State of Connecticut

The Connecticut Agricultural Experiment Station

NEW HAVEN, CONN.

Bulletin 234

BEING THE

TWENTY-FIRST REPORT OF THE STATE ENTOMOLOGIST FOR 1921

W. E. BRITTON, PH.D.

TWENTY-FIRST REPORT

OF THE

STATE ENTOMOLOGIST

OF

CONNECTICUT

FOR THE YEAR 1921

(Being Bulletin 234, Connecticut Agricultural Experiment Station)

BY

W. E. BRITTON, PH.D.

State Entomologist

NEW HAVEN, CONN.

1922

CONNECTICUT AGRICULTURAL EXPERIMENT STATION

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January, 1922

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W. E. BRITTON, PH.D., *Entomologist in Charge; State Entomologist.*
B. H. WALDEN, B.AGR., M. P. ZAPPE, B.S., PHILIP GARMAN, PH.D. — *Assistant Entomologists.*
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P. C. MANGELSDORF, B.S., *Assistant.*

In charge of the Tobacco Station.
G. H. CHAPMAN, PH.D., Windsor, Conn.

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NOTE REGARDING AUTHORSHIP.

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BULLETIN 234

TWENTY-FIRST REPORT

OF THE

State Entomologist of Connecticut

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

Herewith, I transmit my twenty-first annual report as State Entomologist of Connecticut. The financial statements are for the State fiscal year ending June 30, 1921, but in other matters this report covers the activities of the department for the full calendar year of 1921. This publication contains reports on the various lines of regulatory work placed upon the office by Statute, such as inspecting nurseries, imported nursery stock, and apiaries, and suppressing the gipsy moth. It also includes articles dealing with the mosquito elimination work of the year, the asparagus beetles, injury to tobacco plants by the seed corn maggot, outbreak of the arbor vitae leaf-miner, the corn ear worm, investigations on the violet gall midge, and the European red mite, the tulip-tree scale, the terrapin scale, the pine leaf scale, the euonymus scale, and the cottony maple scale. Short articles and miscellaneous notes are given regarding many other insects.

Respectfully submitted,

W. E. BRITTON,
State and Station Entomologist.

REPORT OF RECEIPTS AND EXPENDITURES OF THE STATE ENTOMOLOGIST, FROM JULY 1, 1920, TO JUNE 30, 1921.

RECEIPTS.

From E. H. Jenkins, Treasurer	$7,500.00	
Account of 1920, Balance	850.44	
Transferred from Gipsy Moth Account by Board of Control	321.23	
State Comptroller, Gipsy Moth Account	148.87	
M. P. Zappe, Automobile mileage	11.16	
Interest on Bank Deposits	9.59	
		$8,841.29

EXPENDITURES.

For Field, Office and Laboratory Assistance:		
B. H. Walden, salary	$2,000.01	
M. P. Zappe, salary	1,949.98	

Philip Garman, salary	$2,166.71		
Gladys M. Finley, salary	895.50		
Other assistance	224.00		
		$7,236.20	
Printing and Illustrations		72.80	
Postage		90.72	
Stationery		33.06	
Telephone and Telegraph		2.33	
Office Supplies		59.36	
Library		122.25	
Laboratory Supplies		58.29	
Express, Freight and Cartage		5.01	
Tools and Supplies		77.43	
Traveling Expenses		316.30	
Insurance		92.98	
Automobile repairs and Equipment		669.56	
Miscellaneous		5.00	
			$8,841.29

MEMORANDUM:—This account has been audited by the State Auditors of Public Accounts. The item of $148.87 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 the work of inspecting imported nursery stock.

SUMMARY OF INSPECTION AND OFFICE WORK.

311 samples of insects received for identification.
97 nurseries inspected.
76 regular certificates granted.
30 duplicate certificates furnished to be filed in other states.
83 parcels of nursery stock inspected and certified.
65 orchards and gardens examined.
21 shipments, containing 126 cases, 1,228,560 plants, imported nursery stock inspected.
10 shipments or 47.6 per cent. found infested with insects or fungi.
751 apiaries, containing 6,972 colonies inspected.
30 apiaries and 88 colonies found infested with European foul brood.
19 apiaries and 39 colonies found infested with American foul brood.
2,067 letters written on official work.
108 circular letters.
192 post cards.
25 reports of inspection to Federal Horticultural Board.
1,505 bulletins, etc., mailed on request or to answer inquiries.
94 packages sent by mail or express.
29 lectures and addresses at institutes, granges and other meetings.

PUBLICATIONS OF ENTOMOLOGICAL DEPARTMENT, 1921.

By W. E. Britton:

Twentieth Report State Entomologist of Connecticut (Bulletin 226), 84 pages, 13 figures, 12 plates; 10,500 copies distributed in April, 1921.

Spray Now to Kill the European Red Mite, Bulletin of Immediate Information No. 13 (mimeographed), 3 pages, 600 copies distributed March 10, 1921.

Check-List of the Insects of Connecticut, Bulletin 31, State Geological and Natural History Survey, 397 pages, distributed in spring by State Librarian at Hartford.

The European Corn Borer, Report Connecticut Board of Agriculture for 1919-1920, page 92; 4 pages, 1921.

Report of Committee on Injurious Insects, Proceedings 30th Annual Meeting Connecticut Pomological Society, page 36.

Report of Committee on Insects and Diseases, Insects; Report Connecticut Vegetable Growers' Association, page 21, 1921.

First Report of the Tree Protection Examining Board (Bulletin 231), 12 pages, 11,500 copies distributed in November, 1921; 1,000 copies in the form of a separate to be used by the Board.

The House Fly as a Carrier of Disease Germs and How Controlled, 12 pages, 2 figures; published as an unnumbered bulletin of the State Department of Health. (Revised Edition.)

By W. E. Britton and G. P. Clinton:

Spray Calendar (Bulletin 224), 44 pages, 95 figures; 11,500 copies distributed in March, 1921.

