State of Connecticut
PUBLIC DOCUMENT No. 24

Forty-eighth Report

OF THE

CONNECTICUT AGRICULTURAL EXPERIMENT STATION

NEW HAVEN, CONN.

FOR THE YEAR

1924

PRINTED IN COMPLIANCE WITH STATUTE

NEW HAVEN
PUBLISHED BY THE STATE
1925

PUBLICATION

APPROVED BY

THE BOARD OF CONTROL

PRESS OF
THE WILSON H. LEE COMPANY
NEW HAVEN, CONN.

CONNECTICUT AGRICULTURAL EXPERIMENT STATION

OFFICERS AND STAFF

As of October, 1924.

BOARD OF CONTROL.

His Excellency, Charles A. Templeton, *ex-officio*, *President*.
George A. Hopson, *Secretary*.....Mount Carmel
W. L. Slate, Jr., *Director and Treasurer*.....New Haven
Joseph W. Alsop.....Avon
Charles R. Treat.....Orange
Elijah Rogers.....Southington
Edward C. Schneider.....Middletown
Francis F. Lincoln.....Cheshire

STAFF.

E. H. JENKINS, PH.D., *Director Emeritus*.

Administration.
W. L. SLATE, JR., B.SC., *Director and Treasurer*.
MISS L. M. BRAUTLECHT, *Bookkeeper and Librarian*.
MISS J. V. BERGER, *Stenographer and Bookkeeper*.
MISS MARY E. BRADLEY, *Secretary*.
WILLIAM VEITCH, *In Charge of Buildings and Grounds*.

Chemistry: Analytical Laboratory.
E. M. BAILEY, PH.D., *Chemist in Charge*.
R. E. ANDREW, M.A.
C. E. SHEPARD
OWEN L. NOLAN
HARRY J. FISHER, A.B.
W. T. MATHIS
Assistant Chemists.
FRANK C. SHELDON, *Laboratory Assistant*.
V. L. CHURCHILL, *Sampling Agent*.
MISS MABEL BACON, *Stenographer*.

Biochemical Laboratory.
T. B. OSBORNE, PH.D., SC.D., *Chemist in Charge*.

Botany.
G. P. CLINTON, SC.D., *Botanist in Charge*.
E. M. STODDARD, B.S., *Pomologist*.
MISS FLORENCE A. MCCORMICK, PH.D., *Pathologist*.
WILLIS R. HUNT, M.S., *Graduate Assistant*.
G. E. GRAHAM, *General Assistant*.
MRS. W. W. KELSEY, *Secretary*.

Entomology.
W. E. BRITTON, PH.D., *Entomologist in Charge*; *State Entomologist*
B. H. WALDEN, B.AGR.
M. P. ZAPPE, B.S.
PHILIP GARMAN, PH.D.
Assistant Entomologists.
ROGER B. FRIEND, B.S., *Graduate Assistant*.
JOHN T. ASHWORTH, *Deputy in Charge of Gipsy Moth Work*.
R. C. BOTSFORD, *Deputy in Charge of Mosquito Elimination*.
MISS GLADYS M. FINLEY, *Stenographer*.

Forestry.
WALTER O. FILLEY, *Forester in Charge*.
A. E. MOSS, M.F., *Assistant Forester*.
H. W. HICOCK, M.F., *Assistant Forester*.
MISS PAULINE A. MERCHANT, *Stenographer*.

Plant Breeding.
DONALD F. JONES, S.D., *Geneticist in Charge*.
P. C. MANGELSDORF, M.S., *Graduate Assistant*.

Soil Research.
M. F. MORGAN, M.S., *Investigator*

Tobaco Sub-station at Windsor.
N. T. NELSON, PH.D., *Plant Physiologist*.

TABLE OF CONTENTS.

Report of the Board of Control

OF

THE CONNECTICUT AGRICULTURAL EXPERIMENT STATION

To His Excellency, Charles A. Templeton, Governor of Connecticut:

A detailed report of the work of the year will be found in the Report of the Director (Bulletin 264) which is submitted herewith. There are also submitted nine bulletins by various members of the staff dealing in detail with the investigations and other work accomplished.

The Tobacco Station at Windsor has continued the experiments begun in 1922 and has devoted much time to personal service among growers. The fertilizer trials have now run three years and results for that period are reported in Tobacco Station Bulletin No. 5, submitted as a part of this report.

The Station suffered a very great loss in the death of Judge James H Webb, for many years a member of this Board. At its meeting on May 24, 1924, the Board of Control adopted the following minute:

"Judge James H Webb died on April 19, 1924. For thirty years Judge Webb has been a member of this Board, following his father, who was a member from the establishment of this Station in 1877 till his death in 1884.

Judge Webb was a graduate of the Massachusetts Agricultural College, with experience in the management of a dairy farm, a student of law, a teacher in the Yale Law School, a successful attorney and a judge of the Superior Court.

This Board desires to record its tribute to the very valuable services of Judge Webb to this Station, continued freely for so many years, and its very deep appreciation of them.

Practical acquaintance with the problems of the farm, business experience and knowledge of the law made him an adviser of unusual value to the institution. With their appreciation of his services on this Board, its members cannot refrain from expressing their deep sorrow at the loss of a valued personal associate and friend."

Respectfully submitted,

GEORGE A. HOPSON,

Secretary.

Report of the Treasurer

July 1, 1923—July 30, 1924

W. L. Slate, Jr., in account with The Connecticut Agricultural Experiment Station for the fiscal year ended June 30, 1924.

Receipts.

Balance on hand, July 1, 1923, Miscellaneous Receipts			$226.08
State Appropriation (General or Current Expense)		$50,000.00	
" " (General) (Additions)		599.16	
" " (Food and Drug)		7,500.00	
" " (Insect Pest)		15,000.00	
" " (Insect Pest) (Additions)		759.18	
United States Appropriation (Hatch)		7,500.00	
" " " (Adams)		7,500.00	
Fertilizer Analysis Fees		11,000.00	
Lockwood Trust Fund (including sales of Mount Carmel Farm Produce)		8,000.00	
		$107,858.34	
Miscellaneous Receipts:			
Connecticut State Department of Health (rent)	$200.00		
Sales of gasoline	242.30		
Sales of automobile oil	7.68		
Mileage for use of automobiles	168.80		
Court fees	6.07		
Miscellaneous	48.80		
Interest on bank deposits	192.13		
		865.78	
			108,724.12
			$108,950.20
Less Miscellaneous Receipts Deposited with State Treasurer			817.05
			$108,133.15

Disbursements.

Salaries	$57,314.76	
Labor	10,506.30	
Stationery and Office Supplies	623.24	
Scientific Supplies (chemicals)	829.13	
" " (other laboratory)	270.14	
" " (photographic)	120.22	
Feeding Stuffs	18.00	
Insecticides, Fungicides, etc.	282.98	
Lumber and Small Hardware	124.92	
Miscellaneous Supplies	1,080.99	
Automobile Oil	122.77	
Food Samples	41.90	
Fertilizers	694.05	
Telegraph and Telephone	310.33	
Postage	386.22	
Travel (outlying investigations)	1,537.46	
" (meetings, etc.)	814.54	
" (gasoline for automobiles)	812.44	
Freight, Express and Parcels Post	197.32	
Publications (bulletins, etc.)	60.63	
" (miscellaneous)	134.82	
Coal	2,072.95	
Gas and Electricity	1,684.11	
Water	209.95	
Furniture and Fixtures (new)	443.19	
" " " (repairs)	233.15	
Library (books and periodicals)	724.14	
" (binding)	427.15	
Scientific Equipment (new)	175.73	
" " (repairs)	20.20	
Automobiles (new)	480.25	
" (repairs)	469.08	
Tools, Machinery and Appliances (new)	220.01	
" " " " (repairs)	115.02	
New Buildings and Structures	204.13	
Buildings (repairs and alterations)	716.22	
Insurance (fire, burglary and automobile)	1,443.80	
Taxes	203.99	
Insect Pest Appropriation to State Entomologist	15,759.18	
Miscellaneous Contingent Expenses	77.75	
Total Disbursements		$101,963.16
Balance on hand, June 30, 1924:		
State General Appropriation	$5,895.18	
Miscellaneous Receipts	274.81	
		6,169.99
		$108,133.15

New Haven, Conn., Aug. 1, 1924.

This is to certify that we have examined the accounts of W. L. Slate, Jr., Treasurer of The Conn. Agr. Experiment Station for the fiscal year ending June 30, 1924, and have found them correct.

William P. Bailey,
Lewis W. Phelps,
Auditors of Public Accounts.

REPORT OF

W. L. SLATE, Jr., Director

IN ACCOUNT WITH

Mosquito Elimination Appropriation

For the Fiscal Year Ending June 30, 1924

RECEIPTS.

Balance on hand, July 1, 1923 (Petty Cash Fund)	$500.00	
State Appropriation	6,000.00	
Additions to Appropriation (contributions and collections from towns)	2,210.63	
Total		$8,710.63

EXPENDITURES.

By the State Comptroller on vouchers submitted by W. L. Slate, Jr., Director:		
Salaries	$1,833.34	
Labor	5,359.74	
Supplies	556.47	
Miscellaneous Supplies	68.64	
Travel	392.44	
	$8,210.63	
Balance on hand July 1, 1924 (Petty Cash)	500.00	
		$8,710.63

REPORT OF

W. L. SLATE, Jr., Director

UNDER THE

Tobacco Research Act

(Public Acts, 1921. Chap. 184)

For the Fiscal Year Ending June 30, 1924

RECEIPTS.

State Appropriation	$10,000.00	
Additions to Appropriation	379.53	
Total		$10,379.53

EXPENDITURES.

By the State Comptroller on vouchers submitted by W. L. Slate, Jr., Director:		
Salaries	$600.00	
Labor	4,251.25	
Publications	80.70	
Stationery	76.49	
Telephone and Telegraph	13.82	
Team and Horse Hire	205.32	
Water	5.00	
Tools, Machinery and Appliances (new)	15.00	
Traveling Expenses	198.15	
Insurance	490.00	
Buildings (new)	4,343.80	
Buildings (repairs)	100.00	
		$10,379.53

BULLETIN 261 NOVEMBER, 1924

Connecticut Agricultural Experiment Station
New Haven, Connecticut

Fertilizer Report for 1924

E. M. BAILEY, *Chemist in Charge of the Analytical Laboratory.*

CONTENTS

CONNECTICUT AGRICULTURAL EXPERIMENT STATION

OFFICERS AND STAFF

November, 1924.

BOARD OF CONTROL.

His Excellency, Charles A. Templeton, *ex-officio, President.*

George A. Hopson, *Secretary*.....Mount Carmel
W. L. Slate, Jr., *Director and Treasurer*.....New Haven
Joseph W. Alsop.....Avon
Charles R. Treat.....Orange
Elijah Rogers.....Southington
Edward C. Schneider.....Middletown
Francis F. Lincoln.....Cheshire

STAFF.

E. H. JENKINS, PH.D., *Director Emeritus.*

Administration.
W. L. SLATE, JR., B.SC., *Director and Treasurer.*
MISS L. M. BRAUTLECHT, *Bookkeeper and Librarian.*
MISS J. V. BERGER, *Stenographer and Bookkeeper.*
MISS MARY BRADLEY, *Secretary.*
WILLIAM VEITCH, *In charge of Buildings and Grounds.*

Chemistry. Analytical Laboratory.
E. M. BAILEY, PH.D., *Chemist in Charge.*
R. E. ANDREW, M.A.
C. E. SHEPARD
OWEN L. NOLAN
HARRY J. FISHER, A.B.
W. T. MATHIS
} *Assistant Chemists.*
FRANK C. SHELDON, *Laboratory Assistant.*
V. L. CHURCHILL, *Sampling Agent.*
MISS MABEL BACON, *Stenographer.*

Biochemical Laboratory.
T. B. OSBORNE, PH.D., SC.D., *Chemist in Charge.*

Botany.
G. P. CLINTON, SC.D., *Botanist in Charge.*
E. M. STODDARD, B.S., *Pomologist.*
MISS FLORENCE A. MCCORMICK, PH.D., *Pathologist.*
WILLIS R. HUNT, M.S., *Graduate Assistant.*
G. E. GRAHAM, *General Assistant.*
MRS. W. W. KELSEY, *Secretary.*

Entomology.
W. E. BRITTON, PH.D., *Entomologist in Charge; State Entomologist.*
B. H. WALDEN, B.AGR.
M. P. ZAPPE, B.S.
PHILIP GARMAN, PH.D.
} *Assistant Entomologists.*
ROGER B. FRIEND, B.S., *Graduate Assistant.*
JOHN T. ASHWORTH, *Deputy in Charge of Gipsy Moth Work.*
R. C. BOTSFORD, *Deputy in Charge of Mosquito Elimination.*
MISS GLADYS M. FINLEY, *Stenographer.*

Forestry.
WALTER O. FILLEY, *Forester in Charge.*
A. E. MOSS, M.F., *Assistant Forester.*
H. W. HICOCK, M.F., *Assistant Forester.*
MISS PAULINE A. MERCHANT, *Stenographer.*

Plant Breeding.
DONALD F. JONES, S.D., *Geneticist in Charge.*
P. C. MANGELSDORF, M.S., *Graduate Assistant.*

Soil Research.
M. F. MORGAN, M.S., *Investigator.*

Tobacco Sub-station at Windsor
N. T. NELSON, PH.D., *Plant Physiologist.*

THE WILSON H. LEE CO.

Report on Commercial Fertilizers, 1924.

E. M. BAILEY, *Chemist in Charge, Analytical Laboratory.*

THE FERTILIZER LAW.

The provisions of the fertilizer law have been discussed in previous reports but for more ready reference the essential features may be repeated.

SIGNIFICANCE OF THE TERM "COMMERCIAL FERTILIZERS"

Explaining what is meant by the term "commercial fertilizers" the law says:

"The term 'commercial fertilizers' shall be construed to mean any and every substance imported, manufactured, prepared or sold for fertilizing or manuring or soil amendment purposes, except barnyard manure and stable manure which have not been artificially treated or manipulated, marl and lime. Cottonseed meal, rapeseed meal, castor pomace and all other vegetable products used as fertilizers, including the ashes of cotton hulls and wood ashes, shall be included as fertilizers within the meaning of this act and separate analysis fees shall be paid on each different grade which is sold or offered for sale in the state. The person responsible for paying the fees above prescribed may deduct from the total tonnage sold such sales of cottonseed meal or other vegetable products as are made to anyone who gives a written certificate on a form supplied by the Connecticut Agricultural Experiment Station stating that the material bought by him was to be used exclusively for feed and not for fertilizer."

CONCERNING COTTONSEED MEAL.

Cottonseed meal is a fertilizer within the meaning of the Statute but it is provided that when this product is sold for feeding purposes only, it shall be exempt from the tonnage tax.

The status of cottonseed meal under the fertilizer law has been clearly stated in a bulletin[1] from this Station from which the following may be quoted:

Registration and analysis fees. "Each brand of cottonseed meal must be registered on forms provided by this Station and an analysis fee of ten dollars paid on it before it is sold, offered or exposed for sale, and on the first day of January annually thereafter.

"A distinctive name constitutes a distinct brand. If shipments have different guaranties of composition they are held to be different brands."

Branding or tagging. "Since nitrogen is the only fertilizer ingredient considered in the trade in cottonseed meal no guaranty of phosphoric acid or potash is required. If either is guaranteed by the manufacturer, however, an additional fee of ten dollars must be paid on each element. The statement of composition now legal for feeds may be used hereafter if the percentage of nitrogen is stated.

[1] Bull. of Information No. 9, 1919.

"Note that the law regarding feeding stuffs forbids the use of metal in attaching tags and requires that each package shall be branded or tagged with the statement required by law."

Duties of shippers. "It is assumed from correspondence with shippers outside the state that they will register the brands which they sell in Connecticut, will pay analysis fees as has been done in the past by manufacturers of commercial fertilizers, and will semi-annually thereafter pay the tonnage fees.

"They will report to this Station their total sales and, if they wish, may report what part has been sold for feed exclusively. From the reports of dealers within the state it will be possible to determine quite closely the amounts of each brand actually used as feed.

"In the case the jobber outside the state neglects or refuses to register a brand, the dealer who sells it within the state is responsible under the law."

Duties of dealers. "Dealers are required to file with the director of the Station on July first of each year and semi-annually thereafter a sworn statement of their total sales of each brand of cottonseed meal and the amount of each sold exclusively for feed, during the preceding six months."

Requirements to be Complied with by Sellers of Commercial Fertilizers.

The seller is responsible for the proper labeling of each package, for the registration at the Station of every brand sold by him and for the payment of the analysis fee, before offering for sale, and annually thereafter on January 1st.

The law specifies the information which shall be given on the label as follows:

1. *Weight of each package in pounds.*
2. *Brand name or trade mark.*
3. *Analysis:*
   - (a) *Available phosphoric acid, per cent.*
   - (b) *Total phosphoric acid, per cent.*
   - (c) *Nitrogen, per cent.*
   - (d) *Equivalent ammonia, per cent.*
   - (e) *Potash soluble in water, per cent.*
4. *Name and address of the manufacturer or of the person who is responsible for the statements of the guaranty.*

In the case of bone meal, tankage or other organic products, and in basic slag and mineral phosphates in which a large percentage of the phosphoric acid is not available by laboratory methods, the phosphoric acid shall be claimed as total phosphoric acid unless it is desired to claim available phosphoric acid instead, in which case the guaranty shall take the form set forth above.

The label may be a tag attached to the package or a statement printed thereon. Percentages shall be minimum percentages only.

The presence of leather in its various forms, wool waste, hair or any inert nitrogenous material shall be declared on the label unless, by processing, the activity of these materials has been rendered satisfactory as determined by official methods.

When potash is derived from sulphate or carbonate of potash it may be so claimed.

No claim or guaranty for less than 0.82 per cent of nitrogen, or for less than 1 per cent of phosphoric acid, or for less than 1 per cent of potash shall be regarded in the registration or analysis of any commercial fertilizer.

The seller must also, on the 1st of January and July, report the tonnage of fertilizer sold within the preceding six months and pay to the director of the Station a tonnage fee of 6 cents per ton.

On request, copies of the law and blanks for registration and for tonnage reports will be supplied by the Station.

If, however, proper labeling, registration and payments have been provided for by the manufacturer of the brands or by another responsible person, all sellers of such brands are released from the above mentioned requirements. The retailer, therefore, should assure himself that the requirements of the law have been met by the manufacturers of the brands which he handles, or himself be prepared to meet all these requirements.

Precautions to be Observed in Drawing Samples for Analysis.

The analysis of a fertilizer is of no value unless the sample analyzed represents as nearly as possible the stock from which the sample was drawn. The law prescribes the procedure to be followed by authorized agents of this Station when taking official samples for analysis as follows:

"When samples are taken from fertilizers in bags, a tube shall be used, and it shall be inserted at one end of the bag and shall pass substantially the entire length of the bag, so as to take a core of the material being sampled from substantially the entire length of the bag. Samples thus taken from individual bags shall be thoroughly mixed, and the official samples shall be taken from the mixture so drawn by the method known as 'quartering'. Samples of fertilizer taken as herein provided shall be taken from at least five per centum of the separate original unopened packages in the lot, for the mixture from which the official samples shall be taken. If less than one hundred bags are in the lot, at least five bags shall be sampled; if less than five bags, all shall be sampled. Broken packages shall not be sampled."

Gratuitous Analyses.

Under the fertilizer law the Station is charged only with the analysis of samples drawn by its own agents. It does, however, each year analyze a considerable number of samples drawn by individuals, representing stock purchased by them for their own use. The object of the purchaser is to satisfy himself as to whether he has obtained goods of the grade represented and, perhaps, to obtain evidence upon which to base a claim for shortage should the materials not meet their guaranties. The Station assumes no responsibility for the sampling in case of such unofficial samples

and can only vouch for the accuracy of the results obtained on the materials as submitted. Since a representative sample is as essential as an accurate analysis in judging the quality of a shipment of fertilizer, it is evident that a satisfactory adjustment will seldom be effected on the basis of an unofficial sample. Notwithstanding certain objections which may be raised to the practice of analyzing samples submitted by individuals, the Station is disposed to continue such work so long as there is evidence that it constitutes a useful service; it cannot, however, undertake for any one individual or group, work in such volume or with such frequency that it becomes a systematic control over current purchases. This clearly invades the field of the commercial laboratory.

REGISTRATIONS.

Late Registrations for 1923.

To the brands registered for 1923 in our last report should be added:

Standard Agricultural Chemical Corporation, 2 Rector Street, New York, N.Y.

Prepared Alphano Humus

Registrations for 1924.

For 1924, 56 individuals and firms registered at this Station for sale in this State 433 brands of fertilizers. As required by Statute the brands so registered are listed as follows:

Aben Hardware Co., 74-78 Bank Street, New London, Conn.

5–10–5 Fertilizer

American Agricultural Chemical Co., 2 Rector Street, New York, N.Y.

Agrico Tobacco Manure
Castor Pomace
Cereal Mixture
Complete Potato Mixture
Corn Favorite
Double A Tobacco Fertilizer
Double Manure Salts
Dry Ground Fish
Fine Ground Bone
Fish and Potash
Five–Four–Three Tobacco Fertilizer
Grass and Lawn Top Dressing
Hercules Top Dresser
High Grade Acid Phosphate
Nitrate of Soda
Pulverized Sheep Manure
7% Potash Fertilizer
Sulphate of Potash
Universal Phosphate

Bradley's Complete Manure for Potatoes and Vegetables
Bradley's Complete Tobacco Manure
Bradley's Corn Phosphate
Bradley's New Method Fertilizer
Bradley's Northland Potato Grower
Bradley's Potato Fertilizer
Bradley's Potato Manure
Bradley's Superior Tobacco Compound
Bradley's XL Superphosphate of Lime
Lister's Complete Tobacco Manure
National Complete Tobacco Fertilizer
National Eureka Potato Fertilizer
National Market Garden Fertilizer
National Potato and Corn Phosphate
National Premier Truck Manure
National Special Tobacco
National White Ash Tobacco Grower
National XXX Fish and Potash
Quinnipiac Corn Manure
Quinnipiac Market Garden Manure
Quinnipiac Potato Phosphate
Quinnipiac Prime Tobacco Manure
Quinnipiac Seed Leaf Tobacco Manure
Wheeler's Corn Fertilizer
Wheeler's Cuban Tobacco Grower
Wheeler's Potato Manure
Wheeler's Universal Mixture
Patapsco 5–8–7 Fertilizer
Patapsco 4–8–7 Fertilizer
Patapsco General Truck Fertilizer
Patapsco Matchless Potash Manure
Patapsco Peerless Potato Guano
Patapsco 16% Acid Phosphate

Apothecaries Hall, Co., Waterbury, Conn.

Acid Phosphate
Animal Tankage (9.5–3)
Animal Tankage (7–5)
Bone and Meat Tankage
Bone Meal
Carbonate Potash 62%
Castor Pomace
Double Sulphate Potash and Magnesia 26% K_2O
Fish
Liberty Corn, Fruit and All Crops
Liberty Fish, Bone and Potash
Liberty High Grade Market Gardeners
Liberty High Grade Tobacco Manure
Liberty Market Gardeners Special
Liberty Tobacco Special
Liberty Top Dresser for Grass and Grain
Liberty 2-8-2
Muriate Potash
Nitrate Soda and Potash
Nitrate Soda
Precipitated Bone
Sulphate Potash
Tankage 9-9

Armour Fertilizer Works, 305 Broadway, New York, N. Y.

Armour's Big Crop Acid Phosphate 16%
Armour's Big Crop Fertilizer 8-6-6
Armour's Big Crop Fertilizer 5-8-5
Armour's Big Crop Fertilizer 5-8-7
Armour's Big Crop Fertilizer 4-8-4
Armour's Big Crop Fertilizer 4-6-10
Armour's Big Crop Fertilizer 3-8-4
Armour's Big Crop Fertilizer 2-12-2
Armour's Big Crop Tobacco Special 5-4-5
Armour's Corn Grower 2-8-2
Bone Meal 3-48
Ground Tankage 9-15
Muriate of Potash 48%
Nitrate of Soda 18%
Raw Bone Meal 4.5-47
Sheep Manure 1.5-1-2
Sulphate of Ammonia 25%
Sulphate of Potash 48%

Ashcraft-Wilkinson Company, Trust Co. of Georgia Building, Atlanta, Georgia.

Helmet Brand Prime Cotton Seed Meal
Monarch Brand Prime Cotton Seed Meal
Paramount Brand Prime Cotton Seed Meal

Atlantic Packing Co., New Haven, Conn.

Atlantic 5-8-7
Atlantic 4-8-6
Atlantic Grain Fertilizer 2-8-2
Atlantic Potato Phosphate 3-8-4
Atlantic Special Vegetable 4-8-4
Atlantic Tobacco Grower 5-4-5
Atlantic Tobacco Manure 5-8-6
Atlantic 7-5-4

Baker Castor Oil Company of New Jersey, 120 Broadway, New York, N. Y.

Castor Pomace

Barrett Co., 40 Rector St., New York, N. Y.

Arcadian Sulphate of Ammonia

F. A. Bartlett Tree Expert Co., Stamford, Conn.

Bartlett's Green Tree Food

Berkshire Fertilizer Co., Bridgeport, Conn.

Acid Phosphate
Berkshire Castor Pomace
Berkshire Complete Fertilizer
Berkshire Complete Tobacco
Berkshire Dry Ground Fish
Berkshire Economical Grass Fertilizer
Berkshire Fine Ground Bone
Berkshire Grass Special
Berkshire Long Island Special
Berkshire Market Garden
Berkshire Potato and Vegetable Phosphate

Berkshire Sheep Manure
Berkshire Tobacco Special
Double Manure Salt
Ground Tankage
High Grade Sulphate of Potash
Muriate of Potash
Nitrate of Soda
Precipitated Bone Phosphate
Wool Waste

F. E. Boardman, Middletown, Conn.

Boardman's Complete Fertilizer for Potatoes and General Crops
Boardman's Tobacco Fertilizer.

Bowker Fertilizer Company, 60 Trinity Place, New York, N. Y.

Bowker's All Round Fertilizer
Bowker's Connecticut Valley Tobacco Fertilizer
Bowker's Corn, Grain and Grass Phosphate
Bowker's Fisherman's Brand Fish and Potash
Bowker's Market Garden Fertilizer
Bowker's Potato and Vegetable Phosphate
Bowker's 16% Acid Phosphate
Bowker's Square Brand Farm and Garden Phosphate
Bowker's Sure Crop Phosphate
Stockbridge Early Crop Manure
Stockbridge Potato and Vegetable Manure
Stockbridge Premier Tobacco Grower
Stockbridge Tobacco Manure
Stockbridge Top Dressing and Forcing Manure
Stockbridge Truck Manure

Bridge's Sons, Inc., Amos D., Hazardville, Conn.

Corn, Onion and Potato and General Purpose
Special Tobacco Fertilizer

Buckeye Cotton Oil Company, Cincinnati, Ohio.

"Buckeye" 36% Protein Cottonseed Meal—Good Quality

Chittenden Co., E. D., Bridgeport, Conn.

Chittenden's Acid Phosphate
Chittenden's Castor Pomace
Chittenden's Complete Grain
Chittenden's Dry Ground Fish
Chittenden's Ground Bone
Chittenden's High Grade Tobacco
Chittenden's Nitrate of Soda
Chittenden's Potato Special 4% Potash
Chittenden's Potato Special 6% Potash
Chittenden's Tobacco Special
Chittenden's Top Dresser
Chittenden's Vegetable and Onion Grower
Chittenden's Complete Tobacco and Onion Grower, 4% Potash

Clark Seed Co., Everett B., Milford, Conn.

Acid Phosphate 16%
Clark's Special Mixture for General Use
Clark's Special Mixture with 6% Potash
Clark's Tip Top Brand 5-8-5
Nitrate of Soda

Coe-Mortimer Co., 2 Rector Street, New York, N. Y.

E. Frank Coe's Celebrated Special Potato Fertilizer
E. Frank Coe's Columbian Corn and Potato Fertilizer
E. Frank Coe's Connecticut Wrapper Grower
E. Frank Coe's Gold Brand Excelsior Guano
E. Frank Coe's New Englander Special
E. Frank Coe's Red Brand Excelsior Guano
E. Frank Coe's 16% Superphosphate
E. Frank Coe's Special Grass Top Dressing
E. Frank Coe's Standard Potato Fertilizer

Connecticut Fat Rendering & Fertilizing Corporation, West Haven, Conn.

Tankage

Consolidated Rendering Co., 40 North Market Street, Boston (9), Mass.

Acid Phosphate 16%
Ground Bone (2.50-26)
Ground Bone (3.00-24)
Muriate of Potash
Nitrate of Soda
Sulphate of Ammonia
Sulphate of Potash
Tankage 6-30
Tankage 9-20

Cowles, C. A., Plantsville, Conn.

C. A. Cowles 4-8-4 Fertilizer

Davis, S. P., 207 Southern Trust Building, Little Rock, Arkansas.

Beauty Cottonseed Meal
Goodluck Brand Cottonseed Meal and Cracked Screened Cake
Steerboy Brand Cottonseed Meal and Cracked Screened Cake

Eastern States Farmers' Exchange, 33 Lyman Street, Springfield, Mass.

Acid Phosphate 16%
Castor Pomace
Eastern States 4-8-4
Eastern States 6-3-5
Eastern States 6.25-3-5
Eastern States 7-2-7
Eastern States 3-12-3 No-Filler
Eastern States 5-8-7 No-Filler
Eastern States 5-10-5 No-Filler
Eastern States 7-8-3 No-Filler
Eastern States Dry Ground Fish
Eastern States Fine Bone Meal
Eastern States Sulphate of Potash
Ground Animal Tankage
Muriate of Potash
Nitrate of Soda Reground
Sulphate of Ammonia

Essex Fertilizer Company, 39 North Market Street, Boston, Mass.

Essex Fish Fertilizer for All Crops 3-8-4
Essex 5-8-7 for Potatoes and Vegetables
Essex 4-6-10 for Potatoes and Vegetables
Essex Market Garden for Potatoes, Roots and Vegetables 4-8-4
Essex Potato Phosphate 4-8-7 for Potatoes and Vegetables

Essex Special Tobacco 5-4-5
Essex Tobacco Manure 5-8-6
Essex 2-8-3 for All Crops
Essex 2-8-2 for Farm and Garden

Frisbie Co., L. T., New Haven, Conn.

Castor Pomace
Dry Ground Fish
Frisbie's Bone Meal
Frisbie's Corn and Grain Fertilizer 2-8-2
Frisbie's 5-8-7
Frisbie's Market Garden 4-8-6
Frisbie's Special 4-10-6
Frisbie's Special 3-8-4
Frisbie's Special Vegetable and Potato Grower 4-8-4
Frisbie's Tobacco Grower 5-4-5
Frisbie's Tobacco Manure 5-8-6
Frisbie's Top Dresser 7-5-4

Humphreys-Godwin Co., Inc., Memphis, Tennessee.

Bull Brand Cottonseed Meal
Danish Brand Cottonseed Feed
Dixie Brand Cottonseed Meal

International Agricultural Corporation (Buffalo Fertilizer Works), Boston, Mass.

Buffalo Crop Grower
Buffalo General Favorite
Buffalo High Grade Manure
Buffalo New England Special
Buffalo Phosphate and Potash
Buffalo Sixteen Per cent.
Buffalo Tobacco Producer
Dry Ground Fish
I. A. C. Connecticut Valley Special
International Double Strength 10-8-10

Joynt, John, Lucknow, Ontario, Canada.

The Joynt Brand Canada Unleached Hardwood Ashes

Lovitt & Co., L. B., Memphis, Tennessee.

Lovit Brand Cottonseed Meal 5.75%
Lovit Brand Cottonseed Meal 6.58%
Lovit Brand Cottonseed Meal 6.88%

Lowell Fertilizer Company, 40 North Market St., Boston, Mass.

Lowell Animal Brand, a High Grade Manure for All Crops 3-8-4
Lowell Bone Fertilizer, For Corn, Grain, Grass and Vegetables 2-8-2
Lowell 5-8-7 for Potatoes and Vegetables
Lowell 4-8-4 for Potatoes, Corn and Veg.
Lowell 4-6-10 for Potatoes and Vegetables
Lowell Potato Phosphate for Potatoes and Vegetables 4-8-7
Lowell Tobacco 5-4-5 for Tobacco, Fruits and Vines
Lowell Tobacco Manure 5-8-6
Lowell Top Dressing 7-5-2

Mapes Formula & Peruvian Guano Co., 110 William St., New York, N. Y.

The Mapes Connecticut Valley Special
The Mapes Corn Manure
The Mapes C. S. Tobacco Manure
The Mapes General Tobacco Manure
The Mapes General Truck Manure
The Mapes General Use Manure
The Mapes Grain Brand
The Mapes Onion Manure
The Mapes Potato Manure
The Mapes Tobacco Ash Constituents
The Mapes Tobacco Manure—Wrapper Brand
The Mapes Tobacco Starter Improved
The Mapes Top Dresser

Memphis Cottonseed Products Co., Inc., 1015 Falls Building, Memphis, Tennessee.

Durham Thirty-Six

Mitchell, Walter L., 699 Forest Road, New Haven, Conn.

Mitchell's 5-8-7
Mitchell's Tennessee Phos-Pho-Flour

Natural Guano Company, Aurora, Illinois.

"Sheep's Head" Pulverized Sheep Manure

Neal & Co., Inc., R. N., Memphis, Tennessee.

"Triangle" Brand Prime 36% Protein.
"Triangle" Brand Prime 41% Protein
"Triangle" Brand Prime 43% Protein

New England By-Products Corp., 20 West Street, Lawrence, Mass.

Ground Steamed Bone
Pure Bone Meal

New England Fertilizer Co., 40A North Market Street, Boston, Mass.

Fish
New England Corn Phosphate for Grain and Vegetables 2-8-2
New England 5-8-7 for Potatoes and Market Gardens
New England 4-8-4 for Potatoes, Vegetables and Grass
New England Potato Phosphate 4-8-7 for Potatoes and Vegetables
New England Superphosphate, a High-Grade Fertilizer for all Crops, 3-8-4
New England Tobacco 5-4-5
New England Tobacco Manure 5-8-6
New England 2-8-3 for Vegetables and Grain

Nitrate Agencies Company, Bound Brook, N. J. (104 Pearl St., New York, N. Y.)

Naco Brand 2-8-2
Naco Brand 4-8-4
Naco Brand 4-8-7
Naco Brand 5-8-7
Naco Brand Acid Phosphate
Naco Brand Animal Tankage
Naco Brand Castor Pomace
Naco Brand Fish
Naco Brand Muriate of Potash

Naco Brand Nitrapo
Naco Brand Nitrate of Soda
Naco Brand Peruvian Guano
Naco Brand No. 12 Peruvian Guano Mixture
Naco Brand No. 14 Peruvian Guano Mixture
Naco Brand No. 50 Peruvian Guano Mixture
Naco Brand Equivalent 5-8-7 Genuine Peruvian Guano Mixture
Naco Brand Raw Bone Meal
Naco Brand Steamed Bone Meal
Naco Brand Sulphate of Ammonia
Naco Brand Sulphate of Potash

Olds & Whipple, Inc., Hartford, Conn.

Double Manure Salts
H G Sulphate of Potash
Nitrate of Soda
O & W Acid Phosphate
O & W Blue Label Tobacco Fertilizer
O & W Bone Phosphate and Potash Compound
O & W Castor Pomace
O & W Complete Corn, Potato and Onion Fertilizer
O & W Complete Tobacco Fertilizer
O & W Dry Ground Fish
O & W Fish and Potash
O & W H G Potato Fertilizer
O & W H G Starter and Potash Compound
O & W H G Tobacco Starter
O & W Precipitated Bone
O & W Pure Bone Meal
O & W Spec Comp Corn, Onion and Potato Fertilizer
O & W Top Dressing for Grass
Sulphate of Ammonia

Pacific Manure & Fertilizer Co., 429 Davis St., San Francisco, California.

Groz-It Brand Pulverized Sheep Manure

Parmenter & Polsey Fertilizer Co., 41 North Market St., Boston, Mass.

Parmenter & Polsey 5-8-7 for Potatoes and Market Gardens
Parmenter & Polsey 4-8-4 for Potatoes, Corn and Vegetables
"P & P" Plymouth Rock Brand for all Crops 3-8-4

Platt Co., The Frank S., Inc., 450 State Street, New Haven, Conn.

Platco Special 4-8-6

Potash-Marl, Inc., 15 East 40th Street, New York, N. Y.

Potash-Marl

Premier Poultry Manure Company, 431 So. Dearborn St., Chicago, Ill.

Premier Brand Pulverized Poultry Manure
Premier Brand Pulverized Sheep Manure

Pulverized Manure Company, 828 Exchange Ave., Union Stock Yards, Chicago, Ill.

Wizard Brand Manure
Wizard Brand Sheep Manure

Rogers & Hubbard Company, The, Portland, Conn.

Acid Phosphate
Castor Pomace
Cotton Seed Meal
4-8-4 Fertilizer
Garden Fertilizer
Ground Fish
Hubbard's "Bone Base" Fertilizer for Oats and Top Dressing
Hubbard's "Bone Base" Fertilizer for Seeding Down
Hubbard's "Bone Base" Soluble Corn and General Crops Manure.
Hubbard's "Bone Base" Soluble Potato Manure.
Hubbard's "Bone Base" Soluble Tobacco Manure
Hubbard's Pure Raw Knuckle Bone Flour
Hubbard's Strictly Pure Fine Bone
Nitrate of Soda
Richmond's Special
Rogers & Hubbard's All Soils-All Crops Fertilizer
Rogers & Hubbard's Climax Tobacco Brand.
Rogers & Hubbard's Corn and Grain Fertilizer
Rogers & Hubbard's High Potash Fertilizer
Rogers & Hubbard's Potato Fertilizer
Rogers & Hubbard's Tobacco Grower, Vegetable Formula
Sulphate of Potash

Royster Guano Company, F. S., 1604 Munsey Building, Baltimore, Md.

Dry Ground Fish
Muriate of Potash
Nitrate of Soda
Royster's Bully Guano
Royster's Fine Ground Bone Meal
Royster's Quality Trucker
Royster's 16% Acid Phosphate
Royster's Spearhead Guano
Royster's Top Dresser
Royster's Trucker's Delight
Royster's Valley Tobacco Formula
Royster's Wrapper Brand
Sulphate of Ammonia
Sulphate of Potash

Sanderson Fertilizer & Chemical Co., New Haven, Conn.

Sanderson's Acid Phosphate
Sanderson's Atlantic Coast Bone, Fish and Potash
Sanderson's Castor Pomace
Sanderson's Complete Tobacco Grower
Sanderson's Corn Superphosphate
Sanderson's Dry Ground Fish
Sanderson's Fine Ground Bone
Sanderson's Formula A
Sanderson's Formula B
Sanderson's Kelsey's Bone, Fish and Potash
Sanderson's Nitrate of Soda
Sanderson's Potato Manure
Sanderson's South American Sheep and Goat Manure
Sanderson's Top Dressing for Grass and Grain

Shoemaker & Co., Inc., M. L., Venango St. and Delaware Ave., Philadelphia, Pa.

Nitrate of Soda
Shoemaker's Bone Meal
"Swift-Sure" Bone Meal
"Swift-Sure" Crop Grower
"Swift-Sure" Potato No. 1
"Swift-Sure" Tobacco and General Use
"Swift-Sure" Tobacco Special
"Swift-Sure" Tobacco Starter

South Texas Cotton Oil Co., Victoria County, Texas (Agents, M. B. Jones & Co., Inc., Produce Exchange, New York, N. Y.)

43% Protein Cottonseed Meal

Springfield Rendering Company, Springfield, Mass.

Springfield Animal Brand 3-8-4
Springfield Market Garden Grower and Top Dresser
Springfield Special Potato, Onion and Vegetable 4-8-4
Springfield Tobacco Special, 5-4-5

Standard Agricultural Chemical Corporation, 2 Rector St., New York, N.Y.

Prepared Alphano Humus
Super-Alphano

Virginia-Carolina Chemical Company (of Delaware), Equitable Bldg., 120 Broadway (Room 2249), New York, N. Y.

Genuine Imported Kainit
Muriate of Potash
Nitrate of Soda
Pure Raw Bone
Sulphate of Ammonia
V-C Aroostook Potato Grower
V-C Champion Brand
V-C Double Owl Brand
V-C Fish, Phosphate and Potash Brand
V-C Indian Chief Brand
V-C Marvel Brand
V-C Perfection Brand
V-C Tip-Top Brand
V-C Universal Brand

Vitogro Chemical Co., 38 Middle St., Lowell, Mass.

Vitogro for Flowers, Shrubs and Vegetables
Vitogro for Lawns
Vitogro for Vegetables

Wilcox Fertilizer Company, 56 Main Street, Mystic, Conn.

Wilcox Acid Phosphate
Wilcox Corn Special
Wilcox Dry Ground Fish
Wilcox Fish and Potash
Wilcox 5-8-7 Fertilizer
Wilcox 5-10-5 Fertilizer
Wilcox 4-8-4 Fertilizer
Wilcox Grd. Steamed Bone

Wilcox Muriate of Potash
Wilcox Nitrate of Soda
Wilcox Potato and Vegetable Phosphate
Wilcox Tobacco Special

Woodruff & Sons, S. D., Orange, Conn.
Woodruff's Home Mixed Fertilizer

Worcester Rendering Company, Auburn, Mass.
Prosperity Brand Complete Dressing
Prosperity Brand Corn and Grain
Prosperity Brand Ground Tankage
Prosperity Brand Market Garden
Prosperity Brand Potato and Vegetable Fertilizer

INSPECTION OF 1924.

During the year, Mr. Churchill, the sampling agent of the Station, has visited ninety-six towns and villages in the State and has taken 592 official samples of fertilizers which number includes all the registered brands which were found on sale. These together with samples submitted by purchasers or others interested may be classified as follows:

CLASSIFICATION OF FERTILIZERS ANALYZED.

I. RAW MATERIALS CHIEFLY VALUABLE FOR NITROGEN.

NITRATE OF SODA.

Pure nitrate of soda contains 16.47 per cent of nitrogen. Commercial grades of this salt generally contain from 15 to 16 per cent of nitrogen which is equivalent to from 18.2 to 19.5 ammonia or 91 to 97 per cent nitrate of soda.

Twenty-three samples were examined and the results are given in Table I.

Sample **23039** was considerably under guaranty and a second sample, **23306,** from the same lot was also deficient. Sample **23013** was found to be deficient but a second sample of the same brand taken from a different source was well over the guaranty. Two samples, Nos. **23204** and **23205,** submitted by purchasers, were found to be considerably under the guaranty of 15 per cent nitrogen. The salt was red-brown in color and contained much insoluble matter. The Apothecaries Hall Company, who distributed this chemical, sold in original bags as received by them. They investigated and found that the low grade product constituted but a small part of their entire stock; they were allowed a rebate by the importers from whom they bought and reimbursed their customers accordingly.

Nitrogen from this source has cost from 20.6 to 28.9 cents per pound, the average being about 23.3 cents. Ton prices have ranged from $62.50 to $75.00.

We are uncertain about the guaranties on samples **21899, 21900, 21901** and **21902.** The jobbers claim the goods were guaranteed 15 per cent nitrogen, while the information submitted by the purchasers is that the salt was supposed to analyze 95 per cent nitrate of soda, which is about 15.60 per cent nitrogen. We have no information as to whether any adjustment was made or asked for.

TABLE I. ANALYSES OF NITRATE OF SODA.

Station No.	Manufacturer or Jobber.	Purchased, Sampled or Sent by	Per cent. Nitrogen. Found.	Guaranteed.
22954	Sanderson Fertilizer and Chemical Co., New Haven	Station agent at the factory, New Haven	15.28	15.00
23237	Consolidated Rendering Co., Boston	Station agent. Stock of The L. T. Frisbie Co., New Haven	15.50	15.22
23306	The E. B. Clark Seed Co., Milford	Station agent. Stock of D. L. Clarke & Sons, Milford	13.72	15.00
21900	W. R. Grace Co., New York	American Sumatra Tobacco Co., Bloomfield	15.52	15.60
21899	W. R. Grace Co., New York	" "	15.40	.....
21901	W. R. Grace Co., New York	" "	15.32	.....
21902	W. R. Grace Co., New York	" "	15.24	.....
23141	The L. T. Frisbie Co., New Haven	W. T. Clark, Norwich	15.44	15.00
23067	F. S. Royster Guano Co., Baltimore	Station agent. Stock of W. S. Brown, Trumbull	15.64	15.00
22904	East'n States Farmers' Exchange, Springfield	Station agent. Stock of H. H. McKnight, Ellington	15.22	14.80
23130	Nitrate Agencies Co., Bound Brook, N. J.	Station agent. Stock of Joseph Adams, Westport	14.96	15.00
23197	Wilcox Fertilizer Co., Mystic	Station agent. Stock of M. E. Thompson, Ellington	15.50	15.00
23269	American Agricultural Chemical Co., New York	Station agent. Stock of J. H. Paddock, Wallingford	15.26	15.00
22934	Olds & Whipple, Hartford	Station agent at factory	15.16	15.00
22898	Berkshire Fertilizer Co., Bridgeport	Station agent at factory	15.06	14.80
22899	Apothecaries Hall Co., Waterbury	Station agent. Stock of J. A. Glasnapp, West Cheshire	15.32	14.80
22957	The Rogers & Hubbard Co., Portland.	Station agent at factory	15.16	15.00
23192	Virginia - Carolina Chemical Co., New York	Station agent. Stock of E. O. Chapman, North Haven	15.32	14.80
168	Armour Fertilizer Works, New York	Station agent. Stock of F. L. Wadhams, Torrington	15.72	14.81
23039	E. B. Clark Seed Co., Milford	Station agent. Stock of D. L. Clarke & Sons, Milford	13.26	15.00
23013	Armour Fertilizer Works, New York	Station agent. Stock of F. C. Benjamin, Danbury	14.00	14.81
23205	Apothecaries Hall Co., Waterbury	John H. R. Bishop, Cheshire	12.48	15.00
23204	Apothecaries Hall Co., Waterbury	John H. R. Bishop, Cheshire	12.36	15.00

SULPHATE OF AMMONIA.

Ten samples were examined and the results are given in Table II. Pure ammonium sulphate contains 21.2 per cent of nitrogen, but the commercial grades usually contain about 20.5 per cent, which is equivalent to about 25 per cent of ammonia or about 97 per cent of ammonium sulphate.

As sold in the State this year this salt has contained from 20.2 to 20.9 per cent of nitrogen. Sample **23240** was a second sample drawn as a check on sample **23146**; both were substantially up to the guaranty. Sample **161** was a check on **23011** and exceeded the guaranty, whereas the first sample was slightly low. Sample **23395** showed a shortage of 0.33 per cent nitrogen. This was a small lot and was not resampled.

According to prices quoted, the cost per pound of nitrogen has ranged from 9.8 to 19.3 cents, the average being 16.6 cents; this is $3.32 per unit of nitrogen, or $2.73 per unit of ammonia. Ton prices have ranged from $40.00 to $79.00.

TABLE II. SULPHATE OF AMMONIA.

Station No.	Manufacturer or Jobber.	Purchased, Sampled or Sent by	Per cent Nitrogen. Found.	Per cent Nitrogen. Guaranteed.
23011	Armour Fertilizer Works, New York..	Station agent. Stock of F. A. Bartlett, Stamford.....	20.36	20.56
23265	Virginia - Carolina Chemical Co., New York.....	Station agent. Stock of Rackliffe Bros., New Britain....	20.54	20.56
23153	Nitrate Agencies Co., New York.....	Station agent. Stock of Jos. Humphreys, Danbury.....	20.56	20.56
23146	L. T. Frisbie Co., New Haven.....	Sent by Walter Clark, Norwich.....	20.40	20.50
22922	Barrett Co., New York.....	Station agent. Stock of Berkshire Fertilizer Co., Bridgeport.....	20.86	20.75
22939	Olds & Whipple, Inc., Hartford.....	Station agent at the factory..	20.80	20.58
23040	F. S. Royster Guano Co., Baltimore.....	Station agent. Stock of W. S. Brown, Trumbull.....	20.50	20.56
161	Armour Fertilizer Works, New York..	Station agent. Stock of F. A. Bartlett, Stamford.....	20.60	20.56
23240	Consolidated Rendering Co., Boston....	Station agent. Stock of L. T. Frisbie Co., New Haven...	20.46	20.50
23395	Eastern States Farmers' Exchange, Springfield.....	Station agent. Stock of H. H. McKnight, Ellington.....	20.22	20.55

CASTOR POMACE.

Castor pomace is the residue left after removing the oil from the castor bean. It is actively poisonous to stock and should be stored with due precautions on that account. As a fertilizer it is used chiefly with cottonseed meal in tobacco mixtures. While valuable chiefly for its nitrogen content it contains also about one per cent of potash and two per cent of phosphoric acid.

Fifty-eight samples were analyzed and the results are given in Table III. Fifteen were sampled by the station agent; the remainder were sampled and submitted by purchasers.

Sample **22813** was submitted by the purchaser and was drawn from three bags. The stock was left over from the previous year but when bought was guaranteed to contain 5 per cent of nitrogen. Sample **22951** was sampled by the station agent from six bags of the lot, and samples **22953** and **22960** were taken from each of two bags which were represented in the original purchaser's sample. The two single bag samples show a variation in nitrogen of about 1 per cent. The entire purchase of the previous year cannot be adequately judged, however, by these samples from the left-over stock.

In general, this material has been sold this year under a guaranty of 4.52 per cent nitrogen, which is equivalent to 5.50 per cent of ammonia. In fifty samples where guaranties are known there were forty in which the guaranties were exceeded and ten in which they were not met; but for the total number there was an average overrun of 0.17 per cent of nitrogen.

At the prices quoted to us, confidentially or otherwise, the average cost per ton is $29.76. The average nitrogen content is 4.75 per cent. Disregarding the potash and phosphoric acid contents, nitrogen has cost 31.3 cents per pound, which is $6.26 per unit of nitrogen or $5.13 per unit of ammonia. *If allowance is made for the potash and phosphoric acid present at the rate of four cents per pound each, then the cost per pound of nitrogen is about 28.8 cents.*

TABLE III. ANALYSES OF CASTOR POMACE.

Station No.	Manufacturer or Jobber, Car No. or Mark.	Purchased, Sampled or Sent by	Per cent Nitrogen. Found.	Per cent Nitrogen. Guaranteed.
	The American Agricultural Chemical Co., New York City.			
22926	.....	Station agent from stock of Geo. S. Phelps & Co., Thompsonville.....	4.77	4.53
	Apothecaries Hall Co., Waterbury, Conn.			
22199	7341.....	Hatheway & Steane, Hartford	5.39	....
22200	35014.....	" "	4.86	....
22201	215754.....	" "	4.66	....
22202	63787.....	" "	4.69	....
22664	11260 P. A. R.....	Spencer Bros., Suffield.....	5.19	4.52
22790	32790 H. O.....	" "	4.79	4.52
22793	238188 N. Y. C.....	" "	5.11	4.52
	Baker Castor Oil Co., New York, N. Y.			
21951	75785.....	American Sumatra Tobacco Co., Bloomfield.....	4 46	4 52
21952	81073.....	" "	4.83	4.52
21965	171752.....	" "	4.81	4.52
21966	153850.....	" "	4.87	4.52
21967	253457.....	" "	4.97	4.52
21968	159471.....	" "	4.58	4.52
21985	47750.....	" "	5.12	4.52
21986	96146.....	" "	4.48	4.52
22250	88268.....	" "	4.19	4.52
22294	255465.....	" "	4.57	4.52
22295	93176.....	" "	4.68	4.52
22296	49563.....	" "	4.45	4.52
22297	12105.....	" "	5.28	4.52
22298	84611.....	" "	4.73	4.52
22354	17980.....	" "	4.36	4.52
22355	153676.....	" "	4.00	4.52
22359	96146.....	" "	5.00	4.52
22360	75785.....	" "	4.53	4.52
22369	34670.....	" "	4.78	4.52
22416	86215.....	" "	5.46	4.52
22419	91929.....	" "	5.11	4.52
22436	102234.....	" "	4.62	4.52
22437	98832.....	" "	4.80	4.52
22438	30002.....	" "	4.29	4.52
22439	88268.....	" "	4.70	4.52
22448	7313.....	" "	4.38	4.52
22449	45963.....	" "	4.76	4.52
22450	80744.....	" "	4.84	4.52

TABLE III. ANALYSES OF CASTOR POMACE—*Continued.*

Station No.	Manufacturer or Jobber, Car No. or Mark.	Purchased, Sampled or Sent by	Per cent Nitrogen. Found.	Per cent Nitrogen. Guaranteed.
	Baker Castor Oil Co., New York, N. Y.			
22464	17980.....	American Sumatra Tobacco Co., Bloomfield.....	4.69	4.52
		" "	4.30	4.52
22465	153676.....	" "	4.62	4.52
22472	261920.....		4.82	4.52
22786	156063, R. I.....	John S. Leonard, Burnside...		
23227	.....	Station agent from stock of Olds & Whipple, Hartford.	5.01	4.50
23275	.....	Station agent from stock of F. H. Thrall, Windsor.....	5.02	4.50
	Berkshire Fertilizer Co. Bridgeport, Conn.			
22813	.....	Station agent from stock of Frank Lanati, Windsor Locks.....	3.88[1]	....
22872	.....	Station agent from stock of T. W. Ryan, Stratford.....	4.47	4.50
22951	.....	Station agent from stock of Frank Lanati, Windsor Locks.....	4.26[1]	....
		" "	3.55[1]	....
22952	.....	" "	4.51[1]	....
22953	.....			
22960	.....	Station agent from stock of J. E. Lathrop, Burnside...	4.63	4.50
	E. D. Chittenden Co., Bridgeport, Conn.			
23270	.....	Station agent from stock of E. J. Bantle, Glastonbury	4.28	4.50
	L. T. Frisbie Co., New Haven, Conn.			
163	.....	Station agent from stock of G. O. Case, Burnside.....	4.61	4.52
22962	.....	Station agent from stock of T. J. Coleman, Warehouse Point.....	4.40	4.52
	Nitrate Agencies Co., New York, N. Y.			
23417	Naco.....	Station agent from stock of E. N. Austin, Suffield.....	4.65	4.93
	Olds & Whipple, Hartford, Conn.			
22927	.....	Station agent at factory.....	5.19	4.94

[1] Stock of 1923, omitted from average.

TABLE III. ANALYSES OF CASTOR POMACE—*Concluded.*

Station No.	Manufacturer or Jobber, Car No. or Mark.	Purchased, Sampled or Sent by	Per cent Nitrogen. Found.	Per cent Nitrogen. Guaranteed.
	Olds & Whipple, Hartford, Conn.			
23072	Thum. 48544 M. C. R. R.	H. E. Wells, Windsor Locks	5.16	4.94
23073	Thum. 226956 N.Y.C.	" "	4.90	4.94
23280	.....	L. Wetstone & Sons, Inc., Hartford	5.07	4.52
	The Rogers & Hubbard Co., Portland, Conn.			
22958	.....	Station agent at factory	5.05	5.00
	Sanderson Fertilizer & Chemical Co., New Haven, Conn.			
22988	.....	Station agent at factory	4.71	4.53

COTTONSEED MEAL.

One hundred and thirty-five samples of cottonseed meal have been analyzed and the results are given in Table IV. The grades may be classified as follows:

36 per cent protein containing 5.76 per cent nitrogen equivalent to 7.00 per cent ammonia, 16 samples.

41 per cent protein containing 6.56 per cent nitrogen equivalent to 8.00 per cent ammonia, 82 samples.

43 per cent protein containing 6.88 per cent nitrogen equivalent to 8.30 per cent ammonia, 17 samples.

Four samples have odd guaranties and for 16 samples no guaranties were submitted. There were no samples bearing a guaranty of 38.56 per cent protein (6.17 per cent nitrogen equivalent to 7.50 per cent ammonia).

Of these samples where guaranties are known 82 equaled or exceeded their guaranties and 36 did not. As an average for all samples there was 0.15 per cent of nitrogen in excess of the guaranty.

Reckoning nitrogen at its average cost as deduced from data obtained this year, viz., 39.1 cents per pound, deficiencies in money value in excess of $1.00 per ton were shown in only 15 samples. This is making no allowance for about 3 per cent of phosphoric

acid and 2 per cent of potash which cottonseed meal normally contains and which are fairly valued at 4 cents per pound each.

So far as we have information as to prices, the cost of nitrogen in cottonseed meal has averaged 39.1 cents per pound, and nitrogen has been purchased at somewhat better advantage in the higher grades as appears in the subjoined summary, Table V.

TABLE V. SUMMARY OF DATA ON COTTONSEED MEAL.

GRADE.	Number of Samples.	Average Nitrogen. %	Average Cost per Ton.	Average Cost of Nitrogen, cents per Pound.
36 per cent (5.76 N)	16	5.79	$48.90[1]	42.2
41 per cent (6.58 N)	82	6.76	51.93[2]	38.4
43 per cent (6.88 N)	17	7.02	55.99[3]	39.2
Odd per cent	4	6.00	....	....
No guaranty	16	6.73	50.59[4]	37.6
Total and averages	135	6.66	52.13[5]	39.1

LINSEED MEAL.

Two samples purchased by Hatheway & Steane from Olds & Whipple of Hartford were submitted by the purchasers. Guaranties were not given. The samples, **23174** and **23175**, contained 5.77 and 5.96 per cent of nitrogen respectively, equivalent to 7.02 and 7.25 per cent of ammonia. *The price quoted was $45.50 per ton; thus nitrogen cost about 38.7 cents per pound.*

[1] Based on 12 quotations.
[2] Based on 11 quotations.
[3] Based on 15 quotations.
[4] Based on 11 quotations.
[5] Based on 49 quotations.

TABLE IV. ANALYSES OF COTTONSEED MEAL.

Station No.	Manufacturer or Jobber, Car No. or Mark.	Purchased, Sampled or Sent by	Per cent Nitrogen. Found.	Per cent Nitrogen. Guaranteed.
	Ashcraft-Wilkinson Co., Atlanta, Ga.			
23210	Helmet	Station agent from stock of Meech & Stoddard, Middletown	6.43	6.58
23212	Monarch	" "	6.59	6.88
23211	Paramount	" "	5.71	5.76
201	Paramount, 47866 A. C. L.	The Coles Co., Middletown	6.16	5.76
22531	Paramount, 30277 A. C. L.	" "	5.83	5.76
22561	Paramount, 42996 A. C. L.	" "	5.80	5.76
22777	Paramount, 48488 A. C. L.	" "	5.89	5.76
22666	.....	Clark Bros., Windsor	6.11	6.37
22667	.....	Clark Bros., Windsor	5.94	6.37
	S. P. Davis, Little Rock, Ark.			
157	Beauty	Station agent from stock of A. D. Bridge's Sons, Hazardville	5.86	5.75
153	Steerboy	Station agent from stock of Willimantic Grain Co., Willimantic	7.17	6.88
	Humphreys-Godwin Co., Memphis, Tenn.			
139	Bull. 78627 York	The Coles Co., Middletown	6.78	6.88
149	Bull	Station agent from stock of F. C. Benjamin, Danbury	7.01	6.87
22663	Bull. 75278 N. H.	Spencer Bros., Inc., Suffield	6.96	6.88
22792	Bull 90739 N. H.	Spencer Bros, Inc., Suffield	6.94	6.88
22858	Bull. 31921, Hazardville	L. B. Haas & Co., Inc., Hartford	6.96	6.88
22891	Bull. 23808 M. D.	Hartz Bros., Burnside	6.89	6.88
22910	Bull	Clark Bros., Windsor	6.88	....
23032	Bull	Michael Flemming, Suffield	7.70	6.88
23137	Bull. 93083 N. H.	Spencer Bros. Inc., Suffield	7.71	6.88
23138	Bull. 10650 C. N. E.	Spencer Bros. Inc., Suffield	7.35	6.88
23307	Bull. 35465 M. E. C.	Geo. S. Phelps & Co	7.33	6.88
23326	Bull. 88989 N. H.	Spencer Bros., Inc., Suffield	6.74	6.88
23327	Bull. 11244	" "	6.87	6.88
23328	Bull. 62034 B. & M.	" "	6.71	6.88

TABLE IV. ANALYSES OF COTTONSEED MEAL—*Continued.*

Station No.	Manufacturer or Jobber, Car No. or Mark.	Purchased, Sampled or Sent by	Per cent Nitrogen. Found.	Per cent Nitrogen. Guaranteed.
	Humphreys-Godwin Co., Memphis, Tenn.			
22997	Bull	H. C. Nelson, West Suffield	6.91	6.88
22422	Danish, 21401 N. S.	The Coles Co., Middletown	5.77	5.76
22662	Danish, 29898 A.C.L.	The Coles Co., Middletown	5.49	5.76
22933	Danish	Geo. S. Phelps & Co., Thompsonville	5.95	5.75
23287	Danish, 46812 A.C.L.	Spencer Bros., Inc., Suffield	5.49	5.75
23288	Danish, 67079	" "	5.93	5.75
23289	Danish, 37905 A.C.L.	" "	5.79	5.75
22251	Dixie, 101407 L.& N.	The Coles Co., Middletown	6.38	6.58
22488	Dixie, 31170	American Sumatra Tobacco Co., Bloomfield	6.55	6.58
22497	Dixie, 15794	American Sumatra Tobacco Co., Bloomfield	6.66	6.58
23166	Dixie, 36514	Hatheway & Steane, Hartford	6.69	....
23199	Dixie, 16447	Apothecaries Hall Co., Waterbury	6.15	6.58
23222	Dixie, 81874 N. H.	G. Stephen Potwine, Warehouse Point	6.44	6.58
23276	Dixie, 43621	L. Wetstone & Sons, Inc., Hartford	6.65	6.58
23277	Dixie, 14954	" "	6.63	6.58
23278	Dixie, 91801	" "	6.63	6.58
23279	Dixie, 74337	" "	6.47	6.58
23281	Dixie, 35573	" "	6.65	6.58
23282	Dixie, 36260	" "	6.49	6.58
23164	Dixie, 63253	Hatheway & Steane, Hartford	6.47	....
23165	Dixie, 31048	" "	7.00	....
23167	Dixie, 39544	" "	6.52	....
23168	Dixie, 244814	" "	7.00	....
23169	Dixie, 10447	" "	6.64	....
23170	Dixie, 27292	" "	7.00	....
23171	Dixie, 37185	" "	6.63	....
23172	Dixie, 60718	" "	7.30	....
23173	Dixie, 28511	" "	6.28	....
22911	90083	Clark Bros., Windsor	6.81	....
22299	33861	American Sumatra Tobacco Co., Bloomfield	6.58	6.58
22300	63743	" "	7.34	6.58
22301	31497	" "	7.40	6.58
22302	89420	" "	7.44	6.58
22303	78742	" "	7.42	6.58
22304	93186	" "	7.14	6.58
22305	72820	" "	7.26	6.58
22351	92340	" "	7.36	6.58

TABLE IV. ANALYSES OF COTTONSEED MEAL—*Continued.*

Station No.	Manufacturer or Jobber, Car No. or Mark.	Purchased, Sampled or Sent by	Per cent Nitrogen. Found.	Per cent Nitrogen. Guaranteed.
	Humphreys-Godwin Co., Memphis, Tenn.			
22352	91544	American Sumatra Tobacco Co., Bloomfield	7.38	6.58
22353	20125	" "	7.20	6.58
22363	91906	" "	6.88	6.58
22364	72954	" "	6.70	6.58
22365	90294	" "	7.00	6.58
22366	564320	" "	6.88	6.58
22367	160758	" "	6.76	6.58
22368	76269	" "	6.89	6.58
22370	16028	" "	7.06	6.58
22377	83038	" "	6.59	6.58
22378	87967	" "	6.46	6.58
22379	93694	" "	6.78	6.58
22380	87799	" "	6.47	6.58
22381	76490	" "	7.00	6.58
22382	73020	" "	6.67	6.58
22383	76100	" "	7.18	6.58
22384	88627	" "	6.97	6.58
22385	84866	" "	6.50	6.58
22407	215399	" "	7.04	6.58
22408	31399	" "	6.63	6.58
22409	83078	" "	6.52	6.58
22410	89632	" "	7.10	6.58
22411	92897	" "	6.59	6.58
22412	88599	" "	6.45	6.58
22413	91579	" "	6.41	6.58
22414	540783	" "	7.50	6.58
22415	18125	" "	6.60	6.58
22440	90415	" "	6.57	6.58
22451	81438	" "	6.68	6.58
22452	74828	" "	7.28	6.58
22453	29148	" "	6.81	6.58
22454	47369	" "	7.46	6.58
22455	67508	" "	6.74	6.58
22456	85716	" "	6.82	6.58
22457	33372	" "	6.62	6.58
22458	92847	" "	6.67	6.58
22459	21806	" "	6.74	6.58
22460	56458	" "	6.81	6.58
22461	70995	" "	6.62	6.58
22466	202843	" "	6.51	6.58
22468	88107	" "	6.58	6.58
22469	88691	" "	6.40	6.58
22470	78291	" "	7.00	6.58

TABLE IV. ANALYSES OF COTTONSEED MEAL—*Continued.*

Station No.	Manufacturer or Jobber, Car No. or Mark.	Purchased, Sampled or Sent by	Per cent Nitrogen. Found.	Per cent Nitrogen. Guaranteed.
	Humphreys-Godwin Co., Memphis, Tenn.			
22471	40360	American Sumatra Tobacco Co., Bloomfield	6.75	6.58
22473	200726	" "	6.83	6.58
22474	90716	" "	6.80	6.58
22475	8634	" "	6.61	6.58
22481	64018	" "	6.77	6.58
22482	245905	" "	6.60	6.58
22483	230723	" "	6.57	6.58
22484	220223	" "	6.52	6.58
22490	19330	" "	6.82	6.58
22491	261624	" "	6.60	6.58
22492	102218	" "	6.56	6.58
22493	331174	" "	6.66	6.58
22496	171397	" "	6.48	6.58
22499	115440	" "	6.72	6.58
22500	87372	" "	6.58	6.58
22501	32059	" "	6.90	6.58
22502	72782	" "	6.47	6.58
22503	89230	" "	6.45	6.58
22791	60455 B. & M.	Spencer Bros., Inc., Suffield	6.79	6.88
22630	42378	L. B. Haas & Co., Inc., Hartford	5.94	6.37
	L. B. Lovitt & Co., Memphis, Tenn.			
23213	Thirty-six Brand	Station Agent. Stock of W. L. Thorp, North Haven	5.51	5.75
	Memphis Cottonseed Products Co., Memphis, Tenn.			
23208	Durham	Station agent. Stock of R. G. Davis & Sons, New Haven	6.38	5.75
	R. N. Neal & Co., Inc., Memphis, Tenn.			
151	Triangle	Station agent. Stock of Yantic Grain & Products Co., Norwich	5.60	5.75
23218	Triangle	Station agent. Stock of Geo. E. Ackley Co., New Milford	6.32	6.58

TABLE IV. ANALYSES OF COTTONSEED MEAL—*Concluded.*

Station No.	Manufacturer or Jobber, Car No. or Mark.	Purchased, Sampled or Sent by	Per cent Nitrogen. Found.	Per cent Nitrogen. Guaranteed.
	Olds & Whipple, Hartford, Conn.			
22631	36824.....	L. B. Haas & Co., Inc., Hartford.....	5.99	6.37
22804	61141, B. & M.....	Huntington Bros., Windsor..	7.05	....
22806	22019.....	" "	7.07	....
22807	80886.....	" "	6.53	....
22805	39250.....	" "	6.09	....
	The Rogers & Hubbard Co., Middletown, Conn.			
148	.....	Station agent from factory...	5.82	5.75

II. RAW MATERIALS CHIEFLY VALUABLE FOR PHOSPHORIC ACID.

RAW ROCK PHOSPHATE.

Only one sample was analyzed.

10. Phos-Pho-Flour. Sold by W. L. Mitchell, New Haven, and sampled by the Station agent from stock of H. O. Daniels, Middletown.

It was guaranteed to contain 28 per cent of total phosphoric acid and 30.95 per cent was found.

PRECIPITATED BONE PHOSPHATE.

The bone phosphate of commerce is obtained as a by-product in the manufacture of gelatin and consists largely of dicalcium phosphate. The phosphoric acid in this material is practically all "available."

Four samples were analyzed, all of which exceeded their guaranties. *At the price quoted, available phosphoric acid has cost 6.3 cents per pound. The ton price was $50.00.*

Analyses are given in Table VI.

DISSOLVED ROCK PHOSPHATE OR ACID PHOSPHATE.

This material is the product made by treating raw rock phosphate with sulphuric acid whereby the phosphorus is largely converted into "available" forms. In acid phosphates most of the available phosphoric acid is soluble in water.

The prevailing guaranty is 16 per cent of "available" phosphoric acid, and this amount was exceeded in all of the twenty samples examined.

As regards "available" phosphoric acid this material has varied in composition within the limits of about 50 pounds per ton. The price, however, has ranged from $14.00 to $30,00 and the cost per pound of available phosphoric acid has accordingly varied from 4.2 to 9.2 cents. *On the average, acid phosphate this year has contained 16.73 per cent of available phosphoric acid, which at the average price ($21.11) per ton has made the cost of this constituent 6.3 cents per pound, or $1.26 per unit.*

Analyses are given in Table VII.

TABLE VI. ANALYSES OF PRECIPITATED BONE PHOSPHATE.

Station No.	Manufacturer or Wholesale Dealer.	Place of Sampling.	Phosphoric Acid.			
			Citrate-insoluble.	Total.	"Available".	
					Found.	Guaranteed.
	Sampled by Station:		%	%	%	%
23016	Apothecaries Hall Co., Waterbury	At Factory, East Windsor.	0.91	41.20	40.29	36.00
22918	Berkshire Fertilizer Co., Bridgeport	At Factory	0.37	41.04	40.67	38.00
22928	Olds & Whipple, Inc., Hartford	At Factory	0.50	40.42	39.92	38.00
	Sampled by Purchaser:					
22463	Olds & Whipple, Inc., Hartford	American Sumatra Tobacco, Co., Bloomfield	0.25	38.44	38.19	.....

TABLE VII. ANALYSES OF ACID PHOSPHATE.

Station No.	Manufacturer or Wholesale Dealer.	Dealer or Purchaser.	Phosphoric Acid.				Station No.
			Citrate-insoluble.	Total.	"Available"		
					Found.	Guaranteed.	
	Sampled by Station:		%	%	%	%	
23064	American Agricultural Chemical Co., New York	C. F. Allen, Warehouse Point	0.15	16.83	16.68	16.00	23064
23184	Apothecaries Hall Co., Waterbury	Sampled at Factory	1.38	17.68	16.30	16.00	23184
23007	Armour Fertilizer Works, New York	Robert Greenbacker, Meriden	0.53	16.69	16.06	16.00	23007
22870	Berkshire Fertilizer Co., Bridgeport	T. W. Ryan, Stratford	0.20	17.49	17.29	16.00	22870
23228	Bowker Fertilizer Co., New York	Geo. E. Ackley Co., New Milford	0.15	16.40	16.25	16.00	23228
23271	E. D. Chittenden Co., Bridgeport	J. E. Stoddard, Abington	0.53	16.73	16.20	16.00	23271
23133	Coe-Mortimer Co., New York	J. B. McArdle, Greenwich	0.15	16.48	16.33	16.00	23133
23239	Consolidated Rendering Co., Boston	L. T. Frisbie, New Haven	0.15	17.58	17.43	16.00	23239
99	Eastern States Farmers' Exchange, Springfield	H. H. McKnight, Ellington	0.49	16.52	16.03	16.00	22902
23131	International Agricultural Corporation, Boston	Alva Taylor, West Suffield	0.78	17.80	17.02	16.00	99
22936	Nitrate Agencies Co., Bound Brook, N. J.	Joseph Adams, Westport	0.28	16.43	16.15	16.00	23131
22956	Olds & Whipple, Inc., Hartford	Sampled at Factory	0.72	17.63	16.91	16.00	22936
23019	The Rogers & Hubbard Co., Portland	Sampled at Factory	0.12	18.66	18.54	16.00	22956
23068	The Rogers & Hubbard Co., Portland	The Lyman Farm, Middlefield	0.41	17.21	16.80	16.00	23019
22985	F. S. Royster Guano Co., Baltimore	W. S. Brown, Trumbull	1.63	17.76	16.13	16.00	23068
23194	Sanderson Fertilizer & Chemical Co., New Haven	Sampled at Factory	0.08	16.73	16.65	16.00	22985
23196	Virginia-Carolina Chemical Co., New York	E. O. Chapman, North Haven	1.28	18.23	16.95	16.00	23194
	Wilcox Fertilizer Co., Mystic	W. E. Thompson, Ellington	0.20	18.05	17.85	17.00	23196
	Sampled by Purchaser:						
22230	E. D. Chittenden Co., Bridgeport	A. B. Lapsly, Pomfret Center	0.74	17.46	16.72	16.00	22230
23139	The L. T. Frisbie Co., New Haven	W. T. Clark, Norwich	1.68	17.88	16.20	16.00	23139

III. RAW MATERIALS CONTAINING POTASH.

CARBONATE OF POTASH.

Pure carbonate of potash contains 68.2 per cent of actual potash (K_2O), but commercial grades usually contain from 60 to 65 per cent. Most of the samples submitted were guaranteed to contain 96 per cent carbonate of potash which is equivalent to 65.44 per cent actual potash.

Thirteen samples were analyzed, all but one being submitted by purchasers. Two samples, Nos. **22494** and **22495,** failed to meet their guaranties by 3.01 and 2.18 per cent respectively; these samples were from the same stock as two previous samples viz., **22358** and **22356,** both of which more nearly approached the guaranty.

Analyses are given in Table VIII.

MURIATE OF POTASH.

The usual commercial grade of this salt is about 80 per cent pure containing about 50.5 per cent actual potash. Because it readily absorbs moisture, guaranties are often placed somewhat lower, viz., 48 to 50 per cent. The prevailing guaranty for samples examined this year was 50 per cent.

Thirteen samples were analyzed, four of which contained considerably less than 48 per cent. Sample **22871** was from three bags which represented the remainder of a four-ton lot. The analysis may not, therefore, be representative of the whole shipment.

Nos. **23140** and **23324** were purchaser's samples from the same lot. The goods were sold by the L. T. Frisbie Company and obtained by them from the Consolidated Rendering Company of Boston. These two samples were considerably below the guaranty of 50 per cent; an official sample, **23242,** taken by the Station agent at the plant of the Frisbie Company exceeded the guaranty by nearly 1.5 per cent.

The average for all samples is close to 50 per cent (49.92), of potash which, at the average of prices quoted, $44.40, makes the cost of potash in this material 4.5 cents per pound or 90 cents per unit. The lowest cost noted is 3.8 cents, and the highest is 5 cents per pound.

Analyses are given in Table VIII.

HIGH GRADE SULPHATE OF POTASH.

The commercial grades of this salt generally contain about 48.0 per cent of potash which is approximately 90 per cent sulphate of potash.

Twenty-six samples were examined of which ten were drawn by the Station agent and the remainder by purchasers. The official samples substantially met or exceeded their guaranties. Several samples, submitted by purchasers, while of fair average quality did not meet the guaranties quoted for them which were over 50 per cent. Two, **22350** and **22535,** were considerably under 48 per cent.

The average potash content was 49.1 per cent and the cost per pound, based upon the few prices quoted, averaged 5.5 cents.

Seven samples, representing early season purchases of the American Sumatra Tobacco Co., were submitted by the purchasers. The samples purported to be high grade sulphate but, on analysis, only one conformed to that grade, the others containing from 30 to 40 per cent of potash with considerable and varying amounts of chlorine and magnesia. Investigation by the Station agent showed that this shipment was received in the original import sacks distinguished only by serial numbers; and that there were two grades in the lot, one in bags marked 419 and the other in bags marked 482 and 600. The low grade stock was included in the shipment by mistake and replacement was made.

Analyses are given in Table VIII.

TABLE VIII. ANALYSES OF POTASH SALTS.

Station No.	Manufacturer or Wholesale Dealer.	Dealer or Purchaser.	Potash. Found.	Potash. Guaranteed.	Station No.
	Carbonate of Potash.		%	%	
	Sampled by Station:				
23234	Apothecaries Hall Co., Waterbury	Sampled at Factory	65.86	62.00	23234
	Sampled by Purchaser:				
22417		American Sumatra Tobacco Co., Bloomfield	66.56	.....	22417
22418		" "	61.44	.....	22418
22214	A. Klipstein, New York City	" "	66.28	65.44	22214
22215	" "	" "	66.68	65.44	22215
22248	" "	" "	65.72	65.44	22248
22249	" "	" "	66.32	65.44	22249
22306	" "	" "	64.96	65.44	22306
22356	" "	" "	65.16	65.44	22356
22357	" "	" "	65.52	65.44	22357
22358	" "	" "	64.88	65.44	22358
22494	" "	" "	62.43	65.44	22494
22495	" "	" "	63.26	65.44	22495
	Muriate of Potash.				
	Sampled by Station:				
22923	Apothecaries Hall Co., Waterbury	J. A. Glasnapp, West Cheshire	55.90	50.00	22923
23012	Armour Fertilizer Works, New York	F. A. Bartlett, Stamford	52.08	48.00	23012

TABLE VIII. ANALYSES OF POTASH SALTS—*Continued.*

Station No.	Manufacturer or Wholesale Dealer.	Dealer or Purchaser.	Potash. Found.	Potash. Guaranteed.	Station No.
	Muriate of Potash—*Continued.*		%	%	
	Sampled by Station:				
22871	Berkshire Fertilizer Co., Bridgeport	T. W. Ryan, Stratford	49.12	50.00	22871
23242	Consolidated Rendering Co., Boston, Mass.	The L. T. Frisbie Co., New Haven	51.45	50.00	23242
164	Eastern States Farmers' Exchange, Springfield, Mass.	H. H. McKnight, Ellington	49.47	50.00	164
305	" "	" "	44.89	50.00	305
22905	" "	" "	46.83	50.00	22905
190	Nitrate Agencies Co., Bound Brook, N. J.	E. N. Austin, Suffield	49.62	50.00	190
23151	Nitrate Agencies Co., Bound Brook, N. J.	H. P. Beers, Greens Farms	51.25	50.00	23151
23297	Wilcox Fertilizer Co., Mystic	Sampled at Factory	55.59	50.00	23297
	Sampled by Purchaser:				
23365	American Agricultural Chemical Co., New York	R. E. Upson, Marion	50.62	48.00	23365
23140	The L. T. Frisbie Co., New Haven	W. T. Clark, Norwich	46.86	50.00	23140
23324	The L. T. Frisbie Co., New Haven	W. T. Clark, Norwich	45.26	50.00	23324
	Sulphate of Potash.				
	Sampled by Station:				
22263	S. P. 419	American Sumatra Tobacco Co., Bloomfield	50.36	.....	22263
22925	American Agricultural Chemical Co., New York	Geo. S. Phelps & Co., Thompsonville	49.47	48.00	22925

TABLE VIII. ANALYSES OF POTASH SALTS—*Continued.*

Station No.	Manufacturer or Wholesale Dealer.	Dealer or Purchaser.	Potash. Found.	Potash. Guaranteed.	Station No.
	Sulphate of Potash—*Continued.*		%	%	
	Sampled by Station:				
6	Apothecaries Hall Co., Waterbury	Sampled at Factory	47.44	48.00	6
23018	Apothecaries Hall Co., Waterbury	" "	47.76	48.00	23018
22919	Berkshire Fertilizer Co., Bridgeport	" "	50.15	48.00	22919
23241	Consolidated Rendering Co., Boston, Mass.	The L. T. Frisbie Co., New Haven	49.47	48.00	23241
189	Nitrate Agencies Co., Bound Brook, N. J.	E. N. Austin, Suffield	50.20	48.00	189
23158	Nitrate Agencies Co., Bound Brook, N. J.	H. P. Beers, Greens Farms	49.50	48.00	23158
22938	Olds & Whipple, Inc., Hartford	Sampled at Factory	50.24	48.65	22938
23431	The Rogers & Hubbard Co., Portland	Sampled at Factory	49.61	48.00	23431
	Sampled by Purchaser:				
22420	..... S. P. 500	American Sumatra Tobacco Co., Bloomfield	50.88	.....	22420
22563	30567 S. P. 484	" "	49.69	51.29	22563
22564	26174 S. P. 338	" "	48.77	50.64 [1]	22564
22565	30567 S. P. 218	" "	51.00	52.48 [2]	22565
22566	30567 S. P. 354	" "	48.60	.....	22566
22567	36081 S. P. 498	" "	48.20	.....	22567
22568	36081 S. P. 494	" "	49.56	.....	22568

[1] Guaranteed 93.6 per cent sulphate of potash.
[2] Guaranteed 97.01 per cent sulphate of potash.

TABLE VIII. ANALYSES OF POTASH SALTS—*Concluded.*

Station No.	Manufacturer or Wholesale Dealer.	Dealer or Purchaser.	Potash. Found.	Potash. Guaranteed.	Station No.
	Sulphate of Potash—*Concluded.*		%	%	
	Sampled by Purchaser:				
22583	8812 S. P. 218	American Sumatra Tobacco Co., Bloomfield	51.36	52.48 [3]	22583
22584	8812 S. P. 338	" "	47.68	50.64 [4]	22584
22585	8812 S. P. 484	" "	50.32	51.29 [5]	22585
22586	8812 S. P. 354	" "	49.24	.....	22586
22587	8812 S. P. 492	" "	49.16	.....	22587
22588	8812 S. P. 498	" "	48.44	.....	22588
22589	8812 S. P. 355	" "	49.76	.....	22589
22350	Olds & Whipple, Inc., Hartford	Huntington Bros., Windsor	46.44	48.65	22350
22535	Olds & Whipple, Inc., Hartford	Clark Bros., Windsor	43.32	48.65	22535

[3] Guaranteed 97.01 per cent sulphate of potash.
[4] Guaranteed 93.6 per cent sulphate of potash.
[5] Guaranteed 94.8 per cent sulphate of potash.

DOUBLE SULPHATE OF POTASH AND MAGNESIA OR "DOUBLE MANURE SALTS".

Six samples were analyzed this year and the results are given in Table IX.

This salt contains potash and magnesia combined as sulphate and is relatively free from chlorine, which makes it well adapted for use in tobacco fertilizers. It generally contains from 25 to 28 per cent of potash and from 8 to 12 per cent of magnesia. In the last three years, however, seven out of twenty-one samples examined by us have shown amounts of magnesia less than 8 per cent, these ranging from 6.6 down to as low as 3 per cent. In only four of the total number has chlorine exceeded 4 per cent and in none has it reached 5 per cent.

The average potash content in samples analyzed this year is 27.67 per cent and the average cost per pound of potash, at the prices quoted, is 5.1 cents.

TABLE IX. ANALYSES OF DOUBLE MANURE SALTS.

Station No.	Manufacturer or Wholesale Dealer.	Dealer or Purchaser.	Potash.		Magnesia.	Chlorine.	Station No.
			Found.	Guaranteed.			
	Sampled by Station:		%	%	%	%	
22931	American Agricultural Co., New York..	Spencer Bros., Suffield.....	27.97	26.00	11.51	1.81	22931
23215	Apothecaries Hall Co., Waterbury.....	Station agent at factory.....	28.98	26.00	2.97	1.05	23215
22920	Berkshire Fertilizer Co., Bridgeport....	"	26.18	26.00	6.62	2.48	22920
22935	Olds & Whipple, Inc., Hartford.....	"	27.60	26.00	11.46	1.97	22935
	Sampled by Purchaser:						
22682	Olds & Whipple, Inc., Hartford.....	L. B. Haas & Co., Hartford..	26.52	.....	4.34	0.47	22682
22949	Olds & Whipple, Inc., Hartford.....	L. B. Haas & Co., Hartford..	28.75	26.00	.....	.....	22949

IV. RAW MATERIALS CONTAINING NITROGEN AND POTASH.

One sample of nitrate of potash and three of nitrate of soda and potash have been analyzed, all sampled by the Station agent.

23020. Nitrate of potash from Calcutta, India. Stock of the Lyman Farm, Middlefield.

22924 Nitrate of Soda and Potash. Sold by Apothecaries Hall, sampled from stock of J. A. Glasnapp, West Cheshire.

23416. Nitrapo. Sold by Nitrate Agencies Co., sampled from stock of F. H. Thrall, Windsor.

191. Nitrapo. Sold by Nitrate Agencies Co., sampled from stock of E. N. Austin, Suffield.

Analyses are given in Table X.

TABLE X. ANALYSES OF NITRATE OF POTASH, ETC.

Station No.	23020	22924	23416	191
Nitrogen:				
found	12.60	15.46	14.30	11.78
guaranteed	.....	14.80	14.80	14.80
Equivalent ammonia:				
found	15.32	18.80	17.39	14.32
guaranteed	.....	18.00	18.00	18.00
Potash:				
found	43.45	14.11	17.15	12.41
guaranteed	.....	12.00	15.00	15.00

The price quoted in case of sample **22924** was $75.00 per ton. *Allowing 5 cents per pound for potash the cost of nitrogen was 19.6 cents, which is a little less than the minimum cost calculated for nitrate of soda this year.*

V. RAW MATERIALS CONTAINING NITROGEN AND PHOSPHORIC ACID.

DRY GROUND FISH.

Forty samples were analyzed and the results are given in Table XI.

The prevailing guaranty for nitrogen was 8.23 per cent, equivalent to 10 per cent of ammonia. The guaranties for phosphoric acid varied from 4 to 9 per cent.

The average nitrogen content found was 8.45 per cent, equivalent to 10.27 per cent of ammonia, and the average for phosphoric acid was 7.37 per cent.

Based upon the average cost per ton as quoted, and allowing 5 cents per pound for phosphoric acid, nitrogen in this material has cost about 37.9 cents per pound. There were considerable overruns in phosphoric acid in most cases, assuming an average where no guaranty was given. Taking these into account, there were no deficiencies in nitrogen which exceeded $1.00 per ton except in **23418** where the estimated shortage was $1.14.

TANKAGE.

Tankage is prepared from animal refuse secured from slaughter houses and meat markets and may contain considerable and varying amounts of bone. The distinction between meat tankage and bone tankage is not sharply drawn but, in general, tankage with 5 per cent or less of nitrogen and 15 per cent or more of phosphoric acid shows considerable bone and is often sold as bone and meat tankage. As the nitrogen content increases, phosphoric acid becomes less, and in tankage containing over 5 per cent of nitrogen there is generally less than 15 per cent of phosphoric acid, indicating a preponderance of meat. According to definitions established for tankage to be used for feeding purposes, phosphoric acid in excess of 10 per cent is regarded as bone and meat tankage.

Fineness is an important factor in determining the utilization of tankage by crops, particularly in those products containing the higher amounts of bone.

Eighteen samples have been analyzed and analyses are given in Table XII.

Sample **171** was drawn to check the results obtained on **23142.** Sample **23021** was sold direct to the user and was reinforced with bone phosphate at the direction of the purchaser.

On the basis of the classification suggested above there are six samples in which the nitrogen is less than 5 per cent and the phosphoric acid more than 15 per cent; in the remaining twelve the reverse is true, i. e., nitrogen is more than 5 per cent and phosphoric acid is less than 15 per cent. In the first group the average nitrogen is 4.14 per cent and the average phosphoric acid is 19.86 per cent, which approaches the composition of bone. The average of quoted prices is $34.79.

In the second group the averages for nitrogen and phosphoric acid are 6.62 and 10.35 per cent respectively, and the average price quoted is $46.99.

GROUND BONE.

Twenty-six samples were analyzed and results are given in Table XIII.

The guaranties for nitrogen and phosphoric acid were met in almost all cases, generally with a considerable overage. Two samples which were deficient in phosphoric acid, **23129** and **43,** contained excesses of nitrogen which more than balanced the deficiencies.

In fifteen samples 50 per cent or more of the material was finer than 1/50th of an inch, and in five, 60 per cent or more was of that degree of fineness.

