

State of Connecticut

The Connecticut Agricultural  
Experiment Station

NEW HAVEN, CONN.

**Bulletin 218**

BEING THE

**NINETEENTH REPORT OF THE STATE  
ENTOMOLOGIST FOR 1919**

W. E. BRITTON, PH.D.

NINETEENTH REPORT  
OF THE  
STATE ENTOMOLOGIST  
OF  
CONNECTICUT  
FOR THE YEAR 1919

(Being Bulletin 218 Connecticut Agricultural Experiment Station)

BY  
W. E. BRITTON, PH.D.  
State Entomologist

NEW HAVEN, CONN.  
1920

# CONNECTICUT AGRICULTURAL EXPERIMENT STATION

## OFFICERS AND STAFF

### BOARD OF CONTROL.

His Excellency, Marcus H. Holcomb, *ex-officio*, *President*

James H. Webb, <i>Vice President</i> .....	Hamden
George A. Hopson, <i>Secretary</i> .....	New Haven
E. H. Jenkins, <i>Director and Treasurer</i> .....	New Haven
Joseph W. Alsop .....	Avon
Charles R. Treat.....	Orange
Elijah Rogers .....	Southington
William H. Hall.....	South Willington

### STAFF.

Administration.	E. H. JENKINS, PH.D., <i>Director and Treasurer</i> . MISS V. E. COLE, <i>Librarian and Stenographer</i> . MISS L. M. BRAUTLECHT, <i>Bookkeeper and Stenographer</i> . WILLIAM VEITCH, <i>In charge of Buildings and Grounds</i> .
Chemistry.	
Analytical Laboratory.	E. MONROE BAILEY, PH.D., <i>Chemist in charge</i> . R. E. ANDREW, M. A., C. E. SHEPARD, H. D. EDMOND, B.S., FRANK SHELDON, <i>Laboratory Assistant</i> . V. L. CHURCHILL, <i>Sampling Agent</i> . MISS ALTA H. MOSS, <i>Clerk</i> . <div style="margin-left: 150px;">                     } <i>Assistant Chemists</i>.                 </div>
Protein Research.	T. B. OSBORNE, PH.D., D.Sc., <i>Chemist in Charge</i> .
Botany.	G. P. CLINTON, Sc.D., <i>Botanist</i> . E. M. STODDARD, B.S., <i>Assistant Botanist</i> . MISS FLORENCE A. MCCORMICK, PH.D., <i>Scientific Assistant</i> . G. E. GRAHAM, <i>General Assistant</i> . MRS. W. W. KELSEY, <i>Stenographer</i> .
Entomology.	W. E. BRITTON, PH.D., <i>Entomologist; State Entomologist</i> . B. H. WALDEN, B.AGR., I. W. DAVIS, B.Sc., M. P. ZAPPE, B.S., PHILIP GARMAN, PH.D., K. F. CHAMBERLAIN, MISS GLADYS M. FINLEY, <i>Stenographer</i> . <div style="margin-left: 150px;">                     } <i>Assistant Entomologists</i>.                 </div>
Forestry.	WALTER O. FILLEY, <i>Forester, also State Forester and State Forest Fire Warden</i> . A. E. MOSS, M.F., <i>Assistant State and Station Forester</i> . H. W. HICOCK, M.F., <i>Assistant</i> . MISS E. L. AVERY, <i>Stenographer</i> .
Plant Breeding.	DONALD F. JONES, S.D., <i>Plant Breeder</i> . C. D. HUBBELL, <i>Assistant</i> .
Vegetable Growing.	W. C. PELTON, B.S.

## TABLE OF CONTENTS

---

	Page
Report of Receipts and Expenditures .....	113
Summary of Inspection and Office Work .....	114
Publications of Entomological Department, 1919 .....	115
Department Staff .....	116
Chief Lines of Work .....	117
Inspection of Nurseries .....	118
Nursery Firms in Connecticut Receiving Certificates in 1919 .....	120
Inspection of Imported Nursery Stock .....	122
Pests found on Imported Nursery Stock .....	124
Inspection of Imported Bulbs .....	126
Pests found on Imported Bulbs .....	127
Inspection of Apiaries .....	128
Summary .....	134
Gipsy and Brown-Tail Moth Work in 1919 .....	135
Present Status of the Brown-Tail Moth in Connecticut .....	135
Financial Statement .....	136
Details of Gipsy Moth Work by Towns .....	137
Statistics of Infestation .....	144
The White Pine Weevil .....	144
Evidence of Injury .....	145
Life History .....	146
Distribution .....	147
Food Plants .....	147
Effect of Injuries .....	148
Description .....	148
Natural Enemies .....	150
Methods of Control .....	151
Removing Infested Leaders .....	151
Protecting the Leaders from Injury .....	152
Spraying .....	152
Jarring .....	152
Literature .....	155
The Pine Bark Aphid .....	155
Distribution .....	156
Appearance and Injury .....	157
Life History .....	158
Natural Enemies .....	158
Control Measures .....	158
Literature .....	160
Experiments to Control the Chrysanthemum Gall Midge .....	161
Summary .....	165
Literature .....	165
Prevalence of Green Clover Worm on Beans .....	165
Injury to Beans .....	166
Food Plants .....	167
Habits and Life History .....	167
Description .....	167
Control Measures .....	169
Literature .....	170
Present Status of European Corn Borer in the United States .....	170
Massachusetts Infestation .....	170
New Hampshire Infestation .....	170
New York Infestation .....	171

	Page
Pennsylvania Infestation .....	171
Connecticut Corn Borer a Different Species .....	171
Funds for Combating the European Corn Borer .....	172
A Native Borer Attacking Corn .....	173
Injury to Corn Stalks .....	176
Identity .....	177
Distribution in the United States .....	177
Distribution in Connecticut .....	177
Food Plants .....	177
Life History and Habits .....	178
Description .....	179
Control Methods .....	180
The Stalk Borer .....	180
Control Measures .....	183
Injury to Corn in Connecticut by <i>Crambus praefectellus</i> .....	183
The Army Worm .....	185
The Smear'd Dagger Moth .....	186
The Lined Corn Borer .....	187
The Corn Ear Worm .....	188
Other Insects Attacking Corn in 1919 .....	189
Thrips .....	189
Wireworms .....	190
Noctuid Caterpillars .....	190
The Parsnip Web Worm .....	192
Mosquito Work in 1919 .....	193
Report of Work by Towns .....	194
Entomological Features of the Season .....	197
Miscellaneous Insect Notes .....	198
<i>Enchenopa binotata</i> Reported as Injuring Beans .....	198
Poultry Food Infested with Mites .....	198
A Weevil Breeding in Stems of Pigweed and Ragweed .....	198
Borers in Stems of Evening Primrose .....	199
Plum Curculio in Peaches .....	199
Leopard Moth in Hartford .....	199
The Potato Aphid .....	199
The Gladiolus Aphid .....	199
Abundance of the Pea Aphid .....	200
Swarms of White Moths .....	200
Pink Grasshoppers .....	200
Larch Case Bearer .....	200
The Pine Tube Moth .....	201
The Clover Seed Chalcid .....	201
Swarms of Cotton Moths .....	201
Elm Leaf Beetle Again Abundant .....	202
Beans Injured by Gray Hair-Streak Butterfly .....	202
The White Blotch Oak Leaf-Miner .....	203
Swarms of Aphids .....	203
Flea Beetle on Swiss Chard .....	204
An Outbreak of Book Lice in a House at Milford .....	204
A Tobacco Warehouse Infested by the Cigarette Beetle .....	205
Index .....	207

## NOTE REGARDING AUTHORSHIP.

For bibliographical purposes all matter in this report (Bulletin 218) should be credited to W. E. Britton except where otherwise indicated.

BULLETIN 218  
**NINETEENTH REPORT**  
 OF THE  
**State Entomologist of Connecticut**

*To the Director and Board of Control of the Connecticut Agricultural Experiment Station:*

I submit, herewith, my nineteenth report as State Entomologist of Connecticut for the year 1919. Pursuant to the action of the General Assembly in changing the time of beginning of the fiscal year, the financial statement covers the nine months ending June 30, 1919. As much of the work of the department extends through the summer, the other part of this report covers the season as usual, and includes brief reports of the work of inspecting nurseries, imported nursery stock and bulbs, apiaries, and suppressing the gipsy moth: also separate accounts of the white pine weevil, the pine bark aphid, various borers and other insects attacking corn in Connecticut, outbreak of the green clover worm on beans, chrysanthemum gall midge experiments, progress of mosquito extermination work, and miscellaneous notes on common pests and unusual insects of the season.

Respectfully submitted,

W. E. BRITTON,

*State and Station Entomologist.*

REPORT OF THE RECEIPTS AND EXPENDITURES OF THE STATE ENTOMOLOGIST  
 FROM OCTOBER 1, 1918, TO JUNE 30, 1919.

RECEIPTS.

From E. H. Jenkins, Treasurer .....	\$4,500.00	
Account of 1918, Balance .....	1,440.71	
State Comptroller, Gipsy Moth Account .....	541.98	
M. P. Zappe, Automobile Mileage .....	4.20	
	\$6,486.89	

EXPENDITURES.

For Field, Office and Laboratory Assistance:	
B. H. Walden,* salary .....	\$1,166.64
M. P. Zappe, salary .....	1,125.00
K. F. Chamberlain, salary .....	420.00

\* For seven months: remainder paid from mosquito appropriation.

Martha DeBussy,† salary .....	\$336.00	
Gladys M. Finley, salary .....	222.00	
Other Assistance .....	169.67	
		<u>\$3,449.31</u>
Printing and Illustrations .....	50.50	
Postage .....	30.13	
Stationery .....	23.37	
Telegraph and Telephone .....	4.58	
Office Supplies .....	37.10	
Library .....	224.62	
Machinery, Tools and Supplies .....	143.95	
Express Freight and Cartage .....	3.61	
Traveling Expenses .....	350.41	
Automobile Tires and Repairs .....	279.56	
Balance Cash on Hand .....	1,889.75	
		<u>\$6,486.89</u>

*Memorandum:*—This account of the State Entomologist has been audited by the State Auditors of Public Accounts. The item of \$541.98 credited as having been received from the State Comptroller is really a transfer from the appropriation for suppressing gipsy and brown-tail moths and for inspecting imported nursery stock, and covers the time and automobile mileage of members of the department staff while engaged in inspecting imported stock.

The reason for making this financial statement cover nine months instead of a full year is on account of the change in the beginning of the fiscal year from October 1st to July 1st, made by the last session of the Legislature.

#### SUMMARY OF INSPECTION AND OFFICE WORK.

- 305 samples of insects received for identification.
- 96 nurseries inspected.
- 8 regular certificates granted.
- 22 parcels of nursery stock inspected and certified.
- 57 orchards and gardens examined.
- 131 shipments, containing 1,075 cases, 1,164,701 plants, imported nursery stock inspected.
- 44 shipments or 33.5 per cent. found infested with insects or fungi.
- 317 shipments, containing 924 cases, 1,529,775 imported bulbs inspected.
- 723 apiaries, containing 6,070 colonies inspected.
- 48 apiaries, containing 78 colonies found infested with European foul-brood.
- 22 apiaries, containing 69 colonies found infested with American foul-brood.
- 2,308 letters written on official work.
- 121 circular letters.
- 621 post cards.

† Resigned March 4, 1919.

- 254 reports of inspection to Federal Horticultural Board.  
 798 bulletins, etc., mailed on request or to answer inquiries.  
 51 packages sent by mail or express.  
 23 lectures and addresses at institutes, granges, etc.

## PUBLICATIONS OF ENTOMOLOGICAL DEPARTMENT, 1919.

By *W. E. Britton*.

- Eighteenth Report of the State Entomologist (Bulletin 211), 108 pages, 7 figures, 16 plates; 10,000 copies distributed in May, 1919.  
 Insects Attacking the Potato Crop in Connecticut (Bulletin 208), 20 pages, 6 figures, 8 plates; 10,000 copies distributed in March, 1919.  
 Report of Committee on Injurious Insects, Report of Connecticut Vegetable Growers Association for 1918, page 28, 1919.  
 Report of Committee on Injurious Insects, Proceedings Twenty-Eighth Annual Meeting, Connecticut Pomological Society, page 95, 1919.  
 The European Corn Borer, Proceedings Twenty-Eighth Annual Meeting Connecticut Pomological Society, page 159, 1919.  
 Progress in Mosquito Control in Connecticut in 1917. Proceedings Fifth Annual Meeting New Jersey Mosquito Extermination Association, page 100, 1918.  
 The Iris Borer Again, *Florists' Exchange*, Vol. xlvi, page 531, October 5, 1918.  
 The Chrysanthemum Midge, *Florists' Exchange*, Vol. xlvii, page 45, January 11, 1919.  
 Insects Attacking Maples and Elms, *Florists' Exchange*, Vol. xlvii, page 1,331, June 28, 1919.  
 A Tree Protection Institute, *Florists' Exchange*, Vol. xlviii, page 205, August 2, 1919.  
 Book Review—Washburn's Injurious Insects and Useful Birds, *Science*, Vol. xlix, page 425, May 2, 1919.  
 Elm Leaf Beetle, *New Hampshire Sentinel*, July 23, 1919.  
 Automobile Truck Power Sprayers, *American Fruit Grower*, 2 figures, page 6, October, 1919.  
 Corn Borers, *New England Farms*, June 28, 1919.  
 Corn Borers, *Connecticut Agricultural College Press Bulletin*, July 10, 1919.  
 Corn Borers, *Hartford County Farm News*, July, 1919.  
 Tree Protection Institute, *Hartford County Farm News*, July, 1919.

By *W. E. Britton and M. P. Zappe*.

- Kerosene Emulsion versus Nicotine Solution for Combating the Potato Aphid, *Journal of Economic Entomology*, Vol. 12, page 71, 1919.

By *M. P. Zappe*.

- Aphis Control, Proceedings Twenty-Eighth Annual Meeting, Connecticut Pomological Society, page 145, 1919.



## DEPARTMENT STAFF

W. E. BRITTON, PH.D.,	<i>State and Station Entomologist.</i>	
B. H. WALDEN, B.AGR.,	<i>Photographic and Mosquito Work.</i>	} Assistant Entomologists.
IRVING W. DAVIS, B.SC.,	<i>Deputy in Charge of Moth Work.</i>	
MAX P. ZAPPE, B.S.,	<i>Inspection and General Work.</i>	
KENYON F. CHAMBERLAIN,*	<i>Inspection and General Work.</i>	
PHILIP GARMAN, PH.D.,†	<i>Research Work.</i>	
MISS MARTHA DEBUSSY,‡	} <i>Clerks and Stenographers.</i>	
MISS GLADYS M. FINLEY,§		
H. W. COLEY, Westport,	} <i>Apiary Inspectors.</i>	
A. W. YATES, Hartford,		

Messrs. Walden and Zappe have continued as assistants in the general work of the department. Mr. Chamberlain, who was employed to inspect nurseries in 1918, was reengaged for the season beginning February 24. Mr. Davis was discharged from military service and resumed his duties in charge of the gipsy moth work January 15. During his absence Mr. Ashworth acted as superintendent and deputy.

Dr. Philip Garman, a graduate of the University of Kentucky, class of 1913, was appointed a member of the staff and began his duties September 1. Dr. Garman was a graduate student at the University of Illinois, receiving his doctor's degree in 1916. He was then assistant entomologist at the Maryland Agricultural Experiment Station for three years. Though Dr. Garman may be called upon sometimes to assist in the general work of the department, he will be engaged chiefly in research in connection with injurious and beneficial insects.

Miss Martha DeBussy served as clerk and stenographer from August 26, 1918, to March 4, 1919, when she resigned to accept a position with larger salary. Miss Gladys M. Finley was appointed to fill the position.

Messrs. Coley and Yates have made the inspections of apiaries, as in preceding years, on a *per diem* basis.

Mr. Walden has continued to serve as deputy to the Director in mosquito elimination work, which required nearly all of his time during the summer months. He has done considerable photographic work and has aided in the inspection of nurseries, imported nursery stock and bulbs. He has been in charge of the

\* Beginning February 24.

† Beginning September 1.

‡ Resigned March 4.

§ Beginning March 6.

department during the absence of the Entomologist. Mr. J. Kirby Lewis was employed from August 11 to October 4 to inspect nurseries and bulbs. Mr. Geo. D. Stone, who has been on the gipsy moth force, was employed around Milford in April and May, and again in July to examine corn fields over the state. He also helped to inspect nurseries and imported bulbs, returning in October to the gipsy moth work.

All of the regular members of the staff and the temporary assistants mentioned above have rendered faithful and efficient services which have been appreciated.

#### CHIEF LINES OF WORK.

The regular inspection work as provided for by statute, such as the gipsy and brown-tail moth work, the inspection of nurseries, orchards, gardens, etc., the inspection of imported nursery stock and apiaries has been conducted as in former years.

At the suggestion of the Federal Horticultural Board made during the summer, an attempt has been made to examine all bulbs imported from foreign countries. These shipments began arriving about August 1st, and during the next four months we inspected more than three hundred separate shipments containing 924 cases of bulbs.

Mr. Walden has continued as deputy to the Director in charge of the mosquito drainage work of the state, which during the year has for the most part been maintenance. A few new tide gates have been built, and there have been extensions to the drainage systems in a few towns, but no extensive new work has been carried out.

Mr. Zappe conducted experiments in controlling the chrysanthemum gall midge *Diarthronomyia hypogaea* Loew., in two large commercial greenhouses, in the late winter, and has also continued his studies on the life history of an undescribed sawfly of the genus *Itycorsia* which feeds upon Austrian pine.

Messrs. Zappe and Britton have continued the field experiments begun five or six years ago for the control of the insects attacking cucumbers, squashes, pumpkins and melons in Connecticut. The Entomologist has prepared a paper on this subject which was published as Bulletin No. 216.

Dr. Garman, who began his duties September 1, has already worked out the life history of the bulb mite, *Rhizoglyphus echin-*

*opus* Fumouse and Robin, which up to that time had not been published. The results of his studies are now being prepared for publication.

On account of the menace of the European corn borer, *Pyrausta nubilalis* Hubner, much scouting has been done in various parts of the State to learn whether or not the pest occurred in Connecticut. Though up to this time it has not been found within our State, several borers resembling it were discovered. All are native or long established species, which in themselves need cause no alarm. Many corn fields were visited in late winter and the corn stalks examined in the shock or as left standing in the field. In Milford where borers were found in the stalks, through co-operation with the owners, the stalks were cut and burned in several fields. Mr. George D. Stone was in immediate charge of this work.

Later in the season, Mr. Stone visited a number of towns in each county, and examined the growing corn in the fields, sending to the laboratory specimens of all insects found attacking the corn crop.

In the following pages of this report, the various papers describe in detail these lines of effort.

By action of the General Assembly, the Entomologist is a member of the new Tree Protection Examining Board, and at present he is serving as Chairman of the Board.

The Entomologist has also co-operated with the Farm Bureaus, and has furnished information about insect pests where needed.

Some time and attention during the year has been given to the preparation of papers to be published by the State Geological and Natural History Survey.

#### INSPECTION OF NURSERIES.

The annual inspection of nurseries commenced on August 7, but on account of the unusual abundance of rainy weather and the arrival of shipments of imported bulbs to be inspected, the work was retarded and not finished until October 29. Most of this inspection work was done by Messrs. Zappe, Chamberlain, Walden, Lewis, Davis and Stone, but occasionally they were assisted by Messrs. Garman and Britton. Mr. Lewis was employed temporarily from August 11 until October 4 for this purpose. Mr. Stone, who had been borrowed from the gipsy

moth force service to inspect corn fields, was also pressed into service to inspect nurseries, but returned to gipsy moth work on October 8. Mr. Davis inspected practically all of the nurseries in the eastern part of the State.

The men were transported chiefly by automobile, but Mr. Stone travelled to many outlying nurseries on his motorcycle.

The system of inspection adopted was similar to that of former years. Where important pests were found the trees or plants were marked, and the owner or manager was instructed to destroy or treat them as the needs of the case required. Certificates were not granted until a written statement was received that the directions had been carried out.

In inspecting nurseries year after year, the same kinds of pests are found though they may vary somewhat in the order of their abundance. Thus in 1919 the number of nurseries infested by our common nursery pests corresponds very closely to that of 1918, and is as follows:—

Insects:—Oyster-Shell Scale 38; San José Scale 19; Spruce Gall Aphid 19; White Pine Weevil 5; Tulip Tree Scale 4; Pine Leaf Scale 3; Scurfy Scale 3; Elm Scale 2; Euonymus Scale 2; Green Apple Aphid, *Chermes cooleyi*, Woolly Aphid, Rose Scale, Pine Tube Moth, Peach Borer and Leopard Moth, one each.

Plant Diseases:—Poplar Canker 5; Black Knot of Plum, Fire Blight, and Crown Gall, one each.

In 32 nurseries no pests were found.

As in 1918, the oyster-shell scale was the most common and abundant pest on nursery stock, and before certificates could be granted many trees and shrubs had to be destroyed. San José scale infestations were about the same as last year. The tulip tree scale was found in four nurseries, but was entirely absent in 1918. The Oriental peach moth *Laspeyresia molesta* Busck was not found in any nursery.

Four new nurseries and one old nursery were inspected in the spring and certificates granted; they were again inspected in the fall and are marked (2) on the list.

Twenty-two packages were inspected and certificates granted.

Of the 83 names on the list of nurserymen for 1919, six are new, the names of two have been changed and three have gone out of business. Six nurseries had not destroyed or treated their infested stock in time to receive certificates before this report

went to press. The acreage devoted to the growing of nursery stock remains about the same as last year.

The list for 1919, with location, acreage, date and number of certificate of each is as follows:—

NURSERY FIRMS IN CONNECTICUT RECEIVING CERTIFICATES IN 1919.

Name of Firm.	Address.	Acreage.	Certificate Issued.	No. of Certificate.
Barnes Bros. Nursery Co.....	Yalesville .....	150	Sept. 9	1003
Beattie, Wm. H.....	New Haven .....	1	Sept.22	1011
Bertolf Bros. ....	Sound Beach ....	25	Oct. 1	1022
Brainard Nursery & Seed Co....	Thompsonville ..	6	Nov. 5	1055
Braley & Co.....	Burnside .....	1	Sept. 2	995
Bretschneider, A. ....	Danielson .....	1	Sept.11	999
Brown, F. K. (2).....	Greenwich .....	2	Sept.26	1017
Burr & Co., C. R.....	Manchester, Elling- ton and Durham	500	Sept. 9	1000
Burroughs, Thos. E. ....	Deep River .....	3	Sept.26	1015
Chapman, C. B.....	Groton .....	1	Sept.11	1006
Chapman, C. E.....	North Stonington	4	Sept.11	1005
Coari & Co. (2).....	Norwalk .....	2	Oct. 10	1042
Conine Nursery Co. ....	Stratford .....	50	Sept.23	1012
Conley, L. D.....	Ridgefield .....	5	Oct. 1	1025
Conn. Agricultural College (Prof. S. P. Hollister).....	Storrs .....	1	Sept. 2	990
Conn. Agr. Experiment Station (W. O. Filley, State Forester)	New Haven .....	1	Oct. 7	1034
Conway, W. B.....	New Haven .....	1	Nov. 6	1059
Crofut & Knapp Farm.....	Norwalk .....	20	Nov.12	1066
Cross Highway Nurseries.....	Westport .....	6	Nov. 5	1057
Dallas, Inc., Alexander.....	Waterbury .....	1	Aug.30	989
Elm City Nursery Co., Woodmont Nurseries, Inc. ....	Woodmont & New Haven .....	155	Sept.27	1018
Fairfield Landscape & Nurseries Co. ....	Cannondale .....	5	Nov. 10	1063
Falcon's Flight Farms Nursery (B. Austin Cheney, Prop.)....	Litchfield .....	1	Sept.26	1016
Gardner's Nurseries .....	Cromwell .....	10	Oct. 30	1050
Geduldig, Estate of G.....	Norwich .....	1	Nov. 12	1065
Goodwin Associates, Inc., The James L. ....	Hartford .....	1	Oct. 21	1048
Heath & Co.....	Manchester .....	1	Sept. 9	1002
Hilliard, H. J. ....	Sound View ....	1	Sept. 2	993
Hiti Nurseries (J. H. Bowditch Prop.) .....	Pomfret Center..	5	Sept. 6	996
Holcomb, Irving .....	Simsbury .....	1	Sept.11	1007

## INSPECTION OF NURSERIES.

121

NURSERY FIRMS IN CONNECTICUT RECEIVING CERTIFICATES IN 1919—*Cont'd.*

Name of Firm.	Address.	Acreage.	Certificate Issued.	No. of Certificate.
Horan & Son, Jas.....	Bridgeport .....	1	Nov. 4	1053
Houston & Sons, J. R. ....	Mansfield .....	4	Sept. 2	991
Hoyt's Sons Co., Inc., The Stephen .....	New Canaan ....	300	Oct. 23	1049
Hubbard & Co., Paul M.....	Bristol .....	12	Nov. 1	1051
Hunt & Co., W. W. ....	Hartford .....	10	Sept. 15	1008
Isselee, Charles .....	Darien .....	10	Nov. 7	1062
Kelley, James J. ....	New Canaan ....	1	Oct. 15	1045
Kellner, Herman H. ....	Danbury .....	1	Oct. 1	1024
Keso Nursery (J. J. Kelsey, Prop.)	Clinton .....	1	Sept. 23	1014
Laddin's Rock Nursery (W. L. Marks, Prop.) (2) .....	Stamford .....	5	Oct. 6	1031
Larkin Bros., The.....	New London ....	1	Sept. 6	997
Long, J. A., Mrs.....	East Haven ....	1	Sept. 30	1020
Mallett Co., George A.....	Bridgeport .....	1	Nov. 3	1052
Maplewood Nurseries (T. A. Peabody, Mgr.) .....	Norwich .....	1	Sept. 2	992
Marigold Farm (H. Kelley, Prop.)	New Canaan ....	2	Sept. 27	1019
McDermott, E. F. ....	Windsor .....	1	Oct. 3	1028
Meier & Gillette.....	West Hartford...	2	Nov. 5	1056
Munro, Charles .....	New Haven ....	1	Sept. 30	1021
New Haven Nurseries.....	New Haven ....	10	Oct. 9	1038
New Haven Park Commissioners (G. X. Amrhyn, Supt.) .....	New Haven ....	30	Oct. 7	1033
New London Cemetery Association (Ernest E. Rogers, Pres.)	New London ....	1	Nov. 7	1061
New London County Nurseries (W. J. Schoonman, Prop.) (2)	New London and Stonington ....	5	Dec. 9,	1069
North-Eastern Forestry Co.....	Cheshire .....	20	Aug. 26	988
Oakland Nurseries .....	Manchester ....	1	Sept. 9	1001
Palmer, Est. of L. M. ....	Stamford .....	5	Oct. 1	1026
Park Gardens .....	Bridgeport .....	1	Oct. 10	1040
Pequod Nursery Co.....	Meriden .....	15	Sept. 11	1004
Phelps, J. Wesson.....	Bolton .....	1	Sept. 2	994
Phelps & V. T. Hammer Co., The J. W. ....	Branford .....	2	Oct. 21	1047
Pierson, A. N., Inc.....	Cromwell .....	50	Aug. 23	987
Platt, Co., The Frank S. ....	New Haven ....	1	Oct. 7	1035
Pomeroy, Edwin C. ....	Northville ....	1	Nov. 6	1058
Purinton, Mrs. C. O. ....	Hartford .....	1	Oct. 6	1032
Quality Seed Store .....	Stamford .....	1	Oct. 4	1029
Reck, Julius .....	Bridgeport .....	1	Oct. 10	1036
Rockfall Nursery Co. (P. Marotta, Prop.) (2) .....	Rockfall .....	1	Nov. 4	1054

NURSERY FIRMS IN CONNECTICUT RECEIVING CERTIFICATES IN 1919—*Cont'd.*

Name of Firm.	Address.	Acreage.	Certificate Issued.	No. of Certificate.
Saxe & Floto .....	Waterbury .....	1	Dec. 2,	1068
Schleichert, F. C.....	Bridgeport .....	1	Oct. 10	1041
Scott, J. W.....	Hartford .....	5	Nov. 17	1067
Sierman, C. H.....	Hartford .....	5	Oct. 17	1046
South Wilton Nurseries.....	South Wilton ...	5	Oct. 9	1036
Stannard Hill Greenhouses (J. E. Brooks, Prop.) .....	Westbrook .....	1	Sept. 23	1013
Steck, Charles A. ....	Bethel .....	2	Oct. 9	1037
Stratfield Nursery Co.....	Bridgeport .....	4	Nov. 11	1064
Traendly & Schenck.....	Rowayton .....	2	Oct. 1	1027
Upson, R. E.....	Marion .....	1	Nov. 6	1060
Verkade, H. ....	New London ...	2	Sept. 15	1009
Vidbourne & Co., J.....	Hartford .....	7	Oct. 14	1043
Wallace, Arthur T.....	Wallingford ....	2	Oct. 14	1044
Wild, Henry .....	Riverside .....	1	Oct. 4	1030
Wilson & Co., C. E.....	Manchester ....	10	Sept. 9	998
Yale University Forest School..	New Haven ....	1	Sept. 22	1010
Young, Mrs. Nellie A.....	Pine Orchard ...	1	Oct. 1	1023
Total acreage .....		1,525		

## INSPECTION OF IMPORTED NURSERY STOCK.

For the past ten years an attempt has been made by this department to inspect all woody nursery stock, entering the state, that had been imported from foreign countries. The establishment of the Federal Horticultural Board in 1912, and its system of permits and notices adopted soon afterward, made it possible to examine a much larger proportion of shipments entering the State. From that time to the present, nearly all shipments have been examined, but of course it is nearly impossible to intercept all pests that might be brought over. Especially is this true of plants like azaleas and rhododendrons and certain conifers which are usually shipped with a ball of earth about the roots. Then, too, certain insects may crawl out of the cases and escape before the stock is unpacked or even during the operation.

There had been a rapid increase each year in the number of shipments of this kind coming to Connecticut until the war. In 1917 and 1918, the number of shipments dropped off markedly on account of the blockade and scarcity of tonnage in shipping.