By W. E. Britton and L. O. Howard:

William Hampton Patton, Entomological News, Vol. XXXII, page 33, February, 1921, 8 pages, 1 plate.

By B. H. Walden:

Progress of Anti-Mosquito Work in Connecticut, Proceedings 7th Annual Meeting New Jersey Mosquito Extermination Association, page 92, 1920.

By M. P. Zappe:

Aphis Control, Report Connecticut Board of Agriculture for 1919-1920, page 96, 1921.

By Philip Garman:

A Study of the Bulb Mite (Bulletin 225), 20 pages, 3 figures, 3 plates; 10,500 copies distributed in March, 1921.

The Grass-Feeding Frog-Hopper or Spittle-Bug (Bulletin 230), 12 pages, 3 figures, 2 plates; 10,500 copies distributed in November, 1921.

The Relation of Certain Greenhouse Pests to a Geranium Leaf Spot (Bulletin 239, Maryland Agr. Expt. Station), 30 pages, 7 figures, October, 1920.

The European Red Mite *Paratetranychus pilosus* Can. & Fanz., in Connecticut, Journal of Economic Entomology, Vol. 14, page 355, 1921.

By Philip Garman and F. L. Stevens:

The Genus *Septoria* Presented in Tabulation with Discussion, Trans. Ill. State Acad. Science, Vol. XIII, page 176, 44 pages, 1920.

DEPARTMENT STAFF AND WORK.

W. E. Britton, Ph.D., *State and Station Entomologist.*
B. H. Walden, B.Agr., *Photographic and General Work.* } *Assistant*
M. P. Zappe, B.S., *Inspection and General Work.* } *Entomologists.*
Philip Garman, Ph.D., *Research Work.* }
John T. Ashworth, *Deputy in charge of Gipsy Moth Work.*
James A. McEvoy, *Assistant in Gipsy Moth Work.*
Samuel T. Sealy, *Deputy in Charge of Mosquito Work.*
Miss Gladys M. Finley, *Clerk and Stenographer.*

H. W. Coley, Westport, } *Apiary Inspectors.*
A. W. Yates, Hartford, }

No changes in the personnel of the department staff have occurred during the year, except that Mr. Ashworth who was at first appointed acting deputy in charge of moth work has been promoted to deputy and his appointment made permanent, and Mr. McEvoy has been made assistant in gipsy moth work. Mr. Ashworth, who resides at Danielson, has been in charge of the field work of suppressing the gipsy moth in the eastern end of the State. This work has been done in co-operation with the Federal forces and is described more fully elsewhere in this report.

Mr. Walden has been in charge of the department in the absence of the Entomologist, has done a large part of the photographic work, has aided in making records of the results of the spraying and dusting experiments, and has made field and laboratory studies on the raspberry fruit worm, *Byturus unicolor* Say, and has continued collecting leafhoppers.

Mr. Zappe has been in charge of the inspection of nurseries and of imported nursery stock, and has co-operated with the botanical department in carrying out the series of orchard experiments in dusting and spraying for the control of the chief insect and fungous pests of apple and peach. Mr. Zappe has made studies on the life history of the false apple red bug, the apple leafhopper, the arbor vitae leaf-miner, and has devoted considerable time to rearranging the Coleoptera in the station collection.

Dr. Garman has devoted most of his efforts to research. He has finished a study of the bulb mite and the results were published as Bulletin 225. He has also made studies of the life history and control of the European red mite, *Paratetranychus pilosus,* a pest of orchards discovered in Connecticut last season. He has completed his study of the grass-feeding spittle-bug, and published the results as Bulletin 230. Other species of spittle-bugs (Cercopids) and the violet midge are now being studied. Dr. Garman is preparing a paper on the dragon flies (Odonata) of Connecticut, to be published by the State Geological and Natural History Survey, and the manuscript is nearly completed. Another paper dealing with the mites of Connecticut, also to be published by the Survey, is now in progress, but will require two or three years of study before it can be finished. Dr. Garman's work was interrupted in May by an operation for appendicitis, but he soon recovered and resumed work.

The Entomologist, in addition to the correspondence and other routine work, has devoted much time to the reading of proof on the Check-List of the Insects of Connecticut, which appeared in the spring as Bulletin 31 of the State Geological and Natural History Survey. This is a publication of 397 pages, and has met a favorable reception from entomologists. Much work on the manuscript of the Hemiptera of Connecticut, another paper to be published by the Survey, has been done during the year. All of

the necessary editorial work has been done in this office, and the Entomologist is the author of the manuscript of two families, the Aleyrodidae (white flies) and the Coccidae (scale insects). The entire manuscript is now nearly completed, the illustrations are almost finished and it is expected that it will go to the printer shortly. This paper is an important one, much needed in entomological literature which is now very much scattered, and the list of authors contains sixteen names, all specialists.

The Entomologist has devoted considerable time to the work of the Tree Protection Examining Board of which he is chairman. This Board examines applicants and issues certificates to those qualified who wish to conduct the business of protecting trees. The first report of this Board, prepared by the chairman, was published in the report of this Station for 1920, pages 339-350.

The Entomologist has also revised his bulletin on the house fly for the State Health Commissioner, and a new edition has been published.

Mr. Sealy has continued as deputy in charge of mosquito work, and has seen that the ditches have been maintained in each town receiving State aid, and has supervised the small amount of new work which has been done.

Miss Finley has continued to serve as clerk and stenographer of the department.

Messrs. Coley and Yates as heretofore have inspected the apiaries on a *per diem* basis.

From August 1 to September 10, Messrs. Frank D. Luddington, Edward R. Barton and Robert C. Botsford were employed to assist Mr. Zappe in the work of inspecting nurseries.

All members of the staff have worked faithfully and efficiently, and the Entomologist hereby expresses his appreciation of their services.