Prices quoted ranged from $36.50 to $66.00, the average being $49.72. The averages for nitrogen and phosphoric acid were 3.42 and 24.16 per cent respectively. *Allowing 27 cents per pound for nitrogen, phosphoric acid from this source has cost 6.5 cents per pound.*

TABLE XI. ANALYSES OF

Station No.	Manufacturer or Wholesale Dealer.	Dealer or Purchaser.
	Sampled by Station:	
23062	American Agricultural Chemical Co., New York	Geo. S. Phelps & Co., Thompsonville
23259	American Agricultural Chemical Co., New York	J. P. Norton, Broad Brook
23017	Apothecaries Hall Co., Waterbury	Sampled at factory, East Windsor
22921	Berkshire Fertilizer Co., Bridgeport	Sampled at factory
22961	Berkshire Fertilizer Co., Bridgeport	J. E. Lathrop, Burnside
23294	E. D. Chittenden Co., Bridgeport	E. J. Bantle, Glastonbury
155	Eastern States Farmers' Exchange, Springfield	H. H. McKnight, Ellington
22963	L. T. Frisbie Co., New Haven	T. J. Coleman, Warehouse Point
23262	L. T. Frisbie Co., New Haven	Sampled at factory
138	International Agricultural Corp., Boston	Chas. Maag, Manchester
23418	Nitrate Agencies Co., New York	E. N. Austin, Suffield
40	Olds & Whipple, Inc., Hartford	Sampled at factory
23426	The Rogers & Hubbard Co., Portland	" "
22987	Sanderson Fertilizer & Chemical Co., New Haven	" "
23187	Wilcox Fertilizer Co., Mystic	F. S. Bidwell & Co., Windsor Locks
	Sampled by Purchaser:	
21890	Berkshire Fertilizer Co., Bridgeport	American Sumatra Tobacco Co., Bloomfield
21891	" "	" "
21892	" "	" "
21893	" "	" "
21896	" "	" "
21897	" "	" "
21898	" "	" "
21923	" "	Hatheway & Steane, Hartford
21924	" "	Hatheway & Steane, Hartford
21987	" "	American Sumatra Tobacco Co., Bloomfield
21988	" "	" "
21989	" "	" "
21990	" "	" "
21991	" "	" "
22198	" "	Hatheway & Steane, Hartford

DRY GROUND FISH.

Nitrogen.				Ammonia equivalent to total nitrogen.	Phosphoric Acid.		Station No.
As ammonia.	As organic.	Total found.	Total guaranteed.		Total found.	Total guaranteed.	
%	%	%	%	%	%	%	
1.29	6.51	7.80	8.23	9.48	9.73	6.00	23062
0.27	8.01	8.28	8.23	10.07	9.20	6.00	23259
1.03	8.02	9.05	8.20	11.00	7.06	5.50	23017
....	.....	8.21	8.22	9.98	7.88	6.00	22921
0.19	7.98	8.17	8.22	9.93	7.93	6.00	22961
0.23	9.05	9.28	8.22	11.28	7.70	4.00	23294
0.83	7.43	8.26	8.23	10.04	5.70	.....	155
0.32	7.68	8.00	8.22	9.73	8.79	6.40	22963
0.39	7.89	8.28	8.22	10.07	7.93	6.40	23262
0.19	6.49	6.68	6.58	8.12	7.03	7.00	138
0.59	8.25	8.84	9.04	10.75	5.25	5.03	23418
0.07	9.35	9.42	8.23	11.45	7.80	5.00	40
0.05	9.68	9.73	9.50	11.83	6.95	.....	23426
0.23	8.30	8.53	8.23	10.37	9.42	6.00	22987
0.88	7.99	8.87	9.04	10.78	7.30	6.00	23187
0.15	7.92	8.07	8.23	9.81	7.50	.....	21890
0.07	8.31	8.38	8.23	10.19	7.46	.....	21891
0.07	8.47	8.54	8.23	10.38	7.54	.....	21892
0.13	8.21	8.34	8.23	10.14	7.61	.....	21893
0.14	8.16	8.30	8.23	10.09	7.69	....	21896
0.08	8.34	8.42	8.23	10.24	7.37	....	21897
0.11	8.29	8.40	8.23	10.21	7.46	....	21898
0.11	8.82	8.93	8.23	10.86	7.80	6.00	21923
0.12	8.61	8.73	8.23	10.61	7.77	6.00	21924
....	....	8.31	8.23	10.10	....	....	21987
0.15	8.61	8.76	8.23	10.65	7.22	....	21988
0.11	8.73	8.84	8.23	10.75	6.83	....	21989
0.12	8.37	8.49	8.23	10.32	7.02	....	21990
0.12	8.14	8.26	8.23	10.04	7.60	....	21991
0.13	8.48	8.61	8.23	10.47	7.83	....	22198

TABLE XI. ANALYSES OF

Station No.	Manufacturer or Wholesale Dealer.	Dealer or Purchaser.
	Sampled by Purchaser:	
22212	Berkshire Fertilizer Co., Bridgeport	American Sumatra Tobacco Co., Bloomfield
22213	" "	" "
22386	" "	" "
22387	" "	" "
22388	" "	" "
22389	" "	" "
22390	" "	" "
22441	" "	" "
22462	" "	" "
22722	New England Fertilizer Co., Boston	W. E. Fiske, Warehouse Point

DRY GROUND FISH—*Concluded.*

Nitrogen.				Ammonia equivalent to total nitrogen.	Phosphoric Acid.		Station No.
As ammonia.	As organic.	Total found.	Total guaranteed.		Total found.	Total guaranteed.	
%	%	%	%	%	%	%	
0.10	8.62	8.72	8.23	10.60	7.51	....	22212
0.13	8.52	8.65	8.23	10.52	6.84	....	22213
0.14	8.13	8.27	8.23	10.05	6.74	....	22386
0.08	7.97	8.05	8.23	9.79	6.79	....	22387
0.13	8.11	8.24	8.23	10.02	6.77	....	22388
0.12	7.93	8.05	8.23	9.79	6.49	....	22389
0.14	8.05	8.19	8.23	9.96	6.56	....	22390
0.20	8.36	8.56	8.23	10.41	7.89	....	22441
0.16	8.69	8.85	8.23	10.76	7.25	....	22462
0.08	7.63	7.71	....	9.37	4.29	....	22722

TABLE XII. ANALYSES OF TANKAGE.

Station No.	Manufacturer.	Dealer or Purchaser.	Nitrogen. As ammonia.	Nitrogen. As organic.	Nitrogen. Total found.	Nitrogen. Total guaranteed.	Ammonia equivalent to total nitrogen.	Phosphoric Acid. Found.	Phosphoric Acid. Guaranteed.	Mechanical Analysis. Finer than 1-50 inch.	Mechanical Analysis. Coarser than 1-50 inch.	Station No.
	Sampled by Station:		%	%	%	%	%	%	%	%	%	
23009	Apothecaries Hall Co., Waterbury	Knowles-Lombard, Guilford	0.25	8.14	8.39	7.40	10.20	9.04	9.00	47.0	53.0	23009
23015	" "	Station agent at factory, East Windsor	0.34	8.21	8.55	7.81	10.40	4.21	3.00	55.5	44.5	23015
23185	" "	H. F. Joy, Woodstock	0.13	4.66	4.79	5.75	5.82	18.75	5.00	52.0	48.0	23185
22869	Berkshire Fertilizer Co., Bridgeport	T. W. Ryan, Stratford	....	....	7.23	7.40	8.79	10.84	6.86	52.0	48.0	22869
22897	The Connecticut Fat Rendering and Fertilizing Corp., New Haven	Station agent at factory	....	....	3.83	3.29	4.66	19.85	22.28	43.0	57.0	22897
171	The Consolidated Rendering Co., Boston, Mass	M. E. Cook, Wallingford	0.22	4.92	5.14	4.92	6.25	13.93	14.00	23.0	77.0	171
23236	" "	L. T. Frisbie Co., New Haven	0.19	6.93	7.12	7.41	8.66	10.08	9.15	27.0	73.0	23236
23238	" "	L. T. Frisbie Co., New Haven	0.25	5.16	5.41	4.92	6.58	12.61	14.00	26.0	74.0	23238
341	" "	Chas. E. Lyman Est., Middlefield	0.22	....	4.82	....	5.86	16.25	.....	24.0	76.0	341
22906	Eastern States Farmers' Exchange, Springfield	H. H. McKnight, Ellington	....	....	5.28	5.75	6.42	14.89	6.85	36.0	64.0	22906
23021	The Consolidated Rendering Co., Boston, Mass	The Lyman Farm, Middlefield	0.17	4.46	4.63	....	5.63	15.86	.....	35.5	64.5	23021
23150	Nitrate Agencies Co., Bound Brook, N. J	H. P. Beers, Greens Farms	0.11	7.04	7.15	5.75	8.69	4.06	6.86	59.0	41.0	23150
23474	Worcester Rendering Co., Auburn, Mass	Dayville Coal & Grain Co., Danielson	0.20	5.93	6.13	5.74	7.45	13.70	10.00	34.0	66.0	23474

TABLE XII. ANALYSES OF TANKAGE—*Concluded.*

Station No.	Manufacturer.	Dealer or Purchaser.	Nitrogen. As ammonia.	Nitrogen. As organic.	Nitrogen. Total found.	Nitrogen. Total guaranteed.	Ammonia equivalent to total nitrogen.	Phosphoric Acid. Found.	Phosphoric Acid. Guaranteed.	Mechanical Analysis. Finer than 1-50 inch.	Mechanical Analysis. Coarser than 1-50 inch.	Station No.
	Sampled by Purchaser.		%	%	%	%	%	%	%	%	%	
23325	The Consolidated Rendering Co., Boston, Mass	Walter T. Clark, Norwich	0.26	5.43	5.69	4.92	6.92	11.68	14.00	26.0	74.0	23325
23142	The L. T. Frisbie Co., New Haven	Walter T. Clark, Norwich	0.27	5.60	5.87	4.92	7.14	11.69	14.00	26.0	74.0	23142
23347	Lederle's Laboratory, Pearl River, N. Y	O. G. Beard, Shelton	0.45	7.00	7.45	....	9.06	7.48	.....	8.0	92.0	23347
23078	.....	Nathan Lerner, North Westchester	....	....	3.23	....	3.93	23.80	.....	36.0	64.0	23078
23079	.....	Nathan Lerner, North Westchester	....	....	3.51	....	4.27	24.65	.....	53.0	47.0	23079

TABLE XIII. ANALYSES OF

Station No.	Manufacturer.	Dealer or Purchaser.
	Sampled by Station:	
23065	American Agricultural Chemical Co., New York	W. C. Mansfield, North Haven.
23010	Apothecaries Hall Co., Waterbury	Knowles-Lombard Co., Guilford
23224	Armour Fertilizer Works, New York	Collins & Freeman, Branford. .
23129	Berkshire Fertilizer Co., Bridgeport	C. Buckingham & Co., Southport
23298	The E. D. Chittenden Co., Bridgeport	J. E. Stoddard, Abington
22932	Consolidated Rendering Co., Boston	Geo. S. Phelps & Co., Thompsonville
23247	Consolidated Rendering Co., Boston	John O. Fox & Co., Putnam
22903	Eastern States Farmers' Exchange, Springfield	H. H. McKnight, Ellington
22917	L. T. Frisbie Co., New Haven	Lightbourn & Pond Co., New Haven
166	New England By-Products Corp., Lawrence, Mass.	C. A. Cowles, Plantsville
167	New England By-Products Corp., Lawrence, Mass.	F. L. Wadhams & Sons, Torrington
23152	Nitrate Agencies Co., Bound Brook, N. J.	H. P. Beers, Greens Farms
22940	Olds & Whipple Co., Inc., Hartford	Station agent at factory
22930	The Rogers & Hubbard Co., Portland	Cadwell & Jones, Hartford
23432	The Rogers & Hubbard Co., Portland	Station agent at factory
22929	F. S. Royster Guano Co., Baltimore	F. B. Newton Estate, Plainville
23448	Sanderson Fertilizer & Chemical Co., New Haven	F. Hallock & Co., Derby
22937	M. L. Shoemaker & Co., Philadelphia	Olds & Whipple, Inc., Hartford.
23461	M. L. Shoemaker & Co., Philadelphia	Spencer Bros., Suffield
23191	Virginia-Carolina Chemical Co., New York	E. O. Chapman, North Haven. .
160	Wilcox Fertilizer Co., Mystic. .	M. E. Thompson, Ellington.
	Sampled by Purchaser:	
22203	Apothecaries Hall Co., Waterbury	Hatheway & Steane, Hartford.
22204	" "	Hatheway & Steane, Hartford.
22794	" "	E. F. Clark, Woodbury
43	" "	Geo. W. Fraser, Willimantic
23145	L. T. Frisbie & Co., New Haven	Walter T. Clark, Norwich

GROUND BONE.

Nitrogen. Found.	Nitrogen. Guaranteed.	Ammonia equivalent to total nitrogen.	Phosphoric Acid. Found.	Phosphoric Acid. Guaranteed.	Mechanical Analysis. Finer than 1–50 inch.	Mechanical Analysis. Coarser than 1–50 inch.	Station No.
%	%	%	%	%	%	%	
2.91	2.47	3.54	25.05	22.88	32.0	68.0	**23065**
4.01	3.29	4.88	22.34	20.00	53.5	46.5	**23010**
2.65	2.47	3.22	23.85	22.00	50.0	50.0	**23224**
3.47	1.64	4.22	20.36	25.00	42.0	58.0	**23129**
2.69	2.47	3.27	24.55	22.00	51.0	49.0	**23298**
2.05	2.05	2.49	28.91	26.00	51.0	49.0	**22932**
3.19	2.46	3.88	24.15	24.00	38.0	62.0	**23247**
2.66	2.46	3.23	25.25	23.00	45.0	55.0	**22903**
3.61	2.46	4.39	23.53	20.00	48.0	52.0	**22917**
3.94	3.75	4.79	26.10	25.00	79.5	20.5	**166**
2.02	2.00	2.46	28.40	25.17	54.0	46.0	**167**
2.93	2.46	3.56	24.45	22.88	63.0	37.0	**23152**
2.47	2.50	3.00	26.30	22.00	54.0	46.0	**22940**
3.84	3.82	4.67	26.10	24.70	64.0	36.0	**22930**
4.13	3.29	5.02	22.53	20.50	70.0	30.0	**23432**
2.47	2.47	3.00	27.76	22.90	56.0	44.0	**22929**
2.49	2.47	3.03	26.20	22.88	38.0	62.0	**23448**
4.64	4.51	5.64	23.31	20.00	34.0	66.0	**22937**
5.45	3.69	6.63	21.00	21.00	25.0	75.0	**23461**
4.56	3.70	5.54	20.98	20.60	50.0	50.0	**23191**
2.50	2.46	3.04	22.95	22.80	77.5	22.5	**160**
3.55	....	4.32	24.76	.....	58.0	42.0	**22203**
3.65	....	4.44	24.66	.....	55.0	45.0	**22204**
4.99	....	6.07	22.29	.....	....	....	**22794**
4.65	2.46	5.65	17.62	22.00	44.0	56.0	**43**
3.29	2.46	4.00	24.85	20.00	38.0	62.0	**23145**

VI. MIXED FERTILIZERS.

MIXTURES CONTAINING PHOSPHORIC ACID AND POTASH.

Two samples in which only phosphoric acid and potash were guaranteed were analyzed.

96. Buffalo Phosphate and Potash. International Agricultural Corporation, Boston.

19. Olds and Whipple Bone Phosphate and Potash Compound. Olds and Whipple, Inc., Hartford.

Both samples were drawn by the Station agent. Analyses are as follows:

Station No.		96 %	19 %
Phosphoric acid:			
available,	found	12.01	5.22
	guaranteed	12.00	4.00
total,	found	12.64	5.30
	guaranteed	13.00	4.00
Potash:			
	found	6.16	16.26
	guaranteed	6.00	15.00

MIXTURES CONTAINING NITROGEN AND PHOSPHORIC ACID.

Three samples which contain no potash have been analyzed.

36. Olds and Whipple Top Dressing for Grass, 7-4-0. Sampled by Station agent from stock of F. T. Blish Hardware Co., South Manchester.

23198. Olds and Whipple High Grade Tobacco Starter. Olds and Whipple, Inc., Hartford. Sampled by Station agent from stock of E. O. Gates, Pine Meadow.

23061. Shoemaker's Swift-Sure Tobacco Starter, 4-10-0. Sampled by Station agent from stock of F. S. Bidwell & Co., Windsor Locks.

Analyses are as follows:

Station No.	36 %	23198 %	23061 %
Nitrogen:			
found	5.81	11.15	3.63
guaranteed	5.76	8.23	3.28
Ammonia equivalent to nitrogen found	7.06	13.56	4.41
Phosphoric acid:			
total	7.40	4.30	14.50
available, found	5.15	3.87	10.50
guaranteed	4.00	3.00	10.00

In both these samples the active insoluble organic nitrogen was of good quality as judged by the usual methods.

MIXTURES CONTAINING AMMONIA, PHOSPHORIC ACID AND POTASH.

In Table XIV are given analyses of two hundred and ninety-nine samples of complete fertilizers. Two hundred and eighty-two were drawn officially by the Station agent and seventeen were submitted by purchasers.

In the column headed "grade" appear the figures which represent the guaranteed amounts of ammonia, available phosphoric acid and potash in the order named; thus, 4-8-4 means that the brand is guaranteed to contain 4 per cent of ammonia, 8 per cent of available phosphoric acid and 4 per cent of potash. In the analyses on the right hand pages of the table the corresponding percentages of these constituents as found appear in bold face type.

Concerning Guaranties.

Of the two hundred and eighty-two official samples, one hundred and twenty, or about 40 per cent, failed to completely satisfy their guaranties, deficiencies of 0.12 per cent in ammonia, 0.2 per cent in available phosphoric acid and 0.15 per cent in potash being disregarded. Each sample requires three major determinations in order to check the guaranty, hence eight hundred and forty-six determinations have been required for the official samples in this group. Since some samples have been deficient in more than one item, the total number of deficiencies found was one hundred and forty-nine; in other words, about 82.4 per cent of the individual items of plant food guaranteed have been substantially correct or in excess of guaranties.

Taking the total number of samples of each manufacturer who registered three or more brands, and calculating from the analyses the average shortage or overrun in elements of plant food guaranteed, we deduce the following summary:

Of 26 manufacturers,—

16 equaled or exceeded guaranties in the three elements.
9 equaled or exceeded guaranties in two elements and were short in one.
1 equaled or exceeded the guaranty in one element and was short in two.

Nine of the shortages were in ammonia and there was one each in available phosphoric acid and potash. The ammonia deficiencies ranged from 0.10 to 0.53 per cent; seven were less than 0.25 per cent. The deficiencies in available phosphoric acid and potash were 0.15 and 0.19 per cent respectively.

Analyses Requiring Special Comment.

Special comment or explanation is due in connection with the following analyses:

185. Aben Hardware Co. This sample represents a part of a cargo of fertilizer salvaged from a wrecked vessel. The goods were found to be under guaranty but they were sold for a price at which the purchaser suffered no loss.

158. Am. Agr. Chem. Co., 3-8-4. The manufacturer obtained 3.74 per cent of potash on a duplicate portion of our sample. Our report for potash was 3.71 per cent. On **159,** 5-8-7 of the same manufacturer, their result for potash was 6.71 per cent; our report was 6.50 per cent.

Five of the Armour brands have shown considerable deficiencies. Second samples were analyzed in nearly all cases.

23398. Atlantic Tobacco Manure 5-8-6. This was found below guaranty in ammonia; a second sample, **172,** from another source, was also low. The results for the two samples were 4.44 and 4.77 respectively.

23125. Berkshire Complete Tobacco 5-3-5. This showed 4.83 per cent ammonia but a second sample, **5,** from another source showed 5.22 per cent. The average analysis for the two samples is 5.03-3.89-5.78, which meets the guaranty.

23301. This sample was drawn as Chittenden's Top Dresser 6-8-4, but analysis showed it to be a 4-8-4 brand. Investigation was made but it could not be determined beyond doubt whether Potato Manure was packed in bags marked "Top Dresser" or whether an error in sampling had occurred. A second sample could not be obtained from this or any other purchaser and the sample is, therefore, accepted as a 4-8-4 brand.

23392. Clark's Special Mixture, 4-8-4, was reported low in ammonia and potash, but a second sample, **299,** was found to meet the guaranty. The average of the two analyses is 3.78-8.69-3.99 which satisfies the guaranty, except in ammonia, and shows no significant deficiency in money value.

23038. Frisbie's Special 3-8-4, was reported low in total phosphoric acid; a second sample, **23305,** was below guaranty in total phosphoric acid and in potash. Available phosphoric acid was satisfactory in both cases. The average for the two samples is 2.94-8.17-3.82.

22992. Frisbie's 4-8-4 was reported low in ammonia and potash; the second sample, **23274,** was likewise deficient. The average for the two analyses is 3.76-8.51-3.73.

22990. Frisbie's 5-8-7 was low in ammonia, and the second sample, **23273,** was deficient in ammonia and potash. The average of the two analyses was 4.70-8.85-6.79.

22984. Frisbie's 7-5-4 was reported low in ammonia, and the second sample, **162,** was also below guaranty in this respect. The average of both analyses is 6.52-5.65-4.10.

23037. Lowell 5-8-7, and **23041,** Lowell 4-8-4. These two samples were found to be below guaranty in ammonia. Portions of our samples were submitted to the manufacturer and the check results were in close agreement with our figures.

23243. Lowell Tobacco 5-4-5 was found low in ammonia but the second sample, **8,** was not deficient. The average of two analyses is 4.87-5.05-5.26.

23154. Naco Brand 2-8-2. This brand is called 2-8-2 but its actual guaranty is 2.8-11.3-2.8, the idea being that the purchaser is to understand that a pound of this brand will contain the same amount of plant food as one and 2/5 pounds of a 2-8-2 grade. Several other brands of the Nitrate Agencies goods are listed on this "equivalent" plan. Registrations, however, should declare the percentage amounts of elements in the goods as sold. To have the brand indicate one grade and the analysis another leads only to confusion.

23060. Royster's Top Dresser 7-6-5 was found to be low in ammonia. Analysis of a duplicate portion of our sample by the manufacturer confirmed our result.

23189. Virginia-Carolina 4-8-6; **23193,** 3-9-5; and **92,** 8-6-6. Duplicate portions of our samples were sent to the manufacturer and their results were in substantial accord with ours in all cases.

The Rogers and Hubbard Co. advise us that very discordant results for available phosphoric acid have been reported to them by control and by commercial laboratories on their bone-base goods. In this connection it should be noted that so-called "available" phosphoric acid is largely influenced by the method of determining citrate-insoluble phosphoric acid, which method was devised for use upon acid phosphate and which does not accurately evaluate phosphoric acid from other sources such as bone, tankage, etc.

Deficiencies in Money Value.

In eighteen brands deficiencies have amounted to more than a dollar per ton, the values being arrived at by balancing overruns against shortages and reckoning ammonia at 21 cents per pound and available phosphoric acid and potash each at 4 cents per pound. Where more than one sample of a given brand has been analyzed the commercial shortage has been estimated on the basis of the average of the analyses made. The brands thus found deficient are listed in Table XV.

TABLE XV. DEFICIENT BRANDS, 1924.

No.	Brand.	Approximate deficiency in money value per ton
159	A. A. C. Co.'s Patapsco 5-8-7	$1.06
23350, 662	Armour's Big Crop 3-8-4	1.63[1]
23315, 661	Armour's Big Crop 4-6-10	1.40[1]
23358, 173	Armour's Big Crop 5-8-5	1.24[1]
23312, 664	Armour's Big Crop 5-8-7	1.90[1]
23318, 665	Armour's Big Crop 8-6-6	7.84[1]
23398, 172	Atlantic Tobacco Manure 5-8-6	1.17[1]
23335	Bowker's Market Garden Fertilizer	1.39
23357	Bowker's Stockbridge Potato and Vegetable Manure	1.14
22900, 302, 307	Eastern States 7-8-3 No-Filler	4.50[2]
22984, 162	Frisbie's Top Dresser 7-5-4	1.41[1]
23071	Godfrey's Potato Manure 4-8-5	2.44
137, 669	I. A. C. Double Strength Fertilizer 10-8-10	2.60[1]
23435	Nitrate Agencies Naco Brand 5-8-7	2.11
23429	Nitrate Agencies Naco Equivalent 5-8-7	1.63
23060	Royster's Top Dresser	3.13
23468	Royster's Wrapper Brand	2.21
92, 666	Virginia-Carolina Tip Top Brand	2.20[1]

The products of a given manufacturer are more adequately judged on the record over a period of years than on the results of a single inspection. If the data given in Table XV is combined with similar data for the preceding three years and compared with the total number of samples of each manufacturer's goods analyzed in this four-year period, we find that of approximately one thousand samples, about one hundred have shown deficiencies in money value of more than $1.00 per ton. In other words, purchasers have obtained commercial values substantially equal to guaranties, or in excess of the same, in about 90 per cent of the purchases represented. This is shown in more detail in the accompanying tabulation, Table XVI. A manufacturer's name does not appear unless ten or more official samples have been analyzed in the four-year period, and the figures refer to individual samples and not to averages.

[1] Based on average of two analyses.
[2] Based on average of three analyses.

TABLE XVI. COMMERCIAL DEFICIENCIES 1921-1924 INCLUSIVE.

Manufacturer.	Total number of samples.	Number of samples substantially equaling or exceeding guaranty in money value.
American Agricultural Chemical Co.	188	177
Apothecaries Hall Co.	28	28
Armour Fertilizer Works.	47	32
Atlantic Packing Co.	30	26
Berkshire Fertilizer Co.	32	32
Bowker Fertilizer Co.	57	50
The E. D. Chittenden Co.	26	25
E. B. Clark Seed Co.	18	16
The Coe-Mortimer Co.	30	27
Eastern States Farmers' Exchange	39	32
Essex Fertilizer Co.	31	30
L. T. Frisbie Co.	48	38
International Agricultural Corp.	33	29
Lowell Fertilizer Co.	42	35
Mapes Fertilizer and Peruvian Guano Co.	53	52
New England Fertilizer Co.	33	30
Nitrate Agencies Co.	14	11
Olds & Whipple, Inc.	23	23
Parmenter & Polsey Fertilizer Co.	16	15
The Rogers & Hubbard Co.	53	51
F. S. Royster Guano Co.	30	21
Sanderson Fertilizer & Chemical Co.	34	32
M. L. Shoemaker & Co.	11	11
Springfield Rendering Co.	18	16
Virginia-Carolina Chemical Co.	38	35
Wilcox Fertilizer Co.	31	28
Total	1003	902

CLASSIFICATION OF GRADES WITH REFERENCE TO AMMONIA.

About 70 per cent of the two hundred and eighty-two samples examined have carried guaranties of ammonia of 4 per cent or over. A tabulation for the last four years shows the distribution of ammonia grades and indicates a decrease in the proportion of low nitrogen goods.

Guaranty.	Percentage of Samples. 1921	1922	1923	1924
1 per cent ammonia (0.82 nitrogen)	10.0	6.0	4.2	2.1
2 per cent ammonia (1.65 nitrogen)	20.4	19.1	16.5	12.8
3 per cent ammonia (2.47 nitrogen)	23.2	19.1	16.1	14.9
4 per cent ammonia (3.29 nitrogen)	20.4	25.9	26.1	24.8
5 per cent ammonia (4.11 nitrogen)	21.4	23.0	24.5	27.0
6 per cent ammonia (4.94 nitrogen)	4.6	6.9	4.9	6.7
7 per cent and over (5.76 or more)	....	....	7.7	11.7
Total	100.0	100.0	100.0	100.0

The "New England Standard Nine."

The number of grades represented by the two hundred and eighty-two samples of complete fertilizers and two of the group containing potash and phosphoric acid only is seventy-four. The number of samples falling in the "Standard Nine" grades is ninety-six; but, if several grades closely corresponding to these are included, the number is increased to one hundred and twenty-seven. What proportion of the total tonnage in this State is represented by the "Standard Nine" cannot be stated at this time. Less than one-half of the samples examined have fallen in the selected grades or those closely corresponding thereto.

In the following summary the "Standard Nine" grades are indicated in full face type.

Grade.	Number of samples.
0-12-6	1
2-12-4	2
3-10-3	5
3-10-4	4
3-10-6	0
4-7-5	1
4-8-4	34
4-8-5	2
4-8-6	9
4-8-7	11
5-4-4	1
5-4-5	25
5-8-6	6
5-8-7	22
8-6-6	4
Total	127

Quality of the Nitrogen in Mixed Fertilizers.

The nitrogen derived from nitrates and from ammonium salts is soluble in water and its utilization by plants is relatively rapid and complete. A portion of the organic nitrogen may also be soluble in water and this is presumably more readily utilized by plants than that portion which is insoluble. For many years it has been the practice of agricultural chemists to evaluate approximately the insoluble organic nitrogen of fertilizers. Two methods are employed for this purpose, both of which depend upon the action of dilute solutions of permanganate of potash upon the nitrogenous material under examination, the one an alkaline solution, the other a neutral solution. The results do not measure the availability of the insoluble nitrogen in the generally accepted sense of that term, but they parallel vegetation tests to the extent that low activity values indicate forms of nitrogen which show poor crop-producing power.

In judging the quality of the insoluble nitrogen it is our practice to apply the alkaline permanganate method in all cases where the amount of the insoluble exceeds 3/10 of one per cent. If less than 50 per cent activity is shown, the neutral method is used, check determinations being made in both cases. Activity values of less than 50 per cent by the alkaline method and less than 80 per cent by the neutral method are interpreted as indicating inferior forms of nitrogenous material.

Four samples this year showed results for active insoluble nitrogen less than the limits just quoted. In two of them the actual amounts of insoluble nitrogen were small (0.3 to 0.4), constituting only about 1/10 and 1/4 respectively of the total nitrogen, and judgment was suspended. In Super-Alphano (**127**) and Woodruff's Home Mixture (**23188**), the insoluble nitrogen constituted 3/5 and 2/5 respectively of the total, and the activity figures were 44.4 and 41.8 per cent respectively by the alkaline method and 55 and 74.2 per cent respectively by the neutral method.

TABLE XIV. ANALYSES OF MIXED FERTILIZERS

Station No.	Manufacturer and Brand.	Grade.	Place of Sampling.
	Sampled by Station:		
	Aben Hardware Co., New London.		
185	5-10-5 Fertilizer	5-10-5	Poquonock Bridge.
	American Agricultural Chemical Co., New York.		
23382	Agrico Tobacco Manure	7-3-7	Unionville
23263	Complete Potato Mixture	3-8-4	North Haven
23353	Double A Tobacco Fertilizer	5-4-5	New Milford
23261	Fish and Potash	3-10-3	Thompsonville
23354	Grass and Lawn Top Dressing	6-6-4	Farmington
23066	7% Potash Fertilizer	4-8-7	New Britain
23356	Tobacco Fertilizer, 5-4-3	5-4-3	Glastonbury
23268	Universal Phosphate	1-8-2	Norfolk
23376	Bradley's Complete Manure for Poatoes and Vegetables	4-8-7	Stamford
23373	Bradley's Complete Tobacco Manure	5-4-5	Glastonbury
23266	Bradley's Corn Phosphate	2-8-2	Stamford
23264	Bradley's New Method Fertilizer	1-8-2	Meriden
23267	Bradley's Potato Fertilizer	2-8-3	Bethel
23375	Bradley's Potato Manure	3-8-4	Meriden
23374	Bradley's Superior Tobacco Compound	7-3-7	Glastonbury
309	Bradley's Superior Tobacco Compound	7-3-7	Broad Brook
23371	Bradley's XL Superphosphate of Lime	3-9-2	Suffield
23471	National Complete Tobacco Fertilizer	5-4-5	Warehouse Point
23478	National Market Garden Fertilizer	3-8-4	Greenwich
23472	National Potato and Corn Phosphate	2-8-3	Warehouse Point
23480	National Premier Truck Manure	4-8-7	Silver Lane
23470	National White Ash Tobacco Grower	7-3-7	Warehouse Point
23477	National XXX Fish and Potash	3-10-3	Broad Brook
159	Patapsco, 5-8-7	5-8-7	Norwich
158	Patapsco General Truck Fertilizer	3-8-4	Mansfield Center
152	Patapsco Matchless Potash Manure	2-8-2	Putnam
23372	Patapsco Peerless Potato Guano	4-8-4	Guilford
23381	Quinnipiac Corn Manure	2-8-2	Farmington
23378	Quinnipiac Market Garden Manure	4-8-7	Gaylordsville
23380	Quinnipiac Potato Phosphate	2-8-3	Farmington
23377	Quinnipiac Prime Tobacco Manure	7-3-7	Manchester

CONTAINING NITROGEN, PHOSPHORIC ACID AND POTASH.

Nitrogen.						Phosphoric Acid.			Potash.		
In nitrates.	In ammonia.	Organic, water-soluble.	Organic, water-insoluble.	Total.	Ammonia equivalent to total nitrogen.	Citrate-insoluble.	Total.	So-called "Available."	As muriate.	Total.	Station No.
%	%	%	%	%	%	%	%	%	%	%	
1.50	1.27	0.30	0.91	3.98	**4.84**	0.48	10.18	**9.70**	5.01	**5.01**	**185**
1.08	0.09	0.27	4.28	5.72	**6.95**	0.33	3.98	**3.65**	0.62	**8.07**	**23382**
0.60	0.79	0.42	0.61	2.42	**2.94**	0.58	8.90	**8.32**	4.08	**4.08**	**23263**
0.92	0.06	0.11	2.98	4.07	**4.95**	0.28	4.80	**4.52**	0.40	**5.00**	**23353**
0.60	0.79	0.49	0.59	2.47	**3.00**	0.77	10.75	**9.98**	3.02	**3.02**	**23261**
2.21	1.25	0.75	0.62	4.83	**5.87**	0.60	7.23	**6.63**	4.00	**4.00**	**23354**
0.64	1.27	0.83	0.57	3.31	**4.02**	1.07	8.90	**7.83**	6.94	**6.94**	**23066**
0.94	0.01	0.18	3.01	4.14	**5.03**	0.35	4.58	**4.23**	0.44	**3.16**	**23356**
0.12	0.32	0.33	0.52	1.29	**1.57**	0.69	8.89	**8.20**	2.24	**2.24**	**23268**
0.65	1.28	0.86	0.49	3.28	**3.99**	1.19	8.96	**7.77**	7.10	**7.10**	**23376**
0.75	0.08	0.16	3.10	4.09	**4.97**	0.25	4.60	**4.35**	0.47	**5.11**	**23373**
0.11	0.46	0.71	0.48	1.76	**2.14**	0.65	8.75	**8.10**	2.23	**2.23**	**23266**
0.20	0.37	0.27	0.60	1.44	**1.75**	0.68	8.88	**8.20**	2.28	**2.28**	**23264**
0.12	0.54	0.55	0.54	1.75	**2.13**	0.85	9.03	**8.18**	3.14	**3.14**	**23267**
0.58	0.81	0.51	0.54	2.44	**2.97**	0.46	8.53	**8.07**	4.27	**4.27**	**23375**
0.88	0.12	0.32	4.26	5.58	**6.78**	0.28	4.08	**3.80**	0.58	**7.41**	**23374**
....	....	....	....	5.58	**6.76**	0.45	3.90	**3.45**	0.51	**6.55**	**309**
0.65	0.74	0.66	0.71	2.76	**3.36**	0.75	10.55	**9.80**	2.57	**2.57**	**23371**
1.04	0.00	0.00	2.94	3.98	**4.84**	0.28	4.65	**4.37**	0.53	**5.30**	**23471**
0.64	0.96	0.77	0.47	2.84	**3.45**	0.73	8.94	**8.21**	3.61	**3 61**	**23478**
0.21	0.52	0.53	0.53	1.79	**2.18**	0.96	8.83	**7.87**	3.18	**3.18**	**23472**
0.80	1.21	0.86	0.47	3.34	**4.06**	1.05	9.23	**8.18**	6.33	**6.33**	**23480**
1.11	0.04	0.10	4.25	5.50	**6.69**	0.30	3.90	**3.60**	0.56	**7.80**	**23470**
0.59	0.76	0.49	0.56	2.40	**2.92**	0.74	10.61	**9.87**	2.96	**2.96**	**23477**
0.87	1.87	0.63	0.63	4.00	**4.86**	0.67	8.57	**7.90**	6.50	**6.50**	**159**
0.57	0.78	0.61	0.44	2.40	**2.92**	0.40	8.32	**7.92**	3.71	**3.71**	**158**
0.02	0.55	0.66	0.55	1.78	**2.16**	0.60	8.85	**8.25**	1.94	**1.94**	**152**
0.78	1.23	0.66	0.56	3.23	**3.93**	1.03	9.02	**7.99**	3.86	**3.86**	**23372**
0.10	0.45	0.56	0.54	1.65	**2.01**	0.58	8.88	**8.30**	2.03	**2.03**	**23381**
0.61	1.31	0.87	0.54	3.33	**4.05**	1.09	8.97	**7.88**	6.66	**6.66**	**23378**
0.00	0.54	0.59	0.54	1.67	**2.03**	0.85	9.10	**8.25**	3.25	**3.25**	**23380**
0.95	0.13	0.22	4.22	5.52	**6.71**	0.45	4.13	**3.68**	0.54	**7.81**	**23377**

TABLE XIV. ANALYSES OF MIXED FERTILIZERS

Station No.	Manufacturer and Brand.	Grade.	Place of Sampling.
	Sampled by Station:		
	American Agricultural Chemical Co., New York.—*Continued*		
310	Quinnipiac Prime Tobacco Manure	7-3-7	Buckland
23379	Quinnipiac Seed Leaf Tobacco Manure	5-4-5	Gaylordsville
23479	Wheeler's Corn Fertilizer	2-8-2	Plainville
18	Wheeler's Cuban Tobacco Grower	5-4-5	New Milford
17	Wheeler's Potato Manure	2-8-3	Shelton
	Apothecaries Hall Co., Waterbury.		
23216	Liberty, 2-8-2	2-8-2	East Windsor
23186	Liberty Corn, Fruit and All Crops	2-12-4	Woodstock
22995	Liberty Fish Bone and Potash	3-10-4	Meriden
23310	Liberty Fish Bone and Potash	3-10-4	Branford
22996	Liberty High Grade Market Gardeners	5-8-7	Meriden
23321	Liberty High Grade Tobacco Manure	8-4-5	East Windsor
23183	Liberty Market Gardener's Special	4-8-4	Guilford
23313	Liberty Tobacco Special	5-4-5	Middletown
23314	Liberty Top Dresser for Grass and Grain	10-3.5-8	Middletown
	Armour Fertilizer Works, New York.		
23350	Armour's Big Crop, 3-8-4	3-8-4	Danbury
662	Armour's Big Crop, 3-8-4	3-8-4	New Haven
23315	Armour's Big Crop, 4-6-10	4-6-10	Madison
661	Armour's Big Crop, 4-6-10	4-6-10	New Haven
23311	Armour's Big Crop, 4-8-4	4-8-4	Branford
663	Armour's Big Crop, 4-8-4	4-8-4	Danbury
23358	Armour's Big Crop, 5-8-5	5-8-5	Milford
173	Armour's Big Crop, 5-8-5	5-8-5	Milford
23312	Armour's Big Crop, 5-8-7	5-8-7	Guilford
664	Armour's Big Crop, 5-8-7	5-8-7	Madison
23318	Armour's Big Crop, 8-6-6	8-6-6	Wallingford
665	Armour's Big Crop, 8-6-6	8-6-6	New London
23014	Armour's Big Crop Tobacco Special	5-4-5	Danbury
169	Armour's Big Crop Tobacco Special	5-4-5	Danbury
23349	Armour's Corn Grower, 2-8-2	2-8-2	New Canaan

CONTAINING NITROGEN, PHOSPHORIC ACID AND POTASH—*Continued.*

Nitrogen.					Ammonia equivalent to total nitrogen.	Phosphoric Acid.			Potash.		Station No.
In nitrates.	In ammonia.	Organic, water-soluble.	Organic, water-insoluble.	Total.		Citrate-insoluble.	Total.	So-called "Available."	As muriate.	Total.	
%	%	%	%	%	%	%	%	%	%	%	
....	....	....	....	5.81	**7.06**	0.30	3.85	**3.55**	0.51	**7.12**	**310**
0.68	0.07	0.16	3.14	4.05	**4.92**	0.28	4.33	**4.05**	0.39	**5.58**	**23379**
0.05	0.46	0.68	0.56	1.75	**2.13**	0.95	9.00	**8.05**	2.12	**2.12**	**23479**
0.87	0.03	0.15	3.00	4.05	**4.92**	0.25	4.23	**3.98**	0.39	**5.00**	**18**
0.03	0.50	0.66	0.49	1.68	**2.04**	0.85	9.08	**8.23**	3.01	**3.01**	**17**
1.01	0.14	0.48	0.78	2.41	**2.93**	1.75	10.28	**8.53**	2.26	**2.26**	**23216**
0.00	1.24	0.40	0.11	1.75	**2.13**	1.01	13.01	**12.00**	4.89	**4.89**	**23186**
0.53	1.63	0.56		2.72	**3.31**	0.78	11.13	**10.35**	4.02	**4.02**	**22995**
0.41	1.65	0.36	0.27	2.69	**3.27**	1.00	11.18	**10.18**	4.06	**4.06**	**23310**
1.05	2.90	0.30		4.25	**5.17**	0.49	8.67	**8.18**	7.10	**7.10**	**22996**
0.01	3.19	0.40	3.03	6.63	**8.06**	0.23	6.25	**6.02**	0.64	**6.23**	**23321**
0.80	2.07	0.09	0.35	3.31	**4.02**	0.95	9.10	**8.15**	4.36	**4.36**	**23183**
0.02	1.27	0.37	2.43	4.09	**4.97**	0.25	5.33	**5.08**	0.58	**7.65**	**23313**
4.69	3.00	0.51	0.52	8.72	**10.60**	1.03	6.35	**5.32**	9.63	**9.63**	**23314**
0.23	0.47	0.34	0.78	1.82	**2.21**	0.61	8.53	**7.92**	4.95	**4.95**	**23350**
....	....	....	....	2.50	**3.04**	0.40	7.55	**7.05**	....	**3.86**	**662**
2.25	0.37	0.42	0.58	3.62	**4.40**	0.40	6.26	**5.86**	9.43	**9.43**	**23315**
....	....	....	....	2.78	**3.38**	0.36	6.08	**5.72**	....	**8.64**	**661**
0.53	1.22	0.44	1.15	3.34	**4.06**	0.73	8.47	**7.74**	4.54	**4.54**	**23311**
....	....	....	....	3.05	**3.71**	1.38	9.43	**8.05**	....	**4.21**	**663**
0.83	1.08	0.51	1.05	3.47	**4.22**	0.61	8.68	**8.07**	6.50	**6.50**	**23358**
....	....	....	....	3.84	**4.67**	0.59	8.20	**7.61**	....	**6.50**	**173**
0.46	1.95	0.40	0.93	3.74	**4.55**	0.68	8.75	**8.07**	6.45	**6.45**	**23312**
....	....	....	....	3.98	**4.84**	0.75	9.83	**9.08**	....	**4.81**	**664**
1.38	1.69	0.50	1.33	4.90	**5.96**	0.55	6.68	**6.13**	8.77	**8.77**	**23318**
....	....	....	....	4.34	**5.28**	0.70	9.43	**8.73**	....	**5.74**	**665**
0.59	0.06	0.16	3.02	3.83	**4.66**	0.54	4.78	**4.24**	0.73	**4.60**	**23014**
....	....	....	....	4.12	**5.01**	0.75	5.20	**4.45**	....	**5.15**	**169**
0.12	0.62	0.32	0.59	1.65	**2.01**	0.88	9.00	**8.12**	2.18	**2.18**	**23349**

TABLE XIV. ANALYSES OF MIXED FERTILIZERS

Station No.	Manufacturer and Brand.	Grade.	Place of Sampling.
	Sampled by Station:		
	Atlantic Packing Co., New Haven.		
23337	Atlantic, 4-8-6	4-8-6	Cromwell
23331	Atlantic, 5-8-7	5-8-7	Manchester
23127	Atlantic Grain Fertilizer, 2-8-2	2-8-2	"
23126	Atlantic Potato Phosphate, 3-8-4	3-8-4	"
23332	Atlantic Special Vegetable, 4-8-4	4-8-4	"
172	Atlantic Tobacco Manure, 5-8-6	5-8-6	Glastonbury
23398	Atlantic Tobacco Manure, 5-8-6	5-8-6	Cromwell
23391	Atlantic Top Dresser, 7-5-4	7-5-4	Manchester
	F. A. Bartlett Tree Expert Co., Stamford.		
300	Bartlett's Green Tree Food	6-8-4	Stamford
	Berkshire Fertilizer Co., Bridgeport.		
23214	Berkshire Complete Fertilizer	3-8-3	New Canaan
23125	Berkshire Complete Tobacco	5-3-5	Windsor Locks
5	Berkshire Complete Tobacco	5-3-5	Talcottville
23394	Berkshire Economical Grass Fertilizer	10-3-8	Bridgeport
23225	Berkshire Grass Special	7-2-4	Windsor Locks
23135	Berkshire Long Island Special	5-8-7	Litchfield
23219	Berkshire Market Garden	4-8-4	Litchfield
23209	Berkshire Potato and Vegetable Phosphate	2-8-4	Branford
23399	Berkshire Tobacco Special	7-3-5	Suffield
	F. E. Boardman, Middletown.		
150	Boardman's Complete Fertilizer for Potatoes and General Crops	4-7-4	Middletown
156	Boardman's Tobacco Fertilizer	4-7-4	Middletown
	Bowker Fertilizer Co., New York.		
23329	Bowker's All Round Fertilizer	3-8-4	Meriden
23360	Bowker's Conn. Valley Tobacco Fertilizer	5-4-3	Hazardville
23232	Bowker's Corn, Grain and Grass Phosphate	2-8-2	Colchester
23333	Bowker's Fisherman's Fish and Potash	3-10-3	Meriden
23335	Bowker's Market Garden Fertilizer	4-8-4	Colchester
23229	Bowker's Potato and Vegetable Phosphate	2-8-3	Meriden
23336	Bowker's Square Brand Farm and Garden Phosphate	2-8-2	Unionville

CONTAINING NITROGEN, PHOSPHORIC ACID AND POTASH—*Continued.*

Nitrogen.						Phosphoric Acid.			Potash.		
In nitrates.	In ammonia.	Organic, water-soluble.	Organic, water-insoluble.	Total.	Ammonia equivalent to total nitrogen.	Citrate-insoluble.	Total.	So-called "Available."	As muriate.	Total.	Station No.
%	%	%	%	%	%	%	%	%	%	%	
0.94	0.93	0.61	0.95	3.43	**4.17**	0.58	9.45	**8.87**	6.14	**6.14**	23337
1.52	0.85	0.67	1.00	4.04	**4.91**	0.68	9.40	**8.72**	7.24	**7.24**	23331
0.06	0.83	0.35	0.41	1.65	**2.01**	0.38	8.34	**7.96**	2.17	**2.17**	23127
0.00	1.40	0.44	0.57	2.41	**2.93**	0.60	8.79	**8.19**	3.99	**3.99**	23126
0.97	0.79	0.56	0.82	3.14	**3.82**	0.48	9.00	**8.52**	4.40	**4.40**	23332
1.11	0.70	0.77	1.34	3.92	**4.77**	0.60	9.20	**8.60**	1.02	**6.08**	172
1.23	0.56	0.62	1.24	3.65	**4.44**	0.78	9.00	**8.22**	0.94	**6.26**	23398
2.41	1.48	0.92	0.80	5.61	**6.82**	0.40	5.95	**5.55**	4.34	**4.34**	23391
....	....	....	....	5.06	**6.15**	2.49	9.31	**6.82**	4.33	**4.33**	300
0.92	0.67	0.47	0.61	2.67	**3.25**	0.83	9.38	**8.55**	3.81	**3.81**	23214
0.78	0.17	0.43	2.59	3.97	**4.83**	0.58	4.35	**3.77**	0.93	**6.12**	23125
....	....	....	....	4.29	**5.22**	0.43	4.43	**4.00**	....	**5.43**	5
1.35	5.34	0.53	1.02	8.24	**10.02**	7.18	11.03	**3.85**	8.59	**8.92**	23394
2.86	0.47	0.62	1.73	5.68	**6.91**	1.85	6.95	**5.10**	4.26	**4.26**	23225
1.36	1.31	0.91	0.89	4.47	**5.43**	1.03	9.30	**8.27**	7.84	**7.84**	23135
0.66	1.21	0.79	0.74	3.40	**4.13**	1.00	9.45	**8.45**	4.25	**4.78**	23219
0.50	0.31	0.42	0.52	1.75	**2.13**	1.13	10.07	**8.94**	3.59	**3.59**	23209
1.59	0.12	0.61	3.34	5.66	**6.88**	0.48	4.35	**3.87**	1.05	**5.91**	23399
0.61	0.76	0.67	1.19	3.23	**3.93**	1.23	8.68	**7.45**	4.42	**4.42**	150
0.24	0.97	0.37	1.99	3.57	**4.34**	0.55	7.88	**7.33**	1.10	**4.93**	156
0.58	0.83	0.60	0.50	2.51	**3.05**	0.55	8.69	**8.14**	4.33	**4.33**	23329
0.92	0.07	0.08	3.30	4.37	**5.31**	0.38	5.05	**4.67**	0.24	**3.13**	23360
0.04	0.55	0.56	0.52	1.67	**2.03**	0.68	8.81	**8.13**	2.00	**2.00**	23232
0.60	0.75	0.60	0.58	2.53	**3.08**	0.67	10.68	**10.01**	3.04	**3.04**	23333
0.62	1.27	0.56	0.57	3.02	**3.67**	0.73	8.85	**8.12**	3.88	**3.88**	23335
0.02	0.51	0.58	0.56	1.67	**2.03**	0.88	9.00	**8.12**	3.17	**3.17**	23229
0.09	0.51	0.57	0.58	1.75	**2 13**	0.85	9.00	**8.15**	2.22	**2.22**	23336

TABLE XIV. ANALYSES OF MIXED FERTILIZERS

Station No.	Manufacturer and Brand.	Grade.	Place of Sampling.
	Sampled by Station: **Bowker Fertilizer Co., New York.** —*Continued*		
23319	Bowker's Sure Crop Phosphate	1-8-2	Willimantic
23357	Stockbridge Potato and Vegetable Manure	4-6-10	Brooklyn
23359	Stockbridge Premier Tobacco Grower	7-3-7	South Windsor
23351	Stockbridge Truck Manure	4-8-7	Waterbury
23352	Stockbridge Tobacco Manure	5-4-5	Suffield
23355	Stockbridge Top Dressing and Forcing Manure	6-6-4	Meriden
	A. D. Bridges' Sons, Inc., Hazardville.		
23316	Corn, Onion and Potato and General Purpose	4-8-4	Hazardville
23320	Special Tobacco Fertilizer	5-3-5	Hazardville.
	The E. D. Chittenden Co., Bridgeport.		
23299	Chittenden's Complete Grain	2-8-3	Abington
668	Chittenden's Complete Grain	2-8-3	Glastonbury
134	Chittenden's Complete Tobacco and Onion Grower	4-8-4	Somers
130	Chittenden's High Grade Tobacco, 7½% Potash	6.5-3-7.5	Glastonbury
23293	Chittenden's Potato Special, 4% Potash	4-8-4	Glastonbury
502	Chittenden's Potato Special, 4% Potash	4-8-4	Abington
23301	Chittenden's Potato Special, 4% Potash	4-8-4	Glastonbury
23217	Chittenden's Potato Special, 6% Potash	4-8-6	Windsor Locks
129	Chittenden's Tobacco Special, 5% Potash	5-4-5	Windsor Locks
135	Chittenden's Vegetable and Onion Grower	3-8-3	Somers
	E. B. Clark Seed Co., Milford.		
23392	Clark's Special Mixture for General Use	4-8-4	Milford
299	Clark's Special Mixture for General Use	4-8-4	Milford
12	Clark's Special Mixture for General Use	4-10-4	Branford

CONTAINING NITROGEN, PHOSPHORIC ACID AND POTASH—*Continued.*

Nitrogen.					Ammonia equivalent to total nitrogen	Phosphoric Acid.			Potash.		Station No.
In nitrates.	In ammonia.	Organic, water-soluble.	Organic, water-insoluble.	Total.		Citrate-insoluble.	Total.	So-called "Available."	As muriate.	Total.	
%	%	%	%	%	%	%	%	%	%	%	
0.01	0.24	0.32	0.27	0.84	**1.02**	0.56	8.15	**7.59**	1.72	**1.72**	23319
0.75	1.22	0.41	0.68	3.06	**3.72**	0.55	6.65	**6.10**	9.95	**9.95**	23357
1.09	0.08	0.19	4.28	5.64	**6.86**	0.38	4.20	**3.82**	0.53	**7.58**	23359
0.67	1.26	0.70	0.53	3.16	**3.84**	0.98	9.00	**8.02**	7.02	**7.02**	23351
1.11	0.05	0.01	2.99	4.16	**5.06**	0.28	4.50	**4.22**	0.51	**4.94**	23352
2.66	1.22	0.45	0.61	4.94	**6.01**	0.63	7.05	**6.42**	4.47	**4.47**	23355
0.88	1.15	0.46	1.21	3.70	**4.50**	0.78	9.35	**8.57**	4.23	**5.21**	23316
0.95	0.08	0.12	3.29	4.44	**5.40**	0.35	4.18	**3.83**	0.66	**6.06**	23320
0.48	0.41	0.13	0.40	1.42	**1.73**	0.38	8.53	**8.15**	2.99	**2.99**	23299
....	....	....	....	1.88	**2.29**	0.68	8.68	**8.00**	....	**3.13**	668
0.49	1.85	0.25	0.59	3.18	**3.87**	0.40	8.70	**8.30**	1.01	**4.04**	134
0.15	2.54	0.25	2.41	5.35	**6.50**	0.23	5.95	**5.72**	0.70	**7.57**	130
0.26	2.03	0.34	0.61	3.24	**3.94**	0.37	8.08	**7.71**	2.39	**4.80**	23293
....	....	....	....	3.18	**3.87**	....	8.75	....	....	**5.12**	502
....	....	....	....	3.42	**4.16**	....	9.00	....	....	**3.90**	23301
0.30	1.48	0.53	0.62	2.93	**3.56**	0.44	8.44	**8.00**	7.49	**7.49**	23217
0.11	2.08	0.13	1.43	3.75	**4.56**	0.25	5.23	**4.98**	2.33	**6.77**	129
0.87	1.45	0.20	0.60	3.12	**3.79**	0.93	8.93	**8.00**	3.76	**3.76**	135
0.57	1.24	0.47	0.60	2.88	3.50	1.18	9.80	**8.62**	3.66	**3.66**	23392
....	....	....	....	3.33	**4.05**	0.78	9.53	**8.75**	4.31	**4.31**	299
0.00	2.51	0.36	0.56	3.43	**4.17**	0.55	11.28	**10.73**	4.10	**4.10**	12

TABLE XIV. ANALYSES OF MIXED FERTILIZERS

Station No.	Manufacturer and Brand.	Grade.	Place of Sampling.
	Sampled by Station:		
	E. B. Clark Seed Co., Milford.— *Continued*		
23389	Clark's Special Potash Mixture, 4-8-6	4-8-6	Milford
11	Clark's Tip Top Brand, 4-8-4	4-8-4	Branford
23390	Clark's Tip Top Brand, 5-8-5	5-8-5	Milford
	The Coe-Mortimer Co., New York.		
23231	E. Frank Coe's Celebrated Special Potato Fertilizer	4-8-4	Colchester
23230	E. Frank Coe's Columbian Corn and Potato Fertilizer	2-8-3	Saybrook
23340	E. Frank Coe's Connecticut Wrapper Grower	5-4-5	Suffield
23132	E. Frank Coe's Gold Brand Excelsior Guano	3-8-4	New Canaan
23226	E. Frank Coe's New Englander Special	1-8-2	Bethel
23136	E. Frank Coe's Red Brand Excelsior Guano	4-8-7	Farmington
23334	E. Frank Coe's Special Grass Top Dressing	6-6-4	Colchester
	C. A. Cowles, Plantsville.		
23317	C. A. Cowles', 4-8-4 Fertilizer	4-8-4	Plantsville
	Eastern States Farmers' Exchange, Springfield, Mass.		
22876	Eastern States, 3-12-3 No Filler	3-12-3	South Windsor
306	Eastern States, 3-12-3 No Filler	3-12-3	Ellington
22907	Eastern States, 5-8-7 No Filler	5-8-7	Ellington
314	Eastern States, 5-8-7 No Filler	5-8-7	Farmington
22866	Eastern States, 5-10-5 No Filler	5-10-5	Milford
301	Eastern States, 5-10-5 No Filler	5-10-5	Ellington
22900	Eastern States, 7-8-3 No Filler	7-8-3	South Windsor
302	Eastern States, 7-8-3 No Filler	7-8-3	Ellington
307	Eastern States, 7-8-3 No Filler	7-8-3	Ellington
23044	Eastern States, 4-8-4	4-8-4	Guilford
154	Eastern States, 6-3-5	6-3-5	Ellington
304	Eastern States, 6-3-5	6-3-5	Ellington
22901	Eastern States, 6-3½-7	6-3.5-7	South Windsor
23397	Eastern States, 6¼-3-5	6.25-3-5	Ellington
303	Eastern States, 6¼-3-5	6.25-3-5	"
23396	Eastern States, 7-2-7	7-2-7	"
22908	Eastern States Tobacco Fertilizer, Formula C	6-3-5	"

CONTAINING NITROGEN, PHOSPHORIC ACID AND POTASH—*Continued.*

Nitrogen.					Ammonia equivalent to total nitrogen.	Phosphoric Acid.			Potash.		Station No.
In nitrates.	In ammonia.	Organic, water-soluble.	Organic, water-insoluble.	Total.		Citrate-insoluble.	Total.	So-called "Available."	As muriate.	Total.	
%	%	%	%	%	%	%	%	%	%	%	
0.00	1.91	0.60	0.82	3.33	**4.05**	1.08	9.35	**8.27**	6.21	**6.21**	23389
0.13	1.42	0.58	1.19	3.32	**4.04**	1.53	9.60	**8.07**	4.83	**4.83**	11
0.82	1.63	0.81	0.90	4.16	**5.06**	1.23	9.45	**8.22**	5.14	**5.14**	23390
0.94	1.15	0.49	0.63	3.21	**3.90**	0.81	8.81	**8.00**	3.92	**3.92**	23231
0.13	0.45	0.54	0.55	1.67	**2.03**	0.77	8.83	**8.06**	3.15	**3.15**	23230
0.88	0.07	0.00	2.93	3.88	**4.72**	0.23	4.60	**4.37**	0.43	**5.13**	23340
0.59	0.78	0.73	0.47	2.57	**3.12**	0.46	8.51	**8.05**	4.31	**4.31**	23132
0.14	0.31	0.44	0.56	1.45	**1.76**	0.70	8.90	**8.20**	2.22	**2.22**	23226
0.82	1.27	0.64	0.49	3.22	**3.91**	0.95	8.70	**7.75**	7.32	**7.32**	23136
2.78	1.57	0.17	0.55	5.07	**6.16**	0.95	7.50	**6.55**	4.43	**4.43**	23334
0.58	1.59	0.41	0.50	3.08	**3.74**	0.15	8.28	**8.13**	4.36	**4.36**	23317
0.74	0.60	0.48	0.54	2.36	**2.87**	0.87	12.88	**12.01**	3.09	**3.09**	22876
....	....	....	....	2.50	**3.04**	0.91	12.05	**11.14**	3.19	**3.19**	306
2.12	0.77	0.33	0.59	3.81	**4.63**	0.64	8.83	**8.19**	6.47	**6.64**	22907
....	....	....	....	4.17	**5.07**	0.78	9.20	**8.42**	6.32	**6.32**	314
0.85	2.08	0.29	0.75	3.97	**4.83**	0.65	10.76	**10.11**	5.00	**5.11**	22866
....	....	....	....	3.89	**4.73**	0.92	10.67	**9.75**	4.85	**4.85**	301
1.77	1.52	0.31	0.58	4.18	**5.08**	0.51	8.53	**8.02**	4.59	**4.59**	22900
....	....	....	....	4.61	**5.60**	0.70	9.53	**8.83**	2.93	**2.93**	302
....	....	....	....	5.51	**6.70**	1.65	9.27	**7.62**	2.22	**3.02**	307
1.13	1.16	0.36	0.49	3.14	**3.82**	0.60	9.73	**9.13**	3.85	**3.85**	23044
0.59	0.18	0.07	4.06	4.90	**5.93**	0.33	4.98	**4.65**	1.05	**5.90**	154
....	....	....	....	4.42	**5.37**	0.25	5.25	**5.00**	1.86	**5.82**	304
1.56	0.18	0.30	3.46	5.50	**6.69**	0.43	5.80	**5.37**	1.02	**7.50**	22901
0.19	0.94	0.44	3.88	5.45	**6.63**	0.45	5.33	**4.88**	1.26	**5.46**	23397
....	....	....	....	5.05	**6.14**	0.58	5.25	**4.67**	1.02	**6.12**	303
1.38	0.05	0.70	3.37	5.50	**6.69**	2.50	5.68	**3.18**	1.25	**9.10**	23396
0.55	0.28	0.60	3.50	4.93	**5.99**	0.23	5.35	**5.12**	1.13	**6.36**	22908

TABLE XIV. ANALYSES OF MIXED FERTILIZERS

Station No.	Manufacturer and Brand.	Grade.	Place of Sampling.
	Sampled by Station:		
	Essex Fertilizer Co., Boston, Mass.		
20	Essex 2-8-2 for Farm and Garden..	2-8-2	Hartford.....
22	Essex 2-8-3 for All Crops.....	2-8-3	Plainville
15	Essex Fish Fertilizer for all Crops..	3-8-4	South Manchester.
14	Essex Market Garden for Potatoes, Roots and Vegetables.....	4-8-4	South Manchester.
16	Essex 4-6-10 for Potatoes and Vegetables.....	4-6-10	South Manchester.
21	Essex 5-8-7 for Potatoes and Vegetables.....	5-8-7	Hartford.....
13	Essex Potato Phosphate, 4-8-7....	4-8-7	South Manchester.
23	Essex Special Tobacco 5-4-5.....	5-4-5	Wapping.....
24	Essex Tobacco Manure, 5-8-6.....	5-8-6	West Suffield.....
	L. T. Frisbie Co., New Haven.		
22955	Frisbie's, 4-10-6.....	4-10-6	Woodmont.....
22990	Frisbie's, 5-8-7.....	5-8-7	Clintonville.....
23273	Frisbie's, 5-8-7.....	5-8-7	Wethersfield.....
23042	Frisbie's Corn and Grain Fertilizer, 2-8-2.....	2-8-2	Danbury.....
23245	Frisbie's Market Garden, 4-8-6....	4-8-6	Torrington.....
23038	Frisbie's Special, 3-8-4.....	3-8-4	North Haven.....
23305	Frisbie's Special, 3-8-4.....	3-8-4	Wallingford.....
22992	Frisbie's Special Potato and Vegetable Grower, 4-8-4.....	4-8-4	Wethersfield.....
23274	Frisbie's Special Potato and Vegetable Grower, 4-8-4.....	4-8-4	Danbury.....
23338	Frisbie's Tobacco Manure, 5-8-6...	5-8-6	Burnside.....
23339	Frisbie's Special Tobacco Grower, 5-4-5.....	5-4-5	Ellington.....
22984	Frisbie's Top Dresser, 7-5-4.....	7-5-4	New Haven.....
162	Frisbie's Top Dresser, 7-5-4.....	7-5-4	Pequabuck.....
	Godfrey Fertilizer and Chemical Co., Newark, N. J.		
23070	Godfreys' Potato and Truck Grower, 4-8-4.....	4-8-4	Westport.....
23071	Godfrey's Potato Manure, 4-8-5...	4-8-5	Westport.....
	International Agricultural Corp., Boston, Mass.		
101	Buffalo Crop Grower.....	5-8-7	Simsbury.....
98	Buffalo General Favorite.....	3-10-4	Hazardville.....
97	Buffalo High Grade Manure.....	4-6-10	Manchester.....
100	Buffalo New England Special.....	2-12-4	West Suffield.....

CONTAINING NITROGEN, PHOSPHORIC ACID AND POTASH—*Continued.*

Nitrogen.					Ammonia equivalent to total nitrogen.	Phosphoric Acid.			Potash.		Station No.
In nitrates.	In ammonia.	Organic, water-soluble.	Organic, water-insoluble.	Total.		Citrate-insoluble.	Total.	So-called "Available."	As muriate.	Total.	
%	%	%	%	%	%	%	%	%	%	%	
0.05	0.93	0.30	0.49	1.77	**2.15**	0.38	8.69	**8.31**	2.06	**2.06**	**20**
0.24	0.55	0.30	0.58	1.67	**2.03**	0.68	9.53	**8.85**	3.07	**3.07**	**22**
0.78	0.60	0.32	0.79	2.49	**3.03**	0.78	9.38	**8.60**	4.06	**4.06**	**15**
1.15	0.78	0.59	0.80	3.32	**4.04**	0.60	8.64	**8.04**	3.96	**3.96**	**14**
1.08	0.73	0.76	0.77	3.34	**4.06**	0.55	7.18	**6.63**	10.13	**10.13**	**16**
1.27	0.96	0.90	1.00	4.13	**5.02**	0.75	9.28	**8.53**	7.50	**7.50**	**21**
1.25	0.76	0.68	0.77	3.46	**4.21**	0.63	8.69	**8.06**	7.35	**7.35**	**13**
1.12	0.58	0.62	1.91	4.23	**5.14**	0.25	5.25	**5.00**	0.64	**5.19**	**23**
1.55	0.13	0.44	2.06	4.18	**5.08**	1.23	10.00	**8.77**	1.46	**6.01**	**24**
0.97	0.91	0.49	0.85	3.22	**3.91**	0.95	11.81	**10.86**	6.21	**6.21**	**22955**
1.39	0.91	0.78	0.86	3.94	**4.79**	0.53	9.34	**8.81**	6.54	**6.93**	**22990**
....	1.16	0.85	1.78	3.79	**4.61**	0.50	9.38	**8.88**	6.66	**6.66**	**23273**
0.03	0.83	0.34	0.48	1.68	**2.04**	0.46	8.40	**7.94**	2.08	**2.08**	**23042**
0.94	0.93	0.59	0.81	3.27	**3.98**	0.45	9.18	**8.73**	5.85	**5.85**	**23245**
0.89	0.55	0.28	0.67	2.39	**2.91**	0.65	8.75	**8.10**	3.89	**3.89**	**23038**
0.83	0.62	....	....	2.44	**2 97**	0.45	8.68	**8.23**	3.75	**3.75**	**23305**
0.83	0.81	1.01	0.50	3.15	**3.83**	0.44	9.02	**8.58**	3.65	**3.81**	**22992**
....	0.80	0.79	1.44	3.03	**3.68**	0.40	8.83	**8.43**	3.64	**3.64**	**23274**
1.41	0.56	0.43	1.45	3.85	**4.68**	0.80	9.40	**8.60**	1.08	**6.17**	**23338**
0.98	0.59	0.46	1.91	3.94	**4.79**	0.28	5.08	**4.80**	0.69	**5.59**	**23339**
2.65	1.58	0.45	0.69	5.37	**6.53**	0.27	5.80	**5.53**	4.05	**4.30**	**22984**
....	....	....	....	5.35	**6.50**	0.28	6.05	**5.77**	....	**3.89**	**162**
0.64	0.83	0.79	0.96	3.22	**3.91**	1.48	9.56	**8.08**	4.16	**4.16**	**23070**
0.10	1.37	0.42	0.92	2.81	**3.42**	0.51	8.35	**7.84**	5.15	**5.15**	**23071**
0.00	2.40	0.76	1.09	4.25	**5.17**	0.55	8.15	**7.60**	7.05	**7.05**	**101**
0.26	1.01	0.37	0.70	2.34	**2.84**	0.43	10.39	**9.96**	4.26	**4.26**	**98**
0.00	1.77	0.70	0.69	3.16	**3.84**	0.23	6.41	**6.18**	10.44	**10.44**	**97**
0.28	0.65	0.32	0.54	1.79	**2.18**	0.72	12.59	**11.87**	4.20	**4.20**	**100**

TABLE XIV. ANALYSES OF MIXED FERTILIZERS

Station No.	Manufacturer and Brand.	Grade.	Place of Sampling.
	Sampled by Station:		
	International Agricultural Corp., Boston, Mass.—*Continued*		
95	Buffalo Tobacco Producer	5.5-6-5.5	Manchester
137	Double Strength Fertilizer, 10-8-10	10-8-10	West Suffield
669	Double Strength Fertilizer, 10-8-10	10-8-10	Manchester
91	I. A. C. Connecticut Valley Special	7-6-5	Glastonbury
	Lowell Fertilizer Co., Boston, Mass.		
22875	Lowell Animal Brand, 3-8-4	3-8-4	Cheshire
23244	Lowell Bone Fertilizer, 2-8-2	2-8-2	Shelton
22873	Lowell Potato Phosphate, 4-8-7	4-8-7	Cheshire
23246	Lowell 4-6-10 for Potatoes and Vegetables	4-6-10	Moosup
23041	Lowell 4-8-4 for Potatoes, Corn and Vegetables	4-8-4	Southport
23037	Lowell 5-8-7 for Potatoes and Vegetables	5-8-7	Warehouse Point
23243	Lowell Tobacco 5-4-5 for Tobacco, Fruits and Vines	5-4-5	Warehouse Point
8	Lowell Tobacco 5-4-5 for Tobacco, Fruits and Vines	5-4-5	Windsor
23400	Lowell Tobacco Manure, 5-8-6	5-8-6	East Hartford
22874	Lowell Top Dressing, 7-5-2	7-5-2	Cheshire
	Mapes Fertilizer and Peruvian Guano Co., New York.		
23410	The Mapes Connecticut Valley Special	6-4-7	Suffield
23128	The Mapes Corn Manure	3-8-3	Meriden
23415	The Mapes General Tobacco Manure	5-4-5	Hartford
23330	The Mapes General Truck Manure	5-6-5	Hartford
23414	The Mapes General Use Manure	3-6-4	West Cheshire
23412	The Mapes Grain Brand	2-8-2	Hartford
23411	The Mapes Onion Manure	4-6-4	Hartford
23134	The Mapes Potato Manure	4-7-5	Hazardville
22950	The Mapes Tobacco Ash Constituents	1-4-15	Suffield
23408	The Mapes Tobacco Starter Improved	5-6-1	Windsor Locks
23409	The Mapes Top Dresser	10-4-2	Windsor Locks
23413	The Mapes Tobacco Manure Wrapper Brand	7.5-2-10.5	Warehouse Point

CONTAINING NITROGEN, PHOSPHORIC ACID AND POTASH—*Continued.*

Nitrogen.					Ammonia equivalent to total nitrogen.	Phosphoric Acid.			Potash.		Station No.
In nitrates.	In ammonia.	Organic, water-soluble.	Organic, water-insoluble.	Total.		Citrate-insoluble.	Total.	So-called "Available."	As muriate.	Total.	
%	%	%	%	%	%	%	%	%	%	%	
0.00	2.21	0.41	1.91	4.53	**5.51**	0.18	5.55	**5.37**	0.74	**5.74**	95
0.09	4.54	0.31	2.60	7.54	**9.17**	0.41	8.67	**8.26**	1.59	**9.88**	137
....	....	....	....	7.88	**9.58**	1.18	8.62	**7.44**	....	**10.39**	669
0.77	1.23	0.48	3.22	5.70	**6.93**	2.65	8.80	**6.15**	0.52	**5.77**	91
0.87	0.60	0.28	0.85	2.60	**3.16**	0.72	9.22	**8.50**	4.25	**4.40**	22875
0.06	0.57	0.36	0.57	1.56	**1.89**	0.73	8.93	**8.20**	2.13	**2.13**	23244
1.16	0.80	0.64	0.74	3.34	**4.06**	0.68	9.01	**8.33**	6.99	**7.10**	22873
1.05	0.78	0.63	0.87	3.33	**4.05**	0.55	7.03	**6.48**	10.21	**10.21**	23246
1.05	0.76	0.43	0.89	3.13	**3.81**	0.78	9.03	**8.25**	3.97	**3.97**	23041
1.18	0.81	0.93	1.04	3.96	**4.81**	0.85	8.94	**8.09**	6.89	**6.89**	23037
0.92	0.51	0.60	1.87	3.90	**4.74**	0.35	5.25	**4.90**	0.58	**5.46**	23243
....	....	....	....	4.11	**5.00**	0.20	5.40	**5.20**	....	**5.05**	8
1.48	0.13	0.44	2.05	4.10	**4.98**	1.28	9.98	**8.70**	2.30	**6.89**	23400
0.00	5.21	0.09	0.17	5.47	**6.65**	0.13	5.85	**5.72**	2.14	**2.14**	22874
1.85	0.64	0.89	1.73	5.11	**6.21**	0.95	5.30	**4.35**	0.94	**8.46**	23410
0.90	0.29	0.36	1.18	2.73	**3.32**	1.25	10.33	**9.08**	2.34	**3.67**	23128
1.10	0.51	0.90	1.76	4.27	**5.19**	2.05	5.30	**3.25**	0.78	**6.08**	23415
2.11	0.47	0.42	1.40	4.40	**5.35**	0.70	9.33	**8.63**	2.64	**5.98**	23330
0.84	0.40	0.41	1.13	2.78	**3.38**	1.20	9.90	**8.70**	3.22	**4.72**	23414
0.37	0.23	0.18	1.07	1.85	**2.25**	1.43	11.33	**9.90**	2.86	**2.86**	23412
1.47	0.20	0.29	0.92	2.88	**3.50**	0.65	8.53	**7.88**	0.54	**5.51**	23411
1.41	0.21	0.23	1.10	2.95	**3.59**	1.15	9.40	**8.25**	3.69	**5.50**	23134
....	....	....	....	1.19	**1.45**	1.68	6.82	**5.14**	1.04	**15.03**	22950
1.76	0.44	0.73	1.28	4.21	**5.12**	1.65	9.73	**8.08**	0.62	**2.30**	23408
4.59	0.34	1.93	1.00	7.86	**9.56**	0.75	6.60	**5.85**	2.95	**3.92**	23409
1.80	0.67	1.08	2.93	6.48	**7.88**	1.43	5.38	**3.95**	1.21	**11.46**	23413

TABLE XIV. ANALYSES OF MIXED FERTILIZERS

Station No.	Manufacturer and Brand.	Grade.	Place of Sampling.
	Sampled by Station:		
	W. L. Mitchell, New Haven.		
9	5-8-7 Fertilizer	5-8-7	New Haven
175	5-8-7 Fertilizer	5-8-7	New Haven
	New England Fertilizer Co., Boston, Mass.		
23291	New England Corn Phosphate, 2-8-2	2-8-2	Rockville
38	New England Potato Phosphate, 4-8-7	4-8-7	Unionville
23290	New England Superphosphate, 3-8-4	3-8-4	Rockville
23300	New England 5-8-7 for Potatoes and Market Gardens	5-8-7	Meriden
32	New England Tobacco 5-4-5	5-4-5	Warehouse Point
23295	New England 2-8-3 for Vegetables and Grain	2-8-3	Hamburg
39	New England 4-8-4 for Potatoes, Vegetables and Grass	4-8-4	Hamburg
41	New England Tobacco Manure, 5-8-6	5-8-6	Warehouse Point
	Nitrate Agencies Co., New York.		
23154	Naco Brand, 2-8-2	2.8-11.4-2.8	Danbury
23428	Naco Brand, 4-8-4	4-8-4	Westport
23427	Naco Brand, 4-8-7	4-8-7	Westport
23435	Naco Brand, 5-8-7	5-8-7	Canton Center
23429	Naco Brand Equivalent 5-8-7 Genuine Peruvian Guano Mixture	5.7-9.1-8.0	Greens Farms
23419	Naco Brand Peruvian Guano	12-10-2.5	Suffield
23149	Naco Brand No. 12 Peruvian Guano Mixture	5.2-10.5-5.2	Westport
667	Naco Brand No. 12 Peruvian Guano Mixture	5.2-10.5-5.2	Danbury
23155	Naco Brand No. 14 Peruvian Guano Mixture	4.9-9.9-8.6	Danbury
	Olds & Whipple, Inc., Hartford.		
33	Blue Label Tobacco Fertilizer	6-3-6	Warehouse Point
35	Complete Corn, Potato and Onion Fertilizer	4-8-4	South Manchester.
23190	Complete Tobacco Fertilizer	5-3-5	Warehouse Point

CONTAINING NITROGEN, PHOSPHORIC ACID AND POTASH—*Continued.*

Nitrogen.					Ammonia equivalent to total nitrogen.	Phosphoric Acid.			Potash.		Station No.
In nitrates.	In ammonia.	Organic, water-soluble.	Organic, water-insoluble.	Total.		Citrate-insoluble.	Total.	So-called "Available."	As muriate.	Total.	
%	%	%	%	%	%	%	%	%	%	%	
0.71	2.08	0.52	0.68	3.99	**4.85**	0.53	8.55	**8.02**	6.60	**6.60**	**9**
....	....	....	....	3.85	**4.68**	3.10	11.55	**8.45**	....	**6.22**	**175**
0.07	0.70	0.21	0.66	1.64	**1.99**	0.93	9.75	**8.82**	2.23	**2.23**	**23291**
0.96	0.71	0.83	0.69	3.19	**3.88**	0.63	8.96	**8.33**	6.53	**6.53**	**38**
0.78	0.63	0.31	0.79	2.51	**3.05**	0.65	9.10	**8.45**	4.23	**4.23**	**23290**
0.85	1.10	1.13	0.91	3.99	**4.85**	0.95	9.85	**8.90**	7.23	**7.23**	**23300**
1.27	0.40	0.55	1.85	4.07	**4.95**	0.45	5.55	**5.10**	0.49	**5.13**	**32**
0.03	0.76	0.22	0.60	1.61	**1.96**	0.49	8.37	**7.88**	3.19	**3.19**	**23295**
1.29	0.78	0.53	0.80	3.40	**4.13**	0.58	9.03	**8.45**	4.24	**4.24**	**39**
1.65	0.10	0.46	2.00	4.21	**5.12**	1.05	9.38	**8.33**	1.45	**5.95**	**41**
0.49	0.77	0.54	0.44	2.24	**2.72**	0.93	12.95	**12.02**	2.58	**3.05**	**23154**
0.43	1.49	0.62	0.57	3.11	**3.78**	0.48	9.03	**8.55**	6.17	**6.17**	**23428**
0.50	1.37	0.63	0.70	3.20	**3.89**	0.59	8.28	**7.69**	7.30	**7.30**	**23427**
0.74	1.81	0.51	0.62	3.68	**4.47**	0.85	9.63	**8.78**	5.91	**6.37**	**23435**
0.74	2.05	0.67	0.92	4.38	**5.33**	0.93	10.60	**9.67**	7.08	**7.32**	**23429**
0.00	4.50	1.91	3.77	10.18	**12.38**	1.55	12.05	**10.50**	2.65	**2.65**	**23419**
0.34	1.95	0.56	1.14	3.99	**4.85**	0.77	10.59	**9.82**	5.58	**5.81**	**23149**
....	....	....	....	4.20	**5.11**	0.63	10.90	**10.27**	....	**8.07**	**667**
0.31	1.72	0.80	1.17	4.00	**4.86**	0.90	11.00	**10.10**	8.64	**8.64**	**23155**
1.02	0.10	0.11	3.89	5.12	**6.22**	0.23	4.33	**4.10**	0.69	**7.06**	**33**
0.88	1.06	0.16	1.25	3.35	**4.07**	1.10	9.83	**8.73**	4.32	**4.32**	**35**
1.19	0.00	0.00	3.04	4.23	**5.14**	0.28	4.28	**4.00**	0.70	**5.76**	**23190**

TABLE XIV. ANALYSES OF MIXED FERTILIZERS

Station No.	Manufacturer and Brand.	Grade.	Place of Sampling.
	Sampled by Station:		
	Olds & Whipple, Inc., Hartford.—*Continued.*		
37	Fish and Potash	3-6-5	Hartford
23195	High Grade Starter and Potash Compound	5-4-15	Hartford
31	High Grade Potato Fertilizer	5-8-7	Wethersfield
34	Special Comp. Corn, Onion and Potash Fertilizer	3-8-2	South Manchester.
	Parmenter & Polsey Fertilizer Co., Boston, Mass.		
23466	4-8-4 for Potatoes, Corn and Vegetables	4-8-4	Wallingford
23481	5-8-7 for Potatoes and Market Gardens	5-8-7	New Britain
23465	"P & P" Plymouth Rock Brand for all Crops, 3-8-4	3-8-4	Plainville
	Frank S. Platt Co., New Haven.		
23462	Platco Special, 4-8-6	4-8-6	New Haven
	The Rogers & Hubbard Co., Portland.		
23434	R. & H. All Soils—All Crops Fertilizer	4-10-4	Somers
23034	Hubbard's Bone Base Fertilizer for Oats and Top Dressing	10-3-8	Branford
23036	Hubbard's Bone Base Fertilizer for Seeding Down	3-5-6	Portland
170	Hubbard's Bone Base Fertilizer for Seeding Down	3-5-6	Westville
23033	Hubbard's Bone Base Soluble Corn and General Crops Manure	3-8-6	Branford
23035	Hubbard's Bone Base Soluble Potato Manure	6-8-5	Branford
7	Hubbard's Bone Base Soluble Potato Manure	6-8-5	Naugatuck
23157	Hubbard's Bone Base Soluble Tobacco Manure	6-8-10	Glastonbury
23436	R. & H. Climax Tobacco Brand	5-4-4	Suffield
23433	R. & H. Corn and Grain Fertilizer	1-10-3	Norwich
23147	R. & H. Garden Fertilizer	2-10-4	Hartford
23425	R. & H. High Potash Fertilizer	3-8-10	Branford

CONTAINING NITROGEN, PHOSPHORIC ACID AND POTASH—*Continued.*

Nitrogen.					Ammonia equivalent to total nitrogen.	Phosphoric Acid.			Potash.		Station No.
In nitrates.	In ammonia.	Organic, water-soluble.	Organic, water-insoluble.	Total.		Citrate-insoluble.	Total.	So-called "Available."	As muriate.	Total.	
%	%	%	%	%	%	%	%	%	%	%	
0.93	0.01	0.10	1.83	2.87	**3.49**	0.58	7.35	**6.77**	6.40	**6.40**	**37**
1.40	0.13	0.33	2.51	4.37	**5.31**	0.50	4.70	**4.20**	1.67	**16.04**	**23195**
1.39	0.10	0.94	1.78	4.21	**5.12**	2.60	11.10	**8.50**	0.81	**7.15**	**31**
1.23	0.07	0.13	1.12	2.55	**3.10**	2.20	11.20	**9.00**	2.25	**2.25**	**34**
1.36	0.77	0.42	0.89	3.44	**4.18**	0.70	9.25	**8.55**	4.25	**4.25**	**23466**
1.34	1.01	0.55	1.13	4.03	**4.90**	1.13	9.23	**8.10**	6.72	**6.72**	**23481**
0.88	0.66	0.20	0.75	2.49	**3.03**	0.64	8.64	**8.00**	4.22	**4.22**	**23465**
1.02	0.90	0.50	0.91	3.33	**4.05**	0.68	9.48	**8.80**	6.23	**6.23**	**23462**
1.82	0.09	0.87	0.59	3.37	**4.10**	2.58	12.32	**9.74**	4.47	**4.47**	**23434**
7.55	0.05	0.69	0.27	8.56	**10.41**	2.95	8.53	**5.58**	4.94	**7.70**	**23034**
0.97	0.03	0.27	1.40	2.67	**3.25**	5.05	11.38	**6.33**	6.27	**6.27**	**23036**
....	....	....	....	2.53	**3.08**	4.48	11.77	**7.29**	....	**5.84**	**170**
1.17	0.07	0.33	0.96	2.53	**3.08**	2.80	11.05	**8.25**	6.05	**6.05**	**23033**
2.97	0.19	1.05	0.90	5.11	**6.21**	3.47	11.00	**7.53**	0.90	**5.06**	**23035**
....	....	....	....	5.03	**6.12**	3.28	10.80	**7.52**	....	**4.58**	**7**
2.10	0.15	1.94	0.84	5.03	**6.12**	3.24	10.78	**7.54**	1.20	**10.33**	**23157**
1.53	0.03	0.39	2.16	4.11	**5.00**	0.33	5.60	**5.27**	0.54	**4.69**	**23436**
0.10	0.07	0.48	0.54	1.19	**1.45**	2.71	12.46	**9.75**	3.17	**3.17**	**23433**
0.38	0.15	0.80	0.47	1.80	**2.19**	3.42	12.69	**9.27**	3.90	**3.90**	**23147**
1.06	0.07	0.75	0.63	2.51	**3.05**	3.06	10.64	**7.58**	9.65	**9.65**	**23425**

TABLE XIV. ANALYSES OF MIXED FERTILIZERS

Station No.	Manufacturer and Brand.	Grade.	Place of Sampling.
	Sampled by Station:		
	The Rogers & Hubbard Co., Portland.—*Continued.*		
23148	R. & H. Potato Fertilizer	2-10-4	Branford
23449	R. & H. Richmond's Special Tobacco Formula	5-4-5	New Milford
22964	R. & H. Tobacco Grower, Vegetable Formula	6-4-4	Hartford
22965	R. & H. Tobacco Grower, Vegetable Formula	6-4-4	Hartford
23156	4-8-4 Fertilizer	4-8-4	Guilford
	F. S. Royster Guano Co., Baltimore, Md.		
23443	Royster's Bully Guano	2-8-5	Plainville
23459	Royster's Quality Trucker	4-8-7	Plainville
23453	Royster's Spearhead Guano	3-8-4	Thompsonville
23060	Royster's Top Dresser	7-6-5	Plainville
23444	Royster's Truckers Delight	4-8-4	Milford
23467	Royster's Valley Tobacco Formula	5-4-5	East Windsor Hill
670	Royster's Valley Tobacco Formula	5-4-5	Granby
23468	Royster's Wrapper Brand	7-3-7	Granby
	Sanderson Fertilizer & Chemical Co., New Haven.		
22993	Atlantic Coast Bone, Fish and Potash	2-8-3	Windsor Locks
23063	Complete Tobacco Grower	5-4-5	Windsor Locks
23451	Corn Superphosphate	2-8-2	Hamden
22865	Formula A	4-8-4	Milford
23069	Formula B	4-8-6	Glastonbury
23447	Kelsey's Bone Fish and Potash	3-10-3	Cromwell
23450	Potato Manure	3-8-4	Hamden
22989	Top Dressing for Grass and Grain	6-6-4	New Haven
	M. L. Shoemaker & Co., Philadelphia, Pa.		
23463	Swift-Sure 4-8-5 Potato No. 1	4-8-5	New Milford
23460	Swift-Sure Tobacco and General Use 3-10-3	3-10-3	Thompsonville
23464	Swift-Sure Tobacco Special	5-4-5	New Milford

CONTAINING NITROGEN, PHOSPHORIC ACID AND POTASH—*Continued.*

Nitrogen.					Ammonia equivalent to total n	Phosphoric Acid.			Potash.		Station No.
In nitrates.	In ammonia.	Organic, water-soluble.	Organic, water-insoluble.	Total.		Citrate-insoluble.	Total.	So-called "Available."	As muriate.	Total.	
%	%	%	%	%	%	%	%	%	%	%	
0.34	0.15	0.75	0.50	1.74	**2.11**	2.90	12.81	**9.91**	3.95	**3.95**	23148
1.23	0.03	0.28	2.39	3.93	**4.77**	0.20	4.95	**4.75**	0.37	**5.06**	23449
1.19	0.10	0.35	3.32	4.96	**6.03**	0.61	5.59	**4.98**	0.51	**4.58**	22964
....	....	....	....	4.96	**6.03**	0.55	5.50	**4.95**	0.52	**4.42**	22965
1.92	0.03	0.57	0.78	3.30	**4.01**	2.53	10.54	**8.01**	4.07	**4.07**	23156
0.00	1.10	0.04	0.58	1.72	**2.09**	0.95	9.20	**8.25**	4.87	**4.87**	23443
0.01	2.16	0.18	0.87	3.22	**3.91**	1.23	9.26	**8.03**	6.96	**6.96**	23459
0.00	1.73	0.23	0.69	2.65	**3.22**	1.05	9.38	**8.33**	4.69	**4.69**	23453
0.78	2.37	0.52	1.37	5.04	**6.13**	0.78	7.45	**6.67**	4.97	**4.97**	23060
0.00	2.23	0.41	0.68	3.32	**4.03**	0.58	8.70	**8.12**	3.98	**3.98**	23444
0.42	0.78	0.13	2.52	3.85	**4.68**	0.30	4.75	**4.45**	0.36	**4.93**	23467
....	....	....	....	3.93	**4.78**	0.48	4.93	**4.45**	....	**5.28**	670
0.52	1.29	0.45	2.97	5.23	**6.36**	0.30	3.83	**3.53**	0.77	**7.08**	23468
0.02	0.49	0.43	0.71	1.65	**2.01**	0.90	9.05	**8.15**	3.00	**3.11**	22993
0.92	0.01	0.13	2.94	4.00	**4.86**	0.18	4.28	**4.10**	0.58	**5.98**	23063
0.00	0.42	0.73	0.55	1.70	**2.07**	0.72	8.75	**8.03**	2.22	**2.22**	23451
0.76	1.24	0.66	0.52	3.18	**3.87**	1.11	9.15	**8.04**	4.17	**4.17**	22865
0.77	0.96	0.24	1.58	3.55	**4.32**	0.83	9.03	**8.20**	0.77	**6.28**	23069
0.44	0.71	0.73	0.59	2.47	**3.00**	0.65	10.43	**9.78**	3.22	**3.22**	23447
0.44	0.73	0.83	0.46	2.46	**2.99**	0.50	8.80	**8.30**	4.08	**4.08**	23450
2.77	1.25	0.54	0.53	5.09	**6.19**	0.40	6.59	**6.19**	4.01	**4.19**	22989
0.83	0.07	0.62	1.72	3.24	**3.94**	3.15	12.60	**9.45**	1.58	**5.44**	23463
0.89	0.06	0.47	1.21	2.63	**3.20**	2.78	14.28	**11.50**	0.36	**3.08**	23460
0.93	0.00	0.47	2.75	4.15	**5.05**	1.75	8.25	**6.50**	0.86	**7.98**	23464

TABLE XIV. ANALYSES OF MIXED FERTILIZERS

Station No.	Manufacturer and Brand.	Grade.	Place of Sampling.
	Sampled by Station:		
	Springfield Rendering Co., Springfield, Mass.		
23446	Animal Brand 3-8-4	3-8-4	Thompsonville
23445	Market Garden Grower and Top Dresser 5-8-7	5-8-7	Hazardville
23452	Special Potato, Onion and Vegetable 4-8-4	4-8-4	Stafford Springs
23454	Tobacco Special 5-4-5	5-4-5	Thompsonville
	Standard Agricultural Chemical Corp., New York.		
136	Prepared Alphano Humus	1.5....	Hartford
127	Super-Alphano	5-7-4	New Haven
	Virginia-Carolina Chemical Co., New York.		
30	Aroostook Potato Grower	5-8-7	Guilford
90	Champion Brand	4-8-4	"
23189	Double Owl Brand	4-8-6	"
93	Fish, Phosphate and Potash Brand	2-8-2	Rockville
94	Indian Chief Brand	5-4-5	Hazardville
23193	Perfection Brand	3-9-5	North Haven
92	Tip-Top Brand	8-6-6	North Haven
666	Tip-Top Brand	8-6-6	New Britain
	Wilcox Fertilizer Co., Mystic.		
132	4-8-4, Fertilizer	4-8-4	Montville
133	5-8-7, Fertilizer	5-8-7	Woodstock
374	5-10-5, Mixture	5-10-5	Ellington
131	Corn Special	3-10-4	Montville
23296	Fish and Potash	3-8-3	Mystic
128	Potato and Vegetable Phosphate	4-8-6	Ellington
23292	Tobacco Special	5-4-5	Ellington
	S. D. Woodruff & Sons, Orange.		
23188	Home Mixed Fertilizer	4-8-6	Orange
	Worcester Rendering Co., Auburn, Mass.		
23475	Prosperity Corn and Grain 2-8-2	2-8-2	Putnam
23476	Prosperity Market Garden 5-8-7	5-8-7	Putnam
23473	Prosperity Potato and Vegetable Fertilizer, 4-8-4	4-8-4	Norwich

CONTAINING NITROGEN, PHOSPHORIC ACID AND POTASH—*Continued.*

Nitrogen.					Ammonia equivalent to total nitrogen.	Phosphoric Acid.			Potash.		Station No.
In nitrates.	In ammonia.	Organic, water-soluble.	Organic, water-insoluble.	Total.		Citrate-insoluble.	Total.	So-called "Available."	As muriate.	Total.	
%	%	%	%	%	%	%	%	%	%	%	
0.36	0.54	0.88	0.74	2.52	**3.06**	0.70	9.25	**8.55**	4.14	**4.14**	**23446**
1.16	0.63	1.18	0.93	3.90	**4.74**	0.83	9.55	**8.72**	7.44	**7.44**	**23445**
1.41	0.00	0.91	0.74	3.06	**3.72**	0.65	9.03	**8.38**	4.18	**4.18**	**23452**
1.77	0.00	0.55	1.84	4.16	**5.06**	0.78	6.23	**5.45**	0.52	**5.43**	**23454**
....	....	....	....	1.55	**1 88**	....	0.60	....	....	**0.29**	**136**
1.11	1.52	0.00	1.80	4.43	**5.39**	0.38	7.52	**7.14**	0.60	**4.17**	**127**
0.04	3.17	0.61	0.23	4.05	**4.92**	0.95	8.83	**7.88**	7.13	**7.13**	**30**
0.00	2.48	0.46	0.28	3.22	**3.91**	0.93	9.08	**8.15**	3.75	**3.75**	**90**
0.05	2.59	0.41	0.25	3.30	**4.01**	1.18	8.93	**7.75**	6.38	**6.38**	**23189**
0.13	0.86	0.27	0.40	1.66	**2.02**	1.13	9.28	**8.15**	1.76	**1.76**	**93**
0.36	0.54	0.39	3.09	4.38	**5.33**	0.45	4.82	**4.37**	0.44	**4.53**	**94**
0.00	1.91	0.50	0.19	2.60	**3.16**	1.65	10.23	**8.58**	5.08	**5.59**	**23193**
2.83	2.57	0.57	0.19	6.16	**7.49**	1.00	6.95	**5.95**	3.44	**4.83**	**92**
....	....	....	....	6.38	**7.76**	1.09	7.13	**6.04**	....	**5.55**	**666**
1.70	0.17	0.83	0.80	3.50	**4.26**	0.95	9.53	**8.58**	4.16	**4.16**	**132**
1.79	0.14	0.74	1.30	3.97	**4.83**	2.48	10.85	**8.37**	3.93	**6.74**	**133**
1.84	0.15	0.85	1.23	4.07	**4.95**	1.70	11.55	**9.85**	4.47	**5.23**	**374**
0.87	0.12	0.60	0.80	2.39	**2.91**	0.78	11.25	**10.47**	4.02	**4.02**	**131**
1.07	0.18	0.64	0.77	2.66	**3.23**	0.83	12.10	**11.27**	3.36	**3.36**	**23296**
1.58	0.09	0.48	1.09	3.24	**3.94**	1.40	9.85	**8.45**	2.99	**6.19**	**128**
0.00	0.26	1.51	4.14	5.91	**7.19**	0.28	5.68	**5.40**	0.73	**5.85**	**23292**
1.78	0.00	0.20	1.21	3.19	**3.88**	1.00	7.97	**6.97**	10.76	**10.76**	**23188**
1.04	0.09	0.20	0.43	1.76	**2.14**	0.70	9.05	**8.35**	2.31	**2.31**	**23475**
1.17	0.97	0.83	1.11	4.08	**4.96**	0.79	8.68	**7.89**	7.12	**7.12**	**23476**
0.70	0.77	0.70	1.15	3.32	**4.04**	0.65	8.75	**8.10**	4.00	**4.00**	**23473**

TABLE XIV. ANALYSES OF MIXED FERTILIZERS

Station No.	Manufacturer and Brand.	Grade.	Place of Sampling.
	Sampled by Purchaser:		
	American Agricultural Chemical Co., New York.		
75	National Complete Tobacco Fertilizer	5-4-5	Thompsonville
	Armour Fertilizer Works, New York.		
22610	Armour's, 4-8-4	4-8-4	Preston City
22611	Armour's, 5-8-7	5-8-7	Preston City
	The Berkshire Fertilizer Co., Bridgeport.		
22814	Berkshire Tobacco Special	7-3-5	Windsor Locks
22909	Berkshire Tobacco Special	7-3-5	East Windsor Hill
	Bowker Fertilizer Co., New York.		
342	Bowker's Fertilizer, 5-4-5	5-4-5	Suffield
	The E. D. Chittenden Co., Bridgeport.		
23178	Chittenden's Tobacco Special, 5-4-5	5-4-5	Silver Lane
	L. T. Frisbie Co., New Haven.		
23080	Frisbie's, 5-8-7	5-8-7	Manchester
23144	Frisbie's, 5-8-7	5-8-7	Norwich
23143	Frisbie's Special Vegetable and Potato Grower, 4-8-4	4-8-4	Norwich
	International Agricultural Corp., Boston, Mass.		
23387	Tobacco Fertilizer, 7-6-7	7-6-7	Suffield
	New Jersey Fertilizer & Chemical Co., New York.		
22970	"Croxton Big Crop"	5-8-6	New Preston
	Olds & Whipple, Inc., Hartford.		
23076	High Grade Potato Fertilizer, 5-8-7	5-8-7	Windsor Locks

CONTAINING NITROGEN, PHOSPHORIC ACID AND POTASH—*Continued.*

Nitrogen.					Ammonia equivalent to total nitrogen.	Phosphoric Acid.			Potash.		Station No.
In nitrates.	In ammonia.	Organic, water-soluble.	Organic, water-insoluble.	Total.		Citrate-insoluble.	Total.	So-called "Available."	As muriate.	Total.	
%	%	%	%	%	%	%	%	%	%	%	
....	....	....	....	4.50	**5.47**	0.38	4.65	**4.27**	0.44	**5.24**	**75**
....	....	....	....	3.48	**4.23**	....	....	....	....	....	**22610**
....	....	....	....	2.89	**3.51**	....	....	....	....	....	**22611**
....	....	....	....	5.82	**7.08**	0.26	4.81	**4.55**	....	**5.90**	**22814**
....	....	....	....	6.02	**7.32**	....	4.11	....	....	**6.06**	**22909**
....	....	....	....	3.92	**4.77**	....	4.68	....	....	**4.96**	**342**
....	....	....	....	3.72	**4.52**	0.38	5.63	**5.25**	1.33	**6.09**	**23178**
....	....	....	....	4.04	**4.91**	0.75	9.28	**8.53**	6.94	**6.94**	**23080**
....	....	....	....	4.03	**4.90**	0.73	9.73	**9.00**	7.22	**7.22**	**23144**
....	....	....	....	3.08	**3.74**	0.68	9.15	**8.47**	4.26	**4.26**	**23143**
0.12	2.21	....	....	5.70	**6.93**	0.35	6.35	**6.00**	0.47	**7.36**	**23387**
....	....	....	....	4.19	**5.09**	0.83	9.67	**8.84**	6.22	**6.22**	**22970**
....	....	....	....	4.42	**5.37**	1.57	9.23	**7.66**	0.97	**9.16**	**23076**

TABLE XIV. ANALYSES OF MIXED FERTILIZERS

Station No.	Manufacturer and Brand.	Grade	Place of Sampling.
	Sampled by Purchaser:		
	The Rogers & Hubbard Co., Portland.		
22785	R. & H. Tobacco Grower, Vegetable Formula.....	6-4-4	Burnside.....
	F. S. Royster Guano Co., Baltimore, Md.		
140	Royster's Fertilizer, Sample A..	7-3-7	Rockville.....
141	Royster's Fertilizer, Sample B..	7-3-7	Rockville.....
	The Worcester Rendering Co., Auburn, Mass.		
1	6-6-3, Fertilizer.....	6-6-3	Manufacturer's Sample.....