After the armistice was signed, however, and shipping again resumed, considerable stock was shipped. The Federal Horticultural Board announced an embargo, Quarantine 37, on most kinds of nursery stock and woody field grown florist's stock to take effect June 30, 1919. Certain kinds of stock like seedling fruit and manetti rose, which are used for propagation and which are shipped with roots bare, will still be allowed to enter under the rules and regulations prescribed by the Federal Horticultural Board. There is an arrangement by which new and promising forms and varieties may be imported through the U. S. Department of Agriculture.

The trade evidently tried to bring into the country as much stock as possible before the new restrictive measures went into effect. Consequently between October 1st, 1918, and June 30, 1919, 131 shipments containing 1075 cases and 1,164,701 plants were received in Connecticut and inspected by members of this department. This is nearly twice the number of shipments and nearly three times the number of cases inspected last year, and an increase of 38 per cent in the number of plants. Forty-four shipments or 33.5 per cent were infested with insects or fungi some of which are pests.

Most of this stock was inspected by Messrs. Zappe and Chamberlain, but Messrs. Walden, Davis, and Britton assisted during the rush season. The time required to inspect this stock amounts to 707.5 hours, or 94.3 days of 7½ hours each, or 3.62 months of 26 working days each.

The sources of this stock are given in the following table:—

SOURCES OF IMPORTED NURSERY STOCK, 1918-1919.

Country.	No. of Shipments.	No. of Cases.
Holland .....	98	937
France .....	14	73
England .....	8	23
Scotland .....	5	5
Ireland .....	3	3
Bermuda .....	2	32
Japan .....	1	2
Total .....	131	1,075

The following table shows the quantity of stock as inspected by months:—



Month.	No. of Shipments.	No. of Cases.	No. of Plants.
December, 1918 .....	4	5	20,000
January, 1919 .....	7	55	293,473
February .....	19	85	70,360
March .....	9	40	157,107
April .....	83	242	588,754
May .....	7	40	34,999
June .....	2	8	8
Total .....	131	1,075	1,164,701

Notices were received of five additional shipments containing 35 cases which were not inspected. Three of these shipments were reshipped and sent out of the State, one contained only herbaceous stock, and one was unpacked and the plants distributed before it was possible to inspect them.

As was the situation last year, none of these shipments came directly from Italy, Belgium or Germany.

As in former years, most of the insects and fungi found in the shipments are (1) species which are already present in this country or (2) species which are not important as pests. However, there are some exceptions. Among the insects intercepted when the plants were inspected in 1919, are the Brown-tail moth, *Euproctis chrysorrhoea* Linn., regarded as an important pest but already present in the New England states; European tent-caterpillar *Malacosoma neustria* Linn., a pest of trees in Europe, which though several times intercepted on stock brought into this country, is not yet established here; *Agelastica alni* Linn., and *Emphytus cinctus* Linn., also brought in many times but not established here; *Otiorynchus sulcatus* Fabr., *Coccus hesperidum* Linn., and the oyster-shell scale are already established in this country. The infestations found during the year are given in detail as follows:—

#### PESTS FOUND ON IMPORTED NURSERY STOCK, 1918-1919.

44 Shipments Infested.

##### *Insects, etc.*

- Agelastica alni* Linn. on trees. Van Gelderen & Co., Boskoop, Holland.  
*Amara communis* Panz. Trees. Koster & Co., Boskoop, Holland.  
*Anisodactylus binotatus* Fabr. Trees. Visser Bros., Naarden, Holland.  
*Aphodius granarius* Linn. on Taxus. Koster & Co., Boskoop, Holland.  
*Barypithes pellucidus* Boh. Taxus trees. Koster & Co., Boskoop, Holland.  
*Carabus nemoralis* Mull. on trees. Van Heinigen Bros. & Co., Boskoop, Holland.

- Clivina fossor* Linn. on trees. Van Heinigen Bros. & Co., Boskoop, Holland.
- Coccinella 7-punctata* Linn. Azaleas. H. M. Hardyzer, Boskoop, Holland.
- Coccus hesperidum* Linn. on laurel trees. Flandria Societe Anonyme, Bruges, Belgium.
- Curculionid larvae. Trees. H. M. Hardyzer, Boskoop, Holland.
- Elaterid larvae on shrubs. H. M. Hardyzer, Boskoop, Holland; Van Heinigen Bros. & Co., Boskoop, Holland.
- Emphytus cinctus* Linn. on Manetti Rose. R. H. Bath, Ltd., Wisbech, England; S. Bide & Sons, Farnham, Surrey, England; Vincent Lebreton, La Pyramide-Trelaze, France; As. Ouwerkerk, Boskoop, Holland; Thomas Smith & Sons, Troon, Scotland; Louis Leroy Nurseries Co., Angers, France.
- Emphytus cinctus* Linn. larva. E. Turbat & Co., Orleans, France.
- Euproctis chrysorrhoea* Linn. on fruit trees. Franco-American Seedling Co., Nantes, France.
- Falagria* sp. D. Prior & Sons, Colchester, England.
- Forficula auricularia* Linn. on trees. H. M. Hardyzer, Boskoop, Holland.
- Lampyrid larva on Juniper trees. Van Heinigen Bros. & Co., Boskoop, Holland.
- Lathrobium brunnipes* Fabr. on trees. Van Heinigen Bros. & Co., Boskoop, Holland; M. Koster & Sons, Boskoop, Holland.
- Lepidopterous pupa on spruce. M. Koster & Sons, Boskoop, Holland.
- Malacosoma neustria* Linn. on shrubs. Visser Bros., Naarden, Holland.
- Milliped on Manetti Rose. Vincent Lebreton, La Pyramide-Trelaze, France.
- Mycetaea hirta* Mar. D. Prior & Sons, Colchester, England.
- Nest of Rats on blue spruces. Harry Koolbergen, Boskoop, Holland.
- Noctuid cocoon on trees. Franco-American Seedling Co., Nantes, France.
- Pterostichus vulgaris* Linn. In soil. Koster & Co., Boskoop, Holland.
- Otiorhynchus sulcatus* Fabr. Taxus. Van Heiningen Bros. & Co., Boskoop, Holland.
- Oyster Shell Scale on Boxwood. Sliedrecht & Co., Boskoop, Holland; Schaum & Van Tol, Boskoop, Holland; Koster & Co., Boskoop, Holland; Visser Bros., Naarden, Holland; Ebginge & Van Groos, Boskoop, Holland; Van Heiningen Bros. & Co., Boskoop, Holland; H. den Ouden & Son, Boskoop, Holland; C. Van Kleef & Co., Boskoop, Holland; F. J. Grootendorst & Sons, Boskoop, Holland; W. Van & Sons, Boskoop, Holland; As. Ouwerkerk, Boskoop, Holland.
- Sow bug on shrubs. K. Kromhout & Sons, Boskoop, Holland.
- Spiders eggs, one mass on shrubs. K. Kromhout & Sons, Boskoop, Holland.
- Triaena plebeja* Gyllh. on trees. Ebginge & Van Groos, Boskoop, Holland.

#### Plant Diseases.

- Crown Gall on Manetti Rose. S. Bide & Sons, Farnham, Surrey, England; Vincent Lebreton, La Pyramide-Trelaze, France; Thomas Smith & Sons, Troon, Scotland; As. Ouwerkerk, Boskoop, Holland; Louis Leroy Nurseries Co., Angers, France.

## INSPECTION OF IMPORTED BULBS.

At the suggestion of the Federal Horticultural Board, an attempt has been made, at least for a definite period, to inspect the imported bulbs entering Connecticut, in order to ascertain whether or not any dangerous pests are liable to be introduced in this way. Bulbs were not prohibited under Quarantine No. 37, and no effort has ever been made before to inspect them in Connecticut. The first to arrive were lily bulbs from Bermuda, then narcissus paper whites from France which began coming in July. Later came tulip and hyacinth bulbs from Holland and lily bulbs from Japan.

The source of the shipments inspected are as follows:—

Country.	No. of Shipments.	No. of Cases.
France .....	104	302
Holland .....	147	436
Japan .....	43	141
China .....	9	26
Bermuda .....	4	6
England .....	10	13
Total .....	317	924

The inspections by months are as follows:—

Month.-	No. of Shipments.	No. of Cases.	No. of Bulbs.
July .....	1	3	200
August .....	46	102	71,900
September .....	57	199	231,835
October .....	109	334	629,495
November .....	104	286	596,345
Total .....	317	924	1,529,775

On November 14, notice was received from the Federal Horticultural Board that arrangements had finally been made for these bulbs to be examined at the ports of entry of Boston, New York, Washington, New Orleans, Seattle, Tacoma and San Francisco by Federal inspectors. Consequently, hereafter, at least until further notice, it will not be necessary for us to examine bulbs.

Most of this inspection work has been done by Messrs. Zappe and Chamberlain, but Mr. Davis has inspected those shipments going into the eastern end of the State and Messrs. Lewis, Garman, Stone, Walden and Britton have all helped at times in the work.

In 67 shipments or 21.1 per cent. pests were found, the most common being the bulb mite *Rhizoglyphus hyacinthi* Boisdv., known in Europe as *R. echinopus* Fumouse & Robin, which was found in 39 shipments. Apparently this mite will attack and injure any kind of bulbs, and also some of the stems growing out of them. Another pest found in imported bulbs is the bulb fly *Merodon equestris* Fabr., which was found in 4 shipments. Both the bulb mite and the bulb fly have been brought into this country many times and are no doubt established here.

The time required to inspect these bulbs is equivalent to one man working 847½ hours or 113 days of 7½ hours each, or 4½ months of 26 working days each.

The data regarding the infested shipments of bulbs are as follows:—

## PESTS FOUND ON IMPORTED BULBS, 1919.

## 67 Shipments Infested.

*Insects, etc.*

- Atheta* sp. C. J. Speelman & Sons, Holland (1).  
 Capsid bug. Van Zonneveld Bros. & Philippo, Holland (1).  
*Cathartus advena* Wal. C. G. Van Tubergen, Jr., Haarlem, Holland (1).  
 Elaterid larva in hyacinths. C. J. Speelman & Sons, Sassenheim, Holland (1).  
 Lepidopterous larvae in buckwheat chaff. L. Van Leeuwen & Son, Holland (5); M. Van Waveren, Holland (1); C. J. Speelman & Sons, Sassenheim, Holland (1); Baartman & Koning, Sassenheim, Holland (1).  
*Merodon equestris* Fabr. L. Van Leeuwen & Son, Sassenheim, Holland (1); M. Veldhuyzen Van Zanten & Son, Lisse, Holland (1); J. Schilpzand & Sons, Hillegem, Holland (1); Van Zonneveld Bros. & Philippo, Sassenheim, Holland (1).  
*Pyralis farinalis* Linn. in buckwheat chaff. L. Van Leeuwen & Son, Sassenheim, Holland (1); C. J. Speelman & Sons, Sassenheim, Holland (1).  
*Rhizoglyphus echinopus* Fumouse and Robin. A. & L. Bremond Freres, Ollioules, France (1); Guldemon & Son, Lisse, Holland (4); Meskers Bros., Holland (1); K. Van Bourgondier & Son, Hillegem, Holland (3); C. Colyn & Son, Voorhout, Holland (1); M. Veldhuyzen Van Zanten & Son, Lisse, Holland (2); J. Schilpzand & Sons, Hillegem, Holland (2); Lagarde & Speelman, Ollioules, France (2); Van Zonneveld Bros. & Philippo, Sassenheim, Holland (5); Vandervooit Alkemade, Naardwyk, Holland (1); L. Van Leeuwen & Son, Island of Guernsey (2); D. Nieuwehuis & Sons, Lisse, Holland (1); C. J. Speelman & Sons, Holland (5); Zanbergen Bros., Valkenberg, Holland (1); Drevon-Tegelaar & Co., Ollioules, France (1); M. Van Waveren & Sons, Hillegem, Holland (3); Van Meeuwen & Tegelaar, Lisse, Holland (3); Richachiro Tanoi, Yokohama, Japan (1).

- Sitodrepa panicea* Linn. Van Zooneveld Bros. & Philippo, Sassenheim, Holland (1).  
 Staphylinids in narcissus. Zaubergen Bros., Valkenberg, Holland (1).  
*Tenebrio molitor* Linn. in chaff packing. L. Van Leeuwen & Son, Holland (1); C. G. Van Tubergen, Jr., Holland (1).  
*Tenebrio* sp. (?) in buckwheat chaff. Van Zooneveld Bros. & Philippo, Holland (2); Baartman & Koning, Sassenheim, Holland (1).  
*Typhoea fumata* Linn. C. G. Van Tubergen, Jr., Haarlem, Holland (1).

#### Fungi.

- Papulospora* sp. L. Van Leeuwen & Sons, Sassenheim, Holland (1).  
*Penicillium* sp. L. Van Leeuwen & Sons, Sassenheim, Holland (1).

### INSPECTION OF APIARIES.

There has been no change in the personnel of the inspectors or in the system of inspecting apiaries, during the year; Mr. H. W. Coley of Westport has inspected in Fairfield, New Haven, Middlesex and New London Counties, and Mr. A. W. Yates of Hartford has inspected in Litchfield, Hartford, Tolland and Windham Counties, each working on a *per diem* basis.

On account of the change in the fiscal year, all work done prior to July 1, 1919, was paid for out of the old appropriation, leaving a balance of \$43.70. The General Assembly increased the appropriation from \$750.00 to \$2000.00 annually, the new and increased appropriation becoming available July 1, 1919. The wages of the inspectors were increased July 1 from four to five dollars per day, which accounts in part for the increased cost of inspection per apiary and per colony, over former years. The report of the inspection work for the entire season is contained in this paper.

The General Assembly at the request of the Connecticut Beekeepers Association enacted a law, requiring beekeepers to register with the town clerks of their respective towns, as follows:—

#### CHAPTER 174, PUBLIC ACTS OF 1919.

An Act concerning Registration of the Owners of Honey Bees.

*Be it enacted by the Senate and House of Representatives in General Assembly convened:*

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 with the name and place of residence of the registrant and the definite location in the town where bees are kept by him shall be recorded in a separate book in the office of the town clerk, which records shall be accessible to the public.

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.

Approved, May 1, 1919.

This law will enable the inspectors to find the apiaries, so that in localities where diseases occur, it will be much easier to eradicate them.

During the season, 723 apiaries, containing 6,070 colonies, were inspected. The record for 1918 was 385 apiaries, and 2,913 colonies. In making these inspections, 102 towns were visited as against 83 last year. Inspections were made in the following towns which were not visited last year:

Fairfield County—Bridgeport.

New Haven County—Branford, Cheshire, Guilford, Hamden, Meriden, Oxford and Wolcott.

Middlesex County—Durham, East Haddam, East Hampton, Killingworth, Middletown, Portland, Saybrook and Westbrook.

New London County—Lisbon, Stonington and Groton.

Litchfield County—Bethlehem, Harwinton, Thomaston, Torrington, Warren and Washington.

Hartford County—Avon, East Hartford, Glastonbury, Granby, Manchester, Marlborough, Rocky Hill, Southington, West Hartford, Wethersfield and Windsor.

Tolland County—Andover, Bolton and Tolland.

Windham County—Brooklyn, Putnam, Thompson and Woodstock.

On the other hand, several towns in which inspections were made in 1918 were not visited this year. These are as follows:—

Fairfield County—Trumbull.

New Haven County—Ansonia.

Litchfield County—Colebrook, Cornwall, Goshen, Kent, New Hartford, Norfolk, Canaan, Salisbury, Sharon and Winchester.

Tolland County—Columbia, Ellington and Somers.

Windham County—Ashford, Canterbury and Chaplin.

In Avon, Oxford, Saybrook and Westbrook no inspections had ever been made until 1919. There still remain twelve towns where inspections have never been made, as follows: Tolland County, Union; Windham County, Eastford; Fairfield County, Sherman and New Fairfield; New Haven County, East Haven; Middlesex County, Essex, Chester, Middlefield and Old Saybrook; New London County, Lebanon, Preston and Voluntown. An effort will be made to inspect some of the apiaries in these towns next year.

The inspections made during 1919 show that the European foul brood continues to decrease as has been the case each year for the past ten years since the inspection service began. In 1910 when the first inspections were made, 75.9 per cent of the apiaries and 49.7 per cent of the colonies had European foul brood. In 1919, the infestation was only 6.6 per cent of the apiaries, and 1.2 per cent of the colonies. During the past season European foul brood was found in the following 34 towns:—Fairfield County, Bridgeport, Norwalk, Redding and Stamford; New Haven County, Cheshire and Wolcott; Middlesex County, Durham; New London County, Norwich and Old Lyme; Litchfield County, Bethlehem, Bridgewater, Thomaston, Torrington, and Watertown; Hartford County, East Hartford, Farmington, Glastonbury, Granby, Manchester, Marlborough, New Britain, Plainville, West Hartford, Wethersfield, Windsor and Windsor Locks; Tolland County, Coventry and Vernon; Windham County, Brooklyn, Killingly, Pomfret, Scotland, Sterling and Windham.

American foul brood was first found by the inspectors in 1914, and since then in two or three places each year, but the percentage of apiaries infested has never been much above one per cent, or of colonies one-third of one per cent, until 1919, when 3.0 per cent of the apiaries and 1.1 per cent of the colonies were found infested. The disease, therefore, has been more prevalent and infests a higher percentage of apiaries than ever before. One of the principal centers of infestation was Wallingford, where twenty-seven colonies in eleven apiaries were found diseased. It was also present in the following eight towns;—Stamford, Shelton (Huntington). Wallingford, Madison, Killingworth, East Lyme, Waterford and East Hampton. These towns are all in

Mr. Coley's territory in the southern half of the State, and must be given particular attention next year.

The statistics of the apiaries examined in 1919 in each of the 102 towns are given by counties in the following tables, the summary occurring on page 134.

## APIARIES INSPECTED IN 1919.

	No. Apiaries		No. Colonies	
	Inspected.	Diseased.	Inspected.	Diseased.
Fairfield County:				
Bethel .....	2	0	5	0
Bridgeport .....	4	1	100	2†
Danbury .....	9	0	90	0
Darien .....	3	1	26	1§
Easton .....	2	1	86	1§
Fairfield .....	9	0	193	0
Greenwich .....	12	0	166	0
Huntington .....	1	1	3	1*
Monroe .....	1	0	2	0
New Canaan .....	5	1	37	1†
Norwalk .....	10	2	97	5†
Redding .....	6	0	64	0
Ridgefield .....	7	0	69	0
Stamford .....	21	6	230	7‡
Stratford .....	2	0	63	0
Westport-Weston .....	10	0	120	0
Wilton .....	13	0	156	0
	117	13	1,515	18
New Haven County:				
Beacon Falls .....	1	0	28	0
Branford .....	5	1	41	4§
Cheshire .....	7	1	58	1†
Derby .....	2	0	47	0
Guilford .....	3	1	34	5
Hamden .....	7	1	28	1†
Madison .....	7	2	29	2*§
Meriden .....	18	0	146	0
Middlebury .....	1	0	34	0
Milford .....	1	0	52	0
Naugatuck .....	6	0	37	0
New Haven .....	3	0	28	0

\* American Foul Brood.

† European Foul Brood.

‡ 2 American Foul Brood, 1 European Foul Brood and 4 Sacbrood.

§ Sacbrood.

|| Paralysis.



	No. Apiaries		No. Colonies	
	Inspected.	Diseased.	Inspected.	Diseased.
Oxford .....	3	0	25	0
Prospect .....	6	0	53	0
Seymour .....	2	0	26	0
Wallingford .....	20	11	155	27*
Waterbury .....	6	0	26	0
Wolcott .....	2	1	14	1†
	<u>100</u>	<u>18</u>	<u>861</u>	<u>41</u>
Middlesex County:				
Durham .....	5	3	114	11‡
East Haddam .....	4	0	47	0
East Hampton .....	3	1	36	4*
Killingworth .....	2	1	11	2*
Middletown .....	1	0	31	0
Portland .....	3	0	30	0
Saybrook .....	2	0	20	0
Westbrook .....	1	0	8	0
	<u>21</u>	<u>5</u>	<u>297</u>	<u>17</u>
New London County:				
East Lyme .....	5	3	69	5*
Groton .....	4	0	6	0
Lisbon .....	1	0	8	0
Montville .....	6	0	42	0
New London .....	3	0	42	0
Norwich .....	9	1	106	1†
Old Lyme .....	2	1	53	2†
Stonington .....	1	1	20	2‡
Waterford .....	5	2	46	18*
	<u>36</u>	<u>8</u>	<u>392</u>	<u>28</u>
Litchfield County:				
Bethlehem .....	3	1	3	1†
Bridgewater .....	9	1	65	1†
Harwinton .....	2	0	7	0
Litchfield .....	13	0	153	0
New Milford .....	8	0	79	0
Plymouth .....	7	0	19	0
Thomaston .....	8	1	49	1†
Torrington .....	7	1	133	1†
Warren .....	4	0	31	0

\* American Foul Brood.

† European Foul Brood.

‡ 10 American Foul Brood, 1 European Foul Brood.

|| Paralysis.

	No. Apiaries		No. Colonies	
	Inspected.	Diseased.	Inspected.	Diseased.
Watertown .....	6	3	57	3†
Washington .....	4	0	137	0
	<u>71</u>	<u>7</u>	<u>733</u>	<u>7</u>
Hartford County:				
Avon .....	2	0	13	0
Berlin .....	7	0	75	0
Bloomfield .....	2	0	159	0
Bristol .....	11	0	100	0
Burlington .....	10	0	54	0
Canton .....	15	0	67	0
East Granby .....	3	0	19	0
East Hartford .....	15	1	95	2†
East Windsor .....	9	0	98	0
Enfield .....	8	0	39	0
Farmington .....	21	1	98	1†
Glastonbury .....	27	4	119	9†
Granby .....	4	1	48	1†
Hartford .....	24	1	99	1
Manchester .....	14	1	87	1†
Marlborough .....	2	1	46	3†
New Britain .....	9	1	100	6†
Newington .....	4	0	50	0
Plainville .....	10	3	31	9†
Rocky Hill .....	3	0	24	0
Southington .....	5	0	14	0
South Windsor .....	8	0	32	0
Suffield .....	9	0	34	0
West Hartford .....	25	1	117	2†
Wethersfield .....	11	2	55	3†
Windsor .....	11	2	28	2†§
Windsor Locks .....	4	2	13	2†
	<u>273</u>	<u>21</u>	<u>1,714</u>	<u>42</u>
Tolland County:				
Andover .....	3	0	21	0
Bolton .....	5	0	16	0
Coventry .....	11	1	59	1†
Mansfield .....	5	0	41	0
Stafford .....	3	0	23	0
Tolland .....	2	0	4	0
Vernon .....	8	1	40	2†
Willington .....	11	0	33	0
	<u>48</u>	<u>2</u>	<u>237</u>	<u>3</u>

† European Foul Brood.  
 § Sacbrood.  
 || Paralysis.

Windham County:	No. Apiaries		No. Colonies	
	Inspected.	Diseased.	Inspected.	Diseased.
Brooklyn .....	1	1	2	1†
Killingly .....	6	2	32	3†
Plainfield .....	8	0	43	0
Pomfret .....	15	1	94	2†
Putnam .....	2	0	11	0
Scotland .....	5	2	47	2†
Sterling .....	2	1	9	2†
Thompson .....	2	0	20	0
Windham .....	15	1	58	1†
Woodstock .....	1	0	5	0
	<u>57</u>	<u>8</u>	<u>321</u>	<u>11</u>

## SUMMARY.

County	No. of Towns	No. Apiaries		No. Colonies	
		Inspected	Diseased	Inspected	Diseased
Fairfield .....	18	117	13	1,515	18
New Haven .....	17	100	18	861	41
Middlesex .....	6	21	5	207	17
New London .....	9	36	8	392	28
Litchfield .....	11	71	7	733	7
Hartford .....	26	273	21	1,714	42
Tolland .....	8	48	2	237	3
Windham .....	10	57	8	321	11
	<u>105</u>	<u>723</u>	<u>82</u>	<u>6,070</u>	<u>167</u>

	No. Apiaries	No. Colonies
Inspected .....	723	6,070
Infested with European foul brood .....	48	78
Per cent. infested .....	6.6	1.2
Infested with American foul brood .....	22	69
Per cent. infested .....	3.0	1.1
Sacbrood .....	9	12
Pee paralysis .....	3	8
Average number of colonies per apiary...		11.2
Cost of inspection .....		\$1,771.03
Average cost per apiary .....		\$2.45
Average cost per colony .....		.29

† European foul brood.

GIPSY AND BROWN-TAIL MOTH WORK  
IN 1919.

BY IRVING W. DAVIS.\*

*Assistant and Deputy in Charge of Moth Work.*

This work has been conducted as in preceding years, in co-operation with the Federal Bureau of Entomology. Apparently there has been no marked wind-spread of the gipsy moth since 1916, consequently the results of careful and persistent efforts show a rather decided decrease in both the number of infestations and number of egg-clusters in the towns now infested. Moreover, in eight towns considered as infested in 1918, no infestations were found by the Federal Scouts. In seven of these and in three others,—making ten altogether, the quarantine has been removed.

The last session of the General Assembly increased the appropriation for suppressing the gipsy and brown-tail moths, and for inspecting imported nursery stock, to \$70,000.00 for the biennial period ending June 30, 1921. The appropriation for similar work for the preceding biennial period was \$40,000.00.

PRESENT STATUS OF THE BROWN-TAIL MOTH  
IN CONNECTICUT.

For the last three or four years, the brown-tail moth has been very scarce in Connecticut, due it is believed to natural enemies, or at least to natural causes. Consequently it has not seemed advisable for the state to attempt to carry out any control measures, or to order municipalities to take action in the matter. The Report of this Station for 1918, page 286, explains how the number of towns quarantined on account of this insect was reduced from seventy-one in 1915 to thirty-one in 1918. The number was further reduced to twenty-one the past year by the release of the following ten towns:—Stafford, Willington, Ashford, Mansfield, Windham, Franklin, Sprague, Bozrah, Norwich and Preston.

A close watch for winter nests was kept by State men when they were travelling about the State on other work, and likewise

\* Note:—Mr. Davis returned January 15, 1919 from service in the U. S. Marine Corps, and since then has been in immediate charge of all field operations. During his absence, Mr. John T. Ashworth served acceptably as Superintendent.—W. E. Britton.

for adult moths around lights during the period of their flight in July. Very few of either were noticed. The Federal Scouts, however, found a few nests in Stonington near the Groton town line in the spring. These were sent to the laboratory at Melrose Highlands, for the purpose of recovering parasites.

## FINANCIAL STATEMENT.\*

## RECEIPTS.

Appropriation for biennial period ending Sept. 30, 1919.....	\$40,000.00
Transfer by Board of Control .....	103.97
Total Receipts for biennial period .....	\$40,103.97
Amount expended, year ending Sept. 30, 1918 .....	22,644.18
Balance .....	\$17,459.79

## CLASSIFIED EXPENDITURES FOR THE NINE MONTHS ENDING JUNE 30, 1919.

## Salaries and Wages:

I. W. Davist .....	\$ 962.50	
J. T. Ashworth .....	925.00	
J. A. McEvoy .....	825.44	
F. C. Rich .....	827.26	
E. A. Smith .....	648.45	
R. G. Newton .....	509.34	
D. LaBelle .....	708.06	
H. L. Bodo .....	709.63	
J. W. Longo .....	429.35	
K. E. Buffington .....	443.30	
Other labor .....	<u>3,383.17</u>	\$10,371.50
Printing and illustrations .....		6.50
Postage .....		6.27
Stationery .....		.20
Telegraph and Telephone .....		46.73
Office Supplies .....		53.80
Express, Freight and Cartage .....		285.94
Machinery, Tools and Supplies .....		3,200.22
Insurance .....		389.26
Rental and Storage .....		127.00
Traveling Expenses .....		1,004.40
Automobile Tires and Repairs .....		1,272.28
Inspection of Imported Nursery Stock .....		665.69
Miscellaneous .....		<u>30.00</u>
Total .....		\$17,459.79

\* The General Assembly at its last session changed the time of beginning the fiscal year from Oct. 1st to July 1st. Hence the classified expenditures cover only nine months.

† For six and one-half months.

## DETAILS OF GIPSY MOTH WORK BY TOWNS.

The following pages give a detailed account of the work in each of the infested towns:—

## THOMPSON—86 Infestations—2448 Egg-clusters.

In the report of last year a decrease was noted in the number of gipsy moth colonies in Thompson, and it was explained that this was partly due to the fact that single egg-clusters were not counted as infestations. The same practice was followed this year and resulted in finding only eighty-six colonies, as compared with two hundred and seventy-five for the preceding year. These colonies were mostly in the central and eastern portion of the town, there being comparatively few found to the west of the New London and Worcester branch of the N. Y., N. H., and H. R. R. The colonies themselves were smaller than in some of the previous years, the largest containing less than one hundred egg-clusters. In many cases however the egg-clusters were scattered over a large area which made control measures difficult. During the early part of the spring a good deal of undergrowth was cut near many of the colonies, to make the control measures more effective. The larger infestations were also given special attention as were also those which were so located as to make spraying impracticable. Following this the colonies in windswept localities, from which there was great danger of spread of caterpillars, were banded with raupenleim. In the course of the spraying season, both the horse-drawn and automobile truck power sprayers were used in this town, and sixty-seven of the eighty-six colonies were sprayed.

## WOODSTOCK—36 Infestations—876 Egg-clusters.

This town was the first one scouted this year, due to the fact that the western portion was not covered in the scouting of a year ago. It was expected that the western section would contain the majority of the colonies and exactly half of those found in Woodstock were located there near Woodstock Valley and from there south to the Eastford line. The northwestern section did not contain any colonies, and the remaining eighteen were scattered throughout the eastern part of the town. In several cases but one tree was infested and wherever possible these trees were cut and burned. A few of the woodland colonies were also

cleaned of undergrowth and as in Thompson the banding of trees was practised on all colonies in windswept locations. During the month of June, twenty-two of the colonies were sprayed with arsenate of lead, and the patrolling work later indicated a successful season.

#### UNION—1 Infestation—1 Egg-cluster.

The scouting for the gipsy moth in Union during the past winter was done by the Federal men. The town was only partly scouted and the result was the finding of a single egg-cluster.