ENTOMOLOGICAL FEATURES OF 1921.

The preceding winter was one of the mildest on record, and spring came early. Vegetation was advanced two to three weeks ahead of normal, yet no warm weather came until late in May. On the whole it was rather cold and wet during the first half of the season, and though some crops could be started early, those needing a high temperature did not thrive in advance of the normal season. Corn and Lima beans had to be planted over and much seed was destroyed by seed maggots, low temperature and abundance of moisture in the soil.

Apples and pears were in full bloom on April 24, but the weather was cool with a number of cloudy and rainy days, making it unfavorable for bees to work the flowers. On May 12, there was a frost in some parts of the State which injured or entirely ruined the fruit crop, which on the whole was a light one.

The first half of the season was moist but August and September were months of light precipitation, and backward crops had a chance to mature as there were no early frosts.

One of the chief entomological features of the season was the discovery that the apple and thorn skeletonizer *Hemerophila pariana* Clerck, is now distributed nearly all over the State, and specimens were received from, or the work of the insects observed in, many localities. This insect is discussed in greater detail on page 186.

In the apple orchards everywhere, curculio injury was very prominent and it was particularly noticeable in our experiments in spraying and dusting apple orchards. One apple showed 40 curculio marks.

The tent caterpillar, which has been very scarce for several years, is on the increase again and may be expected to become prevalent soon.

The apple aphids were present in the orchards early in the season, but did not do much damage and soon disappeared.

The Oriental peach moth *Laspeyresia molesta* Busck, which was found at Stamford in 1918, has not been noticed in the State during the season, though the members of this department have been on the watch for it.

The peach borer *Synanthedon exitiosa* Say, has been very abundant and destructive during the year and tests of Paradichlorobenzene are now being conducted in the peach orchard at the Station farm for controlling this pest.

The fall canker-worm *Alsophila pometaria* Harr., seems to be on the increase again. Though usually locally abundant this pest has been comparatively scarce for the past three or four years.

San José scale *Aspidiotus perniciosus* Comst., which almost disappeared from orchards a few years ago, was noticeable on the fruit in several orchards in 1921, and was more abundant in nurseries than for several years.

There was practically no injury, at least in the orchards where our dusting and spraying experiments were conducted, from the attacks of the red-banded leaf-roller *Eulia velutinana* Walker, and the lesser apple worm *Enarmonia prunivora* Walsh. Both these insects were abundant in 1920, and caused considerable surface injury to the maturing fruit, late in the season.

The European red mite *Paratetranychus pilosus* Can. & Fanz., which was so injurious in certain orchards in 1920, was much less so in those same orchards in 1921, but was present and caused some damage in other places.

The apple maggot *Rhagoletis pomonella* Walsh, was present in about the usual proportions.

The false apple red bug *Lygidea mendax* Reut., was abundant locally as is the case nearly every year.

The apple seed chalcid *Syntomaspis druparum* Boh., was for the first time discovered in the State at Milford and Cornwall.

The brown-tail moth was not found anywhere within the State during 1921, and no portion of Connecticut is now quarantined on account of this insect.

Gipsy moth scouting this fall shows that there was a considerable wind-spread last May resulting in several towns being added to the infested area in Connecticut.

There was an outbreak of the arbor vitae leaf-miner *Argyresthia thuiella* Packard, around New Haven, and many trees were seriously injured.

The box leaf-miner or midge *Monarthropalpus buxi* Labou, was received from Norwalk.

The oyster-shell scale, *Lepidosaphes ulmi* Linn., continues to be the most prevalent insect pest found in nurseries, and though it infests apple orchards, does not injure them seriously in Connecticut. Many shade and forest trees and cultivated shrubs are attacked and severely injured, and occasionally killed by this insect. The trees and plants most commonly injured are ash, birch, silver maple, butternut, willow, poplar and lilac. It is thought by some entomologists that there are two species of oyster-shell scale, that found upon apple differing somewhat in appearance, as well as in times of hatching and moulting, and in the number of circumgenital pores, from the scale occurring on the other trees named above. Whether correct or not, it is a fact that much damage is done and that control measures must be practiced, especially in nurseries, in order to prevent the destruction of much infested stock annually. All badly infested trees or branches should be cut out and burned, and the remaining portions sprayed about June 10 (in Connecticut) with a contact insecticide like kerosene emulsion or nicotine soap solution to kill the young.

Another sucking insect which seems to be on the increase each year in the spruce gall aphid *Chermes abietis* Kalt. Norway and other kinds of spruces in nurseries are often infested and sometimes seriously injured. One nurseryman has controlled the pest by clipping off and burning the galls as soon as noticed. This practice kept up throughout the season gave good results, and the young trees were remarkably free from galls. Another method is to spray with a contact insecticide either in late fall or in early spring to kill the adults which live over winter on the twigs. At one nursery, for several seasons the spruces have been sprayed in early spring with Scalecide, one part in twenty parts water, with satisfactory results.

The seed corn maggot *Hylemyia cilicrura* Rond., caused serious injury to the newly-set plants in a tobacco field in Windsor in May. Wireworms also injured plants in some plantations.

The cabbage maggot *Chortophila* (*Phorbia*) *brassicae* Bouché,

was present in about the usual numbers and injured early-set plants. The cabbage aphid *Brevicoryne brassicae* Linn., was unusually abundant and infested nearly every field. As the infested plants fail to head or make only loose heads, considerable injury resulted.

The turnip aphid *Aphis pseudobrassicae* Davis, was prevalent during the season and injured turnips in various portions of the State.

The potato aphid *Macrosiphum solanifolii* Ashm., appeared in some fields but shortly disappeared without doing much damage. In one case at least the aphids disappeared after a heavy rain.

Perhaps the outstanding entomological feature of the season was the abundance of the corn ear worm *Chloridea obsoleta* Fabr., which was very prevalent in all parts of the State on late maturing corn, doing considerable damage. This invasion extended throughout all of the northeastern United States.