CONTAINING NITROGEN, PHOSPHORIC ACID AND POTASH—*Concluded.*

Nitrogen.					Ammonia equivalent to total nitrogen.	Phosphoric Acid.			Potash.		Station No.
In nitrates.	In ammonia.	Organic, water-soluble.	Organic, water-insoluble.	Total.		Citrate-insoluble.	Total.	So-called "Available."	As muriate.	Total.	
%	%	%	%	%	%	%	%	%	%	%	
....	....	....	....	4.99	**6.07**	0.70	5.19	**4.49**	....	**4.42**	**22785**
....	....	....	....	5.84	**7.10**	....	4.30	....	....	**6.06**	**140**
....	....	....	....	4.48	**5.45**	....	6.70	....	....	**6.57**	**141**
0.48	1.83	0.81	1.37	4.49	**5.46**	0.83	6.70	**5.87**	3.31	**3.31**	**1**

SPECIAL MIXTURES AND HOME MIXTURES.

Twenty-eight samples of home-mixed goods or fertilizers mixed by manufacturers according to formulas furnished by purchasers, have been analyzed and are reported in Table XVII. Eleven were sampled by the Station and the remainder were submitted by purchasers.

TABLE XVII. ANALYSES OF SPECIAL MIXTURES

Station No.	Manufacturer.	Place of Sampling.
	Sampled by Station:	
195	American Agricultural Chemical Co., New York	Arthur Manning, So. Manchester
188	Apothecaries Hall Co., Waterbury	A. F. Newmarker, Rockville
194	Apothecaries Hall Co., Waterbury	Arthur Manning, So. Manchester
193	Berkshire Fertilizer Co., Bridgeport	" "
196	Berkshire Fertilizer Co., Bridgeport	" "
23386	L. T. Frisbie, New Haven	L. P. Hickey, East Hartford
192	Olds & Whipple, Inc., Hartford	Arthur Manning, So. Manchester
22867		T. W. Ryan, Stratford
22868		T. W. Ryan, Stratford
187		Geo. Webster, Rockville
	Sampled by Purchaser:	
22442		American Sumatra Tobacco Co., Bloomfield
22443		" "
22608		" "
22444		" "
22590		" "
22467		" "
22609		" "
22489		" "
23388	Apothecaries Hall Co., Waterbury	W. J. Burgess, Thompsonville
23348	Berkshire Fertilizer Co., Bridgeport	H. Rashall, Ellington
23176	L. T. Frisbie Co., New Haven	W. T. Clark, Norwich
23074	Olds & Whipple, Inc., Hartford	H. E. Wells, Windsor Locks
23075	" "	H. E. Wells, Windsor Locks
22948	" "	G. Stephen Potwine, Warehouse Point
23029	" "	G. Stephen Potwine, Warehouse Point
23308	" "	H. Whitaker, Hazardville
23309	" "	H. Whitaker, Hazardville
23177		Aleck Sullivan, East Windsor Hill

Nitrogen.					Ammonia equivalent to total nitrogen.	Phosphoric Acid.			Potash.		Station No.
In nitrates.	In ammonia.	Organic, water-soluble.	Organic, water-insoluble.	Total.		Citrate-insoluble.	Total.	So-called "Available"	As muriate.	Total.	
%	%	%	%	%	%	%	%	%	%	%	
....	....	....	....	5.64	**6.86**	1.18	6.00	**4.82**	0.41	**5.31**	**195**
....	....	....	....	5.35	**6.50**	2.18	8.10	**5.92**	0.78	**8.24**	**188**
....	....	....	....	6.11	**7.43**	0.98	6.15	**5.17**	0.65	**6.24**	**194**
....	....	....	....	7.91	**9.62**	0.80	2.88	**2.08**	....	....	**193**
....	....	....	....	5.69	**6.92**	1.55	6.23	**4.68**	0.64	**5.91**	**196**
....	....	....	....	5.35	**6.50**	0.38	8.53	**8.15**	0.89	**8.70**	**23386**
....	....	....	....	6.12	**7.44**	1.08	6.38	**5.30**	0.36	**6.30**	**192**
....	....	....	....	3.92	**4.77**	1.43	11.37	**9.94**	....	**7.36**	**22867**
....	....	....	....	4.70	**5.71**	0.56	8.20	**7.64**	5.87	**6.12**	**22868**
....	....	....	....	4.76	**5.79**	0.93	9.28	**8.35**	....	**4.64**	**187**
....	....	....	....	5.38	**6.54**	....	5.82	....	0.16	**5.93**	**22442**
....	....	....	....	6.02	**7.32**	....	4.87	....	0.16	**6.04**	**22443**
....	....	....	....	5.64	**6.86**	....	6.83	....	0.31	**7.77**	**22608**
....	....	....	....	6.14	**7.47**	....	5.55	....	trace	**7.54**	**22444**
....	....	....	....	5.53	**6.72**	....	4.64	....	0.29	**8.58**	**22590**
....	....	....	....	5.08	**6.18**	....	4.96	....	0.16	**9.44**	**22467**
....	....	....	....	5.92	**7.20**	....	5.36	....	0.35	**7.74**	**22609**
....	....	....	....	5.21	**6.33**	....	5.39	....	0.15	**8.92**	**22489**
0.08	0.13	....	....	5.59	**6.80**	0.30	6.00	**5.70**	0.57	**9.13**	**23388**
....	....	....	....	6.68	**8.12**	....	3.75	....	0.81	**7.88**	**23348**
....	....	....	....	4.93	**5.99**	0.45	9.88	**9.43**	6.09	**6.09**	**23176**
....	....	....	....	5.92	**7.20**	1.10	6.10	**5.00**	1.44	**11.72**	**23074**
....	....	....	....	5.67	**6.89**	1.06	6.28	**5.22**	1.54	**11.39**	**23075**
....	....	....	....	3.67	**4.46**	....	5.78	....	0.98	**14.03**	**22948**
....	....	....	....	2.95	**3.59**	2.33	14.24	**11.91**	4.99	**4.99**	**23029**
....	....	....	....	5.78	**7.03**	0.28	5.80	**5.52**	0.51	**6.66**	**23308**
....	....	....	....	5.60	**6.81**	0.30	6.00	**5.70**	0.52	**6.73**	**23309**
....	....	....	....	6.16	**7.49**	0.43	3.85	**3.42**	0.76	**5.87**	**23177**

VII. MISCELLANEOUS FERTILIZERS, AMENDMENTS AND WASTE PRODUCTS.

WOOD ASHES.

Twenty samples have been examined. No. **22959** was wet and low in potash. No. **23302** was also low grade. The other samples submitted contained from 4.80 to 7.83 per cent of potash and were of good quality. Wood ashes contain from 1 to 2.5 per cent of phosphoric acid and 30 per cent or more of lime, but they are an expensive source of potash. The prevailing price quoted is $5.00 per unit, which is about five times the cost of other equally available forms of potash.

Analyses are given in Table XVIII.

SHEEP MANURE, ETC.

Fourteen samples of this class of materials have been analyzed, ten of which were sampled by the Station agent. Analyses are given in Table XIX.

Ton prices have ranged from $30.00 to $50.00, the avcrage being about $45 00.

TABLE XVIII. ANALYSES OF WOOD ASHES, ETC.

Station No.	Manufacturer.	Purchaser.	Phosphoric acid.	Water-soluble potash.	Insoluble material.
	Sampled by Station:		%	%	%
22959	John Joynt, Lucknow, Canada	J. E. Lathrop, Burnside.	1.22	2.47	.....
	Sampled by Purchaser:				
23023	John Joynt, Lucknow, Canada	Hatheway & Steane, Hartford.....	2.03	7.49	12.17
23024	" "	" "	1.90	5.70	24.20
23025	" "	" "	2.33	7.08	14.56
23026	" "	" "	2.28	6.01	14.25
23027	" "	" "	2.40	5.07	16.22
23202	" "	" "	2.25	5.88	11.38
23203	" "	" "	1.80	7.63	6.83
23255	" "	" "	2.10	5.99	13.78
23256	" "	" "	2.95	7.83	11.40
23257	" "	" "	2.08	6.01	10.63
23258	" "	" "	2.08	4.98	18.75
23200	" "	Hunting Bros., East Hartford.....	2.10	6.86	7.65
23201	" "	Hunting Bros., East Hartford.....	1.88	6.27	10.43
23283	" "	Henry Sachs, Collinsville	2.18	6.82	8.00
22914	" "	Steane, Hartman & Co., Inc., Hartford.....	1.93	6.48	8.71
22944	" "	Steane, Hartman & Co., Inc., Hartford.....	1.47	4.80	7.50
23221	Lucian North, Avon, Conn...	S. W. Eddy, Avon.....	1.53	7.27	5.08
23028	.....	Sperry & Barnes, New Haven.....	2.08	6.18	4.33
23302	.....	A. S. Pons, Bristol.....	1.45	3.19	12.75

TABLE XIX. ANALYSES OF

Station No.	Manufacturer or Brand.	Purchased, Sampled or Sent By.
23260	American Agricultural Chemical Co., New York City	Station Agent from Geo. S. Phelps & Co., Thompsonville
23008	Armour Fertilizer Works, New York	Station Agent from Collins & Freeman, Branford
23393	Berkshire Fertilizer Co., Bridgeport	Station Agent from C. Buckingham & Co., Southport
22982	*Sheep's Head.* Natural Guano Co., Aurora, Illinois	Station Agent from Cadwell & Jones, Hartford
22991	*Groz-It.* Pacific Manure & Fertilizer Co., San Francisco, Cal.	Station Agent from Meech & Stoddard, Middletown
23457	*Premier.* Premier Poultry Manure Co., Chicago, Illinois	Station Agent from Lightbourn & Pond, New Haven
23458	*Premier.* Premier Poultry Manure Co., Chicago, Illinois	Station Agent from Lightbourn & Pond, New Haven
22983	*Wizard.* The Pulverized Manure Co., Chicago, Illinois	Station Agent from F. S. Bidwell & Co., Windsor Locks
23043	*Wizard.* The Pulverized Manure Co., Chicago, Illinois	Station Agent from F. C. Benjamin, Danbury
22986	*So. American Sheep and Goat Manure.* Sanderson Fertilizer & Chemical Co., New Haven	Station Agent from Factory
180	*Groz-It.* Pacific Manure & Fertilizer Co., San Francisco, Cal.	C. L. Bardo, New Haven
181	*South American Sheep and Goat Manure.* Sanderson Fertilizer & Chemical Co., New Haven	C. L. Bardo, New Haven
22811	[1] Pigeon Manure (kept under cover)	Karl Jursek, Mt. Carmel
22812	[2] Pigeon Manure (exposed to weather)	Karl Jursek, Mt. Carmel

[1] Water 42.36%
[2] Water 59.35%

SHEEP MANURE, ETC.

Total nitrogen.	Ammonia equivalent to total nitrogen.		Phosphoric Acid.				Potash.		Station No.
			Available.		Total.				
	Found.	Guaranteed.	Found.	Guaranteed.	Found.	Guaranteed.	Found.	Guaranteed.	
%	%	%	%	%	%	%	%	%	
2.12	2.58	1.75	....	....	1.30	0.75	2.07	2.00	23260
1.31	1.59	1.50	....	....	0.98	1.00	3.04	2.00	23008
2.34	2.84	2.18	....	....	1.28	1.00	2.14	2.00	23393
2.47	3.00	2.73	1.66	1.00	1.75	1.25	2.07	2.00	22982
1.33	1.62	1.80	....	....	0.81	1.25	2.76	3.00	22991
1.81	2.20	2.25	0.80	1.00	0.88	1.25	2.57	2.00	23457
5.25	6.38	5.00	3.10	1.70	3.28	2.70	1.44	1.30	23458
2.07	2.52	2.43	1.36	1.25	1.45	....	2.04	2.00	22983
2.01	2.44	2.10	1.05	1.00	1.43	....	1.56	1.00	23043
1.30	1.58	1.50	....	....	0.95	1.00	2.70	2.50	22986
1.25	1.52	....	....	....	0.90	....	2.94	....	180
1.49	1.81	....	....	....	1.00	....	2.87	....	181
3.80	4.62	....	....	....	1.76	....	1.39	....	22811
0.93	1.13	....	....	....	1.19	....	0.77	....	22812

SEWAGE SLUDGE.

142. *Sludge* from Sewage Disposal Plant, Stamford.
Analysis:

Water 17.34 per cent, ash 38.95 per cent, organic and volatile matter 43.71 per cent, nitrogen 2.27 per cent.

21860. *Activated sludge.* Sanitary District of Chicago.
Manufacturer's sample. This is the product obtained in the process of purifying sewage by aeration methods.
Analysis:

Nitrogen in ammonia 0.06 per cent, organic nitrogen 5.42 per cent, total nitrogen 5.48 per cent, active insoluble organic nitrogen 2.93 per cent, inactive insoluble organic nitrogen 1.79 per cent, available phosphoric acid 3.00 per cent, total phosphoric acid 3.91, total potash 0.79 per cent.

The activity of the insoluble organic nitrogen is about 62 per cent by the method employed (alkaline permanganate).

LIME.

The application of lime for purposes of soil improvement has been practiced since very remote times. Marl and ash were used for this by the ancient Greeks and Romans and in early English history the practice of spreading chalk on the land is recorded. The early colonists in America brought the practice with them, and marl, ashes, and gypsum or land plaster are conspicuous in the records of colonial agriculture. With the advent of artificial fertilizers the use of liming materials was largely suspended but modern agricultural practice has restored lime to wider recognition than ever before.

In the earlier sense of the term "lime", a miscellaneous group of calcium-containing materials were included such as marls, chalk, oyster and clam shells, limestone, marble, and the ashes of wood and other organic substances in which calcium is combined wholly or in part as carbonate; gypsum or land plaster which is calcium sulphate; and phosphate of lime which is derived from phosphatic rocks and from bone. The current usage of the term, however, is more restricted and applies chiefly to calcitic and dolomitic limestones, oyster shell lime, calcareous marls and the several forms of lime derived from them.

The practical use of lime in New England may be discussed very briefly as follows:

1. The chief function of lime is to make the soil less "acid". The exact nature of this "acidity" is a matter on which scientists are not entirely agreed, but all agree that lime will change the reaction.

2. The soils of Connecticut are usually acid, due to lime deficiency of the rock from which they are derived, the relatively high leachiness of our soils, and the long period of time which

most of the tillable area has been under cultivation. Also, due to the variable factors of original soil material, leachiness and past agricultural practice, our soils vary widely in the degree of acidity.

3. We are not so much concerned with soil acidity as such, as with the success of a large number of crops such as clover, alfalfa, timothy, redtop, tobacco, potatoes, tomatoes, lettuce, beets, carrots, spinach and many others. It has also been shown, particularly by the Rhode Island Station, that crops vary greatly in their sensitiveness to acidity and in their response to applications of lime. For instance, red top, strawberries and watermelons do very well under acid conditions while others, like beets, onions and alfalfa, require a condition much less acid. Certain diseases, like potato scab and tobacco root-rot, are controlled by keeping the soil moderately acid.

4. A knowledge of the intensity of soil acidity is manifestly of great importance as a guide to farm practice in regard to any given crop to be grown. The "litmus paper" test was formerly used in this connection, but it is not sufficiently sensitive to show the finer distinctions in soil reaction that modern research has shown to be necessary, and there are much better methods, which, while far more perfect, do give a fairly accurate estimate of the degree and intensity of the acidity.

5. Our liming practice should therefore be based on the following information:

a– What crops are to be grown?
b– What amounts of stable manure are used?
c– What kinds and amounts of fertilizer are used?
d– When, in what form and what amounts has lime been used?
e– What is the reaction of the soil?

This last can be learned by sending representative samples from various fields to the Experiment Station. Such samples should be accompanied by the information indicated in a, b, c and d above, if advice is desired relative to the use of lime.

The inference should not be drawn that we now have accurate information on all the problems concerned with "acidity," but progress is being made and on certain crops there is quite accurate information.

The relation between actual lime (calcium oxide, CaO), and the several natural and manufactured lime products is illustrated as follows: If 100 lbs. of pure crushed limestone are burned in a kiln at suitable temperature (650-900 °C. or 1200-1650 °F.), 56 pounds of actual lime (calcium oxide, CaO), are obtained, the remaining 44 pounds being lost in the form of carbon dioxide gas (CO_2). This actual lime is known also by other names such as "stone lime" or "quicklime". Actual lime or quicklime is very

irritating to handle and in practice slaked lime is more often used. This is obtained by treating quicklime with water, with which it combines vigorously with the production of considerable heat. There is enough moisture in the air to accomplish the slaking process, but a longer time is required. The 56 lbs. of actual lime obtained from the original 100 lbs. of limestone will obviously increase in weight as it combines with water and will weigh 74 lbs. when completely slaked. This slaked lime is otherwise known as hydrated lime, calcium hydrate or calcium hydroxide. When quicklime is allowed to air-slake, however, it absorbs carbonic acid as well as moisture from the air so that the product is a mixture containing some quicklime, hydrated lime and carbonate of lime, or, in other terms, calcium oxide, calcium hydrate and calcium carbonate.

The changes described take place also in the case of limestones which contain magnesium (dolomitic limestones), the product of burning being in such cases the mixed oxides of lime and magnesia.

Commercial liming materials are judged on the basis of actual lime and magnesia (oxides of calcium and magnesium), which they contain, and upon their degree of fineness. The various products are quite variable in composition but in general they will contain mixed oxides about as follows:

Material	Oxides of calcium and magnesium (CaO + MgO)
	%
Carbonates:	
Limestone	45–55
Oyster shell	40–50
Marl	40–50
Burned Lime:	
Hydrated lime, high grade, less than 10% carbonates	65–75
Low grade, mixture of hydrate and carbonate	55–65
Lime ashes	50–60

The effectiveness of lime in the soil will depend directly upon its degree of fineness. Neither the carbonates nor hydrated limes are readily soluble in soil water and the rate at which they will be dissolved will depend upon the size of the particles. The smaller the grains the greater the relative amount of surface exposed to the action of the solvent.

Fineness of Lime.

Since there is a direct relationship between the fineness of lime products and their rate of availability in the soil, it might appear that the greatest degree of fineness is desirable. Yet because of the cost of grinding the lime to a very fine condition and the rapidity with which such material disappears in the soil, a medium ground lime seems to be the more desirable commercial product. A reliable authority assumes that pulverized limestone, all of which will pass a 10 mesh sieve, 70% of which will pass a 50 mesh sieve, and 50% of which will pass a 100 mesh sieve, should give excellent results and yet be cheap enough to make its use worth while. In Ohio the standard required by law for agricultural ground limestone is that 95% of the material shall pass a 10 mesh screen, 50% shall pass a 50 mesh screen, and 30% shall pass a 100 mesh screen.

If immediate effects are desired in the use of moderate quantities of lime for a special crop of high money value, extreme fineness may be desirable, regardless of the greatly increased cost. This is usually obtained in hydrated limes.

In table XX are given analyses of 46 samples of lime. Some of these were collected and examined two years ago but the results have not been published.

Comments on Analyses.

22349. This was a sample of limestone dust which accumulated in the manufacture of poultry grit and was not offered for sale as an agricultural lime.

23030, 23031, 23254. The first two samples were submitted by purchasers. The manufacturer advised that the analysis of **23030** was quite unlike the composition of their product as shown by frequent check analyses of their own. Accordingly an official sample, **23254,** was drawn which was supposed to be the same material as **23030** but was sampled from different stock. This showed a composition substantially in accord with the manufacturer's claim and in agreement also with purchaser's sample **23031.** Evidently **23030** had become mixed with some material containing a relatively large amount of insoluble matter.

The cost of lime, so far as ton prices have been quoted to us, show considerable variation. Thus, four quotations for limestone have varied from $6.75 to $10.00 per ton. For hydrated lime, containing from 62 to 77 per cent of effective oxides, prices have ranged from $9.50 to $15.00.

TABLE XX. ANALYSES OF

LIMESTONE, ETC.

Station No.	Manufacturer or Brand.	Place of Sampling.	Chemical Analysis. Lime (CaO). Found.	Lime (CaO). Guaranteed.	Magnesia (MgO). Found.	Magnesia (MgO). Guaranteed.	Total oxides.	Insoluble in acid.	Carbon dioxide.	Mechanical Analysis. 20 mesh.	40 mesh.	50 mesh.	80 mesh.	100 mesh.	Station No.
			%	%	%	%	%	%	%	%	%	%	%	%	
	Ground Limestone.														
	Manufacturer Unknown.														
23482	Berkshire Ground Limestone	Southport	41.95	.....	9.17	.....	51.12	6.13	28.18	95.00	85.50	76.50	67.00	63.50	23482
	C. W. Coe & Sons, Northford.														
23494	Ground Limestone	Factory	52.91	.....	0.70	.....	53.61	3.21	.....	78.50	61.00	52.50	45.00	43.00	23494
	Kapailo Mfg. Co., Inc., New York.														
22349	Limestone Dust	New Haven	30.74	.....	21.09	....	51.83	1.85	.....	.....	100.00	87.00	59.00	50.00	22349
	Grangers Mfg. Co., West Stockbridge, Mass.														
19944*	Grangers Agricultural Limestone	Hazardville	36.80	35.00	9.84	1.00	46.64	13.84	.....	.....	.....	82.00	....	53.50	19944
19945*	" "	Suffield	35.72	35.00	9.78	1.00	45.50	16.22	.....	.....	.....	77.50	....	59.50	19945
19946*	" "	Waterbury	43.46	35.00	6.88	1.00	50.34	8.80	.....	.....	.....	67.00	....	42.00	19946
23030†	" "	Hartford	39.96	.....	0.65	.....	40.61	28.83	.....	100.00	100.00	99.50	94.50	89.50	23030
23031†	" "	Avon	51.82	.....	0.97	.....	52.79	6.85	.....	100.00	100.00	99.00	92.00	87.00	23031
23254	Grangers Limestone	Windsor	50.68	.....	1.26	.....	51.94	8.70	.....	100.00	100.00	99.50	93.00	89.00	23254
334	Grangers Limestone	Rockville	51.85	.....	0.58	.....	52.43	6.37	41.22	.....	.....	.....	.....	.....	334
	Clifford L. Miller, West Stockbridge, Mass.														
23491	Monarch Brand	Bridgeport	43.27	36.87	8.42	13.72	51.69	5.63	39.46	98.00	87.00	77.00	66.00	62.50	23491
	The Stearns Lime Co., Danbury.														
18529*	Ground Limestone	Danbury	41.80	.....	4.87	.....	46.67	.....	.....	.....	.....	88.80	.....	76.30	18529
18561*	" "	Roxbury	43.17	.....	.....	.....	.....	13.27	.....	.....	.....	.....	.....	.....	18561
19941*	" "	Branford	46.06	43.00	4.44	2.00	50.50	9.45	.....	.....	.....	85.50	.....	65.00	19941
	White Marble Products Co., Ashley Falls.														
18530*	Ground Limestone	Ashley Falls, Mass.	29.98	.....	20.62	.....	50.60	.....	.....	.....	.....	77.40	.....	48.80	18530
18560*	Ground Limestone	Roxbury	30.74	.....	.....	.....	.....	1.60	.....	.....	.....	.....	.....	.....	18560
	Hydrated Lime.														
	Cheshire Lime Mfg. Co., Cheshire, Mass.														
20013*	Agricultural Lime	Hartford	61.28	58.00	2.48	0.60	63.76	1.36	.....	.....	.....	.....	.....	.....	20013
	Conn. Lime Co., Canaan.														
19943*	Agricultural Lime	Hartford	47.38	.....	31.37	27.00	78.75	1.78	4.41	.....	.....	.....	.....	.....	19943
19948*	Dry Hydrated Lime	Litchfield	48.36	.....	30.46	.....	78.82	1.89	6.11	.....	.....	.....	.....	.....	19948
19949*	Air Slacked Lime (waste)	Canaan	30.51	.....	20.67	.....	51.18	1.48	10.21	.....	.....	.....	.....	.....	19949
20014*	Canaan Agricultural Lime	Canaan	44.14	52.00	29.25	23.00	73.39	1.00	3.90	.....	.....	.....	.....	.....	20014
20017*	Lee Hydrate, Conn. Brand	East Canaan	46.98	.....	32.08	.....	79.06	1.48	1.98	.....	.....	.....	.....	.....	20017
20018*	Air Slacked Lime (waste)	Canaan	39.80	.....	27.80	.....	67.60	1.23	.....	.....	.....	.....	.....	.....	20018
23485	Agricultural Lime	Hartford	51.62	.....	12.51	.....	64.13	1.33	15.47	91.00	72.00	58.50	47.50	44.50	23485
23486	Burned Lime Screenings	Ellington	41.44	.....	27.23	.....	68.67	1.00	4.32	73.00	43.50	34.00	28.50	27.50	23486
	Hoosac Valley Lime Co., Adams, Mass.														
23077†	Agricultural Lime	Warehouse Point	60.58	58.00	0.69	0.50	61.27	3.38	.....	75.50	52.50	39.50	29.00	26.00	23077

* Analyzed in 1922.
† Sampled by Purchaser.

TABLE XX. ANALYSES OF

Station No.	Manufacturer or Brand.	Place of Sampling.
	Hydrated Lime.	
	Knickerbocker Lime Co., Philadelphia.	
23489	Knickerbocker Hydrated Lime	Glastonbury
	Lee Lime Co., Lee, Mass.	
22830†	Hydrated Lime	Hartford
22831	Agricultural Lime	Hartford
23492	Lee Hydrated Agricultural Lime	Pequabuck
	Clifford L. Miller, Stockbridge, Mass.	
22833†	Hydrated Agricultural Lime	Avon
	New England Lime Co., Danbury.	
20012*	Adam's Granular Finishing Lime	Windsor Locks
20016*	Connecticut Agricultural Lime	East Canaan
20015*	" "	New Milford
19942*	" "	Willimantic
22832†	Hydrated Lime	Avon
22861†	Agricultural Hydrated Lime, Nelco Brand	Hartford
23483	Burned Lime	Southport
23488	Connecticut Agricultural Lime	New Hartford
23490	Hydrated Mason Lime	Milford
23493	Granular Lime	Hartford
340	Connecticut Agricultural Lime	Middlefield
	Rockland & Rockport Lime Corp., Rockland, Me.	
20187*	R. R. Land Lime	Somers
22856†	R. R. Land Lime	Hartford
23487	R. R. Land Lime, High Calcium Lime	Hazardville
308	R. R. Land Lime	Granby

* Analyzed in 1922.
† Sampled by purchaser.

LIMESTONE, ETC.—*Concluded*

Chemical Analysis.							Mechanical Analysis.					
Lime (CaO).		Magnesia (MgO).										
Found.	Guaranteed.	Found.	Guaranteed.	Total oxides.	Insoluble in acid.	Carbon dioxide.	20 mesh.	40 mesh.	50 mesh.	80 mesh.	100 mesh.	Station No.
%	%	%	%	%	%	%	%	%	%	%	%	
46.10	45.00	29.42	30.00	75.52	1.39	1.56	100.00	100.00	99.00	97.00	95.00	23489
48.57	45.00	33.30	39.00	81.87	1.10	0.71	100.00	100.00	99.00	96.00	94.00	22830
42.16	.....	28.18	.....	70.34	0.80	11.89	55.00	33.00	27.00	24.00	23.00	22831
48.25	.....	32.53	.....	80.78 [1]	1.21	1.36	100.00	100.00	98.00	95.00	94.00	23492
63.46	.....	7.60	.....	71.06	1.43	6.09	99.00	94.00	85.00	75.00	70.00	22833
87.38	.....	4.45	.....	91.83	1.82	2.74	.....	.....	.....	.....	.....	20012
45.86	40.00	31.44	15.00	77.30	0.84	3.00	.....	.....	.....	.....	.....	20016
48.20	40.00	32.53	15.00	80.73	2.73	4.12	.....	.....	.....	.....	.....	20015
50.48	.....	21.00	.....	71.48	3.39	4.85	.....	.....	.....	.....	.....	19942
47.65	.....	24.14	.....	71.79	1.61	13.64	100.00	100.00	99.00	96.00	93.00	22832
42.65	49.34	29.39	33.54	72.04	1.31	12.59	100.00	100.00	100.00	98.00	96.00	22861
46.14	.....	30.75	.....	76.89	0.88	1.58	81.50	67.00	59.50	55.00	54.50	23483
47.31	.....	30.57	.....	77.88	1.65	1.55	100.00	100.00	100.00	98.00	96.50	23488
46.69	.....	30.04	.....	76.73	1.86	0.88	100.00	100.00	100.00	98.00	96.50	23490
87.33	.....	1.34	.....	88.67	2.07	5.84	68.50	36.50	20.50	9.50	7.50	23493
46.23	72.00 [2]	31.38	7.00 [3]	77.61	1.95	1.51	100.00	100.00	100.00	98.50	97.00	340
61.62	60.00	1.69	0.80	63.31	2.00	.....	.....	.....	.....	.....	.....	20187
60.50	60.00	1.24	0.50 [4]	61.74	3.22	20.35	95.00	86.00	78.00	68.00	65.00	22856
59.95	60.00	2.35	0.50 [4]	62.30	3.85	15.88	96.00	88.00	79.50	66.50	63.00	23487
66.40	60.00	1.20	0.50 [4]	67.60	....	10.67	98.50	94.00	90.00	83.00	79.50	308

[1] Guaranty: Total oxides 85 per cent.
[2] Guaranty: 70-80 per cent.
[3] Guaranty: 7-10 per cent.
[4] Guaranty: 0.5-5.0 per cent.

MISCELLANEOUS.

23430. *Potash-Marl.* Potash-Marl, Inc., New York. Sampled by the Station agent from stock of F. H. Leggett & Co., Stamford. Only phosphoric acid is guaranteed.
Analysis:

Available phosphoric acid found 0.42 per cent, guaranteed 0.47 per cent, total 1.05 per cent, guaranteed 1.30 per cent.

This material may contain 6 per cent or more of potash not, however, in water soluble forms. The phosphoric acid and total potash in this fertilizer are probably overvalued at $5.00 per ton but the price quoted is $40.00.

174. *Carbit.* The Hyper-Humus Co., Newton, N. J. This material was sampled from the stock of Olds and Whipple, Inc., Hartford. The chief value claimed for it by the manufacturers is to be found in the beneficial bacteria with which it is inoculated. The Station cannot judge its worth from that standpoint. It is recommended for tobacco and its usefulness can only be determined by experiment.

23235 and **23370.** *Hair Tankage.* Berkshire Fertilizer Co., Bridgeport. Sampled by Station agent at the factory. The two samples contained 2.74 and 3.34 per cent of ammonia respectively. It was guaranteed to contain 3 per cent ammonia.

22966. *Base Goods.* The Rogers and Hubbard Co., Portland. This material was examined for quality of its nitrogen as follows:

Nitrogen in nitrates 0.26 per cent, in ammonia 0.68 per cent, water-soluble organic 2.02 per cent, water-insoluble organic 2.18 per cent, total 5.14 per cent.

The activity of the insoluble organic nitrogen was 66.2 per cent by the alkaline method and 89.6 per cent by the neutral method.

22498. *Burnt Bone.* This was a waste product sent by R. E. Gerth of West Hartford. Most of the nitrogen had been destroyed but the phosphoric acid content was 38.92 per cent.

22967 and **22699.** *Coal.* The first was a sample of Station coal and the second was submitted by C. Q. Eldredge of Mystic. They contained 8.56 and 21.77 per cent of ash respectively.

Eight other samples of unclassified materials including soils require no particular comment.

CHECK COTTONSEED MEAL AND CHECK FERTILIZERS.

The laboratory has continued its co-operation in the program of the American Oil Chemists' Society in testing weekly samples of cottonseed meal, and of the Royster Guano Co. in analyzing monthly samples of various fertilizers. Thirty samples of meal and twelve of fertilizers have been reported.

BULLETIN 262 DECEMBER, 1924

Connecticut Agricultural Experiment Station

New Haven, Connecticut

The Rainbow Forest Plantations

Guide to Experimental Plots

and

Report of Progress

1924

Forestry Publication No. 15

The Bulletins of this Station are mailed free to citizens of Connecticut who apply for them, and to other applicants as far as the editions permit.

CONNECTICUT AGRICULTURAL EXPERIMENT STATION

OFFICERS AND STAFF

December, 1924.

BOARD OF CONTROL.

His Excellency, Charles A. Templeton, *ex-officio, President.*

George A. Hopson, *Secretary*.....Mount Carmel
W. L. Slate, Jr., *Director and Treasurer*.....New Haven
Joseph W. Alsop.....Avon
Charles R. Treat.....Orange
Elijah Rogers.....Southington
Edward C. Schneider.....Middletown
Francis F. Lincoln.....Cheshire

STAFF.

E. H. Jenkins, Ph.D., *Director Emeritus.*

Administration.
W. L. Slate, Jr., B.Sc., *Director and Treasurer.*
Miss L. M. Brautlecht, *Bookkeeper and Librarian.*
Miss J. V. Berger, *Stenographer and Bookkeeper.*
Miss Mary Bradley, *Secretary.*
William Veitch, *In charge of Buildings and Grounds.*

Chemistry. Analytical Laboratory.
E. M. Bailey, Ph.D., *Chemist in Charge.*
R. E. Andrew, M.A.
C. E. Shepard
Owen L. Nolan
Harry J. Fisher, A.B.
W. T. Mathis
Assistant Chemists.
Frank C. Sheldon, *Laboratory Assistant.*
V. L. Churchill, *Sampling Agent.*
Miss Mabel Bacon, *Stenographer.*

Biochemical Laboratory.
T. B. Osborne, Ph.D., Sc.D., *Chemist in Charge.*

Botany.
G. P. Clinton, Sc.D., *Botanist in Charge.*
E. M. Stoddard, B.S., *Pomologist.*
Miss Florence A. McCormick, Ph.D., *Pathologist.*
Willis R. Hunt, M.S., *Graduate Assistant.*
G. E. Graham, *General Assistant.*
Mrs. W. W. Kelsey, *Secretary.*

Entomology.
W. E. Britton, Ph.D. *Entomologist in Charge; State Entomologist.*
B. H. Walden, B.Agr.
M. P. Zappe, B.S.
Philip Garman, Ph.D.
Assistant Entomologists.
Roger B. Friend, B.S., *Graduate Assistant.*
John T. Ashworth, *Deputy in Charge of Gipsy Moth Work.*
R. C. Botsford, *Deputy in Charge of Mosquito Elimination.*
Miss Gladys M. Finley, *Stenographer.*

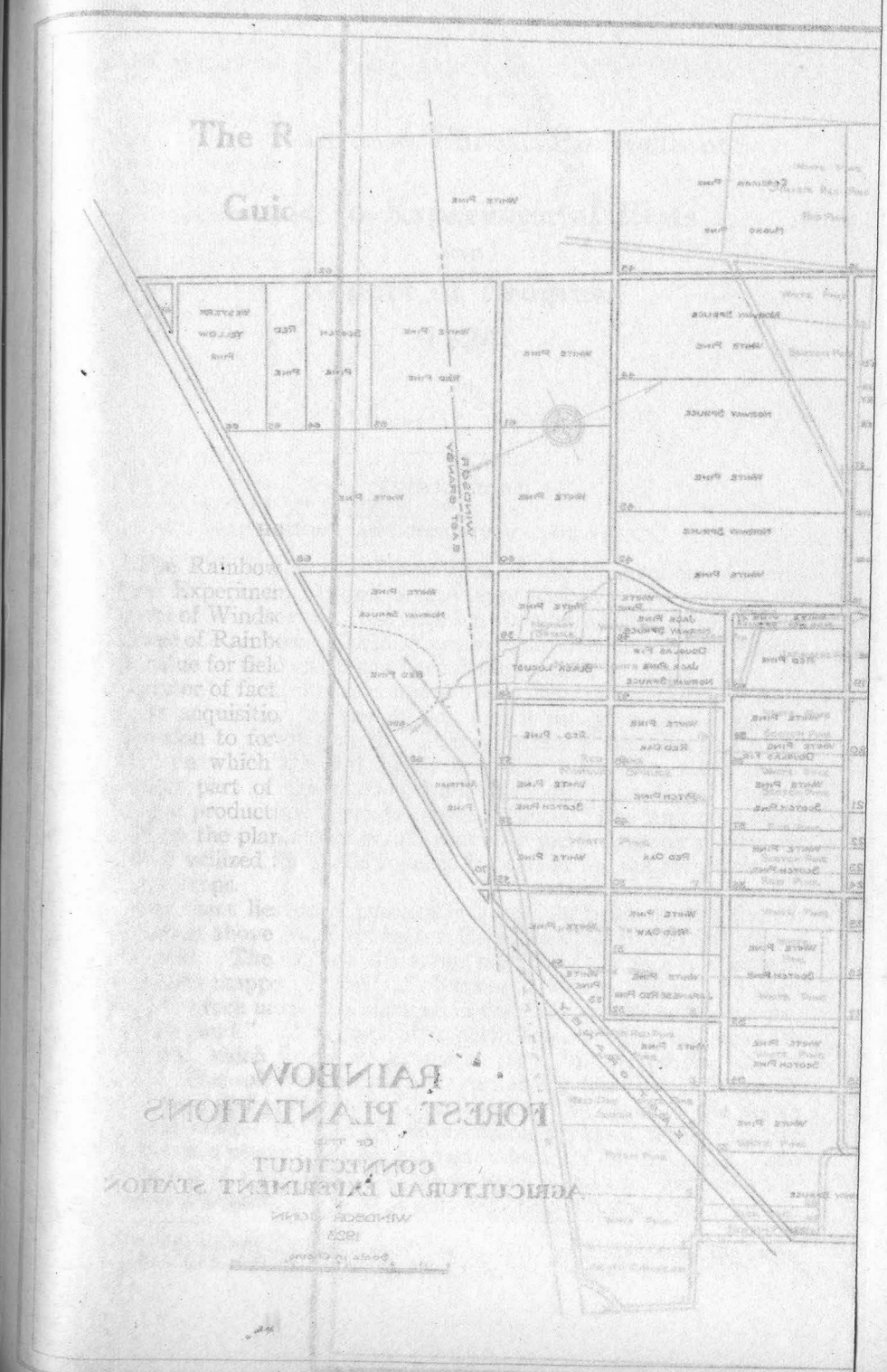
Forestry.
Walter O. Filley, *Forester in Charge.*
A. E. Moss, M.F., *Assistant Forester.*
H. W. Hicock, M.F., *Assistant Forester.*
Miss Pauline A. Merchant, *Stenographer.*

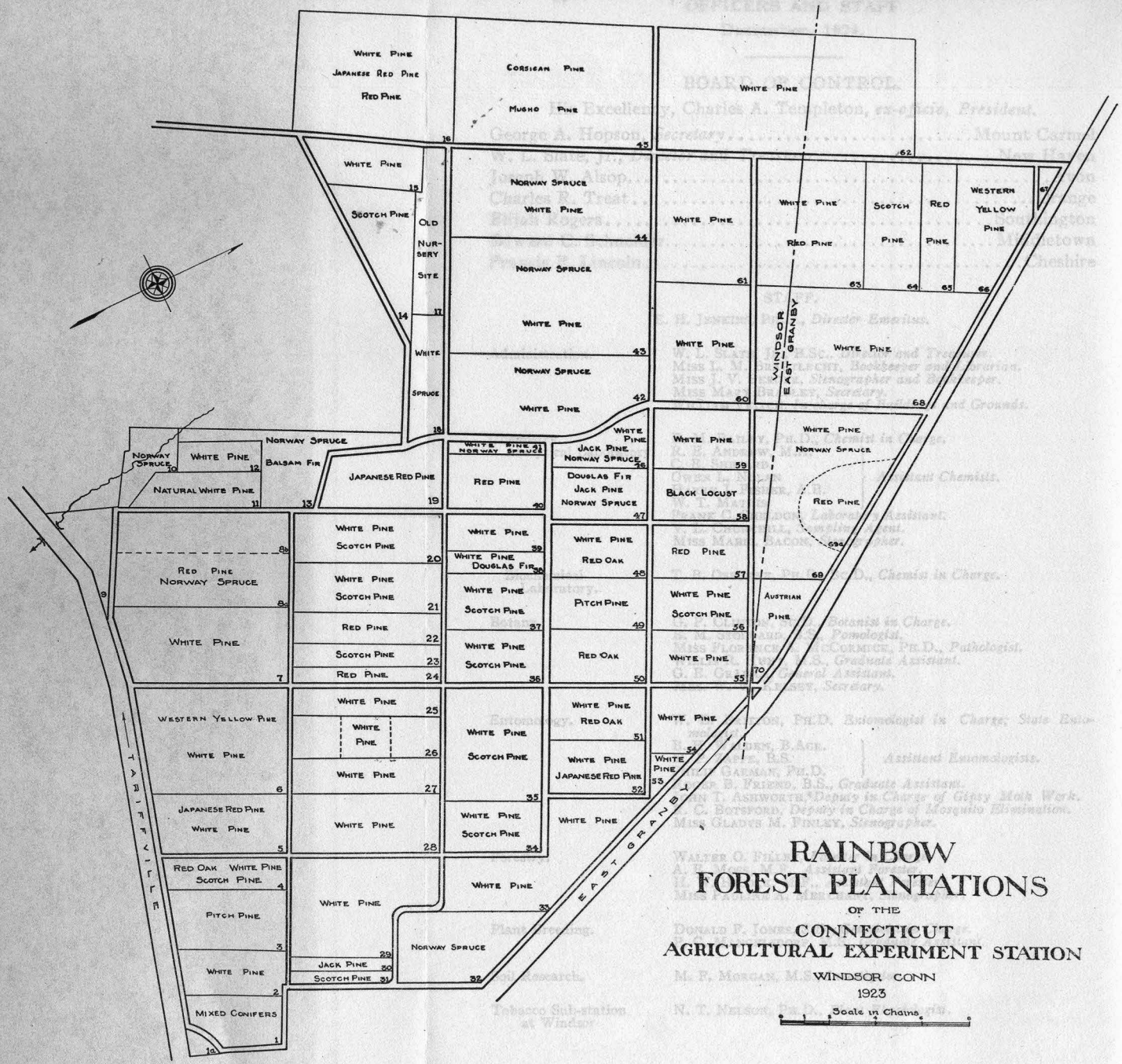
Plant Breeding.
Donald F. Jones, S.D., *Geneticist in Charge.*
P. C. Mangelsdorf, M.S., *Graduate Assistant.*

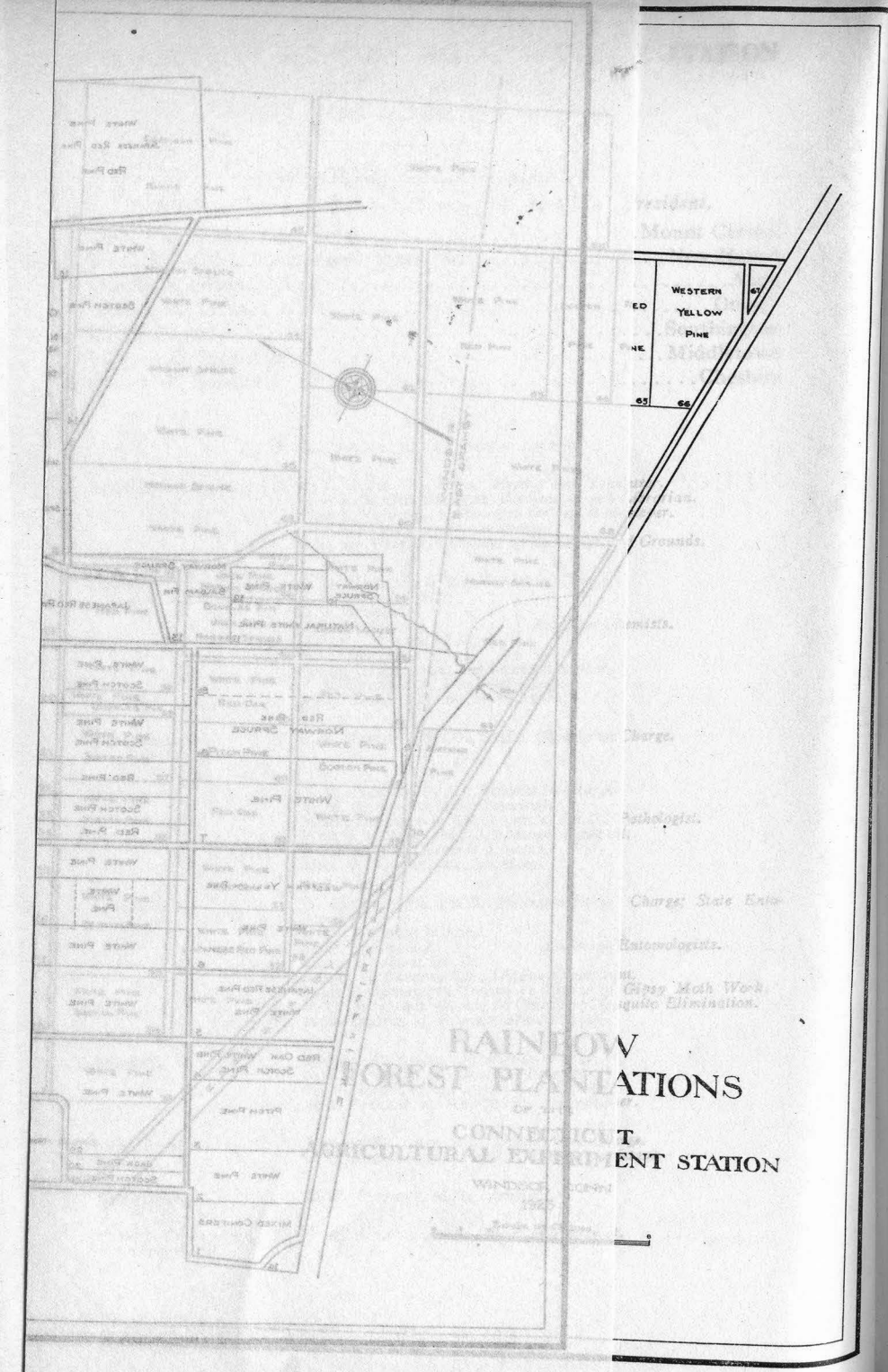
Soil Research.
M. F. Morgan, M.S., *Investigator.*

Tobacco Sub-station at Windsor
N. T. Nelson, Ph.D., *Plant Physiologist.*

The Wilson H. Lee Co.




WHITE PINE
JAPANESE RED PINE
RED PINE
CORSICAN PINE
MUGHO PINE
WHITE PINE
WHITE PINE
SCOTCH PINE
OLD NURSERY SITE
NORWAY SPRUCE
WHITE PINE
NORWAY SPRUCE
WHITE PINE
NORWAY SPRUCE
WHITE PINE
WHITE PINE
WHITE PINE
RED PINE
SCOTCH PINE
RED PINE
WESTERN YELLOW PINE
WHITE PINE
WHITE PINE
WINDSOR
EAST GRANBY
NORWAY SPRUCE
NORWAY SPRUCE
WHITE PINE
BALSAM FIR
NATURAL WHITE PINE
JAPANESE RED PINE
RED PINE
WHITE PINE
NORWAY SPRUCE
JACK PINE
NORWAY SPRUCE
DOUGLAS FIR
JACK PINE
NORWAY SPRUCE
WHITE PINE
BLACK LOCUST
WHITE PINE
NORWAY SPRUCE
RED PINE
RED PINE
NORWAY SPRUCE
WHITE PINE
SCOTCH PINE
WHITE PINE
SCOTCH PINE
RED PINE
SCOTCH PINE
RED PINE
WHITE PINE
DOUGLAS FIR
WHITE PINE
SCOTCH PINE
WHITE PINE
SCOTCH PINE
WHITE PINE
RED OAK
PITCH PINE
RED OAK
RED PINE
WHITE PINE
SCOTCH PINE
WHITE PINE
AUSTRIAN PINE
WESTERN YELLOW PINE
WHITE PINE
JAPANESE RED PINE
WHITE PINE
WHITE PINE
WHITE PINE
WHITE PINE
SCOTCH PINE
WHITE PINE
RED OAK
WHITE PINE
WHITE PINE
JAPANESE RED PINE
WHITE PINE
WHITE PINE
WHITE PINE
SCOTCH PINE
WHITE PINE
RED OAK WHITE PINE SCOTCH PINE
PITCH PINE
WHITE PINE
MIXED CONIFERS
WHITE PINE
WHITE PINE
JACK PINE
SCOTCH PINE
NORWAY SPRUCE
TARIFFVILLE
EAST GRANBY
RAINBOW
FOREST PLANTATIONS
OF THE
CONNECTICUT
AGRICULTURAL EXPERIMENT STATION
WINDSOR CONN
1923
Scale in Chains



The Rainbow Forest Plantations

Guide to Experimental Plots
and
Report of Progress
1924

By

HENRY W. HICOCK

INTRODUCTION

HISTORY AND DESCRIPTION OF TRACT.

The Rainbow Forest Plantations of the Connecticut Agricultural Experiment Station occupy approximately 100 acres in the towns of Windsor and East Granby, about one-half mile west of the village of Rainbow. The land was purchased at a low figure because its value for field crops had been demonstrated to be very low. As a matter of fact, cultivation had been given up several years prior to its acquisition by the Station and it was in various stages of reversion to forest growth. During recent years adjoining property, on which the soil differs but very little from that on the greater part of the Station land, has been cleared and utilized for the production of shade grown tobacco. The land now occupied by the plantations would probably yield a greater return per acre if utilized for shade tobacco instead of for the production of forest crops.

The tract lies on a practically level bench about 100 feet in elevation above the Farmington River and 160 to 180 feet above sea level. The soil* on the major portion of the area is what was originally mapped by the U. S. Bureau of Soils in 1899 as "Windsor Sand", which name was changed in their Bulletin 96 to "Merrimac Coarse Sand." It is part of a deep deposit of glacial outwash material which forms an extensive plain in this portion of the state. The soil is a coarse sand, containing less than 10% of silt and clay, and the texture is very nearly the same to the depth of many feet. The surface soil contains sufficient organic matter to give it a medium brown color to a depth of 5 to 7 inches. The subsoil is of a yellowish color to a depth of about 3 feet, where it grades gradually to the dull gray which is imparted to it by the

*Notes on soil conditions furnished by Mr. M. F. Morgan of the Dept. of Soils, Connecticut Agricultural Experiment Station.

undiscolored coarse granules of impure quartz sand which predominate.

In small local areas (referred to in the plot descriptions as "barren areas") near the western border of the tract, expecially in Plots 16, 44 and 45, the soil is somewhat coarser than is the rule, and contains so little silt and clay that it has even less coherence than usual. On such areas all plant growth is either much stunted or is altogether lacking. The change from these areas to those that support a normal plant growth is very abrupt. Trees planted on the sterile spots either grow very slowly or do not survive at all. Red pine seems to make a little better growth on them than does white, but the needles of both are yellow and in general the trees are crooked and sickly.

On the higher ground in the northeastern portion of the tract, especially in Plots 68 and 69 and in the northern portions of Plots 59 and 60, the soil is finer in texture consisting of about 7 inches of medium brown loamy sand surface soil, with a yellow subsoil of a similar texture to a depth of about 2½ feet overlying the unweathered glacial till. The latter is made up largely of a mass of red shale and sandstone rock fragments of moderate size (less than 6 inches in diameter), with a considerable admixture of grayish sand and fine gravel. This soil type was identified in the 1899 Bureau of Soils Survey as "Enfield Sandy Loam" but this name was changed to "Manchester Fine Sand" in U. S. Bureau of Soils Bulletin 96.

The natural forest growth of the region is inferior hardwoods (mostly grey birch and oaks) and pitch pine, with some chestnut and white pine. The latter species is the only one to make good growth although the chestnut did well before it was attacked by the blight. Land abandoned for agriculture first seeds in to broom sedge and similar plants, followed by grey birch and pitch pine. Later stages of reversion show a diminution of grey birch and an increase of inferior oaks and pitch pine, with some white pine coming in.

The plantations were begun in 1901 on the present tract and in 1902 on another known as Mundy Hollow. The latter was abandoned after a few years. The plans were made for the first Forester of the Station, Mr. Walter Mulford, by the U. S. Forest Service, and comprised an elaborate series of experiments in artificial regeneration of hardwoods and conifers by seeding and planting. The tract was divided up into plots varying in size from ¼ acre to 6 acres in area, a large percentage of them averaging about 1 acre. Wherever feasible, the plots were laid off as rectangles. Numerous methods were tried out. These are described later under individual plots, insofar as the results of these methods are now present. Many of the earlier experiments were complete failures and in such cases no specific reference is made to them in this publication but the reader is referred to Reports of the Station for the years 1906, 1907 and 1912.

Some method of artificial regeneration has been undertaken nearly every year since the plantations were started, the amount varying with the funds available, until at present practically the entire tract is under some kind of forest cover.

For a number of years a nursery was operated in connection with the tract but this practice was abandoned and stock procured either from the Station nursery at Mt. Carmel or by purchase from commercial nurseries.

The plantations have always been used as a field laboratory for the study of insects and fungi by the Entomological and Botanical Departments of the Station, and since 1919 as an object of field study by students from the Yale School of Forestry, who have laid off sample plots and made thinnings in some of the older stands. This work is recorded under individual plots.

The tract has been under the general oversight of a local resident since its inception. Mr. Judson Leonard had charge from 1901 to 1909; Mr. Henry Palmer, from 1909 to 1920. Mr. Frederick M. Snow, the present superintendent, lives near the end of the Rainbow trolley line and about ½ mile from the plantations. He will be glad to aid visitors in every way possible. Forestry operations have so far consisted of planting, cleaning, a small amount of thinning and control of the white pine weevil. Such work has been done either by the local superintendent, by members of the staff of the Forestry Department or by students from the Yale School of Forestry.

As yet the tract has not produced sufficient revenue to pay expenses, although carrying charges have been considerably lessened by the sale of cordwood from cleanings, of some chestnut and large pitch pine for saw-logs, of overtopped spruce for Christmas trees and of Mugho pine for ornamental purposes. In time the tract as a whole should become nearly self-supporting although it will probably never be wholly so.

Only a small amount of planting is needed to bring the entire tract under a forest cover. Future operations will consist of thinning the older stands as they need it, of weevil control, of cleanings and other improvement cuttings, of pruning experiments, of experiments in the most effective methods of cutting hardwoods to obviate rapid sprouting, etc.

The amount of damage from various causes has been relatively small. A rather elaborate system of exterior and interior fire lines, which are harrowed frequently, has been instrumental in keeping the burned area under 6 acres during the last 22 years. Rodents kept the red oak cut back so that experiments with this species are almost a complete failure. Several species of insects have proved troublesome but in only one case has an insect destroyed the entire value of an experiment. The locust borer, *Cyllene robiniae*, mined the trunks and limbs of the black locust so severely that the experiments with this species have been

abandoned. The insect requiring the most work to control is the white pine weevil, *Pissodes strobi*, which attacks the terminal shoot of white pine, Japanese red pine, Mugho pine and Norway spruce, thus deforming the stem. White pine is most severely attacked, followed by the others in the order named. Cutting and burning the infested leaders is the most practical method of control. This work is needed annually. Norway spruce seems to recover better from the injury than do the pines. The spruce gall, *Chermes abietes*, has made much of the Norway spruce unsightly and has probably impaired the growth to some extent although no stunting is apparent and no trees have been killed. The chestnut blight, *Endothia parasitica*, persistently kills back the chestnut trees used in the early experiments. Two rusts have also been found on different species of pines. One, *Peridermium cerebrum*, found on jack pine, has for its alternate host, various species of oaks. This rust was evidently brought in from Michigan on the planting stock and no new outbreaks have been found. The other rust, *Peridermium pyriforme*, which has for alternate hosts two species of toadflax, *Comandra pallida* and *C. umbellata*, has been found on Austrian, Scotch and bull pine. On the first two species it does not seem to have done much damage beyond deforming a few trees. The bull pine, however, seems more susceptible. A few trees die from the disease each year and indications are that the species will eventually be killed out here.

Description of Plots.

Following is a description of the seventy plots which make up the tract. A preliminary survey was made by Mr. S. E. Parker in March, 1923 and all measurements and counts are as of that date unless otherwise noted. Heights were taken with a 10 foot pole or with a Faustmann hypsometer, and diameters with a diameter tape.

Plot 1. Exotic conifers. Area about .7 acre. Planted in the spring of 1907 by sections as follows: east side, Austrian pine, 2 year seedlings, spaced 5 x 5 feet; center, European larch, 2 year seedlings, 5 x 6 feet; west side, Scotch pine, 2 year seedlings, 6 x 6 feet. In 1911 a fire destroyed about ⅔ of the plot and in 1913 the blanks were filled with Douglas fir, 7 year transplants and Chinese arbor-vitae, 6 year transplants. Two partial rows of Japanese red pine planted about 1913 occur on the west side of the plot. A description of this species under Plot 5 will cover this part of Plot 1. The arbor-vitae was a complete failure and the fir, coming from Pacific Coast seed, was not hardy and is represented by a few stunted trees. The failure of these two species has left the stand quite open and irregular although some native pitch pine helps to increase the density. Scotch pine has made the best growth, averaging 23 feet tall and 3 inches in diameter. The trees are fairly uniform in size but are somewhat crooked. Austrian pine has done fairly well, averaging 9 feet tall and 1.4 inches in diameter. The larch averages 1 foot taller than the Austrian pine but individuals vary greatly, some equaling the Scotch pine in height while others are mere shrubs. The plot was cleaned by lopping hardwood brush in 1919. Several individuals of Scotch and Austrian pine infected with *Peridermium pyriforme* (See page 106) were removed in 1910.

Plot 2. White pine. Area .8 acre. Planted in the spring of 1907 with 2 year seedlings, spaced 6 x 6, 5 x 5, 4 x 4, and 3 x 3 feet. In 1911 a fire destroyed the north end of the plot including the 4 x 4 and 3 x 3 foot spacings and in the spring of 1913 blanks were filled with 8 year white pine transplants spaced 5 x 5 feet, thereby destroying the value of the original experiment in different spacings. On the unburned south end only about ten per cent of the trees are missing and the stand is just closing. Only a few trees have any dead limbs. The average size on the 6 x 6 foot spacing is height 13 feet, diameter 2.0 inches and on the 5 x 5 foot, height 9 feet; diameter 1.9 inches. The 1913 planting averages 5.5 feet high but is very open and irregular owing to the failure of about 50% of the trees. Weevil damage (See page 106) amounts to 25% for the plot as a whole. A more recent fire (1923) destroyed about ⅓ of the 1913 planting. The plot was cleaned by lopping birch in 1919.

Plot 3. Pitch pine. Area 1.3 acres. In 1902 seed sown on cultivated strips 1½ feet wide and 4 feet apart as follows: on the south half at the rate of 2 pounds per acre and on the north half at the rate of 1 pound per acre. The seed was brushed in. On the south half a very dense stand resulted. Trees average 1 foot apart in the rows, 17 feet in height and 2 inches in diameter, and have dead limbs for 8 feet above ground. About 60% of the trees have died from crowding. The stand on the north half is not so dense. Trees average 6 feet apart in the rows, 15 feet in height and 3 inches in diameter, and have dead limbs for 3 feet above ground. Very few trees have died from crowding. Spacing in the rows is not uniform and the stand on both sections is very uneven, especially on the north half but here gaps are being filled by natural seeding. Several trees badly infected with *Peridermium pyriforme* were removed in 1910. On both sections the trees have the poor form characteristic of pitch pine in this region. Compare with Plot 49.

Plot 4. White pine—Red oak—Scotch pine. Area .7 acre. Planted in the spring of 1904 with red oak, 3 acorns in a hole, and white pine 2 year seedlings, spacing 6 x 6 feet, a solid row of oak alternating with a row of oak and pine mixed. Losses were small for the first three years. Since then rodents have kept the oak cut back so that at present only 40 % of them are living and of

these only 15% have made even fair growth. However, an occasional individual has done nearly as well as the pine showing that the species will grow on poor soil if not attacked by rodents. About 1913, gaps caused by failure in the oak on the south end of the plot were filled with Scotch pine; the north end remains unfilled, leaving the white pine spaced 12 x 12 feet. With this wide spacing the white pine is thick boled, badly deformed by weevil and shows dead branches for only 3-4 feet. Where Scotch pine has been used it has closed the stand and is approximating the white pine in height. It has dead branches for 3-4 feet above ground but it has not yet influenced the pruning of the white pine growing with it. Average sizes: heights,—white pine, 19 feet; red oak, 7 feet and Scotch pine, 16 feet: diameters,—white pine, 4.5 inches; red oak, 1.0 inch and Scotch pine, 3.0 inches. The north end of this plot may be compared with Plots 48 and 51 where red oak and white pine were planted together but with different arrangement of species and the south end with Plots 35, 36 and 37 where Scotch pine has been used as a filler in older white pine plantations..

Plot 5. Japanese red pine and White pine. Area 1.4 acres. Planted in the spring of 1910 with Japanese red pine 2 year seedlings, spaced 6 x 6 feet. The following summer was very dry and a 50% loss resulted. Blanks were filled in the spring of 1911 with 3 year transplants of the same species. Further failures resulted and in 1913 blanks were filled with white pine 4 year transplants. The present stand is practically complete and is made up of ⅔ Japanese red and ⅓ white pine. The plot is just about to close. It has been kept free of hardwood competition and is therefore open grown. The Japanese red pine shows a 10% damage by weevil as compared with 45% for the white pine. The latter averages 8 feet in height and the former 7 feet. The Japanese red pine does not appear to be a good tree to plant in the open because of its tendency to divide at the base into many stems. In the spring of 1924 all leaders, except one, were removed from each Japanese red pine in an attempt to make this species produce one good stem. The results of this work are not yet apparent but the plot may be compared with Plot 52 where this tree has been grown under similar conditions without reducing the number of leaders. The plot may also be compared with Plot 19 where the species was grown for about 10 years under a dense shade of birch. Japanese red pine has borne cones very prolifically for a number of years and many seedlings up to 10 inches tall are growing in the openings.

Plot 6. Western yellow (bull) pine and White pine. Area 2.7 acres. Planted in the spring of 1908 with bull pine 2 year seedlings, spaced 5 x 5 feet. Losses up to 1912 had amounted to 45% and in 1912 and 1913 blanks were filled with 4 year white pine transplants. Further losses have occurred and these have

not been filled, so that the present stand is 35% bull pine, 35% white pine and 30% blanks. The white pine, even though it has been very heavily damaged by weevil (65%), now equals the bull pine in height which now averages 6.5 feet. The bull pine is subject to attack by *Peridermium pyriforme*, a fungous disease which kills a few trees each year. In fact, it seems probable that this disease may eventually kill out the species here. Compare with Plot 66.

Plot 7. White pine. Area 2.3 acres. Planted in the fall of 1913 with 3 year transplants, spaced 6 x 6 feet, as a test of fall planting. The experiment was a complete success, over 95% of the trees being alive at present. The stand is irregular, the trees varying in height from 2 to 10 feet and averaging 6 feet. This unevenness is due to some extent to weevils which have attacked 60% of the trees but numerous individuals are stunted without having been attacked by weevil. The stand apparently underwent a period of stagnation for about eight years and the irregularity may be due to the fact that some trees are recovering sooner than others. This stagnation period is characteristic of all white pine plantations on the tract. The species seems to grow slowly for a longer period after planting than most of the others used. The plot has had numerous weevil cuttings and was entirely cleared of birch in the winter of 1921-1922.

Plot 8a. Red pine and Norway spruce. Area 1.7 acres. Cleared in the winter of 1921-1922 of birch for cordwood and planted in the spring of 1922 with red pine and Norway spruce 3 year transplants, spaced 6 x 6 feet, and alternating by rows except the four rows on the west side which are all pine. Most of the birch was at the south end of the plot. The plantation is over 90% complete but the pine averages 18 inches tall and looks thrifty, whereas the spruce is only 6 inches in height and is yellow and sickly except where it received shade from small birch sprouts. It would seem that this mixture is not feasible in the open as the pine will probably suppress the spruce in the same way that the white pine did on Plot 69, leaving the red pine spaced 6 x 12 feet with the spruce forming an understory. The mixture might have been more successful under a heavy brush cover which would have held back the pine more than the spruce and acted as a nurse for the latter until it was well started. (See plot 42.)

Plot 8b. Norway spruce. Area 1.3 acres. Cleared with Plot 8a leaving a few scattering native white pines about 15 feet high. Planted in the spring of 1924 with 2 year seedlings, spaced 5 x 5 feet, as a Christmas tree experiment. The stock was small, the season dry, and only about 10% of the trees survived the first summer. Plot may be compared with Plot 18 where white spruce stock of the same size was planted under an overwood. The latter

plantation is over 90% complete thus demonstrating the value of cover during the early years.

Plot 8b contains much chestnut from an experiment started in 1903. It is interesting to note that this species, even though killed back repeatedly by blight, still persists on this poor leachy soil better than most of the hardwoods used, red oak and locust excepted.

Plot 9. Pitch pine and Hardwoods. Area about .6 acre. Natural growth, not planted.

Plot 10. Norway spruce. Area about .6 acre. Planted in 1912 under a stand of old growth chestnut. Spacing is irregular but averages about 8 x 8 feet. The chestnut died and was removed in 1922 leaving a younger growth, consisting principally of oak, as a cover for the spruce. This cover was opened up in the spring of 1923 to give the spruce more light and will be further reduced or removed at a later date. The spruce has grown slowly but the trees are healthy, except for a small amount of weevil damage, and show every indication of coming through and forming a stand. Spruce is very tolerant and while it will not make fast growth under dense shade it will persist for a long time and, when released, makes a good recovery and increases in size rapidly. Compare with Plot 42, an older spruce plantation under shade which has been reduced from time to time.

Plot 11. Native white pine. Birch cutting experiment. Area .7 acre. The north end of the plot has been devoted for some years to an experiment in bringing a scattered stand of natural reproduction of white pine through a heavy cover of old field grey birch. The pine is doing fairly well but has been badly weeviled and is of poor form.

In October, 1924, an experiment was started to determine the sprouting qualities of birch under different methods of cutting at different times of year. This experiment should give some valuable information on the best season to release plantations and the best cutting methods to use in order to get a minimum of sprouts. The experiment was laid out as a number of different series of four sections each, each series to be cut at a different time of year. One series was cut during October, 1924. Another will be cut in the spring of 1925, and still another in mid-summer, 1925. The four sections in each series are as follows:

a. Check—no cutting.
b. Birch cut off close to the ground.
c. Birch lopped off 2 to 3 feet above ground.
d. Birch lopped partly off and bent over so that the trees will still continue to live.

Plot 12. White pine. Area .6 acre. Planted in the spring of 1902 with 3 year seedlings, spaced 5 x 5 feet, under a cover of grey

birch 15 to 20 feet tall. Fail places were filled in the spring of 1904 with 3 year transplants. The cover was removed in 1910 and 1911 and a final release cutting was made in 1919. This is one of the best plantations of white pine on the tract. Because of the heavy cover for the first 10 years the average growth has not been rapid (average height 19 feet and diameter 3 inches) but the trees are of excellent form, uniform in size and with almost no injury from weevil. Dead limbs extend to 7 feet above the ground and are quite small. Annual height growth almost doubled after the cover was removed in 1910-11.

Plot 13. Norway spruce and Balsam fir. Area about 1.2 acres. In 1910, 71 balsam firs were planted along the northern border of Plots 11 and 12, and about 1916 the remainder of the plot with the exception of a narrow strip to the west of Plot 12 was planted with Norway spruce. Spacing is irregular but averages about 8 x 8 feet. Planting was done under a moderately heavy cover consisting of old pitch pine and a lower stand of hardwoods. Both spruce and fir average 5 feet tall and show the effect of too much shade. However, they are of good color and look healthy, and on removal of the overwood, should make an increased growth in height. The cover was thinned in the fall of 1923 to give the planted trees more light but a further thinning is needed as the cover is still too dense.

Plot 14. Scotch pine. Area 1.2 acres. Planted in the spring of 1907 with 2 year seedlings, spaced 5 x 6 feet, the trees set in furrows plowed through the brush to try out Scotch pine in competition with an advanced hardwood growth. A part of the brush was removed in 1910 and the balance in 1913. A second release cutting was made in 1919 and third in 1924. This should be the last one needed. In addition, several large chestnuts were removed from the south side in 1921. The experiment was only a partial success because, in spite of frequent releasings, the hardwoods killed out over ⅓ of the pine. However, those that have survived have made good growth and are in sufficient numbers to form the final stand. Average height 22 feet; diameter 4.5 inches. Dead branches extend for 10 feet above the ground. This plot demonstrates very well the inadvisability of attempting to grow Scotch pine under any kind of cover. The species is very intolerant and cannot stand even moderate shade. Compare with Plot 23 which was kept entirely free of brush.

Plot 15. White pine. Area .9 acre. Planted in the spring of 1906 with 3 year seedlings, spaced 5 x 6 feet. This plot was started and has been treated in about the same manner as Plot 14, but the trees show far less injury from hardwood competition than do the Scotch pines. About 90% of the trees are still living and the result is a very dense stand with trees averaging 19 feet in height and 3.5 inches in diameter. Dead branches extend for

6 feet above ground. All brush was cleaned from the plot in 1913 and a second and final release cutting was made in 1919. Weevil damage has been very slight, probably because of the density of the stand and the fact that the trees were in brush for seven years. The stand offers a good example of the results of close spacing, i. e., good form with small side branches that are killed early. It is probably too dense for practical purposes as the first thinning will not yield enough to pay for making it. All vegetation has been shaded out and 2 to 3 inches of needles cover the ground.

Plot 16. White pine—Red pine—Japanese red pine. Area 3.7 acres. Spacing 5 x 5 feet. Planted in 1917 as follows: west side, pure red pine; center, white pine and Japanese red pine alternating by rows; and east side, red pine and white pine alternating by rows. The red pine has made the best growth, averaging 5 feet in height, followed by the white with 4 feet and the Japanese red with 3 feet. The stand is practically complete, blanks amounting to less than 15%. The white and the Japanese red pines have both been attacked by the weevil, the former more heavily than the latter. The Japanese red has developed the same bushy habit as in Plots 5 and 52, and is bearing cones prolifically but no seedlings were found. The stand has not yet closed although the pure red pine on the west side has nearly done so. Except immediately under the trees, the crowns have not killed out the vegetative cover. Numerous barren areas occur on this plot. (See page 104.)

Plot 17. Headquarters Site. Area .9 acre. The east end of this plot is used as a location for a portable headquarters cabin. The remainder of the plot which was formerly the old nursery site contains an assortment of many kinds of trees left in the old nursery rows, together with enough later plantings of red and white pine to make up a stand.

In October, 1924, an experiment in pruning young conifers was started directly behind the cabin in a planting of red pine made in the fall of 1919. The experiment includes some 50 trees divided about equally among 4 rows. The row nearest the cabin was pruned to leave a leader and two whorls of branches, the next to leave a leader and one whorl, the third to leave a leader and 3 whorls and the fourth left unpruned as a check. For row 1 (east), the live crown averages about ½ the total height of the tree; for row 2, ⅓ the height; for row 3, ⅖ the height; and for row 4, the entire height. A whorl of branches is to be removed from each row (the check excepted) each year, the object being to find out how much the crowns can be reduced without diminishing the growing power of the trees.

Plot 18. White spruce. Area .7 acre. Planted in the spring of 1924 with 2 year seedlings, spaced 8 x 8 feet, under a cover made up of pitch pine 8 to 10 inches in diameter with an understory of

smaller hardwoods. Less than 10% of the trees had died at the end of the first growing season, demonstrating the fact that spruce (2 year stock) can be planted successfully on a leachy soil if given sufficient protection against drying out. This plot may be compared with 8b where small stock of Norway spruce was planted in the open, the result being almost a complete failure. The cover should be removed, or at least greatly reduced, within five years.

Plot 19. Japanese red pine. Area 1.2 acres. Planted in the spring of 1910 with 2 year seedlings, spaced 6 x 6 feet. Loss was heavy and blanks were filled in 1911 with 3 year transplants of the same species. There were further failures and at present the stand is only 50% stocked. In 1919 the hardwoods, which had completely outgrown the pine, were thinned but not heavily enough and in 1922 they were removed altogether. The interesting feature on this plot is that hardwood competition forced the pine to confine its growth normally to one stem. As a matter of fact this competition was so severe that it caused the pine to become very slender and crooked. Since releasing, however, the trees have recovered and made a much increased height growth. Weevil damage has amounted to very little and the production of cones has been small. This plot forms a very marked contrast to Plot 5 where this species was planted in the open. The average height on Plot 19 is 12 feet, nearly twice that on Plot 5. It would seem that the proper conditions under which to grow this tree successfully would be under a cover kept sufficiently dense to prevent the pine from producing several stems, but not dense enough to cause suppression and crooked, slender boles. The species seems to be fairly tolerant of shade, probably ranking with red pine in this respect.

Plots 20 and 21. White pine and Scotch pine. Area 1.3 acres each. Planted in the spring of 1910, using 4 year transplants of white pine and 2 year seedlings of Scotch pine. Spacing 5 x 5 feet, the species alternating by rows. Scattered white pine set out in 1904 were ignored in the 1910 planting. The experiment does not promise to be a success. The Scotch pine is growing faster than the white and probably will suppress it. In fact the Scotch pine compares favorably with the white planted in 1904. Failures have amounted to over 30%, chiefly in the white pine and the stand is ragged and has not closed. The Scotch pine has dead limbs for a height of 4 feet, while the white has no dead limbs. The Scotch pine averages 17 feet in height and 3 inches in diameter; the white averages 10 feet tall and 2½ inches in diameter (1904 planting excluded). Weevil damage in the white pine has been very slight, due probably to the fact that this species has always been shorter than the Scotch and therefore protected by it. These plots demonstrate that it is not feasible to plant white and Scotch

pine at the same time in mixture. Comparison may be made with Plots 4, 35, 36, 37 and 56 where Scotch pine was used as a filler in white pine plantations that were much older, and with Plot 34 where white pine was used as a filler in a Scotch pine stand that was several years older.

Plot 22. Red pine and White pine. Area .8 acre. Planted in the spring of 1902 with red pine 4 year transplants, spaced 4½ x 5 feet (except for about 100 trees at the north end which are white pine apparently planted at the same time and with the same spacing). Failures in the red pine were filled in 1904 with the same species. The stand has but few blanks. The red pine averages 20 feet tall and 3.8 inches in diameter and the white, 16 feet tall and 2.4 inches in diameter. Red pine has dead branches for 7 feet above ground while the white has them for only 4 feet. The dead branches on the red pine are small, brittle and may be broken off easily though most of them still persist. The white pine has been damaged but very little by weevil, probably because this block of trees is almost completely surrounded by taller trees. This plot may be compared with Plots 23, 28 and 49, all of which were planted at the same time and under about the same conditions, but with different species. The spacing on Plot 22, as well as on Plots 23, 24 and 28, is too close from a practical standpoint. The first thinning will not yield enough returns to pay for making it. Theoretically, the narrow spacing is ideal insofar as it causes the trees to produce small side limbs which die early.

Plot 23. Scotch pine. Area .6 acre. Planted in the spring of 1902 with 3 year seedlings, spaced 4 x 5 feet. The plot has been kept free from hardwood competition and there have been practically no failures. Scotch pine has shown the best growth of any tree used on the tract, with the possible exception of black locust. Heights now average 29 feet and diameters 3.5 inches, while some individuals have reached a height of 33 feet and a diameter of 5 inches. Dead branches extend for 14 feet above the ground and are quite rotten, more so than those of red and white pine of the same age and spacing. The trees are of good form although there is the usual tendency of this species to make crooked boles. Scotch pine is quite intolerant, more so than either red or white pine. So far as can be judged from 20 years of growth, Scotch pine is an excellent tree for use on sandy soils provided it does not have to compete with hardwoods. Compare with Plot 14 for the effects of hardwood competition and with Plots 22, 24, 28 and 49 for the results from planting other species at the same time and under approximately the same conditions.