#### PUTNAM—28 Infestations—777 Egg-clusters.

The gipsy moth colonies in Putnam were well scattered throughout the town, with the exception of one group which was found on the road leading north from East Putnam. Five infestations were located in this vicinity, but none were of a serious nature. The largest colony found was on the Torrey farm in the eastern part of the town. This colony, consisting of 359 egg-clusters, was found on a wooded hillside about 200 yards back from the road. The egg-clusters were scattered over ten acres, which naturally made this colony a difficult one to handle. During the spring a large part of this area was cleaned and the brush burned. This infestation was sprayed in the early part of June, and but few living caterpillars were found. The work of cleaning up the colonies was carried on at seven infestations in Putnam and twenty-six infestations were sprayed.

#### POMFRET—29 Infestations—314 Egg-clusters.

The twenty-nine infestations found in Pomfret were scattered throughout its entire area, but none of these were large, or in any way of a serious nature. The largest colony found was in the southeastern part of the town on land owned by Mr. Fayette L. Wright. This colony was in a large oak and stone wall and contained sixty-six egg-clusters, thirty-two of which were old ones. The undergrowth near this was cut and burned, and the remaining foliage was sprayed later in the season. Another important colony was found in the woodland near the Eastford town line. While this infestation contained only nineteen egg-clusters, these were so widely scattered that it made control measures difficult. This colony was sprayed during June as were also eleven others in this town.

## EASTFORD—21 Infestations—173 Egg-clusters.

This town was scouted by the Federal men, and resulted in locating twenty-one infestations containing 173 egg-clusters. There were no colonies found in the extreme northern portion of the town, but in the south and central sections the infestations were well distributed. The most dangerous colony was found on land of Mr. Andrew Chilkott about a mile to the west of Eastford village. The growth here was largely oak and maple, and the egg-clusters were scattered over a considerable area of it. Its location together with the large area it covered rendered it impossible to do any banding, but this entire tract of woodland was sprayed. Another infestation of note was on land of Mr. John Fitts near the Ashford line. This was also in the woodland, but was not scattered as much as the former colony. It was also sprayed during June. Altogether ten of the infestations in Eastford were sprayed and five were cleaned of the undergrowth.

## ASHFORD—1 Infestation—1 Egg-cluster.

Mr. H. L. McIntyre of the Federal force found a single egg-cluster of the gipsy moth in Ashford. This was sent to the Government Parasite Laboratory in Melrose Highlands, Mass., and the report from there stated that this egg-cluster was infertile.

## KILLINGLY—27 Infestations—755 Egg-clusters.

The twenty-seven colonies of the gipsy moth found in this town were widely scattered, and none of them were considered of a serious nature. Among the larger colonies might be mentioned two which were in the northwestern part of the town and near the state road leading to Putnam. One of them was in two large pasture oaks and 107 egg-clusters were creosoted on these trees. The other colony, a short distance south of the first, was in an old apple tree. This tree was cut, and in the course of cleaning it up 118 egg-clusters were found and destroyed. In the course of scouting for larvae several egg-clusters were found and during June these areas were sprayed making in all thirty-eight different localities in Killingly which were sprayed this year.

## BROOKLYN—16 Infestations—1433 Egg-clusters.

During the scouting this past winter, sixteen colonies of the gipsy moth were located here principally in the eastern and southern portions of the town, and among them were some of



the largest colonies found this season. One infestation worthy of note was found on land of Mr. DeMott in the eastern part of the town near the Killingly line. While there were 796 egg-clusters here, the growth was very small consisting of one or two small oak trees. This colony was sprayed early in the season with a hand-sprayer and from later observations it is believed that the colony has been exterminated. Another large colony was found in a maple swamp in the northern part of the town. This infestation was scattered over a large area and was so located that it was not feasible to spray it. The most dangerous colonies in this town were cleaned of undergrowth and during the month of June, fourteen of the colonies were sprayed with arsenate of lead.

#### HAMPTON—12 Infestations—30 Egg-clusters.

There were very few egg-clusters of the gipsy moth found in Hampton this year as compared with last, when 336 egg-clusters were destroyed. The colonies also were small; the largest containing only seven egg-clusters, and located around the borders of the town while in the central portion none were found. Five of them contained but a single egg-cluster each, and none of them were serious enough to warrant spraying.

#### MANSFIELD—1 Infestation—1 Egg-cluster.

Mansfield was scouted by the Federal men and their work consisted largely of scouting around the colonies of the previous year. Only one egg-cluster was found near one of these infestations.

#### STERLING—10 Infestations—216 Egg-clusters.

Sterling was first found infested by the gipsy moth in the winter of 1914-15. Scattering colonies were located during the next two years, but in 1917 a general infestation occurred. The result of the scouting this winter was the finding of ten colonies and several single egg-clusters. Most of the colonies were in the northern section of the town, a few were in the extreme southern portion, leaving an area in the central part where but few traces of the moth were found. The largest colony in the town contained forty-nine egg-clusters in the village of Oneco. This was on the eastern slope of a small hill and the egg-clusters were found in some oaks and a nearby stone wall. The presence of a lot of rubbish and undergrowth made cleaning necessary

and this colony was later sprayed. Other colonies of importance include one of thirty-two egg-clusters found in an abandoned orchard near the Killingly line, and one in the extreme southern part of the town on land of Addie Fenner. These colonies together with four others were sprayed during June.

PLAINFIELD—18 Infestations—756 Egg-clusters.

In this town the infestations were almost all rather large, three of them containing over 100 egg-clusters each. Two of these were in the north part of the town, and one in the south part near the Griswold line. These were all in orchards, which made control measures rather easy. No cleaning was necessary, but all three were sprayed. Several of the colonies in this town were found in pasture oaks. In such cases the nearby brush was cut and burned and wherever possible the infestation was later sprayed. The Federal sprayer was used in this town, and twelve of the colonies were sprayed.

CANTERBURY—10 Infestations—248 Egg-clusters.

Only ten infestations were found as the result of scouting Canterbury this past winter. These may be roughly located in three groups, one in the south part of the town in the vicinity of South Canterbury, another in the central part near Canterbury Plains, and the third in the northwestern corner near the Hampton line. The largest colony was found in an apple tree in the south part of the town. Fifty-eight egg-clusters were found when this tree was cut and as it together with the nearby brush was burned, it was not thought necessary to spray this infestation. In all, five colonies were considered serious enough to spray and in Canterbury this was accomplished by the Federal truck during the early part of June.

SCOTLAND—1 Infestation—3 Egg-clusters.

During the winter of 1917-18 seven infestations containing 136 egg-clusters were located in this town. This year but a single infestation was found and that contained only three egg-clusters. This was not sprayed, as it was not thought to be of sufficient importance.

VOLUNTOWN—3 Infestations—81 Egg-clusters.

Three infestations were found in Voluntown this year, all in the northern part of the town. All were located in apple trees,

and during April all were banded with raupenleim. One colony found on land of Sarah Greene contained seventy-five egg-clusters. Several larvae were found here in the early part of June and during the latter part of the month this infestation was sprayed with arsenate of lead.

GRISWOLD—8 Infestations—16 Egg-clusters.

The gipsy moth colonies in Griswold were all within a small area in the northeastern corner of the town. These colonies were all small and did not require much attention. In the course of the spraying work gipsy moth caterpillars were found at two places on the State road leading from Jewett City to Plainfield. Both of these were sprayed and the finding of several dead larvae a few days later indicated that the work had been effective.

LISBON—1 Infestation—3 Egg-clusters.

Lisbon was scouted by the Federal men during the past winter and only one infestation, containing three egg-clusters, was found.

NORWICH—1 Infestation—11 Egg-clusters.

One colony of eleven egg-clusters was found in the western part of Norwich near the Bozrah line. These were removed and sent to the Government Laboratory and it was later reported that all were infertile.

NORTH STONINGTON—1 Infestation—1 Egg-cluster.

In this town only one egg-cluster was found, and that near an infestation of the preceding year.

LEDYARD—1 Infestation—11 Egg-clusters.

The Federal men scouted this town, and found one colony which contained eleven egg-clusters. This colony was visited by the State men early in the season and as it was in a young apple orchard, the control was easily accomplished.

The following eight towns were scouted by the Federal men and no signs of the gipsy moth were found:

Chaplin	Preston
Windham	Sprague
Franklin	Groton
Bozrah	Stonington

The recent quarantine maps issued by the Government show that ten Connecticut towns have been removed from the area quarantined on account of the gipsy moth, namely:

Ashford	Bozrah
Mansfield	Norwich
Windham	Preston
Franklin	Groton
Sprague	Stonington

The last two—Groton and Stonington—are still quarantined on account of the brown-tail moth.

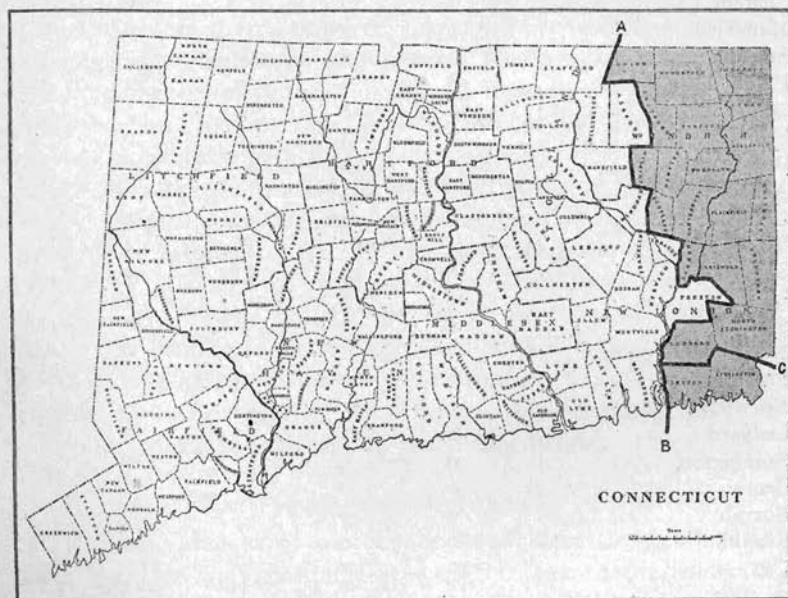


Figure 16. Map of Connecticut showing areas infested by gipsy and brown-tail moths. All territory east of the line A B is quarantined on account of the brown-tail moth. All territory east of the line A C is quarantined because of the gipsy moth.

The Connecticut territory now under Federal quarantine on account of the gipsy moth and the brown-tail moth, includes nineteen towns for the gipsy moth and twenty-one for the brown-tail moth, as shown on the map in figure 16.

## STATISTICS OF INFESTATIONS.

The following table summarizes the work by towns:—

	No. of Infestations	No. of Egg Clusters Destroyed	No. of Bands Applied	No. of Infestations Sprayed	No. of Larvae Destroyed
Thompson .....	86	2,448	221	67	2,881
Woodstock .....	36	876	173	22	....
Putnam .....	28	777	219	22	1,564
Pomfret .....	29	314	35	12	....
Eastford .....	21	163	36	10	....
Killingly .....	27	755	399	38	5,988
Brooklyn .....	16	1,433	246	14	887
Hampton .....	12	29	241	0	....
Chaplin .....	0	0	....	0	....
Mansfield .....	1	1	....	0	....
Sterling .....	10	216	362	7	337
Plainfield .....	18	756	492	12	529
Canterbury .....	10	248	349	5	2
Scotland .....	1	3	....	0	....
Windham .....	0	0	....	0	....
Ashford .....	1	1*	....	0	....
Union .....	1	1	....	0	....
Voluntown .....	3	81	86	1	....
Griswold .....	8	16	185	2	....
Lisbon .....	1	3	....	0	....
Sprague .....	0	0	....	0	....
North Stonington .....	1	1	....	0	....
Preston .....	0	0	....	0	....
Norwich .....	1	11*	....	0	....
Ledyard .....	1	11	....	0	....
Stonington .....	0	0	....	0	....
Groton .....	0	0	....	0	....
Bozrah .....	0	0	....	0	....
Franklin .....	0	0	....	0	....
	312	8,144	3,044	212	12,188

## THE WHITE PINE WEEVIL.

*Pissodes strobi* Peck.

Notwithstanding the injury caused by the pine bark aphid, the white pine-currant blister rust and various other pests, it may be stated without fear of contradiction that the weevil causes more damage to young white pines in Connecticut than any of them and possibly more than all of them together.

\* Egg-clusters infertile.

As no comprehensive account of this insect has ever appeared in the reports of this Station, and as frequent requests for information are received and supplied, it is desirable that the facts be brought together in available printed form for the use of the large and increasing number of owners of white pine plantations.

The insect causing this injury is a small brown snout beetle often called weevil or curculio belonging to the family Curculionidae of the order Coleoptera. It was described in the Massachusetts Repository and Journal of January 1817, by Professor W. D. Peck of Harvard University. This paper by Peck is believed to be the first in which an American injurious insect was described.

Thus for more than a hundred years, this weevil has continued to ravage the plantations and natural seedings of white pines in the Northeastern States, and though it seldom kills the trees, it deforms them making them unfit for timber and greatly checks the total or acreage growth.

Ever since the publication of the description of this insect by Peck in 1817, the white pine weevil has been recognized as one of the most injurious pests of pine plantations in this part of the country. It attacks young trees between three and twelve feet in height chiefly, killing the leader or topmost shoot and causing the trunks to become crooked and illshaped. After a tree reaches a height of twelve to fifteen feet, though sometimes weeviled, it is not injured so seriously, but in many cases it takes a long time for the tree to reach that height.

#### EVIDENCE OF INJURY.

The first evidences of attack are small clear drops of pitch which ooze out from the punctures on the bark of the leader or topmost shoot. Later this pitch dries to whitish spots and in some cases runs down the stem. This oozing out of pitch may not be very conspicuous, however, and as a rule the owner does not notice anything the matter with his pines until the leaders begin to wilt and droop, usually during the month of July. In Connecticut this first shows early in the month but there are some trees which do not show it until later. The wilted and drooping leaders soon turn brown and die as is shown on plate IX.

Usually the attacks of the insect are confined to the leaders or topmost shoot, but occasionally lateral branches are weeviled,

and rarely weevils are found below the whorl of branches in two-year-old wood. Normally the weevils attack only wood of the previous season's growth.

White pine is the common host and the only forest tree in Connecticut seriously injured by *Pissodes strobi*, though this weevil is recorded as occasionally attacking other pines, and certain kinds of spruces. Small spruces in nurseries (chiefly Norway spruce) are commonly injured by this weevil. There are also other species of *Pissodes* which are found on some of the pines and spruces: for instance *Pissodes approximatus* Hopkins was reared from the thick bark of *Pinus resinosa*, attacking the old wood even down to the ground. Then *Pissodes affinis* Randall breeds in the thick bark of white pine stumps. All three species, *affinis*, *approximatus* and *strobi*, are found in Connecticut, but it is *strobi* which is responsible for the injury to young white pine trees.

#### LIFE HISTORY.

There is only one generation each year. Just where the adult beetles hibernate or pass the winter is a question. Hopkins says\* "evidently in the ground." Though some closely allied weevils are found during the winter months under the bark of dead trees, stumps, etc., I do not recall ever having seen the white pine weevil in such places. As pupation takes place in the burrows in the leaders of the white pine, it would hardly seem necessary that the beetles go into the ground to pass the winter as adults. But wherever they hibernate they appear in Connecticut about May 1st on the young pines. They feed on the bark for a few days, and soon deposit their eggs in punctures (shown on plate XII, b.) in the bark of the leader or topmost shoot of the previous season's growth. The eggs hatch in from six to ten days, and the minute white grubs at first feed upon the cambium or inner bark, usually going downward and into the pitch. There is great variation in the length of the larval period depending upon food supply, latitude, altitude, etc., but as a rule the larva becomes fully grown in less than two months. It then excavates a larger and deeper burrow or cell in which, surrounded by shreds of wood like excelsior, it transforms. The cells are shown on plate XIII, and in Figure 17. The pupa stage lasts about ten days.

\* Circular No. 90. Bureau of Entomology, U. S. Dept. of Agr., 1907.

There is a period of egg laying, so that with the variation in the length of the larval period, it is not uncommon to find the larvae in all stages of development and likewise pupae in the months of July and August. The adults begin to emerge through round holes in the bark as shown on plate XIII, a, the latter part of July and continue into September. Hopkins states\* that the principal period of emergence is between July 25 and August 15, and that practically all adults will have emerged by the middle of September. According to Hopkins it is believed that an individual adult weevil may live for two or three years depositing eggs each year. As has already been stated, in Connecticut the adults appear about May 1st, and they are fairly abundant on the pines for five or six weeks. They are also common in

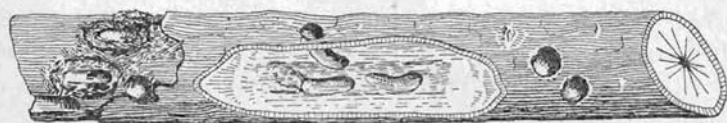


Figure 17. Pupal cases, larval cells and exit holes of the white pine weevil. About twice natural size.

August during the period of emergence. Reared and collected specimens in the Station Collection bear the following dates: April 22; May 1, 7, 8, 13, 14, 15, 17, 22, 29, 31; June 3, 9, 10, 17, 23; July 10; August 3, 9; September 4.

#### DISTRIBUTION.

According to all accounts, the white pine weevil occurs from North Carolina northward into Canada and westward into Wisconsin, thus occupying the natural range of the white pine. It will probably be found in every town in Connecticut.

#### FOOD PLANTS.

As has already been stated, the chief injury is to white pine *Pinus strobus* but occasionally it attacks the Scotch pine *Pinus sylvestris*, the jack pine *Pinus divaricata*, the pitch pine *Pinus rigida*, the Norway spruce *Picea excelsa* and the red spruce *Picea rubens*.

\* *Loco citato*.



## EFFECT OF INJURIES.

When the leader of a pine tree dies, the height growth is seriously checked, but whether or not this affects the diameter growth is uncertain as data are not available covering this point. Usually one of the lateral branches in the whorl immediately below the leader grows faster than the others and soon assumes an upright position, taking the place of the fallen leader. This causes a crooked trunk which the tree will outgrow in a few years if no further weevil injury occurs. But possibly and probably the new self-appointed leader may likewise be weeviled the following year, and the axis of the tree is exaggerated in its crookedness.

Occasionally two laterals instead of one will straighten and rival each other for the leadership. If both grow, a crotch or forked trunk is the result. If one is afterward weeviled and the other escapes, no great harm will result ultimately. Occasionally several laterals assume the upright position and make an illshaped tree. Forked and crooked trunks are undesirable in the growth of timber and the checking of the height growth is a serious matter in forest plantations where it is an advantage to obtain the maximum growth in the minimum time to bring the greatest possible return on the investment. If the plantation is a small one for ornament, for windbreak or to cover a watershed, the effects of serious weevil injury are no less important. Weeviled trees are always unsightly and never develop as satisfactorily as uninjured trees.

Kellicott observed\* that weeviled trees were more susceptible to the attacks of the pine tip moth *Pinipestis zimmermani* Grote.

Some plantations are very seriously injured by the white pine weevil, many trees losing a leader each season for a period of years, thus greatly interfering with the normal commercial development of the trees. Crooked, forked and otherwise deformed trees are not desirable for the production of timber and a stand of them would probably bring a lower price.

## DESCRIPTION.

The adult beetle is about one-fourth of an inch (4.5 to 6 mm.) in length, reddish-brown in color, marked more or less distinctly

---

\* Canadian Entomologist, Vol. xi, page 115, 1879.

by a spot or patch of whitish scales on the apical third of each wing-cover near the median margin. The color varies from light to dark reddish-brown, and the markings also show great variation: in some specimens they are exceedingly distinct while in others they are almost wanting,—the wing-covers being nearly unicolorous. There are small and irregularly arranged patches of white scales on the thorax, the femora, and on the under side of the thorax and abdomen, but these are inconspicuous or wholly wanting in some individuals. Head and legs are colored

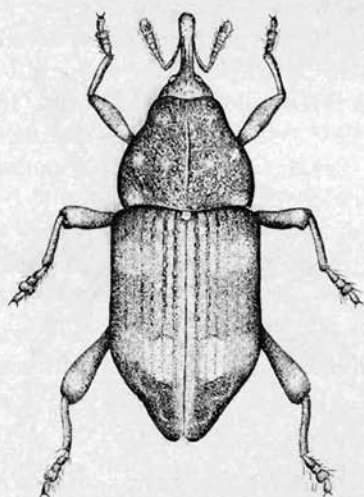


Figure 18. The white pine weevil. Enlarged about six times.

like the body, the head being elongated to form a slender snout after the fashion of the Curculionidae. The length of head and thorax together is only slightly less than that of the wing-covers. The thorax and head are both rather regularly and densely punctured, the punctures arranged chiefly in rows. The wing-covers are covered with horizontal striae with rows of pits in the grooves, the pits being considerably larger and deeper than the thoracic punctures.

The pupa is creamy white and about as long as the adult beetle. The eyes and the tips of the mandibles are brown, and as development progresses toward the end of the pupal stage, brownish color shows on the snout and legs. A pair of slender curved spines are borne at the tip of the abdomen.

The larva or grub is without feet, white and varying in size according to the age or period of development.

The egg has not been carefully studied in Connecticut, but according to Dr. Felt, is globular, whitish, transparent, about one-sixteenth of an inch in diameter and is deposited just beneath the bark. The adult weevil is shown in figure 18, and on plate XII, a, and larva and pupa on plate XIII, c.

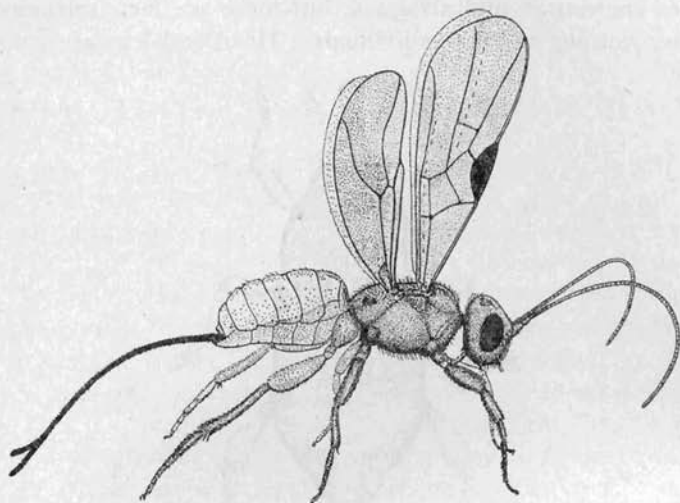


Figure 19. *Habrobraconidea bicoloripes*, a common parasite of the white pine weevil. Eight times enlarged.

#### NATURAL ENEMIES.

A number of natural enemies of the white pine weevil have been recorded. Birds, particularly woodpeckers, tear open the bark covering the cells, and devour the larvae, pupae and also the adults. Hopkins states\* that "some of the larvae apparently die from disease, and when large numbers of them are crowded together the larger ones appear to feed on the smaller ones, so that on the average not more than from three to five per cent of the hatched larvae ever reach maturity and emerge from the infested terminals."

In Connecticut, an ichneumon parasite identified by Mr. H. L. Viereck as *Coeloides pissodis* Ashm. was reared from weevils

\* Circular No. 90. Bureau of Entomology, U. S. Dept. of Agr., 1907.

collected at Rainbow, town of Windsor, in 1911. A closely allied species *Habrobraconidea bicoloripes* Viereck, shown in Figure 19, has been reared in large numbers from weeviled pine leaders from Rainbow in 1910 and 1912, Yalesville 1912 and Portland 1914, and the parasites have been identified, some by Mr. Viereck and some by S. A. Rohwer. Parasitized material gathered by Mr. Zappe in Portland in 1914 yielded 50 adult weevils and five parasites, showing a parasitism of eleven per cent. The following parasites identified by Mr. Rohwer have also been reared from weeviled material in Connecticut:—*Microbracon nanus* Prov., Portland 1914: *Eurytoma pissodis* Girault, Rainbow, 1912: *Rhopalicus suspensus* Ratz., New Haven, 1914: also *Cyanopterus* sp. from Stafford 1911, which Mr. Rohwer thinks may not be a parasite of the white pine weevil. In West Virginia, Dr. Hopkins reared the ichneumon fly *Spathius brachyrus* Ashm., from the weevils.

#### METHODS OF CONTROL.

There are two possible means of reducing the amount of weevil injury as follows:—

- (1) To remove and destroy the infested leaders.
- (2) To prevent the leaders from becoming injured.

The former can be practiced in large white pine plantations where the latter on account of expense is not deemed practicable, but the latter is preferable in ornamental plantings where it is important to prevent injury and the cost does not matter.

Removing and destroying the leaders after they have been injured reduces the number of weevils and also the injury for the following year, but is it not better, where possible, to prevent the injury and thus save the leaders?

#### REMOVING INFESTED LEADERS.

The only method practiced in forest plantations is to cut out all the leaders as soon as they begin to wilt, making the cut with a pair of pruning shears at the base of the leader just above the whorl of lateral branches. The shoots are then gathered and burned before the weevils emerge. If the severed leaders are allowed to remain on the ground for two months or until the beetles escape, the practice would be of no value in reducing their numbers for the next year, though it might improve the appearance of the plantation.

As some of the weevils are parasitized, and the parasites as well as their hosts are destroyed by fire, Dr. Hopkins of the Bureau of Entomology has recommended that the cut shoots be placed in a tight box or barrel with an opening covered with fine wire netting which will allow the small parasites to escape, but through which the adult weevils cannot pass. This arrangement provides for the destruction of the weevils, for they will die in the cage, but allows their parasites to gain the open air so that they may attack and destroy more weevils. Such a cage should be so placed that it will not catch and hold water. It should be in partial shade as it might easily become overheated in full sun so that all insects inside would be killed.

For such a cage, Dr. Hopkins suggests and figures a barrel with wire netting on one or both ends, and a box has been tried in the experimental forest plantation at Rainbow, Conn. At first the wood was so affected by the weather that cracks opened up sufficiently large to allow the weevils to escape. It is very important that the receptacle be tight enough to hold the adult beetles. One of these cages is shown on plate XIV, b.

#### PROTECTING THE LEADERS FROM INJURY.

Simple experiments have been conducted by Mr. Walden and other entomologists of this Station for several years, with a view to discovering some application or other treatment to repel or destroy the adult weevils before they can lay their eggs, and thus save the leaders from injury. In order to be practicable the preparation must repel or poison the weevils without injuring the trees. Such a treatment would be welcome on many estates where pines are planted for ornament or shade and where weevil injury renders them very unsightly. Brief accounts of these tests may be found in the reports of this Station as follows: 1911, page 307; 1914, page 173; 1915, page 134.

#### SPRAYING.

It was found that commercial lime sulphur (1 part in 8 parts water) proved to be one of the best repellents tried. At first it was feared that this concentrated mixture, which is the same as is used on dormant trees to kill the San José Scale, would injure the leaves: but such was not the case. When applied at the proper time (about May 1st for most seasons in Connecticut)

only the old leaves are present. By old leaves is meant those of the preceding season's growth. Not the slightest injury could be detected, even where the mixture was applied directly to the foliage. The bark of the leader was coated with lime-sulphur applied with a small compressed air pump that can be carried about, as shown on plate XV, c.

Arsenate of lead, one ounce of the paste in one gallon of water, sprayed upon the leaders also gave some degree of protection, though not quite equal to the lime-sulphur. Both of these materials were tested in a small way in 1911, 1912 and again in 1915, and in nearly every case the weevil damage to the treated trees was less than half that of the untreated trees. In several cases not a single tree was weeviled where sprayed with lime-sulphur. In 1911 sixty per cent. of the check trees lost their leaders.

A number of other preparations were given a trial, and among these "whale-oil" or fish-oil soap, 8 ounces in one gallon of water, seemed to keep off most of the weevils without injury to the trees.

Mr. S. A. Graham of Minnesota has also experimented along this line and finds that creosote and carbolineum are more effective when applied to the leaders than lead arsenate and lime-sulphur, not a single tree being weeviled, though from thirty to forty per cent. of the untreated trees lost their leaders. However, some injury to the trees followed their use.

Mr. Graham also applied bands of tree tanglefoot to a number of pines, one band at the base and another just below the topmost whorl of branches. Very few of these trees were injured, which strongly indicates that the adults crawl up the trunks instead of flying into the tops of the trees. A large number of weevils were liberated in the vicinity of these trees and most of them were afterward found on the trunks below the lower tanglefoot bands.

#### JARRING.

In 1913, Dr. E. P. Felt, State Entomologist of New York, recommended\* collecting the weevils from the pine leaders, using a net of about 15 inches diameter. "This work should begin in April, as soon as the weather is moderately warm, and be con-

---

\*Tribune Farmer, August 7, 1913; also 29th Report New York State Entomologist, page 32, 1913.

tinued for several weeks at intervals of approximately a week or ten days. Practical work done this season shows that it is possible to make four collections from an acre of young pine at a cost of \$1.28 an acre."

Dr. Felt states that at the outset two to four weevils were caught on each tree, but at the last collection only one or two were found in a row of perhaps 400 trees. Using Dr. Felt's experiments as a cue, similar tests were made in Connecticut in 1914 by Messrs. B. H. Walden and M. P. Zappe, about 1800 trees being treated and more than 1000 were under observation as checks.

For this purpose special nets were constructed having a rim about sixteen inches in diameter with a notch about three inches deep on the side to place against the trunk. After trying this net, it was found that more weevils could be captured by placing the net below the base of the leader and close to the trunk and rapping the opposite side of the leader with a stick as shown on plate XIV, a.

The tests were conducted in the State Forest reservations at Rainbow and Portland, on trees between five and eight feet in height, with results as follows:—

<i>Rainbow.</i>			
	No. trees	Leaders infested	
		No.	Per cent.
Net used	337	9	2.64
Check	116	8	6.79
<i>Portland.</i>			
	No. trees	Leaders infested	
		No.	Per cent.
Net used	1,462	141	8.9
Check	1,009	191	18.9

The season was late and five collections were made at Rainbow, on May 8, 14, 21, 28 and June 3. At Portland four collections were made on May 15, 23, 29, and June 5. Possibly earlier collections would have given better results, though the treated trees in both cases had less than half as many injured leaders as the checks. Probably six collections could have been made at a cost of between \$1.50 and \$2.00 per acre.