The asparagus beetle *Crioceris asparagi* Linn., was abundant and unusually destructive in 1921.

White grubs, *Phyllophaga sp.*, were reported as doing injury from several localities. In some cases they injured lawns, and in others they attacked corn and potatoes.

More detailed accounts of some of the most important of these insect pests will be found in the following pages.

INSPECTION OF NURSERIES.

This work was commenced on August 3, and finished on October 1: it was in charge of Mr. M. P. Zappe, who was assisted from August 1 to September 10, by Messrs. F. D. Luddington, E. R. Barton and R. C. Botsford. Mr. Walden inspected seven small nurseries, where certificates were needed, while the other inspectors were examining the larger nurseries.

The new Ford touring car was used by Mr. Zappe for this work, and on account of good weather satisfactory progress was made.

The general condition of the nurseries was found to be about the same as in 1920, some being clean and well cared for, and others showing signs of neglect.

Pests.

In 25 nurseries no pests were found. These were for the most part small nurseries and some were newly established, where with small-sized stock, pests have not yet become prevalent. The principal pests with the number of nurseries infested by each are given below:

Insects: Oyster-shell scale, 36; spruce gall aphid, 31; San José scale, 28; tulip-tree scale, 7; pine leaf scale, 7; scurfy scale, 6; rose scale, 4; *Chermes cooleyi*, 3; terrapin scale, 2; elm scale,

2; white elm scale, 2; euonymus scale, 1; imported pine sawfly, 2; rhododendron lace bug, willow borers, poplar borers, and white pine weevil, 1 each.

Plant Diseases: Poplar canker, 21; crown gall, 4; blister rust on currants, 2; fire blight, 1.

Comparing the above figures with those of last year, it will be noticed that San José scale was found in 28 nurseries instead of in 11 last year; spruce gall aphid in 31 instead of 21 last year, and the poplar canker was present in 21 nurseries as against 13 in 1920. In 25 nurseries instead of 46 last year no pests were found. The proportions of other infestations run about the same as in former years, the oyster-shell scale continuing in the lead.

Five new nurseries have been started during the year. Two of these were inspected in the spring and certificates issued, and they were again inspected in September. These are marked (2) after the names on the list. Two nurseries have gone out of business and the name of one has been changed. One did not clean out the infested stock in time to receive a certificate before this report went to the printer.

Eighty-three separate parcels of nursery stock have been inspected and certificates granted to accommodate shippers.

The nurseryman's list for 1921 contains 94 names, as follows:

NURSERY FIRMS IN CONNECTICUT RECEIVING CERTIFICATES IN 1921.

Name of Firm.	Address.	Acreage.	Certificate Issued.	No. of Certificate.
Barnes Bros. Nursery Co.	Yalesville	150	Aug. 25	1176
Barnes Nursery & Orchard Co.	Wallingford	20	Aug. 13	1165
Beattie, Wm. H.	New Haven	1	Sept. 6	1186
Benbow, A.	Norfolk	1	Oct. 29	1234
Bertolf Bros.	Sound Beach	25	Sept. 28	1207
Brainard Nursery & Seed Co.	Thompsonville	10	Aug. 31	1182
Braley & Co.	Burnside	1	Aug. 24	1170
Bretschneider, A.	Danielson	2	Aug. 25	1175
Bristol Nurseries, Inc.	Bristol	8	Oct. 3	1216
Burr & Co., C. R.	Manchester, Ellington and Durham	500	Aug. 26	1177
Burroughs, Thos. E.	Deep River	3	Sept. 20	1197
Canner Court Flower Garden Co.	New Haven	2	Sept. 20	1200
Chapman, C. B.	Groton	1	Oct. 8	1218
Chapman, C. E.	North Stonington	4	Oct. 3	1213
Conine Nursery Co.	Stratford	50	Sept. 3	1184
Conley, L. D.	Ridgefield	12	Sept. 29	1210
Conn. Agricultural College (Prof. S. P. Hollister)	Storrs	1	Aug. 25	1172
Conn. Agr. Experiment Station (W. O. Filley, Forester)	New Haven	1	Oct. 22	1229
Crofut & Knapp Farm	Norwalk	20	Dec. 19	1255
Cross Highway Nurseries	Westport	6	Nov. 10	1246
Dallas, Inc., Alexander	Waterbury	2	Oct. 20	1226
Dowd, F. C.	Madison	1	Sept. 15	1194