A few trees infected with *Peridermium pyriforme* have been removed from this plot but the disease does not seem to have made much headway and little trouble is expected from it with this species.

In 1919 students from the Yale School of Forestry laid off and thinned a sample plot covering .089 acre. After thinning there were left on this plot 122 trees which is at the rate of 1,370 per acre. The volume of these trees was 96.3 cu. ft.* of wood or 1,083 cu. ft. per acre.

In 1924 this sample plot was thinned again removing 50 trees or 562 per acre and 39.9 cu. ft. of wood or 448 cu. ft. per acre. After this second thinning there were left 72 trees or 808 per acre and 89.2 cu. ft. of wood or 1,002 cu. ft. per acre. The increase on this plot for the 5 years 1919-1924 had therefore been at the rate of 368 cu. ft. per acre, or 74 cu. ft. per acre per year.

In 1920 another sample plot covering .0804 acre was laid off as a check for the one described above and left unthinned. The number of trees on this plot was 167 or 2,077 per acre and the volume 111.9 cu. ft. or 1,392 cu. ft. per acre. This plot was remeasured again in 1924 at which time there were 151 trees (16 having died from natural causes) or 1,878 per acre. The volume of these was 135.05 cu. ft. of wood or 1,679 cu. ft. per acre. The increase for the four years 1920–1924 had therefore been 287 cu. ft. per acre or 72 cu. ft. per acre per year. Both sample plots will be remeasured and the thinned plot will be thinned again in 1929.

Plot 24. Austrian pine—Red pine—White pine. Area .4 acre. Planted as follows: south end, Austrian pine 4 year seedlings, spaced 4 x 5 feet, summer of 1902; center, red pine 4 year seedlings, spaced 4½ x 5 feet, spring of 1902; north end, white pine, spaced 4½ x 5 feet, 1905.

The plot is chiefly red pine, the Austrian and the white consisting of two blocks of about 100 trees and 50 trees respectively. The white pine being younger is not compared with the others. The Austrian averages 23 feet tall and 4 inches in diameter and the red 21 feet tall and 3 inches in diameter, but the former tends to have a crooked bole. The Austrian pine has dead branches for 10 feet above ground while the red pine has them for only seven. A carpet of needles 2 to 3 inches deep covers the ground and all vegetation has been shaded out. Red pine on this plot, as well as on Plot 22, has not grown as fast as Scotch pine on Plot 23, but is straight boled and generally of better form than the latter. The fact that the Austrian pine averages greater in height and diameter than the red pine may be due to the fact that the total number of the former is relatively small and a greater percentage of the trees border on roads which gives them more growing space. Austrian pine on Plot 24 has been subject to a small amount of infection by *Peridermium pyriforme* but little damage has resulted.

In 1920 students from the Yale School of Forestry laid off a sample plot covering .0919 acre in the red pine. The results of

*Volumes computed from Table 27, Bulletin 13, U. S. D. A., revised and extended to cover the sizes of trees found on this plot.

the counts and measurements were: number of trees 162 or 1,763 per acre; volume 82.4 cu. ft.* of wood or 897 cu. ft. per acre. This sample plot will be remeasured and thinned and a check plot established in 1925.

Plot 25. White pine, wild stock. Area .8 acre. Planted in the spring of 1902 with collected seedlings 8 to 18 inches tall from Granby. Fail places were filled in 1903 with hardwoods, which died and were replaced with wild stock in 1905. Spacing 4½ x 5½ feet. Practically all the pines planted are present but a considerable number are dead from crowding. Heights average 23 feet and diameters 4 inches. Dead branches extend for 7 feet above ground and are small but quite persistent. Weevil damage has been relatively small, due possibly to close spacing. As an experiment in the use of wild stock this plot is a success but at present it would probably cost more to collect such stock than to buy it from a nursery. Compare with red, Scotch and Austrian pine on Plots 22, 23 and 24, and with other white pine from nursery stock on Plots 12 and 28.

Note. The form of the crowns on Plot 25 is quite different from those on Plot 28 which was planted at the same time but with nursery stock. On the latter plot the side branches are quite long, project nearly in a horizontal plane, are interlocking and are dead for 9 feet above ground. The crowns of the wild stock have short slender branches which tend to grow upward. They do not seem to have interfered with each other greatly and are dead for only 7 feet above ground. The general appearance of Plot 25 closely resembles that on 12 where nursery stock was planted and remained for nearly 10 years under a dense cover.

Plot 26. White pine with various spacings. Area 1.2 acres. Planted in the spring of 1903 with 2 year transplants spaced 6 x 6 feet on the south end, 5 x 5 feet in the center, and 4 x 4 feet on the north end. Failures amounting to about 10% occurred in each section. At the end of 10 years the trees with the 4 x 4 foot spacing had made the best growth but at 20 years the 6 x 6 foot spacing had produced larger trees than either of the others, the average being 20 feet in height and 4.3 inches in diameter. The 5 x 5 foot spacing is next with a height of 16 feet and a diameter of 3.5 inches, and the 4 x 4 foot spacing last with a height of 14 feet and a diameter of 2.2 inches. The trees with the 4 x 4 foot spacing showed the greatest height growth between the 8th and 12th years, falling off after that time. Those with the 6 x 6 foot spacing have grown rapidly since the fifth year. Those in the 5 x 5 foot section have grown slowly during the entire period. Damage by weevil has been heaviest in the 6 x 6 foot spacing and lightest in the 4 x 4 foot.

*Volumes computed from Table 27, Bulletin 13, U. S. D. A., revised and extended to cover the sizes of trees found on this plot.

Vegetation has been killed out in all three sections and 2 to 3 inches of needles cover the ground. With all three spacings, trees have dead limbs for 7 feet above ground, but this amounts to about 50% of the total height in the 4 x 4 foot section and only 30% in the 6 x 6 foot. All dead limbs are quite firm. Those on the 6 x 6 foot spacing are much larger than on the others. Because it results in less injury from weevil and in the production of small side branches, the 4 x 4 foot spacing would be more satisfactory if thinnings could be made at about the fifteenth year. As this is not feasible, it is probably better to grow this species with a wider spacing, attempting to get protection from weevil and to prevent the growth of side limbs by using a hardwood cover, and thinning it gradually for the first 15 years.

Plot 27. White pine. Area 1.0 acre. Planted in the spring of 1904 with white pine 2 year seedlings and chestnut 1 year seedlings, 2 rows of pine and 2 rows of chestnut, spacing 5 x 5 feet. The chestnut failed and the chestnut rows were filled in the spring of 1910 with white pine 4 year transplants spaced 6 feet apart in the rows. The results of using white pine as a filler in an older plantation of the same species are not entirely satisfactory. The older pines are bushy with no dead limbs and have been heavily damaged by weevil. They average 17 feet in height and 4.4 inches in diameter while the 1910 trees average 11 feet in height and 1.8 inches in diameter. The latter show only a 10% damage by weevil and are generally of good form. The plot as a whole is quite ragged and uneven and has not closed. The 1910 planting may, because of better protection from weevil and side crowding from the 1904 trees, develop into a stand of good form but the final results will probably not be as good as if the stand were even-aged throughout. This plot may be compared with Plots 4, 35, 36, 37 and 56 where Scotch pine was used as a late filler.

Plot 28. White pine. Area 1.6 acres. Planted in the spring of 1902 with 3 year seedlings and 4 year transplants. Failures were replaced 1904-5 with transplants. A part of this plot was cultivated and fertilized for several seasons but no results of this treatment are apparent. Spacing 4 x 5 feet although many trees are only 3 feet apart and often two or more were planted together. The resultant stand is very dense and many trees are dying from lack of space. Average height, 19 feet; diameter, 3.5 inches. Dead branches extend for 9 feet above the ground and are small but persistent. Weevil damage has been slight. The stand shows the effect of too keen competition and should be thinned immediately in order not to further reduce the amount of living crown. This plot does not compare favorably with Plots 22, 23 or 24 where red and Scotch pine were planted at the same time and with about the same spacing. The stand should have been thinned at 15 years. All vegetation has been shaded out and several inches of needles cover the ground. (See note under Plot 25.)

In 1920 students from the Yale School of Forestry laid off a sample plot covering 1/8 of an acre. The results of the counts and measurements were: number of trees 245 or 1,960 per acre, volume 95.6 cu. ft.* of wood or 764.8 cu. ft. per acre. This sample plot will be remeasured and thinned and a check plot established in 1925.

Plot 29. White pine. Area 2.3 acres. Planted in the fall of 1907 with 3 year transplants, spaced 5 x 5 feet, to test the results of fall planting. The experiment is a moderate success, less than 25% having failed. The stand as a whole, however, is quite ragged and uneven due to the blanks and to the fact that some individuals have grown very slowly. Weevil damage has been quite heavy. Crowns have not closed enough to kill the lower branches and shade out herbaceous growth. The plot was cleared of birch in 1919. Heights average 15 feet and diameters 3.5 inches. For other examples of fall planting see Plots 7 and 69a.

Plot 30. Jack pine. Area .3 acre. Planted in the spring of 1908 with seedlings from Michigan 1 to 2 feet high, spaced 5 x 5 feet. A 50% failure resulted and the present stand is rather open and uneven. It has not yet closed sufficiently to kill the lower branches or to shade out herbaceous cover. Although a few individuals have done well, generally the trees have crooked boles and long side branches. Average height, 16 feet; diameter, 3 inches. In 1910 several trees infected with *Peridermium cerebrum* (See page 106) were removed. This disease was evidently introduced with the stock as no further infections have been found. This pine is bearing cones prolifically and many seedlings up to 12 inches tall may be found in the openings. The plot should be compared with Plot 47 where Jack pine was used as a late filler.

Plot 31. Scotch pine. Area .3 acre. Planted in the spring of 1903 with green ash 1 year seedlings, spaced 10 x 10 feet. In the spring of 1904 Scotch pine 2 year seedlings were planted 5 feet apart in solid rows between the ash rows and alternating with the ash in the rows, making the final spacing 5 x 5 feet. The ash failed thereby reducing the density 25% and this, plus a 5% failure in the pine, leaves the plot about 70% stocked. The stand is very dense and has completely closed. Average height 25 feet; diameter 4.8 inches. Dead limbs extend for 12 feet above ground and the lower ones, though still persisting are quite rotten. They seem to be a little larger than on Plot 23. From the appearance of this plot it would seem that Scotch pine may be planted with a much wider spacing, 7 x 7 or 8 x 8 feet, and still close and prune satisfactorily. The effect of this would be to delay the first thinning until the stand was 30-35 years old when the operation

*Volumes computed from Table 27, Bulletin 13, U. S. D. A., revised and extended to cover the sizes of trees found on this plot.

b. Plot 69. Norway spruce and white pine planted in 1905 in the open. The pine has overtopped 90% of the spruce.

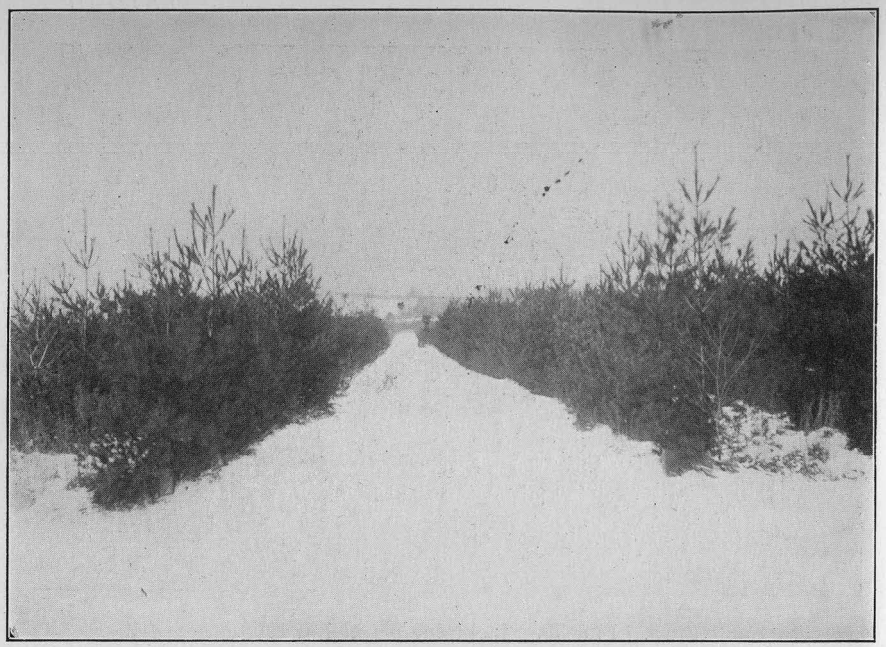
a. Plot 38. Douglas fir and white pine planted in 1903. Note the great variation in size of the fir.

a. Plot 5. Japanese red pine planted in 1910. Note the bushy habit of this species when grown in the open.

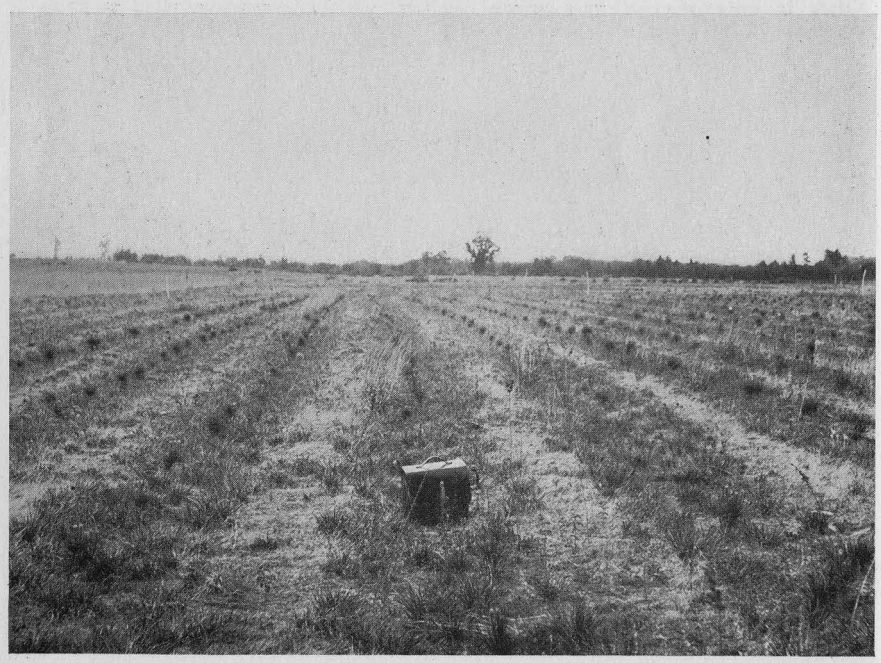
b. Plot 42. Norway spruce and white pine planted in 1906 under an overwood which has since been removed. The spruce is holding its own with the pine. Compare with Plate I b.

a. Plot 30. Jack pine planted in 1908.

b. Plot 68. White pine planted in 1905.



a. Fire line between Plots 60 and 68 in 1912. Compare with Plate VII b.

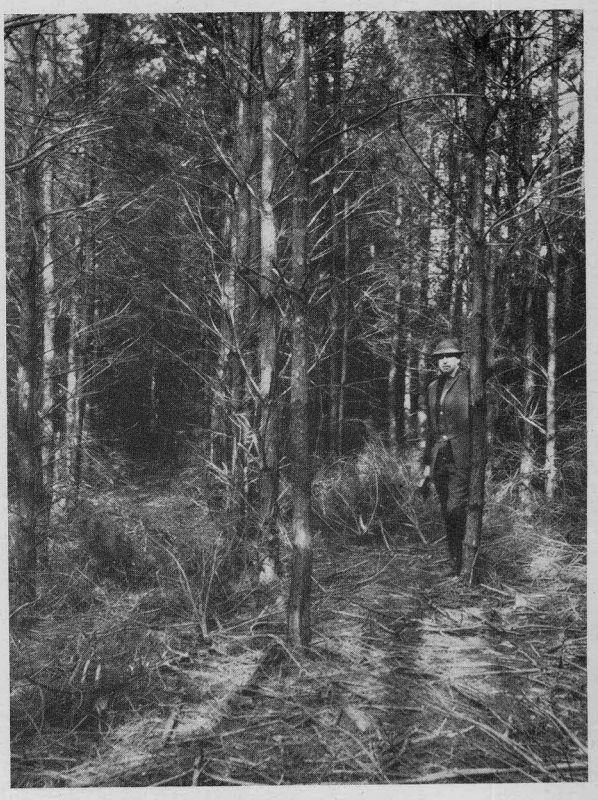


b. Looking north across Plot 23 in 1903, one year after Scotch pine was planted. Note character of ground cover.

a. Red and Scotch pine on Plots 22 and 23 in 1905.

b. Red and Scotch pine on Plots 22 and 23 in 1912.

a.



b.

Plot 23. Scotch pine planted in 1902.
a. Thinned in 1919 and 1924. b. Left unthinned as a check.

a. Plot 24. Red pine planted in 1902. Compare with Plate VI.

b. Fire line between Plots 60 and 68. See Plate IV a.

a. Plot 6. Bull pine planted in 1908, white pine in 1913. Bull pine with the axe leaning against it was killed by the rust.

b. Plot 16. Red pine planted in 1917.

would probably more than pay for itself. The trees are bearing cones prolifically and seedlings up to seven years old may be found around the edges of the plot. All vegetation has been shaded out and a carpet of needles several inches deep covers the ground. Compare with Plot 23.

Plot 32. Norway spruce. Area 1.5 acres. Planted in the spring of 1905 with 2 year seedlings, spaced 5 x 5 feet, under an open growth of pitch pine and hardwoods. The ground had been burned over just before planting. A second fire burned over a portion of the area in 1907 and in 1910 blanks were filled with 4 year transplants. In 1911 a 50% failure had resulted and in 1913 all blanks were filled with 7 year transplants after removing a part of the overwood. In 1923 a fire burned over about ⅓ of the plot near the East Granby highway. This has not been replanted. Exclusive of the recent burn the plot is now only about 50% stocked. The trees seem well established but average only 4 feet in height and show the effect of too dense cover. With the removal of the overwood the stand should recover and increase in height rapidly although it will always be quite open. A few trees of another species, probably white spruce, occur near the southern edge of the plot, also an occasional balsam fir. Many trees, both of Norway and the other spruce, are heavily infested with galls. (See page 106.)

Plot 33. White pine. Area 2.1 acres. Planted in 1905 with 2 year seedlings, spaced 5 x 5 feet, under a medium dense shade of pitch pine and hardwoods. The overwood was thinned in 1913 and birch was lopped back on the west side in 1923. The white pine has not made a rapid growth but the plot is 80% stocked (excluding a 1923 burn covering about a half acre) and the trees are of good form and have not been damaged to any extent by weevil. The white pines are growing into the crowns of the pitch pines and the latter should be removed. Heights average 11 feet; diameters 1.7 inches.

Plot 34. Scotch pine—White pine—Mountain pine. Area .9 acre. Planted in the spring of 1911 with 4 year Scotch pine transplants and 3 year mountain pine seedlings, spaced 6 x 6 feet. About 90% of the latter failed and the blanks were filled in the spring of 1913 with 5 year white pine transplants. About 20% of the Scotch and 10% of the white pine are missing. After the failure of the mountain pine the experiment resolved itself into determining the value of white pine as a filler in an older Scotch pine stand. The results are not promising. The Scotch pine has made a very rapid growth and has spread out so that it nearly closes over the white pine. In fact, it is quite probable that in a few years it will completely suppress the white and form a pure Scotch pine stand spaced 6 x 12 feet. This may prove a desirable density for Scotch pine as it will delay the need of thinning.

The Scotch pine now averages 11 feet in height and 3.1 inches in diameter, while the white is only 6 feet tall. The white pine has been weeviled but very little. As a whole the stand has not closed sufficiently to shade out herbaceous growth or to form a litter of needles. Compare with Plots 4, 35, 36, 37 and 56 where Scotch pine was used as a filler in an older white pine stand.

Note. The mountain pine proved to be of the Mugho variety. Mugho pine when crowded, will abandon its prostrate habit and send up a single stem. In several cases it has reached a height of 6 feet or more. It is attacked to a slight extent by the white pine weevil.

Plot 35. White pine and Scotch pine. Area 2.0 acres. The experiments started in 1903 as an example of mixed planting by groups. Two year transplants of white pine and various hardwoods were planted with a spacing of 4½ x 5 feet and mixed by grouping 3 to 10 trees of each species together. Blanks in the pine were filled with 3 year transplants in 1904. The hardwoods practically all failed and in the spring of 1911 were replaced with Scotch pine 3 year transplants. The present stand is about ¼ white and ¾ Scotch pine minus a few blanks caused by failures. The white pine because of its greater age has made a bushy growth with long side branches. It averages 15 feet in height and 3.4 inches in diameter. Weevil damage has been quite heavy. The Scotch pine has grown rapidly and has nearly caught up with the white. It averages 13 feet in height and 3.2 inches in diameter. The stand is just closing and few trees show any dead branches. Herbaceous growth has been shaded out and 1 to 2 inches of needles cover the ground. The Scotch pine should overtake the white in a few years and it remains to be seen whether it will eventually suppress the white or not. The plot was thoroughly cleaned by lopping birch and girdling pitch pine in 1924. Compare with Plots 4, 34, 36, 37 and 56.

Plot 36. White pine and Scotch pine. Area .9 acre. Planted in the spring of 1903 with white pine 2 year transplants and maple seedlings alternating in the row and spaced 6 x 6 feet. Pine blanks were filled in 1904 with 3 year transplants. The maple failed and was replaced in 1908 with 2 year Scotch pine seedlings. The Scotch pine now averages 18 feet in height and 3.8 inches in diameter and the white, 16 feet in height and 3 inches in diameter. The stand has just closed. All herbaceous growth has been shaded out and 1 to 2 inches of needles cover the ground. Scotch pine has dead branches for a height of 5 feet and white pine for 3 feet. The Scotch was probably used too soon as a filler. It looks now as though it would soon close over and suppress the white, although the latter may respond to crowding with an increased height growth. Compare with Plots 4, 34, 35, 37 and 56.

In 1923 students from the Yale School of Forestry laid off a sample plot covering ¼ acre. The results of the counts and measurements were: number of trees—white pine 162, Scotch pine 125 or 648 and 500 trees per acre, respectively. Volume—white pine 57.4 cu. ft. of wood*, Scotch pine 66.8 cu. ft. or 229.6 cu. ft. and 267.2 cu. ft. per acre, respectively. This sample plot will be remeasured and thinned and a check plot established in 1928.

Plot 37. White pine and Scotch pine. Area 1.0 acre. Planted in the spring of 1903 with white pine 2 year transplants and maple seedlings, spaced 6 x 6 feet, solid rows of maple alternating with a row of maple and pine mixed. The maple was a failure and was replaced in 1911 with 3 year transplants of Scotch pine. Not over 10% of blanks now exist. The Scotch pine has surpassed the white in diameter and in height. It now averages 16 feet tall and 2.8 inches in diameter, while the white is 12 feet tall and 2.2 inches in diameter. The Scotch pine has dead limbs for 3 feet above the ground but the white has live limbs clear to the ground. The stand has closed, shading out herbaceous growth. About 1 inch of litter covers the ground. The white pine shows little weevil injury. Just why the Scotch pine is ahead of the white on this plot and behind it on Plot 35 is not apparent unless the grouping of the white pine on Plot 35 was more stimulating to height growth than the 12 x 12 foot spacing on Plot 37. Compare with Plots 4, 34, 35, 36 and 56.

Plot 38. White pine and Douglas fir. Area .4 acre. Planted in the spring of 1903, spacing 5 x 5 feet, the two species alternating in the rows. The pine has grown faster than the fir and now averages 18 feet tall and 4.6 inches in diameter, while the fir averages 10 feet tall and 1.3 inches in diameter. The early growth of the fir was very slow. This may have been due to the stock not being hardy because many trees have been killed back and deformed. However, the species seems to recover from this and to send up a new leader without any apparent deformation of the stem. The fir has not developed evenly, individuals varying from 1 to 16 feet in height. Some of this irregularity has been caused by suppression by pine. Fir produces a very narrow compact crown while pine, when given sufficient room, produces a wide crown. The result of this is that the stand has just closed and both species have live limbs clear to the ground. The fir seems quite tolerant and shows a considerable tendency to push through the pine crowns. Side limbs on the pine were cut back to favor the fir in 1923 and more of this work will be done in the future. During the last 5 years the fir has shown a greatly increased height

*Volumes computed from Table 27, Bulletin 13, U. S. D. A., revised and extended to cover the sizes of trees found on this plot.

growth and may in time catch up with the pine. It has held its own with the pine better than did Norway spruce planted under about the same conditions on Plot 69.

On account of the differences in crown habit it would seem advisable either to plant the fir about 5 years before the pine with the same spacing or to plant the two species at the same time with a closer spacing.

Plot 39. White pine. Area .7 acre. Planted in the spring of 1903 with white pine and hardwoods, the latter forming 75% of the mixture. The spacing was originally 5 x 5 feet but the hardwoods have failed and the pine is now spaced 10 x 10 feet. The results of this wide spacing are not entirely satisfactory. The pine shows a 50% injury by weevil. The stand is just closing, the side branches are large and long and have died for only a few feet above ground. Heights average 17 feet and diameter, 4.6 inches. All birch was removed from the plot in 1924. It is somewhat difficult to predict what the final results will be but it looks as if these short, large boled trees would produce a heavy yield of inferior lumber. A thinning will not be needed for at least another 10 years. Compare with Plots 4 and 59 for other examples of wide spacing and with Plot 28 for close spacing.

Plot 40. Red pine. Area .9 acre. Planted in the spring of 1924 with 2 year seedlings, spaced 8 x 8 feet, under a dense cover made up of grey birch and scattered trees from a red oak experiment which was a failure because rodents kept the trees cut back. At the end of the first growing season less than 10% of the red pines had failed. The plan is to remove all hardwood cover for cordwood after about 5 years.

Plot 41. White pine and Norway spruce. Area .2 acre. Planted in the spring of 1906 with 2 year seedlings, spaced 5 x 6 feet, under light brush, the species alternating by rows. Fifty per cent of the pine and 20% of the spruce failed. The birch cover was thinned in 1919 and completely removed in 1924. Both the pine and the spruce have been badly weeviled, probably because the plot is very narrow and open to a road on one side. The spruce is also attacked by galls. The two species average about the same in height, 12 feet, but the pine averages 3.5 inches in diameter and the spruce only 1 inch. Spruce has shown a greatly increased height growth in the last 5 years. Neither species shows dead limbs and in general the plot is quite ragged and has not closed. It may be compared with Plot 69 where these two species were planted in the open and the pine suppressed practically all the spruce.

Plot 42. White pine and Norway spruce. Area 2.6 acres. Planted in the spring of 1906 with 2 year seedlings, spaced 5 x 6 feet, the two species alternating by rows. Blanks were filled in

1911 with 5 year white pine transplants. At the time of planting an overwood of pitch pine and hardwoods, which varied in density from heavy on the south end to very open on the north end, covered the area. One acre in the densest portion of the overwood at the south end was cleared in 1911. In 1919, hardwood sprouts from the cutting in 1911, which has overtopped the planted trees, were thinned to give the conifers more light. The plot is now about 75% stocked and is rather uneven. The pine averages 15 feet in height and 2 inches in diameter and the spruce 11 feet in height and 1 inch in diameter. Neither species show dead branches for over 2 feet above ground. Both have been heavily damaged by weevil but the spruce is less deformed by the injury than the pine. The spruce is also heavily infested with galls. The effect of the cover has been to hold back the pine more than the spruce allowing the latter to hold its own with the pine. During the last few years the spruce has increased height growth enormously. Comparison may be made with Plot 69 where these two species were planted in the open.

Plot 43. White pine and Norway spruce. Area 4.2 acres. Planted in the spring of 1905 with 2 year seedlings, spaced 5 x 6 feet, the two species alternating by rows, Blanks were filled with 5 year white pine transplants in 1911. A medium dense overwood, chiefly pitch pine, covered the entire plot. This was removed from the south end in 1923. Both species have grown more slowly than on Plot 42 on which the cover was removed at an earlier date. The pine averages 10 feet tall and the spruce 6 feet. However, weevil damage has been very slight for both species and while the trees are not as large as on Plot 42 they are of much better form. Compare with Plot 69.

Plot 44. White pine. Areas 3.1 acres. Planted in the spring of 1906 with white pine 2 year seedlings, pure on the west side and mixed with maple on the east side. Spacing 6 x 5 feet. The maple failed and blanks were filled in 1910 with 4 year white pine transplants. Failures were filled again in 1911 with 5 year white pine transplants. An overwood of pitch pine and grey birch, varying in density from nothing at the south end to moderately dense in the middle and on the north end, covers the area. Over 80% of the trees are present. In the open they average 14 feet tall and 4.5 inches in diameter and under the overwood, 10 feet tall and one inch in diameter. Only in a few places has the stand closed and live limbs extend to the ground. Herbaceous growth has not been shaded out. A little spruce occurs at the north end, evidently an extension of Plot 43. The most marked feature is the almost entire absence of weevil injury and the smallness of side branches on the portion of the plot under the overwood. A cover of pitch pine is less harmful than is grey birch because its branches are stiff and therefore do not whip the white

pine tops as badly as do those of the birch. Several barren areas (see page 104) occur on Plot 44.

Plot 45. Mountain pine. Area 4.6 acres. Planted in the spring of 1912 with mountain pine, spaced 6 x 6 feet. The stock proved to be the Mugho variety of mountain pine and has been sold for ornamental purposes (See note on Mugho pine under Plot 34). A few Corsican pines from a planting which was made in 1910 and which was almost a complete failure, are scattered over the plot. They have made fair growth but are open grown and bushy. Barren areas (see page 104) similar to those in Plot 44 occur in Plot 45.

Plot 46. White pine—Norway spruce—Jack pine. Area .7 acre. Planted in the spring of 1906 with 2 year seedlings of white pine and spruce, spaced 5 x 6 feet, and alternated by rows. In 1908 fail places were filled with Jack pine. The composition of the plot is now 50% Jack pine, 25% white pine and 25% spruce. Jack pine has grown faster than the other two species averaging 21 feet in height and 4 inches in diameter. The white pine averages 18 feet high and 4.5 inches in diameter and the spruce, 10 feet high and 1.5 inches in diameter. Both spruce and white pine show a small amount of damage by weevil and the former is often infested with galls. The stand is almost entirely closed but there is only a small amount of litter. Jack pine has dead branches extending for 8 feet above ground, and white pine for 5 feet. Spruce has no dead branches. For the first ten years the spruce grew quite slowly but since that time, except where it was heavily shaded, it has increased its height growth enormously, often making 2-3 feet a year. Under stiff competition Jack pine develops well, forming a straight bole and small side branches which die early. This plot demonstrates its value as a late filler, for which it compares favorably with Scotch pine. About 2 cords of birch were removed from the plot in 1919 and a final release cutting was made in 1924. Spruce trees completely covered by pine will be sold as Christmas trees. This plan will also be followed on Plots 42 and 43. Compare Jack pine on this plot with that on Plots 30 and 47 where this tree grew more or less in open stands. Compare the white pine and spruce with that on Plots 41, 42, 43 and 69.

Plot 47. Douglas fir—Jack pine—Norway spruce. Area .9 acre. Planted in the spring of 1903 with Douglas fir and several hardwoods mixed at random and spaced 5 x 5 feet. Practically all the hardwoods failed and blanks were filled in 1908 with Jack pine. The fir is all on the east side of the plot and with the Jack pine and some spruce planted at a latter date forms a fairly good stand. The west side contains a scattering of Jack pine and a volunteer growth of birch and other hardwoods. Some chestnut

from the early hardwood experiment still persists but is kept killed back by the blight. The west side should be used for another experiment. The fir has developed in all respects about as it did on Plot 38. The spruce, being much younger, is mostly overtopped. Jack pine has developed much as it did on Plot 30 where it was open grown, i.e., it produced long side branches and crooked boles. It is bearing cones prolifically and numerous seedlings up to 7 feet tall may be found in the openings. The stand on the west side has not closed sufficiently to shade out herbaceous growth and there is almost no needle litter.

Plot 48. Red oak and White pine. Area .9 acre. Planted in the spring of 1904 with oak 1 year seedlings and pine 2 year seedlings, spaced 6 x 6 feet, 4 rows of oak alternating with 2 rows of pine. Eighty-five per cent of the oak and 70% of the pine are living but 50% of the oak have been kept cut back by rodents. These trees were excluded in the measurements. Oaks not attacked by rodents have done better than the pines and are crowding the latter severely. Oak averages 20 feet in height and 2 inches in diameter and pine averages 18 feet in height and 4 inches in diameter. The best oak on the tract is to be found on this plot. About half the pines have been injured by weevil and are of poor form. The thrifty oaks have dead branches for a height of 10 feet, but dead branches on the pine do not extend over 2 feet above the ground. Most of the pine limbs are small. The stand, as a whole, has closed and most of the herbaceous growth, except brake ferns, has been shaded out. There is very little litter on the ground. Considerable birch in the mixture helps to make the canopy quite dense. This plot is in need of thinning to give the better oak and pine a chance. Compare with Plots 4 and 51.

Plot 49. Pitch pine. Area .9 acre. Planted in the spring of 1903 with 2 year transplants, spaced 5 x 5 feet. Over 90% of the original trees are still living (except on thinned sample plot described below) but the stand is not thrifty. Average height, 15 feet; diameter, 3 inches.

In 1921 students from the Yale School of Forestry laid off and measured two sample plots of 1/16 acre each and thinned one of them. The results of the counts and measurements for the unthinned plot were—number of trees, 131 or at the rate of 2,096 per acre; volume, 26 cu. ft.* of wood or 416 cu. ft. per acre: for the thinned plot—number of trees before thinning, 130 or 2,080 per acre; after thinning, 78 or 1,248 per acre: volume before thinning, 29.4 cu. ft. or 470.4 cu. ft. per acre; after thinning, 20.5 cu. ft. or 328 cu. ft. per acre. These sample plots will be remeasured and the thinned plot thinned again in 1926.

*Volumes computed from Table 27, Bulletin 13, U. S. D. A., revised and extended to cover the sizes of trees found on this plot.

The unthinned pitch pine on Plot 49 has apparently stagnated although the stand does not seem at all dense. Live crowns have been reduced to ⅓ the total height of the tree. Pitch pine seems fairly tolerant of shade of older pitch pine but it does not seem able to stand side crowding. On this plot all trees had an equal amount of growing space and have developed about equally with no marked differentiation into crown classes. On the south half of Plot 3 this species has grown under quite different conditions, more nearly approximating those in nature. The number of seedlings that started was very large and competition during the earlier years quite keen. The stronger individuals developed rapidly, suppressing the weaker trees, thereby obtaining more room for the development of their crowns.

On the sample plot thinned in 1921, crowns are deeper and the trees are generally healthier than on the remainder of the area. Compare Plot 49 with Plots 3, 22, 23 and 28.

Plot 50. Red oak. Area .9 acre. Originally an experiment with red oak but rodents kept the trees cut back so badly that the result is almost a total failure. An occasional individual has not been attacked and has made good growth but these are so scattering as to be worthless as a test of this species. A volunteer stand of birch and pitch pine has taken possession of the plot.

Plot 51. Red oak and White pine. Area .9 acre. Planted in the spring of 1904 with oak 1 year seedlings and pine 2 year seedlings, spaced 6 x 6 feet, two rows of oak alternating with one row of pine. Practically all the oak are present but ⅔ of them have been cut back by rodents. Those not cut back are ahead of the pine but are so scattering as to make the pine appear to be spaced 6 x 18 feet. The thrifty oak averages 19 feet in height and 2 inches in diameter, and the pine 17 feet in height and 5 inches in diameter. About 20% of the pine failed. Those living have been badly weeviled and are of poor form. They have closed in the rows but not between them. Herbaceous vegetation has not been killed out except directly under the pine and there is little litter on the ground. Compare with Plots 4 and 48.

Plot 52. White pine and Japanese red pine. Area .9 acre. Planted in the spring of 1910 with 2 year seedlings, spaced 6 x 6 feet, the two species alternating by rows. Loss in the Japanese red pine was heavy and blanks were filled about 1914 with white pine. The present stand is fully stocked and is 25% Japanese red and 75% white pine. Both species average 7 feet in height. Both have been weeviled, the white the more heavily than the other. The plot was thoroughly cleaned of birch in 1923. Crowns are just commencing to close, much herbaceous cover is still present and there is no litter on the ground. This plot is similar to Plot 5 and has received practically the same treatment except that the

leaders on the Japanese red pine have not been pruned back but left for comparison with Plot 5. Comparison may also be made with Plot 19.

Plot 53. White pine. Area .2 acre. Planted in the spring of 1905 with 2 year seedlings, spaced 5 x 5 feet. Blanks were filled in 1910 with three year transplants. All birch was removed by lopping in 1923. Several large pitch pine and clumps of birch held back or killed the white pine on part of the plot so that the stand is rather irregular and only about half the original number of trees is present. Dead branches extend for 4 feet above ground but are firm. Crowns have closed, resulting in a forest floor without vegetation and covered with 2 to 3 inches of needles. Fifty per cent of the trees have been damaged by weevil. Average height, 13 feet; diameter, 3.3 inches.

Plot 54. White pine and Japanese black pine. Area .9 acre. Planted in the spring of 1910 with 3 year seedlings of white pine and 2 year seedlings of Japanese black pine, spaced 6 x 6 feet, and alternating by rows. The Japanese species was apparently not hardy and 90% of it failed. Those living are only 2 feet tall and tend to have a prostrate habit. Twenty-five per cent of the white pine failed also so that the stand is only 40% stocked. The white pine has been heavily weeviled and is bushy and of poor form. It averages 7 feet in height. The plot was cleared of birch in 1923. Pitch pine is scattered over the plot but is not sufficiently dense to stimulate the white pine.

Plot 55. White pine. Area .9 acre. Planted in the spring of 1903 with 2 year seedlings from Maine, alternating in the rows with beech, spacing 6 x 6 feet. The beech failed and the experiment has become one of pure pine with a spacing of 8½ x 8½ feet. The stand is complete and is just closing. Lower limbs are just beginning to die and ground vegetation is almost completely shaded out. Average height, 17 feet; diameter, 4.5 inches. Fifty per cent of the trees have been injured by weevil. Diameter growth has been consistently large over the whole plot and the stand is thrifty, and in good condition except for weevil damage.

Plot 56. White pine and Scotch pine. Area .9 acre. Planted in the spring of 1903 with white pine 2 year seedlings and beech, spaced 6 x 6 feet, a solid row of beech alternating with a row of beech and pine mixed. In 1911 the beech was replaced with Scotch pine 3 year transplants. The white pine has made a large diameter growth averaging 4.5 inches, but a poor height growth, averaging only 17 feet. The Scotch pine, although 8 years younger, averages 16 feet in height and 3 inches in diameter. The mixture contains about 80% Scotch and 20% white pine. The stand has just closed and dead branches extend for 4 feet above ground. They are large and heavy on the white pine but short and slender

on the Scotch. Half the white pine has been damaged by weevil. Practically all ground cover has been shaded out and 2 to 3 inches of needles cover the ground. Compare with Plots 4, 34, 35, 36 and 37.

Plot 57. Red pine. Area .9 acre. Cleared of a scattered stand of large grey birches in the fall of 1923 and planted in the spring of 1924 with 2 year seedlings, spaced 8 x 8 feet. At the end of the first growing season less than 10% had failed. Compare with Plot 40 for a plantation of red pine made at the same time under heavy cover.

Plot 58. Black locust. Area 1.0 acre. Planted in the spring of 1903 with 1 year seedlings with various spacings. As far as growth is concerned this species has done better than any other used in the plantations, attaining a height of 35 feet and a diameter of 6 to 7 inches and reproducing itself prolifically. However, damage from the locust borer (See page 105) was so great that in the fall of 1923 the stand was removed for cordwood and the experiment abandoned. During the last growing season, sprouts have reached a height of 10 feet.

Plot 59. White pine. Area 1.0 acre. Planted partly in the spring of 1903 with white pine 2 year seedlings and partly in 1904 with white pine 3 year transplants alternating in the row with black birch and spaced 5 x 5 feet. A small portion of the plot was pure pine. The birch failed leaving the pine spaced about 7 x 7 feet on the average, although the spacing is somewhat irregular. Heights average 25 feet; diameters, 6 inches. Dead branches extend for 10 feet above ground and are moderately large and quite firm. Weevils have caused many crooked boles but in spite of this a good height growth has been maintained and the stand appears in good condition. Practically all herbaceous vegetation has been shaded out and 2 to 3 inches of needles cover the ground. This plot may be compared with Plot 39 for white pine with a wider spacing and with Plot 28 for a closer spacing.

In 1922 students from the Yale School of Forestry laid off two sample plots of ¼ acre each. One of these was thinned and the other left as a check. Measurements and counts were as follows: check plot, number of trees, 187 or at the rate of 748 per acre; volume, 219.1 cu. ft.* of wood or 876.4 cu. ft. per acre. Thinned plot, number of trees before thinning, 216 or 864 per acre; after thinning, 158 trees or 632 per acre: volume before thinning, 249.9 cu. ft. of wood or 999.6 cu. ft. per acre; after thinning 208.0 cu. ft. or 832 cu. ft. per acre. Both plots will be remeasured and the thinned plot will be thinned again in 1927.

*Volumes computed from Table 27, Bulletin 13, U. S. D. A., revised and extended to cover the sizes of trees found on this plot.

Plot 60. White pine. Area 2.1 acres. Planted in the spring of 1905, together with Plot 68, with 2 year seedlings, 3 year transplants and wild seedlings from Stafford. Spacing was 5 x 5 and 6 x 6 feet, and trees were set in old furrows and on mounds between. Both plots are the same in all respects and are described together. Both are in excellent condition. Trees average 20 feet in height and 4 inches in diameter. Weevil damage has been comparatively slight and little damage seems to have been done until the trees were 12 feet or more in height. Dead branches extend for 10 feet above ground and are small but quite firm. Herbaceous vegetation has been shaded out and several inches of needles cover the ground. Competition has not been too keen but a thinning is needed to prevent the stand becoming stagnated. These two plots contain the best growth of white pine on the tract.

Plot 61. White pine. Area 2.2 acres. Planted in the spring of 1913 with 5 year transplants, spaced 5 x 6 feet. A few clumps of chestnut sprouts still persist from a previous experiment. A moderately dense stand of grey birch covered the pine until 1923 when it was entirely removed by lopping. This cover does not seem to have been sufficiently dense to protect the pine from weevil as 30 to 40% of the trees have been damaged. Practically the entire planting survives. The stand has not yet closed, and bunch grass and other herbaceous growth still persists. The pine averages 9 feet in height and, in competition with birch sprouts that have come up since the cutting in 1923, should make a good height growth and produce only small side branches.

Plot 62. White pine and Scotch pine. Area 5.1 acres. Planted in the spring of 1907 with 2 year seedlings of white pine, spaced 5 x 5 feet. In 1922 a fire destroyed about 50% of the plot facing Plots 61–64 (measurements and counts exclude this burn). The stand has just closed and some herbaceous cover still persists. Plot was cleaned of birch in 1919. Weevil damage has been quite heavy averaging 35%. Average height, 17 feet; diameter, 3 inches.

The burn was replanted in the spring of 1924 with white and Scotch pine 2 year seedlings. The season was dry, the fire had reduced the tract to a barren sand plain, the stock was small and a very heavy loss resulted during the first growing season.

Plot 63. Red pine and White pine. Area 2.6 acres. Planted in 1917. The species were planted alternately 6 feet apart, in rows 10 feet apart with the idea that at some later date Scotch pine or some other species would be used as a late filler. This has not yet been done. The plot was cleaned of a heavy cover of birch in the spring of 1923. About 95% of the original trees are living. The red pine appears more thrifty and of better form than the white because the latter has been severely injured by weevil. Both species average 5.5 feet tall. The stand is just closing in the rows but not between.

Plot 64. Scotch pine. Area, 1.3 acres. Planted in the spring of 1910 with 2 year seedlings, spaced 6 x 6 feet. Subsequent loss has been rather heavy, due partly to failures at the time of planting and partly to suppression by birch. The birch was thinned in 1923 and completely removed by lopping in 1924. A number of medium sized pitch pines were girdled in 1924. This should be the final release cutting as the Scotch pine can probably take care of itself from now on. The stand is just closing but is rather ragged. Trees average 15 feet in height and 2.5 inches in diameter, and have dead branches for 3 feet above ground. Herbaceous cover still persists and there is little litter on the ground. The extreme intolerance of Scotch pine and the effect of cover on this species are well illustrated.

Plot 65. Red pine. Area .8 acre. Planted in the spring of 1917 with red pine, spaced 5 x 5 feet. There were practically no failures and the stand is quite thrifty except on a few sterile spots (described under Plot 16). A small fire in 1922 destroyed about 75 trees near Plot 66. A heavy birch cover was removed in 1923 but the red pine does not seem to have been held back to any extent by its shade. A few medium sized pitch pines were girdled in the fall of 1924, thus removing the last of the cover from the red pine.

Plot 66. Western yellow (bull) pine. Area 1.5 acres. Planted in the spring of 1908 with 2 year seedlings, spaced 5 x 5 feet. This plot is similar in all respect to Plot 6 except that the blanks, which amount to about 45%, have not been filled. The trees average 11 feet tall, somewhat larger than on Plot 6 but in general development has been similar to that on Plot 6. Bull pine seems to be quite intolerant. Individuals growing in the shade are stunted and, even when growing in the open, the lower branches die from the shade of those above. A ground fire burned over a small area in this plot in 1922 killing the bull pine completely. This species appears to be at least as susceptible to injury by ground fires as red pine.

Plot 67. Native pitch pine. Area .1 acre. No treatment.

Plot 68. White pine. Area 4.3 acres. (See Plot 60.)

Plot 69. White pine and Norway spruce. Area 3.6 acres. Planted in the spring of 1905 with 2 year seedlings, spaced 5 x 5 feet, the two species alternating in the row. Ninety per cent of the pine and 60% of the spruce lived but the pine has grown much the faster of the two and has overtopped about 90% of the spruce completely, making the plot in effect one of pure pine with a spacing of about 7 x 7 feet over an understory of spruce. In a few instances the spruce has grown rapidly and will probably catch up to the pine. The latter has long, heavy side branches which have died for 8 feet above ground but still persist. Weevils have

injured about 30% of the pines. Average sizes: pine, 22 feet tall and 4.5 inches in diameter; spruce, 5 feet tall. Overtopped spruce trees are being removed and sold for Christmas trees as fast as a market can be found for them. This plot demonstrates the fact that it is not feasible to plant spruce and pine in the open at the same time, as the pine grows much faster and completely overtops the spruce. Compare with Plots 41, 42 and 43 where an overwood has held back the pine more than the spruce, enabling the latter to hold its own with the pine. In 1913 a fire burned over about an acre in Plot 69 along the East Granby highway (See Plot 69a).

Plot 69a. Red pine. Area about 1.0 acre. Planted in the fall of 1920 with 3 year transplants, spaced 6 x 6 feet, under a scattering cover of grey birch as a test of fall planting. The experiment was a complete success. Ninety-five per cent of the trees are still living and the average height is 2½ feet. A few spruce and pine from the 1905 planting are scattered over the plot. All hardwood growth was removed by lopping in the fall of 1924.

Plot 70. Austrian pine. Planted in the spring of 1908 with 2 year seedlings, spaced 6 x 6 feet. The trees suffered heavily from drought and winter injury and at present less than 25% of the original planting is present. Heights vary from 2 to 10 feet and average about 3 feet. Most of the trees have crooked boles and, in general, appear sickly and show poor development. The plot was thoroughly cleaned by lopping back the hardwoods in 1923.

Conclusions.

Seeding versus planting. In general it may be said that experiments in regeneration by seeding were not successful. The seed of many species, both coniferous and hardwood, were sown by various methods but results were so poor that regeneration by seeding was soon abandoned. Even during the most favorable seasons the moisture conditions in the surface soil are very poor and it is often several years before any vegetation appears on land abandoned for cultivation. Grey birch, which usually reproduces quite prolifically on bare soil, does not come in readily on bare areas in this region. Planting, on the other hand has been quite successful. When this method has failed, the cause can usually be traced to using unsuitable species or to some other reason.

Hardwoods versus conifers. Of the many experiments with hardwood species, only three were successful enough to warrant comment. Red oak, black locust and chestnut seemed to thrive on poor soil when not attacked by enemies. Unfortunately all three species have been subject to animal, insect or fungous injury and are almost complete failures. The other hardwoods used have either died out completely or are represented by a few

stunted specimens. The conifers, on the other hand, have done well. Some have done better than others but only in one or two cases can an experiment with conifers be called a complete failure. From this it is apparent that the tract is far better suited to coniferous than to hardwood growth, mainly because the former are far less exacting in their moisture requirements than the latter.

Conifers. Three species stand out conspicuously above all others used. They are red, white and Scotch pine. Of these Scotch pine has grown the fastest during the juvenile period, i.e., the first 20 years. However, it is an European species and has not been brought to maturity in this country as a timber tree. There is, therefore, some uncertainty as to just how it will develop between the twentieth year and the time it is ready to cut. Should later development prove satisfactory, its value for planting on poor soils in this country may be very great on account of its rapid growth. Its worst fault seems to be a tendency to form crooked boles. One of the greatest values is as a filler in older plantations of other species where failures have occurred. The wood is somewhat similar to that of red pine and is a little harder and heavier than that of white pine.

The growth of red and white pine is about the same. White pine is a well-known species and its wood is very valuable, more so than that of red pine, although, where they grow naturally together, both species are marketed as white pine. Red pine has no serious enemies. Its form is normally very good and it prunes itself better than white pine under the same conditions. The latter has several enemies, the worst of which in this region is the weevil. This insect causes a large percentage of the trees to form crooked boles which yield inferior lumber. For these reasons the red pine is considered the better of the two species.

Norway spruce, another European species, has done very well when planted under shade sufficiently dense to act as a nurse but not heavy enough to suppress the trees. As in the case of Scotch pine, there are no stands old enough to furnish data on what its later development will be.

Jack pine, which grows naturally on very poor soil in the Lake States, has not done well in pure stands where it forms crooked boles and long side branches. When used as a filler in older stands where it is obliged to grow rapidly in order to survive it does well, having much better form than when grown pure.

Western yellow (bull) pine is not recommended for this kind of site. It has grown slowly and is subject to a fungous disease which threatens to kill out the species here.

Two other European pines, Austrian and Corsican, have not proved satisfactory. In one instance Austrian pine did fairly well but in general losses with both species were heavy at the time of planting and the experiments with them are failures.

Pitch pine has proved as unsatisfactory as it is when it grows naturally. Its form is not good, its growth is slow and on the whole it may be called a worthless species in this region.

Of the two Japanese pines used, the Japanese black was a total failure because it was not hardy. The Japanese red pine shows considerable promise if handled properly. It has a strong tendency when quite young to divide at the base into several stems and form a bushy tree. When severely crowded, however, this species will normally produce only one stem and in such cases the trees make an excellent height growth.

The value of Douglas fir on sandy soil is questionable. The development of this species is exceedingly variable, some individuals having done very well while others are much stunted. During the last five years this tree has shown up much better than it did previously.

The European larch is another tree which varies greatly in growth, some individuals having equalled the Scotch pine in size while others are mere shrubs. Its value on poor soil is probably small.

White spruce has been used too recently to furnish any data on how it will develop.

The other conifers found on the tract, two species of fir and one of arbor-vitae, are too few in numbers to merit comment.

Hardwoods. Only three of the hardwoods used need mention. They are red oak, black locust and chestnut. When not attacked by rodents red oak makes a height growth equal to white pine and is of good form, indicating that this species is adapted to poor soils. However, rabbits kept so many trees cut back that the stands are open and the experiments are failures. Without exception, black locust made the best growth of any species used on the tract but the trees were so completely mined by the locust borer that the plantation had to be abandoned. Chestnut once grew naturally on the tract. It is difficult to say what the results of artificial regeneration of this species might have been. The fact that much chestnut still persists, even after being killed back repeatedly by the blight, indicates that this tree might have been profitably grown on this site.

Other hardwoods used, but which were complete failures, were white oak, green ash,* tulip,* black birch, hard maple,* beech, catalpa, cotton wood, white ash and hickory.*

*No trees of these species were found in the 1924 survey.

List of Species Used on Experimental Plots.

Following is a list giving the common and scientific names and the plot locations of the species used in the experiments.

White pine; *Pinus strobus*, L.*
Plot 2, 4, 5, 6, 7, 11, 12, 15, 16, 17, 20, 21, 22, 24, 25, 26, 27, 28, 29, 33, 34, 35, 36, 37, 38, 39, 41, 42, 43, 44, 46, 48, 51, 52, 53, 54, 55, 56, 59, 60, 61, 62, 63, 68, 69.

Red pine; *Pinus resinosa*, Ait.
Plot 8a, 16, 17, 22, 24, 40, 57, 63, 65, 69a.

Scotch pine; *Pinus sylvestris*, L.
Plot 1, 4, 14, 17, 20, 21, 23, 31, 34, 35, 36, 37, 56, 62, 64.

Pitch pine; *Pinus rigida*, Mill.*
Plot 3, 49.

Austrian pine; *Pinus Laricio* var. *austriaca*, Endl.
Plot 1, 24, 70.

Corsican pine; *Pinus Laricio*, Poir.
Plot 45.

Jack pine; *Pinus divaricata*, Du Mont de Cours.
Plot 30, 46, 47.

Western yellow pine; *Pinus ponderosa*, Laws.
Plot 6, 66.

Japanese red pine; *Pinus densiflora*, Sieb & Zucc.
Plot 1, 5, 16, 19, 52.

Japanese black pine; *Pinus Thunbergii*, Parl.
Plot 54.

Mountain pine; *Pinus montana*, Mill.
Plot 34, 45.

Mugho pine; *Pinus montana* var. *Mughus*, Willk.
Plot 17, 34, 45.

Douglas fir; *Pseudotsuga Douglasii*, Carr.
Plot 1, 17, 38, 47.

Balsam fir; *Abies balsamea*, Poir.
Plot 13, 32.

White fir; *Abies concolor*, Lindl. & Gord.
Plot 17.

European larch; *Larix europea*, de C.
Plot 1, 17.

Arbor-vitae; *Thuya* sp.
Plot 17.

Norway spruce; *Picea excelsa*, L.
Plot 8a, 8b, 10, 32, 41, 42, 43, 44, 46, 47, 69.

White spruce; *Picea canadensis*, Mill.
Plot 18, 32.

Red oak; *Quercus rubra*, L.
Plot 4, 17, 40, 48, 50, 51.

White oak; *Quercus alba*, L.*
Plot 17.

White ash; *Fraxinus americana*, L.
Plot 17.

Black birch; *Betula lenta*, L.
Plot 59.

Grey birch; *Betula populifolia*, Marsh.*
on nearly every plot.

Beech; *Fagus americana*, Sweet.
Plot 20, 21, 55, 56, 57.

Catalpa; *Catalpa* sp.
Plot 5.

Cottonwood; *Populus deltoides*, Marsh.
Plot 6.

Basswood; *Tilia americana*, L.
Plot 47.

Chestnut; *Castanea dentata*, Borkh.*
Plot 7, 8a, 8b, 27, 57, 61, 63, 64, 65, 66.

Black locust; *Robinia Pseudacacia*, L.
Plot 17, 19, 57, 58, 59.

*Found growing naturally, as well as where used in experiments.

BULLETIN 263 DECEMBER, 1924

Connecticut Agricultural Experiment Station
New Haven, Connecticut

SECOND REPORT

OF THE

TREE PROTECTION EXAMINING BOARD

W. E. BRITTON, Entomologist
G. P. CLINTON, Botanist
W. O. FILLEY, Forester

CONNECTICUT AGRICULTURAL EXPERIMENT STATION

OFFICERS AND STAFF

December, 1924.

BOARD OF CONTROL.

His Excellency, Charles A. Templeton, *ex-officio, President.*

George A. Hopson, *Secretary*.....Mount Carmel
Wm. L. Slate, Jr., *Director and Treasurer*.....New Haven
Joseph W. Alsop.....Avon
Charles R. Treat.....Orange
Elijah Rogers.....Southington
Edward C. Schneider.....Middletown
Francis F. Lincoln.....Cheshire

STAFF.

E. H. Jenkins, Ph.D., *Director Emeritus.*

Administration.
Wm. L. Slate, Jr., B.Sc., *Director and Treasurer.*
Miss L. M. Brautlecht, *Bookkeeper and Librarian.*
Miss J. V. Berger, *Stenographer and Bookkeeper.*
Miss Mary Bradley, *Secretary.*
William Veitch, *In Charge of Buildings and Grounds.*

Chemistry: Analytical Laboratory.
E. M. Bailey, Ph.D., *Chemist in Charge.*
R. E. Andrew, M.A. } *Assistant Chemists.*
C. E. Shepard }
Owen L. Nolan }
Harry J. Fisher, A.B. }
Frank C. Sheldon, *Laboratory Assistant.*
V. L. Churchill, *Sampling Agent.*
Miss Mabel Bacon, *Stenographer.*

Biochemical Laboratory.
T. B. Osborne, Ph.D., Sc.D., *Chemist in Charge.*

Botany.
G. P. Clinton, Sc.D., *Botanist in Charge.*
E. M. Stoddard, B.S., *Pomologist.*
Miss Florence A. McCormick, Ph.D., *Pathologist.*
Willis R. Hunt, M.S., *Graduate Assistant.*
G. E. Graham, *General Assistant.*
Mrs. W. W. Kelsey, *Secretary.*

Entomology.
W. E. Britton, Ph.D., *Entomologist in Charge; State Entomologist*
B. H. Walden, B.Agr. } *Assistant Entomologists.*
M. P. Zappe, B.S. }
Philip Garman, Ph.D. }
Roger B. Friend, B.Sc., *Graduate Assistant.*
John T. Ashworth, *Deputy in Charge of Gipsy Moth Work.*
R. C. Botsford, *Deputy in Charge of Mosquito Elimination.*
Miss Gladys M. Finley, *Stenographer.*

Forestry.
Walter O. Filley, *Forester in Charge.*
A. E. Moss, M.F., *Assistant Forester.*
H. W. Hicock, M.F., *Assistant Forester.*
Miss Pauline A. Merchant, *Stenographer.*

Plant Breeding.
Donald F. Jones, S.D., *Geneticist in Charge.*
P. C. Mangelsdorf, M.S., *Graduate Assistant.*

Soil Research.
M. F. Morgan, M.S., *Investigator.*

Tobacco Sub-station at Windsor.
N. T. Nelson, Ph.D., *Plant Physiologist.*

The Wilson H. Lee Co.

ANNOUNCEMENT.

The Tree Protection Examining Board created by the General Assembly of 1919 (see Public Acts of 1919, Chapter 181), has adopted this as its Second Report.

ILLUSTRATIONS.

The illustrations in this report are from photographs from the following sources: Plate XV, a, by Mr. Harry B. Kirk; Plates IX, X, b, XI, a, and XIV, d, by Mr. B. H. Walden; Plates X, a, XI, c and d, XIV, a, XIV, d, and XVI, by Mr. W. O. Filley; Plates XII, XIII, XIV, b and c, XV, b and c, by Dr. W. E. Britton.

W. E. Britton, Entomologist,
Chairman.

G. P. Clinton, Botanist,
Vice Chairman.

W. O. Filley, Forester,
Secretary-Treasurer.

CONTENTS.

SECOND REPORT

OF THE

Tree Protection Examining Board

Covering the Three Years Ending June 30, 1924

The first report of the Tree Protection Examining Board was issued in 1921 as Bulletin 231, and was included in the Annual Report of the Station for that year, pages 339-350. It contained an account of the activities of the Board including the law, rules and regulations, sample examination questions, forms of certificates, institute program, financial statement, list of firms and individuals receiving certificates, and a general discussion explaining the reasons for legislation, and warning tree owners to employ qualified men for their tree work and promising to investigate complaints.

The Station is often asked who is qualified for this work, and since no list had been printed since 1921, a revised list was published, April 25, 1924, as Bulletin of Immediate Information, No. 35, entitled, "Tree Workers Holding Connecticut Certificates." As this leaflet does not contain any account of the other activities of the Board, the present report has been made complete for the period which it covers. Sections on tree surgery and on the common insect and fungous pests of shade trees have also been added as a source of information to tree workers and tree owners.

The members of the Board feel that the legislation on this subject enacted in Connecticut in 1919, was fully justified by the conditions then existing, and believe that, on account of this legislation, these conditions have since greatly improved. Moreover, the Board has received from several other States requests for copies of the Connecticut law, regulations, and examination and certificate forms, with the statement that similar legislation was contemplated in those states. The law and regulations follow:

AN ACT CONCERNING THE IMPROVEMENT, PROTECTION OR PRESERVATION OF FRUIT, SHADE OR ORNAMENTAL TREES.

Chapter 181. Public Acts of 1919. (In effect July 1, 1919.)

SECTION 1. No person, firm or corporation shall advertise, solicit or contract to improve the condition of fruit, shade, forest or ornamental trees, by pruning, trimming or filling cavities, or to protect such trees from damage by insects or disease, either by spraying or any other method, without having secured a certificate as specified in section two of this act; and

any person, firm or corporation failing to comply with the terms of this act shall be fined not more than one hundred dollars; provided any person may improve or protect any tree on his own premises or on the property of his employer or on any property within the limits of the town of which he is a legal resident, without securing such a certificate.

SECTION 2. The botanist, entomologist and forester of the Connecticut Agricultural Experiment Station shall constitute a board which shall, upon application from any person, firm or corporation, examine the qualifications of the applicant to improve, protect or preserve fruit, shade, ornamental or forest trees, and if satisfied that the applicant is qualified, may issue a certificate so stating; which certificate shall be valid for one year from the date of its issue, unless sooner revoked as provided in section three of this act, and may be renewed by the board for succeeding years without further examination, upon payment of the fee hereinafter required, provided any person, firm or corporation receiving such certificate shall be responsible for the acts of all employees in the performance of such work.

SECTION 3. Said board shall prepare all necessary forms and prescribe all rules and regulations governing examinations, and any certificate issued under the provisions of this act may be revoked by it upon proof that improper methods have been used or for other sufficient cause.

SECTION 4. Each applicant for an examination shall pay a fee of five dollars in advance, and a fee of two dollars for each certificate or renewal issued; which fees may be expended by the board for any expense incurred by it in making examinations or issuing certificates, and an account of all receipts and expenditures under this act shall be rendered annually to the state comptroller.

As the law provides that this Board shall consist of the botanist, entomologist and forester of the Station, the Board was organized by electing as Chairman, W. E. Britton, Entomologist, as Vice-Chairman, G. P. Clinton, Botanist, and as Secretary-Treasurer, W. O. Filley, Forester. The following rules and regulations have since been adopted by the Board:

EXAMINATION RULES AND REGULATIONS.

I. Each person, firm or corporation required to secure a certificate under Chapter 181, Public Acts of 1919, shall be examined as follows: When a firm is under control of one person who is solely responsible for the contracts, methods and oversight of each piece of work, this person alone may be required to pass the examination, but when more than one person is responsible for the methods of work and oversight of same, each shall be required to take the examination. When foremen or others are given complete charge of recommending and applying treatments, they shall also be required to take the examination, in so far as it relates to their work. The Examining Board shall decide who shall be required to take the examination.

II. Unless otherwise arranged, candidates for certificates shall appear for examination at the Connecticut Agricultural Experiment Station, at New Haven, at such times as shall be designated by the Board.

III. Examinations may be oral, written, or both, as shall be determined by the Examining Board, and, in general, shall cover tree species, tree life and growth; diseases and insect pests of trees, with treatment for same; pruning and tree surgery.

IV. Candidates prior to the time of examination shall furnish a typewritten statement of their qualifications as follows:

1. General education.
2. Special training for tree protection work.
3. Experience in tree protection work. The latter shall include
   (a) Place of business, name of firm and position now held.
   (b) Previous positions held.
   (c) Total length of experience.
   (d) Contracts now under way or completed during the past 12 months.

In addition three or more recommendations as to reliability and efficiency shall be furnished; and where typed or printed forms of contracts, regulations, etc., are used, these shall also be supplied, or if not available, statements shall be made concerning the same.

V. If satisfied with the qualifications of the applicant, the Board will issue a certificate good for the succeeding twelve months (unless revoked for cause), then to be renewed upon application under such conditions as the Examining Board may require in each case.

VI. Upon evidence of unfitness in training or improper business methods, the Examining Board may refuse to issue a certificate or cancel one that has been issued. Complaints may be made to the Board on these points, and if deemed desirable by the Board, private hearings of the interested parties shall be held.

RENEWAL OF CERTIFICATES.

The provision of Section 4, Chapter 181, Public Acts of 1919, regarding renewal of certificates shall be construed by this Board as meaning a continuous possession of a certificate and not an attempt to obtain a new certificate after a long period during which the old certificate has lapsed. The following rules are hereby adopted:

1. The secretary shall notify each certificate holder at least two weeks before his certificate expires, and again two weeks after date of expiration, unless previously renewed. If a certificate has not been renewed one month after date of expiration it then becomes invalid and the holder shall be notified to that effect.

2. An invalid certificate may be revalidated at the discretion of the Board for the full renewal period or the unexpired portion thereof, if request for such action is received within three years from expiration date and if all renewal fees for the intervening period, as well as the renewal period, are paid in full.

3. If application is made on or before the expiration date of a certificate, a demit or respite covering a period of three years may be issued without charge, entitling the holder to obtain a renewal certificate for one year on payment of the statutory fee of $2.00.

4. If after three years with or without a demit a certificate has not been renewed, a new application with a fee of $5.00 shall be necessary and another examination may be required by the Board.

NUMBER OF CERTIFICATES ISSUED

In all, 109 certificates have been issued by the Board since the law became effective. Of this number, 80 are now in force and 29 have been canceled; three by death, four by changes in business, nine by removal from the state and 13 were not renewed. The following list contains the names of individuals and firms now holding certificates which are in force:

FIRMS AND INDIVIDUALS HOLDING CERTIFICATES

Name	Address	Cert. No.	Certificate Expires
Armstrong Tree Service, Ltd.			
Armstrong, Newton G.	Poughkeepsie, N. Y.	86	May 25, 1925
Parmelee, Leland E.	Poughkeepsie, N. Y.	89	July 23, 1925
Baldwin, Thos. J.	P. O. Box 176, Guilford, Conn.	21	July 15, 1925
Bartlett Tree Expert Co., F. A. (F. A. Bartlett)	Stamford, Conn.	10	July 15, 1925
*Barton, Robert	P. O. Box 57, Hamden, Conn.	66	Dec. 18, 1924
Beaupain & Saunders (Henry F. Beaupain)	So. Norwalk, Conn.	27	Aug. 12, 1925
*Bertolf Brothers (August C. Bertolf)	Sound Beach, Conn.	24	July 29, 1925
Brown, Edgar M.	211 Sisson Ave., Hartford, Conn.	52	June 6, 1925
Calverley, Arthur	763 Campbell Ave., West Haven, Conn.	97	Mar. 31, 1925
Cardarelli, Emilio J.	Cromwell, Conn.	57	Feb. 28, 1925
Clark, Harry E.	Middlebury, Conn.	72	Mar. 8, 1925
Clark, Wyllis S.	New Canaan, Conn.	20	July 15, 1925
Clyne, G. A.	73 Canal St., Waterbury, Conn.	5	July 1, 1925
Condon Co., Maurice L. (Maurice L. Condon)	Lake Mahopac, N.Y.	46	Feb. 2, 1925
Cromie, George A.	18 Compton St., New Haven, Conn.	88	May 25, 1925
Davey Tree Expert Company	Kent, Ohio.		
Baldwin, H. E.	General Delivery, Norwich, Conn.	91	July 23, 1925
Gammie, Peter	P. O. Box 423, Stamford, Conn.	60	May 26, 1925
Grove, D. Q.	Kent, Ohio	87	May 25, 1925
Landis, Ray E.	28 Smith St., Danbury, Conn.	108	May 15, 1925
Liming, O. N.	General Delivery, Stonington, Conn.	102	May 8, 1925
Tuomey, W. W.	General Delivery, South Manchester, Conn.	109	June 15, 1925
†Desmond, Thomas H.	Simsbury, Conn.	50	April 4, 1925
DeWolfe, John C. G.	85 Medford St., Medford, Mass.	80	Aug. 7, 1925
Dunham, L. N.	45 Park Terrace, New Britain, Conn.	104	May 8, 1925
Easton, Clifford H.	P. O. Box No. 1, Scarborough, N.Y.	53	June 16, 1925
*Elm City Nursery Co., J. L. Donnelly,	Box 1588, New Haven, Conn.	105	May 12, 1925
*Ernst, Otto F.	Norwich, Conn.	79	July 14, 1925
Fertsch, Ross L.	P. O. Box 220, Newburgh, N. Y.	84	April 4, 1925
Galligan, Clarence W.	15 Admiral Street, Allingtown, Conn.	74	June 28, 1925

* Is also a nurseryman.
† Is also a landscape architect.

FIRMS AND INDIVIDUALS HOLDING CERTIFICATES—*Continued*

Name	Address	Cert. No.	Certificate Expires
Gibbs, R. M.	33 Fairfield Street, Pittsfield, Mass.	83	April 4, 1925
Gilbert, J. E.	376 George Street, New Haven, Conn.	61	May 26, 1925
†Goodwin Associates, James L., James L. Goodwin	750 Main St., Hartford, Conn.	39	Nov. 26, 1925
Graf, Albert H.	P. O. Box 87, Bardonia, N. Y.	67	Dec. 18, 1924
Grovit, Albert	986 Whalley Ave., New Haven, Conn.	85	April 6, 1925
Gustafson, Harry A.	P. O. Box 81, Watertown, Conn.	96	Mar. 25, 1925
Hartford Forestry Company			
Hansling, Philip, Sr.	65 Sherman Street,	17	July 15, 1925
Hansling, Philip, Jr.	Hartford, Conn.	16	July 15, 1925
Herthal, G. F.	228 Bunnell Street, Bridgeport, Conn.	25	July 29, 1925
Herthal, Gus., Jr.	228 Bunnell St., Bridgeport, Conn.	36	Sept. 17, 1925
Hollister, S. P.	Conn. Agr. College, Storrs, Conn.	47	Mar. 21, 1925
Horlacher, John J.	197 Thomas Street, West Haven, Conn.	103	May 8, 1925
*Hunt & Co., W. W., (W. A. Wright)	167 Blue Hills Ave., Hartford, Conn.	33	Sept. 17, 1925
Kellner, Arthur H.	7 Grove St., South Norwalk, Conn.	26	Aug. 12, 1925
*Kellner, Herman H.	Danbury, Conn.	101	April 1, 1925
*Kelley, James J.	New Canaan, Conn.	19	July 15, 1925
Landscape Foresters, Ltd. (C. E. Mager)	52 Vanderbilt Ave., New York City	32	Sept. 17, 1925
*†Mallett Co., G. A., (George A. Mallett)	95 Catherine St., Bridgeport, Conn.	11	July 15, 1925
Maynard, Eugene	61 Coit St., New London, Conn.	94	Feb. 6, 1925
McLaughlin & Carberry			
Carberry, Joseph V.	Sharon, Conn.	78	July 9, 1925
McLaughlin, J. A.	Sharon, Conn.	77	July 9, 1925
Meader Co., L. H. (Lewis H. Meader)	75 Westminster St., Providence, R. I.	31	Sept. 17, 1925
*Millane Tree Expert Co., (Neal A. Millane)	Middletown, Conn.	1	July 1, 1925
Morris, Harry H.	9 Winthrop Place, Danbury, Conn.	40	Nov. 6, 1925
Munson-Whitaker Co. (Robert O'Shea).	1 Washington St., Boston, Mass.	42	Nov. 25, 1925
Murphy, Allen L.	Bethel, Conn.	106	May 15, 1925
Old Colony Forestry Co. (Thomas J. McGinnis)	415 Savin Ave., West Haven, Conn.	4	July 1, 1925
O'Gara, Charles E.	696 Dixwell Ave., New Haven, Conn.	110	Aug. 28, 1925
Pauley Tree Expert Co., (George A. Pauley)	New Canaan, Conn.	22	July 29, 1925

* Is also a nurseryman.
† Is also a landscape architect.

FIRMS AND INDIVIDUALS HOLDING CERTIFICATES—*Concluded*

Name	Address	Cert. No.	Certificate Expires
Perry, Lewis	Southington, Conn.	95	Feb. 6, 1925
Plumb, C. K. & J. C. (C. K. Plumb)	New Canaan, Conn.	100	Mar. 31, 1925
Pool, William H.	47 Sheffield Ave., Roslindale, Mass.	63	Oct. 10, 1925
Rice, Ralph S.	71 Howard Avenue, New Haven, Conn.	69	Dec. 18, 1924
Rich, Nehemiah L.	101 Warren Street, Stamford, Conn.	3	July 1, 1925
*Rockfall Nursery Co., (Philip Marotta)	Rockfall, Conn.	71	Mar. 8, 1925
Rottenberg, Julius	Newington Gardens, Newington Jct., Conn.	93	Jan. 9, 1925
Royal Forestry Co. (Charles Vallett)	124 Division St., Waterbury, Conn.	62	Aug. 5, 1925
*Schoonman, W. J.	New London, Conn.	6	July 1, 1925
Shaw, Walter	494 Blake St., Westville, Conn.	55	June 16, 1925
*Sierman, C. H.	2291 Albany Ave., West Hartford, Conn.	8	July 1, 1925
*Steck, Harold W.	Newtown, Conn.	92	Jan. 10, 1925
Szirbik, George	77 East Ramsdell St., Westville, Conn.	111	Aug. 28, 1925
*van Heinigen, Jacob C.	South Wilton, Conn.	48	April 4, 1925
van Kleef, Marinus	Bridgewater, Conn.	75	July 4, 1925
*Van Wilgen Company			
Van Wilgen, A. C.	71 Main St.,	99	Mar. 31, 1925
Van Wilgen, W. C.	Branford, Conn.	98	Mar. 31, 1925
*Verkade, H.	Corner Crocker St. and Lower Boulevard, New London, Conn.	18	July 15, 1925
Wilcox, Reginald C.	Essex, Conn.	30	Sept. 17, 1925
Wright, John L.	P. O. Box 593, Putnam, Conn.	43	Nov. 25, 1925

* Is also a nurseryman.

EXAMINATIONS

The law provides that the fee of $5.00 shall be paid in advance. The form of application now in use is as follows:

> TREE PROTECTION EXAMINING BOARD,
> Box 1106, New Haven, Conn.
>
> Gentlemen:—
>
> I hereby apply for a certificate as provided in Chapter 181, Public Acts of 1919, to be issued in the name of
>
> .....
>
> Enclosed is examination fee of $5.00 required by law.
>
> .....
> Signature of Applicant
>
> .....
> Business Address

It has been the practice of the Board to hold an examination only when there were enough applicants to warrant one, rather than to set a special date for each applicant, and it has usually been possible to examine three or more candidates at one time. There have been occasional requests for examination by mail, but as a matter of policy, the Board has insisted on candidates appearing before it in person.

Since the last report, 16 examinations have been held as follows:

In 1921—July 26, October 3, December 19.
In 1922—March 9, May 18, June 26, October 27.
In 1923—April 2, May 25, July 23, November 26.
In 1924—February 5, March 25, May 2, June 6, August 28.

Fifty-three candidates presented themselves. Of this number, 48 were granted certificates without condition, three were requested to take a second examination, one was refused a certificate, and one passed the examination but decided he did not need a certificate. Fifty-one certificates were issued during the period covered, making a total of 109 certificates issued during the first five years of the Board's existence.

Form of Certificates

The form of the regular certificate adopted and used by the Board is as follows:

CERTIFICATE

FROM

Tree Protection Examining Board

STATE OF CONNECTICUT

This is to Certify that _____

of _____ has been duly examined in compliance with the provisions of Chapter 181, Public Acts of 1919, and is considered qualified to conduct the business of protecting trees.

No. _____ Entomologist, *Chairman*

Date _____ Botanist, *Vice-Chairman*

Expires _____ Forester, *Sec'y-Treas.*

Examining Board

CONNECTICUT AGRICULTURAL EXPERIMENT STATION

NEW HAVEN, CONNECTICUT

At the expiration of the regular certificate, if the fee of two dollars ($2.00) has been paid, a renewal certificate is issued in the following form:

RENEWAL CERTIFICATE

FROM

Tree Protection Examining Board

STATE OF CONNECTICUT

This is to Certify that Certificate No.....was issued by this Board on.....to.....

of....., as provided by Chapter 181, Public Acts of 1919, and said certificate is hereby renewed for one year from.....

.....Renewal ..... *Entomologist, Chairman*

Expires..... ..... *Botanist, Vice-Chairman*

Issued..... ..... *Forester, Sec'y-Treas.*

CONNECTICUT AGRICULTURAL EXPERIMENT STATION

NEW HAVEN, CONNECTICUT

To show that men are working under a valid certificate issued by the Board, a small card was furnished for each foreman employed by a firm or an individual. The form of this card is shown below:

State of Connecticut

TREE PROTECTION EXAMINING BOARD

THE BEARER

is working under supervision of and is responsible to

.....

of.....Conn.,

to whom this board has issued Certificate No....as provided by Chapter 181, Public Acts of 1919. Said certificate expires.....

CONNECTICUT AGRICULTURAL EXPERIMENT STATION

NEW HAVEN, CONN. .....

Secretary

Institutes for Instruction

The early examinations, as well as some of the more recent ones, have shown that many of the tree men are not well versed in the life processes and care of trees. Consequently, early in the first year after the law was passed, an institute of instruction was held at the Station at which the various phases of tree life and growth were discussed. The results were such that the Board has, in each of the years 1922, 1923 and 1924, conducted a one-day institute for this purpose, in some cases at the request of the tree workers. In all, four institutes have been held, the program of the first being given in the first Report of the Board. The attendance has varied between 50 and 100, and deep interest has been shown. The program and date of each of the other institutes are given below:

February 21, 1922

10.00 A.M. The Living Tree (Illustrated), by Dr. George E. Nichols, Assistant Professor of Botany in Yale University, New Haven, Conn.; The Pruning and Spraying of Fruit Trees, by Prof. Sherman P. Hollister, Assistant Professor of Pomology, Connecticut Agricultural College, Storrs, Conn.; Effects of Smoke, Gases and Electricity Upon Trees, by Prof. J. W. Toumey, Dean School of Forestry, Yale University, New Haven, Conn.; Observations on Oil Injury to Trees, by Dr. E. P. Felt, State Entomologist, Albany, New York. 12.00, Recess for luncheon. 1.30 P. M. Pruning and Cavity Work as Applied to Shade Trees (Illustrated), by J. Franklin Collins, Forest Pathologist, U. S. Dept. of Agriculture, Brown University, Providence, R.I.; Discussion, led by Dr. George E. Stone, Amherst, Mass.; Modern Methods of Tree Surgery (Demonstration), by F. A. Bartlett, Bartlett Tree Expert Company, Stamford, Conn.; Some Common Insect Pests of Shade Trees (Illustrated), by Dr. E. P. Felt, State Entomologist, Albany, New York; Report on work of Tree Protection Examining Board, by W. O. Filley, Forester, Connecticut Agricultural Experiment Station, New Haven, Conn.; Report of Committee on Organization of a Tree Protective Association in Connecticut.

March 1, 1923

10.00 A.M. Opening Remarks, by Dr. W. E. Britton, State Entomologist, New Haven, Conn.; The Tree in the Landscape (Illustrated), by Ernest F. Coe, Landscape Architect, New Haven, Conn.; The Gipsy Moth, by A. F. Burgess, In Charge of Moth Work, U. S. Bureau of Entomology, Melrose Highlands, Mass.; Some Insects Attacking Shade Trees (Illustrated), by Dr. E. P. Felt, State Entomologist, Albany, N. Y. 12.15 P.M. Recess for luncheon. 2.00 P.M. The Living Tree (Illustrated), by Dr. G. E. Nichols, Assistant Professor of Botany, Yale University, New Haven, Conn.; Wood Rot Fungi (Illustrated), by Dr. W. A. Murrill, New York Botanical Garden, New York, N.Y.; Mechanical Injuries and Their Treatment (Illustrated), by Dr. G. E. Stone, Amherst, Mass.; Fertilizers for Trees, by Dr. E. H. Jenkins, Director, Connecticut Agricultural Experiment Station, New Haven, Conn.

March 11, 1924

10.00 A.M. Opening Remarks, by Dr. W. E. Britton, State Entomologist, New Haven, Conn.; Word of Welcome, by W. L. Slate, Jr., Director, Connecticut Agricultural Experiment Station, New Haven, Conn.; The Living Tree (Illustrated), by Dr. G. E. Nichols, Assistant Professor of Botany, Yale University, New Haven, Conn.; Some Fungous Diseases of Trees (Illustrated), by Dr. A. H. Graves, Curator of Public Instruction, Brooklyn Botanic Garden, Brooklyn, N.Y. 12.15 P.M. Recess for Luncheon. 2.00 P.M. Some Insects Attacking Shade Trees (Illustrated), by Prof. W. C. O'Kane, Professor of Economic Entomology, University of New Hampshire, Durham, N. H.; Some Insects Requiring Special Attention the Coming Season (Illustrated), by Dr. W. E. Britton, State Entomologist, New Haven, Conn.; Cavity Work, Pruning, and Spraying (Illustrated), by George A. Cromie, Superintendent of Trees, New Haven, Conn.

Financial Statements

TREASURER'S ACCOUNT

July 1, 1921—June 30, 1922		
Balance on hand July 1, 1921		$213.98
Received for 18 examination fees @ $5.00	$90.00	
" " 44 renewal fees @ $2.00	88.00	178.00
		$391.98
Expended for Printing and Stationery	$28.45	
" " Postage	18.36	
" " Travel Expenses of Board	20.92	
" " Institute Expenses	36.87	
" " Miscel. office expense	1.80	106.50
		$285.48
Receipts paid Comptroller, for deposit in State Treasury		178.00
Balance on hand June 30, 1922		$107.48
July 1, 1922—June 30, 1923		
Received for 10 examination fees @ $5.00	$50.00	
" " 52 renewal fees @ $2.00	104.00	154.00
		$261.48
Expended for Printing and Stationery	$42.65	
" " Postage	6.00	
" " Institute Expenses	49.29	97.94
		$163.54
Receipts paid Comptroller, for deposit in State Treasury		154.00
Balance on hand June 30, 1924		$9.54
July 1, 1923—June 30, 1924		
Received for 21 examination fees @ $5.00	$105.00	
" " 60 renewal fees @ $2.00	120.00	225.00
		$234.54
Expended for Printing and Stationery	$3.13	
" " Institute Expenses	6.41	9.54
		$225.00
Receipts paid Comptroller, for deposit in State Treasury		225.00

COMPTROLLER'S ACCOUNT

Amounts deposited in State Treasury,		
July 1, 1921—June 30, 1922	$178.00	
July 1, 1922—June 30, 1923	154.00	
July 1, 1923—June 30, 1924	225.00	
		$557.00
Expenditures by Comptroller, on order of the Board,		
For Printing and Stationery	$64.18	
Postage	16.00	
Travel Expenses of Board	7.75	
Institute Expenses	43.52	
Miscellaneous Office Expense	11.98	
		143.43
Balance available in State Treasury, June 30, 1924		$413.57

TREE SURGERY

W. O. FILLEY

The problems confronting those interested in the protection and care of ornamental trees are many and various. Some problems relating to foliage, bark, and exposed portions of the trees are simple of solution and results of treatment are readily observed. In some cases, as in spraying with chemicals, complications may arise which require further study, but even in such cases the parts concerned are open to observation and the methods used are susceptible of proof by observation and test.

The filling of cavities, treatment of wounds, stimulation of growth by fertilization and cultivation of soils, and other problems which involve growth and condition of woody tissues are much more difficult of solution. In such cases, results from applied methods are not easy to determine, and there is great divergence of opinion regarding the efficiency of methods which are difficult to standardize. This fact makes it possible, and almost inevitable, that secret or patented processes should become the basis of business getting rather than knowledge and skill.

With due appreciation of this situation and believing that the solution of many of these problems is possible through concerted action on the part of those interested, this Board invited a number of scientists, tree workers and officials to join it in a Shade Tree Conference at Stamford, Conn., August 25-26, 1924. This conference (probably the first of its kind in this country) was attended by 36 individuals, including botanists, entomologists and practical tree workers. The definite results were summed up in the conclusions of Dr. Haven Metcalf, Forest Pathologist, U. S. Bureau of Plant Industry.

"Tree surgery," he stated, "is about where dentistry was in the 60's; its first object being looks. We believe that it does prolong the life of trees but we cannot prove it, and there is almost no literature on the subject. What is needed more than anything else is research records and case histories."

It was voted that another conference should be held in 1925, of which Dr. Haven Metcalf was elected chairman and W. O. Filley, secretary, with instructions to make all necessary arrangements.

It may be truly stated that nothing new came out of this conference. Everything which was said had doubtless been said before. Nevertheless, the meeting served its purpose in bringing together scientists and tree workers for an informal discussion of shade tree problems. Future conferences will undoubtedly show more definite progress toward their solution.

The feeling of many regarding the uncertain status of cavity work was expressed in a short paper by Dr. Collins of the U. S.

Bureau of Plant Industry. He has consented to its publication as a part of this report.

In common with many other observers, this Board has felt that the importance of cavity treatment and filling was somewhat over-emphasized, as compared with improvement of soil conditions, proper pruning and treatment of wounds, protection from insect and fungous pests, etc. Much wonderfully fine workmanship has gone into the filling of cavities, and in many cases it may have lengthened the life of the trees concerned, but in others it has only served to increase the size of the bill.

Neverthless cavity work, like the treatment of wounds, bracing, and other forms of tree repair, is demanded by tree owners, who are ready to pay for expert knowledge and skill. In return, they have a right to expect definite results, which can only be assured through standardized methods applied with judgment and honest intent. Tree workers ought to be able to say that a certain method is the right one because it has stood the test of time and is so universally used that it has become standardized. This can only come about through careful observation of results, frequent exchange of ideas with other tree workers and close co-operation with scientific workers who are keenly interested in the solution of these problems.

CAVITY WORK

J. FRANKLIN COLLINS

(Read before the Shade Tree Conference, Stamford, Conn., Aug. 25, 1924)

Before speaking of cavity work I wish to correct an erroneous impression that seems to be somewhat prevalent regarding the scope of the tree repair work being done by our Washington office. The Bureau of Plant Industry is not primarily concerned with the work of commercial "tree surgeons," nor has it ever been, so far as I know. Its primary interest lies in trying to help the man who owns a few trees (either shade, ornamental or orchard) to keep them in good condition so far as disease and mechanical injury is concerned, or to advise him how best to repair fresh injuries, as well as neglected ones that may have occurred in the past. To put the matter in another way, we are concerned primarily with the question, "What is the best advice to give to a man who has a few trees that he wants to care for himself and who would never, for financial or other reasons, employ a commercial tree surgeon to attend to them?" That is the information that we have tried to give in Farmers' Bulletin 1178, and the first paragraph in this Bulletin expressly states this to be its object. I might also add, this is its sole object.

I think it is the general opinion of the majority of tree workers that preventing decay is far better, from all points of view, than trying to cure it. I think nearly all tree workers (certainly all scientific workers) also will agree that a decayed spot in a trunk or a large limb should be carefully cleaned out, sterilized, and treated in such a manner as to prevent, so far as possible, any reinfection.

Beyond this point there obviously is a difference of opinion even among commercial tree surgeons, as to what is the best thing to do with the cleaned out cavity: i.e., whether to leave it open, to cover it with sheet metal, or to fill it with concrete or asphalt mixtures, wood, or other materials.