Thus it will be seen that by spraying or by jarring the leaders, it is possible to greatly reduce the amount of weevil injury, and

the cost, though perhaps too great in forest plantations, would certainly be warranted in small ornamental plantations.

## LITERATURE.

- Britton, W. E., Report Connecticut Agricultural Experiment Station for 1917, page 365.
- Britton, W. E., & Walden, B. H., Report Connecticut Agricultural Experiment Station for 1911, page 307.
- Felt, E. P., Insects Affecting Park and Woodland Trees, page 397, 1906. Twenty-ninth Report, New York State Entomologist, page 30, 1913.
- Graham, S.A., Journal of Economic Entomology, Vol. 9, page 549, 1916.
- Hawes, A. F., Vermont Agricultural Experiment Station, Bulletin 156, page 132, 1911.
- Hopkins, A. D., Circular No. 90, Bureau of Entomology, U. S. Department of Agriculture, 1907.  
Technical Series, No. 20, Bureau of Entomology, U. S. Department of Agriculture, page 48, 1911.
- Packard, A. S., Fifth Report U. S. Entomological Commission, page 734, 1890.
- Peck, W. D., Massachusetts Agricultural Journal, Vol. IV, page 207, 1817. (Original description.)
- Walden, B. H., Report Connecticut Agricultural Experiment Station for 1914, page 173; 1915, page 134.

## THE PINE BARK APHID.

*Chermes pinicorticis* Fitch.

There are several species of this genus which suck the sap from the various conifers. Some of these appear on the leaves, twigs or trunks, as bits of cotton or wool and are often called woolly aphids; others, like the spruce gall aphids, form swellings or galls at the base of the new growth, with the young developing inside the galls. In certain species the cotton-like tufts are present on the leaves and twigs and represent the females and eggs or migrants, and the galls on that or another host indicate another stage of the same insect.

It should be stated here that for many years several species of *Chermes* have been confused in entomological literature, and were disentangled by Dr. Edith M. Patch in her paper on "*Chermes of Maine Conifers*"\* in 1909. The present species

\* Bulletin No. 173, Maine Agricultural Experiment Station, 1909.



*Chermes pinicorticis* was not particularly studied by Dr. Patch, and the available literature regarding the species is based on former studies and observations. Confusion may therefore still exist regarding *pinicorticis* but this cannot be determined until some one has made a careful study of its life history. But disregarding the identity and life history, the damage caused by the insect, its appearance on the trees and control measures are such, we believe, as to warrant the present paper.

The white tufts are common on the needles of young white pine trees, and the white flocculent patches may be seen on the bark of the trunk and branches of both old and young white pines. Not only does the insect occur on cultivated trees, but also on native ones throughout Connecticut. Though the injury from its attack is not well understood, it probably checks the growth and reduces the vitality of the tree, and when abundant may cause serious injury. A slight infestation need cause no alarm.

#### DISTRIBUTION.

Apparently this insect was first mentioned by Dr. Fitch as occurring in New York State in 1856. According to Storment\* it has been recorded from New York, Illinois, Iowa, Maryland and the District of Columbia. Dr. Felt states\*\* that Prof. Lawrence Bruner reported it from Nebraska in 1894. Dr. Patch states† that it occurs in Maine. It is also reported from Canada, Minnesota and Ohio and no doubt the species is very generally distributed, and may be expected to occur in nearly all the intervening territory wherever the white pine is grown. As has already been stated, it is found throughout Connecticut, material having been received from the following localities:—Avon, October 24, 1917: Danbury, June 6, 1914, May 22, 1917: Deep River, July 13, 14, 1915: Greenwich, July 10, 1910, October 4, 1911, June 13, 1913: Hazardville, January 5, 1918: Ivoryton, July 30, 1918: Middletown, June 11, 1907, May 28, 1913: New Canaan, June 22, 1917: New Hartford, July 1, 1909, July 18, 1919: New Haven, May 8, 1907, September 27, 1912: Rainbow, June 13, 1913: Riverside, June 22, 1915: Saugatuck, October 14,

\* Insects of Illinois, 20th Report, appendix, pages iii-xxiv, 1898.

\*\* Insects Affecting Park and Woodland Trees, page 193, 1905.

† Bulletin No. 173, Maine Agricultural Experiment Station, page 303, 1909.

1912: South Coventry, December 4, 1917: Southport, June 18.  
 1912: Sharon, July 2, 1912: Wallingford, July 10, 1914: West-  
 brook, November 3, 1916.

#### APPEARANCE AND INJURY.

The pine bark aphid appears as white tufts of cotton or wool at the base of the needles on the twigs, and as white flocculent patches on the bark of trunks and branches as shown on plates XV and XVI. According to Storment\* it occurs more abundantly and more generally on the north exposure of the trunk than on the other sides and around the base, and on the under sides of the lateral branches, indicating that it does not thrive in a strong light. Where there are only a few small scattered patches, they so closely resemble the hardened pitch or gum that without close examination, it is difficult to distinguish one from the other.

There is some question about the exact amount of damage done by the attacks of this insect, though it surely must be considerable in severe infestations. Storment\*\* states that a heavy infestation will kill the lower branches and occasionally the entire tree, and that generally the effect of the infestation is manifest in the shortened leaves and shorter new growth.

Swaine† states that "*Chermes pinicorticis* Fitch is a common and destructive species throughout Eastern Canada, and seriously injures many young white pines, particularly those growing in the shade." Dr. Patch‡ regards it as "a serious enemy to young white pines both in nursery stock and in the open." Finally the Bureau of Entomology§ is responsible for the following statement:—"The pine bark louse (*Chermes pinicorticis* Fitch) was found to be commonly associated with and evidently causes a considerable percentage of the white-pine twig blight which has been so prevalent in the New England States the past year."

Though this insect chiefly attacks the white pine, it is recorded by Dr. C. G. Hewitt|| as causing damage to Scotch pines in Canada.

\* Insects of Illinois, 20th Report, appendix, page iv, 1898.

\*\* Ibid, page iv, 1898.

† 43d Annual Report Entomological Society of Ontario, page 88, 1913.

‡ Maine Agricultural Experiment Station, Bulletin 202, page 160, 1912.

§ Year Book U. S. Department of Agriculture, page 575, 1908.

|| Report of Dominion Entomologist, page 56, 1916.

## LIFE HISTORY.

Though the life history of this insect has not been worked out in detail, it is stated that the eggs begin to hatch on or before the first of May, the young emerging in great numbers from the woolly or cottony masses. At first they are very small and hardly discernible with the unaided eye, and they crawl over the bark for a time seeking a favorable place to attach themselves. They usually settle on the tender bark of the young twigs and begin to suck the sap, increasing in size rather rapidly. They soon change to a dark reddish-brown color approaching black, and the waxy secretion soon hides them in a white mass as though it were a tuft of cotton or wool. Winged females appear about the middle of May, but cannot be found two weeks later. Though the full seasonal life history has apparently not been worked out, indications point to several broods during the summer, and the winter is probably passed by wingless females on the bark, more or less covered by the masses of wax, or "wool" as it is called in some of the literature dealing with this insect. It is not known whether the pine bark aphid remains on the pine throughout the entire season or whether it has an alternate host like many other species of aphids.

## NATURAL ENEMIES.

Like other kinds of aphids, this species is preyed upon by various other insects which no doubt hold it in check under average conditions. The lady beetles are important and those recorded as feeding upon the pine bark aphid are the fifteen-spotted lady beetle *Anatis 15-punctata* Oliv., the two-spotted lady beetle *Adalia bipunctata* Linn., the twice-stabbed lady beetle *Chilocorus bivulnerus* Muls., and the spotted lady beetle *Megilla fuscilabris* Muls., commonly listed as *Megilla maculata* Degeer, a tropical species. The larvae of a syrphid fly, *Syrphus* sp., and of lace-wings or ant-lions, *Chrysopa* and *Hemerobia*, are listed by Mr. Storment as devouring the pine bark aphids.

## CONTROL MEASURES.

As long ago as June 1898, small pines on the Station grounds were infested with a species of woolly aphid which, though not identified at that time, from subsequent observations I am reason-

ably certain was *Chermes pinicorticis*. A single application of "Fir Tree Oil" in the form of a spray rid the trees of these woolly insects.

The most extensive control measures of which I have any record were carried out in June 1911 in the plantation of the Middletown Water Company in the town of Middlefield, Conn. The aphids were abundant on some of the trees and seemed to check their growth. In response to inquiries, I advised spraying the worst infested trees with kerosene emulsion. The superintendent feared that the insect would gain the upper hand and that injury would befall all of the trees; therefore he sprayed the entire 38,000 trees. I visited the place during the operation: 7,000 had already been sprayed. These trees were planted in 1904, consequently were not too large to be sprayed easily. This treatment killed the aphids, the white patches soon disappeared, and there was no material injury to the trees; an occasional slight burning of the needles was observed.

Dr. Felt\* states that Dr. E. B. Southwick of the New York City Park Department has found that a driving spray was effective in combating this pest. In some cases, therefore, plain water from a hose if thrown from the nozzle with sufficient force, would prove the best remedy.

Mr. Storment† mentions the experiments in Illinois with kerosene emulsion which proved effective in killing not only the aphids but the eggs also.

In all probability a spray of nicotine solution and soap would also destroy these aphids, though for use in large plantations might prove more expensive than the kerosene emulsion.

Kerosene emulsion may be prepared as follows:—

Kerosene.....	2 gallons
Common Laundry Soap.....	1 pound
Water.....	1 gallon

Dissolve the soap in hot water, add the kerosene, and churn together with pump until a creamy mass is formed which thickens on cooling. Dilute nine times before using.

\* Insects Affecting Park and Woodland Trees, Vol. I, page 195, 1905.

† Insects of Illinois, 20th Report, appendix, page xii, 1898.

## LITERATURE.

- Britton, W. E., Woolly Pine Aphids, 11th Report of State Entomologist, page 343, 1911. (Note regarding spraying with kerosene emulsion.)
- Felt, E. P., Pine Bark Aphid, Insects Affecting Park and Woodland Trees, Vol. I, pages 192-195, 1905. (General Account.)  
Pine Bark Aphid, 25th Report New York State Entomologist, page 80, 1909. (Note regarding injury to trees.)  
Pine Bark Aphid, 28th Report, New York State Entomologist, page 103, 1912. (Note regarding observations on injury to trees.)
- Fitch, Asa, The Pine Blight, Insects of New York, 1st Report, pages 167-169, 1869. (Repeats original description.)
- Hawes, A. F., Vermont Agricultural Experiment Station, Bulletin 156, page 134, 1911.
- Lintner, J. A., The Pine Bark Chermes, 2d Report, New York State Entomologist, pages 180-184. (General Account, illustrated.)
- Patch, Edith M., Chermes of Maine Conifers. Bulletin 173, Maine Agricultural Experiment Station, pages 303-304, 1909. (Deals chiefly with identity and synonymy.)
- Storment, E. L., The White Pine Chermes. Insects of Illinois, 20th Report, appendix, pages iii-xxiv. (Full account, illustrated.)
- Swaine, J. M., Notes on Some Forest Insects of 1912, 43d Annual Report of the Entomological Society of Ontario, page 88, 1913. (Species is present throughout Eastern Canada and seriously injures many young trees.)
- Washburn, F. L., The White Pine Louse; Pine Blight; Pine Bark Aphid; 12th Report of the State Entomologist of Minnesota, page 100, 1908. (Brief illustrated account.)

EXPERIMENTS TO CONTROL THE  
CHRYSANTHEMUM GALL MIDGE.*Diarthronomyia hypogaea* LOEW.

BY M. P. ZAPPE.

This insect was probably first introduced into Connecticut by florists of the State buying new varieties from other chrysanthemum growers. One grower in particular who grows large quantities of chrysanthemums for cut flowers and cuttings first noticed the work of this insect in 1916, and says that in two years it has caused \$5,000.00 damage. Other growers in the State suffered severe losses in 1917 and 1918. Seven towns in Connecticut are known to be infested with this insect, and the pest probably occurs in many others of which we have no record. The following towns are infested:—New Haven, Bridgeport, Hartford, Cromwell, Fairfield, Derby, East Haven.

Experiments were started in January 1919 to find some simple method of controlling this insect. Fumigation with hydrocyanic acid gas had been recommended, but this was quite a costly operation as it was only effective against the adult midges and had to be repeated every few days. There was also danger of burning the foliage by repeated fumigations, and danger to the operator and others who might come in contact with the gas which is deadly to human beings as well as insects.

The eggs of this insect are laid on the top of the plant where the new leaves are unfolding and as the leaves grow larger, the larvae make their way into the leaves. On large plants that are about to bloom the larvae get into the stem and enlarge and weaken it, causing the blossom to droop. Some varieties of chrysanthemums are very liable to attack by midges, while others are almost immune. In a house where several varieties are grown this is very evident. Some will be found badly infested, while others will not have a single gall. See plate XXXI.

The house in which the experiments were conducted was a small one, having a large center bench and a small one on each side. This house had been used for growing seedling pompons and at the time the experiment started the old plants had been cut off. New plants had sprung up from the roots and were about two inches tall. These plants were badly infested with midge galls.

The following treatments were applied:—

SECTION A. SCREENED.

Carbolic Acid Emulsion.

The section of the bench where this treatment was applied was screened with cheesecloth which after each spraying was carefully replaced in order to catch emerging adults from this plot and to prevent adults emerging elsewhere from attacking the plants. It was thought possible that the carbolic acid emulsion might penetrate the galls and kill the larvae within.

Crude carbolic acid.....	¼ pint.
Yellow laundry soap.....	¼ pound
Water.....	1 quart

This was prepared in the following manner: the soap was dissolved in hot water, then the carbolic acid was added. This was all churned together until it became creamy. When ready to spray, this emulsion was diluted thirty times. The treatment was applied every three or four days for about two months, beginning January 3, and ending March 3, 1919. After six treatments a few adults began to emerge and later a few eggs were seen. At the end of the experiment after seventeen treatments, there were a few new galls present, but not nearly as many as under the screened check.

SECTION B. SCREENED CHECK.

This section of bench was screened on January 3, and on January 6 one male was found under the screen and another on January 13. On January 31 several adults of both sexes were seen and on March 3rd there were many new galls present on the small leaves.

SECTION C. SCREENED.

Nicotine Sulphate 40%.

This was used at the strength of one teaspoonful to one gallon of water plus one ounce of common yellow laundry soap. This treatment was applied every three or four days for two months. There were no adults seen under the screen, so it is safe to assume that they were killed either before they emerged, or while they were emerging. No young galls could be found at the end of the experiment.

## SECTION D. UNSCREENED.

## Check.

On February 3, one month after beginning of experiments, there were many eggs and larvae present on the young leaves. On March 3 there were many young galls present on plants in this section.

## SECTION E. UNSCREENED.

## Arsenate of Lead.

As the eggs of the chrysanthemum gall midge are laid on the surface of the leaves, it seemed to the writer that there might be a time when the young larvae were working their way into the leaves that arsenate of lead would kill them. This was applied the same as the other treatments using one ounce to one gallon of water. At first it looked as though this treatment would be of some value, as this section made a better growth and looked better than the rest. One month after starting the experiment there were many eggs and larvae present and at the conclusion of the experiment there were just as many new galls as on the check section.

## SECTION F. UNSCREENED.

## Fish Oil Emulsion.

This was made similar to the carbolic acid emulsion, except that one and one-half pints of fish oil were used instead of crude carbolic acid. This was diluted ten times. At the end of the first month injury was noticed; the edges of the leaves turned brown and dried up. The dilution was changed to one to fifteen, and at the end of the experiment there were a few new galls present on the young leaves.

## SECTION G. UNSCREENED.

## Powdered Tobacco.

It was thought that this might act as a repellent and prevent oviposition. It was applied by sifting on the top of the plants through a cheesecloth bag. This treatment proved of no value, as there were many new galls present at the end of the experiment.



## SECTION H. UNSCREENED.

## Scalecide.

This was used at a strength of one to twenty, and after a few treatments the edges of the leaves were burned, especially the older leaves. There were no new galls on the leaves that were left on the plant at the end of the experiment.

## SECTION I. UNSCREENED.

## Scalecide.

This treatment was used at a weaker strength than the above, being diluted one to thirty. After two months of treatment there was a slight injury to the leaves, but there were no new galls.

## SECTION J. UNSCREENED.

## Nicotine Sulphate 40%.

This experiment was started about a month later than the others and ended on the same date as the other experiments. At the beginning of the experiment there were many eggs and young larvae present on the new growth. These were all dead three days later. This treatment was applied every three or four days, and continued for a month. At the end of the experiment no new galls could be found.

Another experiment was conducted in a commercial greenhouse, using nicotine sulphate, 1 teaspoonful to one gallon of water and two-thirds of an ounce of soap. This was for the purpose of checking up our other results with the nicotine spray. Young chrysanthemum plants in this house had quite a number of old galls present and were sprayed at intervals of three or four days. The bench treated was mostly of one variety, except the ends, which had a few plants of other varieties. The bench was divided into three parts, both end sections were sprayed and the center section left for a check.

On February 5 the first treatment was given and at this time there were many eggs present, also large galls on the older leaves. The owner of the house began to take cuttings from the sprayed portions of the house on the 27th of February. All these cuttings were put into a propagating house with cuttings from untreated plants from other houses. On March 3 these

cuttings were examined and the sprayed ones were free from young midge galls, and on the untreated ones there were a number of young galls started. There were also a large number of galls present on the check portion of the bench in the house where the spraying was done.

#### SUMMARY.

From the results of our investigations, it would appear that the best time to combat this insect is while it is still in the egg stage, or shortly afterward before the young larvae are entirely within the leaf.

Scalecide killed all eggs and young larvae, but injured the foliage. 40% Nicotine Sulphate and soap applied every three or four days will control this insect and most florists keep this on hand at all times so that this is probably the easiest and best spray for commercial florists to use.

#### LITERATURE.

- Britton, W. E., Chrysanthemum gall midge, 18th Report Connecticut Agricultural Experiment Station, page 345, 1918.
- Felt, E. P., A new pest, the chrysanthemum midge, Journal of Economic Entomology, Vol. 8, page 267, 1915.
- Guyton, T. L., Key to American gall insects, page 208, 1917.
- Nicotine sulphate solution as a control for the chrysanthemum gall midge, Journal of Economic Entomology, Vol. 12, page 162, 1919.

### PREVALENCE OF GREEN CLOVER WORM ON BEANS.

#### *Plathypena scabra* Fabr.

An outbreak of the green clover worm occurred in 1919, and bean plants in nearly all parts of the state were suddenly riddled. At first, the caterpillars which were on the under side of the leaves, dropping to the ground on being disturbed, escaped notice. A careful examination, however, revealed them in large numbers and of all sizes. Both common beans and Lima beans were attacked, and more or less irregular holes eaten in the leaves. In some cases only the veins were left and the pods were also eaten.

Specimens were received from New Haven, Orange and Putnam, and correspondence and telephone calls regarding this insect occupied considerable attention of the office force the last week

in July and the first week in August. The Hartford County Farm Bureau reported twenty telephone calls in one day inquiring about the insect feeding upon beans.

In conversation with other entomologists, I learn that this outbreak was not local, but reached over a large portion of the northeastern United States.

The only prior record on hand of such an outbreak was in 1908, but it was not as severe as that of 1919. An account of the insect with illustrations was printed in the Report of this Station for 1908, page 828. Some of the same illustrations are used herein.

On account of the many complaints and inquiries, the following statement was given out to the press, on August 2, and was printed in many of the newspapers of the state:—

#### GREEN WORMS THREATEN BEAN CROP.

“Slender green striped worms are now devouring the leaves of beans in fields and gardens, and unless prompt measures are taken, the entire crop may be destroyed.

Lima and other shell beans should be sprayed with arsenate of lead, using one ounce of the paste or one-half ounce of the dry powder, in one gallon of water. It would be unsafe to apply this poison to string or snap beans which are nearly ready to harvest, but such beans may be treated by spraying the under surface of the leaves with common laundry soap, four ounces in one gallon of water, or nicotine solution, one teaspoonful in one gallon of water with an inch cube of soap dissolved and added. When disturbed, the worms wriggle and drop to the ground, where they can be reached by the contact spray which will kill all of them that it hits. It may be feasible to shake the vines, and spray the ground afterwards.”

#### INJURY TO BEANS.

The injury is caused by the larvae which eat holes in the leaves. These holes are usually rather irregular in shape, and as the injury progresses, only the net work remains. The writer observed many gardens and fields of beans where the leaves were badly eaten. Pole beans, bush beans, shell beans, string beans and Lima beans were all attacked and severely injured.

Some injury was also done to soy beans. In a number of cases the larvae had eaten holes into the pods. At first the larvae do not eat entirely through the leaf, but the upper epidermis remains. In some cases the injury did not go beyond this point, and the leaves showed these holes as peculiar transparent spots.

#### FOOD PLANTS.

Clover is the common food plant of this insect, but occasionally, when abundant, it attacks and injures beans. Other plants attacked are peas, vetch, soy beans, tickweed (*Meibomia* sp.), strawberry and blackberry.

#### HABITS AND LIFE HISTORY.

This insect passes the winter in the adult stage and in the vicinity of Washington, D. C., the moths often fly during warm sunny days of winter. They emerge from winter quarters early. Chittenden records three generations annually in the latitude of the District of Columbia, though Coquillett found only two broods in Illinois. The eggs require from four to six days to hatch, and the caterpillars reach maturity in about twenty-five days. From ten to fourteen days are passed in the pupa stage.

In 1908, the first adult that was reared from larvae, emerged on July 24. Another emerged on July 29 from a cocoon formed July 16. The moths do not appear with any particular regularity, but are found throughout the latter part of the summer. Specimens in the Station collection bear dates ranging from June to November.

The larvae usually feed from the under side of the leaves and wriggle violently when disturbed. The small ones drop on silken threads, but those nearly grown drop to the ground, wriggling and throwing themselves about. Different sized larvae are found feeding side by side. The larva is slender, about the same color as the leaf upon which it feeds, and it loops with the front half of the body somewhat after the manner of a Geometrid larva. Many of the partially grown larvae were yellow and had a sickly appearance. Probably such would never transform.

#### DESCRIPTION.

Egg:—About 0.5 mm. in diameter and 0.35 mm. in height. Globular, somewhat flattened with the upper half deeply grooved. Light in color.

**Larva:**—About 25 mm. (one inch) in length, about 3 mm. thick in thickest portion near middle from which it tapers slightly toward the head, and considerably toward the posterior extremity. Color light green, striped longitudinally with darker green and fine white or cream-colored lines. Head pale green, shining and hairy. True legs, pale green. There are three pairs of abdominal prolegs in addition to the anal prolegs. Each segment bears dorsally, ventrally and laterally, a number of dark hairs.

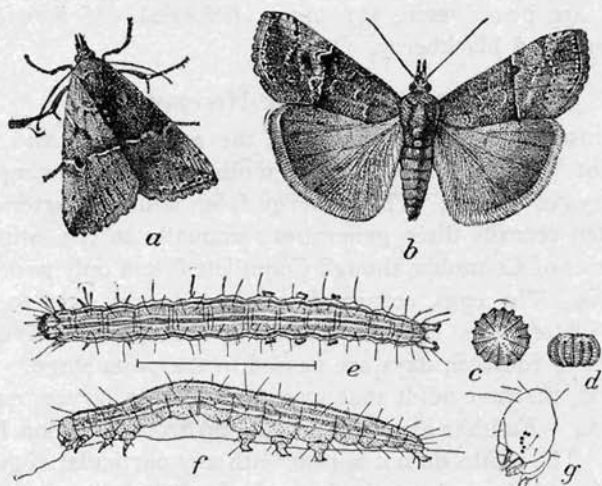


Figure 20. The green clover worm: *a*, moth in natural position with wings folded; *b*, same with wings expanded; *c*, egg from above; *d*, side view of egg; *e*, penultimate stage of larva, dorsal view; *f*, same from side; *g*, head of larva. All enlarged. (After Chittenden, Bulletin 30, Bureau of Entomology, U. S. Department of Agriculture.)

**Pupa:**—About 12 mm. in length, 3 mm. thick, dark brown in color. A dorsal ridge extends from the head over the thorax and first four segments of the abdomen. Some pupae occur in rolled leaves and are usually enclosed in a white silken web or cocoon of loose texture; others are in the ground in earthen cells formed by webbing together particles of soil.

**Adult:**—Wing-expanse from 25 to 37 mm. (one to one and one-half inches) blackish or purplish brown in color, with the outer part of the fore wing shaded with light gray, often showing a brownish tinge. The rear wings are broad and well rounded,

smoky brown and without markings. The males usually show less prominent markings than the females, but there is great variation. Body, legs and antennae brown. The palpi are prominently elongated and project in front of the head as is the case with other members of the group of snout-moths. They are also called Deltoid moths on account of the distinctly triangular shape which they assume when at rest with wings folded. The males are usually larger and more nearly of a uniform color than the females.

The appearance of all stages of this insect is shown in figure 20 and on plate XIX of this report.

#### CONTROL MEASURES.

In order to make a few tests on controlling this insect, some small plots in Hamden, as shown on plate XVIII, were sprayed by hand on July 31, as follows:—

Arsenate of lead (paste) one ounce in one gallon of water, applied to nine rows.

Black Leaf 40, one teaspoonful, one ounce laundry soap, in one gallon of water, applied to two rows.

A few days later, practically all larvae were dead where the arsenate was applied, and only a few were living on the rows treated with nicotine solution.

In order to ascertain if the contact treatment was immediately effective, the vines were brushed over a piece of paper spread upon the ground, and the spray nozzle passed quickly over the paper on which the larvae had dropped. The three following sprays were tried in this manner:—

Black Leaf 40, one ounce soap, one gallon water.

Black Leaf 40, one-half ounce soap, one gallon water.

One ounce soap, one gallon water.

In each case, all of the younger larvae dropped in their tracks, wriggled slightly and died. The larger ones crawled a short distance, but soon died. In no case were they able to get off the paper after being hit by the spray.

In the writer's own garden, clear water from the hose was thrown with considerable force in the form of a spray against the under sides of the leaves. Most of the larvae were dislodged and I am sure that many of the smaller ones were unable to return to the plants.

## LITERATURE.

- Britton, W. E., Report Connecticut Agricultural Experiment Station, page 828, 1908.
- Chittenden, F. H., Bulletin 30, Bureau of Entomology, U. S. Department of Agriculture, page 45, 1901.  
Insects Injurious to Vegetables, page 113, 1907.
- Crosby, C. R., and Leonard, M. D., Manual of Vegetable-Garden Insects, page 85, 1918.

PRESENT STATUS OF THE EUROPEAN CORN BORER  
IN THE UNITED STATES.

In the Report of this Station for 1918, page 316, is given an account of the "European Corn Borer *Pyrausta nubilalis* Hubn.," and its distribution as known at that time. Since this article was written the insect has been discovered in New York State at two widely separated points, namely, near Schenectady and in the western part near Lake Erie. This westernmost infestation also extends into the State of Pennsylvania. Its limits have not yet been definitely determined. An increased area has been found which extends northward into New Hampshire.

## MASSACHUSETTS INFESTATION.

Recent examination of the infested area in Massachusetts shows that the pest has spread farther than was known to be the case a year ago. Instead of covering 300 square miles as was estimated last year, probably six times that number is more nearly the size of the present infested area. The original infestation has extended northward into New Hampshire, and has spread southward from Boston along the bay and practically the whole of Cape Cod is infested. The westernmost towns in which the pest has been found are Tyngsboro, Sudbury and Framingham. There are 111 towns, containing nearly 2,000 square miles, in the infested area.

## NEW HAMPSHIRE INFESTATION.

The insect was not discovered in New Hampshire until late in the summer and at the time of this writing (November 22, 1919), information just received from the New Hampshire

authorities, states that in that state only the three towns of Seabrook, Plaistow and Kingston have been found infested by the European corn borer. Seabrook is a coast town and joins Massachusetts, but is separated from Plaistow and Kingston by two towns. Plaistow also joins Massachusetts, and Kingston joins Plaistow on the north. Apparently there is no general infestation in New Hampshire.

#### NEW YORK INFESTATION.

The pest was found in New York State in January, 1919, near Schenectady, where at present twenty-two towns involving the five counties of Albany, Schenectady, Montgomery, Fulton and Saratoga and an area of about 800 square miles, are infested.

Late in the fall a sparse infestation was discovered in the extreme western portion of the State, along the shore of Lake Erie, extending from Angola, Erie County to Fredonia, Chautauqua County, and southward some ten miles, nearly to Gowanda, an approximate area of perhaps 500 square miles. In all of the New York territory, the infestation is less intense, and the injury much less noticeable than in the older infestation in Massachusetts near Boston.

#### PENNSYLVANIA INFESTATION.

A slight and scattered infestation has been found in the town of Girard in Erie County, Pa., about two miles south of Lake Erie. Only a few larvae were found in one corn field, and these have been doubtfully identified as those of the European corn borer.

#### CONNECTICUT CORN BORER A DIFFERENT SPECIES.

It was mentioned in a foot note on page 316 of the last Report of this Station that borers had been found in corn stalks in Milford, Conn., which might prove to be the European species. At first the larvae seemed scarcely different from preserved material of *P. nubilalis* which the writer collected in eastern Massachusetts in September 1918. Subsequent study of larval characters, however, showed slight differences, and specimens were sent to Dr. E. P. Felt, Albany, N. Y., and to the Bureau of Entomology, Washington, D. C., where they were examined by Mr. Heinrich. Both these entomologists regarded the Con-



necticut material as belonging to the genus *Pyrausta* and probably a native species, but advised that the adults be reared so that the identification would not rest on larval characters alone. It was with considerable interest that we watched the material in the breeding cages, and when no pupae were formed the latter part of May, when adults of *P. nubilalis* should be emerging, it was another indication that our species was something else than the European Corn Borer. The first pupa was noticed on June 26, and the first adult emerged on July 7. During the next few days several other moths appeared. These resembled very closely the specimens of *Pyrausta penitalis* Grote in the Station collection. Specimens were sent to Washington and were identified as a new species since described as *Pyrausta ainsliei* by Mr. Heinrich. This species is discussed more in detail on page 173 of this Report.

