3/4	----	3/4	1,100	100	1,200	500 "
Tolland	3 3/4	3 1/2	7 1/4	7,380	7,000	14,380	2,750 "
Windham	3/4	1 1/2	2 1/4	1,400	1,400	2,800	1,750 "
Totals	51 5/8	15 3/8	67	----	----	----	85,190 qts.

BLACK RASPBERRIES.

County.	Bearing.	Newly Set.	Totals.	Bearing.	Newly Set.	Totals.	Estimated Crop for 1902.
Fairfield	17 1/8	6 3/4	23 7/8	----	----	----	26,400 qts.
Hartford	13 5/8	3	16 5/8	----	----	----	23,710 "
Litchfield	5 3/4	6 1/2	12 1/4	----	----	----	16,130 "
Middlesex	10 5/8	2	12 5/8	20,750	4,000	24,750	13,350 "
New Haven	27 1/8	9 3/4	37 1/12	----	----	----	54,220 "
New London	----	----	----	----	100	----	----
Tolland	1 1/4	1/2	1 3/4	1,705	1,000	2,705	1,070 "
Windham	1	1	2	1,400	900	2,300	1,550 "
Totals	76 1/2	29 1/2	106	----	----	----	136,430 qts.

BLACKBERRIES.

County.	Bearing.	Newly Set.	Totals.	Bearing.	Newly Set.	Totals.	Estimated Crop for 1902.
Fairfield	4 1/8	1 1/4	5 3/8	----	1,000	----	6,900 qts.
Hartford	8 1/2	1/2	9	----	----	----	13,980 "
Litchfield	6	3	9	----	----	----	17,040 "
Middlesex	13 3/4	----	13 3/4	27,500	----	27,500	23,140 "
New Haven	19 1/8	3/4	19 7/8	----	----	----	47,820 "
New London	0	0	0	0	0	0	----
Tolland	1 1/4	1/2	1 3/4	2,247	1,000	3,247	1,040 "
Windham	1/2	1/8	5/8	800	100	900	400 "
Totals	53 1/4	6 1/8	59 3/8	----	----	----	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.

COUNTY.	Bearing.	Newly Set.	Totals.	Bearing.	Newly Set.	Totals.	Estimated Crop for 1902.
Fairfield	4½	½	5	----	600	600	14,100 qts.
Hartford	4¾	----	4¾	----	----	----	7,000 "
Litchfield	3½	----	3½	----	1,500	1,500	7,026 "
Middlesex	¾	⅛	⅞	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.

COUNTY.	Bearing.	Newly Set.	Totals.	Bearing.	Newly Set.	Totals.	Estimated Crop for 1902.
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.

COUNTY.	Bearing.	Newly Set.	Totals.	Bearing.	Newly Set.	Totals.	Estimated Crop for 1902.
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	3.1^{cc}—5.5^{cc}
Black walnut	2.8^{cc}—4.6^{cc}
English walnut	2.8^{cc}—4.6^{cc}

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°
	10% NaCl	.0247 gr.	−2.07°	2 dm.	−41.9°
Preparation *a*.	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

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[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; 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;	The intensity of the reaction increased gradually from Hordein to Leucosin, the former giving a positive reaction, the latter a strong one.

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.

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* 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.

PLATE I.

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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