Name of Firm.	Address.	Acreage.	Certificate Issued.	No. of Certificate.
Elm City Nursery Co., Woodmont Nurseries, Inc.	Woodmont and New Haven	155	Aug. 31	1183
Evergreen Nursery Co.	South Wilton	11	Aug. 30	1180
Fairfield Landscape & Nurseries Co.	Cannondale	5	Nov. 7	1241
Falcon's Flight Farms Nursery (B. Austin Cheney, Prop.)	Litchfield	1	Nov. 7	1240
Gardner's Nurseries	Rocky Hill	1	Nov. 12	1247
Geduldig's Greenhouses	Norwich.	1	Oct. 26	1231
Glenn Terrace Ornamental Nursery (James H. Everett, Prop.)	Mount Carmel	4	Aug. 9	1164
Hartford Park Commissioners	Hartford	1	Nov. 4	1238
Heath & Co.	Manchester	5	Aug. 30	1179
Hilliard, H. J.	Sound View	1	Oct. 3	1213
Hiti Nurseries (J. H. Bowditch, Prop.)	Pomfret Center	8	Aug. 25	1171
Holcomb, Irving	Simsbury	1	Sept. 3	1185
Horan & Son, Jas.	Bridgeport	1	Nov. 3	1235
Houstons' Nurseries	Mansfield	4	Aug. 25	1174
Hoyt's Sons Co., Inc., The Stephen	New Canaan	300	Sept. 26	1205
Hunt & Co., W. W.	Hartford	10	Sept. 9	1187
Isselee, Charles	Darien	10	Oct. 21	1228
Kajok, George	New Haven	1	Sept. 16	1196
Kelley, James J.	New Canaan	1	Nov. 8	1245
Kellner, Herman H.	Danbury	1	Sept. 29	1211
Keso Nursery (J. J. Kelsey, Prop.)	Clinton	1	Sept. 15	1193
Ladd & Nichols, Inc.	Greenwich	2	Nov. 4	1237
Laddin's Rock Nursery (W. L. Marks, Prop.)	Stamford	5	Nov. 15	1248
Langenbach, F. J.	Norwich	1	Oct. 3	1215
Larkin, P. J.	New London	1	Oct. 14	1223
Long, Mrs. J. A.	East Haven	1	Oct. 10	1221
Mallett Co., George A.	Bridgeport	1	Nov. 4	1236
Maplewood Nurseries (T. A. Peabody, Mgr.)	Norwich	1	Oct. 3	1217
Marigold Farm (H. Kelley, Prop.)	New Canaan	4	Sept. 24	1204
Meier, A. R.	West Hartford	1	Nov. 7	1242
Millane Tree Expert Co., The	Middletown	1	Oct. 27	1232
Munro, Charles	New Haven	1	Dec. 31	1256
New Haven Nurseries Co., The	New Haven	10	Oct. 25	1230
New Haven Park Commissioners (G. X. Amrhyn, Supt.)	New Haven	30	Aug. 20	1168
New London Cemetery Association (Ernest E. Rogers, Pres.)	New London	1	Oct. 8	1220
New London County Nurseries (W. J. Schoonman, Prop.)	New London and Stonington	7	Oct. 15	1224
North-Eastern Forestry Co.	Cheshire	20	Aug. 9	1163
Norwalk Nursery	Norwalk	5	Sept. 26	1206
Oakland Nurseries	Manchester	5	Aug. 26	1178
Ouwerkerk & Van der Stam (2)	Yalesville	4	Sept. 29	1208
Palmer, Est. of L. M.	Stamford	5	Sept. 23	1203
Park Gardens	Bridgeport	1	Dec. 3	1252
Pequod Nursery Co.	Yalesville	15	Aug. 17	1167
Phelps, J. Wesson	Bolton	1	Aug. 25	1173
Phelps & V. T. Hammer Co., The J. W.	Branford	2	Dec. 9	1254
Pierson, A. N., Inc.	Cromwell	65	Aug. 22	1169
Polish Orphanage (Rev. L. Bojnowski, Mgr.)	New Britain	1	Sept. 20	1199

Name of Firm.	Address.	Acreage.	Certificate Issued.	No. of Certificate.
Pomeroy, Edwin C.	Northville	1	Sept. 29	1209
Quality Seed Store	Stamford	2	Nov. 8	1243
Reck, Julius	Bridgeport	1	Nov. 8	1244
Rockfall Nursery Co. (P. Marotta, Prop.)	Rockfall	10	Aug. 17	1166
Saxe & Floto	Waterbury	1	Sept. 16	1195
Scheepers, Inc., John	Sound Beach	10	Sept. 15	1191
Schleichert, F. C.	Bridgeport	1	Dec. 3	1253
Scott, J. W.	Hartford	5	Nov. 16	1249
Seely, C. H.	Darien	1	Nov. 16	1250
Sierman, C. H.	Hartford	5	Sept. 15	1190
South Wilton Nurseries	South Wilton	5	Aug. 30	1181
Stannard Hill Greenhouse (J. E. Brooks, Prop.)	Westbrook	1	Oct. 20	1227
Steck, Charles A.	Bethel	2	Oct. 13	1222
Stratfield Nursery Co.	Bridgeport	5	Nov. 28	1251
Traendly & Schenck	Rowayton	2	Nov. 5	1239
Upson, R. E.	Marion	1	Sept. 15	1192
Van Wilgen & Co.	Branford	4	Sept. 13	1188
Verkade's Nurseries	New London	8	Oct. 19	1225
Vidbourne & Co., J.	Hartford	7	Sept. 20	1198
Wallace Nursery	Wallingford	2	Oct. 27	1233
Watrous, Arthur J. (2)	Meriden	1	Sept. 29	1212
Wild, Henry	Riverside	2	Sept. 13	1189
Wilson & Co., C. E.	Manchester	18	Sept. 23	1202
Yale University Forest School	New Haven	1	Sept. 22	1201
Young, Mrs. Nellie A.	Pine Orchard	1	Oct. 8	1219
Total acreage		1,632		

INSPECTION OF IMPORTED NURSERY STOCK.

Though there has been a great decrease in the quantity of nursery stock entering Connecticut since Federal Quarantine No. 37 went into effect, in 1919, the amount received in 1921 considerably exceeded that of the preceding year, not only as regards the number of shipments but also the number of cases and plants, as the following figures show:—

Year.	No. of Shipments.	No. of Cases.	No. of Plants.
1920	17	87	814,491
1921	21	126	1,228,560

This stock was nearly all Manetti rose stock though a few cases contained fruit tree seedlings all of which is to be grafted or budded. Most of the inspection work was done by Mr. Zappe, only one shipment being inspected by Mr. Walden. The time required to make these inspections aggregates 185.5 hours or slightly less than a month of 26 working days of seven and one-half hours each. The cost, amounting to $173.13, was paid out of the appropriation for supressing gipsy and brown-tail moths and inspecting imported nursery stock.

The sources of this imported stock were as follows:

SOURCES OF IMPORTED NURSERY STOCK, 1920-1921.