#### FUNDS FOR COMBATING THE EUROPEAN CORN BORER.

Soon after the discovery of the borers in corn at Milford, I gave a talk before the Farmers Association of the General Assembly on March 25. It was the sense of the meeting that the State should make some provision for fighting the insect in case the Milford larvae should prove to be the destructive European species. Also in case future infestations should be found it seemed wise to have some appropriation available for controlling the pest and not be obliged to wait until the convening of the next General Assembly. Consequently a bill was drawn up and passed making provisions as follows:—

#### Chapter 186, Public Acts of 1919.

#### An Act making provision for the Suppression of the European Corn Borer.

*Be it enacted by the Senate and House of Representatives in  
General Assembly convened:*

Section 1. The board of control, on recommendation of the director and entomologist of the Connecticut agricultural experiment station, at its discretion, is authorized to expend a sum not to exceed ten thousand dollars for the period ending September 30, 1921, for the suppression of the European corn borer. All expenditures authorized by the provisions of this act shall be paid from any unexpended balance in the treasury upon presentation of vouchers approved by the director of the Connecticut agricultural experiment station.

Section 2. This act shall take effect from its passage.

Approved, May 2, 1919.

So far not a dollar of this money has been expended. Nearly \$200.00 was expended around Milford in the Spring, but this and the cost of the scouting throughout the State has been paid out of the general appropriation made to the Station for work with insects.

### A NATIVE BORER ATTACKING CORN.

*Pyrausta ainsliei* Heinrich.

Many cornfields were examined during the winter months to see if any trace of the European corn borer could be found in Connecticut. On March 12, Messrs. Zappe, Chamberlain and Codding visited Milford, as this town is a seed-growing center and much seed corn is shipped out from there to all parts of the country. It seemed probable that certain varieties of corn on the ear might have been brought into this region, in order to grow it for seed, and that some of it might have come from an infested section. After examining several fields in Milford the men visited some small plantations on North Street about three-fourths of a mile from the center. Mr. Chamberlain was the first to discover larvae in the cornstalks. Mr. Zappe telephoned to the office that they had found the European corn borer, and I visited the place in the afternoon.

The larvae resembled very closely those in preservative which I had gathered in eastern Massachusetts the preceding Autumn. In fact we were not able to separate them definitely. Mr. Codding sent specimens to Dr. F. H. Chittenden of the Bureau of Entomology at Washington, who submitted them to Mr. Carl Heinrich, a specialist.

I attended a conference at the State House, Boston, on March 14, and saw Mr. D. J. Caffrey who was in charge of the European corn borer investigations of the Bureau of Entomology, and informed him of the discovery at Milford. At my request, Mr. Caffrey and Mr. W. R. Walton also of the Bureau, visited the region on March 22. We examined some of the infested fields around Milford and they noticed some discrepancies between the injury and that caused by the European corn borer.

Under date of March 15, Mr. Walton wrote that "the specimens were submitted to Mr. Heinrich, yesterday, who examined them carefully and is quite satisfied that they are the larvae of a

species of *Pyrausta*, but he was not willing to make any statement with regard to the species, although he was inclined to believe that it was not identical with *nubilalis*."

Mr. Walton also added:—"However, as our specialists admit that they are not able to distinguish the various species of *Pyrausta* in the larval stages, it seems advisable to proceed on the basis of the supposition that the insect which has been discovered in your State is the European corn borer, as this seems to be the only safe course. I think we all realize by this time that the only way to settle this matter definitely is to rear the adults, and of course that will not be possible for some weeks yet."

As this insect was believed to be the real European corn borer, the following information was given to the press under date of March 15:—"What appears to be a small infestation of the European corn borer was found this week just north of the village of Milford by entomologists of the Agricultural Experiment Station in New Haven. Measures have been taken to suppress the pest."

This notice was printed by many newspapers of the State on March 15 and later. A similar announcement was printed in the Journal of Economic Entomology for April, Vol. 12, page 218.

In April, specimens of the larvae were sent to Dr. E. P. Felt, State Entomologist of New York, who had been making a study of the larvae infesting corn in that State and comparing them with the larvae of other species of *Pyrausta*. Under date of April 8 he wrote as follows:—

"They resemble very closely Massachusetts and New York specimens and for the present we must assume their identity until this is disproved, if it ever is, by rearing."

In looking over Dyar's List of Lepidoptera, I find that there are twenty-five species of *Pyrausta* occurring in the eastern United States, sixteen of which are in the Station collection. As many of these species are unknown in their immature stages, it is not surprising if our specialists are not able to identify the larvae with certainty.

Evidently there was only one way to settle the identity of the Milford corn borer—rear the adults. Here again the Milford larvae did not act quite like the European species; instead of transforming in May as well-behaved European corn borers should, they kept on eating in the old stalks, and the very first

sign of a pupa did not appear until June 26,—more than a month after the time when adults of *nubilalis* should have emerged. It was a period of anxious though watchful waiting.

But meantime forces had not been idle. Preparedness was the watchword. Soon after the borers were found, men were employed to cut, rake together and burn the infested stalks. For, after all, the identity of the borer was uncertain and it might prove to be the dreaded European species. Connecticut could afford to take no chances.

Mr. George D. Stone, a trained gipsy moth scout who had fought with the American Expeditionary Forces in France, and who had been employed by Mr. Davis on gipsy moth work in the eastern part of the State, was brought here to scout for corn borers and to take charge of burning the infested stalks.

A careful scouting was therefore carried on, followed by burning infested stalks, in most cases with the full co-operation of the owner. In some cases the owners cut and burned the stalks themselves under Mr. Stone's direction or supervision. In most of the seed-growing farms in the Milford region, the soil is rather light and the season early. Some of the stalks had already been plowed under before the fields were examined. The stalks were burned in twelve fields having a combined area of about nineteen acres. The owners burned about one and one-half acres without assistance. Mr. Stone burned about four acres without help from the owners, and the remaining thirteen and one-half acres were burned by Mr. Stone and the owners co-operating.

Mr. Stone began this work on March 27 and finished on May 10, covering ground rapidly on a motorcycle. The total cost of this work including wages and expenses was \$192.02. Though more attention was given to the Milford area than any other, Mr. Stone visited Wethersfield, Rocky Hill, Cromwell, Middletown, Stratford, Orange, New Haven, Woodbridge and Hamden. In some of these places the larvae were found in cornstalks, and in nearly all of these towns, the stalks of smartweed (*Polygonum*) in the cornfields contained larvae. Messrs. Zappe, Chamberlain and Walden did considerable scouting before and after the discovery of the larvae in the stalks at Milford, visiting in all eighty-five cornfields in various sections of the State; they noticed the tendency of the smartweed stalks to infestation, and finally

on visiting a cornfield, sought at once the low places or depressions where this weed commonly grows. In many cases they found the larvae in the smartweed stalks, and if the insect was abundant in that locality, some larvae were usually found in the corn.

Imagine our interest when the first moth appeared in the breeding cages on July 7, followed by profound relief, for surely it was not the European corn borer *Pyrausta nubilalis*. It was identified provisionally as a native species, *Pyrausta penitalis* Grote, and this identification was later confirmed by Mr. Heinrich at Washington. The larvae resemble very closely the European corn borer, and only an entomologist and a specialist on *Pyrausta* larvae at that, can distinguish them. But their tunnels average somewhat shorter, and there are not so many in a stalk, and so far as my observations go the tassel and ear are not attacked, or if so, not to such a degree as is the case with that destructive pest, the European corn borer.

#### INJURY TO CORN STALKS.

As has already been mentioned, no injury to tassels or ears by this insect was noticed in Connecticut. The holes were in the main stalks, usually two or three feet from the ground, and just above a node, though in some cases they were just above the first node, only a few inches from the ground. As a rule, the burrows were not more than two inches long, slanted upward from the entrance and were wider near the upper end. Evidently the larva excavated its burrow to a sufficient size so that it could turn around, for all or nearly all of the larvae were found headed downward. Sometimes there were several holes in a stalk, but usually only one. The most found in any one stalk was nine. Consequently the plants were not much injured, and their vitality and growth were unimpaired. Just why the larvae go into the corn at all is a question. If for food, one would expect them to eat larger tunnels. Possibly it is as a place to pass the winter. Yet many of them hibernate in the *Polygonum* stems, and seem to be none the worse for their rather precarious winter quarters. The appearance of the infested stalks is shown on plate XXII. In many cases the stalks had been pecked into by birds, and the burrows were empty.

## IDENTITY.

Though this species was provisionally identified as *Pyrausta penitalis* Grote and in the adult stage resembles that species in collections, recent detailed studies by Mr. Heinrich led him to conclude that heretofore two species have been confused under this name, and that the chief corn-boring species was new and undescribed. As its life history has been carefully studied by Mr. George G. Ainslie, of the Bureau of Entomology, who is stationed at Knoxville, Tenn., Mr. Heinrich has named it *ainsliei*.\* At the time that this paper goes to press Mr. Heinrich's description and name of the new species has just been published.

## DISTRIBUTION IN THE UNITED STATES.

Apparently this species occurs throughout the eastern United States as it has been found in Massachusetts, Connecticut, New York, New Jersey, Tennessee, Illinois, Missouri and Kansas.

## DISTRIBUTION IN CONNECTICUT.

Undoubtedly this corn borer occurs throughout the state, but we have records of it in weeds or in corn from the following towns:—Wethersfield, Cromwell, Middletown, Durham, Meriden, Milford, Orange, Woodbridge, Hamden, New Canaan and Ellington.

## FOOD PLANTS.

The larvae occur most abundantly in the stems of the larger plants of smartweed or jointweed of the genus *Polygonum*, and particularly in that species sometimes called "Lady's thumb" or "heartsease," *Polygonum Persicaria* Linn. This is the species with a dark blotch on the leaf. I am by no means satisfied that the insect is confined to that species and probably it may occur in any of the larger-growing species of *Polygonum*.

Heinrich states† that "the natural food plants of *P. ainsliei* are *Polygonum*, ragweed, and similar plants: and it is frequently

\* Note on the European Corn Borer (*Pyrausta nubilalis* Hübner) and its Nearest American Allies, with Description of Larvae, Pupae, and One New Species, Journal Agricultural Research, Vol. XVIII, page 171, Nov. 1, 1919.

† Ibid., Vol. XVIII, page 176, 1919.

found in corn associated with *P. nubilalis*, for which its larva is easily mistaken." In several cases, what is believed to be the same borer was found in the stems of "lamb's quarters," "goose-foot" or "pigweed," *Chenopodium album* Linn. Similar larvae were found in stems of "beggar's ticks," *Bidens frondosa*, but as the adults were not reared, it is impossible to be sure of its identity.

#### LIFE HISTORY AND HABITS.

The adults emerge in Connecticut the first half of July and soon mate and lay eggs. Our specimens in a large cage over corn plants at the Station Farm at Mount Carmel apparently did not lay any eggs, though there were several individuals present of each sex. Several searches were made, but no eggs could be found. Yet on August 9, small larvae were found boring in smartweed in Hamden, and Mr. Stone found them in Ellington August 11.

Some of the infested smartweed stems were placed in the cage on August 16, and some good-sized uninfested plants of smartweed were transplanted into the cage. Larvae soon left the cut stems and bored into the stems of the growing plants. In September, I noticed that the stems of the smartweed plants were well riddled and several of the larvae were at work in the corn stalks.

Apparently there is only one brood or generation each year in Connecticut, the winter being passed in the stems of plants, particularly in corn and *Polygonum*. The larvae do some feeding in the early summer, pupate late in June, and the adults emerge early in July. The eggs must hatch in July and the larvae spend the remainder of the season tunneling in the stems of plants, often leaving one stem to go to another.

The following paragraph is copied from Mr. Stone's notes:—

"Several instances were observed where the larva had left corn and entered smartweed and *vice versa*. The tunnels were noticeably much shorter where this had taken place, and if anything the borers showed a more mature development. In fields where borers were plentiful, careful observations were made and not a single instance was discovered where a larva had entered a stalk just beneath the leaves. However, many cases were seen where the borer had passed through the sheath of the leaf without entering the stalk at that point. In many cases a semi-circle was

cut in the edge of a leaf directly over the point of entrance into the stalk. The borers entered the stalks on nearly all parts from roots to tassel: the burrows usually were made between the nodes, though in a few cases they occurred directly at the nodes. In smartweed, the entrance was invariably just above the node, and in the majority of cases from two to four inches above the ground, although in a few cases, larvae were found boring in the roots."

#### DESCRIPTION.

**Egg.** The writer has not seen the egg-mass of this species, as none were laid by the females reared. Some eggs dissected from the body of a female were white and slightly longer than broad.

**Larva.** Length about 14 mm., thickness about 2.5 mm., color dirty white or gray to light brown, rather distinctly and conspicuously spotted with darker brown tubercles: dorsally, these tubercles form four longitudinal rows, and there is another row below the spiracles on each side: the tubercles are on the front of each segment forming a transverse row. Beginning with the abdominal segments there are two smaller tubercles on the rear half of each segment. There are also a number of other smaller tubercles definitely arranged. Each tubercle bears a hair. Head dark brown, legs light, unicolorous with ventrum.

**Pupa.** Length about 12 mm., thickness about 2.5 mm., color reddish brown, somewhat darker on dorsal than on ventral surface, head projecting distinctly beyond base of antennae and ending in a blunt projection. Dr. Edna Mosher has studied this pupa in comparison with that of *nubilalis* and the results have been published.\*

**Adult.** Female wing-expanse about 28 mm., color buff, marked with two submarginal narrow zigzag transverse lines. There is usually a darker shading in the discal area. Head, thorax, abdomen, legs and antennae all about the same color as the wings. Male, usually a little smaller than the female, often darker with similar though usually more prominent markings.

There is great variation in the size, color and markings of both sexes of this species.

\* Journal of Economic Entomology, Vol. 12, page 387, October, 1919.



## CONTROL METHODS.

The injury to corn by this insect, so far as observed in Connecticut, has not been of such extent or character as to indicate that control measures are necessary. Probably it is only during occasional seasons when the insect is unusually abundant that it attacks corn: the remaining seasons it is probably present in normal numbers in smartweed and nobody pays attention to it. However, if it should again become unusually prevalent and attack corn, the stalks should be cut into short pieces—say one-half inch in length, and put into a silo or fed directly to stock, the same as ought to be done in case of corn infested by the European corn borer. Stalks that are left in the field over winter should be burned before May 1st. The fields should be kept free from a large growth of smartweed, thus greatly reducing the probability of the corn becoming infested.

## THE STALK BORER.

*Papaipema nitela* Guenée.

The common native stalk borer *Papaipema nitela* Guen., and its variety *nebris* Guen., is present every year in Connecticut and infests a large number of plants including corn, bean, potato, eggplant, tomato, rhubarb, spinach, dahlia, aster, chrysanthemum, gladiolus, lily, hollyhock, peony, sunflower, and most of the common vegetables and larger weeds. In fact, it will tunnel in almost any herbaceous stem. Last year I found a larva in the stem of muskmelon near its base. In 1919, of the specimens submitted to the office, one larva from Greenwich was tunneling in the new shoot of a peach tree, this shoot growing near the ground. Another lot of specimens from Putnam included one larva boring in a raspberry cane.

The stalk borer was abundant in 1918, and caused considerable damage throughout the state, but was even more abundant the past season, and did more injury. Also it seemed to attack corn more than other crops, though perhaps the extra attention paid to the corn crop and the inspections made on account of the possibility of finding the destructive European corn borer may be responsible for bringing this injury to light. Thus between June 12 and August 18, which represents the period of the

greatest activity of the larvae as borers, specimens were sent in from the following places:—

Litchfield County—Litchfield and New Hartford.

Hartford County—Hartford, East Hartford, East Windsor, Windsor, Bloomfield, Granby, Canton Center, New Britain and Southington.

Tolland County—Ellington.

Windham County—Putnam, Pomfret and Sterling.

Fairfield County—Greenwich and Stamford.

New Haven County—New Haven, Hamden (Highwood, Whitneyville and Mt. Carmel), Cheshire, Meriden and Clintonville.

Middlesex County—Saybrook Point.

New London County—Lisbon.

In addition to these localities, Mr. George D. Stone, who was employed to examine cornfields throughout the state, sent in material or observed this insect or its ravages in Litchfield, Hartford, Tolland, Windham, New Haven and New London Counties. These records show that the insect not only occurs, but has injured corn the past year in all sections of the state. Probably it was the most noticeable insect pest of the crop during 1919, and also did more damage than any other species.

The injury is of two sorts. When the young larvae attack the corn, they usually feed on the leaves at first near the whorl, eating ragged holes in them, or eating into the leaves before they unroll. This last mentioned form of injury often shows, when the leaf gets larger, as a row of holes across the blade, somewhat after the manner of "bill-bug" injury. Mr. Stone writes: "The *Papaipema* larvae were found nearly everywhere in Windham County, but not abundant. Their work seems to be very distinctive when the corn is young, and later when the leaves grow out, rows of from three to five little holes across the leaf can be observed. Investigation will invariably show that the borer is inside the developing tassel, or if the holes are far out upon the leaf it will be found boring in the stalk."

The larva later does tunnel downward in the stalk, often going quite to its base. In many cases the characteristic leaf injury was present, but on searching for the cause the larva could not be found, and the injury apparently stopped. Probably many larvae are destroyed by birds or predaceous insects before they enter the stalks. Like the army worm this larva is often found in the top of the corn plant in the whorl at the base of the

leaves, and not very well protected. The characteristic leaf injury is shown on plate XXIV.

The larva of the stalk borer is about one and one-half inches long when mature. In its earlier stages it is somewhat smaller, and is distinctly striped lengthwise with brown and white. There is a rather broad lateral white stripe on either side which is interrupted on the first four abdominal segments, thus giving the appearance of a broad transverse band or girdle of dark brown or gray. The larva is shown on plate XXIV, c. In its mature stage just before pupating, the conspicuous stripes gradually disappear, and the larva is a dirty greenish gray color.

The adult is a purplish gray moth with a wing-spread of about one and one-fourth inches. The typical form *nitela* is nearly uniform in color with a transverse submarginal lighter band shading into the darker margin on the forewings. On some specimens rather inconspicuous black spots show in the discal area. The variety *nebris* Guen., resembles the above, except that it has conspicuous white spots in the discal area, and is shown on plate XXIV, b. From the material gathered from corn and other plants in Connecticut, both forms have been reared, but variety *nebris* is much the more abundant.

There is only one generation each year, and the insect probably passes the winter in the egg stage on the stalks of pigweed, ragweed and other common weeds. These eggs hatch early in June, and the young larvae at once feed upon any suitable plant that is available. The stalk borer occurs throughout the United States and Canada east of the Rocky Mountains.

The stalk borer was strongly parasitized by dipterous larvae in 1919. Mr. Stone saw many dead larvae in Tolland County, and by August 15, could find no living ones in Hartford County. Probably by that time they had pupated. Much of the larval material which he gathered in various parts of the state never transformed, but gave up dipterous larvae, the parasites often pupating in the box in transit.

The parasites reared, were identified by Dr. J. M. Aldrich of the Bureau of Entomology at Washington, as *Masicera myoidea* Desv., and emerged from material collected in Windsor, Hartford, New Britain, and New London.

On account of the large proportion of the larvae being parasitized, a small proportion of adults were obtained from the material

gathered in the field, and this condition leads us to believe that the stalk borer may not be prominent next year in Connecticut cornfields.

#### CONTROL MEASURES.

When the larvae are feeding upon the leaves at the tops of the corn plants, dry arsenate of lead sifted into the whorl will doubtless kill them. After the larvae have commenced to tunnel inside the stalks, there is no satisfactory or practicable method of control that can be practiced in large fields, other than destroying the infested stalks when found.

With a few choice plants in the garden, it may be possible to cut into the stem lengthwise and destroy the borer. Such methods, however, cannot be practiced under field conditions. The destroying of all the larger weeds in which the caterpillars can live will be an aid in reducing their numbers. Burning the stalks of weeds around the field in late fall or early spring to destroy the eggs is to be recommended where the stalk borer is a serious menace to field crops.

#### INJURY TO CORN IN CONNECTICUT BY CRAMBUS PRAEFECTELLUS ZINCK.

On July 3, Mr. L. F. Harvey, County Agricultural Agent, brought to the laboratory some corn plants from a field on Townsend Avenue, New Haven, which had been injured in a peculiar manner by a larva boring into the side of the stalk near its base. This field was only three or four miles from the center of New Haven and contained about an acre. It was in grass in 1918, and plowed in the spring of 1919 and planted to corn.

The plants began to look sickly when only a few inches high and the outer leaves turned brown and died: later the entire plant followed suit. An occasional plant escaped attack and was much larger and more vigorous than the other plants in the field. A few hills near one end of the field were not attacked, and these and occasional scattered stalks produced ears. The crop was almost a total loss.

At first we failed to notice the larva at the base of the stalks because it dropped away with the soil from the roots when the

plant was pulled up, and even after noticing its presence, it was difficult to obtain one as it would wriggle away into a crevice in the soil.

Mr. Zappe with Mr. Harvey examined the plants and collected more material. Later, on July 10, the writer visited the field, which had the appearance shown on plate XXV, a.

Each stalk attacked had a hole eaten into one side at or just above the surface of the ground, as shown on plate XXV, d. Apparently there was only one larva in a stalk. The larva causing the injury was nearly always enclosed in a case formed by webbing together particles of soil as is shown on plate XXV, c. At the time this insect was supposed to be the corn web-worm *Crambus caliginosellus* Clem., a common species which causes considerable injury to corn in the middle and southern Atlantic States.

From the material gathered and placed in the insectary, four adults were reared about the first of September, and proved to be *Crambus praefectellus* Zinck., a native species, which has not heretofore been recorded as causing injury to corn.

The larva is about 12 mm. long, 2.5 mm. thick, dirty white to ash-gray in color, rather prominently marked with darker tubercles. Each abdominal segment bears eight: six in a transverse line near the front margin of the segment, the outer ones being below the spiracles: two transversely elongated ones just back of the middle two, but more widely separated. Prothoracic shield whitish and shiny marked with several small dark gray spots. Anal shield peppered with dark gray spots. Head whitish, shiny, mottled dorsally with brown. Legs, prolegs and ventral surface whitish. Each tubercle bears one or more hairs. Appearance of the larva is shown on plate XXV, b.

The adult is a Pyralid moth, having a wing-expanse of from 20-24 mm.: fore wings brown with a longitudinal white band narrowing to a point before reaching the margin. There is also a brown dash nearly bisecting the apical angle of the fore wing, formed by white markings on each side, but this dash is usually darker than the ground work of the wing. There is a narrow, wavy submarginal transverse line of darker brown; between this line and the margin is a row of five black elongated dots or short dashes. The terminal fringe is light brown. Rear wings white, with a brownish tinge in some individuals. Legs and antennae light brown. Adult is shown on plate XXV, b.

Mr. George G. Ainslie of the Bureau of Entomology, Cereal and Forage Crop Insect Investigations, stationed at Knoxville, Tenn., who has studied this and allied Pyralids, informs me that he has records of *praelectellus* being taken on corn from Florida, Arkansas and Tennessee, and on wheat from Indiana, but in no case was the injury of any extent or of any real importance.

Professor C. H. Fernald in "The Crambidae of North America," published in 1896, states that the early stages and food plants are unknown.

There are few references in literature to this species, and most of them are systematic rather than economic. Apparently this is one of the first instances, if not the first, of any serious injury being caused by this insect.

### THE ARMY WORM.

*Cirphis (Heliophila) unipuncta* Haw.

In certain seasons the army worm is present and attacks corn. During the outbreaks, like that of 1896 and 1914 in Connecticut, the larvae may injure any grain, grass or corn crop, but in many other seasons when there is no particular outbreak, a few larvae here and there are found feeding on corn. The larvae feed on the leaves at their base, and are often found in the whorl in the top of the plant. Mr. Stone found some on corn in Tolland County, July 31, and in Hartford County, August 14, but they were not very abundant in cornfields.

There was a local outbreak, however, in the town of Woodbury, where a field of oats was infested with larvae. Mr. Chamberlain visited the place on August 19 in company with the Litchfield County Agent, who reported the case to this office. On that date the oats had been cut and raked into windrows. There were many full-grown larvae beneath the straw, and many pupae were found in the soil. An adult moth was also received from Southport on September 24.

The army worm has two or possibly three broods each season, the eggs being laid on the leaves of grass or grain. The larvae reach maturity in from twenty to thirty days.

Crosby and Leonard\* state that the insect passes the winter as a partially grown caterpillar. The full-grown larva is about

\* Manual of Vegetable-Garden Insects, page 289, 1918.

one and one-half inches in length, ground color greenish black, striped lengthwise with dark mottled broad and fine white lines. The appearance of the caterpillars is shown on plate XXVI.

A more extended account of the army worm may be found in the Report of this Station for 1914, page 157. In case of an outbreak, it is often necessary to plow a deep furrow with perpendicular side opposed to the line of advance; to plow and harrow the soil just after the caterpillars transform to kill the pupae; arsenical poisons may be applied to any crops not used for food or forage in order to insure them against injury.

### THE SMEARED DAGGER MOTH.

*Acronycta (Apatela) oblongata* S. & A.

The first larva of this species found feeding on corn was collected at Brooklyn, July 8, by the writer, in company with Messrs. Irving W. Davis and George D. Stone. Mr. Stone sent specimens to the office, later, as follows:—Windham County, July 17; New London County, July 23; Tolland County, July 31; Hartford County, August 14.

This caterpillar is brown and hairy. The young ones resemble those of the fall web-worm, though somewhat lighter and more yellow in color. As it passes through its molting stages, it soon takes on a different appearance. In one of these stages—perhaps next to the final one—it has broad longitudinal brown stripes with a narrow dorsal stripe and two broader lateral stripes of yellow. In its final larval stage it is simply a brown hairy caterpillar about one and one-half inches in length and somewhat resembles the larva of *Diacrisia* which is called the "woolly bear."

The adult is a pretty gray moth measuring rather more than two inches from tip to tip of fore-wings, shown on plate XXVII, b. The fore-wings are gray, marked lengthwise with black dashes, and the rear wings are white except for a marginal row of small black dots.

One of the immature caterpillars feeding upon corn is shown on plate XXVII, c. They devour the leaves and are usually near the base of the topmost leaves at the time the tassel first begins to show. Later they may feed anywhere on the upper part of the plant. This insect is probably not a serious pest of corn in

this part of the country, but attacks the crop occasionally and causes slight injury.

The caterpillars have a long and varied list of food plants including smartweed (*Polygonum*), cat-tail flag, willow, poplar, peach, apple, pear, strawberry, raspberry, blackberry, grape, bean, cotton, asparagus, buckwheat, wheat, oak, hazel, elm, alder, butter-nut, pine, button-bush, soft-maple, lilac, canna, honeysuckle, clover, corn and grasses. Forbes\* records two broods in a season in Illinois, but states that it is single brooded in Canada. A specimen in the Station collection was reared from a larva feeding on white pine in Norwich, collected July 19, 1916, and the adult emerged May 26, 1917. A larva was collected on cat-tail flag, East Haven, July 19, 1908.

This species occurs throughout the eastern United States and Canada, and the larva is sometimes called "the smartweed caterpillar." It is not sufficiently abundant in Connecticut to require treatment.

#### THE LINED CORN BORER.

##### *Hadena semicana* Walk.

Early in the season, a circular letter was received from Dr. E. P. Felt, State Entomologist, Albany, N. Y., stating that the lined corn borer *Hadena fractilinea* Grote had been found in a number of fields in New York state. Consequently we were watching for it and on June 16, one larva was received from Farmington, which seemed to answer the description of *H. fractilinea*. This larva was less than an inch long, and striped lengthwise with brown and white as shown on plate XXI, a. Another was found on corn in Bloomfield June 19. In both cases these larvae were feeding upon the leaves and had not begun to tunnel in the stalk. From the Bloomfield specimen an adult emerged August 9, which seems to resemble *Hadena semicana* more closely than *H. fractilinea*, as it does not have the pale color all along the inner margins of the fore-wings.

*H. semicana* Walker is mentioned in the Yearbook, U. S. Department of Agriculture for 1905, page 634, as follows:—"*Hadena semicana* Walk. usually classed among the rarer cutworms, occurred in destructive abundance in Mercer County,

\* Twenty-third Report Illinois State Entomologist, page 170, 1905.



Pa., during June. A similar outbreak occurred in 1893, in an adjoining county in Ohio."

### THE CORN EAR WORM.

#### *Heliothis obsoleta* Fabr.

This is the same insect that is so common in the southern states where it is known as the "cotton boll worm," and the "tomato boll worm," because it eats holes into cotton bolls and ripening tomatoes.

It occurs nearly every year in Connecticut, and feeds upon the tips of the immature ears of late maturing sweet corn and field corn late in the season. Sometimes it is locally abundant, and considerable damage results from its attack, but in general the injury is much less severe in Connecticut, which approximates the northern limits of the species, than farther south, where several generations occur. Apparently there is only one brood annually in Connecticut.

That it occurs throughout the state is evidenced by material received from the following localities:—New Haven, Cheshire, Bethany, Northford, Westport, Wilton, Kensington, Rockville, Colchester and New London.

This insect was formerly known as *Heliothis armigera* Hbn., and it is treated under this name in much of the literature of the species.

In Connecticut the moth lays its eggs on the silk of the corn plant, and the young caterpillars feed upon the silk and soon work their way through the husk and devour some of the unripe kernels at the tip of the ear. Sometimes the injury may extend half way down the ear or even to its base, but this is unusual, and in most cases is limited to the tip of the ear. Many eggs are doubtless laid on the silk, and sometimes five or six caterpillars begin to feed there, but they devour each other, so that finally not more than one or at most two remain on an ear. This insect attacks both sweet corn and field corn, but seems to prefer the former and injures it more severely. On October 8, the writer observed sweet corn on sale in the market of Washington, D. C., nearly every ear of which contained a large caterpillar.

The corn ear worm much resembles a cutworm to which it is closely related. When fully-grown it is one and one-half inches

or more in length, and in color it varies widely from light green to a rather dark brown. It is usually striped lengthwise with lighter and darker stripes, but the markings also vary greatly and the most conspicuous stripe is a pale lateral one in the region of the spiracles or breathing pores.

When mature the larva goes into the ground, and in a burrow a few inches below the surface transforms to a smooth brown pupa, slightly less than an inch long. In Connecticut the winter is passed in the pupa stage, but in the southern states where several broods occur, the pupal period varies from two to three weeks.