For the past 15 years when traveling about the country, primarily on other business, I have made it a point to look over cement-filled cavities wherever I have been and had the time to do so, and check up on their general condition. My method of checking was to count only fillings that had been in place for a few years so as to get some idea of their permanency. Those which showed obvious cracks, chipped cement, severe dying back of the cambium, excessive leakage, or a loose filling were considered defective. Judged on this basis more than 90 per cent. of all the fillings examined have proved to be defective. I was not particularly concerned with who did the work, although in some cases I was told who did it. Undoubtedly most of this work had been done by men trained, at least to some extent, in the work, as the trees examined were located primarily along streets or on large estates where commercial men had been employed to do it.

I have had opportunity to dig out quite a number of fillings that had been in place for periods varying from eight to 15 years, and most of these, even when absolutely perfect on the surface, were found to be badly decayed back of the cement, in some cases the decayed area back of the cement was larger than the original cement-filled cavity itself. As a result of such observations as these it is hardly to be expected that the use of cement in other than small and globular cavities could conscientiously be recommended for the use of untrained persons, to say the least.

So far as asphalt mixtures or wood strips and blocks are concerned I can only say that although they appear to me to give promise of good results after they have been in practical use long enough to know just how they can best be handled, they have not yet stood the test sufficiently long to demonstrate satisfactorily to me their real value and limitations. Consequently, they are not at present recommended by us for the use of untrained men, except on an experimental basis.

SOME OF THE PRINCIPAL INSECTS ATTACKING SHADE TREES IN CONNECTICUT

W. E. BRITTON

It is often necessary to spray shade trees in Connecticut in order to control certain insects which otherwise might seriously injure the trees. In summer there are various chewing insects which devour the foliage, and there are also other insects, such as aphids and scales, which, when abundant, make a heavy drain upon the trees by sucking out the sap. Though most of these pests do not kill the trees in a single season, yet they weaken them, and if a tree is completely defoliated two or three times in succession, death may result.

In cities and towns as well as on large estates and other private holdings where the trees are an important asset, every effort should be put forth to keep the trees in the best possible health and vigor. Such a program must include provision for spraying the trees to rid them of their insect pests. Perhaps it may not be necessary to treat them every season because these pests fluctuate in abundance from year to year, and when absent, it might be wasting money to spray the trees. But the trees should be watched, and materials and apparatus should be always at hand in readiness to make the application whenever the conditions seem to warrant it. In no other way can the trees be given the most intelligent care.

What Insects Are

Insects are small animals belonging to the class Hexapoda (six-legged), and for the most part they have six legs in some stage of their existence. Those attacking trees may be divided roughly into two groups: (1) chewing insects, and (2) sucking insects. The chewing insects (except termites or white ants) have four distinct stages in their life cycles as follows: (1) egg, (2) caterpillar, grub or larva, (3) pupa, (4) adult insect. Such insects are said to have complete transformations. The sucking insects have incomplete transformations and do not pass through these four well-marked stages. There is usually, though not always, an egg stage, and an adult stage, but there is no distinct pupa, except in case of the males in certain scale insects and white flies, and the larvae are called nymphs after hatching from the eggs, and undergo a gradual development, molting several times with only slight changes until the adult stage is reached.

Chewing insects have strong jaws or mandibles with which they bite or tear off bits of the food which they swallow. Sucking insects have beaks or probosces which they insert into the tissues and suck out the sap.

Common Insecticides

Remedies for chewing insects include the arsenical poisons, but these are not effective against sucking insects where it is necessary to employ some substance which will kill by contact. Both kinds of insects may be killed by fumigation.

The most common arsenical poison used in tree spraying is lead arsenate, which may now be obtained in the form of paste, and also as a dry powder. It is used in various proportions from three pounds of paste or one and one-half pounds of dry powder in orchards, to 10 pounds of paste or five pounds of dry powder to 50 gallons of water for gipsy moth and certain other shade tree insects. A spreader is sometimes employed.

FORMULA FOR LEAD ARSENATE

Lead arsenate (paste)	3-10 lbs. or (dry) 1½-5 lbs.
Calcium caseinate spreader	1 lb.
Water	50 gals.

Paris green and calcium arsenate are often used in spraying especially on potatoes. Calcium arsenate is used extensively on cotton in the South, but it causes injury on apple foliage in Connecticut, and is not recommended for tree work. In case it seems necessary to use these poisons, ½ lb. of Paris green, 1½ lbs. air-slaked or hydrated lime may be used to 50 gallons; with calcium arsenate, 1½ lbs. each of the poison and lime may be used to 50 gallons of water.

FORMULA FOR NICOTINE SOLUTION

Nicotine sulphate may be obtained in 40 per cent. solution, and several different brands are on the market. Used to kill aphids and other sucking insects.

Nicotine sulphate	½ pint
Laundry soap	2 lbs. or
Calcium caseinate	1 lb.
Water	50 gals.

Nicotine sulphate solution may be added to lead arsenate if desired, but the soap should be omitted.

LIME-SULPHUR WASH

Liquid lime-sulphur	1 gal.
Water	9 gals.

This is used as a dormant spray to kill scale insects, and is also a good fungicide. Dry lime-sulphur preparations are now on the market and in using them, directions on the package should be followed. Diluted mixtures of lime-sulphur are also used on the foliage as a fungicide.

MISCIBLE OILS

There are several miscible oils on the market, and these may be used at the rate of one part in 15 parts of water as a dormant spray to kill scale insects, and 1-20 for spruce gall aphid.

Leaf-Chewing Insects

Elm Leaf Beetle: The elm leaf beetle, *Galerucella xanthomelaena* Schrank, hibernates in attics, belfries and other protected places, emerges from its hiding place in early spring and eats holes in the expanding leaves in May. The sexes mate and the females deposit on the under sides of the leaves, clusters of flask-shaped, yellow eggs, which, in a normal season, hatch about June 1. The larvae or grubs feed upon the green tissue on the under surface, skeletonizing the leaves. When numerous they leave only the veins and the upper epidermis, and such injured leaves turn brown and fall, usually the latter half of July. At this time the larvae reach their maturity, drop to the ground or crawl down the trunk, and on the ground around the base of the tree transform to bright yellow pupae. About 10 days later the beetles appear and go to the trees, some laying eggs for a second generation, which seldom or never does any harm in Connecticut. The late emerging beetles probably do not lay eggs, but fly about and feed more or less and go early into their winter quarters.

This insect, like humans, congregates in cities and towns, and seldom injures trees in the open country. It is even more injurious to European elms than to the American elm. It was troublesome in 1923 and defoliated trees in some localities. There was little rainfall during the pupating period, and most of the larvae came through to the adult stage. When pupation takes place during a wet period, the pupae are often attacked and killed by a white mold or fungus. *Sporotrichum globuliferum* Speg. (*entomophilum* Peck.) This fungus and the moisture were absent at the time of pupation in both 1923 and 1924; consequently the elm leaf beetle bids fair to be abundant and to cause injury to the trees in 1925. In 1924, the season was late and the insect went through its different stages and defoliated the trees much later than normal.

The remedies are to kill the beetles in attics and belfries, and to kill the pupae on the ground around the trunks of the trees by spraying them with nicotine solution and soap, and to spray the foliage, particularly the under surface, about June 1, with lead arsenate, two to three pounds of the dry powder in 50 gallons of water.

Further information regarding this insect may be obtained from Bulletin 155 of this Station.

Tent Caterpillar: The tent caterpillar, *Malacosoma americana* Fabr., usually confines its attacks to wild cherry and apple, but it is very abundant every 10 or 12 years when it may also attack oak and other trees. The eggs are deposited in July in cylindrical masses around the small twigs, and covered with a gray, glue-like substance, probably for protection. These eggs hatch when the leaf buds first open in April, and the young caterpillars from each egg-cluster live and feed together and form a web or tent in the crotch of the tree or in a fork of one of its branches. The caterpillars go outside of the nest twice a day to feed, and enter it after feeding, except when nearly full-grown they cluster on the outside of the nest. The caterpillars become full-grown about the first week in June and make their light yellow cocoons under rubbish, fence rails, etc., near the ground. The reddish-brown moths emerge two weeks later. There is only one brood each year.

The remedies are cutting off and burning the egg-clusters in winter, removing the nests and caterpillars with a caterpillar brush, or burning them off with a torch, and spraying the foliage with lead arsenate.

Additional information on the tent caterpillar may be found in Bulletin 177 of this Station.

Cankerworms: The fall cankerworm, *Alsophila pometaria* Harris, is a common pest of fruit, shade and woodland trees in Connecticut, and in some cases is accompanied by the spring cankerworm, *Paleacrita vernata* Peck, which is usually much less abundant. Both species cause the same kind of injury, and require similar remedies. Both have winged males and wingless females which crawl up the trees to lay eggs. The moths of the fall cankerworms emerge during the warm days of November and December and the females lay eggs. The adults of the spring cankerworm emerge and lay their eggs in March. The eggs of both species hatch with the first opening buds and the larvae feed upon the leaves of fruit, shade and woodland trees. Cankerworms were so abundant in Greenwich and Stamford in 1924 that small woodland areas and many shade trees were entirely defoliated. The caterpillars normally feed during May, becoming full-grown about June 1st, and during the first week in June go into the ground and transform to naked brown pupae, remaining in this stage until the following November and December, or in case of the spring species, until the following March. In the fall of 1923 the male moths were very abundant flying about and clustering on tree trunks, especially on the warm, foggy days of November and December.

There are two preventive methods: Spraying the foliage with lead arsenate during May, and employing sticky bands to prevent the insects ascending the trees. The spraying should be

done just as early as is possible after the leaves have unfolded enough to catch and hold the poison. By using a strip of cotton batting to fill the crevices in the bark covering this with a 5-inch strip of single ply tarred paper tacked at the lap, tree tanglefoot can be applied to the paper band. It should be kept sticky during November and December, and again during March and April when the eggs hatch. The whole may be removed without disfiguring the trees.

Further information may be obtained from Bulletin No. 1238, United States Department of Agriculture.

Tussock Moths: The white-marked tussock moth, *Hemerocampa leucostigma* S. and A., often injures and defoliates elm, maple, linden, poplar, horse chestnut and other trees in cities and towns. The caterpillars are bright colored and conspicuous, being striped lengthwise with yellow and brown, and having a red head and three long black tufts or pencils of hairs, two near the head and one at the tail. There are four white tufts on the front half of the body. There are two generations each year in Connecticut, one at Albany, N. Y., and three in Washington, D. C. The insect winters in the form of egg-clusters, usually on or near the old cocoons on the trees and covered with a frothy white substance about half an inch in diameter. The eggs hatch in May and the caterpillars become full-grown about the first of July, and make their cocoons on the bark of the trees. Two week later the moths emerge. The eggs for the second brood are laid in July and the caterpillars feed through August and September, then pupate, and the females lay eggs that carry over the winter.

The females, like the cankerworms, are without wings, but as they pupate on the trees, banding is not so helpful. The males are mouse color with characteristic, rather indistinct markings, and are attracted by lights.

Spraying the foliage and gathering and destroying the egg-clusters are the common methods of control.

For further information, see Report of this Station for 1916, page 105.

The hickory tussock moth, *Halisidota caryae* Harris, and the tessellated tussock moth, *H. tessellaris* S. and A. both have tufted caterpillars which feed upon apple, oak, hickory, willow, poplar and other trees, and occasionally may require a spray of lead arsenate to prevent damage. Each species is single-brooded.

For further information, see Report of this Station for 1917, page 325.

Gipsy Moth and Brown-tail Moth: The caterpillars of the gipsy moth, *Porthetria dispar* Linn., when abundant feed upon the foliage of apple, oak, birch, maple, willow, poplar, and even conifers. There is one generation each season; the eggs are laid in clusters on the bark or in cavities in trees, during July and

August, and hatch the following May. Caterpillars become mature the last of June and make their cocoons in protected places. The adults emerge two weeks later. Soaking the egg-clusters with creosote, and spraying the foliage with lead arsenate with four to five pounds of dry lead arsenate in 50 gallons of water, are the most approved methods of artificial control. So far, this insect has been kept in check in Connecticut by the forces employed by the state.

Further information regarding this insect may be found in Bulletin 186 of this Station.

The brown-tail moth, *Euproctis chrysorrhoea* Linn., formerly occurred over the eastern half of Connecticut, but has since disappeared and for several years has not been seen. It was evidently controlled by natural enemies, and it may come back again. The caterpillars feed upon pear, apple, plum, cherry, oak, elm and maple, and live through the winter in a partially grown state in small webs on terminal branches. Brown egg-masses are laid on the under side of leaves in July by the white moths with brown tufts at the end of their bodies. The caterpillars when touched by human hands cause a rash; they become mature in June and make their cocoons on the leaves.

The remedies are to clip off and burn the winter nests, and to spray the foliage in May with lead arsenate.

More detailed information may be found in Bulletin 182 of this Station.

Fall Webworm: The fall webworm, *Hyphantria cunea* Drury, is found on all kinds of fruit, shade and woodland trees the last half of summer, the caterpillars feeding upon leaves enclosed in nests near the ends of the branches. There is a partial second brood in Connecticut, and the eggs are laid on the under side of leaves by the white female.

Clipping off and burning these nests, and spraying the trees with lead arsenate are the remedies.

For further information, see Report of this Station for 1917, page 319.

Walnut Caterpillar: Hickory, butternut and black walnut trees are often stripped of their leaves in late summer by the walnut caterpillar, *Datana integerrima* G. & R. This is a black caterpillar covered with whitish hairs, which feeds gregariously. They molt and leave the cast skins, in the form of gray patches on the tree trunks. Spraying with lead arsenate is the remedy.

For further information, see Report of this Station for 1917, page 326.

Sawflies on Conifers: There are several species of sawflies, the larvae of which feed on the various species of pine trees, occasionally defoliating them. One of the most destructive is the imported pine sawfly, *Diprion simile* Hartig, which attacks the

white pine and other five-needled pines; these may also be attacked by *Neodiprion pinetum* Norton, *Neodiprion lecontei* Norton, and other species feed upon the pitch pine and other kinds of pines.

The larch sawfly, *Lygaeonematus erichsoni* Hartig, is occasionally so abundant as to defoliate larch trees, and sometimes spruce trees are injured by *Neodiprion abietis* Harris. The proper remedy against all these pests is spraying with lead arsenate.

For further information regarding the imported pine sawfly, see Report of this Station for 1917, page 273.

Larch Leaf-miner or Case Bearer: This insect, *Coleophora laricella* Hubn., is a small moth and the larva tunnels inside the leaves from June to September, often ruining them. It then migrates to the twigs, where in brown, cigar-shaped cases it passes the winter. A dormant spray with liquid lime-sulphur in early spring will kill the larvae in their winter cases and is the best remedy known.

Further information may be found in the above mentioned Report, page 288.

Arbor-vitae Leaf-Miner: This small moth, *Argyresthia thuiella* Packard, has recently caused serious injury to arbor-vitae trees and hedges in Connecticut. The tiny larvae tunnel inside the leaves, causing them to appear transparent and later turn yellow and brown. The adults emerge late in May and early in June, and spraying with nicotine solution and soap when the adults are flying and laying eggs will materially reduce the pest.

For further information, see Report of this Station for 1921, page 157.

Imported Willow Leaf Beetle: This small, shiny blue beetle, *Plagiodera versicolora* Laich., has been brought into this country and has spread from the vicinity of New York to various parts of Connecticut. It prefers shiny leaved willows, but may attack poplars. Eggs are laid on the leaves and both beetles and grubs feed upon the leaves, skeletonizing them. There are two complete broods each season, and the beetles hibernate. The remedy consists of spraying with lead arsenate.

For further information, see Report of this Station for 1921, page 195.

Birch Leaf Skeletonizer: The larvae of a small moth, *Bucculatrix canadensisella* Chambers, often skeletonize the leaves of gray, white and yellow birch trees late in the season. There is only one annual generation, and the insect passes the winter in cocoons on the fallen leaves. The remedy consists of spraying with lead arsenate during August.

For further information, see Report of this Station for 1910, page 701.

Spiny Elm Caterpillar: Black, spiny caterpillars are often found feeding gregariously on elm, poplar and willow, stripping the branches. This insect is called the spiny elm caterpillar, and is the larva of the mourning cloak or Antiopa butterfly, *Euvanessa antiopa* Linn. There are two broods each year in Connecticut, and the adult butterflies live through the winter and may be seen flying on warm days. As the caterpillars feed in colonies it is often possible to crush them on the tree or after cutting off the infested branches. Spraying the foliage with lead arsenate is a remedy.

For further information, see Report of this Station for 1906, page 260.

Borers or Wood-Chewing Insects

Maple Borer: Sugar maple trees are commonly injured by the maple borer, *Glycobius speciosus* Say, a handsome black beetle with yellow markings, and about an inch in length. A conspicuous mark is the W on the base of the wing-covers. The beetles appear in Connecticut the first half of July, and a little later the eggs are laid. The tiny grub begins tunneling in the bark, soon entering the sapwood, where it works around the trunk or branch, usually going upward in a spiral course. Two years are probably required for the complete life cycle, and, of course, the grub increases in size with age and makes a much larger burrow when it is nearly full-grown. This results in some large scars on the trees, and when two or more grubs are at work in the same trunk, they sometimes girdle it and the tree breaks over. When mature, the grub pupates in the burrow and emerges the following July through a nearly circular, somewhat flattened hole, nearly half an inch in diameter. The best control measure is to examine trunk and branches of choice maple trees, preferably in September, find the grubs by following up the sawdust emitted, and cut them out or kill by inserting a wire in the burrow. Also destroy the adult beetles when found resting on the trunks of trees in July.

For further information, see Report of this Station for 1922, page 351.

Leopard Moth: Elm, maple and other shade trees as well as fruit trees are attacked by the leopard moth, *Zeuzera pyrina* Linn. The female moth has a wing-spread of about two and a half inches, is white with fore-wings coarsely dotted with blue and black spots. The male is smaller though similarly marked. The moths emerge mostly in July. Eggs are laid in crevices in the bark, and the young caterpillars usually enter the twigs at the base of a bud, and after feeding for a time, leave their burrows and enter larger branches where they excavate large, irregular galleries. The branches are weakened and often break off. The

grub is white or pinkish, with head, neck shield and tubercular spots, black; it is nearly three inches long when fully grown. The borer causes most of its damage the second summer, lives in the burrow the following winter and pupates, the moths emerging in July, two years being necessary for its complete life cycle. A systematic cutting and burning of infested branches will check the pest, and where sawdust is thrown out from the main trunk and larger branches it is possible to dig out the borers. A wire may be inserted in the burrow or a few drops of carbon disulphide injected and the opening closed to kill the borers.

For further information, see Report of this Station for 1911, page 317.

Bronze Birch Borer: Many European white birches, particularly the cut-leaf form, have been killed during the past few years by the bronze birch borer, *Agrilus anxius* Gory. This small beetle begins its attack on the branches in the upper part of the tree and spiral swellings or ridges show on the surface of the bark. Later the lower branches are similarly affected and the tree is soon killed. Native species, though not immune, are less susceptible to injury. If a tree becomes generally infested, it cannot be saved. The beetles emerge in June, feed for a time on the leaves and lay eggs in slits in the bark. There is only one brood annually and the grubs make shallow galleries in the sapwood just beneath the bark. Where a few branches are infested, they should be cut off and burned in early spring. Dead trees should also be burned before the beetles emerge. As the beetles feed somewhat on the leaves, the trees should be well coated with lead arsenate early in June.

For further information, see Report of this Station for 1922, page 359.

The Twig Pruner: Small terminal twigs of oak and some other trees are often cut off by a borer in late summer and fall upon the ground. This is the work of the twig pruner, *Hypermallus villosum* Fabr., one of the long-horned beetles. There is only one brood each year and the borer usually drops to the ground in the base of the severed twig. Consequently, gathering and burning these twigs is advisable, and about the only control measure known. Trees are not seriously injured by the attacks of this insect.

For further information, see Bulletin 332, Ohio Agr. Expt. Station, page 327.

Carpenter Worm: Large grubs, occasionally found tunneling in the heart wood of ash, elm, and other trees, are called carpenter worms, and are the larvae of one of the Cossid or goat moths, *Prionoxystus robiniae* Peck. It is related to the leopard moth, and there is one generation each year. About the only remedy

is to inject carbon disulphide into the burrows and close the opening, or cut out the grubs.

For further information, see Bulletin 332, Ohio Agr. Expt. Station, page 329.

Locust Borer and Painted Hickory Borer: Young locust trees are often killed or deformed by the locust borer, *Cyllene robiniae* Forst., and hickory trees are less seriously injured by a closely related species called the painted hickory borer, *Cyllene pictus* Drury. In fact, some claim that these two species are identical, but there are slight structural differences and the adult of the painted hickory borer emerges in the spring, while the locust species appears in the fall. Both are long-horned, black beetles, three-fourths of an inch in length, marked with narrow cross-bands of greenish yellow and with a W-shaped mark on the base of the wing covers. The life cycle of each occupies about a year. Dr. Craighead reports success by injecting into the burrows kerosene soap emulsion made with water containing five per cent. of sodium arsenate.

For further information, locust borer, see Bulletin 787, U. S. Department of Agriculture: Painted hickory borer, New York State Museum Memoir 8, page 264.

Saperda Borers: Linden trees are often injured by the linden borer, *Saperda vestita* Say, hickory by the hickory borer, *Saperda discoidea* Fabr., poplars by the poplar borer, *Saperda calcarata* Say, elms by the elm borer, *Saperda tridentata* Oliv., and apple by the round-headed apple borer, *Saperda candida* Fabr. Trees badly infested with the elm borer should be cut and burned. These borers are usually cut out, but carbon disulphide may be employed and possibly the poisoned kerosene emulsion may prove successful.

For further information regarding these borers, see Manual of Tree and Shrub Insects.

White Pine Weevil: The leaders or top-most shoots of young white pine trees are commonly attacked and killed by a snout beetle, *Pissodes strobi* Peck, which lays eggs in punctures in the bark of the leader during May. Numerous grubs hatching from these eggs tunnel in the stem, becoming full-grown about July 1, and pupate in oval cells in the wood. The leaders wilt and die during July. Repeated attacks cause the trees to become crooked, forked and ill-shaped. It is commonly recommended that the leaders be cut off and burned before the adults emerge, or still better, place them in cages which will permit the escape of their parasites but not of the snout-beetles. Small plantations and choice ornamental trees may be protected to some extent by spraying the leaders about May 1, with liquid lime-sulphur (1-9) or lead arsenate, or by jarring the leaders twice a week for six weeks and catching the beetles in a net.

For further information, see Report of this Station for 1919, page 144.

The Hickory Bark Beetle and Other Bark Beetles: Hickory trees are beset more or less periodically by epidemic attacks of the hickory bark beetle, *Scolytus quadrispinosus* Say, which breeds in the cambium, effectually girdling the tree. Later the exit holes give the tree the appearance of having been punctured with shot. Thousands of hickory trees have been killed in Connecticut by this insect during the past 25 years. The adults feed on the leaf petioles, and a thorough spraying of the foliage about July 1, with lead arsenate and nicotine sulphate is believed to be of some benefit. Badly infested trees should be cut and burned or barked before the beetles emerge. Related bark beetles with similar habits attack pine, spruce and other kinds, usually the unthrifty trees. Keep all trees as vigorous as possible. Cutting and burning the infested trees will generally check the outbreak.

For further information, see Manual of Tree and Shrub Insects.

The Parandra Borer and the Maple Sesian: Weakened trees of nearly all kinds are attacked by a brown beetle known as the Paranda borer, *Parandra brunnea* Fabr., which tunnels in the heartwood near the ground. The maple sesian is a clear-wing moth, *Sesia acerni* Clem., which breeds in the vicinity of wounds on the trunk and branches, particularly of soft maples. Careful dressing of the wounds is a good preventive. Where trees are kept in a thrifty condition there is little injury from either of these insects.

For further information, see Report of this Station for 1921, page 201 (Parandra borer), and for 1922, page 355 (maple sesian).

Pigeon Tremex: The pigeon tremex, or horn-tail, *Tremex columba* Linn., is a borer in dead and dying trees of nearly all deciduous kinds, and is common in maple, elm and hickory. Round holes the size of a lead pencil mark the points of exit of the adults, which are rather large, four-winged flies, about two inches in length, marked with yellow and black and with a conspicuous horn or ovipositor at the rear end of the body. Trees which are infested by the pigeon horn-tail are commonly visited by two of its very conspicuous parasites called "long stings." In fact, the parasites are usually the first indication to the owner that anything is wrong with his tree, and he thinks them responsible for the injury. The black long-sting, *Megarhyssa atrata* Fabr., and the lunate long-sting, *Megarhyssa lunator* Fabr., are among the largest of the parasitic Ichneumon flies, and the females have bristle-like ovipositors nearly four inches in length and resembling horse hairs.

For further information, see Manual of Tree and Shrub Insects.

Carpenter Ant and Termites: Trees are often tunneled and honeycombed by the large, black, carpenter ant, *Camponotus herculeanus pennsylvanicus* DeGeer, and by the so-called white ants or termites, *Reculitermes flavipes* Kollar. The white ants are white only in their immature stages, the adults being brown. The best remedy for both species is to inject carbon disulphide and confine it in the burrows by plugging the opening.

For further information, see Report of this Station for 1922, page 365.

Sucking Insects

Spruce Gall Aphid: Cone-shaped galls at base of new growth on Norway, black, white and red spruce trees are caused by the spruce gall aphid, *Chermes abietis* Linn. This insect has two generations each year the winter being passed by the immature females on the twigs, and particularly around the buds and under the bud scales. They reach maturity in spring, and lay their eggs about May 1. The young cluster at the tips where the new growth starts, and form the cone-shaped galls. The insects become mature in August and escape from the galls and lay eggs for the second brood. Another species *Chermes cooleyi* Gillette, makes larger galls on the Colorado blue spruce. Thoroughly spraying with nicotine solution and soap, or with a miscible oil (1-20) in the fall or spring will hold this pest in check. Clipping off and burning the galls in early summer can also be practiced on small trees.

For further information see Report of this Station for 1922, page 357.

Leaf Aphids: There are many kinds of aphids which injure the various kinds of trees by sucking sap from the leaves. Some of these are: Green apple aphid, *Aphis pomi* DeG., rosy apple aphid, *Anuraphis roseus* Baker, of apple; woolly aphid of apple and elm, *Eriosoma lanigera* Hausm.; woolly beech aphid, *Prociphilus imbricator* Fitch; birch aphid *Calaphis betulaecolens* Fitch; pine bark aphid, *Chermes pinicorticis* Fitch, and many other species. As a rule, these aphids may be held in check by spraying with nicotine solution and soap. Calcium caseinate may be used as a spreader in place of soap. Dusts containing nicotine may also be blown upon the leaves.

Further information may be obtained from Manual of Tree and Shrub Insects.

Hickory Gall Aphid: The compound leaves of hickory are often distorted and fall in midsummer on account of the attacks of the hickory gall aphid, *Phylloxera caryaecaulis* Fitch, which forms hollow, globular galls on the leaf petioles, often causing them to break off. Apparently no control measures have been worked out for this insect.

For further information, see Manual of Tree and Shrub Insects.

Oyster-Shell Scale: The oyster-shell scale, *Lepidosaphes ulmi* Linn., kills branches and sometimes entire trees, and attacks many kinds of deciduous trees and shrubs. Some of those most commonly attacked are ash, maple, apple, poplar, willow, butternut, birch and lilac. Silver maple street trees are sometimes seriously infested and it makes the branches very brittle so that they break off in storms. This insect has one generation each year and passes the winter as white oval eggs under the old female shells. These eggs hatch during the last days of May, and the young crawl about for several hours and establish themselves on the bark, begin to suck the sap and remain stationary afterward. Late in August, the females become grown and die after depositing eggs under the shells. The shells are mussel-shaped, about an eighth of an inch long, and gray or brown, usually nearly the color of the bark. Spraying with lime-sulphur (1-9) or miscible oil (1-15) in early spring has proved effective. Also a spray of nicotine solution and soap or with kerosene emulsion about June 10th will kill the newly-hatched young.

For further information see Report of this Station for 1903, page 229.

San José Scale: This is a small, circular scale, grayish in color and about one-sixteenth of an inch in diameter. The shell is formed of concentric rings with a nipple in the center. It is called the pernicious or San José scale, *Aspidiotus perniciosus* Comst., and it attacks many different kinds of trees and shrubs, but shows a preference for fruit trees and shrubs of the rose family. There are three broods each year, and the winter is passed in a partially grown condition. The young of the first brood appear the last days of June. Though in part controlled by natural enemies, this insect formerly destroyed hundreds of fruit orchards, and after subsiding as a pest for several years, is now troublesome again. A dormant spray of lime-sulphur (1-9) or of miscible oil (1-15) are the remedies.

For further information, see Bulletin 165 of this Station.

Maple Woolly Leaf Scale: Sugar maple trees throughout the cities and towns of Connecticut are attacked and injured by the woolly maple leaf scale, *Phenacoccus acericola* King. The females are found on the under sides of the leaves in midsummer where they produce their eggs in large flocculent masses of white wax, resembling tufts of cotton or wool. Badly infested leaves drop in July. The male cocoons as well as the winter cases of the immature females are placed in the crevices of the bark of the trunk and at the base of the larger branches. There are three broods each season. Spraying the winter cocoons on the dormant trees in March using lime-sulphur (1-9) with the addition of nicotine has proved an effective remedy in New Haven.

For further information see Report of this Station for 1905, page 226.

Cottony Maple Scale: Soft maples in the vicinity of Stamford for several years have been badly infested with the cottony maple scale, *Pulvinaria vitis* Linn., which also attacks many other kinds of trees. This insect has one generation each year and passes the winter in the form of thin, brown, oval, soft scales on the bark of the twigs. In early summer the development of the egg-sac causes one end of the brown scale to be lifted by a cotton-like mass of white wax. The young are crawling in July. Spraying the trees with miscible oil (1-15) in spring before the buds start has given good control.

For further information, see Report of this Station for 1921, page 179.

Terrapin Scale: Another pest of soft maples is the terrapin scale, *Lecanium nigrofasciatum* Pergande, a small, reddish, convex species occurring on the smooth bark of the smaller twigs. Occasionally the sugar and Norway maples and other kinds of trees are attacked by this scale. Badly injured branches should be cut off and burned, and the trees sprayed in early spring with miscible oil (1-15) or with a kerosene emulsion containing 20-25 per cent. of kerosene.

For further information, see Report of this Station for 1921, page 183.

Tulip Tree Scale: The lower branches of tulip trees are often infested and killed by the tulip tree scale, *Toumeyella liriodendri* Gmel., which appears as brown hemispherical shells nearly one-third of an inch in diameter. There is only one brood each year, and the young hatch in September, establish themselves on the bark, and pass the winter in a partially grown state. The next season they continue to suck sap from the branches, becoming mature in August, and the honey dew drips upon the ground and lower leaves, appearing like a coat of varnish. The best times for treatment are after the leaves drop in the fall, or just before they put out in the spring. Liquid lime-sulphur (1-9) or a miscible oil which does not contain phenol, may be used for this purpose.

For further information, see Report of this Station for 1921, page 176.

Elm Scale: The trunks of small elms and the lower branches of larger trees are often infested and injured by a soft scale called the elm scale, *Gossyparia spuria* Mod. This scale occurs in longitudinal rows in the crevices of the bark, and is oval in shape, chocolate brown in color margined by a whitish fringe of wax filaments. There is only one brood each year, winter being passed in a partly grown state, and the young appear late in June. Spraying with miscible oil in early spring is a satisfactory remedy.

For further information, see Manual of Tree and Shrub Insects, page 161.

Pine Leaf Scale: Small pine trees in protected places are often infested with the pine leaf scale, *Chionaspis pinifoliae* Fitch, which appears as white elongated shells on the needles. It attacks the various species of pines but seldom causes injury in exposed situations. There are two generations each year, though not well defined, the young of the first brood beginning to appear in May and the second in July. It passes the winter in the form of purple eggs under the shells. Badly injured branches should be cut off and burned. Dr Felt advises spraying with miscible oil (1-16) in spring, but it is probable that summer applications of nicotine solution and soap will also keep the pest in check.

For further information, see Report of this Station for 1921, page 181.

Other Scale Insects: There are several other kinds of scales which are occasionally troublesome, such as the scurfy scale, *Chionaspis furfura* Fitch, on trees and shrubs of the rose family, the rose scale, *Aulacaspis rosae* Bouché on roses and blackberries, the euonymus scale, *Chionaspis euonymi* Comst., on euonymus, the apricot or European fruit scale, *Eulecanium corni* Bouché, on various trees and shrubs, and the golden oak or pit-making oak scale, *Asterolecanium variolosum* Ratz., on golden oak. Send specimens to the Station for identification and advice about treatment.

For further information, see Manual of Tree and Shrub Insects.

Lace Bugs and Leaf Bugs: Leaves of sycamore are commonly attacked and somewhat injured by a lace bug, *Corythucha ciliata* Say, oak by another species, *Corythucha arcuata* Say, and rhododendron by *Leptobyrsa rhododendri* Horv. Several kinds of leaf bugs of the family Miridae also injure the leaves by sucking out the sap. As a rule all of these may be controlled by spraying the under sides of the leaves with nicotine solution and soap as for aphids.

FUNGOUS AND NON-INFECTIOUS TROUBLES OF ORNAMENTAL TREES

G. P. CLINTON

This article does not include the troubles of fruit or forest trees except as grown for purely ornamental purposes. Aside from the injuries caused by insects, which are treated elsewhere in this report, the other troubles of ornamental trees fall into two classes: First, a variety of more or less obscure troubles, often non-progressive and always non-infectious, due to a great variety of causes, which we may designate as "unfavorable environment." Second, definite infectious and progressive diseases, which are caused by fungi.

NON-INFECTIOUS TROUBLES

Because the agents are so obscure or are present only for a short period, these troubles are the hardest to identify. Likewise the symptoms may be so similar from dissimilar causes, that, lacking both agent and characteristic symptoms, one often has to give a guess as to the cause. The elimination of other possible causes and extended observation, help to make the guess of value. In our experience with ornamental trees, we have found injuries of the following character: Winter, Drought, Smoke and Gas, Spray, Electrical and Mechanical.

Berls, Knots, Bunched Sprouts: Besides these determined troubles, there occur on certain trees growths whose cause is not definitely known. We do not include here the galls caused by insects, whose nature is usually revealed by some signs of larvae at their center.

Knots: On oak and less frequently on hickory, there are occasionally seen on ornamental, as well as on forest trees, hard, roundish, gall-like growths that vary in size from an inch to a foot in diameter. Usually several or many of these may occur on a single tree, while other trees of the same variety in the vicinity show no such growths. This looks as if the trouble were spreading over the tree. Its infectious nature, however, remains yet to be proved. The resemblance of the smaller knots to crown gall has caused some to think that they may be bacterial in nature. Whatever its cause, this trouble apparently starts with injury or irritation to the cambium layer, so that it is stimulated into great activity and in such unusual directions as to form a gall-like growth rather than the natural woody layers. This growth, however, is usually not so permanent as the normal tissues, though many knots are of considerable age as shown by the growth rings. Where feasible, such growths may be removed by cutting off the branch some distance below the growth.

Bunched Sprouts: Besides knots, certain trees, especially elms and maples, occasionally show bunched growths of fine branches or unexpanded buds on the main trunk. These evidently come from adventitious buds developing because of some hidden injury to the tree. The writer suspects that winter injury is often the cause. When abundant, they give the main trunk a somewhat knotted or scraggy appearance. Continued pruning will probably finally prevent their reappearance.

Winter Injuries: *Conditions.* Trees show winter injuries under the following conditions. 1. Some trees are not hardy, being grown too far north or out of their natural environment. There is a demand for trees of all sorts for ornamental purposes, and nurserymen aim to supply the demand. Inexperience at first induced them to grow semi-tropical trees that were easily winter injured, but now they have largely cut out these for their own protection. However, there are still grown a number of species that are not entirely acclimated and, of course, these suffer most. 2. A cultivated or fertilized fruit tree is more likely to suffer from winter injury than a native forest tree. This is partly because the tissues make a faster, softer growth that often does not properly mature before winter sets in. The ornamental tree occupies a position between these two classes, as it sometimes receives cultivation or fertilization or both. 3. Ornamental trees often stand by themselves and so are more exposed to wintry blasts or, on the other hand, they are planted in sheltered nooks where they receive undesirable stimulation during warm, sunny, winter days. 4. Warm winter weather followed by sudden drops in temperature or extreme cold weather may cause injury to trees ordinarily hardy.

Causes and Types. Winter injury takes place in a variety of ways. With trees grown for their blossoms, severe winter weather or late spring frosts may destroy the blossom buds. Warm, sunny weather of some duration may start sap activity on the south or southwest side and result in death of the bark there, so-called winter sun-scald, when the temperature suddenly drops.

Cankers caused by killing the bark in localized spots, especially at the base of the tree, may result, the latter type being known as collar girdle. We have seen elm trees in the vicinity of Stamford and New Haven that showed cankers of varying size, small on the branches but a foot or more on the main trunk where they are most frequent, for which investigators have been unable so far to find any definite insect or fungous cause. The most reasonable supposition, with our present knowledge, is that these are winter injuries where the cambium has been killed in localized spots. See Plate XV, c.

We have also been shown an elm tree, in Stamford, by the head of the F. A. Bartlett Company, where the inner bark had been winter killed while the cambium remained alive, so that a new growth of smooth bark was formed beneath and finally sloughed off the outer rough bark, thus presenting an unusual appearance.

Sometimes the cold is severe enough to kill trees outright. Even when the tree has its wood properly matured, if the cold is sudden and severe, the difference in temperature between the inner and outer wood is so great that the contraction of the tissues outside is faster than within, and frost cracks suddenly appear in the bark or wood lengthwise of the tree. When healed over, these often show as ridges on the trunk.

With improperly matured wood, winter injury may be localized in the sap wood. If severe and extended enough to kill it prematurely, the next year the tree suffers from lack of sufficient carrying space for the elaborated sap, and the tree makes a very slow growth. This injury shows through the prematurely darkened color of the sap wood, when cut across, and is sometimes followed by rot fungi.

Finally, the injury may be localized in the roots, which are injured or killed, because of too much moisture in the soil in wet places or because weakened by summer droughts. Here the injury is usually hidden from view but sometimes can be detected where the exposed roots join the trunk.

Drought and Heat Injuries: *Heat,* as such, apparently causes very little injury to trees, though, as a factor in excessive transpiration from leaves where there is a limited supply of water to replace that lost, it is indirectly involved. When strong sun light beats down on the exposed south and west sides of trees recently transplanted, and summer sun-scald results, it is probably more directly a cause, though even here the loss of water is a factor. Shading the trunk by V-shaped boards on the south side lessens injury in such cases.

Leaf Scorch. Lack of moisture in the soil, injuries to the roots or wood preventing the conveyance of water to the leaves, bright sunshine suddenly following rainy or muggy weather, or unusually hot days—all are factors in causing transpiration of water from the leaves faster than supplied by the roots with resulting leaf scorch troubles. Whipping winds, also by favoring transpiration and by mechanically injuring the young leaves, are often involved in such troubles. Hard maples, more than any other ornamental trees, are subject to leaf scorch in this state, and, as this injury usually appears suddenly and conspicuously, people often suspect it as being a fungous injury. The tissues of the leaves, especially at their edges, are killed in an irregular manner turning a reddish or brownish color and later they are often infested with saprophytic fungi. They usually adhere to the tree throughout the season, although some may drop pre-

maturely. Sometimes only one tree of several together may show the trouble; this may indicate root injury. Again, trees may show it only on the more exposed side. In the early spring of 1924, when the injury was prominent, trees on the exposed hills were the ones that suffered most. In this case a whipping wind was a prominent factor in the injury. Besides the hard, other maples, elm, ash, and linden less frequently show leaf scorch. Sometimes the pine needle blight is caused in these ways.

Scorch of Evergreens. Another type of leaf scorch is that shown on a variety of evergeens in which the foliage is browned and eventually killed on the more exposed trees, particularly when young in nurseries. Frequently this takes place in late winter or early spring before growth has started, and results from warm days causing transpiration from the leaves when the ground is frozen and the tree cannot replace the water so lost. Again, in severe winters, it may be entirely due to the unusual cold which partly kills the old leaves. Less frequently a very late frost, after new leaves have started, kills their exposed ends but does not injure the protected growing bases, so that the leaves continue to grow but retain the permanently injured tips. These troubles may be considered as a purely winter or a combination of winter and drought injury.

Pine Needle Blight. This is a special form of the leaf scorch of evergreens, and is due to the same causes. The white pine is by far the most susceptible species. The needles are killed from the tip inward, sometimes for half their length. If the injury occurs early in the season, the leaves are often dwarfed and somewhat bunched. As the leaves usually adhere for at least two years, this injury continues to be conspicuous the second year and affects the growth of the tree that year as well. With injury to the new leaves the second year, the trees not infrequently die. Other trees lag along in a sickly condition for a number of years; while those little injured, and with vigorous roots, recover and show no special signs of injury after the blighted needles drop off.

Severe Summer Drought also may cause the premature death of the older leaves of evergreens. These leaves, further back on the branches beyond the new growth, turn brown and eventually drop off prematurely. Before they are shed the injury is prominent because of the evident contrast between the dead and living leaves on the same branch. This prematuring and dropping of the oldest living leaves is merely an effort on the part of the tree to preserve the moisture for the younger leaves and hence protect them from injury. It was quite conspicuous this year, especially on species of Arbor-vitae and Retinosporas, and traced back, in part, to the very dry summer of last year, as well as to the drought of this year.

Yellow Leaf and Leaf Fall. A type of drought injury to deciduous trees is that which takes place when there is a continued severe drought in midsummer or early fall. In this case the roots cannot supply sufficient moisture for the leaves, with the result that those least vigorous and having the most competition for the water drop off. Most leaves of a tree do this gradually, often turning yellow before they fall, as with the elm which also sometimes sheds its young branches as well. With the Norway maple, on the other hand, the leaves may drop off while still green. The dry summer of 1923 caused more of this trouble than that of 1924.

Injured Rootlets. Everyone knows that in transplanting a tree the roots should not be allowed to dry out too much. In case of severe drought this undoubtedly takes place in nature, with the premature death of many of the finer feeding rootlets. The direct injury though hidden from view is shown, in part, by the leaf fall to readjust the foliage and root relationships. Frequently the whole story is not told until the succeeding year, when scantier foliage results, especially as shown in 1924 by certain fruit trees. No doubt, too, such trees come through the winter with less vigorous roots and sapwood. It is difficult, therefore, in some cases where trees are backward, to determine how much injury is due to drought and how much to winter injury, as both may be involved even when the winter is not unusually severe.

Smoke and Gas Injuries: *Smoke Injury* of trees in this state usually comes from brick kilns, though occasionally we have seen injury from smoke stacks of factories. In any case, the injury results from sulphur in the coal that, on burning, escapes into the air as sulphur dioxide. Ordinarily this does no harm, when the atmospheric pressure is such that the smoke is carried upward, but when it drags along the ground and the leaves are moistened by rain or dew, this sulphur dioxide is absorbed by the moisture and apparently changed to sulphurous or sulphuric acid with accompanying burn of the foliage. Such injury has occasionally occurred to the trees in East Rock Park and near-by yards in New Haven, showing on birch, beech, elms, maples, spruce and other conifers. With the maple its injury is similar to that caused by sun scorch or gas. Such smoke injury may also affect other vegetation and law suits have occasionally resulted. The smoke in railway yards from engines seems to be more objectionable from the soot settling on the leaves than from actual burn.

Gas Leaks in mains often cause injury to street trees. The leak may not always be close to the tree, but the gas, by following the pipe escapes into the soil in the vicinity of the roots, injuring or killing them. The visible effect is shown, in time, by the sickly appearance or death of the leaves. Hard maples seem to

be most subject to this trouble, and the injury to these is very similar to that of sun scorch. This latter source of injury should be first eliminated as a cause. A gas leak can usually be detected only by the odor, and is especially evident when a hole is bored into the soil at a suspicious location. The gas is rarely or never strong enough to ignite from a match.

Spray Injuries: Occasionally in spraying trees to prevent insect or fungous troubles, there results more injury than caused by these agents. This is not always the fault of the person applying the spray, as he may be doing it under conditions recommended by scientific investigators and which ordinarily cause no injury.

Insecticides. With these, where arsenic in some form is generally used, the poison is supposed to be practically insoluble and so incapable of injury, but various brands, at times, contain an amount that is soluble beyond the danger point. Again the other ingredients, with which the insecticide is combined, may raise the solubility to this degree. For example, the use of salt water from the Sound has been known to increase the solubility of lead arsenate, and produce injury that did not previously occur with the use of well water. Also when mixed with fungicides, the combination of ingredients used sometimes increases the solubility of the arsenic. With certain of the oils or emulsions improperly mixed or applied, serious injury may result even to dormant trees.

Fungicides. On the other hand injury may be directly due to the fungicide as this must be used at a strength that kills, by contact, the fungus, but ought not to be strong enough to injure the tissues of the leaves. Sometimes this strength is beyond that of safety to the foliage, especially of certain trees, and injury results. Again, chemical change, as with Bordeaux mixture, may occur after the spray is put on the foliage; or the higher temperature or rains, following the treatment, are deciding factors that produce injury that would not ordinarily occur. Lastly, sprays are sometimes applied that are sure to cause more or less damage and should never have been used; the injury from this source, however, is becoming less frequent because of greater caution on the part of manufacturers in trying out their insecticides and fungicides before placing them on the market.

Electrical Injuries: *Electric Wires.* The injury from electrical currents, either direct or alternating, of high voltage occurs when the wire comes in direct contact with the wet branches or leaves. Street trees are the most exposed to these conditions. Personally, we have seen very little serious injury from this cause. We have, however, observed street trees along car lines where an occasional branch or leaves or small branches have been killed. Where the feed wire ran through the trees and its insulation had become worn, we have seen maples, whose wet leaves

had blown in contact with the wire at these points, with localized dead foliage on a considerable number of trees.

Stone (Mass. Agr. Exp. Sta. Bull. 170: 233.) says: "When strung too close to trees, wires also often cause serious injury by burning, sometimes mechanical injury is done, and lightning discharges will cause harm when guy wires are attached to trees. Both the alternating and direct currents are used. They produce different physiological effects on plant life, the alternating current apparently being less injurious than the direct. . . . . Most of the injury to trees from trolley or electric light currents is local, *i.e.*, the injury takes place at or near the point of contact of the wire with the tree. This injury is done in wet weather when the tree is covered with a film of water which provides favorable conditions for leakage, the current traversing the film of water on the tree to the ground. The result of the contact of a wire with a limb under these conditions is a grounding of the current and burning of the limb, due to 'arcing'. The vital layer and wood become injured at the point of contact, resulting in an ugly scar and sometimes the destruction of the limb or leader. . . . . Practically all of the burning of trees from either alternating or direct currents occurs in this way, since the high electrical resistance characteristic of trees does not permit injurious currents to pass through their tissues."

There were occasional cases, however, where Dr. Stone found that large trees had been killed when the wire in contact, contrary to the usual custom, carried the negative current and the rails the positive. This resulted in a girdling of the tree near the base and its subsequent death. Professor Toumey claims that injury to the trees may, in part, be due to copper and zinc compounds carried from the corroded wires into the tissues so injured.

Lighting Injuries are said to be of two types, the most common one is where the tree is struck directly and the injury is entirely mechanical, splitting open the wood and breaking loose the bark or breaking off large limbs. Such a tree remains otherwise entirely normal and may live indefinitely, if the mechanical injury has not been too severe or opens the way to further injury by other agents. Plate XV, d, shows a large white pine at Cornwall, Conn., that was injured in the fall of 1917 but is still living.

On the other hand trees when struck are occasionally so badly injured, apparently in the cambium layer, without much evident mechanical injury that death results immediately or in a short time. We have seen white pine trees, dead and dying, where we could find no other evident cause. Mr. Stoddard, of this department, records a case of an oak shade tree at Litchfield, that was struck, and the leaves were immediately killed, the tree soon dying without evident mechanical injury.

In a few cases we have heard of shade trees on which, after a storm, the leaves, or part of them, suddenly died while still

green. In these cases it is possible that the injury was the result of earth discharges as reported by Stone. He says: "These discharges occur during thunder storms, and those who have observed them for many years relate that they give rise to a dull, characteristic report resembling that caused by throwing a wet cloth on a hard surface. The whole tree is not affected as a rule, as the lightning stroke seldom follows up the main trunk, but discharges at the point of several branches. As a rule, however, one side of the trunk and one or more of the limbs on that side are affected and the symmetry of the tree destroyed. The first indication of the discharge is shown by the immediate wilting and subsequent death of the leaves of the affected limbs, which also die later. In the course of time cracks similar to those caused by frost, and later ridges due to healing, will be seen on the trunk, showing the path of the discharge, and occasionally, when the injury is considerable, the bark near the affected part of the tree falls off. The limbs, however, are not always killed, frequently splitting and a cracking of the wood for some depth is now and then observed on the trunk and limbs along the path of discharge."

Mechanical Injuries: Besides the special types of mechanical injuries already mentioned, these may be caused in a variety of other ways, such as by hail, ice and wind storms and by animals, of which mice, horses and men are the chief offenders.

Hail Injury on fruit trees is frequently conspicuous, but apparently shade trees suffer less because of their more hardy bark. On July 17th of the present year, one of the most severe hail storms of recent years caused great harm to the fruit trees in the vicinity of Wallingford, and less costly, though evident, injury to the shade trees. A severe wind greatly exaggerated the injury, as the large hail stones struck with great force. On one small apple tree less than 10 feet high, we counted over 450 distinct bruises on the trunk and limbs. Many of these showed the bark killed, drying up or sloughing off in time, and there resulted small canker-like areas. Later the injury was partly obscured by callus healing of the bark, so that eventually much of the injury will disappear or show merely in irregular growth at these points. The chief injury of course was the severe marring of the fruit, also opening the way for various rots, so that it was of little or no value.

Among the shade trees showing evident injury were red and hard maples, ash, sycamore, hickory, wild cherry and elm. The cankers were most evident, of course, on the smaller more tender branches with smooth bark, but could also be seen on limbs several inches in diameter. They were almost always longer lengthwise of the twigs and varied from one-half to one and a half inches long by a quarter to half an inch wide. Specimens collected

late in the fall by Mr. Stoddard showed most of the cankers completely healed over.

Ice Injury results chiefly from the breakage due to the unusual weight of the ice which is often many times that of the weight of the branch which is encompassed especially on the smaller twigs. Mr. Zappe of this Station records a case in the New Haven storm, referred to later, where the ice was 30 times that of the branch. Whether injury also results from the freezing of the sleet on the twigs is doubtful, though injury of this kind, especially to evergreens or tender deciduous trees, might result. Some believe that the ice acts as a lens in strong sunlight and burning of the enclosed tissues results. If any heating or stimulation of the tissues occurs, the injury probably results from the later freezing at night. It is also uncertain whether the cold of the icy coating causes any more harm than the dry cold on the uncoated branches.

The severe ice storm early in February, 1924, caused unusual damage to ornamental trees in the southern part of the state, especially in the vicinity of New Haven. The ice in this case stayed on the limbs for nearly a week. In the early winter of 1921, a severe ice storm occurred in northern Connecticut and Massachusetts, and caused unprecedented injury to shade trees, besides great damage to fruit trees and especially to telephone, telegraph and electric wires. The financial burden to the towns just in clearing up the rubbish from the trees and on the streets was very heavy. Some idea of the damage wrought by this storm is shown by the photograph, in Plate X, a, which was taken near Pomfret, Conn.

Wind Injury is common with most storms, breaking off the dead branches and those weakened from disease first. With very severe storms, large branches of the healthy but unprotected or soft wooded trees are blown down. The worst injury occurs when the heavy wind accompanies an ice storm. The wreckage from the ice storm at New Haven in 1924, while great, was much less than it would have been had a strong wind occurred during the five or six days that the ice was on the trees. (See Plate IX.)

Animal Injury is most common on street trees. The gnawing of the bark by horses hitched near the trees used to be a very common occurrence, and there are still in evidence large canker-like areas on many of our street trees caused by the repeated injuries they have received in the past. Now the automobile seems to have replaced the horse somewhat as a cause of barking trees. Injury by mice, especially at the base when long covered by snow in winter, occurs prominently in some years, but not in well kept yards. In orchards, nurseries or isolated places along the roadside it is not infrequent and may be quite severe.

Of all the animals, man leads in the mechanical injuries he

inflicts on trees. The cutting off of branches to allow passage of telephone and electric wires is a common occurrence, but not nearly so obnoxious as formerly because done in a more scientific manner. Changing the soil level, cutting off interfering roots for laying walks and pavements, and grading and digging for lawns and buildings are other common causes of injury. Improperly moving and transplanting large trees also often results in a sickly growth or their final death.

Bleeding, Sour Sap, Slimy Flux: *Bleeding* usually results from some mechanical injury but under ordinary conditions stops of itself. This was the case with the maples following the recent ice storm in New Haven, as the injury occurred about the time active sap flow was starting. The dripping from the broken twigs occasionally formed icicles during the night, or frequently made a wet spot on the sidewalk that was still evident long after it dried out. Of course some food, as sugar, etc., was lost to the trees in this way, but this injury was negligible.

Bleeding may also start as a result of pruning or cavity work and in the elm, from whatever cause, it is sometimes very difficult to stop. The loss of the water or sap, while undesirable, is not the evident evil here. The food in the sap affords a fine opportunity for the development of bacteria and *Sour Sap* results. This leakage may in time become a soft slime through the presence of both bacteria and yeast fungi. Good examples of this, as *Slimy Flux,* can be seen on the stumps of yellow birch that are cut in late winter or early spring. In any case, this infected sap, covering the healthy bark, is likely in time to kill the cambium and decay of the bark results. Leakage is frequently prevented or stopped by searing over the exposed sap wood with a hot iron. Again the drip is sometimes successfully carried away from the bark by a protruding iron pipe in the filling. There are cases, however, where bleeding and injury result despite all precautions.

Treatments: *Watering.* For all of these injuries spraying, of course, is of no value. With valuable trees where drought is long and severe, watering is helpful. This must be kept up, however, until the danger is past. It should not be of the frequent sprinkling type, as given to lawns, but rather an occasional good soaking in which the water penetrates deep into the soil. This may be aided by drill holes around the trees in which the hose is inserted.

Fertilizing. Where injury is manifest but the tree is still vigorous enough to save, whether the injury is due to drought or winter, fertilization, especially of deciduous trees, may be employed. One must use care, however, that this is given early enough in the season so that the tree may properly mature its wood and buds before winter sets in. Manure can be used with less impunity in this respect than most chemical fertilizers. The quickest action is obtained with the use of nitrate of soda; this can be placed in drill holes in the ground, about 10 feet apart with large trees, around the spread of the branches and washed in with a hose. From one to 10 pounds, according to the size of the tree, may be used. A complete fertilizer scattered broadcast over the ground is sometimes used to increase the general vigor of the tree. Dr. Jenkins has recommended, in the past, the following: Nitrate of soda, acid phosphate and muriate of potash, each five parts by weight, to be mixed not more than a week before using and to be spread broadcast, one-half pound to each 50 square feet of ground, in two applications one month apart in the spring.

Pruning, etc. With the preceding tree injuries, of course, one of the first treatments consists in removing seriously injured and dead branches, and protecting the cut and exposed surfaces. The trimming should be done with reference to preserving or renewing the symmetry of the tree. Bark loosened but not torn off may sometimes be grown back by nailing to the tree, if done immediately and protected from drying out. If dead it should be cut back to the living tissues to prevent decay and to favor proper callus formation. Sometimes cavity work may be necessary, especially later if wood rot starts.

FUNGOUS DISEASES

While the injuries caused by fungi may be as conspicuous as those caused by insects, nevertheless, the general public is not so often microscopic in size, and usually not readily differentiated well acquainted with their causal agents, since the fungus is from the injury itself. They have, on the other hand, this advantage to the scientist—they do not fly away after causing the injury but stay there permanently, though they are not always easily determined individually because the fruiting stage is often late in maturing. To understand fungi and the injury they cause, it is desirable to know something of their general, as well as their specific, nature. We give this information briefly in the following paragraphs:

Nature. Fungi are the lowest forms of plant life. They differ from all other plants in lacking the green coloring matter, characteristic of leaves known as chlorophyll. Lacking this they cannot manufacture from water, gases and the chemical constituents of the soil, their food. This they must obtain in an organized form from products of living or dead plants or animals. If from the living, they produce disease as a result and are called parasites; if from the dead, they merely produce decay and are called saprophytes. With wood destroying fungi decay of the dead heart wood by a saprophytic fungus may, by weakening the

strength of the trunk or roots, be indirectly responsible for more injury than the parasitic form that directly attacks the living tissues.

Stages. Fungi consist of two stages, a vegetative stage that has to do with gathering their food, and spore stages that perpetuate their existence the same as the seeds do the flowering plants. The vegetative stage is usually inconspicuous and often not visible to the naked eye, as it consists of microscopic branched threads that ramify through the substratum or host, on which it occurs, in search for food. There is comparatively little difference in the appearance of the vegetative stage, or *mycelium,* of different fungi, hence the necessity of seeing the spore stages for identification.

The *spores* are formed on or near the surface of the host and are much more conspicuous and differentiated especially as seen under the compound microscope. Mushrooms and shelf fungi are the largest fruiting forms. Unlike flowering plants, fungi may have more than one kind of spores, but only one corresponds directly to the seed in that it is the result of fertilization of the sexual elements, the other kinds being of an asexual nature such as buds, tubers, runners, etc., in plants. Some spores are temporary and are merely useful in quickly spreading the fungus over the host or to new ones. Other spores are more hardy and serve to carry the fungus over unfavorable periods, such as winter. With the rusts, not infrequently, certain spore stages occur as parasites on one host and others on an entirely different host species, thus greatly complicating the life history of the fungus.

Infection. In any case the spores give rise to new individuals by germinating into threads that by later growth form the mycelium. With parasitic forms this germ tube or thread must penetrate in some manner into the living tissues in order to gain the food necessary for its growth. All preventive treatments of fungous diseases by spraying are based on killing the spores that are carried to the susceptible parts of the plants before they can gain entrance by their germ tubes into the tissues. Once inside, the mycelium is no more injured by the spray than the plant tissues on which it is placed. This makes it necessary to protect the tissues by repeated and thorough spraying as long as there is danger of the fungus gaining entrance. It also means that the fungicide must be able to kill the spores or their germ tubes but cause no injury to the plant tissues.

LEAF AND BARK FUNGI

We may include most of the parasitic fungi of trees with those that cause injury to the leaves or the bark. They are numerous and of great variety. Quite frequently each species is limited to a single kind of tree or its very close relatives. Usually the

earlier spore stages are parasitic while the later ones merely occur as saprophytes on the dead or dying tissues. We can best consider them here, grouped semi-scientifically, under the following headings: Anthracnoses, Leaf Spots, Leaf Curls, Powdery Mildews, Rusts, Blights and Cankers.

Anthracnoses: This is a general term applied to certain genera of fungi that locally kill the tissues of the leaf or the twig and ooze out their spores as inconspicuous, sticky drops on the surface of the host. The more common ones met with so far in this state are as follows:

Ash Anthracnose, *Gloeosporium aridum* Ell. & Holw., in wet years, especially along the coast, has caused considerable injury to the white ash foliage, large areas withering up or turning a light brown color.

Maple Anthracnose, *Gloeosporium saccharini* Ell. & Ev., is most likely to show on the sugar maple, but only occasionally causes conspicuous injury. It is so similar to the leaf scorch of this tree that one usually has to examine the leaves microscopically for the spores before he can be sure of the real cause.

Oak Anthracnose, *Gloeosporium canadense* Ell. & Ev., was unusually conspicuous last spring on white oaks, but, partly because it does not carry over so abundantly on the twigs, the injury is less evident than that of the sycamore. Fewer leaves are killed in the bud, and the injury is more localized as light brown dead areas on the mature leaves.

Sycamore Anthracnose, *Gloeosporium nervisequum* (Fckl.) Sacc., derives its specific name from the fact that it seems to prefer the tissue of the leaf along the main veins. It develops early in the season, often as soon as the buds begin to unfold, with the result that many of the leaves fail to develop. It can do this because its spores develop first on the young branches and are washed into the opening buds. The injury was the most severe in the spring of 1924 that we have ever seen. Some trees had all their very young leaves killed and had to develop a new crop, which, of course, resulted in a scanty foliage all summer. When seen at first it looked as if the trees were dead or doomed to die, but sycamores can stand a lot of such punishment and still survive. However, they usually look in this state as if half winter killed, because of repeated attacks. The European sycamore is much less susceptible to injury than the American.

Other Anthracnoses, of a less conspicuous nature, are those occasionally occurring on hickory, *Gloeosporium Caryae* Ell. & Dearn.; Linden, *Gloeosporium Tiliae* Oud.; Poplar, *Marsonia Castagnei* (Desm. & Mont.) Sacc.; Butternut and Walnut, *Marsonia Juglandis* (Lib.) Sacc. We even found an unusual one, more or less conspicuous the past year, on Beech, *Gloeosporium Fagi* var. *Americana* Ell. & Ev.

Leaf Spots: These are injuries of leaves very similar to the Anthracnoses, usually showing as small, circular or angular, dead spots, varying in color but occasionally occupying areas of considerable extent. They are caused by a great variety of microscopic fungi whose fruiting stages may show as inconspicuous pustules imbedded in the injured or dead tissues or as a moldy growth on the surface.

Ash Leaf Spot or Speck, *Piggotia Fraxini* Berk. & Cke., shows as small purplish specks on the upper surface of the leaves with the fruiting stage of the fungus rather prominently scattered over the lower surface as small black pustules. It is not a very important parasite. There are several other fungi that cause more definite leaf spots of the ash but are infrequently seen here.

Box Elder Leaf Spot, *Phyllosticta minima* (Berk. & Cke.) Ell., appears as grayish or reddish-brown circular spots, a quarter of an inch or so in diameter, with minute, black, fruiting pustules imbedded in the center. This leaf spot is identical with or very closely related to similar spots on leaves of various maples, *P. acericola* Cke. & Ell. On the latter, in some seasons, it is quite prominent and has been complained of as causing marked injury.

Catalpa Leaf Spot, *Macrosporium Catalpae* Ell. & Mart., shows in certain seasons as definite, rounded, reddish-brown spots an inch or less in diameter appearing suddenly on the new leaves, often rather abundantly, so that partial defoliation results. Similar spots are said to be caused by another fungus, *Phyllosticta Catalpae* Ell. & Mart., but while we have found one or the other occasionally present, more frequently a definite fruiting stage is absent and we still are in doubt as to the real cause. The Japanese catalpa apparently is most frequently attacked. Whether spraying will prove of value remains yet to be demonstrated.

Chestnut Leaf Spot, *Septoria ochroleuca* Berk. & Cke., is usually very evident as numerous, grayish, circular spots with a purplish border about a quarter of an inch in diameter. The fruiting bodies are more evident beneath as small, embedded, blackish specks. This trouble, on account of the rarity of its host as a shade or forest tree, is now seen only occasionally on sprout growth.

Elm Leaf Spot, *Dothidella ulmea* (Schw.) Ell. & Ev., known also as *Gnomonia ulmea* (Schw.) Thuem., forms minute black eruptions, somewhat clustered together in small circles or scattered over the whole upper surface of the living leaves. In time there is a whitish or grayish margin around these groups, due to the wearing away of the epidermis. The fungus matures its spore stage on the old leaves on the ground in spring, its fruiting perithecia opening on the lower surface. When severe, more or

less defoliation in midsummer takes place. Occasionally it is quite bad, and it is usually present in a small way every year. Burning the leaves in the fall is desirable.

Hawthorn Leaf Spot, *Entomosporium Thuemenii* (Cke.) Sacc., appears as very small, angular, reddish-brown spots most frequently on the English hawthorn, grown occasionally in yards. It has been sent in for identification a few times as it causes some defoliation where bad.

Horsechestnut Leaf Spot, *Phyllosticta Paviae* Desm., seems to occur largely on the European species commonly grown in this state. Some years, like 1922, it is very injurious and again, like the present dry year, comparatively inconspicuous. It is one of the most injurious of our leaf spot diseases of trees, since the reddish-brown dead areas often cover a considerable part of the leaves. Most of the leaves of the tree are infected and early defoliation occurs. It looks very much like a sun scorch. The tree itself does not seem to be so seriously injured as might be expected, since the next year it usually starts out with a full crop of leaves. Besides spraying with Bordeaux, raking up and burning the leaves is desirable.

Maple Tar or Black Spot, *Rhytisma acerinum* (Pers.) Fr., as its name indicates, shows as a black spot on the upper surface of the leaf much resembling a finger print. The tissues involved are somewhat thickened and slightly raised above and are concave and lighter colored below. Many of these spots are often crowded on the leaf. An inconspicuous summer spore stage is said to develop in these spots but the mature stage does not appear until the following spring, on the dead leaves on the ground. Soft maples, especially the cut-leaf form, are especially subject to attack. The fungus also is common on the red maple. Burning the leaves in the fall, or when they drop prematurely, is recommended.

Leaf Curls: These produce a thickening of the leaf tissue, together with a cupping or other slight distortion, and, occasionally when involving buds or fruits, form a bag-like enlargement. They are found chiefly on fruit and forest trees. The infected tissues are often whitish or flesh colored.

Oak Leaf Curl, *Taphrina caerulescens* (Desm. & Mont.) Tul., is about the only conspicuous form occurring on ornamental trees, where we have noticed it common the past few years. It produces a cupped thickening of the leaf tissues an inch or less across, often several occurring closely placed over the leaf. The upper surface is light colored while the lower reveals a grayish-purple growth of the fruiting stage. The same tree often shows the trouble year after year, indicating that it might be carried over on the young branches though it is said not to be perennial. Here

is another case where burning the fallen leaves might prove helpful. A related species, occasionally found on the elm, is *Taphrina Ulmi* (Fckl.) Joh.

Powdery Mildews: These differ from most of the other disease producing fungi in that almost all of their mycelium, as well as their fruiting stages, is exposed on the surfaces of the tissues, only short sucker-like threads penetrating these to extract the food necessary for growth. They consequently form a whitish cobweb-like growth more or less evident to the naked eye. The small blackened dots embedded in this growth are the mature fruiting bodies, or perithecia. Under the microscope these show numerous appendages radiating out from the central spore case. Quite a few trees, as well as shrubs and herbaceous plants, are attacked by these mildews, chiefly on the leaves, but rarely serious injury results to the ornamental trees. The following may be briefly listed:

Catalpa Powdery Mildew, *Microsphaera elevata* Burr., is considered by some as not distinct from that on oak or chestnut. It shows as a rather inconspicuous whitish growth, most commonly on the upper surface of the leaves.

Chestnut, Oak, Powdery Mildew, *Microsphaera alni* (Wallr.) Wint., attacks a wide variety of trees and shrubs, both cultivated and wild. Usually there is a conspicuous, cobweb-like coating, most frequently on the upper surface of the leaf, and in this are finally seen the numerous, small, black, spore-bearing receptacles.

Maple, etc., Powdery Mildews: *Uncinula circinata* Cke. & Pk., on the hard maples, usually forms a rather inconspicuous mycelial growth in spots on the leaves, with few perithecia; *U. flexuosa* Pk., on horsechestnuts, has a similar but more general growth over the whole leaf surface; while *U. Salicis* (D.C.) Wint., on willows, is apt to be very evident and with a great abundance of perithecia. All these species, as the generic name (*Uncinula*) indicates, have appendages hooked at the end.

Rusts: These are the most interesting and destructive of all fungi because of their several spore stages, some of which occur on entirely different hosts, and because in all stages they are strict parasites. They usually form dusty, erumpent, small pustules, more or less thickly scattered over the infected tissues. The earlier spore stages are generally a yellow or orange color, and the later a red- or black-brown. Seen by the naked eye, they are not apt to be confused with any other fungi, except the smuts which do not occur on trees. Not only do the rusts cause serious injury to trees, but they are among the most destructive parasites of all kinds of plants, particularly the cereals. Because the different stages frequently inhabit different hosts and their relationships were or are not known, scientific names have been given to the

earlier or immature stages that apply only to them, while the name given to the latest, or mature stage, not only applies to it but to all of the stages. For example:

Ash Rust, *Aecidium Fraxini* Schw., is the early stage of a rust that has the repeating and mature stages, known as *Puccinia Fraxinata* (Lk.) Arth., on marsh grass. Therefore the most complaint of injury to ash trees in this state is in the vicinity of the Sound, where marsh grass is common. The rust not only attacks the leaves, petioles and young twigs but also the winged fruits of the ash. It occurs in the cluster cup stage projecting above the tissues as minute, aggregated, toothed receptacles filled with orange colored spores. The infections give rise to some swelling and distortion of the invaded tissues.

Flowering-Crab Rust, *Roestelia pyrata* (Schw.) Thax., is a stage similar to the preceding, on apple leaves, but differs chiefly in having the cluster-cups fringed with hairs rather than toothed. Its mature stage occurs in the jelly-like horns, formed during wet spring weather, on the so-called "cedar apples" of the red cedar. The flowering crab is one of the most susceptible hosts attacked, though the Wealthy variety of apples is about as bad.

Mountain-Ash Rust, *Roestelia cornuta* (Pers.) Fr., is similar to the apple rust. It is rarely found here and has its mature stage on the juniper.

Poplar Rusts: *Melampsora Medusae* Thuem. is not infrequent on the Carolina poplar, showing, in its repeating stage, as minute yellow pustules and, in its mature stage, as reddish blisters, on the under surface of the leaves. Its earlier stage occurs on the larch. A very similar rust, known as *Melampsora Abietis-canadensis* (Farl.) Ludw., occurs on the large tooth aspen and has its earlier stage on the cones and leaves of the hemlock.

Willow Rusts, *Melampsora Biglowii* Thuem. and *M. americana* Arth., are very similar rusts on the leaves of these hosts, and have their earlier stages on the larch and balsam.

White-Pine Blister Rust, *Peridermium Strobi* Kleb., is the rust that was accidentally imported from Europe some years ago and against which such united effort by government and state officials has been expended to prevent its further spread in this country. The stage on the white pine is the early one, showing as conspicuous white blisters that soon rupture and disclose the orange powdery mass of spores. These carry the fungus to *Ribes* species, currants and gooseberries, and form there the later stages known as *Cronartium ribicola* Fisch. de Wald. On the latter hosts there is formed, first, the repeating stage, showing as small powdery pustules whose spores spread the fungus on these hosts during the summer and, finally, the mature stage, short hair-like spores that carry the rust back to the pine needles in the fall.

The injury to the currants and gooseberries is not serious, though frequently causing defoliation, but to the pine, because of its perennial mycelium, the rust eventually girdles the trunk or branch and causes its death. The disease is controlled on ornamental trees by isolation from *Ribes* and by cutting off infected branches some distance below the infested place. In plantations, eradication of all *Ribes,* within and nearby, is advocated. A similar rust on several two- and three-needle pines, *Peridermium Comptoniae* Arth., in this state, has its mature stage, *Cronartium Comptoniae Arth.,* on sweet fern.

Other Rusts, occurring on ornamental trees here but never causing serious damage, are: *Gymnosporangium Juniperi-virginianae* Schw., on cedars, mature stage of *Roestelia pyrata* (Schw.) Thax., *q. v.; Peridermium acicolum* Underw. & Earle and *Peridermium delicatulum* Arth. & Kern., on pitch pine needles, mature stages on goldenrod and asters known as species of *Coleosporium; Peridermium Peckii* Thuem., on leaves of hemlock, mature stage on huckleberries and blueberries known as *Pucciniastrum Myrtilli* (Schum.) Arth.; *Caeoma Abietis-canadensis* Farl., on leaves and cones of hemlock, mature stage of *Melampsora Abietis-canadensis* (Farl.) Ludw., *q. v.*

Bacterial Blights and Galls: These diseases are not common on ornamental trees, though a number have been found on fruit trees. Their cause, as indicated by the above title, is bacteria, the smallest of living things, which are so destructive to other plant life and are responsible for many of the contagious diseases of animals.

Crown Gall, *Pseudomonas tumefaciens* (S. & T.) Stev., as its name indicates, produces galls on the trunk and roots and occasionally higher up on the limbs of a great variety of trees, as well as of shrubs and herbs. So far we have found it on ornamental trees only on poplar and willow. The obvious treatment is to cut off the infected limb some distance below the gall. When on the main trunk, cutting out the infected tissues is of doubtful value.

Mulberry Blight, *Pseudomonas Mori* (B. & L.) Stev., produces small, watery, reddish-brown areas on the leaves and cankers usually on the younger twigs. It is rarely met with.

Fire Blight, *Bacillus amylovorus* (Burr.) De Toni, while common on such fruit trees as pear, quince and apple, has only been seen once on trees grown for ornament. In this case it was quite prominent on the English Hawthorn. The young twigs are killed back for a foot or more, the blackened leaves still adhering. infection takes place chiefly at blossoming time. The bacteria are carried there accidentally by bees, etc., and multiplying in the nectar of the blossoms, work downward through the tender

tissues of the twigs. More rarely large branches are killed through cankers in the bark. Cutting off the infected twigs, when dormant, some distance below the diseased tissue and wiping the pruning tool each time with a cloth saturated with carbolic acid or corrosive sublimate, to kill adhering germs, has been the common method for control.

Cankers: When a fungus enters a branch or trunk of a tree, it usually becomes perennial there and, gradually killing the bark, makes a cankered spot which, if it encircles the branch, causes death of the parts above. Fortunately, few of the fungi thus invade large limbs or the main trunk.

Chestnut Blight, *Endothia parasitica* (Murr.) Anders., is one of these canker fungi that has proved destructive in this way. Its action has been unique in tree history in this state, as it has practically eradicated not only all forest chestnuts but ornamental ones as well. All that are left are the sprouts that come up from the cut trees and occasional small seedlings, both of which are still subject to attacks. Treatment of any kind, so far, has been unsuccessful with this disease. This and the forestry department, however, expect soon to start small seedling plantations for future observation.

Poplar Cankers, *Dothichiza populea* Sacc. & Bri., is another, apparently European, importation that has recently been producing havoc with our ornamental poplars, especially the Lombardy. Not all the injury, however, is due to this fungus, as insects and winter injury have played their part. The remedy for this trouble seems to be to start with a young tree entirely free from the disease, as we have seen large isolated trees that continue to escape any injury.

Nectria Cankers, *Nectria cinnabarina* (Tul.) Fr., and *N. galligena* Bres., are apt to produce more localized cankers, especially the latter. The former, in our opinion, is not a serious trouble as it seems to follow winter injury only, and is especially prominent on those trees least hardy. The clustered bright-red fruiting pustules are conspicuous on the dead bark. The latter species makes a distinct canker that slowly enlarges year after year, in time showing a series of concentric rings of denuded wood with the canker deepest at the center. It is especially prominent on black birch in the woods but is occasionally found on cultivated trees of this species as well as on apple, maple and oak.

Treatment: Treatment of leaf destroying fungi by spraying depends upon prevention rather than cure. Hence the sprayings must begin before infection and continue while this danger lasts. This usually takes from two to five treatments according to the disease. With the anthracnoses and leaf curls, these treatments usually have to be started quite early, in some cases as soon as the buds begin to swell in the spring; with the leaf spots and mil-

dews, some time in the late spring or summer, before the first signs of injury show. With rusts, spraying is usually of little or no value. In deciding whether spraying is desirable, one must take into consideration how injurious or obnoxious the fungus has proven, especially the preceding year, and how frequently it causes trouble. The 4-4-50 Bordeaux mixture, on the whole, is the best fungicide to use; in some cases where conspicuous sediment is objectionable, commercial lime and sulphur, 1 to 50 gallons of water, can be used. When necessary, an insecticide can be added to either. See the Station's Spray Calendar for further information.

Treatment for the Blights, Cankers, and Blister Rust is chiefly, as already indicated, through pruning off the invaded parts. Occasionally, under certain conditions, spraying is also given.

WOOD DESTROYING FUNGI

Nature: Almost all of the wood destroying fungi, whether on living or dead wood, belong with that class known as shelf fungi and toadstools. These represent the larger and more conspicuous fungi. Some of them are real parasites on the trees, killing the living tissues first and later causing decay of the dead wood; others are saprophytes, occurring only in the heartwood and causing its decay. Many, while not strictly parasites, are semi-parasitic as they cause some injury to the living tissues though usually confined to the dead. Therefore, it is not always easy to distinguish the parasitic from the saprophytic forms. We treat them together here, dealing, however, only with those saprophytic forms, that, in our experience, commonly occur on the dead wood of living ornamental trees. Most of the fungi discussed belong to that group known as Polypores, so-called because their spores are borne in pores that form the lower surface of the conspicuous fruiting bodies. Some have their spores borne on spines, teeth, gills, etc. Many other species are more prominent as agents of decay in dead forest trees than those mentioned here. There are others that are more important as parasites of living trees, but we have not met with them on ornamental trees in this state.

Trunk Forms: *Daedalea quercina* (L) Pers. confines itself largely to oaks and is rarely seen fruiting on living trees though on dead stumps in the forest it is common. It occasionally causes a heart rot of the ornamental oaks even if rarely fruiting on the same. The fruiting body shows as a conspicuous bracket, light brown in color and of a semi-corky texture. The lower fruiting surface has very large irregular or labyrinthiform pores.

Fomes applanatus (Pers.) Wallr., like all the species of the genus *Fomes*, is a perennial fungus developing a new poroid fruiting layer each year over that of the preceding year, so that when

cut through these show as a series of stratified tubes. This species is one of the largest and most common of the shelf fungi. It is not found fruiting on living trees as commonly as on the dead ones. The woody shelf varies in size from a few inches to even a foot or more in width, and projects out from the trunk horizontally almost as far. Its upper surface is a light brown and its fruiting surface is white, minutely poroid and easily etched; the tissues within are chocolate-brown. We have found it occasionally on living maples, poplars, willows, apples and peaches, and believe it to be the common heartwood rot of the maple.

Fomes connatus Fr. is a whitish, semi-fleshy or finally somewhat woody, species less than a foot wide and consists usually of several irregular shelving and overlapping brackets. The fruiting surface develops flesh-colored, small, thin-walled pores having a satiny lustre. We have found it fruiting on hickory and hard maple where it caused heartwood rot.

Fomes igniarius (L.) Gill. is a single, woody, roundish to hoof-shaped bracket four to eight inches wide. It is at first light brown and smooth above but with age dark brown and more or less concentrically zoned and rimmed. Below, the minutely poroid surface is a rusty-brown color. It has been found on oaks and apples, where it seems to injure somewhat the living tissues as well as cause rot of the wood.

Polyporus squamosus (Huds.) Fr. is a semi-fleshy mushroom-like fungus with a side stem. The upper surface is covered with conspicuous patches of rusty scales and the lower is coarsely poroid. It has been found a few times on living maples where heart rot was present.

Polyporus sulphureus (Bull.) Fr. is a striking species with adhering and overlapping brackets of considerable size that are at first fleshy but on drying corky in texture. The upper surface is orange-red while the lower is a sulphur-yellow with moderate sized pores. While commonly a saprophyte on stumps and logs, at times, it is parasitic on living trees especially, as seen here, on oak.

Polystictus conchifer Schw. is a small, papery, conch-like species found on elm limbs where it produces slow rot and causes the branches to break off easily in storms. Some writers consider it semi-parasitic.

Pleurotis sapidus Kalch., *P. ostreatus* Jacq., oyster mushroom, and *P. ulmarius* Bull. are all evident, fleshy, gill fungi of the mushroom type. The two former occur as large, usually clustered or overlapping, brackets with the individual parts narrowed backward to a more or less distinct base down which the gills run for a short distance. The last species consists of a single fruiting body with a much more pronounced stem, arising near the center of the cap, to which the gills are attached by a notch. All are white forms with the tops often more or less brownish, especially

toward the center. They are most frequently found on the elm and hard maple and are associated with a heart rot of the wood. All three species are edible.

Hydnum septentrionale Fr. is a very conspicuous but rather uncommon, semi-fleshy when young but leathery when old, bracketed form with the overlapping irregular shelves joined to the trunk by a united but not distinct base. The tops of the shelves are whitish, often somewhat scabrous and the lower fruiting surfaces are differentiated quite markedly from other fungi by the very crowded, pinkish, fine, fruiting spines about half an inch in length. It has been found here, so far, only on hard maple and hickory and is apparently semi-parasitic.

Root Forms: It is not always easy to determine whether roots have been killed by these larger fungi, since the fruiting bodies are not usually present. Even when either the mycelial threads or the fruiting bodies are seen it is still a possibility that the fungus is a secondary agent following winter or some other injury. The only two species we have found here apparently injuring the roots of ornamental trees are of the toadstool type.

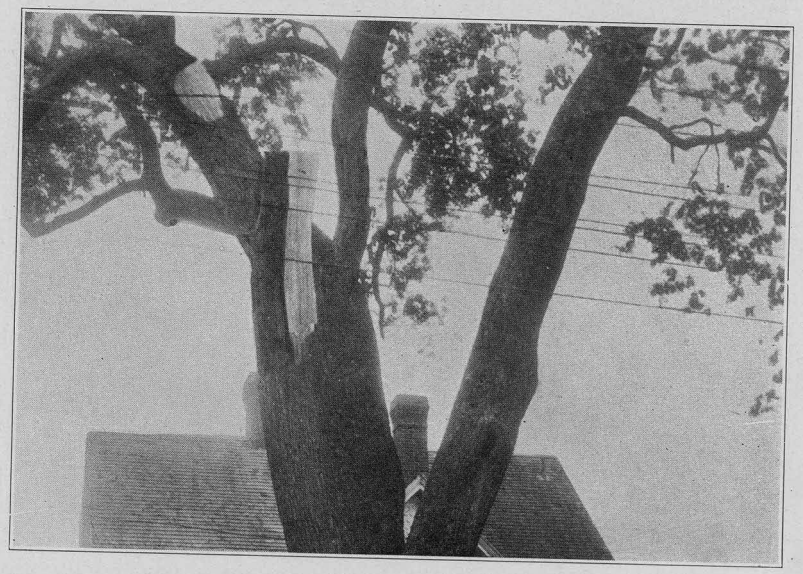
Armillaria mellea (Vahl) Quel. is the most important of the mushrooms attacking the roots of living trees. The umbrella-like cap is usually a honey-yellow with patches of brownish scales; the gills are white and the central stem has a more or less evident ring. They occur in clusters on the ground with the mycelium forming conspicuous, dark colored, rounded strands running over the roots and flattening out under the bark where the woody tissues are invaded. It is more likely to attack coniferous than deciduous trees.

Collybia velutipes Curt. is a yellowish to tawny mushroom, somewhat smaller than the preceding, that is especially distinguished by the velvety brown stems of the clustered fruiting bodies. It is claimed by some to cause injury to the roots of trees though commonly found on dead wood.

Treatment: For further statements concerning the control of wood-destroying fungi, the reader is referred to the articles by Collins and Filley elsewhere in this Report. We shall mention here only the fundamental requirements. The first is the complete removal of all decayed or infected wood and bark to prevent, or at least to arrest, further decay. The exposed wood is usually given an antiseptic and waterproof coating or coatings. The cavity should be properly shaped and the bark so left that rapid callus formation is favored. Whether or not the cavity should be filled is a matter of opinion, but, if filled, there is no question that it should be done properly. This means that the filling should be permanent, semi-flexible, waterproof, non-injurious to the living tissues, especially the cambium layer, tight fitting or better adherent to the wood, and so shaped that the callus readily grows over its exposed surface.

Black oak on Station grounds, broken by ice on February 5, 1924. A tree surgeon is needed in such a case.

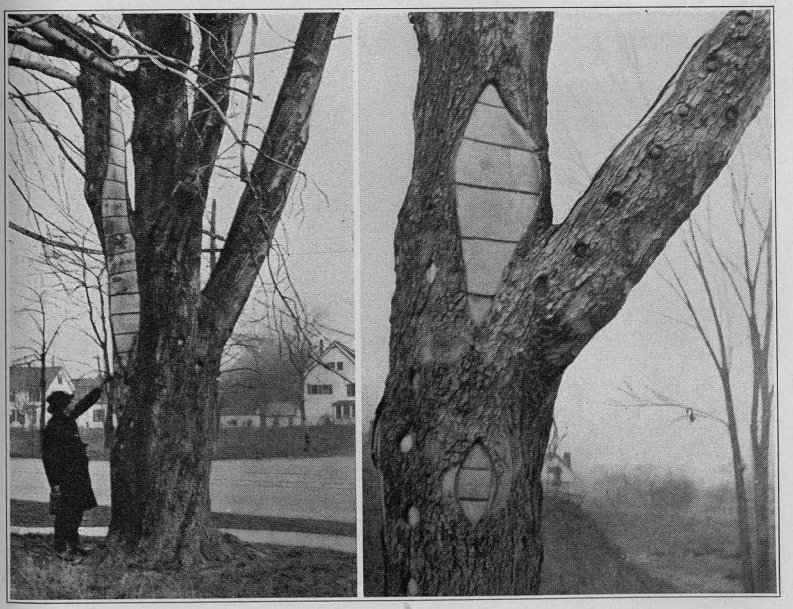
a. View in Pomfret where trees were broken by ice storm of November 27–30, 1921. This scene also justifies the tree surgeon. Photograph December 6, 1921.



b. Elm tree in Mount Carmel, showing bad pruning. Cavities usually follow such careless work. All cuts should be made close to the trunk or branch. Photograph 1909.

a. Young elm tree in Pomfret, where a large branch had been removed the preceding year. This was a good cut, and healing is well started. Photographed in 1909.

b. The same wound four years later. Photographed in 1913.



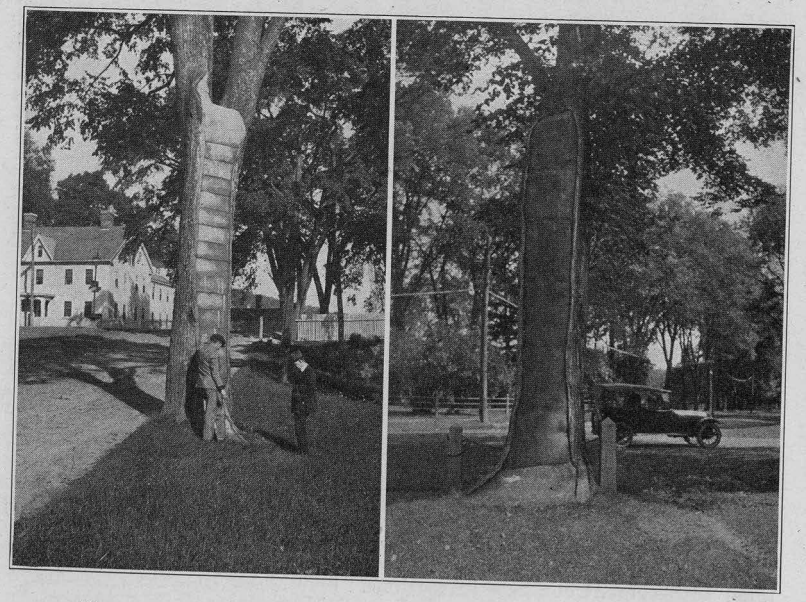
c. Large red maple in Bridgeport injured by fire. Cavities were filled with cement concrete in sections.

d. Sugar maple near the preceding, Bridgeport.

The work on both trees was overdone. The bolts were so near together that the cambium died between them.

a. Elm tree, Stamford, filled with "Nu Wud". Cambium dead at bottom of cavity. Filling has since been replaced. Photographed August 26, 1924.

b. Elm tree, Greenwich, filled with "Nu Wud". Photographed August 25, 1924.