	No. Shipments.	No. Cases.	No. Plants.
France	5	59	641,000
Holland	10	53	400,060
England	6	14	187,500
	21	126	1,228,560

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

Month.	No. Shipments.	No. Cases.	No. Plants.
December	7	28	307,750
January	9	56	560,565
February	3	32	296,000
March	1	4	27,245
April	1	6	37,000
	21	126	1,228,560

Two shipments (number of cases not given) containing 4,000 plants reached their destination and were unpacked and distributed by the consignee in the belief that they had been inspected at the port of entry, New York City. This was a mistake as the cases there were examined only by the custom house inspectors; but as notice of shipment was not sent to this office until after the stock had been distributed, it was not inspected.

One shipment of two cases and 30,000 plants was reshipped into New York State, and therefore was neither unpacked or inspected in Connecticut.

No attempt was made to inspect bulbs as was done in 1919, as this work is now done by Federal inspectors at the port of entry.

Of the 21 shipments, 10 shipments or 47.6 per cent. were found to contain insects or other animals, or plant diseases, some of which are well-known pests. Details of these infestations are as follows:—

PESTS FOUND ON IMPORTED NURSERY STOCK.

10 Shipments Infested.

INSECTS.

Calophasia lunula Hubn., pupa. (1 shipment) Louis Leroy's Nurseries, Angers, France.

Cryptophagid beetle on Manetti rose. (1 shipment) Louis Leroy's Nurseries, Angers, France.

Emphytus cinctus Linn. (5 shipments) A. M. Gielen, Oudenbosch, Holland; Vincent Lebreton's Nurseries, La Pyramide, France; Louis Leroy's Nurseries, Angers, France; T. Bidersons, Ltd., Farnham, England; King's Acre Nursery, Hereford, England.

Euproctis chrysorrhoea Linn. Brown-tail moth on apple seedlings. (3 shipments) Georges Benard, Orleans, France; Franco-American Seedling Co., Nantes, France.

Nest of Lepidopterous larvae. (1 shipment) Georges Benard, Orleans, France.

VERTEBRATE ANIMALS.

Frog. (1 shipment) A. M. Gielen, Oudenbosch, Holland.
Mice. (1 shipment) A. M. Gielen, Oudenbosch, Holland.

PLANT DISEASES.

Crown Gall on rose. (5 shipments) A. M. Gielen, Oudenbosch, Holland; Georges Benard, Orleans, France; King's Acre Nurseries, Hereford, England; S. Bide & Sons, Ltd., Patenham, England.

INSPECTION OF APIARIES.

This work has been conducted in the same manner as in preceding years, Mr. H. W. Coley of Westport inspecting in Fairfield, New Haven, Middlesex and New London Counties, and Mr. A. W. Yates of Hartford inspecting in Litchfield, Hartford, Tolland and Windham Counties, each being employed at the rate of six dollars per day and expenses.

Though the preceding winter was a mild one, and most bees gathered ample stores in 1920 to carry them through the winter, warm weather came early and started heavy brood rearing; this later led to starvation in unfed colonies which were short of food. This was the apparent cause of the most excessive swarming known in years, resulting in the increased number of colonies per apiary, for the inspections show that the apiaries are larger, the average being 9.2 instead of 6.5 colonies per apiary as in 1920. Thus in 1921, fewer apiaries were inspected than in 1920, yet the number of colonies was much greater, as the following figures show:—

Year.	No. Apiaries.	No. Colonies.	Average No. Colonies per Apiary.
1920	762	4,797	6.5
1921	751	6,972	9.2

In making these inspections, 122 towns were visited as against 119 towns in 1920. No apiaries have ever been inspected in the towns of Union (Tolland County) and Eastford (Windham County).

Inspections were made in the following 28 towns not visited in 1920:

Fairfield County: Bethel, Newtown and Redding. *New Haven County:* Ansonia and Oxford. *Middlesex County:* Killingworth and Portland. *New London County:* Groton, North Stonington, Old Lyme and Stonington. *Litchfield County:* Plymouth. *Hartford County:* Avon, Canton, Manchester, Windsor and Windsor Locks. *Tolland County:* Somers, Stafford, Tolland and Willington. *Windham County:* Ashford, Chaplin, Hampton, Pomfret, Putnam, Thompson and Woodstock.

On the other hand, inspections were made in 1920 in the following 25 towns, not visited in 1921:—

Fairfield County: Bridgeport, Brookfield, Darien, New Fairfield, Sherman and Weston. *New Haven County:* Bethany and East Haven. *New London County:* Colchester, Griswold and Voluntown. *Litchfield County:* Bridgewater, Canaan, Cornwall, Goshen, New Milford, Norfolk, North Canaan, Roxbury, Salisbury, Sharon and Torrington. *Hartford County:* Bloomfield, Hartland and Rocky Hill.

European foul brood has decreased each year since the inspection service was established in 1909, and in 1921 the percentage of infested apiaries was 3.99 instead of 4.3 in 1920. In 1921 this disease was found in the following 21 towns:

Fairfield County: Greenwich, New Canaan and Stamford. *New Haven County:* Cheshire, Hamden, New Haven, North Haven, Prospect and Wallingford. *Middlesex County:* Durham, Middletown and Saybrook. *New London County:* Old Lyme. *Litchfield County:* Thomaston. *Hartford County:* Manchester, New Britain, Southington and Windsor Locks. *Tolland County:* Coventry and Mansfield. *Windham County:* Pomfret.

American foul brood was present in 2.5 per cent. of the apiaries visited, and in .56 per cent. of the colonies as against 1.18 per cent. and .25 per cent. respectively for 1920. It appeared in 1921 in the following 11 towns:—

Fairfield County: Greenwich and Stamford. *New Haven County:* Derby, Hamden and Wallingford. *Middlesex County:* Durham. *New London County:* East Lyme. *Litchfield County:* Washington. *Hartford County:* Bristol and Simsbury. *Tolland County:* Mansfield.

The statistics of the apiaries inspected in 1921 in each of the 122 towns visited, are arranged by counties in the following pages, and summarized on page 131.