The adult moth has a wing-spread of about one and one-half inches, ground color of fore-wings buff, with darker brown markings. The markings usually consist of a discal spot and sub-terminal bands, but there is great variation; fringe buff or light brown. The rear wings are cream-color with a broad cross band of dark brown next to the cream-colored fringe. Head, thorax, abdomen, legs and antennae buff like ground color of the fore-wings.

The appearance of an infested ear and the adult moth are shown on plate XXVIII.

There is no good method of controlling the corn ear worm on field corn, but experiments in New Jersey show that on sweet corn it may be held in check by dusting the silk soon after it appears with powdered arsenate of lead and fine sulphur, equal parts. Early planted fields and early maturing varieties usually escape injury. Fall plowing of badly infested fields is to be advised.

## OTHER INSECTS ATTACKING CORN IN 1919.

### THRIPS.

On June 24, some corn plants were received from Mr. A. G. Davis, Litchfield County Agent, which had been injured by thrips. Some of the insects had been collected and mounted on a microscope slide, and submitted with the plants. This mounted material was divided and a part sent to the Bureau of Entomology at Washington, D. C., where it was identified by Mr. A. C. Morgan, who stated that the slide contained two species,—“two

females of the grass thrips *Anaphothrips striatus* Osborn, and one female of *Plesiothrips (Thrips) perplexus* Beach. Practically nothing is known concerning the habits of the last named species." Apparently all the other specimens from Litchfield represent the grass thrips, which is doubtless the species responsible for the injury on corn.

Similar injury to corn caused by thrips was received from Putnam, June 28, and from West Hartford, July 5; it was observed many times by members of the staff in examining cornfields in various sections of the state. As a rule the injury was not very severe, but confined to a few of the lower or outer leaves on a plant here and there. The surface of the leaf was grooved in white lines in the manner shown on plate XXIX, a, and the injured leaves withered and died very quickly. Treatment would not be practicable in the field, but in the home garden a spray of soap and nicotine solution would rid the plants of these minute insects.

#### WIREWORMS.

Corn plants were received on June 27 from Bristol which had been injured by wireworms, as shown on plate XXIX, b. The base of the stalk had been hollowed out and two larvae were present. The species has not been identified. Wireworm injury is occasionally serious and difficult to control, the only practicable measures being cultural ones such as crop rotation, fall plowing and thorough harrowing.

#### NOCTUID CATERPILLARS.

When examining a cornfield in Hamden, June 30, a green rather stout larva about one inch long with white stripe along each side was taken on corn. No description was made at the time, but it was placed in the insectary and from it was reared on July 9 an adult of *Autographa falcigera* Kirby var. *simplex* Guen. The larva feeds on a great variety of plants chiefly of the cabbage family.

Mr. Stone collected on corn another pale green larva mottled with darker green in Tolland County, July 31, and from it was reared on August 23, an adult of *Mamestra subjuncta* Gr. & Rob. The larva is a general feeder, especially, on grasses and weeds.

The writer found in Bloomfield, June 19, a partially grown slender green larva feeding at the base of the corn leaves in the whorl. Its length was about 15 mm., thickness about 2.5 mm., general color grass-green, granular, each segment margined posteriorly on the dorsum with a tinge of yellow. A narrow yellowish stripe extends along each side from head to anal prolegs just below the spiracles. Head, legs and prolegs, green. The body bears a few scattered hairs, which are most pronounced laterally: dorsum almost smooth. Shown on plate XXIX, c.

The same or a similar species was taken by the writer at Brooklyn, July 8, and Mr. Stone observed and sent in specimens from Windham, Tolland, Hartford and Litchfield Counties. Mr. Stone writes that the green larva can nearly always be found upon the upper surface of the leaf and the holes which it eats are irregular. It eats the tender leaves chiefly, and seldom injures the tassel. This larva is somewhat different from that collected in Bloomfield, but may represent a later instar of the same species. Each is about 25 mm. long, 4 mm. thick, and there are faint longitudinal green lines of lighter and darker shades on the dorsum. The lateral stripes also vary from yellow to white and some even show a pinkish tint.

Though some of these larvae went into the ground in July to pupate, no adults have yet been reared, so the identity of the species is unknown.

Some small zebra caterpillars, *Mamestra picta* Harris, were found feeding upon corn at the Station farm Mount Carmel, June 20, by Mr. Zappe. They were brought to the insectary and adults emerged August 25. These caterpillars feed in clusters when young. When mature they are about two inches long, black or dark brown, strikingly marked with yellow. The adult has a wing-spread of one and one-half inches. The thorax and fore wings are reddish brown without prominent markings. The rear wings are nearly white, margined with light brown.

This insect is a general feeder and we may expect to find the caterpillars feeding upon almost any garden or field crop.

## THE PARSNIP WEB WORM.

*Depressaria heracliana* Linn.

On June 23, Mr. G. M. Coddington brought to the laboratory some stems of cow parsnips collected in the vicinity of Danbury by Fairfield County Agent L. A. Bevan. The stems had been hollowed out by the larvae burrowing in them, and when received contained several pupae as shown on plate XXX, c.

On July 16 several adult moths emerged: they have a wingspread of about one inch, with fore-wings of buff or light brown marked by short longitudinal dashes of dark brown or black: rear wings lighter brown, but with a suffused darker shade near the distal margin. Shown on plate XXX, b.

This insect passes the winter as an adult under loose bark and in other sheltered places, and the eggs are laid in May or June on the leaves. The young greenish yellow caterpillars web together the leaves and devour the unfolding blossom buds. This is quite a serious pest in fields where parsnip and carrot seeds are grown. The mature caterpillar is slightly over half an inch in length, greenish yellow in color, somewhat paler laterally and ventrally, with head, legs and cervical shield shining black. Each thoracic and abdominal segment bears black tubercles, with a hair arising from each. Shown on plate XXX, b.

When nearly mature, the larva leaves the web and enters the stalks, usually through the axil of a leaf and for the rest of its larval existence tunnels inside the stem. The pupa is about half an inch long, with dark brown thorax and light brown abdomen, and is formed inside the stalks. The moths emerge in about three weeks, and there is only one generation each year.

The native food plants are wild carrot, wild parsnip, cow parsnip and other plants of the family Umbelliferae. Messrs. Zappe and Chamberlain collected this insect in stems of wild parsnip in Goshen, July 6. Mr. Zappe observed it on seed parsnips in his garden in Hamden, and from a letter I am sure that the same pest was injuring plants in a garden in Stratford, though the infested plants had been removed prior to a visit by Mr. Walden on June 30.

The only control methods are to remove and destroy occasional infested plants, and after blossoming, the plants may be sprayed or dusted with arsenate of lead.

## MOSQUITO WORK IN 1919.

BY B. H. WALDEN.

In 1919 the ditches on the salt marshes which have been drained to eliminate mosquito breeding were maintained as in 1918. This includes approximately 5,000 acres located in the towns of Madison, Guilford, Branford, East Haven, New Haven, Orange and Fairfield. In most of the towns it was possible to obtain the same men that were employed in 1918, although it was necessary in certain cases to pay somewhat higher wages.

The ditches were all gone over in April and May and obstructions removed and the necessary cleaning done to provide good circulation of the water.

During the first half of the season the marshes were comparatively dry and free from breeding. Conditions throughout the latter half of the season, however, were extremely favorable for mosquito breeding. Frequent rains and high tides kept the depressions in the marshes filled with water for periods sufficient to produce extensive mosquito breeding.

An attempt to control this breeding by the means of additional ditching and oiling would have increased the cost of maintenance to more than one dollar per acre, which is the maximum amount that can be expended under the law.

**Legislation.** Under the law passed in 1917 providing for the elimination of mosquito breeding places,\* some of the towns have objected to paying three-fourths of the supervision charges in addition to three-fourths of the labor for maintenance. Furthermore, it has been more or less of a question as how to divide these expenses among the various towns as the amount of supervision in a town depends upon the character of the marshes and the judgment of the men employed in carrying out the work. It was undoubtedly the intentions of those drafting the bill for this law that the cost of supervision be paid directly by the State.

Section 2410 of the General Statutes was therefore amended by the 1919 Legislature to read as follows:—

---

\* Seventeenth Report Connecticut State Entomologist, page 345, 1917.

## CHAPTER 21.

## AN ACT CONCERNING MOSQUITO BREEDING AREAS.

*Be it enacted by the Senate and House of Representatives in General Assembly convened:*

Section 1. Whenever any swamp, marsh or other land has been drained to the approval of said director, he shall keep the same in repair and free from obstruction, and construct or repair tide gates or otherwise treat such areas so as to make such work effective. The cost of such maintenance or treatment, not exceeding in any year one dollar per acre, shall be paid by the state, and the town, city or borough within which such place or area is located shall reimburse the state for three-fourths of the amount so expended. Said director shall certify to the comptroller the amount due from any town, city or borough under the provisions of this section, and the treasurer of such town, city or borough, as the case may be, shall pay to said comptroller such amount. All amounts so collected shall be available for expenditures under the provisions of this section. Said director may appoint one or more deputies to supervise the work done under the provisions of this and the preceding section, who may exercise the authority granted to such director, and the expense of said director and said deputies for supervision and inspection shall be included in computing the cost of any such work, but the actual cost of making preliminary inspections and surveys and for the supervision and inspection of the construction and maintenance by the said director or his deputies shall be borne wholly by the state and paid from the funds appropriated for the purpose. The comptroller may advance to said director such amounts, within the appropriation therefor, as are necessary to meet the current expenses for labor authorized under the provisions of this and the preceding section. Any person obstructing the work of examining, surveying or ditching or otherwise treating such mosquito breeding areas, or obstructing any ditch, canal or drain, or the natural outlet of any marsh forming, mosquito breeding areas, shall be fined not more than one hundred dollars or imprisonment not more than ninety days or both.

Section 2. This act shall take effect from its passage.

Approved March 19, 1919.

## REPORT OF WORK BY TOWNS.

**Madison.** The selectmen as in 1918 transferred Mr. Russell Bartlett from the road work to mosquito maintenance from April 14 to September 12. The ditches were cleaned in the spring and attention given them as needed throughout the summer. It was necessary to reopen the outlets of the creeks along Madison Beach at frequent intervals.

**Guilford.** The ditches were cleaned in the spring by Mr.

Frank Blatchley, who has been furnished by the selectmen for the past two seasons. Although the ditches were gone over two or three times during the season, more labor than was available was needed during portions of the season. The tide gate installed on the Great Harbor marsh in 1918 greatly improved the conditions on the marsh during the past season.

**Branford.** Mr. L. E. Rice was again in charge of the mosquito work in Branford. Owing to insufficient labor to thoroughly clean the ditches on some of the marshes in 1918, an extra amount of work was necessary this season. The ditches on the Hotchkiss Grove marsh were considerably damaged by musk rats and required extra work to put them in shape.

**East Haven.** The maintenance work in this town was done in connection with the New Haven work.

**New Haven.** Laborers were hired by the writer to clean the ditches in the spring. Mr. Draper, after finishing his college work in June, was again employed on the work for the remainder of the season.

The city of New Haven is constructing new tide gates on the West River at Congress Avenue bridge, and a new sewer is being laid in Westville, two improvements which should greatly improve the mosquito breeding conditions in the western part of the city. The tide gates which are nearly completed have the abutments and frame work of reinforced concrete with gates of double three-inch tongue and grooved planks and hung with special hinges. These gates control the water on about 130 acres of marsh between Congress Avenue and Chapel Street ditched in 1917,\* which has been flooded much of the time during 1918 and 1919.

The new sewer in Westville will receive the pollution from several factories which for a number of years has been emptied into the upper portion of the West River, causing extensive breeding of *Culex pipiens*†.

**Orange.** The maintenance work in Orange was continued under the direction of Dr. Phelps. In addition to cleaning the

\* Seventeenth Report Connecticut State Entomologist, page 349, 1917.

† Thirteenth Report Connecticut State Entomologist, page 245, 1913.



ditches, the creek that runs into the cove marsh was cleaned for several hundred feet to the north, thus draining a semi-fresh water swamp that was a possible malarial mosquito breeding area.

**Fairfield.** Mr. Nicholas Matiuck was continued in charge of the mosquito work in Fairfield. The large amount of fresh water mosquito work which is being done in the town requires more attention than the twelve hundred and fifty acres of salt marsh. To adequately handle this problem requires a larger appropriation than has been available in the past.

In the western part of the village of Fairfield is a section known as the Thorpe estate, a low area which was divided into building lots and a number of houses have been built by laborers. The natural drainage was cut off by three streets across the area, and by property owners filling in portions of the main ditch. *Anopheles* larva have been found in the water that collected in rainy weather, and the only method of preventing mosquito breeding was by oiling.

During the past season the old ditch was re-opened and deepened throughout this area and for several hundred feet beyond where it joined a creek in the salt marsh. Tile drains were placed across the three streets: 50 feet of eighteen inch and 140 feet of 12 inch tile was used. A gate was placed on the outer culvert to prevent high tides from flooding the area.

No new mosquito control work was done under the state law during the year, although the writer by request examined marsh areas and made recommendations regarding mosquito elimination in the towns of Westbrook and Groton. In the latter town plans have been made and funds are being raised to drain fifty or sixty acres of salt marsh at Groton Long Point during next season.

COST OF MAINTENANCE WORK FOR 1919.

Madison .....	\$505.38
Guilford .....	432.28
Branford .....	409.22
East Haven .....	25.62
New Haven .....	804.97
Orange .....	200.97
Fairfield .....	1,217.32
Total .....	\$3,595.76
Average cost per acre .....	.727
Expenses in connection with proposed new work .....	\$15.07

## ENTOMOLOGICAL FEATURES OF THE SEASON.

The winter of 1918-1919, unlike the preceding, was unusually mild. There was little snow and the temperature was seldom below zero. Honey bees and native bees which winter-killed severely in 1917-1918, came through the winter nicely and scarcely needed the protection which most of the beekeepers gave their colonies on account of the losses the preceding winter.

The planting season opened late and cold, and plant development and consequently insect development was some two weeks behind that of normal seasons. During June the rainfall was somewhat below normal, but from the middle of July until the end of October, heavy and frequent rains kept the soil soaked with water and many crops needed sunlight. The total rainfall for the season was about six inches more than normal.

Orchard aphids caused considerable injury throughout the state.

Canker worms were present in some localities, but the tent caterpillar was scarce, only a few nests being observed.

The white-marked tussock moth was present, but this and other tussock moths were much less abundant than in 1918.

The potato flea-beetle was abundant and caused considerable damage as in 1918.

The potato aphid was present in small and in moderate numbers on potato and tomato plants, but it did not seem to cause much injury and most owners did not spray to control it.

Aphids attacked peas and injured them considerably. The turnip aphid was also present and injured many small turnip plantings.

The elm leaf beetle was present in injurious numbers and in several towns the trees were sprayed where this practice has been abandoned for several years.

Two of the most conspicuous entomological features of the season were the severe attack on beans everywhere by the green clover worm, and the unusual prevalence of corn borers and other insects attacking corn.

A native borer *Pyrausta ainsliei* Hein., which we may call the smartweed borer, was found in corn stalks in Milford in March, and was thought to be the European corn borer, until the adults were reared in July when it was identified. The stalk borer was very abundant especially in corn and was present in all parts of the state and caused considerable injury.

*Crambus praefectellus* Zinck. attacked and ruined a small field of corn in New Haven, this being the first instance on record of any real damage being caused by this insect.

The corn ear-worm was responsible for a moderate amount of injury to corn. Specimens were received from various parts of the state, and it was observed in many other localities.

A search was made for larvae and injury of the oriental peach moth *Laspeyresia molesta* Busck, in Stamford where it was found in 1918, but no trace of it was discovered.

The brown-tail moth, though slightly more abundant than in 1918, is still scarce.

The gipsy moth has been well held in check. The number of infestations is now less than half that of a year ago, and if there is no wind-spread the coming spring, it is expected that the number of infestations will again be materially reduced.

On account of the excessive rainfall, it was difficult to prevent the breeding of mosquitoes, and there were some complaints, even where the salt marshes have been ditched. The rain barrel or house mosquito was particularly troublesome and had a chance to breed in pools and receptacles everywhere, as the constant rains prevented these breeding places from becoming dry.

#### MISCELLANEOUS INSECT NOTES.

**Enchenopa binotata Say, Reported as Injuring Beans:**—On July 16, specimens of this peculiar bug were received for identification from Stamford, where it was said to be causing injury to garden beans. This species commonly occurs on "bitter-sweet" *Celastrus scandens*, and is occasionally found on black locust.

**Poultry Food Infested with Mites:**—On August 22, a sample of poultry food was received from Winsted, which was thoroughly infested with mites. This mite was identified by Dr. Philip Garman of this department as *Tyroglyphus farinae* Deg., a species often occurring in food products.

**A Weevil Breeding in Stems of Pigweed and Ragweed:**—Stems of red-root pigweed, *Amarantus retroflexus*, and ragweed, *Ambrosia artemisaefolia*, infested with larvae were collected in

Wethersfield February 7. On June 12 a large number of weevils emerged from the stems and were identified as *Baris scolopacea* Germ.

**Borers in Stems of Evening Primrose:**—Mr. Walden collected stems of evening primrose, *Oenothera biennis*, in Orange, February 20, which contained in the pith a large number of small yellow larvae. On July 17, a number of small white and brown moths emerged from the stems. These were identified as *Mompha eloisella* Clem.

**Plum Curculio in Peaches:**—Mr. Zappe gathered some unripe peaches at Sound Beach, Stamford, on June 23, which were infested by small larvae. Several infested fruits were also received from Mr. Stancliff Hale, South Glastonbury, on June 16. Adults of the plum curculio, *Conotrachelus nenuphar* Herbst, emerged July 23 from the Glastonbury material.

**Leopard Moth in Hartford:**—On July 9, a girdled and broken elm branch was received from the Superintendent of trees in the city of Hartford. Without question this was the work of the leopard moth, *Zeuzera pyrina* Linn., which though common enough along the coast has never before been found so far inland in Connecticut, or I think elsewhere in this country.

**The Potato Aphid:**—So much damage was caused in 1918 by the potato aphid, *Macrosiphum solanifolii* Ashm., that we expected recurring injury in 1919. The species could be found in small numbers in many fields, of potatoes and tomatoes, but in most cases it was not sufficiently abundant to do much damage, and the writer did not learn of a single case where fields were sprayed on account of it.

**The Gladiolus Aphid:**—On June 17, some gladiolus corms infested with immature aphids, were received from Bristol. These corms had been stored over winter. One of them was planted in a pot in the insectary and soon began to grow, but the aphids multiplied so rapidly that the plant was soon killed. Plate XXXII, a, shows the appearance of the plant when literally covered with aphids. This is known as the gladiolus aphid, *Aphis gladioli* Felt.

**Abundance of the Pea Aphid:**—On June 6 and 13, pea vines were brought to the office from the vicinity of New Haven, infested by the pea aphid, *Macrosiphum pisi* Kalt., with the report that this aphid was doing great damage to garden peas. In the large truck fields, no treatment is usually practiced in Connecticut. In the home garden, spraying the vines, especially the under sides of the leaves, with nicotine solution and soap will hold this pest in check. Even a forceful spray of water from the hose will knock them off and many will fail to get back to the leaves. If this is repeated every few days, little harm to the plants will result.

**Swarms of White Moths:**—For two or three nights about September 19, there were great numbers of large white moths with dotted black markings, around the electric lights in New Haven, and doubtless in other towns and cities of Connecticut. This is called the "chain-dotted geometer," *Cingilia catenaria* Drury, and the larvae feed upon the leaves of sweet fern and bayberry. The larvae were very abundant in 1903, and again in 1919, especially in Windham County, where many sweet fern and bayberry bushes were stripped.

**Pink Grasshoppers:**—A pink form of one of the so-called angular winged grasshoppers or katydids, *Amblycorypha rotundifolia* Scudder, was brought to the Station on August 20, from Orange where it was collected by Mrs. George D. Bathgate. The specimen was a female. On August 12, 1918, a pink female of *Amblycorypha oblongifolia* Deg., was received from New Haven, collected by Miss Molly Hart. On September 21, 1914, two specimens of *Scudderia furcata* Bruner, were received from Derby and a note regarding them was printed in the Report of this Station for 1914, page 187. The adults of these species are normally green, but occasionally the pink forms occur.

**Larch Case Bearer:**—On August 14, Dr. G. P. Clinton, botanist of this Station, handed the writer some larch twigs which he had collected in Greenwich. The leaves had been mined at the tips by the larvae and had turned brown. There were several of the characteristic cases on the leaves. The insect is an European species known as the larch case bearer, *Coleophora*

*laricella* Hubner, and it has been recorded from different parts of New England at various times as causing considerable injury. There is only one generation each year, and the adult is a small gray moth which emerges early in June and July. The winter is passed by the larvae which rest in their cases attached to the bark of the twigs. This insect can doubtless be controlled by spraying with arsenate of lead which has been found effective against the closely allied case-bearers on fruit trees.

**The Pine Tube-Moth:**—While inspecting nursery stock in Hartford in October, Mr. Zappe observed some large white pines growing near the nursery with many of the leaves fastened together to form cases or tubes inside of which the larva feeds. This is the work of the pine tube builder, *Eulia pinatubana* Kearfott. The larva is about one-third of an inch long, pale green with light brown head. The adult is a small moth with a wing-expanse of slightly more than half an inch, and with forewings of a dull rust-red color, crossed by two oblique parallel paler bands: rear wings are silky gray. The tube is formed of about fifteen needles fastened together with silk threads as shown on plate XXXII, b. There is probably one brood each season. The insect is not of great economic importance, but if it should prove injurious to choice ornamental trees, spraying with lead arsenate will doubtless be effective in holding it in check.

**The Clover Seed Chalcid:**—On August 4, Mr. Pelton of the Station Staff brought to the laboratory some seed of a choice hardy variety of clover, which had been procured from Ohio, for seeding in Connecticut. Nearly all of the seeds had a small hole in one side, where some insect had emerged. Many of these seeds were examined and in some were found the dead bodies of a small chalcid fly, which Mr. Walden identified as the clover seed chalcid *Bruchophagus funebris* How. The eggs are laid on the clover heads in the field, the larvae feed inside the seeds and the adults emerge after the seeds are ripe. This insect occurs wherever clover is grown, and there are three broods each year in Illinois. Early cutting of clover is a remedy. The seeds with exit holes are shown on plate XXX, a.

**Swarms of Cotton Moths:**—On October 5, on Chapel and other business streets of New Haven, there were large numbers

of brown moths resting with folded wings on the plate glass store windows. They flew around the lights the preceding evening and in a few days had all disappeared. Specimens were received from Bridgeport, and Dr. Felt informed the writer that swarms appeared in various sections of New York state at about the same time. This is the cotton moth, *Alabama (Aletia) argillacea* Hubner, which occurs in great numbers in the cotton belt of the southern states, and migrates northward in the fall. Occasionally the swarms reach Connecticut before they are dissipated. Such a swarm appeared in New Haven in 1911, and was mentioned in the Report of this Station for that year, page 339.

**Elm Leaf Beetle Again Abundant:**—This insect was formerly very destructive to elm trees in southern Connecticut, but for the past few years has not been much in evidence as a pest. Beginning in 1917, it has increased each year and did enough damage in 1918, so that some communities decided to spray their trees in 1919. Trees were sprayed in West Haven and in Clinton, which were not sprayed the preceding year. Possibly the moist weather during the latter part of July and afterward may have induced the growth of the fungus which attacks the pupae, but it came rather late in the season for the best results, and all communities where trees are menaced should prepare to spray the foliage in 1920.

**Beans Injured by Gray Hair-Streak Butterfly:**—Green slug-like larvae were received from two correspondents in Hartford, on September 15 and 22, respectively, in both cases reported as feeding upon Lima beans. These are the larvae of one of our small butterflies called the gray hair-streak, *Uranotes melinus* Hubner. As a rule, this is not considered a pest in Connecticut, but further south the species is regarded as a minor pest of beans and peas. The butterfly has a wing-spread of one and one-fourth inches, and the wings are blackish with blue-gray tints. Near the tips of the rear wings is a row of bluish spots, with a large orange spot in the center surrounding a small black one, and the rings terminate in slender tail-like processes. There are two broods each year in the north and three in the South. Wherever abundant, this insect may be kept in check by spraying with lead arsenate.

**The White Blotch Oak Leaf-Miner:**—Several complaints were received regarding an insect attacking the leaves of white oak trees, especially in the central portion of the state, and specimens were received from Cromwell and New Haven. Some of the leaves had been crumpled and possibly attacked by more than one insect, but the samples submitted all showed the presence of the white blotch oak leaf-miner, *Lithocolletis hamadryadella* Clemens. This insect makes a whitish blotch-like mine on the upper surface of the leaf, and attacks different kinds of oaks. The larva is very small, flat, and without feet, and brownish yellow in color. It transforms within the mine, and the adult is a small silvery white moth with a wing-expanse of about a quarter of an inch. There are said to be five or six annual broods in the vicinity of Washington, D. C. There is no method of control known, except to gather and destroy the infested leaves.

**Swarms of Aphids:**—On June 23, the writer's attention was called to the swarms of green winged aphids which had for a few days been present on Chapel Street and in other parts of the city. The tops of automobiles and the clothes of persons were literally covered. There were many inquiries at a local seed store, and some persons thought they were seventeen-year locusts. One of the Station employees stated that when riding his bicycle into New Haven on Dixwell Avenue, his clothes were fairly covered with these aphids. Assistants were sent to Chapel Street to collect specimens, and found them to be aphids with heavily-marked wing-veins. Some were mounted on microscope slides and sent to Dr. Edith M. Patch, Agricultural Experiment Station, Orono, Me., who identified the species as *Calaphis betulaecolens* Fitch. This aphid feeds upon birch, is supposed to remain on its host throughout the season, and was extraordinarily abundant all over Connecticut in 1919. Of course there are few birches in the city, but there are many acres of gray or bobbin birches, *Betula populifolia*, in Orange only three or four miles from the center of New Haven, and with the prevailing winds blowing from the southwest, this section was probably their source. Possibly they became so abundant that they were obliged to leave their hosts in search of food. There were a number of newspaper accounts of the incident, some being more startling than accurate.



**Flea Beetle on Swiss Chard:**—On June 28, one larva feeding on swiss chard was received from Salisbury, with the statement that the insect was causing considerable injury in gardens in that vicinity. The larva was about a quarter of an inch long, and covered with black spines which are white at the tips. An adult emerged July 21, and proved to be the spinach flea beetle, *Disonycha xanthomelaena* Dalman. It feeds upon pigweed, beet, swiss chard and spinach, the larvae occurring on the under side of the leaves. When young the larvae feed in clusters, but separate when they are partly grown. They often drop to the ground when disturbed. At first they eat only the epidermal layer, but later eat holes through the leaves. The adult is about one-fifth of an inch long, greenish black with yellow prothorax, and hibernates as an adult. In the vicinity of Washington, D. C., there are two broods annually.

Of course it is not safe to apply poison to any foliage which is to be used for food. Therefore on swiss chard and spinach, it may be possible to spray the under surface with strong soap and water, or to brush the plants just before cultivating. The adults can be caught like the flea beetles by passing over the rows a box lined with tanglefoot.

**An Outbreak of Book Lice in a House at Milford:**—On August 6th, a telephone communication was received at the Station from Milford regarding some very small insects infesting a dwelling house, and from the description, the identity of the insect could not be established. Therefore the writer was sent to investigate. The insect found proved to be a species of book louse, *Atropos pulsatoria* Linn., belonging to the order Corrodentia. The individuals were numerous, being present in all parts of the house, in the cracks of the floors, on the stairs, under rugs, behind pictures, and some were also found on the furniture.

The owner of the house thought that the pest might have been brought into the house on baskets of eggs from the hen houses, which on examination were found also infested.

The injury caused by the insects was more imaginary than real; the housewife was worried because she did not know what the insects were, or how to get rid of them. The only place where they seemed to be doing any damage was on the under side of the

dining room chairs. The chair seats were made of strips glued together, and many book lice were present on the under side, together with some very fine white dust, which the members of the family declared was not there when the chairs were purchased a short time before. There is still some doubt whether the book lice were responsible or whether the wood was powder posted before or soon after being made into chairs.

The treatment advised for the control of this insect was to wash floors and woodwork with hot water and soap and to wipe over the furniture and pictures, etc. with the same. The house was again visited on December 1, and the family reported that the book lice had then all disappeared, but that they were present until the cold weather set in, and probably were not all killed by the treatment. It is probable that the insects may appear again in the spring, and if so, the house will be fumigated with hydrocyanic acid gas.—M. P. Zappe.

**A Tobacco Warehouse Infested by the Cigarette Beetle:—**

On December 31, 1918, there was brought to the Station a handful of choice shade-grown wrapper-leaf tobacco infested with larvae and adults of the cigarette beetle, *Lasioderma ser-ricorne* Fabr. This tobacco came from a large tobacco storehouse, where on the fourth floor several hundred bales of the 1917 crop were stored. The writer visited this storehouse on January 2nd, 1919. Some bales were rather badly infested around the edges and butts.

A local contractor had tried to kill the insects by fumigating with carbon disulphide, first by fumigating the whole room (which was a failure) and, second, by putting a dose on the top end or side of each opened bale. The second method killed some of the insects but did not penetrate sufficiently to prove effective, and those inside were alive after the treatment. Moreover, there was the disagreeable odor of the carbon disulphide discernible in several of the bales, and there was some apprehension that it might affect seriously the quality of the tobacco, which would obviously be ruined for wrapper purposes if the insects were not killed promptly. The storage room was said to contain 93,000 cubic feet.

After a general survey of the situation, I advised heat as the most practical method of treatment. A sweating room opening

out of the large storeroom was at a temperature of 96° F. at the time of my visit. Only two pipes had steam in them and ten more were available. Additional steam coils could be installed if needed to bring the temperature up to the required point.

On January 10th, I made another visit to the warehouse. The heat had been given a trial. Additional pipes were added and the temperature was raised to 148° F. The tobacco bales were placed in the room January 8th and left there over night: they were stacked flatwise with 2 x 4 inch scantling between them to allow for circulation. A thermometer placed inside one of the bales registered 130° F.