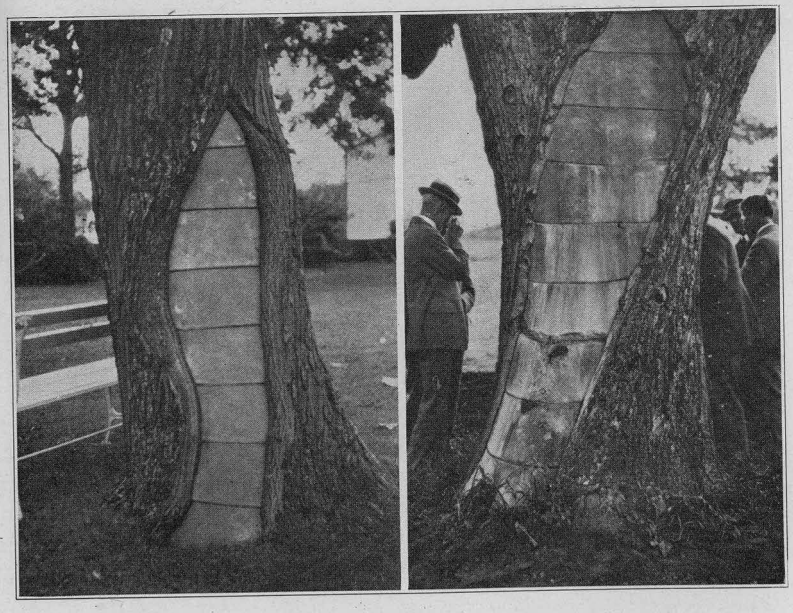


c. Elm tree at Baltic filled with cement concrete in sections. Photographed September 13, 1919.

d. Elm tree at Old Lyme injured by fire and filled with cement concrete not in sections. Photographed September 12, 1919.

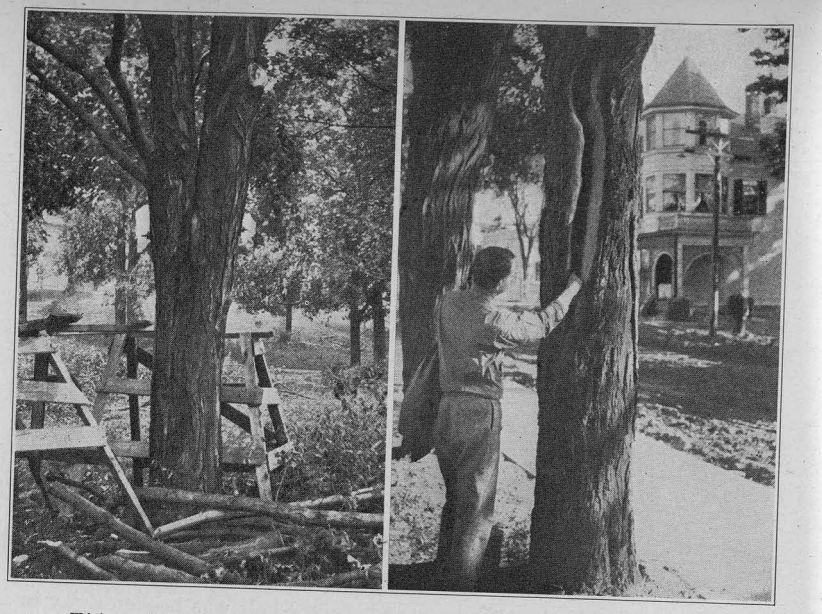
a. Large double elm, Westport, where one-half was broken away in a storm. Resulting cavity was filled with stone and brick and covered with a layer of cement, which has now broken apart. A home-made filling. Photographed August 26, 1924.

b. Elm in Greenwich where cavity had been filled with monolithic cement concrete. Photographed August 25, 1924.

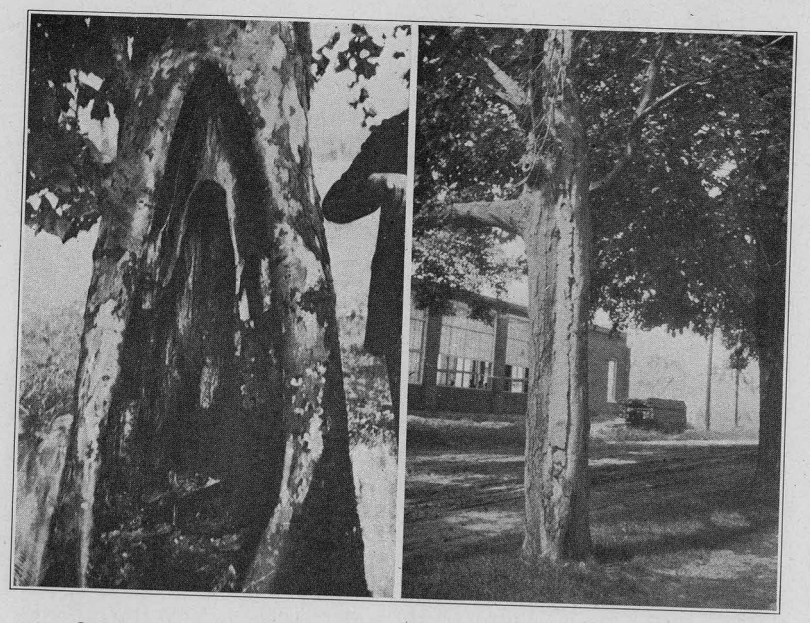


c. A satisfactory filling of sectional cement concrete in oak, Sound Beach. Photographed August 26, 1924.

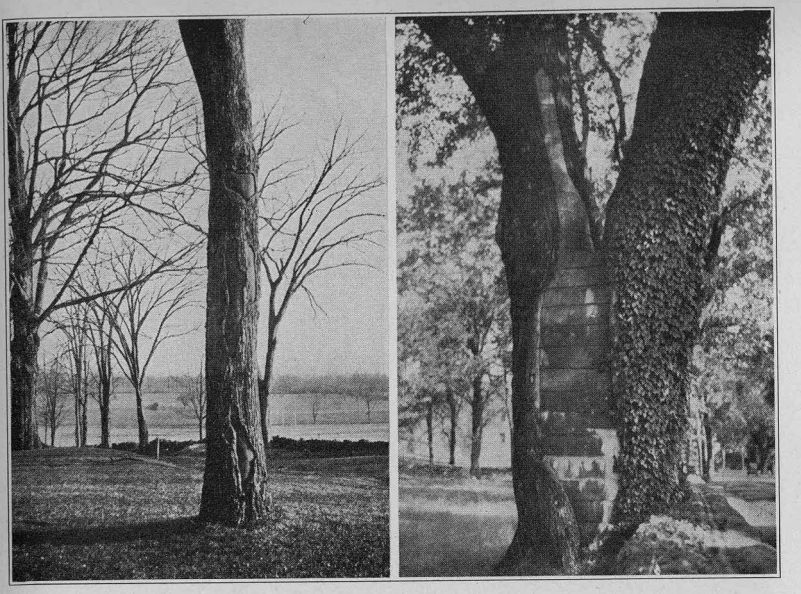
d. Large white oak at Rye, N. Y., filled with sectional cement concrete. This is rather unsatisfactory, as filling is broken somewhat and new tissue has been killed at base. Photographed August 25, 1924.



a. This splitting tree, a sugar maple, Cheshire, has just been bolted. Photographed August, 1920.
b. Example of poor cavity work in a sugar maple, Goodyear. The filling has mostly fallen out. Photographed September 13, 1919.

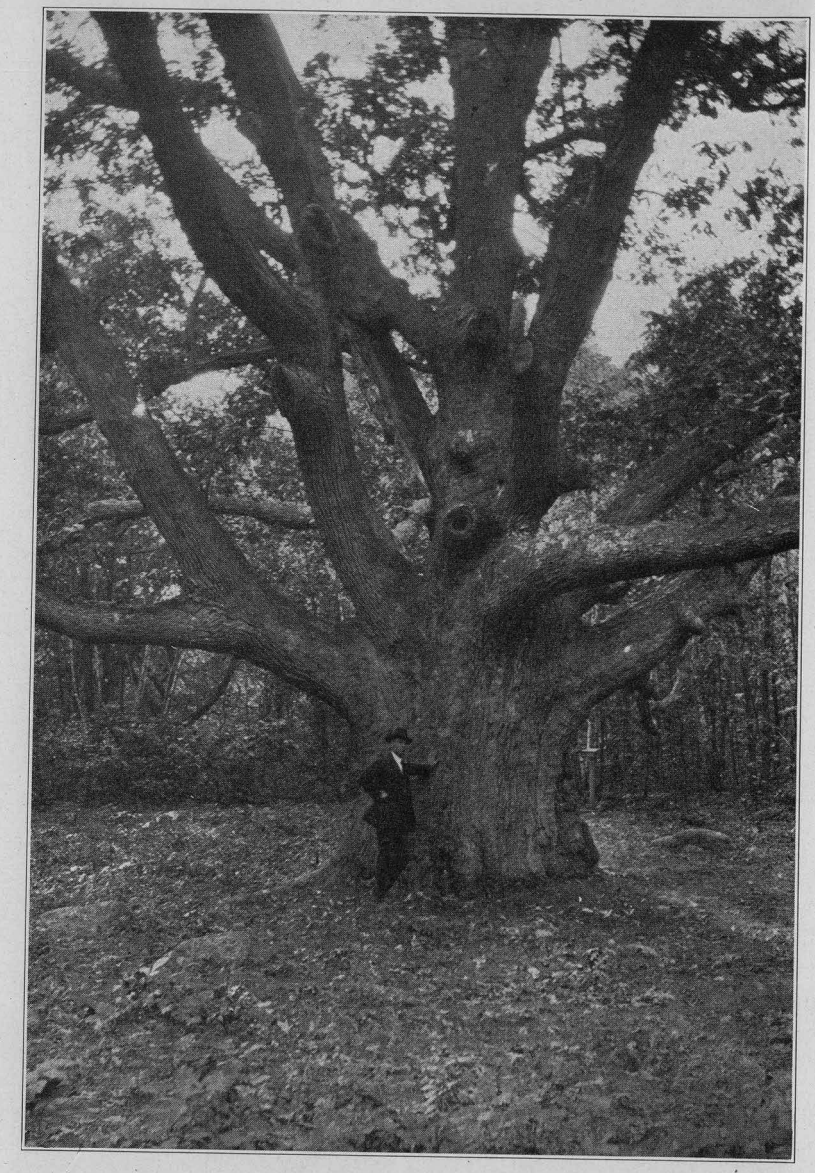


c. Open cavity in large sycamore, Bronx Parkway, N. Y. Unsatisfactory because decay sets in back of the waterproof coating. Photograph August 25, 1924.
d. Unsatisfactory filling of monolithic cement concrete. This filling was put in over the bark and is now being pushed out by new growth. Sugar maple tree in Hamden. Photographed in 1909.



a. Elm in Wallingford where curious shaped cavities (possibly cankers) have been filled. Photographed in 1912.
b. Large elm, Stamford, filled with sectional cement concrete. There is a white exudation near the base and the bark has been killed. Photographed August 25, 1924.

c. Elm in New Haven, showing cankers on the trunk. Photograph August 27, 1924.
d. White pine in Cornwall, struck by lightning, showing scar on trunk. Photographed September 13, 1917.



Giant white oak on farm of Dr. C. B. Graves, Ledyard. This tree has survived for at least 300 years without the aid of a tree surgeon.

BULLETIN 264 JANUARY, 1925

Connecticut Agricultural Experiment Station
New Haven, Connecticut

Report of the Director

For the
Year Ending October 31, 1924

The Bulletins of this Station are mailed free to citizens of Connecticut who apply for them, and to other applicants as far as the editions permit.

CONNECTICUT AGRICULTURAL EXPERIMENT STATION

OFFICERS AND STAFF

As of
October 31, 1924.

BOARD OF CONTROL.

His Excellency, Charles A. Templeton, *ex-officio, President.*

Charles R. Treat, *Vice President*.....Orange
George A. Hopson, *Secretary*.....Mount Carmel
Wm. L. Slate, Jr., *Director and Treasurer*.....New Haven
Joseph W. Alsop.....Avon
Elijah Rogers.....Southington
Edward C. Schneider.....Middletown
Francis F. Lincoln.....Cheshire

STAFF.

E. H. Jenkins, Ph.D., *Director Emeritus.*

Administration.
Wm. L. Slate, Jr., B.Sc., *Director and Treasurer.*
Miss L. M. Brautlecht, *Bookkeeper and Librarian.*
Miss J. V. Berger, *Stenographer and Bookkeeper.*
Miss Mary E. Bradley, *Secretary.*
William Veitch, *In charge of Buildings and Grounds.*

Chemistry. Analytical Laboratory.
E. M. Bailey, Ph.D., *Chemist in Charge.*
R. E. Andrew, M.A.
C. E. Shepard
Owen L. Nolan
Harry J. Fisher, A.B.
W. T. Mathis
Assistant Chemists.
Frank C. Sheldon, *Laboratory Assistant.*
V. L. Churchill, *Sampling Agent.*
Miss Mabel Bacon, *Stenographer.*

Biochemical Laboratory.
T. B. Osborne, Ph.D., Sc.D., *Chemist in Charge.*

Botany.
G. P. Clinton, Sc.D., *Botanist in Charge.*
E. M. Stoddard, B.S., *Pomologist.*
Miss Florence A. McCormick, Ph.D., *Pathologist.*
Willis R. Hunt, M.S., *Graduate Assistant.*
G. E. Graham, *General Assistant.*
Mrs. W. W. Kelsey, *Secretary.*

Entomology.
W. E. Britton, Ph.D., *Entomologist in Charge; State Entomologist.*
B. H. Walden, B.Agr.
M. P. Zappe, B.S.
Philip Garman, Ph.D.
Assistant Entomologists.
Roger B. Friend, B.S., *Graduate Assistant.*
John T. Ashworth, *Deputy in Charge of Gipsy Moth Work.*
R. C. Botsford, *Deputy in Charge of Mosquito Elimination.*
Miss Gladys M. Finley, *Stenographer.*

Forestry.
Walter O. Filley, *Forester in Charge.*
A. E. Moss, M.F., *Assistant Forester.*
H. W. Hicock, M.F., *Assistant Forester.*
Miss Pauline A. Merchant, *Stenographer.*

Plant Breeding.
Donald F. Jones, S.D., *Geneticist in Charge.*
P. C. Mangelsdorf, M.S., *Graduate Assistant.*

Soil Research.
M. F. Morgan, M.S., *Investigator.*

Tobacco Sub-station at Windsor
————— —————, *In Charge.*
N. T. Nelson, Ph.D., *Plant Physiologist.*

The Wilson H. Lee Co.

Report of the Director

For the Year Ending October 31, 1924.

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

The year under review has been one of satisfactory progress. Detailed reports on all departmental work are presented in later pages. Here follows a very brief mention of the most outstanding accomplishments of the year.

"Defense" (Control) Work.

In protecting the people of the State by analyzing fertilizers, foods, drugs and insecticides, the analytical laboratory renders one

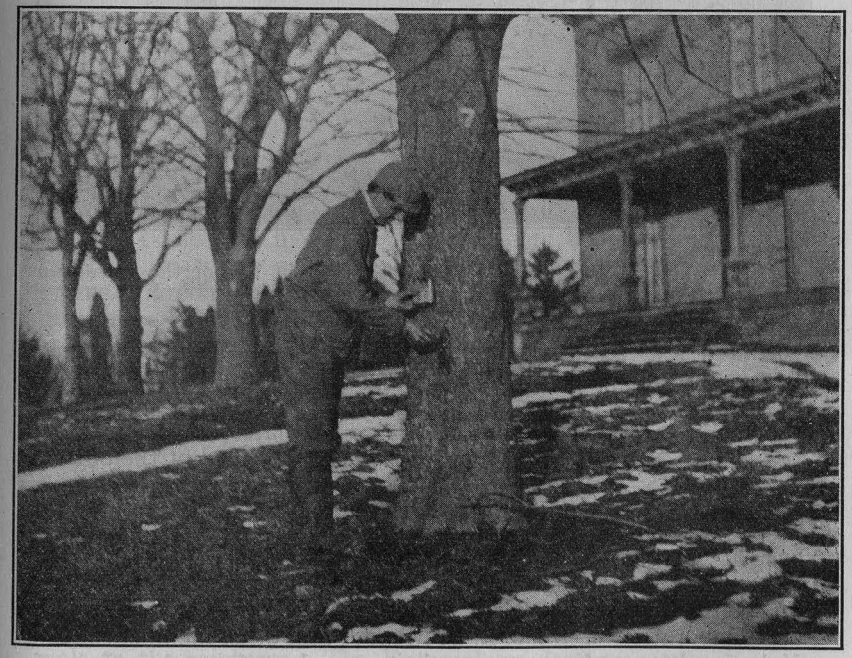


Fig. 1. Gipsy Moth Control—Creosoting Egg Mass.

of the most valuable services that the Station offers. Although not spectacular the work of the chemist is a highly important factor in the agricultural life of the State and in the protection of public health. In 1924, 880 samples of fertilizers, 352 samples of feeding stuffs and 1,800 samples of foods and drugs were examined in addition to many other materials collected or submitted.

Seed testing is an important project of the Botany department as is also the plant disease survey, which aims to discover any new or old diseases as soon as they appear within our boundaries.

The State entomologist, who is also the Station entomologist, is responsible for all work pertaining to insect pests. He has been able to prevent damage by the Gipsy Moth and predicts that,

Fig. 2. Burning Weeds and Rubbish that might harbor the European Corn Borer.

within a few years, liberated parasites will automatically hold this pest in check. Like the botanist, he attempts to scout the State constantly for new insects or outbreaks of old, thus giving the citizen warning and protection. The latest invasion is by the European Corn Borer which we hope to control at the outset.

The Vegetable Proteins.

For many years Dr. Osborne and his associates have intensively studied the nature of these complex substances and many contributions to our knowledge of their nutritive value have resulted. In collaboration with Dr. L. B. Mendel and other members of the Yale faculty, studies are now being conducted on the effect of

various diets on growth, reproduction and on the occurrence of rickets.

Rickets in rats can be induced or cured at will by suitable adjustment in the diet. This study is important not only in relation to rickets in children but to leg weakness in chickens, for it has recently been demonstrated that this poultry disease is a form of rickets which can be cured by the same methods demonstrated to be successful on the albino rat.

It has heretofore been thought that too much protein in the ration injures the kidney. This, however, has not been confirmed by the experimental feeding of rats within the periods of time thus far studied. The kidneys, although enlarged, are not otherwise abnormal.

It has also been found that a diet may be entirely adequate for vigorous growth over long periods, but still be deficient in some factor which determines fertility. This fact may become important in the feeding of farm animals since it may later be discovered that the feeding of highly concentrated rations to high bred stock may be responsible for their lack of fertility.

In connection with this brief summary of biochemical investigations mention must be made of the development of methods for preparing pure protein substances in large quantities which has been the basis of past experimentation. In feeding these products to animals it has been shown conclusively that some proteins are inadequate for proper growth and development, while others possessing known or unknown characteristics are amply sufficient. The ability to prepare large amounts of pure proteins provides a sure foundation for further investigation in this field.

Spraying vs. Dusting.

In recent years there has been considerable controversy on the merits of the two methods. Experiments begun in 1920 have failed to show any sound reason for abandoning the spray programs. A combination of dust and spray applications did not give great promise in 1924, but will be continued.

Root and Ear Rots of Sweet Corn.

Steady progress is being made in developing disease-free seed by selection, the selected strain yielding 173 bushels as against 154 for the unselected seed. In the selected seed the per cent of disease has fallen from 51 to 18 in four years.

The Chemistry of Spray Mixtures.

In spite of our long experience with sprays, much is yet to be learned, especially because of the frequent addition of new materials to the mixtures. The Entomology department is engaged in a detailed study of this whole problem.

The Cabbage Maggot.

The control of this pest is still a problem. A new mode of attack involves the use of traps with proper baits, the problem being to find the aromatic substance in cabbage which seems to attract the moth.

Fig. 3. White Pines at Rainbow. Planted 1905.

The Experimental Forest at Rainbow.

Begun in 1902, these experimental plantations have now reached an age to yield valuable information. Plantings of hardwoods, with the exception of red oak, black walnut and chestnut, have failed on the coarse sand which covers the Rainbow plain. Of the conifers, the white, red and Scotch pine have made the most notable growth. It is yet too early, however, to recommend Scotch pine since it is a new type in this country.

Breeding Better Corn.

One of the notable achievements of the Station in plant breeding has been the production of a new kind of sweet corn for canners and market gardeners. By continuous self-fertilization, the corn of two different strains was reduced to a state of great purity but little vigor. To reattain vigor these two purified strains were crossed and the new corn produced.

Because of the reddish color of the leaves the corn has been named Red Evergreen. It was tested in Ontario in 1923-24 and produced six tons of ears per acre in comparison with a standard variety of Evergreen which produced only three and one half tons.

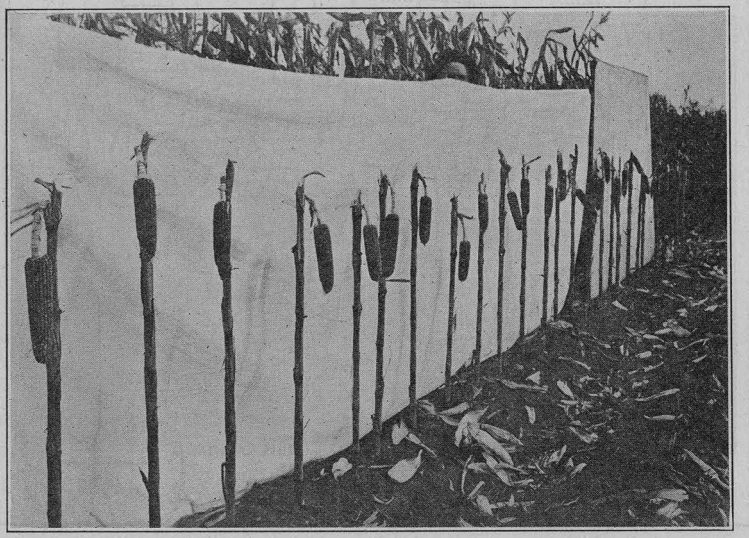


Fig. 4. Corn Produced from a Cross of Inbred Strains.—A perfect ear on every stalk.

The new corn has also been tested by several market gardeners in Connecticut and by canners in New York state with favorable results.

The method by which this corn was produced (selection in a self-fertilized line and crossing of fixed inbred strains) will be applied to other standard varieties of sweet corn.

Soils of Connecticut.

A complete knowledge of our soils must be the basis of an intelligent use of our land resources. Soil surveys of Connecticut land were begun in 1923, two towns being carefully mapped. In 1924

six areas were added and a new laboratory equipped to study the nature of each of the important soil types identified. The possible results of this work are far-reaching. The farmer who has been on the land for a generation knows his soil, but to bring together widely scattered and diverse information by means of a survey must be the task of the soil scientist. Once this is accomplished, we have not only a sound basis for land utilization and taxation but a better knowledge of how to treat those areas which are intensively planted in tobacco or vegetables.

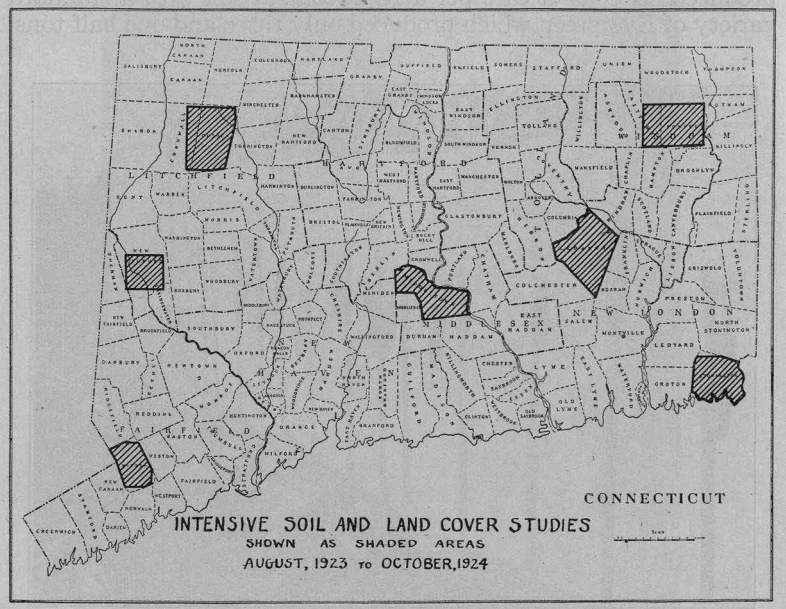


Fig. 5. Progress of the Soil Survey.

Mt. Carmel Farm Field Day.

The annual Station Field Day was held on August 11. This coincided with the field trip of the American Pomological Society and a joint program was held. President Charles L. Beach of the Connecticut Agricultural College gave the principal address.

Changes in Staff.

Appointments:

W. T. Mathis, Assistant Chemist, November 1, 1924.
N. T. Nelson, Ph.D., Assistant in Plant Physiology at Tobacco Sub-Station, April 15, 1924.
Roger B. Friend, B.S., Assistant Entomologist, Jan. 1, 1924.
Willis R. Hunt, M. S., Assistant Botanist, July 1, 1924.

Resignations:

C. M. Slagg, M. S., in charge of Tobacco Sub-Station, March 31, 1924.

Fig. 6. Field Day at Mt. Carmel Farm, August, 1924.

Publications.

Bulletins.

No. 250. Fertilizer Report for 1923.
No. 251. The Raspberry Fruit Worm.
No. 252. The European Red Mite.
No. 253. Better Forests for Connecticut.
No. 254. Report of the Director for the Year Ending October 31, 1923.
No. 255. Report on Food Products and Drugs (1923).
No. 256. Report of the State Entomologist (1923).
No. 257. Report on Commercial Feeding Stuffs (1923).
No. 258. Report on Insecticides and Fungicides (1923).
No. 259. Corn in Connecticut.
No. 260. Rust Infection of Leaves in Petri Dishes.

Tobacco Bulletins.

No. 4. Revised Recommendations for the Control of Wildfire.

Circulars of Immediate Information.

No. 28. Winter Condition of Apple and Peach Buds.
No. 29. Dormant Sprays for Orchard Pests.
No. 30. Information About Insecticides and Fungicides.
No. 31. Why and How to Spray.
No. 32. Varietal Susceptibility of Apples to Diseases and Injuries.
No. 33. The Prepink and Pink Sprays for Apples.
No. 34. Spray for the Imported Current Worm.
No. 35. Tree Workers Holding Connecticut Certificates.
No. 36. The Calyx and Later Summer Sprays.
No. 37. Peach Spraying.
No. 38. Grape Spraying.
No. 39. The Apple and Thorn Skeletonizer.
No. 40. Spraying Shade Trees.
No. 41. The Oriental Peach Moth.
No. 42. Spraying Potatoes.
No. 43. The Apple Maggot or Railroad Worm.
No. 44. The Gipsy Moth Quarantine.
No. 45. Sun Scorch, Anthracnose, etc. of Shade Trees.
No. 46. Prematuring of Vegetables, Rots of Lettuce and Similar Troubles.
No. 47. Prematuring and other Potato Troubles.

Journal Papers.

Some Basic Substances from the Juice of the Alfalfa Plant.
By Charles S. Leavenworth, Alfred J. Wakeman and Thomas B. Osborne. J. Biol. Chem., 1923., LVIII, 209-214.

Experimental Production of Rickets with Diets of Purified Food Substances.
By Thomas B. Osborne, Lafayette B. Mendel and Edwards A. Park. Proc. Soc. Exper. Biol. and Med., 1923, XXI, 87-90.

The Effect of Diet on the Content of Vitamine B in the Liver.
By Thomas B. Osborne and Lafayette B. Mendel. J. Biol. Chem. 1923, LVIII, 363-367.

Nutrition and Growth on Diets Highly Deficient or Entirely Lacking in Preformed Carbohydrates.
By Thomas B. Osborne and Lafayette B. Mendel. J. Biol. Chem., 1924, LIX, 13-32.

Nutrition and Growth on Diets Highly Deficient or Entirely Lacking in Preformed Carbohydrates.
By Thomas B. Osborne and Lafayette B. Mendel. Proc. Soc. Biol. Chem., J. Biol. Chem., 1924, LIX, xliv.

Nutrition and Growth on Diets Highly Deficient or Entirely Lacking in Preformed Carbohydrates.
By Thomas B. Osborne and Lafayette B. Mendel. Proc. Am. Physiol. Soc. Am. J. Physiol., 1924, LXVIII, 143.

The Nutritive Value of Lactalbumin.
By Thomas B. Osborne and Lafayette B. Mendel. J. Biol. Chem. 1924, LIX, 339-345.

The Vegetable Proteins, Second Edition.
By Thomas B. Osborne, Longmans, Green & Co., London, 1924, pp. xiii +154.

Ophthalmia as a Symptom of Dietary Deficiency.
By Thomas B. Osborne and Lafayette B. Mendel. Am. J. Physiol., 1924, in press.

Evidence expérimentale du manque de vitamine dans l'alimentation.
By Lafayette B. Mendel. Bull. Soc. Scient. d'Hyg. Alimentaire, 1924, XII, 29.

Nutrition: The Chemistry of Life.
By Lafayette B. Mendel. Yale University Press, 1923, pp. xii +150.

Investigation on the Nitrogenous Metabolism of the Higher Plants. V. Diurnal Variations in the Protein Nitrogen of Runner-Bean Leaves.
By Albert Charles Chibnall. Biochem. J., 1924, XVIII, 387-394.

Investigations on the Nitrogenous Metabolism of the Higher Plants. VI. The Role of Asparagine in the Metabolism of the Mature Plant.
By Albert Charles Chibnall. Biochem. J., 1924, XVIII, 395-404.

Investigations on the Nitrogenous Metabolism of the Higher Plants. VII. Leaf Protein Metabolism in Normal and Abnormal Runner-bean Plants.
By Albert Charles Chibnall. Biochem. J., 1924, XVIII, 405-407.

Some Nitrogenous Constitutents of the Juice of the Alfalfa Plant. I. The Amide and Amino Acid Nitrogen.
By Hubert Bradford Vickery. J. Biol. Chem., 1924, in press.

Some Nitrogenous Constituents of the Juice of the Alfalfa Plant. II. The Basic Nitrogen.
By Hubert Bradford Vickery. J. Biol. Chem., 1924, in press.

Pathogenesis of the Ocular Lesions Produced by a Deficiency of Vitamine A.
By Arthur M. Yudkin and Robert A. Lambert. J. Exp. Med., 1923, XXXVIII, 17-24.

Changes in the Paraocular Glands Accompanying the Ocular Lesions which Result from a Deficiency of Vitamine A.
By Robert A. Lambert and Arthur M. Yudkin. J. Exp. Med., 1923, XXXVIII, 25-32.

An Experimental Study of Ophthalmia in Rats on Rations Deficient in Vitamine A.
By Arthur M. Yudkin. Arch. Ophthalmology, 1924, in press.

Diseases of Connecticut Vegetables in 1923.
By G. P. Clinton. Rept. Conn. Veg. Growers' Assn. (1923) p. 45.

Injuries and Diseases of Connecticut Fruits in 1923.
By G. P. Clinton. Rept. Conn. Pom. Soc. (1923) p. 37.

Spraying Strawberries for the Control of Fruit Rots.
By E. M. Stoddard, D. H. Rose, and N. E. Stevens, U. S. Depart. Agr. Circ. 309, p. 1.

Will The Chestnut Trees Come Back?
By G. P. Clinton. The New Eng. Farmer, Vol. 49, p. 1.

Seed Notes.
By E. M. Stoddard. Seed World, Vol. 15, No. 11, p. 34; Vol. 16, No. 8, p. 31.

Report of Committee on Injurious Insects.
By W. E. Britton, Conn. Pom. Soc. Proceedings (1924) p. 41.

Some Insects to be Combated Next Season.
By W. E. Britton, Conn. Pom. Soc. Proceedings (1924) p. 72.

Insects Attacking Vegetable Crops in Connecticut in 1923.
By W. E. Britton, Rept. Conn. Veg. Growers' Assn. (1924) p. 43.

An Asiatic Beetle (Anomala orientalis) in Connecticut.
By W. E. Britton. Jour. Econ. Ent. (April 1924) Vol. 17, p. 309.

The Gipsy Moth and Our Forests.
By W. E. Britton. New Eng. Farms (June 21, 1924.)

Connecticut Tree Workers' Institute.
By W. E. Britton. Florists' Exch. (March 22, 1924), Vol. LVII, p. 890.

Proceedings, Shade Tree Conference.
By W. E. Britton. Florists' Exch. (Sept. 6, 1924), Vol. LVIII, p. 703.

Meeting of Connecticut Entomologists.
By W. E. Britton. Jour. Econ. Ent. (Dec., 1924), Vol. 17, p. 669.

Control of European Red Mite in Connecticut.
By Philip Garman. Conn. Pom. Soc. Proceedings (1924) p. 44.

Factors Influencing the Effectiveness of Arsenate of Lead.
By Philip Garman. Florists' Exch. (Sept. 6, 1924), Vol. LVIII, p. 685.

The Raspberry Fruit Worm.
By B. H. Walden. Conn. Pom. Soc. Proceedings (1924) p. 124.

Results of Dusting versus Spraying in Connecticut Apple and Peach Orchards in 1922.
By M. P. Zappe and E. M. Stoddard. Crop Prot. Digest. (June 1924), Bull. Series No. 4, p. 2.

Progress of Spraying and Dusting Experiments.
By M. P. Zappe and E. M. Stoddard. Conn. Pom. Soc. Proceedings (1924) p. 52.

Accomplishments in the Past Year in Anti-Mosquito Work in Connecticut.
By R. C. Botsford., N. J. Mosquito Exter. Assn. Proceedings (1924) p. 80.

Some Insect Information from a Connecticut Conference.
By W. E. Britton. Florists' Exch. (Nov. 29, 1924),Vol. LVIII, supplt. Page A.

Waxy Endosperm in New England Maize.
By P. C. Mangelsdorf. Science (Sept. 1924). Vol. 60, p. 222.

Selective Fertilization among the Gametes from the Same Individuals.
By D. F. Jones. Proc. of the National Acad. Sciences (June, 1924), Vol. 10, p. 218.

Methods for Seed Corn Production Being Revised.
By D. F. Jones. Jour. Heredity (July), 1924), Vol. 15, p. 291.

Heritable Characters of Maize (XII) Mealy Endosperm.
By P. C. Mangelsdorf. Jour. Heredity (Aug.-Dec., 1922),Vol. 13, p. 359.

The Inheritance of Defective Seeds in Maize.
By P. C. Mangelsdorf. Jour. Heredity (June, 1923), Vol. 14. p. 119.

Land Cover Studies as a Basis for a More Accurate Interpretation of the Soil Survey.
By M. F. Morgan. Jour. Am. Soc. of Agron. (July, 1924), Vol. 16, No. 7, p. 452.

Physical Equipment.

The removal of the Board of Health Laboratory to Hartford made available the lower floor and basement of the old Botany building, in which a very complete Soils laboratory has been installed. The small greenhouse has been repaired and will be used for pot experiments.

About 900 volumes were added to the library, which now contains 11,800 volumes.

REPORTS OF DEPARTMENTS.

Analytical Chemistry.

Dr. E. M. Bailey in charge.

1. **Control of Fertilizers.** Eight hundred and eighty samples of commercial fertilizer have been analyzed, the results reported to the manufacturer and others interested, and the complete data classified and arranged for publication.

2. **Inspection of Feeding Stuffs.** Three hundred and fifty-two samples of commercial feeding stuffs and other fodder materials have been examined and the results published together with a discussion of the law relating to this subject.

3. **Inspection of Foods and Drugs.** Control and investigational work on food products and drugs has entailed the examination of about 1,800 samples.

4. **Calibration of Babcock Glassware.** Nearly 4,000 pieces of Babcock glassware have been checked for accuracy of calibration.

5. **Inspection of Insecticides and Fungicides.** About 70 samples of spraying and dusting materials were examined and the results published together with the text of the insecticide law recently enacted and rules and regulations for its enforcement as formulated jointly by the Director of this Station and the Dairy and Food commissioner.

6. **Studies on Methods.** Collaborative work has been carried on with the Association of Official Agricultural Chemists upon methods for the analysis of spices and other condiments and of cacao products.

7. **Analysis of Diabetic Foods.** The station has collaborated with the Council on Pharmacy and Chemistry of the American Medical Association on the subject of diabetic and special foods.

8. **Analysis of Check Samples—Cottonseed Meal and Mixed Fertilizers.** The Station has collaborated with the American Oil Chemists Society and the F. S. Royster Guano Co., in the analyses of check cottonseed meal and mixed fertilizers.

Biochemistry.

Dr. T. B. Osborne in charge.

(In collaboration with Dr. L. B. Mendel, Yale University.)

Protein Research and Nutrition Studies.

1. **A Study of the Proteins of Green Plants.** Investigations of the constituents of the alfalfa plant have been continued. New methods of fractionation have been developed and have indicated the presence in alfalfa juice of new substances, including a new base, not yet identified. A protein with no carbohydrate impurity

has been derived from cell cytoplasm of the spinach plant, by a new method of separation. Its isolation in a state of purity will be of importance in the study of the chemistry of the living cell.

2. **The Relation of the Chemical Constitution of the Diet to the Development of Rickets.** (With Dr. Park of the Yale School of Medicine.) Observations are being attempted under conditions of carefully controlled diet. Diets of purified food substances have been formulated which lead to the development of either rachitic or osteoporotic changes in the bones. It is inadvisable as yet to form generalizations from the extensive data collected.

3. **Studies of the Relation of Vitamines to Nutrition.** Experiments show that when smaller doses of protein-free vitamine B concentrate are fed to larger animals a decline in weight ensues; with intermediate doses there may be maintenance at various levels of body weight; with the larger vitamine B intake for the smaller animals growth ensues.

4. **The Part Played by Proteins, Carbohydrates and Fats in Nutrition.** (With cooperation of Drs. Park and Winternitz of the Yale School of Medicine.) The extent to which preformed carbohydrates are essential in metabolism, and the development of hypertrophy of the kidneys in protein-fed rats were further investigated. The success of varied types of experiments on diets extremely unlike those of every day experience seems to indicate that surprisingly large variations in the quantitative make-up of the diet may apparently be tolerated so long as the "law of minimum" is not violated.

5. **The Effect on the Eye of a Deficiency of the Fat Soluble Vitamine.** (With Dr. Judkin of the Yale School of Medicine.) It was found that ophthalmia occurs among rats living on "purified" Vitamine A free diets to a percentage as high as 82.

6. **The Effect of Diet on Fertility.** (With Dr. Mason of the Yale School of Medicine.) On our "standard" casein diet, which has proved adequate for growth but not for reproduction, definite degeneration of the germ cells of the testes of rats, reared from weaning on the casein diet, was recorded. Ordinary mixed diet has not restored sterile rats to a normal condition after periods of 100 days.

7. **The Relation of the Chemical Structure of the Proteins to their Nutritive Value.** Much remains to be learned concerning the part played in nutrition by the various amino-acids which proteins yield on digestion. As a preliminary to further study in this field much time has been devoted to preparing large quantities of pure amino-acids which can be used in feeding experiments.

Botany.

Dr. G. P. Clinton in charge.

1. **The Effect of Fertilizers, Especially Nitrate of Soda, on the Growth, Yield, Longevity and "Yellows" of Peaches.** Since it was started in 1909, records in this experiment have been kept on the health and length of life of each tree, of the growth in diameter of the trunk during the earlier years and of the yield from each during the bearing years. Since 1916 nitrate of soda has been the fertilization used on each of the nine different blocks.

Serious drought in July 1924, and later, a severe hail storm, practically ruined the season's crop. The chief causes of failures and poor crops have been winter and drought injuries, fungi and insects being secondary in importance.

2. **The Nature and Cause of Mosaic Disease of Plants.** The cause of mosaic disease still remains in doubt, altho interesting observations have been made, some of them apparently new. The experiment represents a continuation of work on Calico of Tobacco published several years ago, and is chiefly concerned with that host and the relationship of its mosaic to other hosts. The work of the past two years has been chiefly microscopic and with varied infectional experiments outdoors and in the greenhouse.

3. **The Ustilaginales of North America.** This is a supplement to the work the writer published some years ago. During the winter material was partially assembled but not completed. The work may be finished for publication during the coming year.

4. **The Rusts of Connecticut.** This is a list of the rusts, with their hosts, so far collected in this state. Their distribution is given by towns, together with the dates of collection, collectors, and occasional notes. Every town in the state is represented by one or more collections. Total collections now number more than 2,500, representing nearly 120 species and 20 genera. The manuscript for publication, including keys to the genera and species, has been partially prepared.

5. **Plant Disease Survey of Connecticut.** Altho a dry season was experienced, on the whole rather unfavorable for fungous diseases, the Disease Survey for 1924 includes more than the usual number of notes on distribution, etc. Two or three new bacterial diseases of economic plants were listed for the first time. Preliminary reports to the U. S. Bureau of Plant Industry have been made.

6. **Thielavia Basicola, a Study of the Perfect Stage.** Evidence has accumulated that the conidium-chlamydospore strains and the perithecial strains do not belong to the same fungus, altho the perithecia have been hitherto considered the perfect stage of *Thielavia basicola*. Successful crossings besides those

of *Thielavia basicola* and *Thielaviopsis basicola* have been made of asco strains with a species of *Aspergillus* and *Fusicladium pyrinum* as well as with *Cladosporium fulvum*. Crossings made with *Thielaviopsis paradoxa* failed to produced perithecia. Attempts to determine the parasitism of the asco strains have so far yielded negative results altho perithecia have been found deeply embedded in the roots of tobacco, pea and violet, but in these cases always associated with the conidium-chlamydospore stages.

7. **A Study of Pythiums.** Artificial cultures of various fungi are obtained and kept going on special media in the test tubes. These are then available for special study as desired. Pythium species obtained from about a dozen different hosts, chiefly as dampening-off fungi, are among those now being especially collected.

8. **Comparison of Spraying and Dusting on Apples and Peaches, Especially to Try New Dusts.** (Joint project with Entomological Department.) For fungi, spraying has uniformly given the better control. This year, however, the dust control more nearly approached the spraying because of dry weather which prevented the development of fungi. A test of spray and dust combination did not give marked results but it seems desirable to experiment further with combinations of spray and dust as this seems to be the way that dust may be used in the control of apple troubles.

9. **Control of Celery Blights with Sprays and Dusts.** During the past year tests were made in thirteen fields with eight different growers. Home-made 4-4-50 Bordeaux mixture was compared with Niagara Sulfodust and Niagara D25 Copper Dust, checks being kept in each test. Comparatively little blight injury occurred in the fields so that decisive results were not obtained. On the whole control and yields seem to point to the following order of the plots: (1) Bordeaux Mixture, (2) Copper Dust, (3) Sulphur Dust, (4) Check.

10. **Control of Root Rot and Improvement of Sweet Corn by Seed Selection.** This experiment was started in 1920 to determine if it was possible, by seed selection, to control root and ear rots of sweet corn grown for seed. A composite sample of seed selected from the best lines during the preceding four years was planted in comparison with unselected seed of the same strain and unselected seed of the same variety grown in the same locality from a different seed source. The selected seed gave a better stand and more even growth especially early in the season. The number of diseased ears did not differ greatly in the three plots, but the yields of selected seed were much greater. The selected seed has also shown a steady increase in average per cent of disease-free ears, determined by germination tests.

11. **Comparison of Sprays and Dusts on Potatoes.** (Joint project with Entomology Department.) Copper dust has been

compared with 4-4-50 Bordeaux mixture in this experiment. There has been no blight in three years but each year the sprayed plot has given greater yield than the dusted, and the dusted has been better than the check. The sprayed vines have shown less injury from tipburn and flea beetle injury and have lived longer than those in the dusted and check plots.

12. **Seed Testing.** This is one of the oldest lines of work of the Station and is largely routine in nature. Farmers, and others, wishing to know the germination and purity of seeds purchased, send them in for testing. Particular attention is paid to testing seed-corn for experimental purposes. At times special work is done on certain seeds. For example, grass and forage crop seeds were tested the past year to determine if their standard of purity and germination in this state compared favorably with that in other states, which seems to be the case as shown by the result of the tests.

13. **Peach "Yellows."** Started in connection with fertilizer experiments of peaches in 1908, this study has consisted, in part, of "Yellows" surveys in different orchards over a series of years. Budding and other infection experiments have also been carried on. No results have been published except general notes.

14. **Musk Melons and Blight Resistance.** Some time ago this experiment was carried on over a period of several years. It consisted in growing 100 so-called varieties for three years and in making studies on blight resistance, quality and yield with sprayed and unsprayed vines of a selected variety, Miller's Cream. The results have never been published and no recent work has been done; the fields of commercial growers have been visited from time to time.

15. **Chestnut Blight.** This subject was investigated and the results published some years ago. Renewed interest in the future of the chestnut in this state has induced the Botany and Forestry departments to take up some new phases of the subject in 1924. Surveys were made in several marked localities on the number of dead, diseased and free sprouts, seedlings and trees. Records will be kept and these plots examined again yearly. Seed was obtained and placed outdoors to grow seedlings, in part, for planting eventually under forest conditions, and, in part, for inoculation with old and new cultures of the blight.

16. **White Pine Blister Rust.** Two papers have already been published on this subject. Only a little infection work has been done during the past year. Considerable data has been obtained that has not been published. A final study may be made of assembled data during 1925 and the results published in the next report.

17. **Infection Experiments and Other Studies with Rusts.** Work along infection lines has been carried on in the past. Much of

this has been done with leaves in petri dishes. A bulletin (No. 260) on this work is now in press.

18. **Tobacco Diseases.** All field and observational work on tobacco is included under this general title. Field and greenhouse studies on black and red root rot and general notes on all tobacco troubles, including culture of the fungous ones, are the chief phases of investigation at present.

19. **Onion Diseases.** Work in the past has consisted of general notes on the troubles of this host, seed treatment for smut on infected seed, and spraying experiments against blast of the seed crop.

20. **Tree Diseases.** General forestry and shade tree work is covered in this project. A list by hosts, of all of the fungi that had been collected on either living or dead trees and their products, has been prepared. A general article on Fungous and non-Parasitic Diseases of the Ornamental Trees of Connecticut has also been written.

21. **Bud Inheritance on Yield of Peaches.** It is planned to start a young orchard with scions budded from the most prolific and healthy, as well as from the less prolific and healthy trees, which have been under observation during the past sixteen years at the Barnes Experimental Peach Orchard. This is to determine if bud selected trees from these two sources will continue to show the same differences in yields. This will indicate if it is more advantageous to select buds from high-bearing trees than to practice miscellaneous selection. Seed stock for the budding has already been grown.

22. **Influence of Root Grafts on Scions of Apples.** This is to determine the effect of root on scion (1) on Baldwin with respect to quality of fruit borne (2) on McIntosh to observe the effect of root on color of fruit. Scions will be taken from Baldwin trees that have borne good fruit on their own roots and will be placed on roots from trees that bear poor fruit. This operation will be duplicated with poor-fruited trees. The McIntosh striped and self-colored trees will be grown each on its own roots and on roots of the opposite color.

Entomology.

Dr. W. E. Britton in charge.

1. **The Life History, Habits and Control of the Plum Curculio on Apple.** Several new facts regarding the habits and life history of *Conotrachelus nenuphar Hbst.* have been learned during a study of two seasons in the five year program for the study and control of the plum curculio on apples. No satisfactory control methods have been ascertained, however.

2. **Tests of Paradichlorobenzene to Control the Peach Borer.** (Inactive.)

3. **Comparisons of Spraying and Dusting on Apples and Peaches, Especially to Try New Dusts.** (Joint project with Botany Department.) (See Botany.)

4. **Comparisons of Sprays and Dusts on Potatoes.** (Joint Project with Botany Department.) (See Botany.)

5. **The Life History, Habits and Control of the European Red Mite.** (Inactive.)

6. **Control of Foul Brood of Bees.** Testing denatured alcohols to obtain a satisfactory product for making Hutzelman's alcohol formalin solution, in addition to comb treatment with the commercial preparation for control of American foul brood, comprised the work during 1924.

7. **A Study of the Asiatic Beetle, Anomala orientalis.** A study of this beetle was undertaken following a severe infestation of New Haven lawns. Some progress has been made in life history studies. Calcium cyanide is effective in killing larvae of the beetle but it injures vegetation and is a menace to children and dogs. Carbon disulphide is more satisfactory.

8. **The Life History, Habits and Control of the Raspberry Fruit Worm.** (Completed.)

9. **Insect Survey of Connecticut.** For four years data has been gathered on the prevalence or absence of insect pests and monthly reports have been sent to the Federal Bureau of Entomology for publication in a bulletin covering conditions in the United States.

10. **Inspection of Orchards and Nurseries.** All nurseries (116 in 1924) were inspected for insect pests. The botanist, co-operating with the inspectors, searched for plant diseases. Forty-seven orchards and gardens were inspected on request.

11. **Control of the Gipsy Moth.** State scouts covered 73 towns. Federal scouts 35 towns in 1923-24. All of the 10,007 egg clusters found were creosoted, and 327 infestations were sprayed in May and June, using 8,483 pounds of lead arsenate. Around the infestations, 6,315 larvae were destroyed besides those killed by spraying. State scouts covered 6,975 miles of road.

12. **Elimination of the Mosquito Nuisance in Salt Marshes.** Under State supervision 5,000 acres of salt marsh were patrolled throughout the season and 154,000 lineal feet of ditches recut. Salt marsh areas in Stamford were reditched and new ditching is in progress in Westbrook. Ten new iron culverts and six new iron tide gates were installed. One dike was repaired.

13. **Inspection of Apiaries.** Among 953 apiaries, containing 8,929 colonies of bees, 17 apiaries (47 colonies) were found infested with European foul brood, and 10 apiaries (20 colonies) with American foul Brood. Directions and, in some cases, demonstrations, were given the owners regarding control.

14. **A Study of the Chemical Changes in Standard Spray Mixtures.** (Joint project with Chemical Department.) Tests of the effect which the order of mixing various ingredients has upon color, character of sediment and suitability for spraying of the spray mixture and also analyses of various combinations for water soluble arsenic to determine which combinations are best from a chemical standpoint, have yielded results which must be verified by additional chemical study.

15. **Bionomics of the Birch Leaf Skeletonizer, Bucculatrix canadensisella.** The main points in the life history have been worked out and several parasites uncovered. Work has been started on fungous diseases. Some features of morphology have been established and control measures determined. The distribution of the insect in Connecticut has been partly surveyed.

16. **Experiments with Baits Attractive to the Cabbage Maggot Fly.** The residue left from distilling an alcoholic extract of cabbage was found to be attractive when in suitable medium. This has been compared with other baits and is being developed as an efficient control measure.

17. **Life History and Methods of Controlling the Oriental Peach Moth, Laspeyresia molesta.** Threatening outbreaks late in the season of 1923 led to control studies in which nicotine dusts and sprays were tried with 50% control. A limited number of observations have been made on the life history in Connecticut and a general, observative survey of the State, supplemented with information from questionnaires sent to various growers, has been made.

18. **Life History of Imported Current Worm.** Data has been collected on egg laying habits, number of eggs laid by individuals, period of incubation, etc. Adults appeared two to three weeks late in 1924 and there were apparently only two broods.

19. **Control of the European Corn Borer.** Federal men scouted all towns along the shore, also Orange and Wethersfield and found seven infestations. State scouts covered four towns. All infested fields and some adjoining fields were burned over.

Forestry.

Mr. W. O. Filley in charge.

1. **Experimental Plantations on a Sandy Tract at Rainbow.**

a. Comparison of a wide variety of conifers and hardwoods.

b. Methods of management for those species that have survived.

c. Studies on growth and habits of the several species. These were begun in 1902. In 1924 liberation cuttings and cleanings were completed where needed, fire lines were harrowed and new plantations were started to replace discontinued or unsuccessful experiments. New experiments include under-planting of red oak with red pine; plantations of white spruce and red pine in the open and replanting a burned area with white pine. A report covering the results to date is now in press. (Bul. 262.)

2. **Effect of Thinning in White Pine (At Shaker Station)—Three Grades of Thinning.**

Students from the Yale Forest School made a second thinning in two of the plots in the spring of 1924.

3. **Effect of Thinning in Hardwoods (At Quassipaug Lake).** The plots were visited in connection with other work but no measurements were taken and none are planned until 1927.

4. **Studies on White Pine Needle Blight.** No definite observations were made during the year, the season apparently not being conducive to this trouble.

5. **Distribution of Planting Stock to Small Holders at a Reasonable Price.** The department again assisted land owners in securing forest planting stock. A total of 775,000 trees, mostly two year seedlings, were distributed on 95 orders.

6. **Willow Culture (for Basket and Furniture Manufacture).** One holt was discontinued and the roots pulled up. Preparations were made to distribute a large number of cuttings but only two requests were received and only 1,000 cuttings were sent out for the cost of packing and postage. Distribution will be continued and plantings already made will be visited.

7. **Control of White Pine Blister Rust (a Control Project).** Wild currant and gooseberry bushes were eradicated from 6,000 acres in the towns of Canaan, Cornwall, North Canaan, Litchfield and Salisbury. About 20% of the cost was paid by town appropriations or private subscriptions. Educational work was carried on co-operatively with the Federal Bureau of Plant Industry by two field agents employed throughout the year. New Haven and Fairfield Counties have been covered and scouting in Litchfield County is practically completed. Eradication and educational work will be continued.

8. **Studies of Forest Plantations (Listing All Plantations and Taking Notes on Conditions, Success, Etc.).** Blister rust agents have reported on more than 7,500 acres of plantations in 81 towns, but the studies are not yet completed. During 1925 the reports of plantations will be checked and additional studies made, with the plan of publishing a bulletin on forest planting before the close of the year.

9. **Replacing Chestnut with Conifers in a Farm Woodlot.** Planted evergreens have in most cases made good growth. Another cleaning will be necessary in 1925 and it may be desirable to remove more of the overwood.

10. **Forest Soils Study.** On 116 plots, for which the soil series and type have been determined, the following data has been recorded: (1) Locality, slope, aspect, site, quality, fires, silvicultural

treatment, (2) Forest cover (main stand) tallied on 1/20 acres by species, diameter and crown class, (3) Reproduction tallied on 1/100 acre by species and by height classes, (4) Shrubby undergrowth noted as abundant, medium or scant for the 1/20 acre, (5) Herbaceous growth noted similarly to (4). No definite conclusions have been formulated from the assembled data, and plans for the coming year must await the derived results. More plots will probably be necessary to make proper correlations.

11. **Coniferous Seed Bed Study to Determine:**
    1. The value of fertilizers in seed beds.
    2. The value of different amounts of seed.
    3. The value of dusts and sprays in preventing damping off.

Thirteen seed beds were laid off on the Station grounds and were treated as outlined above. The experiment will be continued and data recorded.

Genetics (Plant Breeding.)

Dr. D. F. Jones in charge.

1. **The Inheritance of Characters in Corn.** The widespread occurrence of lethal factors producing aborted and defective grains in corn has been determined and the effect of these factors upon development is being studied as well as their mode of inheritance. A number of factors influencing the development of the floral organs and affecting the fertility of the corn plant have been located.

2. **The Effect of Inbreeding and Crossing Upon Corn.** Four inbred strains of corn self-fertilized for eight generations were separated into two lines each and continued for eight generations more. Two of these four paired lines were visibly different at the end of this period and all gave significant increases in growth when the paired members were intercrossed.

3. **Methods for the Improvement of Naturally Cross-Fertilized Plants by Selection in Self-Fertilized Lines.** Preliminary crosses were made between the most promising selected lines of Evergreen sweet corn. Crosses between various lines of early maturing dent and flint corn were grown from which a type for grain in Connecticut will be developed. Seventy-five lines of Whipple's Early Yellow Sweet Corn were started for the purpose of producing an early medium-sized yellow sweet corn of good quality for market gardeners.

4. **Methods of Improving the Naturally Self-Pollinated Tobacco Plant.** Forty-two selections from a cross of Cuban and Broadleaf tobacco have been grown. These include lines which have been one, two or three times back-crossed with Cuban. These are being selected as a shade type and being studied to determine to what extent the shade tobacco characteristics can be retained with added improvements from the other type.

Soils.

Mr. M. F. Morgan in charge.

1. **Utilizations and Fertilizer Requirements of Important Soil Types of Connecticut.** Previous intensive studies of soil conditions and land utilization in Lebanon yielded data which was studied in relation to the economic survey conducted by the department of Rural Economics of the Connecticut Agricultural College. It was found that, in the above town, the area in which the Charlton series of soil occurred, was markedly superior as a dairy region to the other portions of the town where Gloucester fine sandy loam, Gloucester stony fine sandy loam and the Merrimac series were the principal soils. Interesting relationships of soils to land cover were also manifested.

These results having shown the necessity for further study in regions where somewhat different soil conditions occurred, the areas of Wilton, Goshen, Middletown, Pomfret, Eastford and Stonington were surveyed during the field season. The use of airplane photographs materially aided the study of land utilization and accurate mapping of soil type areas in the town of Middletown.

A lack of uniformity of soil conditions was found in the areas studied during the 1924 field season but certain soil types were shown to be fairly constant in their characteristics wherever found.

Land utilization studies as tabulated thus far bear out the fact that soils such as the Gloucester stony fine sandy loam, are of value chiefly for forestry and recreational sites, those similar to the Charlton loam are particularly adapted to dairying; while soils like the Merrimac sandy loam are peculiarly adapted to potatoes, intensive trucking and vegetable gardening.

The need for a thorough soil and land utilization survey becomes more and more apparent as the results of the present studies are considered.

Sub Project A—Soil Survey and Land Cover Studies of Selected Areas in Connecticut. This project has taken three phases of development: (1) Completion of maps and data incident to the soil-land cover and economic survey of Lebanon town, (2) Detailed land cover and soil type studies in the towns of Wilton, Goshen, Middletown, Pomfret, Eastford and Stonington, (3) Tabulation of data on these areas to show distribution of cover on the more important soil types.

Sub Project B—Pot Experiments on Effects of Fertilization of Important Soil Types. Pot experiments with 12 soil types of Connecticut, using alfalfa and buckwheat to show the effects of Lime, Nitrogen and Phosphorus, and these plus Potassium, show wide differences in fertility of untreated soils and in relative

responses to treatment. Sixteen samples of soil have been collected for further experiment.

Sub Project C—Soil Reaction Studies. Samples of various horizons of most of the soil types represented in each area studied in sub-project A have been collected for studies in lime requirement, h-ion concentration, and soluble aluminum compounds.

Sub Project D—Mechanical Analyses of Important Soil Types. Similar samples have been collected for this experiment in determination of mechanical analyses by U. S. Bureau of Soils and Harlan Jonson's method, and determination of colloidal material.

Sub Project E—Studies of Forest Adaptations of Important Soil Types. This experiment has two phases: (1) Identification of soil types on plots upon which forestry department made detailed studies of stands and associations, (2) Collections of seven soil types upon which studies are to be made of growth of seedlings of forest species in pot experiments.

Sub Project F—Chemical Analyses and Reaction Studies of Particular Pasture Soils. Soil samples have been collected from 25 pasture demonstration fields located in various parts of the state to determine the total Nitrogen, Phosphorus, Potassium, Calcium and Magnesium and the reaction of all samples.

Tobacco Sub-Station at Windsor.

The sudden resignation of Mr. C. M. Slagg on March 1, made necessary a restriction of the Service work possible during the season of 1924. The experimental program, however, went forward without interruption. A very elaborate new project was launched, having as its object the improvement of the several types of Broadleaf and Havana now recognized among growers. A large number of so-called strains of each type were grown at Windsor and on plots scattered about the various type districts. These will be continued next year. Experiments under way may be listed:

1. Fertilizer Experiments
   a. Sources of Nitrogen.
   b. Ratio of Phosphoric Acid.
   c. Sources of Potash.
   d. Fractional Applications.
   e. Manure (New York and cow (steer) compared with none).
   f. Magnesium, Chlorine and Sulfur. (U. S. D. A.).
2. Varietal Improvement
   a. Strain trials of Broadleaf, Havana and Cuban as a basis for future improvement.
   b. Tests of crosses made by Dr. Jones.
   c. Round tip cultural experiments to improve quality.
   d. Trials for "foreign" or new types.
   e. N. rustica as a source of nicotine.
3. Curing Experiments.
   Lack of land for growing material prevented the carrying out of these as planned.
4. Diseases.
   a. Tests of Control Measures for Wildfire.
   b. Brown Root Rot (U. S. D. A.).
   c. Black Root Rot, the effect of soil treatments.

Except as noted, the above program was carried out in spite of the fact that the position of superintendent was not filled. The weather was extremely dry and a partial crop failure resulted. At this time it is too early to estimate the results, the crop not being sorted.

A Field Day was held at the farm on August 5, about 400 persons attending. An excellent lunch was served by the ladies of a local church. A program for the day, held in the new shed, was a unique feature.

List of Publications Available for Distribution.

CROPS

150. Clover Seed in the Connecticut Market
180. Studies on the Tobacco Crop of Connecticut
191. Tests of Soy Beans, 1915
192. Observations on Alfalfa
193. Tests of Soy Beans, 1916
228. Connecticut Round-Tip Tobacco
259. Corn in Connecticut

FEEDING STUFFS

138. Commercial Feeding Stuffs in the Connecticut Market
141. Commercial Feeding Stuffs in the Connecticut Market
206. Report on Commercial Feeding Stuffs, for 1917
212. Report on Commercial Feeding Stuffs, for 1918
221. Report on Commercial Feeding Stuffs, for 1919
229. Report on Commercial Feeding Stuffs, for 1920
238. Report on Commercial Feeding Stuffs, for 1921
249. Report on Commercial Feeding Stuffs, for 1922
257. Report on Commercial Feeding Stuffs, for 1923

FERTILIZERS

156. Cotton Seed Meal As a Fertilizer
170. The Trade in Cotton Seed Meal
194. Manure from the Sea
198. Domestic Supplies of Potash
204. Report on Commercial Fertilizers, for 1917
209. Report on Commercial Fertilizers, for 1918
217. Report on Commercial Fertilizers, for 1919
223. Report on Commercial Fertilizers, for 1920
233. Report on Commercial Fertilizers, for 1921
241. Report on Commercial Fertilizers, for 1922
250. Report on Commercial Fertilizers, for 1923

FOOD AND DRUG PRODUCTS

200. Report on Food and Drug Products, for 1917
210. Report on Food and Drug Products, for 1918
219. Report on Food and Drug Products, for 1919
227. Report on Food and Drug Products, for 1920
236. Report on Food and Drug Products, for 1921
248. Report on Food and Drug Products, for 1922
255. Report on Food Products and Drugs, for 1923

FOODS

201. Food Fats and Oils
213. Condensed Milk, Malted Milk, Milk Powder
215. The Food Value of Milk
220. Report on Diabetic Foods
240. Commercial Vitamine Preparations

FORESTRY

231. Report of the Tree Protection Examining Board
253. Better Forests for Connecticut

INSECTS

155. The Elm Leaf Beetle
169. The Leopard Moth
177. The Apple Tree Tent Caterpillar
182. The Brown-Tail Moth
186. The Gypsy Moth
195. Insects Injuring Stored Food Products in Connecticut
203. Report of the Entomologist, for 1917
211. Report of the Entomologist, for 1918
218. Report of the Entomologist, for 1919
225. A Study of the Bulb Mite.
226. Report of the Entomologist, for 1920
230. The Grass-Feeding Frog-Hopper or Spittle-Bug
231. Report of the Tree Protection Examining Board
242. Report on Commercial Insecticides and Fungicides, 1922
245. Results of Dusting vs. Spraying in Connecticut Apple and Peach Orchards in 1922
246. The Apple and Thorn Skeletonizer
247. Report of the Entomologist, for 1922
251. The Raspberry Fruit Worm
252. The European Red Mite
256. Twenty-third Report of the State Entomologist (1923)
258. Report on Insecticides and Fungicides (1923)

PLANT DISEASES

214. Report of Botanist, for 1917 and 1918
222. New or Unusual Plant Injuries and Diseases Found in Connecticut 1916-1919
231. Report of the Tree Protection Examining Board
237. Control of the White Pine Blister Rust in Connecticut
239. Wildfire of Tobacco in Connecticut
242. Report on Commercial Insecticides and Fungicides, 1922
245. Results of Dusting vs. Spraying in Connecticut Apple and Peach Orchards in 1922
258. Report on Insecticides and Fungicides (1923)

POULTRY

202. An Experience in Keeping Poultry in the City

REPORTS OF DIRECTOR

232. Report of the Director for the Year Ending October 31, 1921
243. Report of the Director for the Year Ending October 31, 1922
254. Report of the Director for the Year Ending October 31, 1923
264. Report of the Director for the Year Ending October 31, 1924

REPORTS

Beginning with the year 1877 and ending with 1916 the Station issued Annual Reports. Of these the following are out of print: 1877-1880 inclusive, 1882, 1883, 1885, 1886, 1887, 1889-1892 inclusive, 1895-1906* inclusive.

Commencing with the year 1917, the annual reports include all regular bulletins; they are issued in parts and each part bears a bulletin number.

*Of some other reports the Station has but a limited number, which are reserved to complete library sets.

Connecticut Agricultural Experiment Station
New Haven, Connecticut

TWENTY-FOURTH REPORT

OF THE

STATE ENTOMOLOGIST

OF

CONNECTICUT

1924

W. E. BRITTON, Ph.D.
State Entomologist

CONNECTICUT AGRICULTURAL EXPERIMENT STATION

OFFICERS AND STAFF

March, 1925.

BOARD OF CONTROL.

His Excellency, John H. Trumbull, *ex-officio, President.*

Charles R. Treat, *Vice President*.....Orange
George A. Hopson, *Secretary*.....Mount Carmel
Wm. L. Slate, Jr., *Director and Treasurer*.....New Haven
Joseph W. Alsop.....Avon
Elijah Rogers.....Southington
Edward C. Schneider.....Middletown
Francis F. Lincoln.....Cheshire

STAFF.

E. H. Jenkins, Ph.D., *Director Emeritus.*

Administration.
Wm. L. Slate, Jr., B.Sc., *Director and Treasurer.*
Miss L. M. Brautlecht, *Bookkeeper and Librarian.*
Miss J. V. Berger, *Stenographer and Bookkeeper.*
Miss Mary Bradley, *Secretary.*
William Veitch, *In Charge of Buildings and Grounds.*

Chemistry: Analytical Laboratory.
E. M. Bailey, Ph.D., *Chemist in Charge.*
R. E. Andrew, M.A., C. E. Shepard, Owen L. Nolan, Harry J. Fisher, A.B. — *Assistant Chemists.*
Frank C. Sheldon, *Laboratory Assistant.*
V. L. Churchill, *Sampling Agent.*
Miss Mabel Bacon, *Stenographer.*

Biochemical Laboratory.
T. B. Osborne, Ph.D., Sc.D., *Chemist in Charge.*

Botany.
G. P. Clinton, Sc.D., *Botanist in Charge.*
E. M. Stoddard, B.S., *Pomologist.*
Miss Florence A. McCormick, Ph.D., *Pathologist.*
Willis R. Hunt, M.S., *Graduate Assistant.*
G. E. Graham, *General Assistant.*
Mrs. W. W. Kelsey, *Secretary.*

Entomology.
W. E. Britton, Ph.D., *Entomologist in Charge; State Entomologist.*
B. H. Walden, B.Agr., M. P. Zappe, B.S., Philip Garman, Ph.D. — *Assistant Entomologists.*
Roger B. Friend, B.Sc., *Graduate Assistant.*
John T. Ashworth, *Deputy in Charge of Gipsy Moth Work.*
R. C. Botsford, *Deputy in Charge of Mosquito Elimination.*
Miss Gladys M. Finley, *Stenographer.*

Forestry.
Walter O. Filley, *Forester in Charge.*
A. E. Moss, M.F., *Assistant Forester.*
H. W. Hicock, M.F., *Assistant Forester.*
Miss Pauline A. Merchant, *Stenographer.*

Plant Breeding.
Donald F. Jones, S.D., *Geneticist in Charge.*
P. C. Mangelsdorf, M.S., *Graduate Assistant.*

Soil Research.
M. F. Morgan, M.S., *Investigator.*
George C. Scarceth, B.S., *Graduate Assistant.*

***Tobacco Sub-station at Windsor.**
———————, *In Charge.*
N. T. Nelson, Ph.D., *Plant Physiologist.*

The Wilson H. Lee Co.

CONTENTS.

Authorship.

For bibliographical purposes, all matter in this Report (Bulletin 265) should be credited to W. E. Britton, except where otherwise indicated.

Illustrations.

The illustrations in this Bulletin are from the following sources: text figures are from drawings as follows: Fig. 7, map drawn by Alex. Cahn and shaded by Stoddard; Figs. 8-15, drawn by B. H. Walden. Plates are from photographs: Plate XXXVI, b, by R. B. Friend; XXX, b, by Dr. Philip Garman; XXXIII, b and c, by Nicholas Matiuck; XXIV, b, and XXV, a, by J. L. Rogers; XXXIII, a, and XXXIV, by R. C. Botsford; XVII, XVIII, b, XIX, XX, XXI, a, XXV, b, and XXIX, c, by W. E. Britton; XVIII, a, XXI, b, XXII, XXIII, XXIV, a, XXVI, XXVII, XXVIII, XXIX, a and b, XXX, a, b, c, d and e, XXXI, XXXII, XXXV, and XXXVI, a, by B. H. Walden.

BULLETIN 265

TWENTY-FOURTH REPORT

OF THE

State Entomologist of Connecticut

To the Director and Board of Control of the Connecticut Agricultural Experiment Station.

I have the honor to transmit, herewith, my twenty-fourth annual report as State Entomologist of Connecticut. As in preceding years, the report covers the activities of the Department of Entomology, as regards both the control and inspection work provided for by Statute, and the various lines of research which after all more properly represent the type of effort for which Agricultural Experiment Stations were established.

Respectfully submitted,

W. E. Britton,

State and Station Entomologist.

INSECT PEST ACCOUNT.

Report of Receipts and Expenditures of the State Entomologist

From July 1, 1923 to June 30, 1924.

Receipts.

From W. L. Slate, Jr., Treasurer		$15,000.00	
Added to appropriation from miscellaneous receipts by State Board of Control		759.18	
Miscellaneous receipts during year	$82.55		
	117.79		
	400.30		
	30.92	631.56	
			$16,390.74
Less miscellaneous receipts deposited with State Treasurer during the year		600.64	
			$15,790.10

Expenditures.

For Salaries and Wages	$11,022.34
Printing and Illustrations	79.23
Postage	22.29
Stationery	36.63
Furniture and Fixtures	316.43
Books and Periodicals (new)	61.61
Books and Periodicals (binding)	128.25
Laboratory Supplies	186.26
Spraying Supplies	116.44
Express, Freight and Cartage	20.67

Automobiles: Insurance	$ 86.39	
Supplies and Equipment	97.95	
Repairs	173.36	
Gasoline	206.99	
Oil	10.55	
Traveling Expenses	482.03	
Miscellaneous	2.40	
Telephone and Telegraph	2.34	
Rental and Storage	2.50	
		$13,054.66
Balance on hand June 30, 1924	$2,704.52	
Miscellaneous receipts	30.92	2,735.44
		$15,790.10

Memorandum.—This account has been audited by the State Auditors of Public Accounts and the balance returned to the State Treasurer.

SUMMARY OF INSPECTION AND OFFICE WORK.

337 samples of insects received for identification.
122 nurseries inspected.
118 regular certificates granted.
5 special raspberry certificates granted.
116 duplicate certificates furnished to be filed in other states.
109 parcels of nursery stock inspected and certified.
953 bales of mountain laurel and willow (21 trips) inspected and certified for shipment into New York.
49 orchards and gardens examined.
33 shipments, containing 313 cases, 3,489,170 plants, imported nursery stock inspected.
17 shipments, or 51 per cent. found infested with insects or fungi.
953 apiaries, containing 8,929 colonies inspected.
17 apiaries and 47 colonies found infested with European foul brood.
10 apiaries and 20 colonies found infested with American foul brood.
2,265 letters written on official work.
456 circular letters.
591 post cards.
46 reports to Federal Horticultural Board.
2,303 bulletins, etc., mailed on request or to answer inquiries.
70 packages sent by mail or express.
38 lectures and addresses at institutes, granges and other meetings.

PUBLICATIONS OF THE ENTOMOLOGICAL DEPARTMENT, 1924.

By W. E. Britton:
Twenty-third Report of the State Entomologist of Connecticut (Bulletin 256), 96 pages, 8 figures, 16 plates; 10,500 copies distributed in July.
Inspection of Nurseries in 1923, 8 pages, reprinted from the Report.
The Apple and Thorn Skeletonizer, Bulletin of Immediate Information 39, May 17.
Spraying Shade Trees, Bulletin of Immediate Information 40, May 20.
The Apple Maggot or Railroad Worm, Bulletin of Immediate Information 43, June 16.
The Gipsy Moth Quarantine, Bulletin of Immediate Information 44, 4 pages, July 15.
Report of Committee on Injurious Insects, Proceedings 33rd Annual Meeting Connecticut Pomological Society, page 41, 1924.

Some Insects to be Combatted Next Season, Proceedings 33rd Annual Meeting, Connecticut Pomological Society, page 72, 1924.
Insects Attacking Vegetable Crops in Connecticut in 1923, Report Connecticut Vegetable Growers' Association, page 43, April 1924.
An Asiatic Beetle (*Anomala orientalis*) in Connecticut, Journal of Economic Entomology, Vol. 17, page 309, April, 1924.
The Gipsy Moth and Our Forests, New England Farms, June 21, 1924.
Connecticut Tree Workers' Institute, Florists' Exchange, Vol. LVII, page 890, March 22, 1924.
Proceedings Shade Tree Conference, Florists' Exchange, Vol. LVIII, page 703, September 6, 1924 (also a four-page reprint).
Some Insect Information from a Connecticut Conference, Florists' Exchange, Vol. LVIII, Supplement Page A, November 29, 1924.
Meeting of Connecticut Entomologists, Journal of Economic Entomology, Vol. 17, page 669, December, 1924.

By W. E. Britton, Philip Garman, G. P. Clinton and E. M. Stoddard:
Information about Insecticides and Fungicides, Bulletin of Immediate Information 30, March 26.
Why and How to Spray, Bulletin of Immediate Information 31, March 28.

By W. E. Britton and Philip Garman:
Dormant Sprays for Orchard Pests, Bulletin of Immediate Information 29, March 22.

By W. E. Britton, G. P. Clinton and W. O. Filley:
Tree Workers Holding Connecticut Certificates, Bulletin of Immediate Information 35, 4 pages, April 25.

By W. E. Britton and R. C. Botsford:
Mosquitoes and Human Welfare by W. E. Britton, and Mosquito Control Work, Season of 1923 by R. C. Botsford, 16 pages, 2 plates (1,000 copies reprinted from Report), June 24.

By Philip Garman:
The European Red Mite, Bulletin 252, 25 pages, 2 figures, 2 charts, 4 plates; 10,600 copies, February 1924.
Control of European Red Mite in Connecticut, Proceedings, 33rd Annual Meeting, Connecticut Pomological Society, page 44, 1924.
The Oriental Peach Moth, Bulletin of Immediate Information 41, May 20.
Factors Influencing the Effectiveness of Arsenate of Lead, Florists' Exchange, Vol. LVIII, page 685, September 6.

By B. H. Walden:
The Raspberry Fruit Worm, Bulletin 251, 11 pages, 1 figure, 4 plates; 10,600 copies, February 1924.
The Raspberry Fruit Worm, Proceedings, 33rd Annual Meeting, Connecticut Pomological Society, page 124, 1924.
Spray for the Imported Currant Worm, Bulletin of Inmediate Information 34, April 21.

By M. P. Zappe and E. M. Stoddard:
Results of Dusting *versus* Spraying in Connecticut Apple and Peach Orchards in 1922, Crop Protection Digest, Bulletin Series No. 4, page 2, June 1924.
The Calyx and Later Summer Sprays, Bulletin of Immediate Information 36, May 1.
Peach Spraying, Bulletin of Immediate Information 37, May 3.
Progress of Spraying and Dusting Experiments, Proceedings 33rd Annual Meeting Connecticut Pomological Society, page 52, 1924.

By M. P. Zappe and G. P. Clinton:
The Prepink and Pink Sprays for Apples, Bulletin of Immediate Information 33, April 15.

By R. C. Botsford:
Accomplishments in the Past Year in Anti-Mosquito Work in Connecticut, Proceedings 11th Annual Meeting of the New Jersey Mosquito Extermination Association, page 80, 1924.

DEPARTMENT STAFF AND WORK.

W. E. Britton, Ph.D., *State and Station Entomologist.*
B. H. Walden, B.Agr., *Photographic and General Work.*
M. P. Zappe, B.S., *Inspection and General Work.*
Philip Garman, Ph.D., *Research Work.*
} *Assistant Entomologists.*
Roger B. Friend, B. Sc., *Graduate Research Assistant.*
John T. Ashworth, *Deputy in Charge of Gipsy Moth Work.*
James A. McEvoy, *Assistant in Gipsy Moth Work.*
Robert C. Botsford, *Deputy in Charge of Mosquito Work.*
Miss Gladys M. Finley, *Clerk and Stenographer.*

H. W. Coley, Westport,
A. W. Yates, Hartford,
} *Apiary Inspectors.*

The only change in the staff during the year was the appointment of Mr. Roger B. Friend, who began his duties January 1, 1924, as part time assistant. Mr. Friend graduated from the Massachusetts Agricultural College in 1923, and was employed for the remainder of that year by the Conservation Commission of New York State, on gipsy moth work. Mr. Friend is studying at Yale University for his doctorate, and is employed at the Station during the time when not busy with his studies. He is investigating the bionomics of the birch leaf skeletonizer and has also given considerable attention to control methods of certain insects attacking vegetable crops. Articles occur elsewhere in this Report giving the results of Mr. Friend's work on Substances Attractive to the Cabbage Maggot Fly, and Experiences in Dusting to Kill the Pea Aphid, Cabbage Aphid and Onion Thrips.

Mr. J. Leslie Rogers was employed as assistant from February 25 until the end of the year. He was engaged until the nurseries had been inspected, then was continued to help in scouting for the European corn borer. Mr. T. F. Cronin was also employed to assist in inspecting nurseries, working from June 23 until September 15, when he returned to his studies at the Connecticut Agricultural College at Storrs. Mr. W. R. Hunt, graduate assistant in the Botanical Department of this Station, was placed on the pay roll of this Department for the three months from July 1 until October 1, and assisted in the inspection of nurseries, paying particular attention to plant diseases.

Mr. Walden has done most of the photographic work of the Department, has had charge of the office in the absence of the Entomologist, and has assisted in scoring apples in the dusting and spraying experiments. He has also conducted some research work on the imported currant worm, *Pteronidea ribesi* Scop.

Mr. Zappe has been in charge of the inspection of nursery stock, and of scouting and clean-up work on account of the European corn borer in co-operation with the Federal Bureau of Entomology. He and Dr. Garman have investigated the life history and control of the Asiatic beetle, and the plum curculio as a pest of apple orchards. In co-operation with Mr. Stoddard of the Botanical Department, he has made further tests of various dusts in comparison with sprays for the control of various insect and fungous pests of apple orchards.

Dr. Garman has conducted investigations regarding methods of control for the Oriental peach moth, the American foul brood disease of bees, has continued his studies on life histories and habits of spittle insects, the European red mite, and, as noted above, jointly with Mr. Zappe, has investigated the plum curculio, and the Asiatic beetle. Dr. Garman has also constantly revised his manuscript on the Odonata or dragon flies of Connecticut, which is now ready and will sometime be published as a bulletin of the State Geological and Natural History Survey.

Mr. Botsford has continued to serve as Deputy to Director W. L. Slate in charge of mosquito elimination work, and Miss Finley has done the necessary clerical and stenographic work of the Department.

The gipsy moth control work has been prosecuted vigorously as in past years, the field work being entirely in charge of Deputy John T. Ashworth, assisted by James A. McEvoy. This work is carried on in co-operation with the Federal Bureau of Entomology and is fully described in this Report.

The apiaries have been inspected as in past years by Messrs. H. W. Coley and A. W. Yates, on a *per diem* basis.

The Entomologist, besides directing the work of the Department and attending to the correspondence of the office, has continued to serve as Associate Editor of the Journal of Economic Entomology, as Chairman of the Tree Protection Examining Board, and as Insect Pest Reporter for the Insect Pest Survey of the Federal Bureau of Entomology. He has in preparation a list of additions and corrections to the Check List of the Insects of Connecticut, which it is hoped can be published at an early date by the State Geological and Natural History Survey.

Messrs. Britton and Walden are collaborators of the Federal Horticultural Board, and Zappe, Garman, Friend and Ashworth are collaborators of the Bureau of Entomology.

In July, a new Chevrolet touring car was purchased and was used nearly all of the time for transporting the men while engaged in the work of inspecting nurseries.

The more important activities of the Department are described in the various papers in the following pages of this Report.

ENTOMOLOGICAL FEATURES OF 1924.

The season of 1924, like that of 1923, was abnormal and began with cool moist weather followed by a drought. Very little rain fell between July 1 and October 1, and the drought of 1924 was even more severe than that of 1923.

Some of the outstanding features of the season were the disappearance in injurious numbers of the apple and thorn skeletonizer, which was so abundant in 1923, the greater increase in the Oriental peach moth, and further infestations of the European corn borer in six towns along the coast.

There has been no serious spread of the gipsy moth, though a few additional towns were found infested by the Federal scouts. Because it was not possible for the Federal men to scout the entire southern portions of New Haven and Middlesex Counties and it was not known whether or not they were infested, some 23 additional towns were included in the quarantined area.

Though a watch has been kept, not a single nest of the brown-tail moth has been seen in Connecticut since 1919.

Fruit Insects.

The tent caterpillar, *Malacosoma americana* Fabr., continued to be abundant throughout the State, though particularly so in the western portion. Every 10 or 12 years this insect reaches its period of greatest abundance, being comparatively scarce half way between these high periods, probably checked by natural enemies.

The fall canker worm, *Alsophila pometaria* Harris, which is present locally somewhere in the State nearly every year was very abundant in Greenwich and Stamford in early summer and stripped many kinds of deciduous trees, apple, elm, hickory and oak being particularly injured. A few caterpillars were found feeding on maple, but the trees were not stripped. Around New Haven, this insect was present in destructive numbers, but no injury was observed or reports of injury received from outside of New Haven and Fairfield Counties. See Plate XXXII.

The apple and thorn skeletonizer, *Hemerophila pariana* Clerck, which was so prominent and was responsible for so many brown apple trees in 1923, was conspicuous by its absence in 1924. Evidences of its presence could be found in nearly every orchard by the slight skeletonization on terminal leaves, but its work had been arrested, the caterpillars were not there and no particular damage had been done. Apparently natural enemies have been unusually prompt in subduing this insect.

On the other hand, the Oriental peach moth, *Laspeyresia molesta* Busck, was much more in evidence than in 1923, and wormy peaches were rather common in Fairfield and New Haven Counties, late in the season. If this pest continues to spread, its control will become one of our most important problems. Further details will be found elsewhere in this Report.

The European red mite, *Paratetranychus pilosus* Can. and Fanz., was less abundant in 1924 than in 1923, and no serious injury from its attacks was brought to my attention. Eggs were present in winter in many orchards, especially in the northern portion of the State, but spraying the dormant trees with miscible oils was generally practiced with satisfactory results. Probably the wet spring may have reduced the numbers of this pest, for it was not evident later in the season in most orchards, and I have yet to learn of a single case where it was considered necessary to give a summer spray in 1924 for its control.

The sinuate pear borer, *Agrilus sinuatus* Oliv., continues to spread eastward and it causes some injury at first. This European insect first appeared in the United States in New Jersey some 20 years ago, caused serious injury there for a few years, but is now not regarded as a serious pest. It was first recognized in Connecticut in 1917 at Norwalk, and the writer observed its destructive work in a pear orchard in Stamford in 1920. In May 1924, after the receipt of specimens, Mr. Zappe visited the premises of Mr. W. T. Camp, Shelton, where several old trees had been nearly killed by this insect, and had been removed. Other pear trees in the vicinity had been more or less injured. Probably the best treatment consists in removing and burning the seriously injured trees and branches; then cut out the borers from the remaining portion and coat the bark with a wash of lime-sulphur and lead arsenate to repel the beetles and possibly kill the larvae when they enter the bark. The foliage should also be kept covered with lead arsenate during May and June to kill the adult beetles which feed there before laying eggs. If the trees are kept well fertilized and cultivated, they will be more apt to outgrow injury caused by this insect.

Males of the lime tree winter moth, *Erannis tiliaria* Harris, were fairly abundant flying about lights in the fall, and the greenish-yellow black-spotted females were found on tree trunks. The caterpillars feed upon apple trees and on elm, linden and other trees in the woodlands. The caterpillars feed at about the same time as canker worms, but are larger and there is danger that they will cause some damage the coming season. Spraying with lead arsenate is the remedy. Further information will be found on page 311 of this Report.

The light or false apple red bug, *Lygidea mendax* Reut., was rather less abundant than usual, though it caused some injury locally here and there. Fruit injured by it in Wallingford and Danbury was brought to our attention.

The rosy apple aphis, *Anuraphis roseus* Baker, was rather scarce in most orchards early in the season, though egg-infested twigs were received in March from Middlebury, Middlefield, Milford,

Cannondale and South Glastonbury. On June 9 it was observed in Stamford and Wallingford. By June 24, it was present in moderate numbers in nearly every orchard and injury was caused by it in some cases.

The green apple aphid, *Aphis pomi* DeGeer, hatched in April, and on the 25th at Milford there was an average of about one aphid per bud, but on May 22, practically all aphids had disappeared in the orchards under observation in Milford, New Haven, Hamden and Cheshire.

The woolly apple aphid, *Eriosoma lanigerum* Hausm., seems to be present in nearly every orchard though it is uncertain just how much injury is caused by it. Further information regarding this insect may be found on page 308 of this Report.

The pear psylla, *Psylla pyricola* Foerster, was abundant on pear trees in Wallingford, Southington, Hebron and other places, though in one garden it was less common then for several years. It can be controlled by dormant sprays of nicotine solution and soap, of lime-sulphur and of miscible oils. Sometimes it may be necessary to give a summer treatment either as a spray or dust to prevent blackening of the fruit by later broods.

Leafhoppers were abundant on apple foliage, May 22, in Milford, Hamden and Cheshire.

The plum curculio, *Conotrachelus nenuphar* Herbst, yet remains one of the important pests of the apple orchard and series of experiments have given results which though somewhat contradictory, seem to indicate that thorough applications of lead arsenate at the pink, calyx and two weeks spray, will give fair control. Scarcely any additional benefit could be seen from the seven day treatment. Dr. Garman and Mr. Zappe have already worked two seasons on the five-year program for the study and control of this insect in apple orchards.

The currant aphid, *Myzus ribis* Linn., was present as usual on currant bushes, and specimens were received from Hebron on May 9, and from Colchester on May 16.

A particularly striking case of injured currant twigs attacked by the currant stem girdler, *Janus integer* Nort., was brought to the Station from Woodbridge in April.

Vegetable Insects.

Most of the common insect pests of the vegetable garden were present in 1924, but on account of the backwardness of the season, appeared two or three weeks later than usual. The absence of rain during July, August and September was favorable to some kinds of insect life and unfavorable to plant growth.

The usual amount of injury was caused by cutworms. During June, reports were received of injury to nearly all kinds of vegetable plants in New Haven County, but probably such injuries were not confined to one county but occurred all over the State. A more

general use of poisoned bran mash would certainly reduce the losses occasioned annually by cutworms.

The stalk borer, *Papaipema nitela* Guen., as a pest is fairly constant each year, and tunnels in nearly all kinds of herbaceous stems, even in weeds. It attacks plants here and there, but never are all stems attacked. Growers pay little attention to it, until the stems have been injured. Control measures other than destroying the infested stalks are not successful. Probably on account of the wide distribution of this insect and the character of the injury which it causes, few reports come to this office. However, specimens were received in potato from Terryville, August 7, and in rhubarb from Wethersfield, August 12.