APIARIES INSPECTED IN 1921.

Fairfield County:	No. Apiaries Inspected.	No. Apiaries Diseased.	No. Colonies Inspected.	No. Colonies Diseased.
Bethel	9	0	65	0
Danbury	3	0	108	0
Easton	3	0	118	0
Fairfield	5	0	63	0
Greenwich	10	2	54	5**
Monroe	4	0	90	0
New Canaan	5	1	57	8†
Newtown	1	0	44	0
Norwalk	5	0	67	0
Redding	3	0	40	0
Ridgefield	2	0	44	0
Shelton	2	0	55	0
Stamford	21	3	263	5***
Stratford	2	0	26	0
Trumbull	4	1	45	1‡
Westport	6	0	80	0
Wilton	1	0	18	0
	86	7	1,237	19

†European Foul Brood.
**3 American Foul Brood and 2 European Foul Brood.
***3 American Foul Brood and 2 Sacbrood. ‡Sacbrood.

	No. Apiaries Inspected.	No. Apiaries Diseased.	No. Colonies Inspected.	No. Colonies Diseased.
New Haven County:				
Ansonia	4	0	27	0
Beacon Falls	1	0	22	0
Branford	4	1	31	1‡
Cheshire	4	2	44	4†
Derby	5	1	70	1*
Guilford	2	1	39	2‡
Hamden	5	2	36	3**
Madison	5	0	26	0
Meriden	26	0	215	0
Middlebury	1	0	40	0
Milford	1	0	45	0
Naugatuck	7	0	61	0
New Haven	5	2	42	9†
North Haven	5	1	55	25†
Oxford	1	0	12	0
Prospect	5	3	79	4†
Seymour	1	0	22	0
Wallingford	26	10	149	23***
Waterbury	7	0	49	0
Woodbridge	2	0	40	0
	117	23	1,104	72
Middlesex County:				
Chester	5	0	41	0
Clinton	3	0	29	0
Cromwell	6	1	39	1‡
Durham	8	3	159	6****
East Haddam	1	0	12	0
Essex	2	0	30	0
Haddam	3	0	26	0
Killingworth	2	0	11	0
Middlefield	4	0	55	0
Middletown	7	2	97	3†
Old Saybrook	2	0	28	0
Portland	6	0	9	0
Saybrook	3	1	13	1†
Westbrook	1	0	8	0
	53	7	557	11
New London County:				
Bozrah	2	0	22	0
East Lyme	3	1	48	3*
Franklin	4	0	29	0
Groton	5	0	26	0
Lebanon	2	1	21	1‡
Lisbon	1	0	12	0
Montville	1	0	4	0
New London	7	1	77	1‡

*American Foul Brood.
**2 American Foul Brood and 1 European Foul Brood.
***14 American Foul Brood and 9 European Foul Brood.
****3 American Foul Brood and 3 European Foul Brood.

	No. Apiaries Inspected.	Diseased.	No. Colonies Inspected.	Diseased
North Stonington	1	0	3	0
Norwich	10	0	510	0
Old Lyme	3	1	43	2†
Preston	2	0	8	0
Stonington	1	0	16	0
Waterford	4	0	29	0
	46	4	848	7
Litchfield County:				
Barkhamsted	3	0	71	0
Colebrook	2	0	13	0
Harwinton	1	0	6	0
Litchfield	1	0	10	0
Morris	4	0	32	0
New Hartford	1	0	6	0
Plymouth	4	0	7	0
Thomaston	14	1	97	1†
Washington	5	1	163	4*
Watertown	13	0	88	0
Winchester	17	0	88	0
	65	2	581	5
Hartford County:				
Avon	1	0	10	0
Berlin	21	1	187	1‖
Bristol	5	1	38	3*
Burlington	2	0	15	0
Canton	7	0	70	0
East Granby	8	0	43	0
East Hartford	12	0	75	0
East Windsor	11	0	110	0
Enfield	8	0	47	0
Farmington	17	0	90	0
Glastonbury	25	0	125	0
Granby	6	0	59	0
Hartford	23	0	130	0
Manchester	19	2	134	6†
Marlborough	2	0	32	0
New Britain	16	1	134	1†
Newington	8	0	78	0
Plainville	2	0	7	0
Simsbury	9	2	57	2*
Southington	16	1	153	1†
South Windsor	1	0	5	0
Suffield	8	0	66	0
West Hartford	21	0	118	0
Wethersfield	12	1	76	1‡
Windsor	17	0	102	0
Windsor Locks	2	1	14	1†
	279	10	1,975	16

‖Paralysis.

	No. Apiaries Inspected.	Diseased.	No. Colonies Inspected.	Diseased.
Tolland County:				
Andover	2	0	15	0
Bolton	3	0	16	0
Columbia	1	0	5	0
Coventry	8	1	83	1†
Ellington	15	0	73	0
Hebron	1	0	6	0
Mansfield	7	2	76	3**
Somers	5	0	29	0
Stafford	8	0	23	0
Tolland	4	0	27	0
Vernon	1	0	1	0
Willington	11	0	52	0
	66	3	406	4
Windham County:				
Ashford	1	0	8	0
Chaplin	1	0	5	0
Hampton	1	0	5	0
Pomfret	14	2	89	5†
Putnam	5	0	37	0
Thompson	8	0	42	0
Windham	3	0	39	0
Woodstock	6	0	39	0
	39	2	264	5

SUMMARY.