Though most of the insects had apparently been killed, there were a few still alive, and one of the owners seemed to regard the treatment as a failure. Considerable material was gathered and brought to the laboratory and examined with the following results:—

	Dead	Living
Larvae .....	273	7
Pupae .....	3	0
Adults .....	62	0
Total .....	<hr/> 338	<hr/> 7

These figures show that 2.56 per cent. of the larvae, or 2.1 per cent. of all stages came through alive. In spite of the fact that some were not killed, this seemed to me by far the best possible method of treatment, and it is probable that if the temperature could have been kept for a few hours longer to allow the bales of tobacco to become thoroughly heated through, it would have killed all the insects. A communication to this effect was sent to the owners, who later were asked about the matter and replied as follows:—"Our treatment to rid ourselves of the cigarette beetle consisted in putting the entire tobacco in one of our sweatrooms and running the heat up to 130° F. At this temperature we left the tobacco in the room for five hours. A day or two later we took all of the packages out of the sweat-room and put them in a building without heat. It so happened that the days following were extremely cold. We have examined any number of the packages from time to time and have found no trace of living beetles or larvae. The bulk of the tobacco has been shipped to the various customers and we have not had a single complaint regarding it."

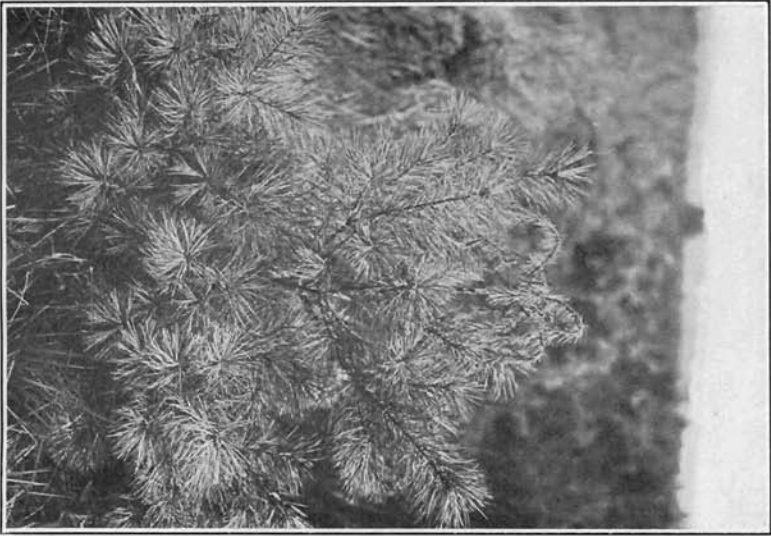
## INDEX

- Acronycta (Apatela) oblinita*, 186  
*Adalia bipunctata*, 158  
*Agelastica alni*, 124  
*Alabama argillacea*, 202  
*Amara communis*, 124  
*Amarantus retroflexus*, 198  
*Amblycorypha oblongifolia*, 200  
     *rotundifolia*, 200  
*Ambrosia artemisiifolia*, 198  
*Anaphothrips striatus*, 190  
*Anatis 15-punctata*, 158  
*Anisodactylus binotatus*, 124  
*Anopheles*, 196  
 Aphid, 197  
     Birch, 203  
     Gladiolus, 199  
     Green Apple, 119  
     Pea, 200  
     Pine Bark, 155-160  
     Potato, 197, 199  
     Spruce Gall, 119  
     Turnip, 197  
     Woolly, 119  
*Aphis gladioli*, 199  
*Aphodius granarius*, 124  
 Army Worm, 185-186  
*Atheta* sp., 127  
*Atopos pulsatoria*, 204  
*Autographa falcigera* var. *simplex*,  
     190  
*Baris scolopacea*, 199  
*Barypithes pellucidus*, 124  
*Betula populifolia*, 203  
*Bidens frondosa*, 178  
 Black Knot, 119  
 Book Lice, 204  
 Brown-tail Moth, 124, 135, 198  
*Brucophagus funebris*, 201  
 Canker Worms, 197  
*Calaphis betulaecolens*, 203  
 Capsid Bug, 127  
*Carabus nemoralis*, 124  
*Catharus advena*, 127  
*Celastrus scandens*, 198  
 Chain-dotted Geometer, 200  
*Chenopodium album*, 178  
*Chermes cooleyi*, 119  
     *pinicorticis*, 155-160  
*Chilocorus bivulnerus*, 158  
 Chrysanthemum Gall Midge, 161-165  
*Chrysopa* sp., 158  
 Cigarette Beetle, 205  
*Cingilia catenaria*, 200  
*Cirphis (Heliophila) unipuncta*, 185  
*Clivina fossor*, 125  
 Clover Seed Chalcid, 201  
*Coccinella 7-punctata*, 125  
*Coccus hesperidum*, 124, 125  
*Coeloides pissodis*, 150  
*Coleophora laricella*, 201  
*Conotrachelus nenuphar*, 199  
 Corn Ear Worm, 188-189, 198  
 Cotton Moths, 201  
*Crambus caliginosellus*, 184  
     *praefectellus*, 183-185, 198  
 Crown Gall, 119, 125  
*Culex pipiens*, 195  
 Curculionid larvae, 125  
*Cyanopterus* sp., 151  
*Depressaria heracliana*, 192  
*Diacrisia*, 186  
*Diarthronomyia hypogaea*, 117, 161-  
     165  
*Disonychia xanthomelaena*, 204  
 Elaterid larvae, 125, 127  
 Elm Leaf Beetle, 197, 202  
*Emphytus cinctus*, 124, 125  
*Enchenopa binotata*, 198  
*Eulia pinatubana*, 201  
*Euproctis chrysoorrhoea*, 124, 125  
 European Corn Borer, 170-173  
     Tent-caterpillar, 124  
*Eurytoma pissodis*, 151  
*Falagria* sp., 125  
 Fire Blight, 119  
 Flea Beetle, 204  
*Forficula auricularia*, 125  
 Gipsy Moth, 135, 198  
 Gray Hair-streak, 202  
 Green Clover Worm, 165-170, 197  
*Habrobraconidea bicoloripes*, 150, 151  
*Hadena fractilinea*, 187  
     *semicana*, 187  
*Heliothis armigera*, 188  
     *obsoleta*, 188-189  
*Hemerobia* sp., 158  
 Inspection, Apiaries, 128  
     Imported Bulbs, 126  
     Imported Nursery Stock, 122  
     Nurseries, 118  
*Itycorsia*, 117  
 Lampyrid larva, 125  
 Larch Case Bearer, 200  
*Lasioderma serricorne*, 205  
*Laspeyresia molesta*, 119, 198  
*Lathrobium brunnipes*, 125

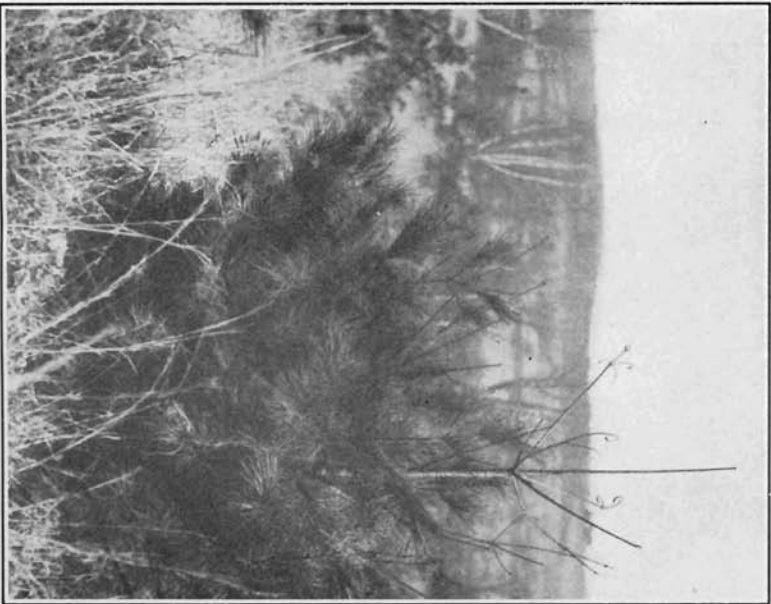
- Leopard Moth, 119, 199  
 Lined Corn Borer, 187  
*Lithocolletis hamadryadella*, 203  
*Macrosiphum pisi*, 200  
   *solanifolii*, 199  
*Malacosoma neustria*, 124, 125  
*Mamestra picta*, 191  
   *subjuncta*, 190  
*Masicera myoidea*, 182  
*Megilla fuscilabris*, 158  
   *maculata*, 158  
*Meibomia* sp., 167  
*Merodon equestris*, 127  
*Microbracon nanus*, 151  
 Milliped, 125  
 Mites, 198  
*Mompha eloisella*, 199  
 Mosquito Work in 1919, 193-196  
   Madison, 194  
   Guilford, 194  
   Branford, 195  
   East Haven, 195  
   New Haven, 195  
   Orange, 195  
   Fairfield, 196  
*Mycetaea hirta*, 125  
*Enothera biennis*, 199  
 Oriental Peach Moth, 119, 198  
*Otiorynchus sulcatus*, 124, 125  
*Papaipema nebris*, 182  
   *nitela*, 180-183  
*Papulospora* sp., 128  
 Parsnip Web Worm, 192  
 Peach Borer, 119  
*Penicillium* sp., 128  
*Picea excelsa*, 147  
   *rubens*, 147  
 Pine Bark Aphid, 155-160  
 Pine Tip Moth, 148  
   Tube Moth, 119, 201  
*Pinipestis zimmermani*, 148  
*Pinus divaricata*, 147  
   *resinosa*, 146  
   *rigida*, 147  
   *strobus*, 147  
   *sylvestris*, 147  
*Pissodes affinis*, 146  
   *approximatus*, 146  
   *strobi*, 144-155  
*Plathypena scabra*, 165-170  
*Plesiothrips perplexus*, 190  
 Plum Curculio, 199  
*Polygonum*, 175, 176, 177, 178, 187  
   *Persicaria*, 177  
 Poplar Canker, 119  
 Potato Flea-beetle, 197  
*Pterostichus vulgaris*, 125  
 Publications of Department, 115  
*Pyralis farinalis*, 127  
*Pyrausta ainsliei*, 172, 173-180, 197  
   *nubilalis*, 118, 170-173, 174, 175, 176,  
   179  
   *penitalis*, 172, 176, 177  
*Rhizoglyphus echinopus*, 117, 127  
   *hyacinthi*, 127  
*Rhopalicus suspensus*, 151  
 Scale  
   Elm, 119  
   Euonymus, 119  
   Oyster-shell, 119, 124, 125  
   Pine Leaf, 119  
   Rose, 119  
   San José, 119  
   Scurfy, 119  
   Tulip Tree, 119  
*Scudderia furcata*, 200  
*Sitodrepa panicea*, 128  
 Smear'd Dagger Moth, 186-187  
*Spathius brachyrus*, 151  
 Spruce Gall Aphid, 119  
 Stalk Borer, 180-183  
 Staphylinid Beetle, 128  
*Syrphus* sp., 158  
*Tenebrio molitor*, 128  
 Thrips, 189  
*Triaena plebeja*, 125  
*Typhoea fumata*, 128  
*Tyroglyphus farinae*, 198  
*Uranotes melinus*, 202  
 White Blotch Oak Leaf-miner, 203  
 White-marked Tussock Moth, 197  
 White Pine Weevil, 119, 144-155  
 Wireworms, 190  
*Zeuzera pyrina*, 199

## ILLUSTRATIONS.

All plates are from photographs from the following sources:—Plates IX, a, X, b, and the right half of Plate XVI, by W. O. Filley; Plate XI, a and b, by Professor Samuel J. Record; Plate XIII, c, by Harry A. Doty; left half of Plate XVI, by D. B. Pangburn; Plate XIII, b, by Harry B. Kirk; Plates XIV, b, XVIII, a, XIX, b, XX, a, by W. E. Britton; Plates XVIII, b, XXI, a, XXII, b, XXIII, a, XXIV, a, XXV, a, c and d, XXVII, a and c, XXIX, a, b and c, XXX, a and c, by K. F. Chamberlain. All others by B. H. Walden. The text figures are from drawings as follows:—Figure 16 prepared from map by Mr. Walden; figures 17 and 18 by A. B. Champlain; figure 19 by Dr. Philip Garman. Figure 20 from Bureau of Entomology, U. S. Department of Agriculture.



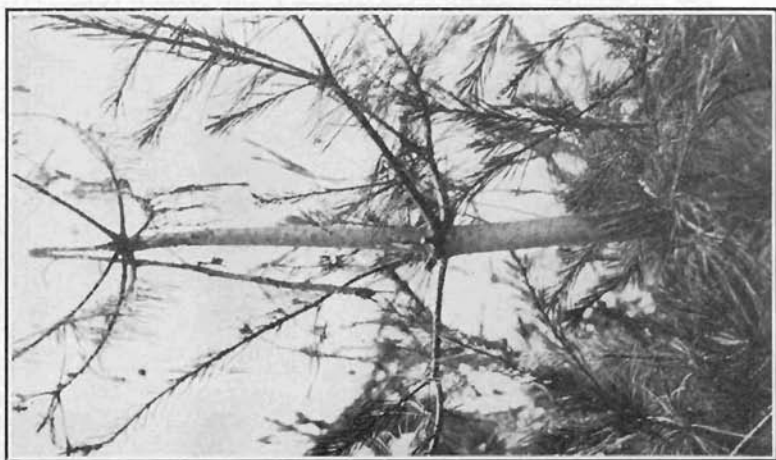
a. Young white pine tree with leader killed by weevil.



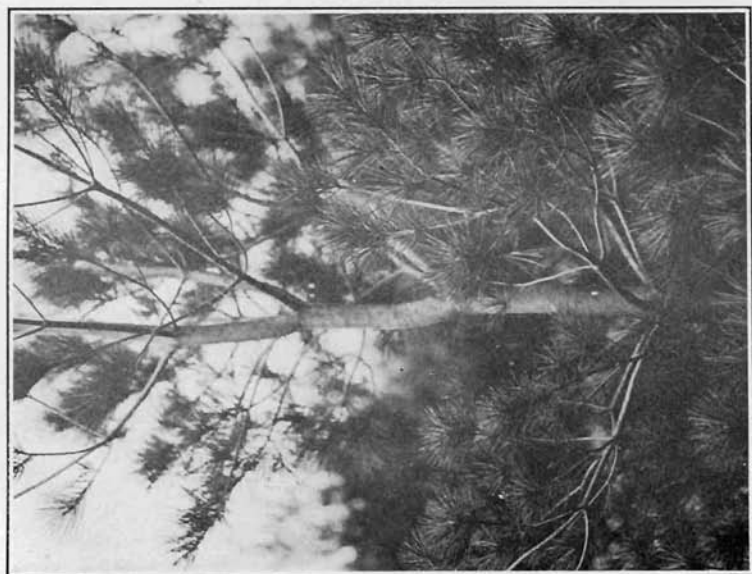
b. Young pine tree with leader and some of the lateral branches killed by weevil.

WHITE PINE WEEVIL.

PLATE X.

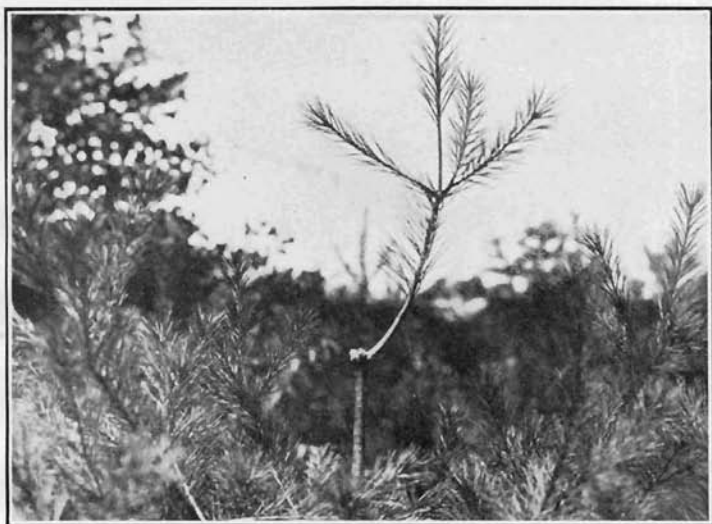


b. Leader killed by weevil and bark torn away by birds, to get at the grubs.



a. Result of weevil injury. This tree has lost its leader several times.

WHITE PINE WEEVIL.



a. All laterals removed except this one, to induce a stronger growth.

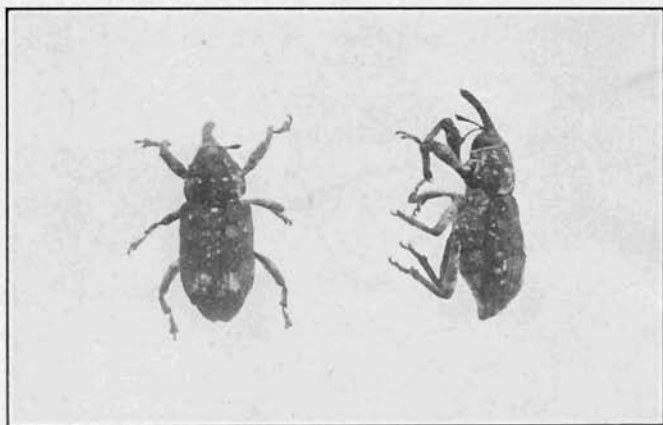


b. A forked tree resulting from the loss of the leader by weevil injury.

**WHITE PINE WEEVIL.**



PLATE XII.

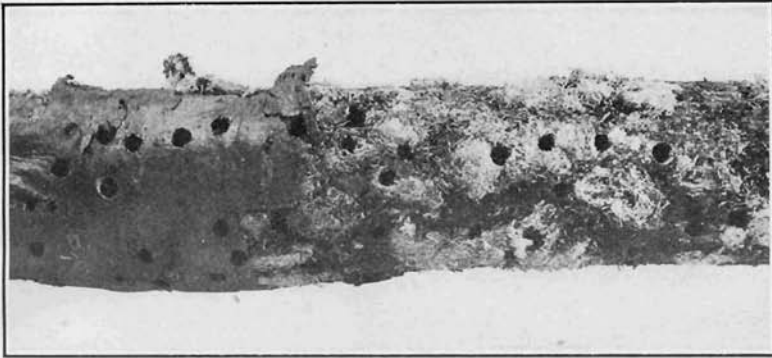


a. The white pine weevil. Adult beetles, four times enlarged.



b. Weevil punctures and resin exudation from them. Natural size.

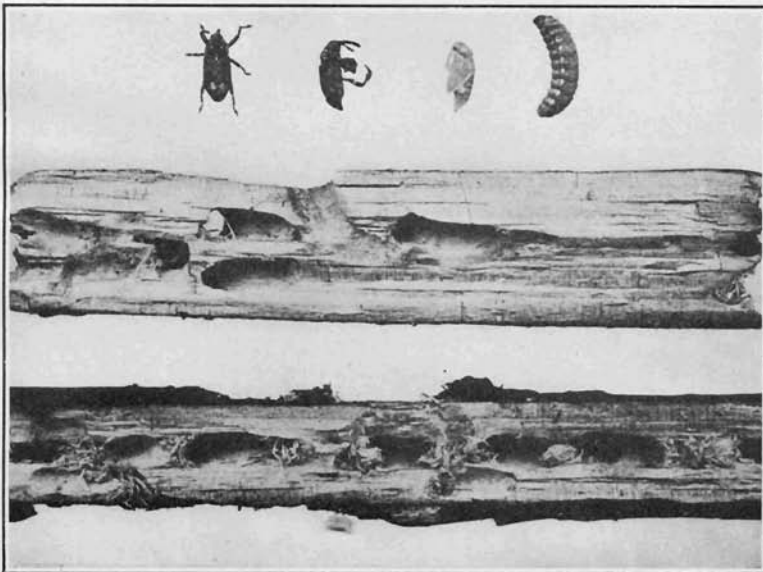
WHITE PINE WEEVIL.



a. Exit holes of white pine weevil. Natural size.



b. Larval cells in pine leader. Natural size.



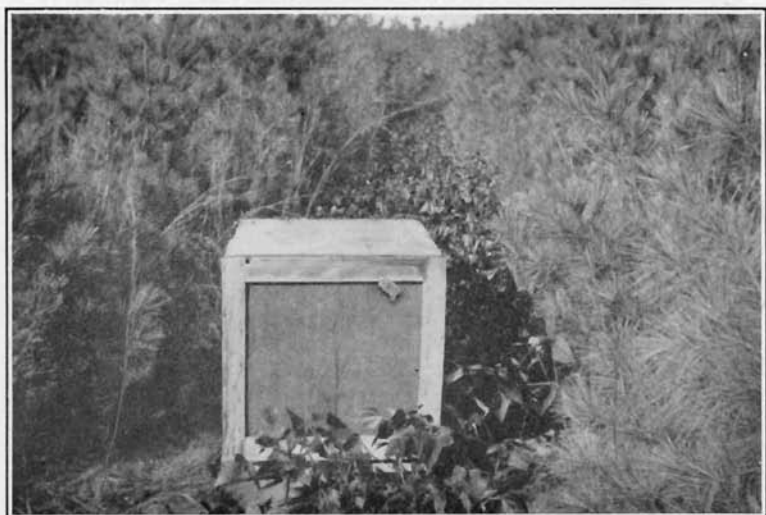
c. Adults, larva, pupa and cells in pine leader. Slightly enlarged.

**WHITE PINE WEEVIL.**

PLATE XIV.

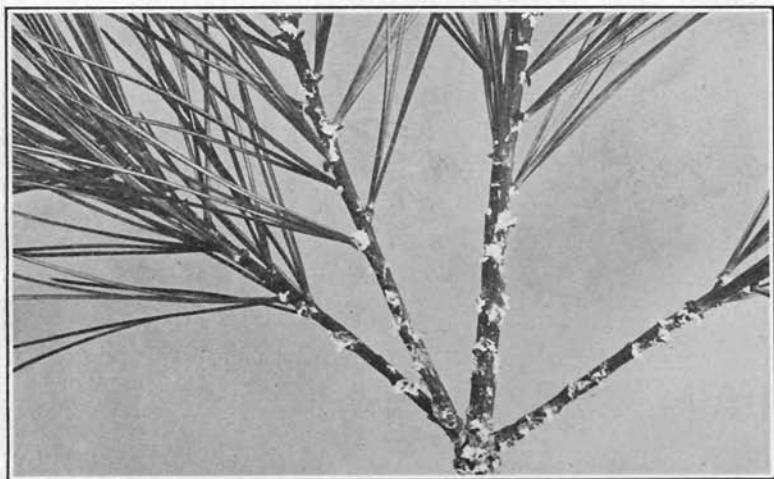


a. Method of collecting weevils in white pine plantations.

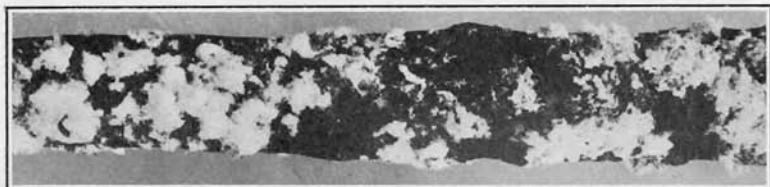


b. Box to hold cut leaders. Wire screen allows parasites to escape but weevils are imprisoned.

**WHITE PINE WEEVIL.**



a. The pine bark aphid in small tufts on twigs and leaves.  
Natural size.



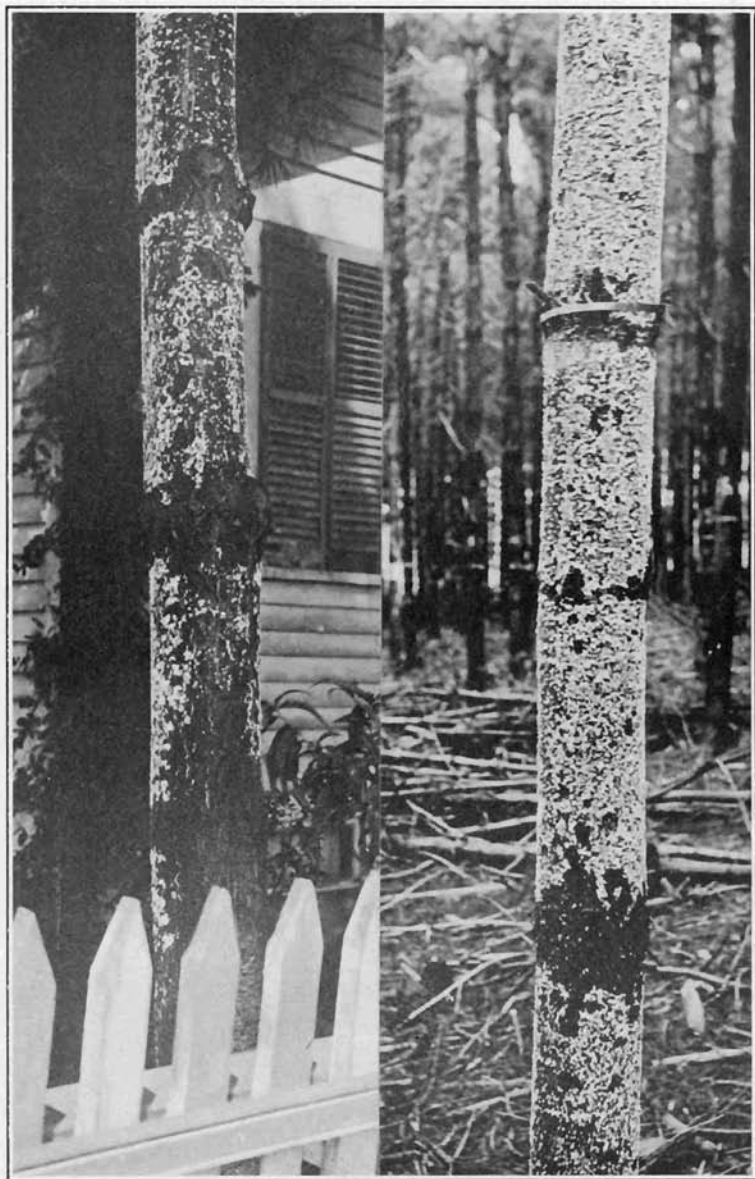
b. Pine bark aphids in larger tufts on twig. Natural size.



c. Method of hand spraying pine trees.

**PINE BARK APHID.**

PLATE XVI.



The pine bark aphid on trunks of trees.

**PINE BARK APHID.**



a. Automobile truck power sprayer taking water from canal.



b. Spraying woodland trees with automobile truck power sprayer.

GIPSY MOTH WORK.

PLATE XVIII.

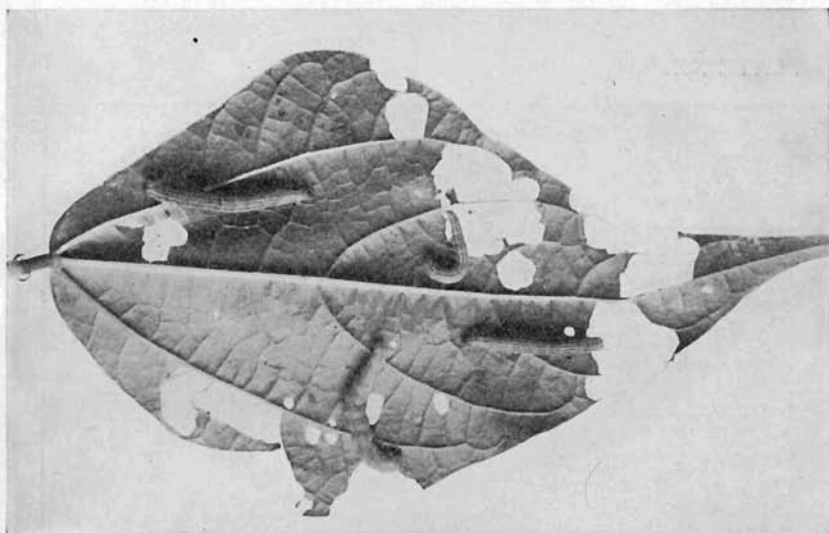


a. Underspraying beans with nicotine solution and soap.

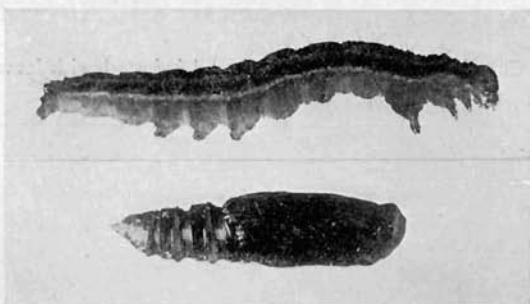


b. Patch of beans in a garden showing injury by the caterpillars.

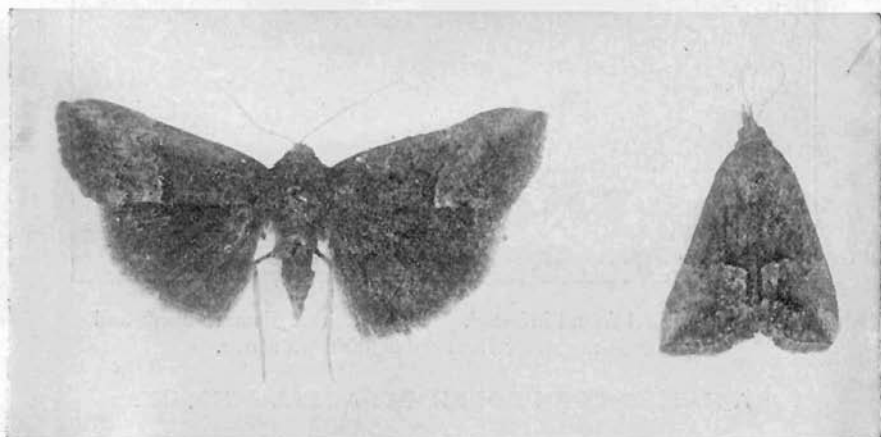
**GREEN CLOVER WORM.**



a. Larvae feeding upon bean. Natural size.



b. Larva and pupa. More than twice natural size.



c. Adult moths. Twice natural size.  
**GREEN CLOVER WORM.**



PLATE XX.