The cucumber or potato flea beetle, *Epitrix cucumeris* Harris, is usually a garden pest each year, and in 1924, was abundant in many fields attacking potato, tomato, egg-plant, cucumber and squash. Reports were received of the abundance of this insect at Woodstock, Brooklyn, Killingly, Cheshire, North Haven, Southington, Plainville and Stratford in June. In the potato field at the Station Farm, Mount Carmel, the beetles were very abundant on the untreated rows, moderately abundant on the rows treated with Niagara potato dust, and much less so on the rows heavily sprayed with Bordeaux mixture and lead arsenate. About 300 gallons per acre was applied on August 2.

On July 18, specimens were received from Shelton of the silver-striped webworm, *Crambus praefectellus* Zinck., which eats into the side of the corn plant near the surface of the ground. Occasionally this insect is the cause of considerable injury, and in 1919, an acre field of corn in New Haven was destroyed by it.

Only limited numbers of the corn ear worm, *Chloridea obsoleta* Fabr., were present on the ears of late maturing corn. Specimens were received on October 17, from Milford, where in one field about five per cent. of the ears were injured. On the whole, this insect did little damage.

The western corn root worm, *Diabrotica longicornis* Say, is present in Connecticut, where it was found in Granby feeding on the petals of flowers. More information regarding this insect may be found under Notes on Miscellaneous Insects in this Report.

One of the tortoise beetles, *Deloyala clavata* Fabr., feeding on potato, was received from Norwalk, July 25. Only rarely are these beetles sufficiently abundant to cause injury, and lead arsenate is an effective remedy, as it is also on foliage for the blister beetles, of which there are several species.

The spinach leaf-miner, *Pegomyia hyoscyami* Panzer, was present around New Haven, Stratford and Westport, in moderate numbers, but Mr. Friend failed to find a badly infested field suitable for a line of experiments which had been planned.

The cabbage maggot, *Hylemyia brassicae* Bouche, was scarce in Litchfield County, but was reported as causing much injury in New

Haven, Hamden, Vernon, Hebron and Ellington late in June. By June 26, it had attacked cabbage and cauliflower in Ridgefield, Bethel and Danbury. Common control measures are tarred paper disks, and the corrosive sublimate treatment, but Mr. Friend obtained good control by trapping the adult flies. His experiments are given in detail on page 314 of this Report.

The green cabbage worm, *Pontia rapae* Linn., though fairly abundant at the Station Farm, Mount Carmel, was generally scarce and caused little damage. In most cases no poison was applied. The cabbage looper, *Autographa brassicae* Riley, was more prevalent than the green cabbage worm, and injured the leaves and heads by riddling them with holes.

Another pest, the parsnip leaf-miner, *Acidia fratria* Loew, was discovered in Wethersfield, July 12. The infestation was slight though the mines were rather extensive in the leaves. The species has before been taken in Connecticut, but we have never observed its injury until 1924. The life history and control measures have not been worked out, and therefore we cannot recommend any treatment.

The onion thrips, *Thrips tabaci* Linde., was found injuring a field of onion sets at Wethersfield. The plants had not been wilted, and on July 16 and 21, nicotine was applied as described on another page of this Report.

Asparagus beetles, *Crioceris asparagi* Linn., and *C. 12-punctata* Linn., were reported as being troublesome at Suffield, June 9; Black Hall, June 18; Riverton, June 24, and Danbury and Norwalk, June 26. As a rule, spraying with lead arsenate after the cutting season is over, and on young beds will control these beetles. Some growers report success with applications of nicotine sulphate.

Aphids of certain kinds were present in usual numbers and caused the usual amount of damage. On August 6, the turnip aphid, *Aphis pseudobrassicae* Davis, was brought to the Station from East Haven, where it had killed and seriously injured turnip plants in a small field. The pea aphid, *Illinoia pisi* Kalt., was not generally troublesome, though it did injure certain fields, and made its appearance very late in the season. It was reported from Thomaston and Danbury on June 24, and a heavy infestation at Ridgefield on June 26. A small field in New Haven was found infested on June 19, and a few days later a small portion of it was dusted with nicotine by Messrs. Friend and Walden. The results are given on page 319 of this Report. The potato aphid, *Macrosiphum solanifolii* Ashm., was rather scarce and only one thoroughly infested field in Branford, was observed on July 1, but the aphids were heavily parasitized. Slight infestations were observed in Westville and Highwood on June 30, but there was no infestation of the potato fields at the Station Farm at Mount Carmel. The cabbage aphid, *Brevicoryne brassicae* Linn., was common throughout the State, but repeated applications of nicotine dust gave satisfactory control.

A detailed account of the European corn borer infestations and the Asiatic beetle which is still injuring lawns in New Haven will be found on pages 277 and 294 of this Report.

Shade Tree and Forest Insects.

The great abundance of the tent caterpillar, *Malacosoma americana* Fabr., and of the fall canker worm, *Alsophila pometaria* Harris, in southwestern Connecticut, as well as the lime tree winter moth, have already been mentioned under Fruit Insects. They are also pests of shade and woodland trees, and might be included here with equal appropriateness. The gipsy moth also is a pest of both fruit and shade trees, but is discussed separately on page 254 of this Report.

The fall webworm, *Hyphantria cunea* Dru., was less abundant than in 1923, except in New London County, where it was about as abundant.

The elm leaf beetle, *Galerucella xanthomelaena* Schrank (*luteola* Mull.) was a contributing cause to many brown and leafless elm trees in certain localities in central and southwestern Connecticut in August. Even some trees which had been sprayed with lead arsenate presented a pitiable condition. Of course the extreme drought aggravated this condition and new growth did not follow quickly as is the case in a moist season. All choice trees should be sprayed very carefully the coming season to prevent defoliation, as three successive and complete defoliations will usually kill a tree.

The oak leaf-roller, *Tortrix quercifoliana* Fitch, was particularly conspicuous around Stamford, where certain pin oaks were nearly defoliated, as is described on page 336.

Woolly aphids on conifers were particularly abundant in 1924, perhaps the most noticeable being the larch leaf aphid, *Chermes strobilobius* Kalt., and the one attacking Douglas fir, which is probably *Chermes cooleyi* var. *coweni* Gill. The latter was unusually common, was sent to the Station several times, and the members of the staff observed it widely. Spraying with nicotine solution and soap is a remedy.

The arbor vitae leaf-miner, *Argyresthia thuiella* Pack., was not particularly injurious in 1924, yet some of its work could be seen here and there about the State. Twigs received from Pomfret, July 5, had the leaves partially mined by this insect.

The larch leaf-miner or case bearer, *Coleophora laricella* Hubn., was somewhat in evidence, though not so destructive as in 1923.

The leopard moth, *Zeuzera pyrina* Linn., though not so destructive to trees along the coast as a few years ago, has spread inland and is the cause of considerable injury. The writer saw in Hartford during the winter many branches which had broken

from the trees on account of having been weakened by the large burrows of the larvae of this insect. Material has also been received from New Haven and Highwood during the season.

Sawfly larvae were rather more abundant than usual on pines, causing some defoliation.

The birch leaf skeletonizer, *Bucculatrix canadensisella* Chambers, was generally less abundant than in 1923, but there were portions of the State where locally the gray birches were brown in September.

One event of the season was the recognition of a European sawfly, *Fenusa pumila* Klug., which has apparently become established in this country and which is a leaf-miner on the terminal leaves of gray birch.

Evidence was also obtained to show that the European pine shoot moth, *Evetria buoliana* Schiff., occurs in Connecticut.

The bronze birch borer, *Agrilus anxius* Gory, continues to kill European cut-leaf white birches throughout the State.

The juniper webworm, *Dichomeris* (*Ypsolophus*) *marginellus* Fabr., was received from New Canaan, June 19.

Miscellaneous Insects.

The European fly, *Muscina pascuorum* Meigen, which appeared in New England in 1922*, and which was rather abundant in Connecticut in 1923, was not seen at all around the Station laboratory in 1924. Plans were made for Mr. Friend to work out the life history of this fly, but as no material could be obtained, the plans were suspended.

Another instance was brought to our attention of a nuisance caused by the presence in greenhouses at Rowayton, of large number of the tropical cockroach, *Pycnoscelus surinamensis* Linn. (See Notes on Miscellaneous Insects.)

The biting dog louse, *Trichodectes latus* Nitzsch, (order Mallophaga) was received from Pomfret, this being the first record of the species in Connecticut.

Defoliation of honeysuckle shrubs and vines was caused by sawflies, *Abia americana* Cress., and of Rudbeckia, "golden glow", by some other species of sawfly which has not yet been identified with certainty.

Ants were very abundant everywhere during 1924, and many complaints were received of ants in houses, of ants injuring vegetable and flowering plants in gardens, and of ants infesting lawns. In each case a copy of Bulletin of Immediate Information No. 17, "Control of Ant Invasions", was sent and in several instances the Federal formula for poison bait given on page 4, was used with success.

* Report of this Station for 1922, page 373.

Convention of Entomological Workers.

As there are now several entomologists employed at this Station, and several field foremen on gipsy moth work, several Federal men in the State on gipsy moth and European corn borer control, teachers of entomology in Yale University and the Connecticut Agricultural College, and several amateur entomologists, it was thought desirable to bring them all together for a conference. Consequently they were invited to meet at the Station on October 31, 1924. Dr. Britton was elected Chairman of the meeting and additional talks were given by Mr. D. J. Caffrey, a former Assistant at the Station, now in charge of the Federal European Corn Borer Laboratory, Arlington, Mass., and by Mr. S. S. Crossman of the Federal Parasite Laboratory, Melrose Highlands, Mass., who has made several trips to Europe in search of gipsy moth parasites. The following program was arranged and carried out, not a single speaker being absent.

PROGRAM.

A.M.

10.00 Words of Welcome, W. L. Slate, Jr., New Haven
10.05 Entomological Work of the Station, W. E. Britton, New Haven
10.15 Some Animal Parasites, G. H. Lamson, Jr., Storrs
10.30 The Asiatic Beetle in Connecticut, M. P. Zappe, New Haven
10.45 Teaching Entomology in Connecticut Institutions:
Connecticut Agricultural College, J. A. Manter, Storrs
Yale University Undergraduates, A. Petrunkevitch, New Haven
Yale University School of Forestry, W. R. Coe, New Haven
11.30 Opportunities for Beekeeping in Conn., L. B. Crandall, Storrs
12.00 Oriental Peach Moth in Conn., Philip Garman, New Haven
12.30 Luncheon.

P.M.

1.45 Some Baits Attractive to Cabbage Maggot Flies,
R. B. Friend, New Haven.
2.00 Hints on Photographing Insects, B. H. Walden, New Haven
2.15 Gipsy Moth Work in Connecticut in 1924,
J. T. Ashworth, Danielson
2.45 Status of the Gipsy Moth in the United States,
A. F. Burgess, Melrose Highlands, Mass.
3.30 The European Corn Borer in the United States,
L. H. Worthley, Arlington, Mass.
4.15 Anti-Mosquito Work in Connecticut in 1924,
R. C. Botsford, New Haven

Messrs. Zappe, Friend, Walden, Garman and Botsford illustrated their talks by lantern slides.

There were a number of opinions expressed, all to the effect that the meeting had been a success and a hope that other meetings may be held in the future. About 60 were present as follows: Mr. and Mrs. A. F. Burgess, A. F. Burgess, Jr., C. W. Collins, H. L. Blaisdell, S. S. Crossman, Melrose Highlands, Mass.; L. H. Worthley, D. J. Caffery, R. A. Vickery, T. M. Cannon, Arlington, Mass.; Mr. and Mrs. Albert Hartzell, Yonkers, N. Y.; H. C. Huckett, Riverhead, N. Y.; H. J. Evans, Mineola, N. Y.; D. G. Murphy, Pittsfield, Mass.; H. A. Ames, Bound Brook, N. J.; Professors Alexander Petrunkevitch and W. R. Coe, Yale University, New Haven, Conn.; Professors G. H. Lamson, Jr., J. A. Manter, L. B. Crandall, A. J. Grady, T. F. Cronin, V. A. Johnson, J. W. Balock, Storrs, Conn.;

F. C. Rich, Ansonia, Conn.; W. A. Collins, New Milford, Conn.; J. J. Pillsbury, Burnside, Conn.; Professor Pauline H. Dederer, Connecticut College for Women, New London, Conn.; S. E. May, Canaan, Conn.; P. H. Meagher, Wallingford, Conn.; John T. Ashworth, J. W. Longo, A. J. Gilbert, H. A. Woodmancy, H. E. Cook, O. B. Cooke, C. M. Spencer, Danielson, Conn.; Dolor LaBelle, Ballouville, Conn.; James A. McEvoy, Putnam, Conn.; A. W. Yates, Hartford, Conn.; H. W. Coley, Westport, Conn.; E. J. Smith, Clintonville, Conn.; Mr. and Mrs. Henry S. Woolley, Waterbury, Conn.; P. L. Buttrick, New Haven, Conn.; Robert E. O'Brien, New Haven, Conn.; and Messrs W. L. Slate, Jr., E. H. Jenkins, G. P. Clinton, E. M. Stoddard, G. E. Graham, Philip Garman, M. P. Zappe, B. H. Walden, R. C. Botsford, R. B. Friend, Leslie Rogers and W. E. Britton of the Agricultural Experiment Station, New Haven, Conn.

INSPECTION OF NURSERIES IN 1924.

The annual inspection of growing nursery stock was begun July 25, and was finished October 14, except for one plantation inspected December 30. This work was in charge of Mr. M. P. Zappe, and was conducted about the same as in 1923, except that Mr. W. R. Hunt of the Botany Department assisted and was present during the inspection of all the larger nurseries. Consequently more attention could be given to plant diseases than heretofore. The work was done by Messrs. Zappe, Friend, Hunt, Cronin and Rogers. Mr. Ahearn inspected one strawberry nursery and Dr. Britton helped inspect two nurseries. Two nurseries were inspected in the spring and again at the time of the annual inspection.

In addition to the inspections made from this office, the gipsy moth scouts were instructed to make careful inspections for gipsy moth eggs in and around nurseries, and to have it reported to the office in case any were found.

In 33 nurseries, no important pests were found. Following is a list of insects and plant diseases found in nurseries, together with the number of nurseries infested by each, as taken from the inspection reports on file in the office:

List of Pests Found in Nurseries in 1924

Nurseries uninfested 33

INSECTS

Aphids, apple, green	7	Curculio, poplar	1
woolly	5	Elm leaf beetle	1
pine bark	3	Fall webworm	4
spruce gall,		Lace bugs, on rhododendron	3
Chermes abietis	40	Leopard moth larva	1
cooleyi	12	*Laspeyresia molesta*	6
Apple and thorn skeletonizer	2	Leaf hoppers, on apple	4
Birch Bucculatrix	4	Mite, European red	2
Birch leaf-miner	1	pear blister	4
Borer, lilac	2	*Papaipema* larva	1
locust	1	Red humped caterpillar	2
poplar	1	Sawfly, *Diprion simile*	2

INSECTS—*concluded.*

Sawfly, larch	1	Scale, San José	32
Scale, elm	8	scurfy	2
euonymus	1	tulip tree	6
lecanium	1	West Indian peach	1
oak	1	white elm	1
oak gall scale (*Kermes*)	1	on *Juglans*	1
oyster-shell	44	White pine weevil	5
pine leaf	5	White grub in seed beds (*Abies*)	1
rose	6	White grub in Multiflora roses	1

PLANT DISEASES

Apple scab	12	Mildew on cherry	1
Black knot	1	cornus	1
Brown rot	4	grapes	6
Canker on apricot	1	lilac	2
horsechestnut	1	peaches	1
nectria	2	roses	15
poplar	25	snowdrop	1
sycamore	1	Mosaic, raspberry	8
Crown gall	3	Rust on ash	1
Fire blight	1	blackberry	1
Leaf spot on roses	2	white pine blister, (on Ribes)	8
Mildew on apples	5	cedar (on apple)	15
catalpa	3		

From the preceding list it may be seen that the oyster-shell scale is still the commonest pest found in Connecticut nurseries, and was found in 44 different nurseries. The next commonest is the spruce gall aphid, 40 nurseries. Next in order is the San José scale, 32 nurseries. Following these comes a fungus, the poplar canker, 25 nurseries.

In order to show how the figures of 1924 correspond with those obtained in preceding years, the following table gives the figures as reported by the inspectors for the past seven years.

Seven Year Record of Serious and Common Nursery Pests.

Pest	1918	1919	1920	1921	1922	1923	1924
Oyster-shell scale	39	38	38	36	44	42	44
San José scale	18	19	11	28	19	20	32
Spruce gall aphid	15	19	21	31	21	28	40
White pine weevil	5	5	1	1	19	17	5
Apple and thorn skeletonizer	..	..	..	..	1	18	2
Poplar canker	6	5	13	21	31	34	25
Blister rust (on Ribes)	1	..	..	2	9	6	8
No pests	32	32	46	36	36	32	33

It may be seen from the figures given in the table above that the oyster-shell scale (44) is, and has been for the past seven years, the most common pest found in nurseries. In 1924, the pests which were the next commonest are the spruce gall aphid (40), the San José scale (32), and the poplar canker (25). Then follows the pine blister rust which was found in eight nurseries, in all cases on the leaves of *Ribes*. The apple and thorn skeleton-

izer was found in two nurseries in 1924 as against 18 nurseries in 1923. Brief accounts of three of these major pests were given in the Report of this Station for 1923 (Bulletin 256), page 240.

Number of Nurseries.

During the year, 122 regular nurseries have been inspected, and 118 certificates granted. Since last year, eight nurseries have gone out of business, three have changed firm names, and 18 new nurseries have been started. Two nurseries were inspected in the spring and certificates issued, and again examined and certificated at the time of the regular inspection. Besides these inspections, 109 separate parcels of nursery stock were inspected and certificates furnished; also 116 duplicate certificates were furnished for filing in other States.

The total area of Connecticut nurseries in 1924 is 1,779 acres, and the nurserymen's list contains 116 names, as follows:

Nursery Firms in Connecticut Receiving Certificates in 1924

Name of Firm	Address	Acreage	Certificate Issued	No. of Certificate
Barnes Bros. Nursery Co.	Yalesville	150	Aug. 30	1490
Barnes Nursery & Orchard Co.	Wallingford	45	Oct. 1	1519
Barton Nursery	Hamden	1	Oct. 9	1541
Beattie, Wm. H.	New Haven	1	Oct. 2	1527
Benbow, A.	Norfolk	1	Oct. 15	1547
Berkshire Nurseries (C. B. Myers, Prop.)	Milford	6	Oct. 23	1553
Bertolf Brothers	Greenwich	25	Sept. 17	1508
Brainard Nursery & Seed Co.	Thompsonville	10	Sept. 13	1502
Braley & Co.	Burnside	1	Aug. 28	1487
Bretschneider, A.	Danielson	1	Sept. 10	1498
Bristol Nurseries, Inc	Bristol	16	Oct. 7	1539
Burr & Co., C. R.	Manchester, Ellington and Durham	500	Aug. 20	1476
Burroughs, Thos. E.	Deep River	3	Sept. 2	1491
Chapman, C. B.	Groton	1	Sept. 12	1499
Chapman, C. E.	No. Stonington	2	Sept. 18	1509
Clinton Nurseries (Warren Richards, Mgr.)	Clinton	1	Oct. 8	1540
Coari, Louis (2)	Southport	6	Sept. 30	1518
Conine Nursery Co	Stratford	50	Sept. 12	1501
Conn. Agricultural College (Prof. S. P. Hollister)	Storrs	1	Aug. 19	1473
Conn. Agr. Exp. Sta. (W. O. Filley, Forester)	New Haven	2	Oct. 6	1536
Crofut & Knapp Farm	Norwalk	20	Dec. 31	1583
Cross Highway Nurseries	Westport	6	Dec. 31	1580
Dallas, Inc., Alexander	Waterbury	1	Nov. 13	1563
Dawson's Nursery	Willimantic	2	Sept. 20	1511
De Wyn, Peter	Yalesville	1	Aug. 22	1481
Dowd, Inc., F. C.	Madison	1	Sept. 3	1493
Dunlap, Daniel S.	Cromwell	1	Sept. 16	1504
East Rock Nursery (J. Palmeri, Prop.)	New Haven	1	Oct. 6	1535

Nursery Firms in Connecticut Receiving Certificates in 1924—*Con.*

Name of Firm	Address	Acreage	Certificate Issued	No. of Certificate
Edgewood Nursery, Vidal, Inc.	Stamford	5	Nov. 5	1560
Eells, Wm. W.	Manchester	1	Sept. 9	1497
Elm City Nursery Co., Woodmont Nurseries, Inc.	Woodmont and New Haven	155	Sept. 6	1495
Evergreen Nursery Co.	Wilton	10	Aug. 27	1482
Fairty, C. H.	New Canaan	1	Dec. 1	1572
Fraser, G. W.	Willimantic	1	Aug. 19	1474
Gardner's Nurseries	Rocky Hill	8	Sept. 16	1506
Geduldig's Greenhouses	Norwich	1	Sept. 27	1514
Glenn Terrace Ornamental Nursery (James H. Everett, Prop.)	Mount Carmel	10	Dec. 1	1573
Heath & Co.	Manchester	5	Aug. 19	1471
Hilliard, H. J.	Sound View	1	Dec. 24	1577
Hiti Nurseries (J. H. Bowditch, Prop.)	Pomfret Center	9	Aug. 20	1475
Holcomb, Irving	Simsbury	1	Sept. 5	1494
Holdridge, S. E.	Ledyard	2	Dec. 31	1585
Hoogendoorn, C.	Yalesville	1	Aug. 22	1480
Horan & Son, Jas.	Bridgeport	1	Oct. 29	1559
Houston's Nurseries	Mansfield	4	Nov. 7	1562
Hoyt's Sons Co., Inc., The Stephen	New Canaan	250	Sept. 16	1507
Hull, Curtis M.	Wallingford	1	Oct. 24	1554
Hunt & Co., W. W.	Hartford	10	Oct. 4	1533
Isselee, Charles	Darien	10	Nov. 15	1564
Jones, William	Norwalk	1	Oct. 2	1524
Kelley, James J.	New Canaan	1	Nov. 28	1569
Kellner, Herman H	Danbury	1	Oct. 1	1522
Keso Nursery (J. J. Kelsey, Prop.)	Clinton	1	Nov. 24	1568
Leghorn, John J.	Cromwell	1	Sept. 16	1505
Long Hill Nursery	Burnside	1	Dec. 22	1576
Mallett Co., George A.	Bridgeport	1	Oct. 14	1545
Maplewood Nurseries (T. H. Peabody, Mgr.)	Norwich	1	Oct. 3	1531
Marigold Farm (H. Kelley, Prop.)	New Canaan	6	Nov. 24	1567
Meier, A. R.	West Hartford	1	Oct. 25	1555
Millane Tree Expert Co., The	Middletown	1	Nov. 18	1565
New Haven Florist Co.	New Haven	1	Dec. 30	1579
New Haven Nurseries, The	New Haven	1	Aug. 28	1485
New Haven Park Commissioners (G. X. Amrhyn, Supt.)	New Haven	30	Aug. 28	1486
Newington Gardens	Newington	1	Oct. 2	1526
New London Cemetery Association (Ernest E. Rogers, Pres.)	New London	1	Oct. 3	1532
New London County Nurseries (W. J. Schoonman, Prop)	New London	5	Oct. 7	1538
New London Greenhouses and Nursery	New London	1	Oct. 21	1550
New Milford Nurseries	Northville	1	Sept. 30	1517
Nicolson & Thurston (2)	Litchfield	1	Oct. 15	1548
North-Eastern Forestry Co.	Cheshire	20	Aug. 14	1470
Norwood Nursery	Hamden	1	Oct. 6	1537
Oakland Nurseries	Manchester	5	Aug. 20	1477

NURSERY FIRMS IN CONNECTICUT RECEIVING CERTIFICATES IN 1924—*Con.*

Name of Firm	Address	Acreage	Certificate Issued	No. of Certificate
Outpost Nurseries (L. D. Conley, Prop.)	Ridgefield	25	Sept. 25	1513
Ouwerkerk & Van der Stam	Yalesville	7	Aug. 22	1479
Park Gardens	Bridgeport	1	Oct. 1	1521
Park Hill Flower Shop	Manchester	1	Sept. 9	1496
Pequod Nursery Co.	Yalesville	15	Aug. 27	1483
Phelps & V. T. Hammer Co., The J. W.	Branford	2	Oct. 11	1544
Pierson, A. N., Inc.	Cromwell	75	Aug. 22	1478
Polish Orphanage Farm (Rev. L. Bojnowski, Mgr.)	New Britain	1	Oct. 14	1546
Pomeroy, Edwin C.	Northville	1	Sept. 30	1516
Reck, Julius	Bridgeport	1	Nov. 28	1570
Reumann, Theodore	Stamford	1	Oct. 1	1520
Rockfall Nursery Co. (P. Marotta, Prop.)	Rockfall	40	Sept. 27	1515
Rowayton Greenhouses	Rowayton	1	Sept. 16	1503
Ryther, O. E.	Norwich	6	Nov. 5	1561
Saxe & Floto	Waterbury	1	Dec. 31	1584
Scheepers, Inc., John	Stamford	6	Dec. 13	1575
Scott, J. W.	Hartford	5	Dec. 2	1574
Sierman, C. H.	Hartford	5	Oct. 27	1557
South Wilton Nurseries	South Wilton	6	Nov. 19	1566
Stamford Seed & Nursery Co.	Stamford	1	Oct. 2	1525
Stannard Hill Greenhouse	Westbrook	1	Aug. 29	1488
Steck, Charles A.	Newtown	5	Oct. 28	1558
Steck, Mrs. Sarah B.	Bethel	1	Oct. 21	1551
Stratfield Nursery Co.	Bridgeport	10	Dec. 31	1581
Stratford Florist Co. (C. A. Cooper)	Stratford	1	Oct. 1	1523
Stratford Rose Nurseries (John Barrow, Prop.)	Stratford	1	Oct. 2	1530
Sunny Ridge Nursery (Charles A. Steck, Jr.)	Bethel	5	Oct. 2	1528
Tanner's Nursery Co.	Manchester	1	Aug. 27	1484
Tow Path Gardens (S. W. Eddy, Prop.)	Avon	1	Oct. 27	1556
Upson, R. E.	Marion	1	Oct. 9	1542
Vanderbrook & Son, Chas. L.	Manchester	5	Aug. 19	1472
Van Wilgen & Co.	Branford	15	Oct. 21	1552
Vasileff, Nicholas	Greenwich	1	Dec. 31	1582
Verkade's Nurseries	New London	20	Sept. 12	1500
Vidbourne & Co., Estate of J.	Hartford	3	Nov. 28	1571
Wallace Nursery	Wallingford	4	Sept. 2	1492
Wheeler, Chas. B.	No. Stonington	1	Oct. 6	1534
Wilcox, Harry D.	Avon	1	Oct. 2	1529
Wild, Henry	Greenwich and Norwalk	16	Sept. 25	1512
Wilson & Co., C. E.	Manchester	50	Sept. 19	1510
Woodruff, C. V.	Orange	1	Oct. 9	1543
Yale University School of Forestry	New Haven	1	Oct. 18	1549
Young, Mrs. Nellie A.	Pine Orchard	1	Dec. 27	1578
Zack, Co., H. J.	Deep River	4	Aug. 29	1489
Total acreage		1,779		

INSPECTION OF RASPBERRY PLANTATIONS.

In addition to the inspection of nursery stock, some fruiting plantations were examined to ascertain whether or not they were free of the disease known as mosaic. This disease is not very well understood and its cause is not definitely known, but has at different times and by various investigators been supposed to be an enzyme or chemical ferment, and an ultra-microscopic germ or organism of bacterial or protozoan nature. Whatever may be the cause, it is fairly well established that it is transmitted by a small species of aphid, *Aphis rubiphila* Patch. This makes it somewhat analogous to the mosaic of potato which is transmitted by the potato aphid, *Macrosiphum solanifolii* Ashm.

Recently an attempt has been made in New York State to grow raspberry plants which are free from mosaic, and nurserymen are not allowed to ship raspberry plants into New York State unless some similar method of inspection and eradication is in practice in the State where the stock is grown. Similar action has been taken by the States of Ohio, Michigan and Minnesota. Consequently there were several applications for inspections on account of this disease, some from regular nurserymen, and others from owners of fruiting raspberry plantations.

As this problem required the co-operation of the Botanical and Entomological Departments, arrangements were made to visit New York State and learn the status of the raspberry inspection and the eradication of mosaic. By appointment, Messrs. Clinton and Hunt, Botanists, and Britton and Zappe, Entomologists, visited Poughkeepsie and Highland, N. Y., on July 10, where Dr. W. H. Rankin showed his work and gave the visitors all the information on the subject at his command. Evidently some varieties are much more susceptible to the disease than others, and it seems to be a difficult matter to grow the standard varieties of red raspberries and have them free from mosaic. The everbearing varieties, though not immune, are not commonly affected, and the black-caps and purple canes are not or almost never attacked. Blue stem and curly leaf are two other troubles apparently distinct from mosaic, though not well understood. The former is a disease of black-caps and the latter is found on red raspberries as well as is mosaic, though less common.

Shortly after returning to Connecticut, some inspections of raspberry plantations were made by Messrs. Zappe, Clinton and Hunt, beginning July 16 and extending through the regular inspection of nurseries. In a portion of the plantations of certain varieties, if much mosaic occurred, the owner expressed a desire to destroy the plants and not attempt to obtain a certificate. Certain other varieties were free or nearly free from mosaic and the diseased plants were removed or "rogued out" and a second inspection made a month or six weeks later. Thus it was possible

to grant certificates on certain varieties where it had to be refused on other varieties. Altogether, eight plantations were inspected and five special certificates granted. These certificates were signed by both the Botanist and the Entomologist. The list of growers receiving special raspberry certificates is as follows:

SPECIAL CERTIFICATES ON RASPBERRY PLANTS.

Name of Firm	Address	Variety	Certificate Issued	No. of Certificate
Barnes Bros. Nursery Company	Yalesville (Durham plantation)..	La France, Latham, King, Red Path...	Oct. 10	3
Barnes Nursery and Orchard Company..	Wallingford...	Erskine Park, St. Regis...	Oct. 10	4
Bertolf Brothers.....	Greenwich....	La France..	Oct. 10	5
Croteau, Fannie.....	Mount Carmel	St. Regis...	Sept. 15	1
Scheepers, Inc., John..	Stamford.....	La France..	Oct. 10	2

INSPECTION OF IMPORTED NURSERY STOCK.

The nursery stock imported from foreign countries and entering Connecticut during 1924 was inspected as in preceding years, mostly by Mr. Zappe, but assisted by Messrs. Botsford, Friend, Rogers and Walden. Though the number of shipments was slightly less than last year, there was an increase of about 75 per cent. in the number of cases and 71 per cent. in the number of plants. The following table shows the number of shipments, number of cases, and number of plants, inspected at destination, during each of the last five years:

Year	No. of Shipments	No. of Cases	No. of Plants
1920.....	17	87	814,491
1921.....	21	126	1,228,560
1922.....	30	159	1,997,595
1923.....	35	179	1,981,895
1924.....	33	313	3,489,170

These 33 shipments were imported by eight different Connecticut firms, 24 of them being consigned to two firms. Most of the stock consisted of seedling fruit and Manetti rose, for grafting and budding. There were 14 shipments of fruit seedlings, and 19 shipments of rose stocks; two shipments contained both fruit and rose stocks.

The cost of inspecting this imported nursery stock was about $500.00.

As in preceding years, the bulk of the shipments came from France and Holland, with a few shipments from England and other countries. The sources of this stock inspected during the year were as follows:

SOURCES OF IMPORTED NURSERY STOCK, 1923-1924.

Country	No. of Shipments	No. of Cases	No. of Plants
France.....	13	164	2,033,600
Holland.....	12	119	1,126,070
England.....	6	21	259,500
Italy.....	1	2	10,000
Germany.....	1	7	60,000
	33	313	3,489,170

The following table shows the quantities of stock as inspected by months:

Month	No. of Shipments	No. of Cases	No. of Plants
November.....	2	5	105,000
December.....	4	25	229,500
January.....	6	66	720,820
February.....	17	174	1,984,900
March.....	4	43	448,950
	33	313	3,489,170

In addition to the material tabulated above, there were 13 shipments containing 16 packages of seeds, mostly of trees and palms, which were not inspected in Connecticut.

Of the 33 shipments of stock inspected, 17 shipments or 49 per cent. were found infested with insects or plant diseases, though most of them were not dangerous pests. Details regarding these pests are given below.

PESTS FOUND ON IMPORTED NURSERY STOCK.

17 Shipments Infested.

INSECTS.

Emphytus cinctus Linn., on Manetti rose. (15 shipments). S. Bide & Son, Ltd., Farnham, Surrey, England; W. Fromow & Sons, Windlesham, Surrey, England; W. C. Slocock, Woking, England; B. Ruys, Ltd., Dedensvaart, Holland; Franco-American Seedling Co., Angers, France; Georges Benard, Olivet-Orleans, France; Oudyh Brothers Nurseries, Boskoop Holland; Association Flora, Boskoop, Holland; H. K. Woldering, Veendam, Holland; M. Gielen, Oudenbosch, Holland; V. Levasseur & Sons, Ussy, Calvados, France; D. J. de Jonge, Sappemeer, Holland. On Fruit stock, Andre Choplin, Maze, France.

Lepidopterous pupae on apple. (3 shipments.) Andre Choplin, Maze, France; Franco-American Seedling Co., Angers, France. On Quince, Louis Leroy's Nurseries, Angers, France.

Notolophus antiqua Linn., on apple (1 shipment.) Franco-American Seedling Co., Angers, France.

PLANT DISEASES.

Crown Gall on Manetti rose. (4 shipments.) W. C. Slocock, Woking, England. On fruit stock, Andre Choplin, Maze, France; Franco-American Seedling Co., Angers, France.

INSPECTION OF APIARIES IN 1924.

In 1924, as in past years, the apiary inspection work has been done by Messrs. H. W. Coley of Westport and A. W. Yates of Hartford on a *per diem* basis. Mr. Coley covers the southern half of the State, comprising Fairfield, New Haven, Middlesex and New London Counties. Mr. Yates covers the northern half, composed of Litchfield, Hartford, Tolland and Windham Counties.

This work required a total of 159 man days and the entire cost for the season was $2,306.40.

More apiaries and more colonies were inspected in 1924 than have ever before been inspected in a single season. The following table shows the number of apiaries and colonies inspected, and the average number of colonies per apiary for each year since the inspection work was commenced in 1910.

FIFTEEN YEAR RECORD OF APIARY INSPECTION IN CONNECTICUT.

Year	No. of Apiaries	No. of Colonies	Average No. Colonies per Apiary	Cost of Inspection Per Apiary	Cost of Inspection Per Colony
1910	208	1,595	7.6	$2.40	.28
1911	162	1,571	9.7	1.99	.21
1912	153	1,431	9.3	1.96	.21
1913	189	1,500	7.9	1.63	.21
1914	463	3,882	8.38	1.62	.19
1915	494	4,241	8.58	1.51	.175
1916	467	3,898	8.34	1.61	.19
1917	473	4,506	9.52	1.58	.166
1918	395	3,047	7.8	1.97	.25
1919	723	6,070	11.2	2.45	.29
1920	762	4,797	6.5	2.565	.41
1921	751	6,972	9.2	2.638	.24
1922	797	8,007	10.04	2.60	.257
1923	725	6,802	9.38	2.55	.27
1924	953	8,929	9.4	2.42	.25

In 1924, apiaries were inspected in 142 towns as against 119 towns in 1923, and 125 towns in 1922.

For the first time an inspection was made in the town of Union, as the inspector heretofore had been unable to learn of any bees in that town. On account of the law compelling registration, he obtained this information and made the inspection. However, it was only one apiary containing two colonies of bees.

In 1924 inspections were made in the following 35 towns not visited in 1923: *Fairfield County*: Brookfield, Ridgefield and Weston; *New Haven County*: East Haven, New Haven, North Branford, Wolcott and Woodbridge; *Middlesex County*: Portland and Westbrook; *New London County*: Colchester, Griswold, Ledyard, Lisbon, North Stonington, Salem, Sprague and Voluntown; *Litchfield County*: Bridgewater, Canaan, Cornwall, New Milford, Norfolk, North Canaan, Roxbury, Salisbury and Sharon; *Hartford County*: Avon and Hartland; *Tolland County*: Stafford, Tolland, Union and Willington; *Windham County*: Ashford and Thompson.

In 1923, apiaries were inspected in the following 13 towns not visited in 1924: *Fairfield County*: Bethel; *Middlesex County*: Saybrook; *Litchfield County*: Harwinton and New Hartford; *Hartford County*: Bloomfield, East Granby, East Windsor, Granby, Suffield, Windsor and Windsor Locks; *Tolland County*: Bolton and Hebron.

EUROPEAN FOUL BROOD.

This disease is caused by *Bacillus pluton* which attacks and kills the young larvae in the cells, being more destructive in spring and early summer than in other seasons. The odor of fermentation is usually present but it is not very offensive and the contents of the cells are usually not gelatinous or ropy. The common remedy consists of requeening with Italian queens and having the colonies strong by uniting if necessary.

Of the 953 apiaries, and 8,929 colonies inspected in 1924, 17 apiaries and 47 colonies were found infested with European foul brood. This is 1.78 per cent. of the apiaries and .526 per cent. of the whole number of colonies inspected during the season. Though the percentage of colonies infested is somewhat larger than 1923, the percentage of infested apiaries is smaller than ever before. In fact this disease has shown almost a gradual reduction, due we believe to the system of inspection and better handling of apiaries, since the inspection work began in 1910, as the following table will show:

RECORD OF EUROPEAN FOUL BROOD.

Year	Percentage of Infestation Apiaries	Percentage of Infestation Colonies
1910	75.9	49.7
1911	51.8	27.4
1912	47.7	23.5
1913	44.4	24.5
1914	32.6	13.9
1915	26.1	10.3
1916	18.8	7.05
1917	16.7	4.86
1918	9.8	3.3
1919	6.6	1.2
1920	4.3	1.5
1921	3.99	1.26
1922	4.14	.85
1923	2.34	.36
1924	1.78	.526

During 1924, European foul brood was found only in Meriden and Waterbury, New Haven County; Durham and East Hampton, Middlesex County; Lebanon, Old Lyme, Salem and Stoning-

ton, New London County; Barkhamsted, Cornwall and Roxbury, Litchfield County; Hartland, Hartford County; Ellington, Tolland County; Brooklyn, Plainfield, Putnam and Sterling, Windham County. This disease was not found in any of the apiaries inspected in Fairfield County.

American Foul Brood.

American foul brood is also a bacterial disease caused by *Bacillus larvae,* and attacks the brood at a later stage than European foul brood. It usually shows itself at the time the larvae are mature and pupating, when the cells are sealed or capped. The diseased cells later become sunken and if broken open the contents emit an offensive odor, and have a peculiar stringy or ropy consistency. Shaking into clean hives, destroying all infected combs and disinfecting the old hives is the treatment. Almost the whole danger of a recurrence is careless treatment and reinfection from infected combs and honey. Some authorities are recommending and using an alcohol-formalin solution containing 20 per cent. formalin, in which they soak the combs to sterilize them, after which they can be safely used. This may prove of great value in stamping out the disease.

Of the 953 apiaries and 8,929 colonies inspected in 1924, 10 apiaries and 20 colonies were found diseased with American foul brood. This is 1.04 per cent. of the apiaries and .22 per cent. of the colonies, a slight increase in percentage of the apiaries and decrease in that of the colonies over last year. With American foul brood there has never been any gradual decrease as in the case of European foul brood, but spasmodic outbreaks have occurred here and there since 1914. The following table will show the percentages of apiaries and colonies found diseased with American foul brood since the beginning of inspection work in Connecticut.

Record of American Foul Brood.

Year	Percentage of Infestation Apiaries	Colonies
1910	0	0
1911	0	0
1912	0	0
1913	0	0
1914	1.07	.7
1915	.8	.18
1916	1.07	.15
1917	.42	.17
1918	1.01	.32
1919	3.	1.1
1920	1.18	.25
1921	2.5	.56
1922	1.38	.27
1923	.965	.323
1924	1.04	.22

During 1924, American foul brood was found in the towns of Greenwich and Shelton, Fairfield County; Naugatuck and Wallingford, New Haven County; Clinton, East Hampton and Haddam, Middlesex County; Old Lyme, New London County; Thomaston and Washington, Litchfield County. The disease was not found in any apiaries inspected during the season in Hartford, Tolland or Windham Counties.

The system of controlling this disease in some of the States is that known as the "area clean-up" method, and an attempt is made to eradicate the disease, working around the centers of infection. A movement has been started to procure Federal cooperation in this work.

Statistics of Inspection.

The statistics of apiary inspection by towns and counties may be found on the following pages, with summary on page 252.

Towns	No. Apiaries Inspected	No. Apiaries Diseased	No. Colonies Inspected	No. Colonies Diseased	American Foul Brood	European Foul Brood	Sacbrood	Paralysis
Fairfield County:								
Brookfield	4	0	56	0	0	0	0	0
Danbury	5	0	29	0	0	0	0	0
Darien	6	2	61	3	0	0	3	0
Easton	4	1	181	1	0	0	1	0
Fairfield	10	1	104	1	0	0	1	0
Greenwich	9	1	54	1	1	0	0	0
Monroe	4	0	88	0	0	0	0	0
New Canaan	5	0	63	0	0	0	0	0
Newtown	10	1	115	1	0	0	1	0
Norwalk	4	0	37	0	0	0	0	0
Redding	3	0	22	0	0	0	0	0
Ridgefield	6	1	22	1	0	0	1	0
Shelton	3	1	47	2	2	0	0	0
Stamford	21	0	187	0	0	0	0	0
Stratford	2	0	14	0	0	0	0	0
Trumbull	4	0	57	0	0	0	0	0
Weston	2	0	11	0	0	0	0	0
Westport	5	0	26	0	0	0	0	0
Wilton	12	0	161	0	0	0	0	0
	119	8	1,335	10	3	0	7	0
New Haven County:								
Beacon Falls	3	0	52	0	0	0	0	0
Branford	3	0	12	0	0	0	0	0
Cheshire	8	0	71	0	0	0	0	0
Derby	3	1	16	1	0	0	1	0
East Haven	2	0	22	0	0	0	0	0
Guilford	5	0	59	0	0	0	0	0
Hamden	8	0	107	0	0	0	0	0
Madison	3	1	32	1	0	1	0	0

APIARIES INSPECTED IN 1924—*Continued.*

Towns	No. Apiaries Inspected	No. Apiaries Diseased	No. Colonies Inspected	No. Colonies Diseased	American Foul Brood	European Foul Brood	Sacbrood	Paralysis
New Haven County: —*Concluded.*								
Meriden	25	2	208	2	0	0	2	0
Milford	5	0	69	0	0	0	0	0
Naugatuck	6	2	19	2	1	0	1	0
New Haven	3	0	14	0	0	0	0	0
North Branford	2	0	50	0	0	0	0	0
North Haven	11	1	158	2	0	0	2	0
Orange	2	0	10	0	0	0	0	0
Prospect	9	0	79	0	0	0	0	0
Seymour	1	0	10	0	0	0	0	0
Wallingford	23	6	145	8	4	0	4	0
Waterbury	10	1	71	2	0	2	0	0
West Haven	3	0	30	0	0	0	0	0
Wolcott	2	0	7	0	0	0	0	0
Woodbridge	2	1	27	1	0	0	1	0
	139	15	1,268	19	5	3	11	0
Middlesex County:								
Chester	5	0	48	0	0	0	0	0
Clinton	8	5	71	20	2	0	18	0
Cromwell	7	0	37	0	0	0	0	0
Durham	7	2	136	2	0	1	1	0
East Haddam	7	0	172	0	0	0	0	0
East Hampton	10	2	117	2	1	1	0	0
Essex	4	0	67	0	0	0	0	0
Haddam	4	2	50	5	5	0	0	0
Killingworth	7	1	38	4	0	0	4	0
Middlefield	3	0	91	0	0	0	0	0
Middletown	10	0	104	0	0	0	0	0
Old Saybrook	6	1	67	2	0	0	2	0
Portland	8	0	45	0	0	0	0	0
Westbrook	2	0	9	0	0	0	0	0
	88	13	1,052	35	8	2	25	0
New London County:								
Bozrah	3	0	112	0	0	0	0	0
Colchester	9	0	43	0	0	0	0	0
East Lyme	3	0	56	0	0	0	0	0
Franklin	1	0	24	0	0	0	0	0
Griswold	4	1	89	2	0	0	2	0
Groton	6	0	31	0	0	0	0	0
Lebanon	10	1	144	1	0	1	0	0
Ledyard	1	0	18	0	0	0	0	0
Lisbon	2	0	43	0	0	0	0	0
Montville	6	0	83	0	0	0	0	0
New London	5	0	90	0	0	0	0	0
No. Stonington	2	0	27	0	0	0	0	0
Norwich	13	1	425	2	0	0	2	0
Old Lyme	3	1	61	2	1	1	0	0
Preston	7	0	49	0	0	0	0	0
Salem	2	1	42	1	0	1	0	0
Sprague	2	0	39	0	0	0	0	0

APIARIES INSPECTED IN 1924—*Continued.*

Towns	No. Apiaries Inspected	No. Apiaries Diseased	No. Colonies Inspected	No. Colonies Diseased	American Foul Brood	European Foul Brood	Sacbrood	Paralysis
New London County: —*Concluded.*								
Stonington	8	1	63	1	0	1	0	0
Voluntown	1	0	14	0	0	0	0	0
Waterford	7	0	52	0	0	0	0	0
	95	6	1,505	9	1	4	4	0
Litchfield County:								
Barkhamsted	4	2	41	10	0	10	0	0
Bethlehem	2	0	8	0	0	0	0	0
Bridgewater	12	0	91	0	0	0	0	0
Canaan	5	0	28	0	0	0	0	0
Colebrook	2	0	5	0	0	0	0	0
Cornwall	9	3	40	4	0	4	0	0
Goshen	3	0	29	0	0	0	0	0
Litchfield	19	0	122	0	0	0	0	0
Morris	5	0	27	0	0	0	0	0
New Milford	11	0	101	0	0	0	0	0
Norfolk	6	0	24	0	0	0	0	0
North Canaan	5	0	65	0	0	0	0	0
Plymouth	9	0	51	0	0	0	0	0
Roxbury	4	1	21	2	0	2	0	0
Salisbury	8	0	49	0	0	0	0	0
Sharon	3	0	68	0	0	0	0	0
Thomaston	12	1	39	1	1	0	0	0
Torrington	2	0	7	0	0	0	0	0
Washington	7	1	121	2	2	0	0	0
Watertown	5	1	19	2	0	0	0	2
Winchester	7	1	44	1	0	0	0	1
Woodbury	9	0	65	0	0	0	0	0
	149	10	1,065	22	3	16	0	3
Hartford County:								
Avon	3	0	4	0	0	0	0	0
Berlin	12	0	255	0	0	0	0	0
Bristol	19	0	97	0	0	0	0	0
Burlington	8	0	38	0	0	0	0	0
Canton	12	0	80	0	0	0	0	0
East Hartford	1	0	3	0	0	0	0	0
Enfield	3	0	11	0	0	0	0	0
Farmington	11	0	66	0	0	0	0	0
Glastonbury	24	0	164	0	0	0	0	0
Hartland	1	1	103	2	0	2	0	0
Manchester	10	0	70	0	0	0	0	0
New Britain	18	0	148	0	0	0	0	0
Newington	8	0	66	0	0	0	0	0
Plainville	12	1	25	2	0	0	0	2
Rocky Hill	5	0	47	0	0	0	0	0
Simsbury	8	0	37	0	0	0	0	0
Southington	14	0	80	0	0	0	0	0
South Windsor	14	0	120	0	0	0	0	0
West Hartford	26	0	168	0	0	0	0	0
Wethersfield	5	0	30	0	0	0	0	0
	214	2	1,612	4	0	2	0	2

APIARIES INSPECTED IN 1924—*Concluded.*

Towns	No. Apiaries Inspected	No. Apiaries Diseased	No. Colonies Inspected	No. Colonies Diseased	American Foul Brood	European Foul Brood	Sacbrood	Paralysis
Tolland County:								
Andover	5	0	27	0	0	0	0	0
Columbia	3	0	15	0	0	0	0	0
Coventry	11	0	75	0	0	0	0	0
Ellington	15	3	67	4	0	4	0	0
Mansfield	4	1	46	1	0	0	0	1
Somers	3	0	19	0	0	0	0	0
Stafford	6	0	25	0	0	0	0	0
Tolland	6	0	35	0	0	0	0	0
Union	1	0	2	0	0	0	0	0
Vernon	7	0	32	0	0	0	0	0
Willington	9	0	47	0	0	0	0	0
	70	4	390	5	0	4	0	1
Windham County:								
Ashford	1	0	16	0	0	0	0	0
Brooklyn	5	1	177	1	0	1	0	0
Canterbury	3	0	26	0	0	0	0	0
Chaplin	1	0	1	0	0	0	0	0
Eastford	3	0	11	0	0	0	0	0
Hampton	7	0	78	0	0	0	0	0
Killingly	11	0	48	0	0	0	0	0
Plainfield	24	4	114	12	0	12	0	0
Pomfret	3	0	8	0	0	0	0	0
Putnam	5	1	36	1	0	1	0	0
Sterling	3	1	11	2	0	2	0	0
Thompson	4	0	47	0	0	0	0	0
Windham	6	0	84	0	0	0	0	0
Woodstock	3	0	45	0	0	0	0	0
	79	7	702	16	0	16	0	0

SUMMARY.

County	No. Towns	No. Apiaries Inspected	No. Apiaries Diseased	No. Colonies Inspected	No. Colonies Diseased	American Foul Brood	European Foul Brood	Sacbrood	Paralysis
Fairfield	19	119	8	1,335	10	3	0	7	0
New Haven	22	139	15	1,268	19	5	3	11	0
Middlesex	14	88	13	1,052	35	8	2	25	0
New London	20	95	6	1,505	9	1	4	4	0
Litchfield	22	149	10	1,065	22	3	16	0	3
Hartford	20	214	2	1,612	4	0	2	0	2
Tolland	11	70	4	390	5	0	4	0	1
Windham	14	79	7	702	16	0	16	0	0
	142	953	65	8,929	120	20	47	47	6

	No. Apiaries	No. Colonies
Inspected	953	8,929
Infested with European foul brood	17	47
Per cent. infested	1.78	.526
Infested with American foul brood	10	20
Per cent. infested	1.04	.22
Sacbrood	17	47
Bee paralysis	4	6
Average number of colonies per apiary		9.4
Cost of inspection		$2,306.40
Average cost per apiary		2.42
Average cost per colony		.25

REGISTRATION OF BEES.

There is still much confusion regarding the registration of bees, and many beekeepers are not complying with the law. Some beekeepers think that if they register once, they need not do so again. Certain others probably have never registered their bees; though they are subject to a five dollar fine for not doing so on or before October 1. Apparently the law is not enforced in most towns. In the town of Stafford, one beekeeper who failed to register on the date prescribed was prosecuted and fined. I have not heard of another similar case. The law, Chapter 174, Public Acts of 1919, as amended in Chapter 129, Public Acts of 1923, is as follows:

"Section 1. Every person owning one or more hives of bees shall, annually, on or before the first day of October, make application to the town clerk of the town in which such bees are kept, for the registration of such bees, and such town clerk shall issue to such applicant a certificate of registration upon the payment of a recording fee of twenty-five cents, which certificate shall be in the form prescribed and upon blanks furnished by the commissioner of domestic animals and shall be recorded in the office of such town clerk.

Sec. 2. A record of such registration and of the name and place of residence of the registrant and the definite location in the town where bees are kept by him shall be kept in a separate book in the office of the town clerk, which record shall be accessible to the public. Each town clerk shall file with the state entomologist of the Connecticut Agricultural Experiment Station a complete list of such registrations and locations on or before the first day of February of the year succeeding such registrations. Any town clerk failing to perform such duty shall be fined not more than ten dollars."

Sec. 3. Any owner of bees who shall fail to register as required by the provisions of this act shall be fined not more than five dollars."

According to records in this office, 1,416 beekeepers registered in the State in 1923, yet the inspections of 1924 contained 166 names that were not registered the preceding October. As only 923 apiaries were inspected in 1924, which is less than two-thirds of the number registered, there must have been considerably more than 166 beekeepers who failed to register. Moreover, it is rather difficult to obtain complete data from the town clerks.

Of course the law does not compel them to report to the State Entomologist in case no bees have been registered in a given town. Yet unless they do report, the State Entomologist has no way of knowing whether none were registered or whether registrations were made and the clerk failed to report them. Repeated requests and considerable correspondence have been necessary to obtain from the town clerks even an approximate record of the beekeepers who have registered throughout the State.

All beekeepers should each year on or before October 1, register with the town clerk in the towns where their bees are kept.

All town clerks should report complete data regarding such registration to the State Entomologist. They need not wait to do this but may report any time after October 1, and must do so on or before February 1, following such registration.

REPORT OF GIPSY MOTH WORK.

Year Ending June 30, 1924.

By W. E. Britton and John T. Ashworth.

This work has been conducted as in former years by State and Federal agencies working in co-operation, the Federal agencies expending their efforts near the margin of the area known to be infested in order to prevent further spread and the State forces working within the infested area in order to hold the pest in check. This co-operation has proven very satisfactory and we hereby wish to express our appreciation and thanks to Mr. A. F. Burgess, in charge of moth work and Mr. H. L. Blaisdell, in charge of field work, both of the Federal Bureau of Entomology.

A somewhat detailed account of how the work is organized and prosecuted was published in the 22nd Report of the State Entomologist, page 290 (see Report of Connecticut Agricultural Experiment Station for 1922, page 290) and need not be repeated here. The fact that a larger area is now infested than was known to be infested at that time does not mean that the pest has been spreading rapidly during this period. The explanation lies rather in the extensive windspread of May, 1920, and possible additional spread of 1921, the limits of which have only recently been discovered. Both Federal and State funds have not been adequate to cover all suspected territory in any one season.

New Equipment.

The Buick touring car purchased in 1921 was exchanged March 31, 1924, for a new Buick of similar type.

One new Ford light delivery truck was purchased on December 24, 1923.

As some of the spray hose had seen its best days, it was necessary to replace it, and five hundred feet were purchased on June 23, 1924, from the Acme Rubber Company of Boston, Mass.

The above-mentioned articles, together with a few small tools such as pliers, screw drivers and hammers, comprise the new equipment for the year.

Details of Infestations.

WINDHAM COUNTY.

As Windham County lies nearest to the center of the large infested region in New England and was the first county in the State to become generally infested with the gipsy moth, it may rightly be regarded as the most densely infested portion of Connecticut. Such is the case. The following table will show the conditions in the county in 1923 as compared with those in 1917, but does not include the towns of Thompson, Woodstock, Putnam and Plainfield, where the scouting was not completed this year.

Year	Colonies Found	No. of Egg-Clusters	Colonies Sprayed
1917.....	245	3,758	45
1923.....	150	3,089	114

By comparing these figures, it will be seen that the control measures taken and the work done have not been in vain. Parasites have been liberated over the entire county and it is our aim to collect egg-masses in this district this season to determine whether or not they have become established and to what extent they are working.

The following is a brief summary of the work done in each town in the county. In Brooklyn, though no large colonies were found, one of 34 egg-clusters in woodland owned by John Harrington a little west of the Old Trinity Church, and another of 23 egg-clusters in oaks in the Quinebaug mill yard, were the two largest colonies found in the town. Fifteen of the 16 colonies were sprayed by State men in the summer.

Canterbury was scouted in the early fall, and the infestations found were all in the northern half of the town. Three small colonies were found just south of Westminster village, and all others were north of this region. The largest was one of 83 egg-clusters in mixed woodland and a stone wall on land owned by Sherman Gallowy in the northwestern part of the town, near the Hampton line. Ten of the 13 infestations were sprayed by State men in June.

One of the five colonies found in Chaplin contained 24 egg-clusters, but the others were all small. Seven single egg-clusters were also found scattered widely over the town. The above-mentioned infestation was found in two white oaks on a woodland edge owned by John Evans in the extreme northwestern corner

of the town near the Ashford line. All five of the colonies were sprayed by State men during June.

Hampton was scouted the latter part of August, four colonies and five singles being found. The colonies were all small, the largest containing 17 egg-clusters on apple trees and in a stone wall on an abandoned farm in the northern end of the town about one quarter mile from the Ashford town line. Three of the colonies were sprayed in June by State men.

Killingly was used as a school for training new men this year. The result shows the town to be infested generally, and that there are several large colonies. Four of the largest will be described in this report. The largest one had 490 egg-clusters on willow, maple and apple trees located on Mechanics Street, Danielson. The willow trees were badly infested, and most of the egg-clusters were found on them. Another colony of 96 egg-clusters was found in woodland owned by Mrs. Simmons and Mrs. Clement located nearly on the Rhode Island State line in the southeastern part of the town. One of 73 egg-masses was found in woodland owned by E. T. Kelley near the Plainfield town line on the east side of Snake meadow brook. The fourth one contained 46 egg-masses on apple and oak trees along the edge of woodland owned by T. E. Hopkins near the Hygeia water reservoir. There were a number of other colonies containing from 15 to 25 egg-clusters each. During the summer, 63 of the 88 infestations in the town were sprayed by State men.

Plainfield was only partly scouted this year, about 20 miles of road in the southern part of the town being done. One colony of 16 egg-clusters and seven single egg-cluster infestations were found. The colony was on a white oak on the roadside at Joe Bole's place, located in the south center of the town near the Griswold town line. This place was sprayed in the summer by State men.

As in the case of Plainfield, Putnam was only about one-fourth scouted, the work being done in the eastern end of the town, where five colonies and four single egg-clusters form the total. None of the colonies were large, 16 egg-clusters in an apple orchard at Cady's corner being the largest. Three of the colonies were sprayed in the summer by State men.

In Scotland, the work was confined to the territory around last year's infestations on account of the lateness in the season when this town was reached. Two small colonies of seven egg-clusters each were found in the center of the town near the post office, one on land owned by Charles Wheeler and the other on land owned by Louis B. Crosby. One single egg-mass was found in an apple tree owned by Mr. Romson located in the extreme northwestern corner of the town. Both of the seven egg-cluster colonies were sprayed in June by State men.

Twenty colonies were discovered in Sterling this year, only two

of them being very large. One of 85 egg-clusters was found in an orchard owned by Mr. Brown, about one and a half miles north of Oneco village. The other contained 56 egg-clusters in an oak owned by E. Wicks, about two and a half miles north of the above-mentioned colony. Fifteen of these colonies were sprayed in June by State men.

About 26 miles of roadside scouting were done in the town of Thompson by men who were being trained. This took in nearly the whole northeastern quarter of the town. Eighteen colonies were found, all small except two; one of 128 egg-clusters in an apple orchard and stone wall on land owned by Allen Bixby along the State road connecting Brandy Hill and Webster, Mass., near the Midland division railroad crossing; the other was in woodland at the northern end of Quadick Reservoir owned by Sheriff Bates, where 60 egg-clusters were found. Fifteen of the 18 places were sprayed during the last of June and first of July by State men.

Windham was one of the last towns to be scouted this year, and the spraying season came on before the work was completed. Thirty-five miles of roadway were covered and only one colony of six egg-clusters could be found. This was in an oak tree in a pasture owned by William F. Spokesfield in South Windham.

The scouting done in Woodstock was started in the late spring and the men kept at it until the spraying crew overtook them. Spraying was stopped on July 12, for by that time the larvae were nearly mature, and eating very little. Spraying under such conditions does very little good. Seventy infestations were found in the northern half of the town that was covered; single egg-clusters where larvae were found feeding were sprayed the same as colonies of five or more egg-clusters each. No very large colonies were found, four of the largest being as follows: one of 67 egg-clusters in a roadside oak owned by Edward Chamberlin near the north end of Roseland Lake; another of 50 egg-clusters in an orchard and woodland owned by L. M. Dodge in the northwestern corner of the town near the Massachusetts line; two others, one of 44 and one of 43 egg-clusters on land owned by Mr. Redhead and I. A. Paine respectively, located about two miles west of the North Woodstock post office, both in apple orchards. Sixty-five places were sprayed by State men in Woodstock this spring.

TOLLAND COUNTY.

Coventry was scouted by State men this year. The three largest colonies were found in a straight line east and west along the northern end of the town nearly parallel with the Tolland line. The other four infestations were small and widely scattered. One of the above mentioned colonies was in apple and oak trees in a pasture owned by Phineas Talcott, and contained 13 egg-clusters. Another of 17 egg-clusters was found in an old apple tree

on land owned by S. R. Carpenter, and the third had 11 egg-clusters in an orchard owned by W. R. Hawkins. Spraying was done at two of these places on June 17 by State men.

The scouting done in Ellington was in the sections of the town where infestation occurred last year, and all but two of the infestations were found on or near the Vernon and Somers State road. These were all small, one of 14 egg-clusters in Mr. Kobbe's orchard near the Somers line being the largest, and another of nine egg-clusters in an orchard and wall owned by Frank Gotcha about two miles east of the colony just described. On June 13, five of the colonies in Ellington were sprayed by State men.

Several large colonies were discovered in Mansfield this year. The town is generally but lightly infested. Three of the largest colonies may be described as follows: one of 68 egg-clusters was found in shade trees in the dooryard of W. H. Dumack in the extreme southwestern corner of the town; another of 60 egg-clusters in an orchard owned by Mr. Early in Mansfield Center; the last was a colony of 53 egg-clusters in apple and plum trees owned by Bark Shelchofer in the Merrow district. Thirteen colonies were sprayed in June by State men.

The three infestations found in Somers this year were discovered by a Federal man while making collections and observing the date of the first hatching of larvae in this section of New England. They were cleaned up and creosoted by State men, and also two of the places sprayed on June 12. None were large colonies, the largest being one of 18 egg-clusters in two apple trees in a pasture owned by Mr. Miller. Another of six egg-clusters was in two apple trees in a pasture owned by F. Kibbe in the village of Somers. A third infestation of two egg-clusters was found in an orchard about one and a half miles north of the two colonies just mentioned and owned by H. N. Kibbe.

On account of the lateness in the season when scouting was taken up in Tolland, the work was confined to the territory around last year's infestations. Scouting was done in an area about one mile outside each place where the gipsy moth was found last year, but nothing was found at any of these places.

Similar work was done in Vernon, and no egg-clusters were found in the town.

In Willington, nearly all the infestations were found in the northern half of the town, the largest one being in an orchard owned by Frederick Draper, about a mile east of West Willington post office, containing 33 egg-clusters. Another of 32 egg-clusters was found in an orchard owned by Felix Kash on the State road leading to Stafford Springs, about one mile south of the Stafford line. Twenty-five egg-clusters were found in an orchard owned by Emery Kucko in the north center of the town. The other colonies were nearly all under five egg-clusters each, and 11 places were sprayed in June by State men.

HARTFORD COUNTY.

The scouting in Hartford County was all done by State men this year and every town in the county was fully scouted except Marlborough. In Bristol, Canton, Glastonbury, Manchester, Newington; Plainville, West Hartford and Windsor Locks no gipsy moth infestations were found.

In Avon, one colony of 12 old egg-clusters was found on oaks in woodland owned by Edward Lasing, near the center of the township. In the spring after hatching had started, men were sent to look for larvae or signs of feeding there, but as none were found, no further work was thought necessary.

One colony of four egg-clusters was found in Berlin on a roadside maple on the property of Ralph R. Carter, near the Hartford State road just south of Berlin village. On June 18, this colony was sprayed by Federal men.

Four of the six infestations found in Bloomfield were situated within one mile of the post office and the other two were in the northwestern part of the town. The largest colony contained 40 egg-clusters on willow and oak trees owned by William Sherman at the first four corners west of the post office. The next largest colony was on apple trees owned by Miss Isabelle Tollar in the northwestern part of the town, where 13 egg-clusters were found. The other infestations were small. All six places were sprayed on June 19 by Federal men.

In Burlington, two colonies were found this year, one of 14 egg-clusters in an orchard owned by Mr. K. Szuster in the northwestern part of the town, and another of nine egg-clusters also in an orchard, in the southwestern corner of the town and owned by Mr. Christian Dichal. The first colony mentioned was sprayed June 21 and the other June 25 by Federal men.

Three infestations were found in East Granby this season. Two of them were large ones for this territory, although not hard to reach and control. The first was one of 70 egg-clusters found on willow trees and fence posts owned by Mr. Vitten about one-half mile north of the post office. The next largest was one of 63 egg-clusters on trees in a yard owned by E. W. Kellogg in the extreme northwestern part of the town. One small colony of two egg-clusters was found in an orchard owned by J. R. Holcomb. All three of the infestations were sprayed by Federal men on June 25.

East Hartford was scouted during the last of March and the first of April. One colony was found along the Connecticut River bank just north of the bridge on land owned by the Hartford Bridge Commission, where 31 egg-clusters were found on four willow trees. Two other small infestations were found in the town. Two places were sprayed on June 11 by State men.

Four small infestations were found in East Windsor, the largest colony containing seven egg-clusters, in an orchard owned by

Mrs. A. E. Haynes in the eastern part of the town. The other three infestations contained one, two and three egg-clusters respectively. Three of these infestations were sprayed on June 11 by State men.

In Enfield, one colony of 10 egg-clusters and three smaller ones were found. They were widely separated, there being one on each side of the town. The colony mentioned above was found in oaks on land owned by Andrew Gornet in the southeastern corner of the town. All four of the places were sprayed June 12 by State men.

In Farmington, two colonies and one single egg-cluster were found this year. Thirty-five egg-clusters were found in apple trees on land owned by John Wall about one mile west of the village. The other colony was in woodland owned by Charles Beech in the extreme northeastern corner of the town, where there were 28 egg-clusters on 10 different trees. Both these colonies were sprayed in the spring by Federal men. Twelve acres of woodland were sprayed at the woodland colony.

Five infestations were found in Granby this year, containing a total of 159 egg-clusters. Of this number, 145 egg-clusters were found in woodland owned by Max Shinder in the southwestern corner of the town near the Canton line. The Federal men sprayed three of the infestations on June 23.

Six colonies were found in Hartford this season. Five of them had over 15 egg-clusters each, and one in particular was a very large colony. This infestation was situated near the river east of the Fuller Brush Company's factory on Windsor Avenue. Nine hundred and thirty-six egg-clusters were found on willow, oak and maple trees here. This colony was one of the hardest to control of any found in the entire State this year, as the land was under water nearly all this spring. Spraying was done, however, by Federal men about the middle of June, 625 pounds of dry lead arsenate being used in the operation. A colony of 25 egg-clusters was found on Farmington Avenue; one of 15 egg-clusters on West Boulevard on apple and maple trees owned by Mr. Kenneth French; a colony of 27 egg-clusters on apple, elm and willow trees near the brook west of Hillside Avenue; one of 22 egg-clusters on apple trees and rose bush in yard owned by A. O. Doule on Allen Place; and the last was a colony of 24 egg-clusters found on New Britain Avenue at the Kings Daughters House, on apple and poplar trees, and on the foundation and sides of the house. All the colonies were sprayed by Federal men in June.

Hartland had five infestations found in it this year, with a total of 29 egg-clusters; 15 were in an orchard owned by the T. A. Howell Estate in the northwestern part of the town; the other infestations were small. Four of the colonies were sprayed by Federal men in July.

In New Britain three single egg-cluster infestations and one colony of 110 egg-clusters were found in oak trees, on houses, hen coops and fences on Bassett Street opposite the High School. This colony was sprayed June 21 by Federal men.

One large colony containing 137 egg-clusters was found in Rocky Hill on a pasture oak owned by Thomas Griswold, in the center of the township. This colony was sprayed by Federal men on June 11.

A small woodland colony of five egg-clusters was found in Southington on land owned by Charles Stewart in the southeastern corner of the town near the Meriden town line.

The two colonies found in South Windsor were both in the northwestern part of the town; one of 18 egg-clusters was in two apple trees in a field owned by Paul Banker and the other was in an orchard owned by H. F. Farnham. Both of these places were sprayed on June 11 by State men.

The town of Suffield was found to have 17 infestations scattered over the entire township. Some were quite large; one colony in particular in willow trees on land owned by Miss Antoinette Clark about one mile north of the village, near the State road leading to Enfield contained 650 egg-clusters. There were two other large colonies, one in an orchard owned by William Carney of Hasting Hill, containing 50 egg-clusters, and the other in four willow trees on Holiday Avenue, owned by Walenta Drenscak, containing 45 egg-clusters. The other infestations were small. Sixteen of the 17 infestations were sprayed in June by Federal men.

In Simsbury two infestations were found, one along both sides of the State road just south of the village, on land owned by The Ensign-Bickford Company, containing 458 egg-clusters, on oak, apple and elm trees. The other was a small colony of three egg-clusters in an orchard owned by Anson P. Tyler in the western end of the town near the Canton town line. Both colonies were sprayed by Federal men. At the larger colony, 1,125 pounds of dry lead arsenate (making 18,000 gallons of spray mixture) were used.

In Wethersfield, four infestations containing 626 egg-clusters were found; 622 were on apple, maple and willow trees on both sides of the road running east from the village toward the Connecticut River, on land owned by Messrs. Rusti, Crane, T. Smith and Hale. The other three infestations were all close by and may be regarded as a natural spread from the large colony. Three of the places were sprayed in June by Federal men.

Three of the five infestations found in Windsor this year were close together in the southern end of the town near the Hartford line. The largest was one of 73 egg-clusters on willow and walnut trees in a field owned by J. M. Sloan; another just north of this colony had 16 egg-clusters on willow trees owned by George

Reed. One colony of 17 egg-clusters was found in an oak tree owned by William Kennedy in the northwestern part of the town. Four of the colonies were sprayed by Federal men on June 20.

LITCHFIELD COUNTY.

A large portion of the territory in Litchfield County was covered by the Federal men, including the following towns where no infestations were found: Bethlehem, Bridgewater, Canaan, Kent, North Canaan, Roxbury, Sharon, Warren, Watertown, Washington and Woodbury. Harwinton was scouted by State men and nothing found. The following is a description of the infestations in Litchfield County.

Barkhamsted was scouted by State men and three infestations discovered. All were small ones and in apple orchards. One colony was sprayed June 9 by Federal men.

State men scouted Colebrook and five infestations were found, three of which are herein described. The largest was one of 16 egg-clusters on apple and maple trees owned by L. J. Phelps near the Norfolk line. Another of 11 egg-clusters was in an apple orchard just east of Colebrook post office owned by W. E. Lewis. The third colony was a peculiar one, containing 10 male and 25 female pupae in cavities in old apple trees owned by G. C. McKenzie about half way between the two colonies mentioned above. The moths had all emerged but not a single egg-cluster could be found. Four of the infestations were sprayed in June by Federal men.

Cornwall was scouted by Federal men, one colony of 46 egg-clusters being found in the southern part of the town about one mile west of East Cornwall village, in woodland owned by W. C. Clark. Over 14 acres of woodland was sprayed here by Federal men in the summer.

One four egg-cluster colony was found in New Hartford by State men in an apple tree owned by Koch Brothers, about two miles west of the New Hartford post office. It was sprayed on July 9 by Federal men.

All work in New Milford was done by Federal men. One colony of 35 egg-clusters was found in woodland owned by F. L. Wanger and H. T. Erickson in the southern end of the town near the New Fairfield line. About 26 acres of woodland were sprayed.

The scouting in Plymouth was done by State men and confined to the territory around last year's infestation, but nothing was found.

Two infestations were found in Salisbury, both of them on property owned by Thomas Bornetti, about a mile north of the Salisbury post office. Eight egg-clusters were found at both places, and about four acres of woodland sprayed, all the work being done by Federal forces.

Torrington and Winchester were both scouted by State men. One old egg-cluster was found in each town. No further work was thought necessary.

NEW LONDON COUNTY.

East Lyme was scouted by State men this year the latter part of April and the first of May. One colony of 10 egg-clusters was found in woodland oaks owned by Mr. Dennison located on the road leading to Black point. This colony and woodland around it to the extent of one acre were sprayed in the summer by State men.

About 84 miles of roadside scouting was done in Griswold this spring by a State crew, the largest colony found being one of seven egg-clusters in woodland owned by William Sullivan in the northeastern corner of the town near the Plainfield town line. Another of five egg-clusters was found in white oaks in the village of Glasko. The five other infestations were all smaller. Four of the seven places were sprayed by State men about the middle of June.

There were three clusters of infestations found in Groton this year, one in each of the villages of Groton, Noank and Mystic river; in the remainder of the township only five scattered colonies were found. The infestations were all small, 15 egg-clusters being the largest; these were in apple trees owned by Charles Heath and Charles Benjamin, located on the State road just west of Mystic River village. The next largest was in Noank on maple and apple trees owned by H. E. Bently, where 13 egg-clusters were found; the other infestations were nearly all under five egg-clusters each. Spraying was done at 12 of the 19 infestations this summer by State men.

In Lisbon three of the four infestations found were in the southern part of the town near the Quinebaug River, and the fourth was a single egg-mass in an orchard in the northern part of the town. There were two colonies large enough to mention; one of 21 egg-clusters found in apple and oak trees on land owned by Sherman Waters, and the other contained nine egg-clusters in an orchard belonging to Paul Geist. Both colonies were along the river; three of the infestations were sprayed on June 14 by State men.

One colony of 14 egg-masses was found in an old apple tree in Mr. John Barko's pasture in Montville this season. This tree was cut down and split open and the egg-clusters creosoted. No further work was thought necessary at this colony.

In New London two infestations were found, one of four egg-clusters on apple trees in the yard of Mr. E. N. Crocker, and the other of three egg-clusters on maple shade trees on town property. Both of these infestations were sprayed June 10 by State men.

Five infestations were found in Norwich, with a total of 31 egg-clusters. Over half of them were found at one place, in an

apple tree and stone wall in a pasture owned by Louis Webber in the district known as East Great Plain, containing 17 egg-clusters. The other four colonies were all small, five egg-clusters being the largest. Three of the five infestations were sprayed June 13 by State men.

The scouting in Old Lyme was confined to the sections of the town where gipsy moth infestations were found last year, namely, the northeastern and southwestern parts of the township. About 50 miles of roadside scouting was completed and nothing found.

One hundred and ninety-five egg-clusters were found in Preston, of which 144 were in two colonies. The first to be mentioned was the largest and was found in a white oak and stone wall in a pasture owned by Mr. Boswell, just west of Preston village on the south side of Prospect Hill, containing 122 egg-clusters. The next largest was one of 22 egg-masses, found on oak and apple trees in H. L. Harris' yard in the west end of the town near Laurel Hill; the four other colonies were small. All but one of these colonies were sprayed in June by State men; this one could not be reached with the hose available.

On account of the lateness of the season when reached, the scouting in Voluntown had to be confined to the areas around last year's infestations as larvae were already hatching. Three infestations were found, none of them large. Two of the colonies were close together in the southwestern corner of the town near the Griswold line; one contained seven and the other three egg-clusters. It was impossible to spray at these places as the road was impassable for the sprayer truck. The single egg-mass infestation found on an apple tree owned by Mr. Wilcox near the pond in Great Meadow Brook was sprayed as larvae were found feeding when the egg-cluster was discovered. This work was done by State men.

One egg-cluster was found in Waterford and the larvae had already hatched and were feeding. This egg-mass was in an apple orchard owned by G. W. Peabody, located about one mile north of Manetock Hill near Jordan Brook. This infestation was sprayed June 11 by State men.

MIDDLESEX COUNTY.

Only one town, Cromwell, in Middlesex County was completely scouted this year, though two other towns were partly scouted, all the work being done by State men.

In Cromwell, no egg-clusters were found.

Old Saybrook was scouted only around last year's infestations and nothing was found.

In Middletown, similar methods were used and one new egg-cluster found on an apple tree in an orchard owned by C. L. Johnson near Bear Hill. This egg-cluster was found just outside last last year's infestation at Mr. Johnson's place. Spraying was considered unnecessary.

NEW HAVEN COUNTY.

Two towns in New Haven County, Hamden and New Haven, were found to be infested this year, one colony being found in each town. That in New Haven was at 387 Howard Avenue, just south of the railroad bridge in three trees and on shrubs in a yard owned by M. J. Paxson, and contained six egg-clusters. The spraying was done on May 31 by State and Federal men.

The infestation in Hamden contained four egg-clusters and spraying was thought unnecessary. Federal men scouted these towns, and also Bethany, Derby, East Haven, Middlebury, Milford, Orange, Oxford, Southbury and Woodbridge, in which no infestations were found.

Branford, Guilford, Madison and North Branford were scouted by State men and no infestations found. In the towns of Cheshire, Wallingford, Waterbury and Wolcott, the scouting was confined to the territory around last year's infestations because the scouting season had so far advanced by the time these towns were reached that it was impossible to complete them before the men had to begin spraying. Nothing was found in these towns.

FAIRFIELD COUNTY.

The work in Fairfield County was done by Federal men and consisted of scouting three towns, namely: Brookfield, New Fairfield and Sherman, no spraying being needed because no infestations were found.

STATISTICS OF INFESTATIONS

Towns	No. Infestations Found	No. Egg-Clusters Creosoted	No. Colonies Sprayed	No. Lbs. Poison Used	No. Larvae Killed
Windham County—15 Towns Infested.					
Ashford[1]	0	0	0	0	0
Brooklyn	16	219	16	302	85
Canterbury	13	253	10	222	115
Chaplin	5	62	5	75	34
Eastford	0	0	0	0	43
Hampton	4	44	3	38	18
Killingly	44	2,114	63	820	761
Plainfield[2]	1	16	1	6	6
Pomfret[1]	0	0	0	0	59
Putnam[2]	5	50	3	45	60
Scotland	3	15	2	12	2
Sterling	20	376	15	178	118
Thompson[2]	18	485	15	168	1,311
Windham[2]	1	6	0	0	130
Woodstock[2]	70	1,085	57	705	1,352
	200	4,725	190	2,571	4,094

[1] Not scouted.
[2] Partially scouted.

STATISTICS OF INFESTATIONS—*Continued*

Towns	No. Infestations Found	No. Egg-Clusters Creosoted	No. Colonies Sprayed	No. Lbs. Poison Used	No. Larvae Killed
New London County—20 Towns Infested.					
Bozrah[1]	0	0	0	0	0
Colchester[1]	0	0	0	0	0
East Lyme	1	10	1	44	0
Franklin[1]	0	0	0	0	0
Griswold[2]	7	21	4	63	5
Groton	19	87	12	184	54
Lebanon[1]	0	0	0	0	0
Ledyard[1]	0	0	0	0	0
Lisbon[2]	4	33	3	37	20
Lyme[1]	0	0	0	0	0
Montville	1	14	0	0	0
New London	2	7	2	37	0
Norwich	5	31	3	25	6
No. Stonington[1]	0	0	0	0	0
Old Lyme[3]	0	0	0	0	0
Preston	6	195	5	66	19
Salem[1]	0	0	0	0	0
Sprague[1]	0	0	0	0	0
Stonington[1]	0	0	0	0	0
Voluntown[2]	3	11	1	12	0
Waterford	1	1 hatched	1	6	0
	49	410	32	474	104

[1] Not scouted.
[2] Partially scouted.
[3] Scouted only around infestations.

Towns	No. Infestations Found	No. Egg-Clusters Creosoted	No. Colonies Sprayed	No. Lbs. Poison Used	No. Larvae Killed
Tolland County—14 Towns Infested.					
Andover[1]	0	0	0	0	0
Bolton[1]	0	0	0	0	0
Columbia[1]	0	0	0	0	0
Coventry	7	50	2	22	0
Ellington[2]	9	39	5	63	67
Hebron[1]	0	0	0	0	0
Mansfield	31	405	13	131	169
Somers[2]	3	26	2	13	5
Stafford[1]	0	0	0	0	0
Tolland[3]	0	0	0	0	0
Union[1]	0	0	0	0	0
Vernon[3]	0	0	0	0	0
Willington	22	215	11	101	77
	72	735	33	330	318

[1] Not scouted.
[2] Partially scouted.
[3] Scouted only around infestations.

STATISTICS OF INFESTATIONS—*Continued*

Towns	No. Infestations Found	No. Egg-Clusters Creosoted	No. Colonies Sprayed	No. Lbs. Poison Used	No. Larvae Killed
Middlesex County—3 Towns Infested.					
Chester[1]	0	0	0	0	0
Clinton[1]	0	0	0	0	0
Cromwell	0	0	0	0	0
Durham[1]	0	0	0	0	0
East Hampton[1]	0	0	0	0	0
East Haddam[1]	0	0	0	0	0
Essex[1]	0	0	0	0	0
Haddam[1]	0	0	0	0	0
Killingworth[1]	0	0	0	0	0
Middletown[3]	1	1	0	0	0
Old Saybrook[3]	0	0	0	0	0
Portland[1]	0	0	0	0	0
Saybrook[1]	0	0	0	0	0
Westbrook[1]	0	0	0	0	0
	1	1	0	0	0

[1] Not scouted.
[2] Partially scouted.
[3] Scouted only around infestations.

Towns	No. Infestations Found	No. Egg-Clusters Creosoted	No. Colonies Sprayed	No. Lbs. Poison Used	No. Larvae Killed
Hartford County—29 Towns Infested.					
Avon	1	12*	0	0	0
Berlin[2]	1	4	1	4	0
Bloomfield	6	67	6	150	1
Bristol	0	0	0	0	0
Burlington	2	23	2	68	1
Canton	0	0	0	0	0
East Granby	3	135	3	225	10
East Hartford	3	35	2	19	1
East Windsor	4	13	3	31	5
Enfield	4	15	4	37	4
Farmington	3	64	2	581	0
Glastonbury	0	0	0	0	0
Granby	5	159	3	75	11
Hartford	6	1,043	6	587	1,178
Hartland	5	29	4	285	5
Manchester	0	0	0	0	0
Marlborough[1]	0	0	0	0	0
Newington	0	0	0	0	0
New Britain	4	113	1	344	20
Plainville	0	0	0	0	0
Rocky Hill	1	137	1	88	21
Southington	1	5	0	0	0
South Windsor	2	24	2	10	4
Suffield	17	913	16	612	183
Simsbury	2	461	2	1,175	301
Wethersfield	4	626	3	75	0
West Hartford	0	0	0	0	0
Windsor	5	110	4	162	3
Windsor Locks	0	0	0	0	0
	79	3,988	65	4,528	1,748

[1] Not scouted.
[2] Partially scouted.
*Old egg-clusters.

STATISTICS OF INFESTATIONS—*Continued*

Towns	No. Infestations Found	No. Egg-Clusters Creosoted	No. Colonies Sprayed	No. Lbs. Poison Used	No. Larvae Killed
Litchfield County—13 Towns Infested.					
Bethlehem[4]	0	0	0	0	0
Bridgewater[4]	0	0	0	0	0
Barkhamsted	3	9	1	30	50
Canaan[4]	0	0	0	0	0
Colebrook	5	34	4	475	1
Cornwall[4]	1	46	0	0	0
Goshen[1]	0	0	0	0	0
Harwinton	0	0	0	0	0
Kent	0	0	0	0	0
Litchfield[1]	0	0	0	0	0
Morris[1]	0	0	0	0	0
New Hartford	1	4	1	60	0
New Milford[4]	1	35	0	0	0
Norfolk[1]	0	0	0	0	0
North Canaan	0	0	0	0	0
Plymouth[3]	0	0	0	0	0
Roxbury[4]	0	0	0	0	0
Salisbury[4]	2	8	0	0	0
Sharon[4]	0	0	0	0	0
Thomaston[1]	0	0	0	0	0
Torrington[4]	1	1*	0	0	0
Warren[4]	0	0	0	0	0
Watertown[4]	0	0	0	0	0
Washington[4]	0	0	0	0	0
Winchester	1	1*	0	0	0
Woodbury[4]	0	0	0	0	0
	15	138	6	565	51

[1] Not scouted.
[2] Partially scouted.
[3] Scouted only around infestations.
[4] Scouted by Federal men.
*Old egg-cluster.

Towns	No. Infestations Found	No. Egg-Clusters Creosoted	No. Colonies Sprayed	No. Lbs. Poison Used	No. Larvae Killed
New Haven County—6 Towns Infested.					
Ansonia[4]	0	0	0	0	0
Beacon Falls[4]	0	0	0	0	0
Bethany[4]	0	0	0	0	0
Branford	0	0	0	0	0
Cheshire[3]	0	0	0	0	0
Derby[4]	0	0	0	0	0
East Haven[4]	0	0	0	0	0
Guilford	0	0	0	0	0
Hamden[4]	1	4	0	0	0
Madison	0	0	0	0	0
Meriden[1]	0	0	0	0	0
Middlebury[4]	0	0	0	0	0
Milford[4]	0	0	0	0	0
New Haven[4]	1	6	1	15	0
North Branford	0	0	0	0	0

STATISTICS OF INFESTATIONS—*Concluded*

Towns	No. Infestations Found	No. Egg-Clusters Creosoted	No. Colonies Sprayed	No. Lbs. Poison Used	No. Larvae Killed
New Haven County—*Concluded.*					
North Haven[1]	0	0	0	0	0
Orange[4]	0	0	0	0	0
Oxford[4]	0	0	0	0	0
Seymour[4]	0	0	0	0	0
Southbury[4]	0	0	0	0	0
Wallingford[3]	0	0	0	0	0
Waterbury[3]	0	0	0	0	0
Wolcott[3]	0	0	0	0	0
Woodbridge[4]	0	0	0	0	0
	2	10	1	15	0

[1] Not scouted.
[2] Partially scouted.
[3] Scouted only around infestations.
[4] Scouted by Federal Men.

Towns	No. Infestations Found	No. Egg-Clusters Creosoted	No. Colonies Sprayed	No. Lbs. Poison Used	No. Larvae Killed
Fairfield County—No Towns Infested.					
Brookfield[4]	0	0	0	0	0
New Fairfield[4]	0	0	0	0	0
Sherman[4]	0	0	0	0	0
	0	0	0	0	0

[4] Scouted by Federal men.

SUMMARY OF STATISTICS

County	No. Towns Covered	No. Infestations	No. Egg-Clusters Destroyed	No. Infestations Sprayed	No. Lbs. Arsenate Used	No. Larvae Destroyed	No. Miles Roadway Scouted
Windham	13	200	4,725	190	2,571	4,094	659
New London	11	49	410	32	474	104	751
Tolland	7	72	735	33	330	318	391
Middlesex	3	1	1	0	0	0	50
Hartford	28	79	3,988	65	4,528	1,748	2,083
Litchfield	21	15	138	6	565	51	1,529
New Haven	22	2	10	1	15	0	1,337
Fairfield	3	0	0	0	0	0	175
	108	418	10,007	327	8,483	6,315	6,975

Thus it will be seen from the preceding table that work was done in 108 towns last year; that 418 gipsy moth infestations were found and 327 of them sprayed with lead arsenate, using 8,483 pounds or nearly four and one-fourth tons; that 10,007 egg-clusters were destroyed with creosote, and 6,315 larvae destroyed, besides those which may have been killed by the spray; also that 6,975 miles of roadway were scouted by the State men in this

work. In the towns scouted by the Federal men, no record was kept of the number of miles of roadway covered.

Financial Statement.

RECEIPTS

Appropriation for biennial period ending June 30, 1925	$100,000.00

Classified Expenditures for the Period Ending June 30, 1924

Salaries and Wages		$33,749.13	
Printing and Illustrations		48.33	
Postage		12.14	
Stationery		9.56	
Telegraph and Telephone		27.51	
Insurance (supplies including horse sprayer)		29.97	
Spraying Supplies		337.50	
Machinery, Tools and Supplies		345.04	
Express, Freight and Cartage		2.43	
Rental and Storage		761.57	
Automobiles: New	$1,384.00		
Insurance	467.45		
Repairs	874.15		
Supplies and Equipment	1,019.14		
Gasoline	1,610.81		
Oil	161.29		
		5,516.84	
Traveling Expenses		363.42	
Inspection of Imported Nursery Stock		498.09	
Heat and Light		96.48	
			$41,798.01
Balance			58,201.99
			$100,000.00

Parasites.