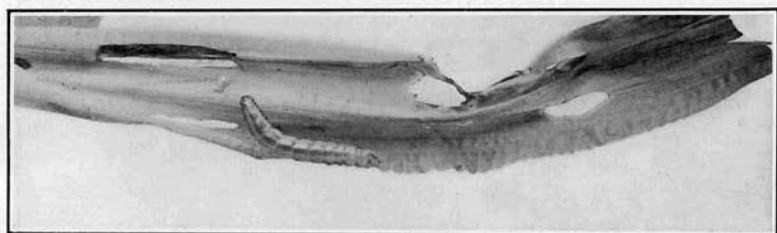


a. Cornfield in Milford, first found infested with larvae.

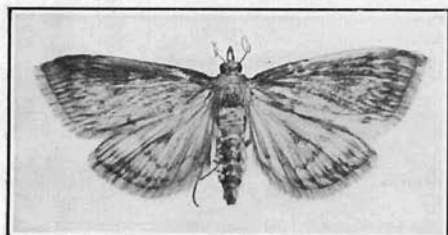


b. Second field found infested. This is a short distance north and across the street from the field shown above.

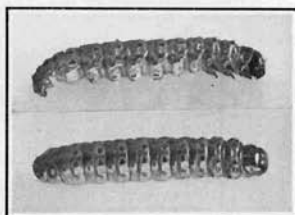
**A NATIVE CORN BORER, *PYRAUSTA AINSLIEI*.**



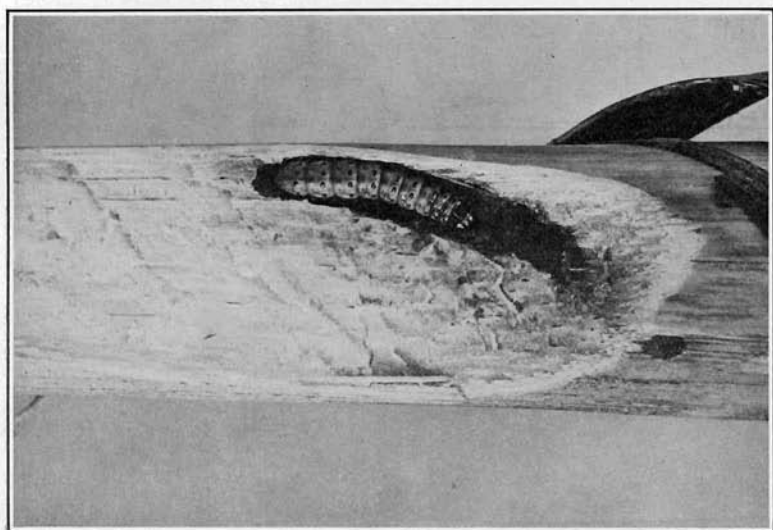
a. The lined corn borer, *Hadena fractilinea*. Larva, natural size.



b. *Pyrausta ainsliei* Hein. Adult twice enlarged.



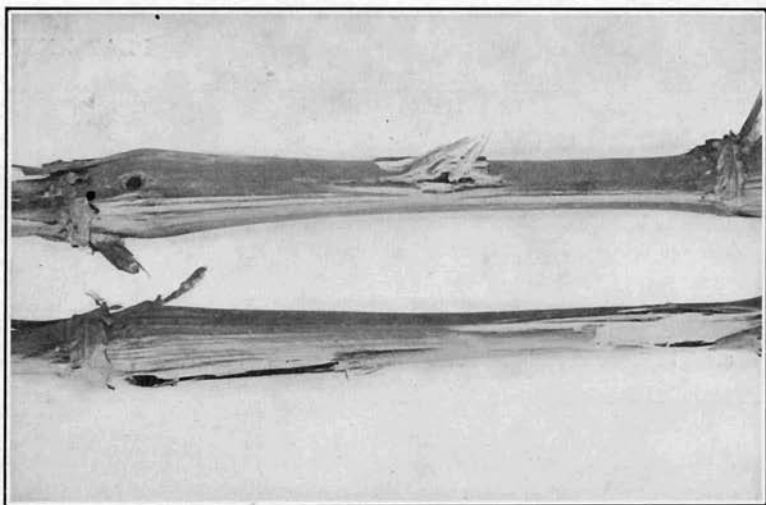
c. *Pyrausta ainsliei*, lateral and dorsal view of larva. Twice enlarged.



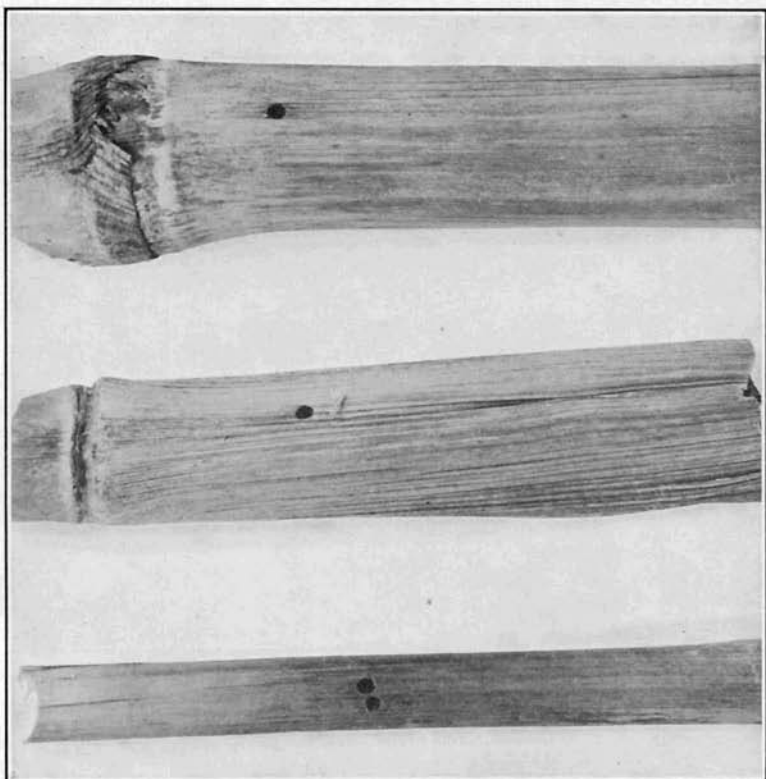
d. Larva of *Pyrausta ainsliei* in burrow in cornstalk. Twice enlarged.

THE LINED CORN BORER, *HADENA FRACTILINEA*.

A NATIVE CORN BORER, *PYRAUSTA AINSLIEI*.

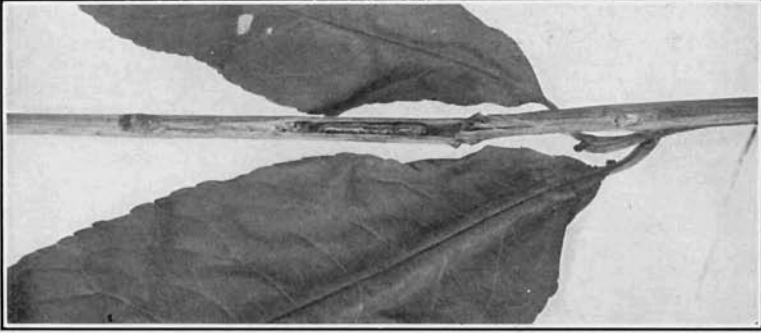


a. Burrows in smartweed, torn open by birds to get at the larvae.  
Natural size.



b. Entrance holes in corn stalks. Natural size.

A NATIVE CORN BORER, *PYRAUSTA AINSLIEI*.

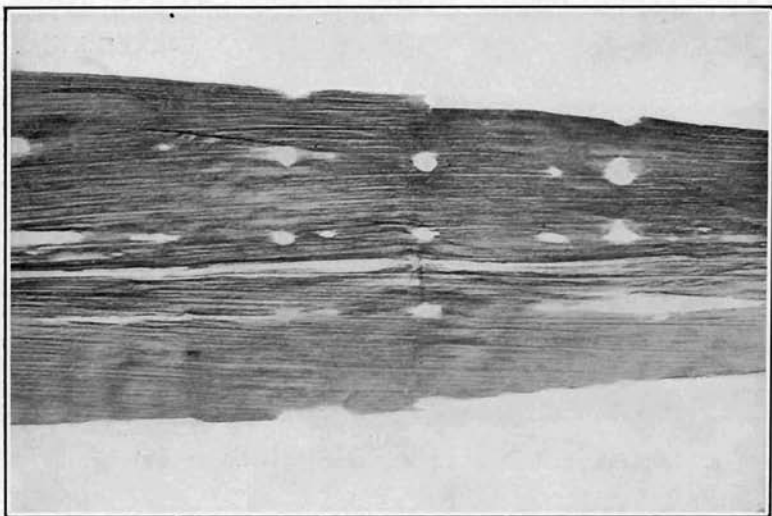


a. Larva in peach shoot growing near ground. Natural size.



b. Burrows in corn stalks. Natural size.

THE STALK BORER.



a. Characteristic injury near tip of blade. Holes eaten by larva before leaf unrolled. Natural size.



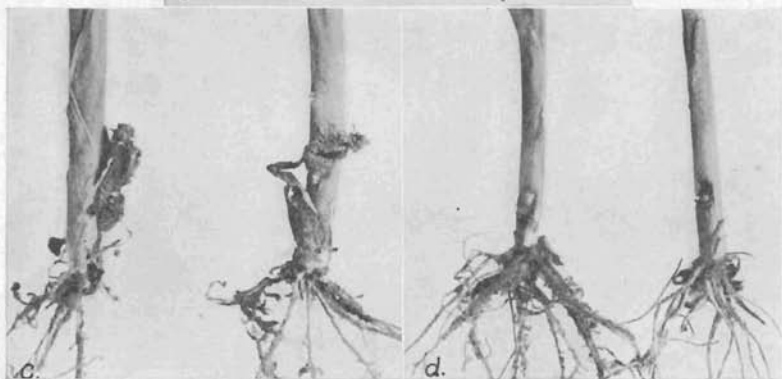
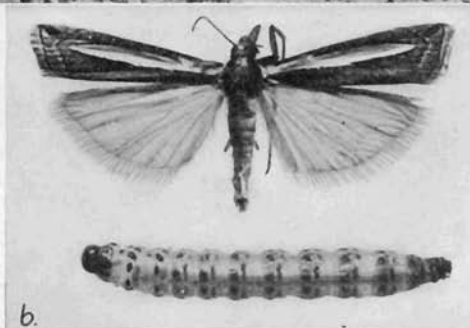
b. Adult of stalk borer.  
Natural size.



c. Immature stalk borer in corn. Natural size.

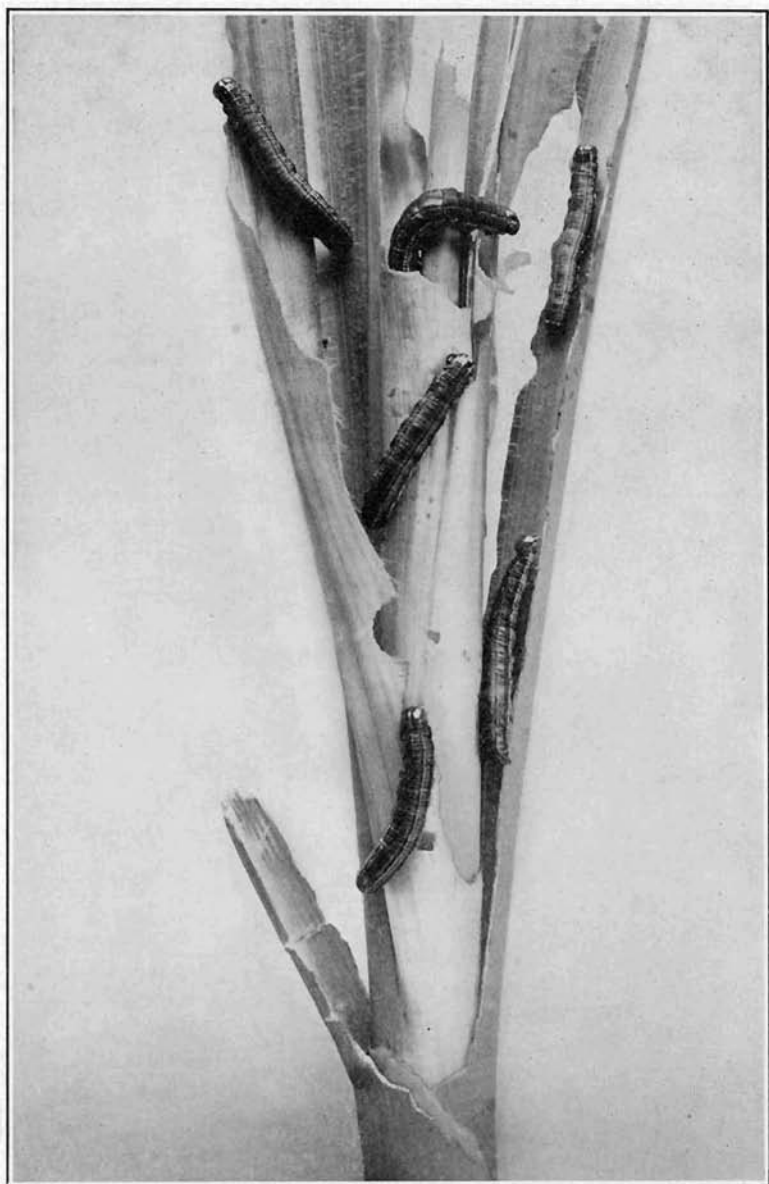


d. Characteristic form of injury caused by the young larvae feeding on the unrolled leaves at the whorl. Reduced.



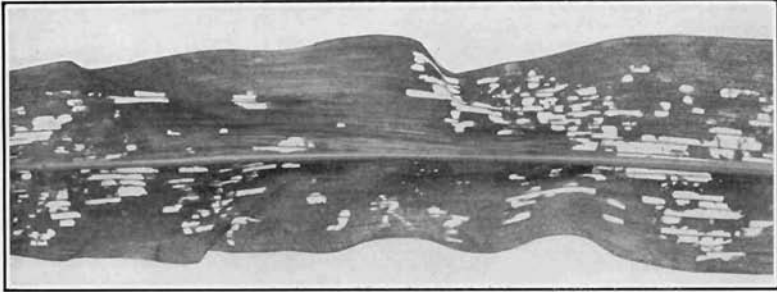
- a. Cornfield ruined by the attacks of the larvae.  
 b. Larva and adult. Four times enlarged.  
 c. Larval cases on base of stalks. Reduced.  
 d. Injury to stalks, cases removed. Reduced.

**CRAMBUS PRAEFECTELLUS.**

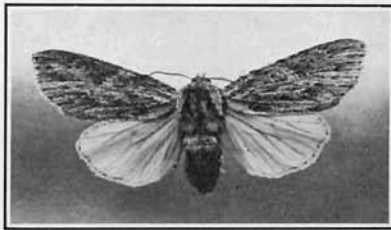


Larvae feeding on corn. Natural size.

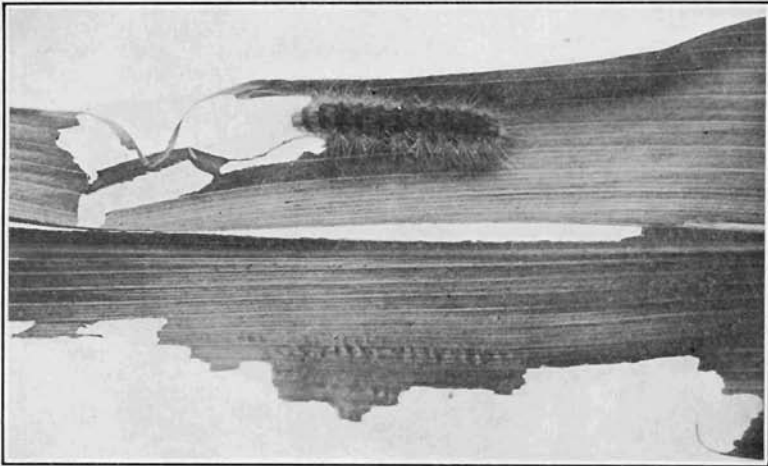
**THE ARMY WORM.**



a. Work of young larvae on corn blade. Much reduced.



b. Adult moth. Natural size.

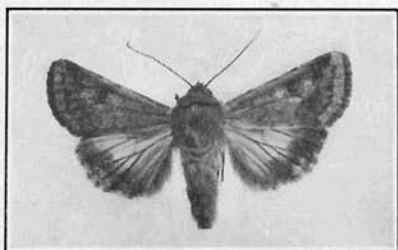


c. Partially grown larva feeding upon corn leaf. Natural size.

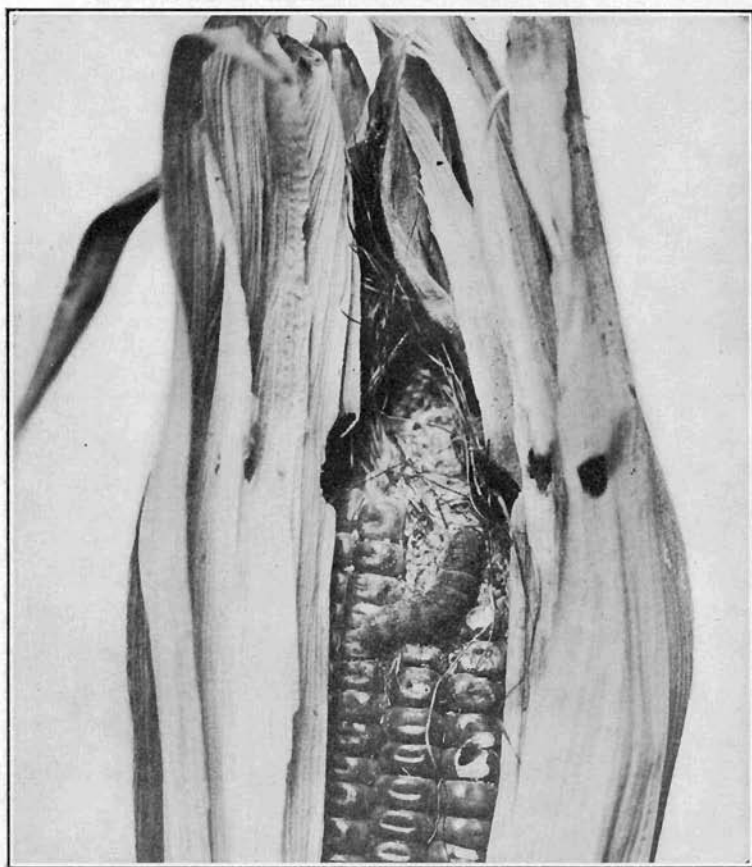
**THE SMEARED DAGGER MOTH.**



PLATE XXVIII.

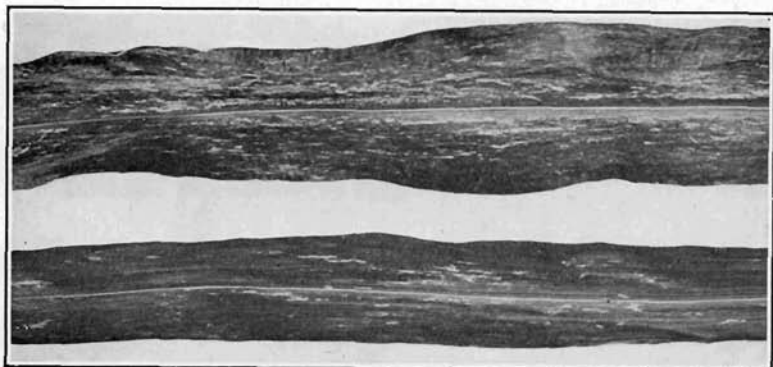


a. Adult moth. Natural size.

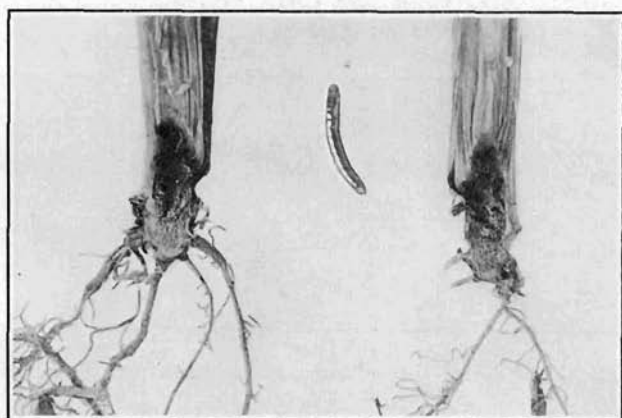


b. Larva feeding at tip of ear of corn. Natural size.

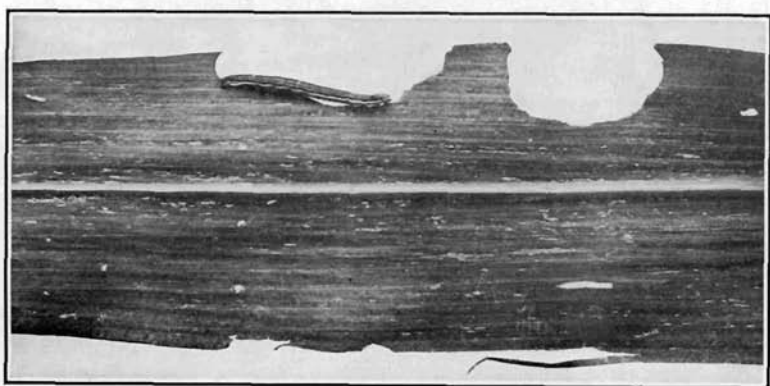
CORN EAR WORM.



a. Injury to leaves by the grass thrips. Much reduced.



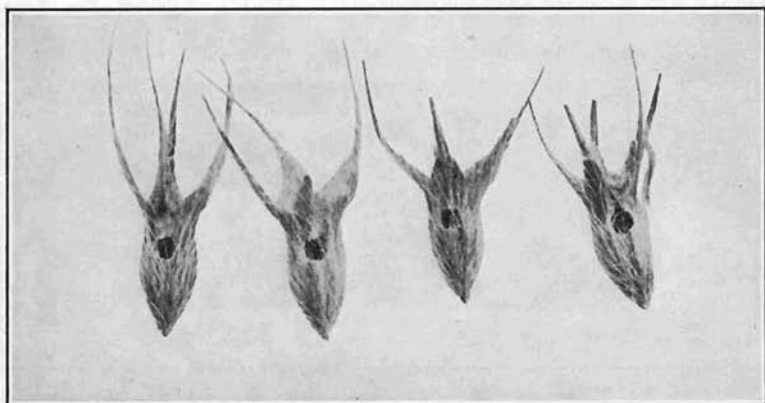
b. Injury by wire worms. Natural size.



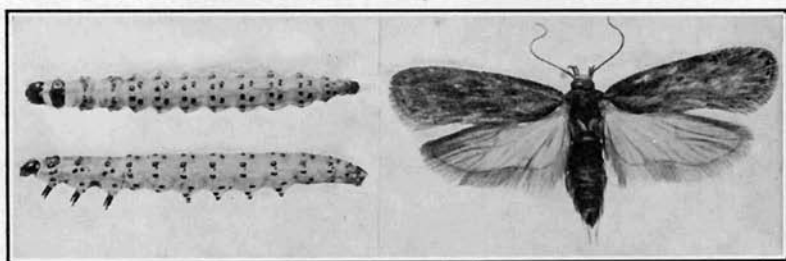
c. A slender green larva feeding upon corn. Unidentified. Natural size.

**CORN INSECTS.**

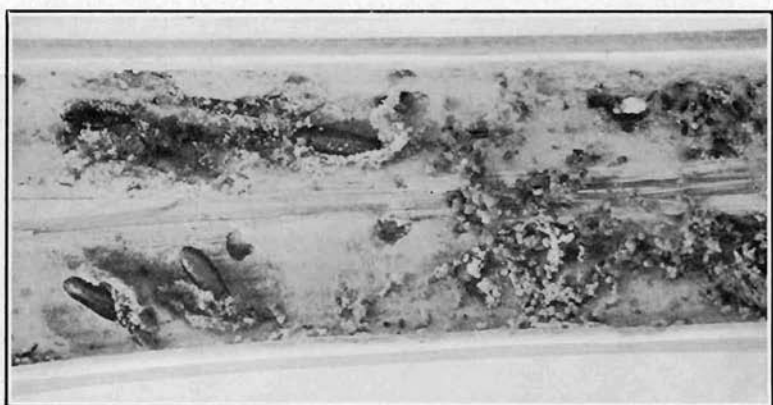
PLATE XXX,



a. Clover seeds showing exit holes of the clover seed chalcid.  
Four times enlarged.

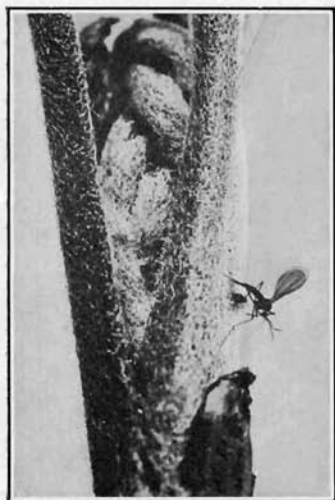


b. Lateral and dorsal view of larva, and adult of parsnip web worm.  
Twice natural size.

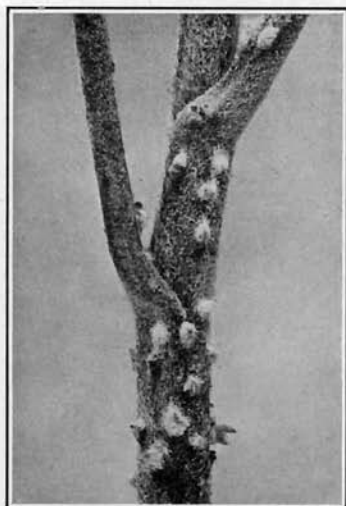


c. Inside of stalk of cow parsnip showing pupae of parsnip web worm.  
Natural size.

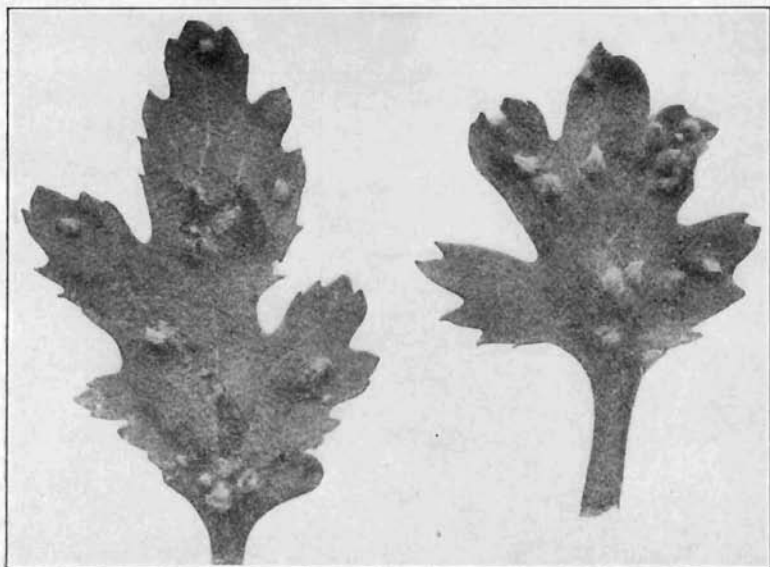
**CLOVER SEED CHALCID AND PARSNIP WEB WORM.**



a. Adult fly laying eggs.  
Three times enlarged.



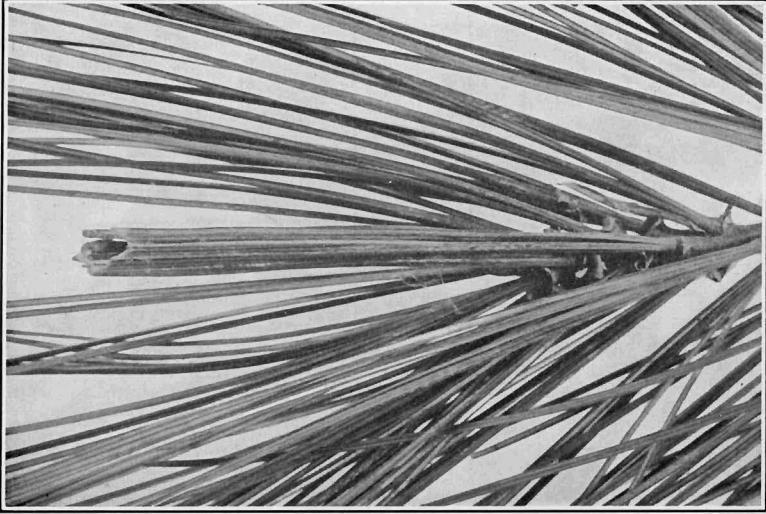
b. Galls on new shoot.  
Twice enlarged.



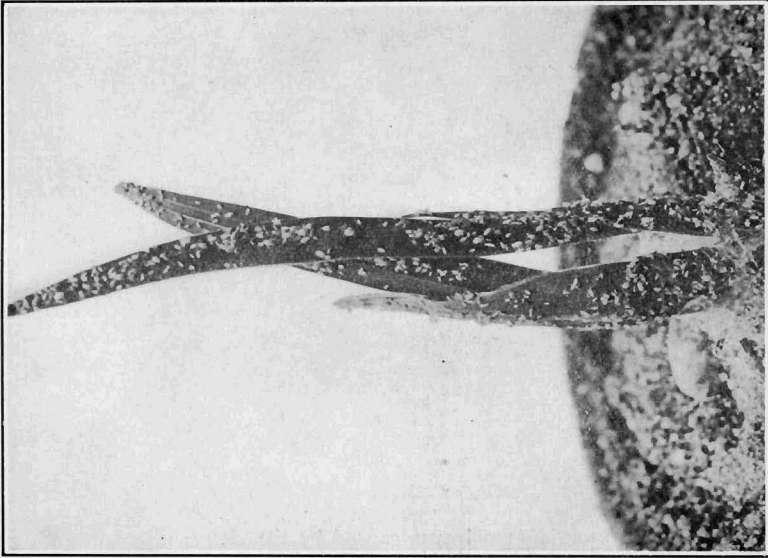
c. Galls on chrysanthemum leaves caused by the chrysanthemum gall midge. Twice natural size.

**CHRYSANTHEMUM GALL MIDGE.**

PLATE XXXII.



b. Characteristic work of the pine tube builder.  
Twice enlarged.



a. Gladiolus plant overcome by gladiolus aphid.  
Natural size.

PINE TUBE BUILDER AND GLADIOLUS APHID.