A somewhat detailed account of the different parasites and predatory insects which have been introduced into this country to attack the gipsy moth may be found in the 22nd Report of the State Entomologist, page 313 (Report of this Station for 1922, page 313) and need not here be repeated. In last year's report, page 265, a table shows the number of individuals of the Japanese egg parasite, *Schedius kuvanae* How., which were liberated in Connecticut in 1923. In 1924, there were liberated in Connecticut, 733,650 *Schedius kuvanae,* 243,000 of another egg parasite, *Anastatus bifasciatus* Fonsc., by State men, and 3,000 of a larval parasite, *Apanteles melanoscelus* Ratz., by Federal men. All of these parasites were reared at the Government parasite laboratory in Melrose Highlands, Mass., and furnished by Mr. Burgess for distribution in Connecticut. The following list, also furnished by Mr. Burgess, shows the number of each kind of parasite liberated, as well as the towns where they were planted:

Gipsy Moth Parasites Liberated in Connecticut
Year Ending June 30, 1924

	Schedius kuvanae	*Apanteles melanoscelus*	*Anastatus bifasciatus*
Brooklyn	56,000		
Canterbury	24,000		
Chaplin	24,000		
Colchester	4,000	500	
Columbia			11,000
Coventry			16,000
Eastford	96,000		
East Lyme	17,900		
East Windsor			11,000
Ellington			23,000
Enfield			4,000
Griswold	40,000		
Groton	20,000		7,000
Hampton	40,000		
Hartford			7,000
Lebanon	9,850	500	3,000
Ledyard	12,000	500	11,000
Lisbon	20,000		
Mansfield			23,000
Montville		500	1,000
New London	28,000		5,000
No. Stonington	4,000		24,000
Norwich	24,000		5,000
Old Lyme	12,000		
Plainfield	20,000		
Pomfret	60,000		
Preston	12,000		15,000
Rocky Hill			2,000
Scotland	32,000		
Simsbury			3,000
Somers	20,000		
South Windsor		500	7,000
Sprague	12,050		
Stafford	24,000		1,000
Sterling	17,850		
Stonington	28,000		
Suffield			17,000
Tolland			25,000
Vernon		500	
Voluntown	32,000		
Waterford	12,000		3,000
Wethersfield			4,000
Willington			15,000
Windham	32,000		
	733,650	3,000	243,000

Unquestionably much benefit has resulted from the combined attacks of the various parasites in the New England area, though the reduction in the numbers of the gipsy moth should not be attributed wholly to the action of parasites. It is the opinion of all men engaged in gipsy moth work, that creosoting of egg-clusters, spraying around infestations, and low temperature which

kills the eggs, are in some measure responsible for the decrease and together with the parasites, have brought about the present conditions. We hope that these gratifying conditions may continue but this is uncertain. It is probably true that there was less stripping in Massachusetts in 1924 than for many years, and as shown in the table on page 255, there were fewer colonies found in Windham County (the County longest continuously infested) than in 1917. These results must in part be accredited to the work of parasites, but it is still too early to abandon the field to them and appropriations should be continued for several years until they surely and permanently gain control of the gipsy moth.

Barrier Zone.

The plan of establishing a barrier or control zone, beyond which the gipsy moth will not be allowed to gain a foothold, was first advocated at a conference held in Albany, November 16, 1922. The proceedings of this conference were published as Agricultural Bulletin 148, Department of Farms and Markets of the State of New York, Albany, December, 1922, and the resolutions were included in the Report of this Station for 1922, page 325. Such a zone would be of no value unless extremely careful and thorough work is maintained in it, and this work is obviously the province of the Federal forces aided by those States west of the zone. However, the success of the plan depends principally upon appropriations adequate to carry it out. Nevertheless, to some extent its success will depend upon the degree of infestation near and east of the barrier zone, and here is where the New England States can help; for if the degree of infestation in western New England is slight, it will be much easier to maintain such a zone. If this area were intensely infested, and the condition favorable for windspread westward, infestations would certainly be carried into and beyond this zone, and it would be difficult and expensive to eradicate them.

This proposed barrier or control zone extends from the Canadian border on the north to Long Island Sound on the south, and includes Lake Champlain and the Hudson River with a strip of land east and west of both, until the Highlands are reached, when it is deflected toward the southeast, crossing Connecticut in a line from New Milford to New Haven. This zone is approximately thirty miles in width.

Quarantines.

As the Connecticut quarantine was last revised and became effective on July 20, 1922, and many additional towns have since been found infested and placed under Federal quarantine, it seemed best to make the State quarantine coincide with the Federal quarantine. Consequently, after due hearing as provided by Section 2106 of the General Statutes, the following quarantine order was

issued as Bulletin of Immediate Information, No. 44, effective July 20, 1924:

STATE OF CONNECTICUT

AGRICULTURAL EXPERIMENT STATION

NEW HAVEN, CONN.

QUARANTINE ORDER NO. 6

Concerning Gipsy Moth

In order to protect uninfested parts of Connecticut from danger of infestation by the gipsy moth, under authority given in Section 2106 of the General Statutes, the following regulations are hereby established.

1. The following towns are hereby placed under quarantine because of the gipsy moth:—

HARTFORD COUNTY:

Avon	Farmington	Plainville
Berlin	Glastonbury	Rocky Hill
Bloomfield	Granby	Simsbury
Bristol	Hartford	Southington
Burlington	Hartland	South Windsor
Canton	Manchester	Suffield
East Granby	Marlborough	West Hartford
East Hartford	New Britain	Wethersfield
East Windsor	Newington	Windsor
Enfield		Windsor Locks

LITCHFIELD COUNTY:

Barkhamsted	Harwinton	Plymouth
Canaan	Litchfield	Salisbury
Colebrook	New Hartford	Thomaston
Cornwall	Norfolk	Torrington
Goshen	North Canaan	Winchester

MIDDLESEX COUNTY:

Chester	East Hampton	Middletown
Clinton	Essex	Old Saybrook
Cromwell	Haddam	Portland
Durham	Killingworth	Saybrook
East Haddam	Middlefield	Westbrook

NEW HAVEN COUNTY:

Branford	Madison	Wallingford
Cheshire	Meriden	Waterbury
Guilford	North Branford	Wolcott
	North Haven	

NEW LONDON COUNTY:

Bozrah	Ledyard	Old Lyme
Colchester	Lisbon	Preston
East Lyme	Lyme	Salem
Franklin	Montville	Sprague
Griswold	New London	Stonington
Groton	North Stonington	Voluntown
Lebanon	Norwich	Waterford

TOLLAND COUNTY:

Andover	Ellington	Tolland
Bolton	Hebron	Union
Columbia	Mansfield	Vernon
Coventry	Somers	Willington
	Stafford	

WINDHAM COUNTY:

Ashford	Hampton	Scotland
Brooklyn	Killingly	Sterling
Canterbury	Plainfield	Thompson
Chaplin	Pomfret	Windham
Eastford	Putnam	Woodstock

These same towns have already been quarantined by the Federal Horticultural Board of the United States Department of Agriculture, and it shall be unlawful to remove from this quarantined area any woody nursery stock, lumber, cordwood, telegraph or telephone poles, railroad ties, or other forest plant products, unless the products shall have been inspected and certified by an authorized State or Federal inspector.

2. In view of possible future changes in the lines between the infested and non-infested areas of the State, the areas quarantined by the State shall conform to those quarantined by the United States Department of Agriculture: furthermore the regulations established by the Federal Horticultural Board of the United States Department of Agriculture for inter-state shipments, are hereby adopted for the inspection and certification of similar shipments from the quarantined area to points outside of this area within the State of Connecticut.

3. This order shall take effect from its date..

Dated July 20, 1924.

W. L. SLATE, JR.
Director, Connecticut Agricultural Experiment Station.

Approved:
CHARLES A. TEMPLETON,
Governor.

The quarantined area is shown on the accompanying map, and includes the following towns not covered in quarantine order No. 4: Cornwall and Litchfield in Litchfield County; Cheshire, Wallingford, Meriden, North Haven, Branford, North Branford, Guilford and Madison in New Haven County; Middlefield, Durham, Haddam, East Haddam, Killingworth, Clinton, Westbrook, Chester, Saybrook, Essex and Old Saybrook in Middlesex County; Lyme and Old Lyme in New London County.

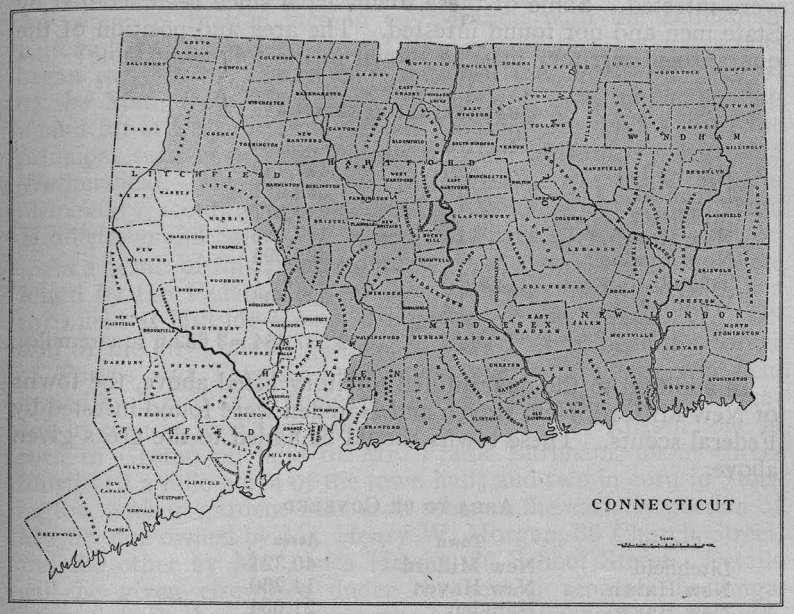


Figure 7. Map of Connecticut. The shaded portion represents the area quarantined on account of the gipsy moth.

All woody field grown nursery stock and forest products to be shipped from the quarantined area into the free area must be inspected by a State or Federal inspector and certified. All frequent shippers should procure a Federal map showing the quarantined area, the location and address of each Federal inspector and the area covered by him. These maps may be obtained from Mr. D. M. Rogers, 408 Atlantic Avenue, Boston, Mass.

An arrangement has been made by which inspections can be made by both State and Federal inspectors. Applications for inspection should be made to the nearest Federal Inspector or to:

D. M. Rogers, 408 Atlantic Ave., Boston, Mass., in charge of Federal inspection service; or

W. E. Britton, State Entomologist, Agricultural Experiment Station, New Haven, Conn., in charge of State inspection service.

Area Which Must Now Be Covered in Gipsy Moth Work.

The greatly increased area now under State and Federal Quarantine in Connecticut because of the gipsy moth includes 118 of the 169 towns of the State, though in some of these towns, especially in New Haven and Middlesex Counties near the coast, no gipsy moth infestations have ever been found. They were included in order to be on the safe side because there was not time to scout them all and it was uncertain whether or not they were infested. Some of these towns have since been scouted by State men and not found infested. The area and position of the quarantined territory may be shown in the following table:

Quarantined Territory.

County	No. Towns	No. Acres
Hartford	29	477,749
Litchfield	15	359,071
Middlesex	15	249,377
New Haven	10	187,083
New London	21	465,091
Tolland	13	266,617
Windham	15	332,696
	118	2,337,684 = 3,652.6 square miles.

In addition to the quarantined territory listed above, the towns of New Milford, New Haven and Hamden were found infested by Federal scouts. These towns should be added to the areas given above.

Area to be Covered.

County	Town	Acres
Litchfield	New Milford	40,321
New Haven	New Haven	14,260
New Haven	Hamden	21,054
	Three towns	75,635
Quarantined area	118 towns	2,337,684
Total	121 towns	2,413,319 = 3,770.8 square miles.

Recommendations.

Considering the large increase in territory to be covered; that there has never been a sufficiently large appropriation to cover the infested territory in one season, and that it will now be difficult to get over it all in two seasons; that it is uncertain just how much can be done by the Federal forces in Connecticut: we have asked for an appropriation of $140,000.00 for the next two years. This is an increase of $40,000.00 over the last appropriation, and seems necessary if the work is to be done properly over the larger territory. The amount requested ($140,000.00) is equivalent to $37.13 per square mile, or five and eight-tenths cents (.058) per acre of ground which must be covered.

THE EUROPEAN CORN BORER IN CONNECTICUT.

W. E. Britton and M. P. Zappe.

In the Report of this Station for 1923, page 277, is an account of three small infestations of the European corn borer, *Pyrausta nubilalis* Hubn., discovered along the Connecticut shore, and measures taken to eradicate them. During 1924, further work was done by Station men in co-operation with the Bureau of Entomology, U. S. Department of Agriculture. Federal scouts began early in the season and examined the entire coast region of the State from New York to Rhode Island, and extending inland for at least one mile. Then scouting was done around the principal seed corn growing districts in Milford, Orange and Wethersfield. Messrs. Zappe and Rogers of this office did supplementary scouting in Woodbridge, Wethersfield, Rocky Hill, Middletown and Salem, equivalent to 14 man days.

As a result of this scouting work, seven small infestations were found by the Federal men in the following locations: one in a corn field at Hillside Home, Bridgeport, in the northeastern portion of the city; one in gardens in New Haven, near the corner of Forbes and Townsend Avenues; one in a small corn field owned by Mr. Way on the eastern side of the town of Old Lyme; one in corn in East Lyme on land of Mr. E. W. Russell; one in corn in Groton on land of Mr. Frank Burnham, about three-fourths of a mile north of the town hall; and two in corn in Stonington, both in gardens near each other in the easterly portion of Mystic, one owned by Mr. Henry W. Morgan, 36 Church Street, and the other by Mr. Amos Hewitt, 26 School Street. Details will be given elsewhere under the several separate headings. After finding the infestations, the region immediately surrounding each was scouted two or three times to see if more larvae could be obtained.

For a portion of the time, the wages and expenses of the Federal scouts were paid from the insect pest appropriation granted to the Station for such work. In cleaning up around the seven infestations, both State and Federal men worked together. This arrangement made it possible to have the use of one of the Federal truck sprayers, designed for burning oil. The State paid for the oil, 5,485 gallons being used. For this purpose, fuel oil was purchased at eight cents per gallon. Burning operations were started on December 1, and completed December 12, 1924.

We desire here to express our appreciation and thanks to Messrs. L. H. Worthley, D. J. Caffrey, and their associates for the efficient and satisfactory co-operation and assistance which they have rendered to the State of Connecticut in this work.

Methods of Clean-Up Work.

The approved methods of clean-up work in and around small infestations of European corn borer, consist of burning all corn stalks, stubble and weeds. It is necessary to dig out the stubble which has been left after cutting the corn, and for this purpose a light mattock is a satisfactory tool. One blow will often dig the stubble from an entire hill, though in other cases it may require several blows, depending upon the number, size and distance apart of the stalks in the hill. On light soil where the corn is small, a potato hook is a handy tool for getting the stubble out of the ground. The roots should be shaken clean of soil as they will dry more readily, burn better and thus effect a saving in oil. Just before burning, the stubble should be raked into windrows or small piles. Shocks of corn may be burned just as they stand in the field.

The burning is greatly facilitated by using a power spray outfit so that the oil is under a pressure of between 150 and 200 pounds. It is conducted through a hose and thrown out through special triplex nozzles made for the purpose and placed on the end of a rod fitted with shut-off so that the operator may stop the flow when not needed (see Plate XXI, b.). The oil is ignited at the nozzles and makes a very hot fire. Corn stalks which are still rather green and contain a large amount of juice are soon heated to such a temperature that all larvae are killed. Dry stalks and weeds are entirely and almost immediately consumed. The entire field is gone over in this manner so that when completed, the field is black and nothing remains except a few charred pieces of corn stalks. All weeds around the margins of the field are also burned.

Bridgeport Infestation.

Hillside Home is the "poor farm" of Bridgeport and is situated on Bond Street just northeast of the city. The infestation was discovered by Federal scouts on July 24, 1924, when two larvae were found in smartweed in a corn field of about two acres near a spur railroad track. Later, October 23, one larva was found in this field in smartweed. The authors visited the place on this date in company with Mr. T. M. Cannon, of the Federal forces, to make plans for the clean-up. The corn had been harvested and put in the silo, and only some stalks, the high stubble and weeds remained. As we were short of help, we asked the Superintendent if he could have the stubble dug so that it would dry off before the time for burning, thinking that he would use some labor of the inmates for this purpose. He promised to do this, and we were greatly surprised when we went to burn, to find that he had tried to plow out the stubble. Some of it was partly plowed under, some loosened with large balls of earth, and most

of it was not disturbed at all. As there had been considerable rainy weather, the roots and stubble were not dry and were difficult to burn. Another corn field of about four acres across the spur railroad track and southeast of the infested field contained many weeds and was also burned over, making about six acres altogether burned over in the Bridgeport infestation. The burning was done on December 5, 8, 9, 10 and 11, and required 27 man days and 3,285 gallons of oil (see Plate XXI).

New Haven Infestation.

This infestation was in a small patch of sweet corn in the adjoining yards of Messrs. Edward W. Lovesey and E. Scandano, near the corner of Townsend and Forbes Avenues, commonly known as the Grannis Corners section. Two larvae were found in sweet corn August 25, 1924. A broom factory is located at 1180 Townsend Avenue and Mr. Lovesey's garden is directly back of the broom factory, though the land fronts upon Woodward Avenue. It is believed that the pest came here in imported broom corn as a number of burrows were found in the butts which had been trimmed off, and one dead larva was found in a burrow. There were also several small plots of sweet corn in adjacent yards altogether covering perhaps two acres. The corn had been cut, so the stubble was dug, and stalks, stubble and weeds burned. Some of the clippings from the broom factory had been dumped on Peat Meadow Road a short distance eastward, and we found exit holes of the borers in some of the clippings. These were all burned, together with all weeds in the vicinity, including those on the western side of the swamp. The stubble in the gardens was all dug in a half day by two men and the burning crew of six men completed the burning around the New Haven infestation in one day, using about 600 gallons of oil. The burning was done on December 4, 1924. (See Plates XXII and XXIII).

Old Lyme Infestation.

The infestation in Old Lyme was discovered on July 10, 1924, when one larva was found in a small corn field owned by Mr. Allen Way, beside the Four Mile River Road and about half-way between the shore road and the post road on the easterly side of the town. This field was surrounded on three sides by pasture and brush land and on the fourth side by the highway. Across the highway was more brush land. The field was about one-half acre in extent, and the corn had been cut and fed to cattle. The stubble was dug in a day by two men. Then it was raked together in a large pile, and this pile together with weeds all around the field was burned in one-half day by a crew of six men, using only about 100 gallons of oil, on December 12, 1924.

East Lyme Infestation.

This infestation was not discovered until November 15, 1924, when Messrs. Lantz and Habberly, Federal scouts, found four larvae in corn beside the west-bound railroad tracks, near the underpass close to the Crescent Beach railroad station. This corn was on Fairhaven Road and was owned by Mr. E. W. Russell. An adjacent field owned by Mr. Stone was near the original infestation and was also burned over. Mr. Russell had two fields:—one of two acres of late planted corn, grown as fodder for cows, another of about one acre of early sweet corn, the stalks of which had been cut and fed to cows. The corn in the larger field had been cut and placed in shocks.

Mr. Stone's corn was late sweet corn, about a half-acre in extent and was growing between the rows of young apple trees. The corn had not been cut, so had to be pulled and moved away from the apple trees before burning. There were also many large weeds which were burned.

In Mr. Russell's fields, the stubble had to be dug and raked together. Five men spent two days preparing these fields for burning and six men did the burning on December 2, 3 and 12 in two and one-half days, using 1,300 gallons of oil.

Groton Infestation.

At this infestation, Federal scouts discovered seven larvae in sweet corn, July 28, 1924, on land owned by Mr. Frank J. Burnham on North Road, about three-fourths of a mile north of the Groton Town Hall. The corn was evidently fed to livestock so that there was little to burn, but on December 1, the bits of stalks as well as the weeds on the land and especially around the edge of a swamp were burned, using 100 gallons of oil.

Stonington Infestations.

Both infestations in Stonington were discovered by Federal scouts on August 4-5, 1924, and these were both on the easterly side of the village of Mystic. One was in the garden of Mr. Henry W. Morgan, 36 Church Street, where two larvae and six pupae were found in corn, and the other was in the garden of Mr. Amos G. Hewitt, 26 School Street, where also two larvae and six pupae were found in the stalks of sweet corn.

The stubble and large weeds in both gardens were dug in one day by two men and left about two weeks to dry. The burning was done on December 1, in about one-half day, and 100 gallons of oil were used. Some corn and weeds in a yard adjoining Mr. Hewitt's were burned at the same time, altogether covering perhaps an acre of ground in Stonington.

Summary of Clean-Up Work.

The clean-up work may be summarized in the following table:

Towns Infested	No. Acres	Time Digging Stubble-Days	Time Burning Man Days	Date of Burning	Oil Used Gallons
Stonington	1	2	3	Dec. 1	100
Groton	1	0	3	Dec. 1	100
East Lyme	3.5	10	15	Dec. 2, 3, 12	1,300
Old Lyme	.5	2	3	Dec. 12	100
New Haven	2	1	6	Dec. 4	600
Bridgeport	6	0	27	Dec. 5, 8, 9, 10, 11	3,285
Total	14	15	57		5,485

Repeal of Quarantine.

At a conference held in Washington, D. C., April 28-30, 1924, at which many officials of the eastern states, Federal Horticultural Board, and United States Department of Agriculture were present, the whole subject of quarantines was considered and recommendations adopted. It was the sentiment of the conference that quarantines should not be established by states against other states when action on the subject has been taken by the Federal Horticultural Board fully covering the matter. The Federal quarantines are generally considered to control inter-state shipments and not those from one point to another within the bounds of a state.

The Connecticut quarantine against the European corn borer was first established, and became effective September 20, 1918. This was revised to include additional territory found to be infested, and Quarantine Order No. 3 was issued, effective June 1, 1920. A further revision was made in Quarantine Order No. 5, effective June 1, 1923, relating to this insect.

Up to this time, these three quarantine orders issued because of the European corn borer, placed restrictions only on shipments entering Connecticut from the infested territory in eastern New England, New York, Pennsylvania, Ohio and Michigan, as no infested territory had been discovered in Connecticut, and could not, therefore, be placed under quarantine. It was evident that our quarantine would be regarded as a restriction placed by a state upon inter-state commerce, and would probably be declared unconstitutional if it came to a test. Moreover, the State of Connecticut had been adequately protected by the Federal quarantine. Consequently the following order was issued:

STATE OF CONNECTICUT

OFFICE OF

AGRICULTURAL EXPERIMENT STATION.

NEW HAVEN, CONN.

QUARANTINE ORDER No. 7.

Effective July 1, 1924.

Whereas, Quarantine Order No. 5, issued from this Office effective June 1, 1923, on account of the European corn borer, *Pyrausta nubilalis* Hubner, prohibited certain portions of corn and other plants from infested regions of Maine, New Hampshire, Massachusetts, Rhode Island, New York, Pennsylvania, Ohio and Michigan, from being brought into Connecticut, the following memoranda may be recorded:

1. That all regions where this insect now exists are under Federal Quarantine.
2. That Connecticut is therefore duly protected by Federal Quarantine.
3. That no portion of Connecticut has been placed under Federal Quarantine on account of the European corn borer.
4. That it was the voice of the quarantine conference at Washington, D. C., April 28-30, 1924, that States should not establish quarantines against other States when the subject has been fully covered by Federal action.
5. That the Federal Quarantine takes precedence in such cases where there is a seeming conflict, and the State quarantine is null and void.
6. That the present case in no way prejudices future action regarding an intrastate quarantine, when it has been found that a portion of the State has become infested.

The present European corn borer regulations (Quarantine Order No. 5) are hereby repealed.

This order shall take effect July 1, 1924.

W. L. SLATE, Jr., Director,
Connecticut Agricultural Experiment Station.

Approved:
CHARLES A. TEMPLETON, Governor.

FURTHER WORK NEXT SEASON.

It will be necessary to do considerable scouting work next year, around these infestations to see if any traces of the pest can be found. Probably it will also be best to rescout the same or similar territory each year to make sure that the European corn borer has not established itself. Various sections of the State will also need to be scouted where there may be danger of infestation or to protect some local vegetable or seed growing industry.

Anticipating work of this nature, an item of $5,000 was placed in the budget of the Station for the next fiscal period, to defray the cost of work against the European corn borer. At this writing it seems doubtful if this will be enough, as more than half as much has already been expended against this insect in the single season of 1924.

INSECTS FOUND ON TWIGS OF FRUIT TREES.

In February, 1924, the officers of the Connecticut Pomological Society requested that the Station give additional services to fruit grower members of the Society by furnishing definite and timely information and advice regarding spray treatment for the various insects and diseases found in Connecticut orchards. After a full consideration of the matter, it was decided to attempt this project and of course the work naturally belongs in the Departments of Entomology and Botany.

It was decided that we needed more data on exact conditions in the various orchards, and that some data could be gathered by personal visits, but that orchardists should send in suspected twigs for examination and report. Messrs. Zappe, Garman and Stoddard visited several orchards, examined the trees for pests, made notes, and in some cases brought back twigs for microscopic examination. Orchardists also cut and sent twigs which were examined for insects in the laboratory by Dr. Philip Garman. In this manner, twigs from 18 different apple orchards were given this laboratory examination and the results afterwards reported to the owners or managers. The result of this examination as regards insects on apple is shown in the following table:

Insect Inhabitants of Apple Twigs.

Examined March and April, 1924

H—Heavy, M—Medium, L—Light.

Name and Locality	Date	European red mite eggs	Oyster-shell scale	Woolly aphid galls	Bark Miner Tunnels	Rosy aphid eggs	Buffalo tree hopper eggs	Ormenis sp. eggs	Tent-caterpillar egg-masses	Name
Hale Orchard Co., Seymour	Mar. 7	Baldwin—H. McIntosh—L.	Baldwin—H.	Baldwin—L. Greening—L.	Baldwin Delicious	0	0	Greening*	0	(Hale)
C. L. Gold, West Cornwall	10	0	McIntosh—L.	McIntosh	0	0	0	0	0	(Gold)
W. F. Platt, Milford	10	Baldwin—L. McIntosh—L. Fall Pippin—L. Greening—L.	Greening—L.	Greening—L. Fall Pippin—L.	McIntosh Fall Pippin	Baldwin—L. McIntosh—L. Fall Pippin—L. Greening—L.	0	0	0	(Platt)
C. E. Lyman Estate, Middlefield	11	Baldwin—L. McIntosh—L. No. Spy—L. Fameuse—L. Ben Davis—L.	0	Baldwin—L. McIntosh—L. Fameuse—L. Ben Davis—L.	Baldwin No. Spy	McIntosh	0	0	1 on Fameuse	(Lyman)
E. Rogers & Son, Southington	12	Baldwin—H. McIntosh—L.	0	Baldwin—L. McIntosh—L.	Baldwin	0	0	0	0	(Rogers)
E. M. Ives, Meriden	12	Baldwin—L. McIntosh—L.	0	McIntosh—L.	McIntosh Other vars.	0	0	0	0	(Ives)
Frank N. Platt, Milford.	14	Baldwin—L. Other var.—L.	0	Baldwin—L. Other var.—L.	Baldwin Other var.	Baldwin Other var.	0	Other var.	0	(Platt)
L. H. Warncke & Son, Cannondale	15	Baldwin—M. Greening—L.	Greening—L.	Baldwin—L. Greening—L.	0	Greening—L.	Greening	0	1 on Greening	(Warncke)
Conn. Agr. College, Storrs	17	Baldwin—L. McIntosh—L. Fall Pippin—M. Winesap—M.	0	Baldwin	0	0	No. Spy	0	0	(College)
J. H. Hale Co., So. Glastonbury	18	Var. ?—L.	0	Var. ?—L.	Var. ?	Var. ?—L.	Var. ?—L.	Var. ?—L.	0	(Hale)
L. C. Root & Son, Farmington	19	Baldwin—H. McIntosh—M. Fall Pippin—L.	0	Baldwin McIntosh	Baldwin McIntosh Fall Pippin	0	0	0	0	(Root)
Mountain View Orchard Co., Hazardville	20	Baldwin—H. Greening—L.	0	Greening—L.	0	0	0	0	0	(Mt. View)
A. F. Greene, Middlebury	22	McIntosh—L. Other var.—L.	0	Other var.—L.	McIntosh Other var.	McIntosh	0	0	1 on McIntosh	(Greene)
Walter H. Baldwin, Cheshire	22	0	0	Baldwin—L. Wagener—L. Sutton—L.	0	0	McIntosh	0	0	(Baldwin)
Conyers Farm, Greenwich	25	McIntosh—L. Gravenstein—L.	0	McIntosh—L. Gravenstein—M. King—L.	0	0	0	McIntosh	0	(Conyers)
Conn. Valley Orchard Co., Deep River	27	0	0	King—L. Russet—L.	King Russet	0	0	0	0	(Conn. Valley)
Gulley & Son, Rockville.	Apr. 1	Fall Pippin—L.	0	McIntosh—L. Fall Pippin—L.	McIntosh Gravenstein	Wagener—M. Fall Pippin—L.	0	Wagener Gravenstein	0	(Gulley)
S. A. Smith & Son, Clintonville	14	Delicious—L.	0	McIntosh—L.	0	0	McIntosh	McIntosh Delicious	0	(Smith)

* Also a few cigar cases of *Coleophora*.

In addition to the apple twigs examined, some peach and pear twigs were also received and examined. Thus Elberta peach twigs from the Hale Orchard Co., Seymour; peach twigs from E. Rogers & Son, Southington; Elberta from L. H. Warncke & Son, Cannondale; peach twigs from the Connecticut Agricultural College, Storrs; Elberta from the Mountain View Orchard Co., Hazardville; Hiley from Conyers Farm, Greenwich; Stump, Elberta and another variety from the Connecticut Valley Orchard Co., Deep River; and Mountain Rose, Belle of Georgia, Carman and Elberta from Gulley & Son, Rockville, exhibited no pests. Elberta from W. F. Platt & Son, Milford, from the C. E. Lyman Estate, Middlefield, and Hale, Elberta and Greensboro from L. C. Root & Son, Farmington, showed eggs of the European red mite, *Paratetranychus pilosus* C. & F., though the infestations were light in all cases. One of the peach twigs from Milford showed evidence, though not unmistakable proof, that it had been attacked by the Oriental peach moth, *Laspeyresia molesta* Busck.

Pear twigs from the Connecticut Agricultural College had been infested with pear psylla, *Psylla pyricola* Foerster, and twigs from Conyers Farm, Greenwich, contained some insect eggs not familiar to us, possibly laid by Membracids or treehoppers. Twigs from the J. H. Hale Orchard Co., were marked with scars caused by hail during 1923.

In case of woolly aphid, *Eriosoma lanigerum* Hausm., galls on the twigs and the waxy exudation were the only evidence. In all other cases except the case bearer, all insects on the apple twigs were in the egg stage.

It is rather surprising and withal somewhat significant that in examining these twigs from 18 different orchards from three-fourths of the Counties of the State (only Windham and New London not being represented) that not a single San José scale, *Aspidiotus perniciosus* Comst., was found.

DUSTING VERSUS SPRAYING.

Season of 1924.

M. P. Zappe and E. M. Stoddard.

The experiments to determine the relative value of dusting and spraying which were begun in 1920 were continued in 1924. While it has been demonstrated that the best grade of apples are grown by spraying, there is considerable value in dusting, especially in dry years. In addition to the plots receiving either spray or dust, we have had during 1924 plots which were both sprayed and dusted.

The results of previous years work have been published as follows: Report for 1920, page 168, results of 1920; Bulletin 235, results of 1921; Bulletin 245, results of 1922; Report for 1923, page 267, results of 1923.

Orchards Under Experiment.

The two orchards used in these experiments were both used in former experiments. One was located in Milford, the orchard of F. N. Platt, and contains 285 trees about 20 years old. The other was the old orchard at the Experiment Station Farm at Mount Carmel. This orchard is about 48 years old and consists of 40 trees, mostly Baldwins and Greenings.

Acknowledgments.

The writers are indebted to Mr. Frank N. Platt of Milford for the use of his orchard, power sprayer and assistance in conducting these experiments, and also to Messrs. George Graham, J. L. Rogers, B. H. Walden, P. Garman, T. F. Cronin and H. F. Bender, who helped in the applications of treatments and in harvesting and scoring the fruit.

Apparatus Used.

The spray outfit was the same as used in the preceding experiments, a 200 gallon Friend power sprayer, carrying two lines of hose with rods and nozzles at about 200 pounds pressure. The duster was a 1923 model Niagara power outfit mounted on an automobile truck.

Spraying and Dusting Materials Used.

Liquid Spray.

Lead arsenate	3 pounds
Dry lime-sulphur	6 pounds
Casein spreader	1 pound
Nicotine sulphate	¾ pint
Water	100 gallons

Sulphur-Lead Arsenate Dust.

Sulphur	90%
Lead Arsenate	10%

Green Copper Dust.

Metallic Copper	6%
Metallic Arsenic	3%

Blue Copper Dust.

Metallic Copper	3.74%
Metallic Arsenic	1.76%

Number and Time of Applications.

Six applications of spray and dust were made in the Platt orchard at Milford, beginning with the prepink treatment on McIn-

tosh only. The owner gave the entire orchard an oil spray when the buds were beginning to open. In this orchard, leafhoppers were very plentiful on the dusted plots so these plots were given an application of nicotine dust on June 2.

Prepink treatment (McIntosh only).....May 1
*Pink treatment.....May 7–8
*Calyx treatment.....May 28
*First after calyx treatment.....June 11–12
Second after calyx treatment.....July 8–9
Third after calyx treatment.....August 6

Plots.

The Platt orchard in Milford was divided into seven plots as shown in Table I. The first three rows (A, B and C) were sprayed; the next three (D, E and F) were dusted with 90-10 sulphur-arsenate dust. The north half of rows G, H and I was treated with green copper dust, while the south half was treated with blue copper dust. The north half of rows J, K and L was treated as follows: prepink, pink and calyx, with spray; first and second after calyx, with 90-10 dust; third after calyx, with spray (combination No. II). The south half of the same rows was treated as follows: prepink and pink, sprayed; calyx and three other applications were of 90-10 dust (combination No. I). Rows M and N were left untreated for a check against the treated plots.

Table 1.

Treatments	Plot 1 Rows ABC	Plot 2 Rows DEF	Plot 3 Rows No. half GHI	Plot 4 Rows So. half GHI	Plot 5 Rows No. half JKL	Plot 6 Rows So. half JKL	Plot 7 Rows MN	
Prepink	Spray	90–10 dust	Green copper dust	Blue copper dust	Spray	Spray	Check	McIntosh variety treated
Pink	Spray	Dust	Dust	Dust	Spray	Spray	Check	All varieties
Calyx	Spray	Dust	Dust	Dust	Spray	90–10 dust	Check	All varieties
1st after calyx	Spray	Dust	Dust	Dust	90–10 dust	90–10 dust	Check	All varieties
2d after calyx	Spray	Dust	Dust	Dust	90–10 dust	90–10 dust	Check	All varieties
3d after calyx	Spray	Dust	Dust	Dust	Spray	90–10 dust	Check	All varieties

Plot 1—Sprayed
Plot 2—90–10 sulphur-arsenate dust
Plot 3—Green copper dust
Plot 4—Blue copper dust
Plot 5—Combination Plot No. 2
Plot 6—Combination Plot No. 1
Plot 7—Not treated—checks.
Checks on all varieties have had no treatment in last four years.

* Nicotine in liquid spray.

Table 2.

Results of Treatments on McIntosh.

Milford Orchard.

	Spray	90–10 Sulphur-arsenate Dust	Green Copper Dust	Blue Copper Dust	Combination 1 South	Combination 2 North	Check
Good	84.3	74.4	68.9	60.5	52.4	60.0	4.4
Scab	6.3	14.4	15.0	24.9	26.5	25.4	71.5
Aphis	2.95	5.5	6.03	3.64	7.3	7.4	10.2
Red bug	3.62	1.9	6.9	6.69	8.94	7.16	20.3
Codling moth	.43	.56	.55	.81	1.38	.44	4.01
Curculio	1.26	1.66	1.66	3.1	6.6	4.01	37.0
Other chewing insects	1.37	2.58	2.72	3.25	3.76	2.02	3.71
Sooty blotch	0	.02	0	Trace	Trace	0	Trace

Discussion of Results.

The sprayed plot gave the highest percentage of good fruit and the 90-10 dust plot came next. The copper dusts were not so good as the 90-10 sulphur-arsenate dust in control of scab. Neither of the combination treatments were as efficient as the spray, the sulphur or the green copper dusts, combination No. 2 being on a par with the poorest of the copper dusts. The plots receiving the combination treatments were at the lower edge of the orchard just east of a woodlot and the trees were in a copper dust plot last year where there was much scab, which may possibly account for the large amount of scab present this season.

Table 3.

Results of Treatments on Baldwin.

Milford Orchard.

	Spray	90–10 Sulphur-arsenate Dust	Green Copper Dust	Blue Copper Dust	Combination 1 South	Combination 2 North	Check
Good	85.9	87.2	86.5	86.5	79.0	85.5	No fruit
Aphis	9.65	8.2	8.5	6.03	15.4	8.1	No fruit
Red bug	2.2	.49	.2	.44	.6	1.42	No fruit
Codling moth	.01	.52	.68	1.88	1.53	.35	No fruit
Curculio	.69	1.1	1.71	.89	1.47	2.2	No fruit
Other chewing insects	1.7	2.4	2.82	4.55	2.4	2.4	No fruit
Scab	0	0	0	Trace	0	0	No fruit
Sooty blotch	0	0	.18	0	0	.14	No fruit

Discussion of Results.

There is very little difference in any of the plots of this variety. Combination plot number one was lower in the percentage of

good fruit than the other plots; this was caused by a higher percentage of injury by aphids. The Baldwin trees in the check rows bore no fruit.

TABLE 4.

RESULTS OF TREATMENTS ON GREENING.

MILFORD ORCHARD.

	Spray	90–10 Sulphur-arsenate Dust	Green Copper Dust	Blue Copper Dust	Combination 1 South	Combination 2 North	Check
Good	75.0	81.0	68.4	68.4	70.0	62.2	10.7
Aphis	22.3	12.9	23.5	23.9	21.0	30.8	5.9
Red bug	.66	.66	1.17	1.17	2.6	6.0	62.5
Codling moth	.63	1.19	1.29	1.05	1.65	.62	4.99
Curculio	.78	2.18	2.62	3.06	2.9	5.7	21.9
Other chewing insects	.726	1.6	1.92	2.82	1.7	2.52	3.44
Scab	.21	.66	2.2	1.56	.95	2.76	27.9
Sooty blotch				.37		1.99	6.83

DISCUSSION OF RESULTS.

In the Greening plots the sulphur-arsenate dust was a little better than the liquid spray. The copper dusts averaged a little more good fruit than the plots receiving a combination treatment. In the check plot the fruit was badly deformed by red bugs and aphids and most of this injury was scored as red bug work, but a good share of it was undoubtedly caused by aphids; probably much more than the figures show. The variation in amount and control of scab was so small between the different treatments that a choice can hardly be made as can easily be done on the McIntosh.

TABLE 5.

RESULTS OF TREATMENTS ON GRAVENSTEIN.

MILFORD ORCHARD.

	Spray	90–10 Sulphur-arsenate Dust	Blue Copper Dust	Combination 1 South	Check
Good	66.2	74.6	75.9	75.3	37.5
Aphis	29.8	22.2	17.5	18.3	31.9
Red bug	.518	1.02	.4	.38	2.74
Codling moth	.28	.05	.23	.31	.98
Curculio	1.8	1.4	1.71	2.78	22.07
Other insects	.97	.9	1.44	1.67	3.82
Scab	.61	2.35	2.99	1.05	13.34
Sooty blotch			.08	.105	2.53
Fruit speck			.13	.005	.239

DISCUSSION OF RESULTS.

The Gravenstein trees are located on only one side of the orchard: therefore there were none in the green copper plot nor in the combination plot number two. The sprayed plot gave the lowest percentage of good fruit because the aphis injury was high on the fruit of this plot. Between the other three treatments there is very little choice, as they produced about the same amount of good fruit. In amount of scab, the sprayed plot was a little lower than the others, the highest percentage except for the check being in the blue copper dust plot. The blue copper dust and combination No. 1 plots showed a small percentage of sooty blotch and fruit speck.

MOUNT CARMEL ORCHARD.

The old orchard at the Experiment Station Farm was divided into two plots. The first application in this orchard was the calyx treatment followed by three others. As there were no varieties in this orchard that were very susceptible to scab, we felt that the prepink and pink treatments could be omitted.

Treatments	Plot 1	Plot 2	Dates of Applications
		90–10	
Calyx	Spray	Dust	May 29
1st after calyx	Spray	Spray	June 13
	90–10		
2d after calyx	Dust	Spray	July 9
	90–10		
3d after calyx	Dust	Spray	August 7

The spray applications in this orchard were applied with an Arlington X. L. Sprayer, using two lines of hose with two nozzles at each rod. The duster was the same as used in the other orchard.

The applications of dust in both orchards were usually put on either in late afternoon or in morning before dew had dried or wind had begun to blow.

The check trees bore no fruit so no data was obtained.

TABLE 6.

RESULTS OF TREATMENTS ON BALDWIN.

MOUNT CARMEL ORCHARD.

	Plot 1 16 trees	Plot 2 4 trees
Good	81.1	67.4
Aphis	11.6	22.1
Red bug	.03	.16
Codling moth	.56	1.02
Curculio	5.27	8.17
Other chewing insects	1.66	3.5
Scab	.04	.03

Discussion of Results.

Plot 1 having first two treatments of liquid spray gave better control of all pests and therefore produced a higher percentage of perfect fruit.

Table 7.

Results of Treatments on Greening.

Mount Carmel Orchard.

	Plot 1 6 trees	Plot 2 7 trees
Good	62.56	54.38
Aphis	14.27	20.72
Red bug	.12	.14
Codling moth	1.66	1.3
Curculio	19.3	22.65
Other chewing insects	2.78	4.55
Scab	4.68	2.84
Sooty blotch		.01
Cedar rust		.11

Discussion of Results.

As in the Balwin plot in this orchard, the treatment on Plot 1 gave a higher percentage of good fruit than Plot 2. The percentage of aphid and curculio injury was much higher on this variety than on the Baldwin. Scab injury is also a little more evident.

Summary.

On the McIntosh, chiefly due to scab control, the liquid spray was 10 to 30 per cent. better than any of the other treatments, with 90-10 sulphur-arsenate dust a close second. The application of nicotine in the spray gave very good control of leafhoppers but the one application of nicotine dust gave in most cases better control of aphis than did the three applications of nicotine spray. This is shown by the fact that in every case where dust gave more perfect fruit than spray, the difference was due to aphis control.

On Baldwin, Greening and Gravenstein, aphids were the controlling factor in the production of perfect fruit. Where aphids were controlled by the treatment or were absent for some other reason, the per cent. of perfect fruit was correspondingly high and vice versa, a high per cent. of aphids lowered the per cent. of perfect fruit. Other insects were controlled about equally well by all the treatments and due to the dryness of the season after June 1, fungi did not develop sufficiently to be important.

At the Mount Carmel orchard, the combination plot (having the calyx and the first treatment after the calyx with liquid spray) was the best on both Baldwin and Greening. Here as in the other orchard aphids were responsible for the largest amount of injury. Curculio ranks next in amount of injury in this orchard.

SUMMARY OF FIVE YEARS WORK ON SPRAYING AND DUSTING.

M. P. Zappe and E. M. Stoddard.

In order to show the relative merits of spraying and dusting as determined by the results of our experiments during the years 1920 to 1924 inclusive, we here present a summary in which are brought out the points that seem to have been demonstrated in these particular experiments. We have included some other interesting features in regard to the occurrence and control of insect and fungous pests.

In the preparation of these data we have scored 564,675 apples, chiefly of four varieties, McIntosh, Greening, Gravenstein and Baldwin, in four different orchards in the vicinity of New Haven.

The following table gives the average results in per cent. for all the spraying, dusting and checks on all varieties for the five years indicated above. In this table "other fungi" includes sooty blotch, fruit speck, rust, black rot and bitter rot. "Other chewing insects" includes the various chewing insects other than are listed which attack the fruit of apples.

Treatment	Good	Scab	Other Fungi	Aphis	Red Bug	Curculio	Codling Moth	Other chewing insects
	%	%	%	%	%	%	%	%
Spray...	68.6	14.7	6.05	10.0	1.3	17.7	.94	1.8
Dust....	41.4	30.2	28.4	10.7	2.6	21.8	1.4	4.7
Check...	12.2	40.5	34.8	9.7	12.8	48.6	11.7	9.8

It would seem from these figures that dusting is practically as good as spraying for the control of red bug, curculio, codling moth, and other chewing insects, but in the control of fungi there is a wide variation in favor of the spraying. Aphids have not been controlled by either treatment, in fact the checks show the least amount of injury. It is evident that aphids and curculio cause the greatest amount of insect injury on treated trees and are the most difficult to control.

Scab took the largest toll of all the fungi, with sooty blotch and fruit speck ranking next, these latter making up the greater part of the injuries listed in the table as "other fungi." Rust, black rot and bitter rot are so rare as to be negligible on the varieties included in the orchards in this study.

In the study of the data it was found that scab was the least prevalent in 1920, which year had the largest amount of rain of all of the five years, and in 1921-22-23-24 which had normal rainfall or less than normal, the per cent. of scab was higher by 50 to 70%. These computations were made on the data from check trees which represent the actual amount of scab present in the orchard, and were not influenced by variations of treatment. A study of the weather conditions during April, May and June of

these years showed that in 1920 the periods of high humidity were very short, the per cent. of humidity dropping immediately and sharply after a rain, while in the other years the humidity dropped slowly after rains, sometimes lagging over three or four days, and very light rains were often accompanied by high and sustained rises in humidity.

Further study will be necessary to establish this apparent relation to per cent. of humidity rather than actual rainfall, but it would seem that better results from spraying would follow if it be done before or during sustained periods of high humidity rather than before rains. It is our belief that a close study of the weather conditions is a safer guide for the orchardist to follow than information as to time and duration of spore discharge, because it is safe to suppose that sufficient spores will always be discharged to cause a damaging amount of infection if weather conditions are suitable for such infection and if the trees are protected during optimum periods for infection the desired control will be obtained. Inability to predict these conditions accurately will necessitate spraying a certain number of times as insurance, timing them as near as possible to give maximum protection.

Our data show that McIntosh is the most severely attacked by scab of the varieties used in the experiments, but the amount of injury from all other insect and fungous pests is considerably less than on the other varieties. Baldwin is the least susceptible to scab but much more susceptible to sooty blotch and fruit speck, and in most cases shows more curculio injury. Gravenstein is most severely injured by aphids of all the varieties observed.

TESTS OF INSECTICIDES FOR THE CONTROL OF THE ASIATIC BEETLE.

Anomala orientalis Waterhouse.

M. P. Zappe and P. Garman.

This insect has caused considerable injury to lawns in the western part of the City of New Haven, in the vicinity where the adults of this insect were first collected on July 16, 1920. In some cases sections of lawns equivalent to 60 square yards and smaller have been ruined by the larvae or grubs, as they are commonly called, which devoured the roots of the grass. Where the infestation is heavy, the turf may be rolled up like a carpet. Many of the property owners have spaded up the infested sections, collected, and killed all the grubs they could find, afterwards reseeding their lawns. During the summer of 1924, tests of several insectides and methods of their application were made to determine which of these are the most practicable and efficient in controlling this insect in the larval stage in lawns. So far as we know, this pest has not been troublesome in gardens, with

the exception of one case where a few grubs were found in a strawberry bed near a badly infested lawn.

Previous accounts of this insect in Connecticut have been published in the Report of this Station for 1922, page 345, and for 1923, page 291.

Calcium Cyanide.

This material was used on lawns in several tests at strengths varying, from four to six ounces per square yard. It is a coarse dust containing from 40 to 50 per cent. of calcium cyanide, and is very poisonous, not only when taken internally, but when the gas is inhaled. The soil where all tests were made was a type of light sandy loam.

Two plots were laid out on an infested lawn; one containing 20 square yards was treated with calcium cyanide at the rate of four ounces to the square yard, the other containing 60 square yards was given a dosage of six ounces per square yard. The cyanide dust was applied to the lawn as evenly as possible with a hand fertilizer drill, after which the ground was thoroughly wet down with a garden hose to wash the cyanide into the soil. (See plates XXIV, b and XXV, a).

Before applying the cyanide, a square foot of soil was dug up and all larvae were counted. There were 63 larvae in this square foot of soil, most of them being in the upper three inches among the grass roots, although a few were found six inches deep. Other sections were also dug, and found to be similarly infested.

Prior to our treatment of this lawn, the owner had spaded part of it and what sod was left had been turned under, so that it was buried four or five inches deep. The treatment was applied on May 14. On May 19, many of the grubs were dead in both plots, but in that portion of the lawn which had been spaded, before treatment, most of the live grubs were in the sod which had been turned under, and were too deep to be killed by the cyanide.

A good kill was obtained on that portion of lawn which had not been spaded, and practically all of the dead larvae were in the first two inches of soil; below this depth there were quite a number of living ones. All grass on the treated portion of lawn was badly burned by the cyanide.

Both plots were treated as one on May 31, with calcium cyanide, using about five ounces per square yard. This time the ground was spaded after the application, then immediately treated again, and watered thoroughly. On this date the wind was quite strong and blew some of the cyanide dust upon rose bushes, Spiraea and Weigela. Nearly all the leaves on the rose bushes were so badly injured that they dropped off, and the Spiraea and Weigela were also injured, though not so badly as the roses. The

roses were not killed, as they produced a new set of leaves in a short time.

A few days later an examination of this plot was made and it was found that about a 100 per cent. kill had been obtained. On May 19, several small wire cages containing three larvae and a small piece of sod each, were buried in small holes in the ground at the following depths from the surface; one hole with two cages, one three inches, the other six inches deep; another hole with cages at five inches and another seven to nine inches deep; and one hole with cage four inches deep. One ounce of cyanide was then placed in a hole eight inches deep and six inches from the holes containing the buried cages of larvae, and covered with soil.

An examination made a week later gave the following result:

Depth Buried Inches	No. Alive	No. Dead
3	3	0
5	2	1
6	3	0
7 to 9	2	1
4	3	Not treated

On another lawn, a plot one yard square was selected and holes made with a crowbar about six inches deep and 12 inches apart; each hole was dosed with one-third ounce of calcium cyanide. After the cyanide was put into the holes, they were filled up with earth. Another plot of two square yards was treated in a similar manner, except that the holes were made two feet apart and were dosed with one ounce of cyanide. An examination of the plots a few days later showed practically no kill of larvae on either plot.

A similar test was made at another place, using one ounce of calcium cyanide, placed at the bottom of a hole four inches deep and three inches in diameter, made by a sod cutter. The cyanide was covered with soil. Other holes the same size and shape as the cyanide hole were made at varying distances from them and an *Anomala* larva in a small wire cage buried in each hole. Eight holes with a larva in each one were made near the hole containing the cyanide. The cyanide and larvae were placed May 28, and examined June 11.

*No. Inches from Cyanide Hole	No. Alive	No. Dead
6	1	1
9	2	0
12	2	0
18	2	0

It may be seen from the tests that the application of calcium cyanide by the hole method was not a satisfactory method of

* Two holes at each distance.

control for *Anomala* larvae. This method has the advantage of not killing the grass. By the broadcast method of application, a good kill of larvae resulted, but the grass was very badly burned. The men broadcasting the cyanide experienced a disagreeable dryness and hoarseness of the throat as well as headaches. More serious effects might be felt if operators were exposed to the action of the cyanide for a longer time. For these reasons it was thought best not to recommend this material for general public use in the control of this insect.

Sodium Cyanide.

This is the ordinary cyanide used in combination with sulphuric acid and water for the fumigation of houses, greenhouses, warehouses, etc., for the control of various insects infesting places that are or can be made air tight. For the control of *Anomala orientalis*, a certain amount of cyanide was dissolved in water and sprinkled on the lawn to be treated, afterward wetting down thoroughly with water from a garden hose.

Three plots were treated with sodium cyanide, using one-eighth, two-eighths, and three-eighths ounces per plot of one square yard. Cyanide was applied as described in the above paragraph. A few days later the plots were dug up and all larvae collected, with the following result:

Ounces per Square Yard	No. Alive	No. Dead
One-eighth	19	4
Two-eighths	6	12
Three-eighths	12	9

Further tests with sodium cyanide were conducted by burying five larvae in a wire cage in the center of a plot one yard square in area. The cyanide was applied as before, dissolved in water and sprinkled on plots with a watering can, then watered with garden hose.

Ounces per Square Yard	No. Alive	No. Dead	Remarks
One-half	5	0	Grass partly killed
Three-fourths	0	5	Grass all killed
One	0	5	Grass all killed

Another plot of 24 square yards was treated with sodium cyanide using one ounce per square yard dissolved in water and applied to the lawn in the usual manner. Treatment was made on June 11, and on June 17, the plot was examined and approximately 90 per cent. of the larvae had been killed. Most of the larvae that were left alive were found rather deep in the soil. The grass on this plot was all killed.

Other insecticides were tried on a small scale to determine their effect upon *Anomala*. Mercuric chloride was tested on a plot of 11 square feet, using one-tenth ounce of this chemical.

It was dissolved in water and sprinkled on the soil, but gave only one per cent. kill.

A 10 per cent. kerosene emulsion applied to a plot one yard square was worthless, as no dead larvae were found when the plot was examined a few days after the treatment.

Carbon Disulphide Emulsion.

The most promising of the insecticides and soil fumigants tested was carbon disulphide emulsion. There is a commercial carbon disulphide emulsion on the market which is sold under the name of Kokotone. This was first used on plots one yard square; in the center of each plot a wire cage was buried containing *Anomala* larvae. Each cage was buried between two and three inches deep. The plots were dosed with one-half pint, one-fourth pint and one-eighth pint of Kokotone. The amount of emulsion to be used on each plot was first diluted in about three gallons of water and then sprinkled on the lawn with a watering pot (Plate XXIV, a) then the ground was soaked with more water from a garden hose to wash the emulsion into the ground. On digging up the cages containing the *Anomala* larvae two days later, it was found that in each plot all the larvae had been killed. The grass was slightly injured on the plots receiving one-half and one-fourth pint of emulsion, but the one-eighth pint plot was not noticeably hurt. All the grass which was burned recovered after a short time.

Another lawn of 32 square yards was then treated with Kokotone using one-eighth pint per square yard, applied in the same manner. Four days later, June 30, the lawn was dug into and 61 dead larvae and pupae were found, also two dead adults. In another place a bunch of tall grass under a Spiraea bush was dug up and five dead pupae and two living larvae were found. This amounts to about a 97 per cent. kill. Grass on this plot was slightly injured but soon recovered.

Kokotone was again used late in the fall on a plot of lawn the same size as above. The amount of Kokotone used and the method of application was the same as on the above plot. The temperature of the air was much lower than on June 30, and the soil temperature was 67° F. This probably accounts for the fact that we found only about a 70 per cent. kill when the lawn was examined on October 9. The gas from the carbon disulphide is apparently not given off fast enough at low temperatures to give a high percentage of kill.

It is also apparent from the work done thus far that it is important to saturate the soil with water after the emulsion is applied in order that it may reach and surround the grubs. It works both as a contact insecticide and as a fumigant when applied in this manner.

Home made carbon disulphide emulsion was prepared after a formula given by Leach and Thomson[1] in an article on the "Control of Japanese Beetle Larvae in Golf Greens." This formula calls for 12.5 grams of resin-fish-oil soap dissolved in 87.5 cubic centimeters of water. This is heated until the soap is dissolved, then the solution is allowed to cool, after which 250 cc. of carbon disulphide is added and the mixture agitated until a white creamy emulsion is obtained. We have found that a fairly stable emulsion can be made by substituting either fish-oil-soap or the ordinary naphtha laundry soap for the resin-fish-oil soap, and is satisfactory for immediate use.

Two plots of one square yard each were treated with this emulsion, one made from fish-oil soap and the other from naphtha laundry soap. In the center of each plot before treatment a small wire cage containing two *Anomala* larvae was buried about two or three inches deep. Two liquid ounces of emulsion were used on each plot diluted with three gallons of water and then watered with five gallons of clear water. On examination a few days later, all larvae were found dead. The grass was not injured.

STUDIES OF THE HABITS AND CONTROL OF THE ORIENTAL PEACH MOTH IN 1924.

Philip Garman.

The Oriental peach moth showed up again in Connecticut in 1924 and was on the whole more abundant than in previous years. It appeared for the first time in appreciable numbers in the peach growing district about Wallingford where a number of growers reported its presence. It was found largely in the southwestern section of the State and in the central section extending northward from New Haven into Hartford County. One orchardist near the Massachusetts line stated that he had seen "worms" in his peaches similar to those of the Oriental peach moth, but this locality is well to the north of the main infestation and its presence should be observed another year in the same locality in order to make sure that it has become established. A questionnaire sent out in October to about 20 peach growers indicated that the insect was present in 11 of their orchards, but most of those reporting it were of the opinion that it did little damage. In the orchard at Conyers Farm, Greenwich, about the same amount of damage as occurred last year was observed by the men in charge, but the possibilities of the pest are evident in the amount of damage found in some of the experimental blocks, where the infestation amounted to from 14 to 23 per cent. of the crop. In that orchard the variety most heavily infested was Belle of Georgia.

[1] Journal of Economic Entomology, Vol. 16, page 312.

Observations on the life history of the insect were made during the summer and though necessarily incomplete, some of the results are given herewith.

June 9—No sign of the Oriental peach moth at Greenwich or New Haven.
June 23—A few tips infested at Greenwich, the larvae one-half or two-thirds grown.
June 25—First infested tip seen at New Haven.
June 30—Most of larvae have left twigs at Greenwich; signs of one having entered a peach—doubtful.
July 3—Pupae obtained from June 23 material.
July 9—Four adults emerged from June 23 material.
July 10—Three adults emerged from June 23 material.
July 14—Many young larvae observed in tips at Greenwich—one in peach.
July 21—One adult emerged from July 23 material.
July 25—One egg found on tree at New Haven.
July 28—Many larvae observed in young orchard at Greenwich.
Aug. 3—Eight adults emerged from July 14 material.
Aug. 5—One adult emerged from July 14 material.
Aug. 7—Three adults emerged from July 14 material.
Aug. 8—One adult emerged from July 14 material.
Aug. 11—Four adults emerged from July 14 material.
Aug. 12—Two adults emerged from July 14 material.
Aug. 13—Twelve adults emerged from July 28 material.
Aug. 14—Four adults emerged from larvae obtained July 28.
Aug. 14—One adult emerged from larvae obtained July 14.
Aug. 15—Collected many small larvae in tips of young trees.
Aug. 15—Hale thinnings gave a total of 1 per cent. infested.
Aug. 25—Two adults emerged from July 28 material.
Aug. 28—Two adults emerged from July 28 material.
Sept. 1—One adult emerged on this date.
Sept. 9—One adult emerged on this date.

Grouping the adult emergence (from larvae collected June 23, July 14 and 28; August 15 and 22 and September 13, 25, 29 and October 1), we obtain the following results:

July 1–9	0 Adults
July 9–21	8
July 21–Aug. 1	0
Aug. 1–7	12
Aug. 7–14	24
Aug. 14–21	15
Aug. 21–Sept. 1	14
Sept. 1–9	2
Sept. 9–31	0

All larvae spinning after August 25 hibernated and did not pupate. Larvae were abundant in fruit from September 13 till October 2, but none of the larvae obtained at this time pupated.

We estimate the presence of at least three broods in Connecticut, but it is evident that adults of the insect did not reach the maximum period of abundance in 1924 until August and that the larvae were most abundant from August 15 until the last of September. From this it is apparent that some of the control measures must be used towards the latter part of the season if the insect is to be controlled effectively.

A general summary of the habits of the Oriental peach moth has already been given[1] and it is advisable to mention here only such features as bear directly on its control, or affect its economic status. The eggs are laid on the underside of the peach foliage and sprays must be made to cover the leaves thoroughly if control is to be secured. The very short length of the egg stage naturally necessitates frequent nicotine or other egg sprays and at least one a week would appear to be necessary from this standpoint alone.

The young larvae soon after hatching may be killed with arsenicals[2] but the older larvae are not easily killed as has been repeatedly demonstrated. Thus we find arsenical applications of little use in mid-summer when the larvae are migrating from twigs to fruit, but later in the season when many go directly into the fruit, such applications may possibly be more effective.

The larvae frequently spin on the ground or near the ground on the trunk and clean cultivation together with such controls as the use of paradichlorobenzene, winter strength lime-sulphur and the like should be of help. The silken cocoon of the larva is water proof and it is not known exactly how sprays of the sort mentioned affect the larvae. Owing to the fact that many of the drop fruits which fall shortly before harvest time contain larvae, it would seem advisable to remove this fruit from the orchard and destroy it as soon as possible because it furnishes material for reinfestation.

Larvae entering peaches some time before ripening usually leave conspicuous evidence of the infestation due to the fact that gum is rapidly thrown out by the growing peach. Early fruit, too, is often infested by larvae migrating from the twigs. As a result there is usually little difficulty in grading out early infested peaches. Larvae which enter the fruit, however, when the latter begins to ripen (owing to the fact that little gum is thrown out and to the fact that many very minute larvae enter direct from the egg) cause much infested fruit which cannot be detected. Many of the larvae enter at the stem end and as shown in the illustrations (See Plate XXVII, a), leave only a very insignificant trace at the point of entrance. Still others enter through the side of the fruit and the frass thrown out at the point of entrance may be washed off or rubbed off in handling which results in a fruit wholly without external signs of infestation. Such fruit cannot be graded out and some of it naturally finds its way to the consumer as well as being shipped into districts where the Oriental peach moth is not yet established; sometimes with unfortunate results.

[1] Britton, W. E., Conn. Agr. Exp. Sta., Bull. 256: 284–287; 1923.
[2] Peterson, Alvah, Journal of Economic Entomology, 13: 391–398; 1920.

We have been much surprised at the amount of fruit infested in some orchards in 1924, especially when the amount of twig injury was relatively small as will be seen in Table 4. Such an increase may be due to the normal increase of the pest but there are also other possibilities—namely that of the shipment of wormy fruit from other infested sections and the consequent increase of the insect in the particular district concerned. Possibly there is also a natural flight of the moths in late summer similar to the case of the cotton moth and apparently so with the corn ear worm.

The adults are active about sundown, but have been seen near midday by some workers[1]. There is some possibility that adults may be killed by nicotine or other dusts; but not much is known of this phase of the problem.

In general the history of the Oriental peach moth thus far has been that it appears in destructive numbers for a few years, and then becomes relatively scarce. This has apparently been the case in Maryland and Virginia, due without doubt to the beneficial action of parasites. How often these waves of injuriousness will occur remains to be seen, and what will happen next year in Connecticut is only a guess but it will probably increase in intensity in sections hitherto not greatly affected, and decrease in sections where the greatest amount of damage was done in 1924.

Control Experiments.

The only field control experiments were conducted at Conyers Farm and were made possible through the kindness of Messrs. G. A. Drew and H. B. Reed, who granted the use of the treated blocks and furnished the labor for spraying and other operations. Four plots were used each consisting of six rows containing 54 to 61 trees. Nearly all were bearing, well cared for, and fertilized so that good growth resulted and a good crop of fruit was harvested, amounting in many cases to 10 to 15 baskets per tree.

The ingredients of the sprays and dusts used are as follows:

(1) Nicotine sulphate, ½ pint to 50 gallons.
(2) Lead arsenate, 1 pound to 50 gallons.
(3) Self-boiled lime-sulphur, 8-8-50 formula.
(4) P. & G. Naphtha soap, 2 pounds to 50 gallons.
(5) Casein lime spreader, ½ pound to 50 gallons in sprays containing lead arsenate and self-boiled lime-sulphur.
(6) 90–10 sulphur-arsenate dust.
(7) Commercial nicotine dust, guaranteed 2.7 per cent. nicotine.

The following applications were made on the four different blocks:

[1] Guyton, T. L., Journal of Economic Entomology, 17: 415; 1924.

(1) Fungicide only—self-boiled lime-sulphur, June 9 and July 14.
(2) Self-boiled lime-sulphur plus lead arsenate, plus nicotine sulphate, plus casein lime, June 9 and July 14; nicotine sulphate plus soap, June 30, July 28 and August 15.
(3) Self-boiled lime-sulphur plus lead arsenate, June 9 and July 14.
(4) Sulphur arsenate dust followed by nicotine dust, June 9 and July 14; nicotine dust, June 30, July 15 and August 2.

Counts were made of all drop fruits from 10 selected trees in the center of each block and of all fruit from five selected trees in each block, the scoring being done by exterior examination, grading into infested and uninfested lots. A number of each of these lots were then cut open and the correction for infested peaches overlooked in the first grading, applied to those figures. The results are seen in Table 3.

No conclusions will be drawn from these experiments until checked by similar tests, but they are presented here in order to show what was obtained in the way of control measures in 1924.

ORIENTAL PEACH MOTH CONTROL—1924.

Table 1—Picked Fruit from Five Selected Trees.

Block No.	Treatment	Good	Infested	Per Cent. Infested
1	Fungicide only, 2 sprays	3,237	393	10.8
2	5 sprays containing nicotine sulphate 2 with lead arsenate	2,528	190	6.9
3	Fungicide plus lead arsenate	3,539	408	10.3
4	5 dusts containing nicotine, 2 with arsenate	1,847	63	3.2

Table 2—All Fruit from Five Selected Trees.

1	.....	4,040	655	13.9
2	.....	3,518	301	7.8
3	.....	4,036	556	12.1
4	.....	3,867	250	6.0

Table 3—Corrected Figures from Table 1 Based on Cut Fruit.

1	.....	2,786	844	23.
2	.....	2,167	351	14.
4	.....	1,692	218	11.

Table 4—Twig Counts of all Trees Made July 28, 1924.

Block No.	Treatment	No. Trees in Block	Total No. Injured Twigs	No. Injured Twigs per Tree
1	.....	54	318	5.8
2	.....	61	177	2.9
3	.....	56	192	3.4
4	.....	56	178	3.1

EFFECT OF VARIOUS INSECTICIDES ON THE EGGS OF THE EUROPEAN RED MITE (P. pilosus C. & F.)

PHILIP GARMAN.

Since the publication of Bulletin 252, on the European red mite, a number of tests have been made of the killing power of certain insecticides on the winter eggs. These tests are laboratory tests and results are comparable to what was obtained in previous experiments. For convenience, two proprietary oils now on the market have been compared and the results are shown in Table 2. Results in this table are a total of all tests made to date, including those reported in Bulletin 252.

TABLE 1.

	Materials Used	Total No. of Eggs	Hatched Number	Hatched Per Cent.
1.	Niagara dormant dust	119	19	15.9
2.	Soluble sulphur 1 oz. in 1 quart	115	29	25.2
3.	" " " " "	198	32	16.1
4.	" " " " "	478	98	20.5
5.	" " " " "	230	99	43.0
6.	" " " " "	201	49	24.3
7.	Sunoco spray oil 1–15	231	1	.4
8.	" " " 1–15	323	12	3.7
9.	" " " 1–15	548	3	.5
10.	" " " 1–20	227	1	.4
11.	Carboleine 1–15	282	3	1.0
12.	" 1–20	332	2	.6
13.	Volcks 3%	467	2	.4
14.	" 6%	469	9	1.9
15.	Sherwin Williams Free Mulsion 1–15	202	4	1.9
16.	Check—no treatment	483	225	46.5

Note. Tests 2-5 were made with fresh soluble sulphur of good yellow color; No. 6 with the same material after standing a year.

TABLE 2.

	Materials Used	Total No. of Eggs	Hatched Number	Hatched Per Cent.
1.	Scalecide 1–15	4,853	238	4.9
2.	" 1–20	182	0	0.0
3.	" 1–25	1,258	68	5.4
4.	" 1–50	968	66	6.8
5.	Sunoco 1–15	1,055	18	1.7
6.	" 1–20	227	1	.4
7.	" 1–25	180	6	3.3
8.	" 1–50	325	56	17.2

The percentage of hatch in the two lots should not necessarily be taken to indicate superiority of either oil, since the experimental error and variation is considerable. The experiments, however, indicate consistently that a dilution of 1 to 20 or 1 to 25 does not greatly reduce the toxicity of miscible oils of this type. As indicated in Table 1, soluble sulphur compounds do not give

as high a mortality in laboratory tests, although they have in common with oils, the property of covering all parts of the twig and "crawling" into spots not actually reached by the spray.

Some criticism of Table 14, Bulletin 252, has been received from manufacturers. Owing to omission of results in Table 11 from the final summary, Sunoco Spraying Oil was placed at the bottom of the list. Revised from the data as summarized in Table 14 from previous records in Bulletin 252, the last five items should read.

Exp. No.	Treatment	Hatched Per Cent.	Possible Kill Per Cent.	Number Eggs Used
10	Wormol	9.2	83.4	711
11	Scalecide	6.8	87.3	8,154
12	Sunoco Spray Oil	4.3	92.1	1,573
13	2% Red Engine Oil Emulsion	3.3	93.8	968
14	Jarvis Compound	.6	99.0	896

The original idea of this table was not to indicate superiority of any particular product especially where percentages are close, since the conditions of experiment varied, but was intended to show the increased kill in the case of certain types of miscible oils over other ovicides, namely lime-sulphur compounds or substitutes. However, in view of the possible harm done to certain manufacturers of spray materials we take pleasure in revising the latter part of this table and presenting it in corrected form. The figures represent a summary of all tests made with different dilutions and obviously should not be used as a direct comparison of different products.

THE ALCOHOL-FORMALIN SOLUTION FOR CONTROL OF AMERICAN FOUL BROOD.

PHILIP GARMAN.

Dr. J. C. Hutzelman was the first to demonstrate that combs containing American foul brood may be successfully sterilized with a mixture of formalin and alcohol. For this purpose he used[1] a solution of 20 per cent. formalin in alcohol, soaking the combs 48 hours after extracting all honey. He reports the successful sterilization of many combs. These facts together with the recommendation of this treatment by one of the largest manufacturers of bee supplies makes it advisable to explain the methods more fully, examining the constituents of the solution in detail in order to know what may be expected of it.

The procedure in general[4] is as follows.—Infected hives are removed to a "hospital yard" away from the main apiary, the bees shaken, hives disinfected and the combs treated according to the following method. The cells are uncapped, honey extracted and the combs are then placed in warm water which is later thrown

[1] See references at the end of this article.

out in the extractor. This treatment is necessary in order to remove all traces of honey which might remain in the combs and interfere with the disinfection. The combs are then placed in the alcohol-formalin solution and allowed to remain 48 hours after which the formalin solution is extracted and the combs allowed to dry. After these operations are complete, the bees are given a new queen and returned to the disinfected hive and combs.

Some workers state that it is not necessary to uncap all cells before immersion in the solution, but the advisability or inadvisability of this method has not been fully demonstrated. Knowing, however, the nature of the disease, that is, its bacterial origin, and the difficulty in getting rid of such diseases, it seems necessary to omit no precautions and to exercise the greatest care in treating the combs, It is known, moreover, that spores of American foul brood may remain without germination for many years and the inadvisability of basing conclusions on one season's work seems undesirable, unless of course the disease reappears within that time.

The minimum amount of the solution required is not less than five gallons and for practical purposes not less than 10 gallons should be purchased. For larger amounts special tanks should be constructed and special equipment obtained[4]. The material may be used repeatedly according to the manufacturer's recommendations.

Alcohol-formalin solution is very irritating and troublesome to handle. The fumes given off are stifling especially if confined to a closed room. We therefore recommend that it be handled in the open or in a place where there is plenty of ventilation. If the contents of each comb after soaking in the solution, are shaken back into the treating tank, fumes will be produced which will cause much discomfort to the operator. It is best to place the combs in the extractor direct, cover same and extract under cover; and it is especially desirable to handle the combs being treated with rubber gloves or some tool which will prevent the solution from coming into contact with the hands.

Formaldehyde gas dissolved in water is known commercially as formalin, and contains about 40 per cent. formaldehyde gas. Information about the process of manufacture reveals that formaldehyde is made from methyl or wood alcohol and the solution usually contains some of this chemical as a stabilizer. In nearly all formalin solutions obtained on the market there is also some paraformaldehyde, a white insoluble substance derived from formaldehyde. If this substance remains in the combs they will smell of formaldehyde long after the combs have been dried. The best way to remove paraformaldehyde should enough remain to be noticeable, is apparently by the use of sodium sulphite*

*A chemical used in photography costing about 25 cents a pound.

solution. Combs containing a large amount of paraformaldehyde were successfully treated at the Experiment Station by soaking after drying in a solution of this material containing 1 pound in 8 gallons of water.

The question very naturally arises whether it will pay the average small beekeeper to disinfect with alcohol-formalin solution. The minimum amount of the solution which may be used is about 10 gallons. At present prices this will cost about $15.00. It will follow that should the value of the stock or combs infected rise greatly above this initial cost, it would be to the advantage of the person interested to make use of the solution: otherwise it would seem better economy to destroy completely the infected bees and equipment. For the larger beekeeper who is liable to encounter the disease year after year, it should be of more value. Reports from other states seem to be favorable, but the opinion of Connecticut beekeepers is not definitely formed regarding the economic value of the treatment and several years will probably elapse before we shall know whether it will receive the endorsement or condemnation of beekeepers in general.

So far our experiments have not demonstrated conclusively whether the solution will or will not control American foul brood. Work along this line is to be continued.

References.

1. Hutzelman, J. C. Gleanings in Bee Culture, 50: 764-766: 1922.
2. Gleanings in Bee Culture, 51: 773: 1923.
3. White, G. F. American Foul Brood, U. S. Dept. Agr. Bull. 809:1920.
4. Demuth, G. S. Gleanings in Bee Culture, 51: 712-717: 1923.
5. White, G. F. Gleanings in Bee Culture, 52: 284-288: 1924.
6. Gleanings in Bee Culture, 52: 9: 1924 (editorial).
7. Root, E. R. Gleanings in Bee Culture, 52: 86-89: 1924.
8. Root, E. R. Gleanings in Bee Culture, 52: 212-214: 1924.
9. Byer, J. L. Gleanings in Bee Culture, 52: 230-231: 1924.
10. Byer, J. L. Gleanings in Bee Culture, 52: 584: 1924.
11. Gleanings in Bee Culture, 52: 43: 1924 (Gleaned by Asking).
12. Barber, O. E. Gleanings in Bee Culture, 52: 716: 1924.
13. Gleanings in Bee Culture, 52: 138: 1924 (editorial).
14. Jones, Dan. H. Gleanings in Bee Culture, 52: 364-6: 1924.

THE EGG OF THE BLUEBERRY SPITTLE-BUG,

Clastoptera proteus Fitch.

Philip Garman.

Eggs of this species were obtained in 1924 from bugs kept in confinement on growing plants. A search during the winter brought to light many old egg punctures and some live eggs in a similar position on wild bushes. Since the eggs of the species have not been recorded it seems advisable to describe their general form and location.

The eggs of *Clastoptera proteus* are similar to that of the alder bug *C. obtusa* and are laid beneath the bark on the outer twigs. They are sometimes thrust directly into the plant parallel to the axis of the stem and sometimes diagonally. Not more than three have been observed in a single puncture though only one may sometimes be found in each. Some of the characteristic punctures are shown on Plate XXX, f.

Total length .7 mm. greatest width .35 mm.; rounded at one end and tapering to a rather definite point at the other.

The eggs of six species representing four of the five genera of spittle-bugs occurring in this section are now known; leaving only the egg laying habits of *Aphrophora* species yet to be discovered. In general it may be stated that those eggs known so far are similar in form, being pointed at one end and rounded at the other, the only great differences being those of size. All are placed on the plants themselves, being either thrust into dead stems, into the sheath of the growing plant or just beneath the bark on new growth. The function of the rather stout ovipositors of members of the group therefore is plainly evident.

A list of references relating to the eggs and egg laying habits is given herewith.

Philaenus lineatus (Linnaeus), Barber, G. W. and Ellis W. O., Psyche, 29: 3: 1922. Garman P., Conn. Agr. Exp. Station, Bull. 230; p. 328: 1921.

Philaenus leucophthalmus (Linnaeus), Barber, G. W. and Ellis W. O., Psyche, 29: 3: 1922.

Clastoptera obtusa (Say) Garman, P., Ann. Ent. Soc. Amer., 16: 155: 1923.

Lepyronia quadrangularis (Say) Garman, P., Ann. Ent. Soc. Amer., 16: 160: 1925. Doering, Kathleen. Kans. Univ. Science Bull., 14: 536: 1922.

Philaronia bilineata (Say). Barber, G. W. and Ellis W. O., Psyche, 29: 3: 1922.

THE WOOLLY APHID OF APPLE AND ELM.

Eriosoma lanigerum Hausman.

The apple tree woolly aphid is said to occur throughout the world wherever the apple is grown. In England it is called the "American blight" and in Germany the "Blutlaus." It is a bark feeding aphid with two forms; one on the roots and the other on the twigs and branches. It is generally noticeable above ground, on account of the bluish-white patches on the twigs, shown on Plate XXIX, c with reddish-brown aphids close to the bark. The whitish color is due to many minute filaments of wax secreted and protruded by small pores in the epidermal coverings of the bodies of the aphids. These aphids often cluster in wounds such as scars, cankers or where branches have been cut off, and prevent their healing. In some cases, galls are formed on the twigs by the clusters of woolly aphids, and these galls together with the

whitish wax adhering around the margins of wounds are an indication of the presence of the pest. Several years ago, a seedling apple came up in a protected place just south of one of the Station buildings, where it was allowed to grow for several years. Each summer nearly every branch bore one or more of the bluish white patches, each patch being a colony of woolly aphids. Later the little tree was literally covered with swellings or galls on the twigs and branches as the result of the infestation, and the tree was finally removed to make room for needed improvements.

On the roots, galls are nearly always formed by this insect, and where this infestation is heavy, the root system may be only a mass of galls. These galls decay, often ruining the root system of the tree. I well remember some 12 years ago, a man in Groton purchased several hundred apple trees from a Tennessee nursery, and when they arrived, many of the trees had lost all of the smaller roots by decay following woolly aphid infestation. Some of the old stump roots were photographed and are shown on Plate XXIX, b. Most of the trees had galls on the roots but many of them had decayed and were worthless for planting. I was asked to make a statement and issue a certificate regarding the condition of this stock, to be used by the purchaser in making adjustment with the nurseryman. I also wrote to the nurseryman and to the official in charge of nursery inspection in Tennessee, and hope that such stock will not again be shipped into Connecticut. The root form also produces the white wax filaments but these are shorter and less conspicuous than is the case with the aerial form.

The woolly aphid is a much more serious pest further south than in Connecticut, but no doubt it causes some damage here. Nursery trees and young orchard trees are more seriously injured than larger and older orchard trees. The Northern Spy and some other varieties are said to be more or less exempt from attack. In examining apple twigs in the spring of 1924, evidences of the presence of woolly aphid were found in every one of 18 orchards submitting twigs, covering all parts of the State except New London and Windham Counties. Though perhaps the woolly aphid is not a major pest in Connecticut, some attention should be paid to it particularly in nurseries, and in newly established orchards. We believe that it will not seriously injure trees in Connecticut after they have become well established and have reached bearing size.

Gillette and Taylor state that "If Colorado orchardists should vote their opinion as to what ought to be called the worst orchard pest in the State, it is very doubtful whether the codling moth or the woolly aphis would carry off the honors."[1]

Life History.

The winter eggs are laid in the crevices of the bark on elm trees probably in September, and hatch in early spring. The aphids hatching from these eggs are wingless females, called stem mothers, which feed upon the expanding leaves and become mature late in May and cause the leaves to curl or form rosettes. Their young are also wingless and are born alive like the other summer generations of most aphids. The next generation, however, have wings and are known as spring migrants; they mature the latter part of June and migrate to apple trees. Sometimes they go to pear, quince, hawthorn or mountain ash. There are three summer generations in Maine[3] and in August winged females appear and shortly afterward lay the winter eggs.

According to Slingerland and Crosby, the development of the root form is quite similar to that of the form on the twigs and branches, though perhaps not fully worked out; also that "many of these wingless agamic nymphs persist on the roots, and some of them even on the tree above ground, all the year through even in New York State and other cold northern latitudes."[4]

Control Measures.

In general, orchardists should be advised not to plant trees with many galls on the roots. Nursery trees which have been seriously injured by the woolly aphid should be destroyed. Those which are not injured but which show evidences of infestation should before planting be either fumigated with hydrocyanic acid gas, or treated by dipping the roots in a nicotine solution containing a spreader, or in kerosene emulsion containing 15 per cent. kerosene. Hot water (130°-150° F.) is also recommended. Lime-sulphur, however, should not be used, as it may cause injury to the small roots.

In Missouri in 1896, experiments were rather successful in treating ten year old trees in the orchard by removing four inches of the top soil around each tree for a distance of two feet from the trunk and scattering evenly over this area four or six pounds of tobacco dust, then replacing the soil. With nursery trees, the dust was placed in trenches close beside the rows. In Georgia[5] more than ten years later, similar and more detailed experiments with various forms of tobacco in excavated areas and trenches gave very unsatisfactory results, but by removing three inches of the surface soil extending from one and one-half to four feet from the trunks, depending upon the size, and treating with 15 per cent. kerosene emulsion, good results were obtained. From three gallons of this emulsion on the smaller areas, to six gallons on the larger, saturated the soil to a depth of from two to four inches, and it gradually permeated the soil to a depth of a foot or more and the odor lasted for many weeks.

During the seasons of 1914 and 1915, Mr. B. R. Leach of the

Bureau of Entomology, conducted experiments against the woolly aphis in Virginia using various materials including kerosene emulsion, sodium cyanide, and carbon disulphide emulsion. His best results were obtained with carbon disulphide emulsion at the rate of one-half pound in four gallons of water, thoroughly agitated. A shallow basin was made around the tree and three-fourths of a gallon of the emulsion per square foot of soil was applied in the basin. He found this method quite satisfactory on small trees, where the conditions are favorable. The applications can be made at any time during the summer months, but are successful only when the soil is moist. Since Mr. Leach carried on these experiments, a soap emulsion of carbon disulphide has been manufactured and is now sold on the market. It is also possible to make at home a fairly good emulsion, and it is believed that these soap emulsions would also be effective in killing the root forms of woolly aphis, particularly after the proper proportions have been determined. Such emulsions have been used in this Department to kill the grubs of the Asiatic beetle, and did not injure the grass.

The aerial form of the woolly aphid can readily be killed by spraying with kerosene emulsion, or with nicotine sulphate and soap.

Literature.

The economic literature of this species is very voluminous, and only a few references are given here.

[1] Gillette, C. P., and Taylor, E. P., Bulletin 133, Colorado Agricultural Experiment Station, page 5, 1908.

[2] Leach, B. R., Bulletin 730, United States Department of Agriculture, pages 29-40, 1918.

[3] Patch, Edith M., Bulletin 256, Maine Agricultural Experiment Station, 1916.

[4] Slingerland, M. V., and Crosby, C. R., Manual of Fruit Insects, page 156, 1914.

[5] Smith, R. I., Bulletin 23, Georgia State Board of Entomology, 1907.

[6] Stedman, J. M., Bulletin 35, Missouri Agricultural Experiment Station, 1896.

THE LIME TREE WINTER MOTH.

Erannis tiliaria Harris.

This native American insect occurs throughout the eastern United States and Canada, westward to the Rocky Mountains. The larvae feed upon the foliage of apple, pear, linden, birch, elm, oak and hickory and probably other forest trees. As a rule it is not very abundant in Connecticut and therefore little attention has been paid to it. Occasionally it becomes so abundant as to cause damage by defoliating trees, and such may be the case in Connecticut in 1925, as the male moths were very abundant in October and November, flying around electric lights in cities and villages. Not only were the moths noticeable in Connecticut, but were reported as being abundant throughout Massa-

chusetts and portions of New York State. On November 1, a specimen of the male was received from Sharon with a statement that it was very abundant there, and since then I have learned that the caterpillars of this insect in the summer of 1924 caused noticeable damage to the beautiful elm trees on the village green. Hence, all persons responsible for the care of valued shade trees, whether on public or private grounds, should be warned to look out for the depredations of this insect early in the coming summer.

Other common names of the caterpillars are: lime tree span worm, lime inch worm and ten-lined inch worm.

Injury.

The injury consists in the caterpillars feeding upon the leaves during the month of May. This may well be ascribed to canker worms as it has a similar appearance and occurs at about the same time. In fact the larvae or caterpillars are often found feeding with canker worms, but as they are larger and have a more distinctly yellowish color on the lower portion of the sides and on the under surface, they can readily be distinguished from them. In 1912, this insect appeared in large numbers in western New York, and riddled the foliage of apple and cherry trees along the roadsides and to some extent in commercial orchards. Linden and elm trees were also partially defoliated.[3] In 1914, an outbreak of this insect was reported from Ulster County, N. Y., and orchard and woodland trees were attacked.[2]

At first the caterpillars eat elongated holes, but when they are abundant they completely riddle the leaves.

Habits and Life History.

Like the canker worms, this insect has one generation annually, the females are wingless, the caterpillars feed upon the leaves at the same time of the year and loop in crawling. The eggs hatch in April or early in May and the caterpillars become fully-grown early in June and transform to the pupa stage in cells in the ground. Some may pupate in May and usually all have pupated by the middle of June. The caterpillars have the habit of remaining rigid in one position or feigning death, sometimes fastened only at one end and the other standing out in a straight line like a twig. In Connecticut the adults for the most part emerge in the fall, though according to Dr. Saunders, in Canada fall emergence is rare and most of them emerge in spring.

One of the best biological accounts of this insect published in recent years is by Professor W. J. Schoene, in Bulletin 421, of the New York (Geneva) Agricultural Experiment Station, page 376, Plates V and VI, May, 1916, and the present writer has drawn upon it freely. Professor Schoene records no observations on the hatching of the eggs, but states that the females in a cool

room continued to oviposit for a week, scattering their eggs over the bark, some in cracks, some under the edges and some on exposed situations; also that 533 eggs were taken from the abdomen of one female.

On October 15, 1924, the males were quite abundant around electric lights, and several were collected. They did not disappear at once but were seen on warm nights through the remainder of October and November. Mr. Rogers spent some time looking over trees but did not find any females. The writer collected three females from the trunks of woodland trees, November 20, in Macedonia State Park, Kent.

The Station collection contains males collected by the writer in New Haven, 25 November, 1905; 7 November, 1906; 15 October, 1924. Two specimens from Pemaquid Point, Me., collected in August, 1906, by Professor H. W. Foote are also in our collection.

Descriptions.

Egg: Cream color, shape somewhat cylindrical, bluntly rounded at the ends. The sides and one end where the cap is situated are marked with compressed hexagonal reticulations, most pronounced on the cap. Laid singly or sometimes in loose clusters generally attached by one side. Length about .9 mm., width about .52 mm. The eggs are shown on Plate XXX, c.

Larva: A bright yellow looping caterpillar with rust-brown head and ten crinkled black lines extending longitudinally along the back. There is great variation in width of these lines, so that the dorsal view of some caterpillars is nearly black, and others are distinctly light-colored. The outer black line or stripe is often heavier or more pronounced than the others and is wavy, giving a scalloped appearance to the margin. The under surface is yellow and paler than the yellow between the black lines. Legs and prolegs yellow. Length of mature larva, nearly 1.5 inches. See Plate XXX, d.

Pupa: The pupae are brown, slightly more than half an inch in length and rather stout, though the females are somewhat shorter and thicker than the males. The pupae of both sexes terminate in a sharp point.

Adults: Male, forewings buff, marked transversely with two wavy brown bands, and sprinkled with fine brownish dots; rear wings, lighter buff or nearly white with no prominent markings. Scales of head, thorax, abdomen, and legs and antennae about the same tint as ground color of forewings. Wing-expanse about 1.75 inches.

Female, wingless, greenish-yellow, varying to light gray or brown, with two rows of black spots on the back. Legs and antennae are ringed with black and yellow or the ground color. Length about half an inch.

Both sexes are shown on Plate XXX, a and b.