County.	No. of Towns.	No. Apiaries. Inspected.	Diseased.	No. Colonies Inspected.	Diseased.
Fairfield	17	86	7	1,237	19
New Haven	20	117	23	1,104	72
Middlesex	14	53	7	557	11
New London	14	46	4	848	7
Litchfield	11	65	2	581	5
Hartford	26	279	10	1,975	16
Tolland	12	66	3	406	4
Windham	8	39	2	264	5
	122	751	58	6,972	139

	No. Apiaries.	No. Colonies.
Inspected	751	6,972
Infested with European foul brood	30	88
Per cent. infested	3.99	1.26
Infested with American foul brood	19	39
Per cent. infested	2.5	.56
Sacbrood	8	11
Bee paralysis	1	1
Average number of colonies per apiary		9.2
Cost of inspection		$1,981.70
Average cost per apiary		$2.638
Average cost per colony		.24

**1 American Foul Brood and 1 with 1 colony Sacbrood and 1 European Foul Brood.

REPORT OF GIPSY MOTH WORK.

Season of 1920-1921.

By John T. Ashworth and W. E. Britton.

The policy pursued in former years has been continued in work against the gipsy moth. The co-operation between our men and those of the Federal Bureau of Entomology has been most satisfactory and has resulted in greater effectiveness than would be the case if any other system were followed. In general the Federal men have scouted those towns along the border of the infested territory to prevent further spread, while most of the State appropriation has been expended in the towns which were known to be infested.

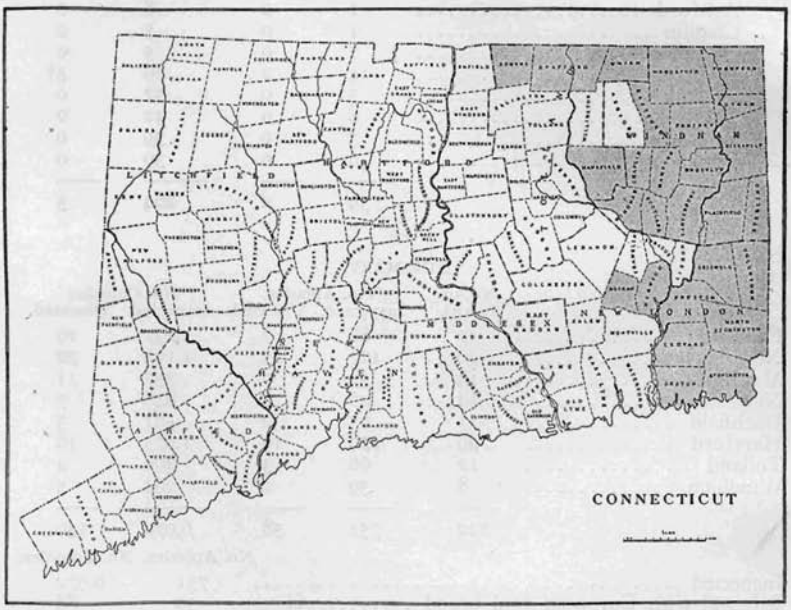

Figure 1. Map of Connecticut showing area now quarantined on account of the gipsy moth.

Mr. Ashworth was promoted to the position of deputy in charge of moth work, in place of Mr. Davis who resigned in June 1920, and has been in immediate charge of all field work. Mr. James A. McEvoy was promoted to the place of Assistant formerly held by Mr. Ashworth.

Infestations were found for the first time in the towns of Somers and Stafford. Mansfield, Windham, Groton and Ston-

ington, which were formerly infested, were not found infested in 1919-1920. Infestations have formerly occurred in Franklin and Sprague, but nothing was found in these towns in 1920. The quarantined area is shown on the accompanying map (see figure 1).

As in former years, single egg-clusters were not counted as infestations in the older and more heavily infested towns, but have been included in the border towns.

All of the work described in this report relates to the gipsy moth. The brown-tail moth has been very scarce for the past few years; though a watch has been kept for infestations, none were found and no control measures are needed at present in Connecticut.

New Equipment.

During the season of 1920-1921 some of the old equipment has been replaced by new. The Ford car that was converted into a truck in 1918, also the two purchased in 1919, were exchanged for two new Ford trucks with delivery bodies.

The Buick touring car bought in 1919, having been driven over 27,000 miles at a cost of about $30.00 for renewed parts, and quite a large outlay being needed in the near future, it was thought an act of economy to turn it in, and purchase a new one, which was done; this brings the motor equipment of the commission up to a high standard for the coming year.

One thousand feet of rubber-covered one-inch spraying hose was also purchased from the Acme Rubber Company of Boston, Mass., it being the policy of those in charge to renew some of the hose each year so as to keep a certain amount of hose on hand; no suction hose was bought as it was thought there was enough on hand at present.

Details of Gipsy Moth Work by Towns.

The following pages give a detailed account of the conditions in each town in the infested area:

Thompson—119 Infestations—2,605 Egg-clusters.

In scouting Thompson this season an agreeable surprise was met as we expected, on account of the deep snow of last year, to find an increase in the number of infestations this year; but instead there was a drop of 15 colonies and 1,737 egg-clusters. However, with this substantial drop, Thompson is still the most heavily infested town in the State.

Scouting was started in Thompson the last of December and finished the first of February, two crews working, one in the eastern and one in the western half of the town. The town is generally

infested throughout, although the northern part adjoining Massachusetts is more heavily infested. There were no very large colonies, but three may be noted as being the largest in the town. The first contained 96 egg-clusters, and was on land owned by the Grosvenordale Mill Co., and is situated on woodland about one-half mile northwest of the mill at Grosvenordale. The second contained 93 egg-clusters, on land owned by L. A. Logee, and situated about one mile west of the lower end of Quadick Reservoir, three apple trees and a stone wall being infested. The third contained 88 egg-clusters, and was on land situated on north side of railroad about three-quarters of a mile west of the road known as the Brandy Hill road, owned by E. C. Bixby. Of these colonies, 90 were sprayed by State crews during June.

Woodstock—33 Infestations—862 Egg-clusters.

The number of infestations in Woodstock was smaller this year than last, although the number of egg-clusters was nearly as great, there being a larger number of single egg-clusters located this year than ever before. This is due to the high winds of last spring. There were only two colonies large enough to mention, one containing 79 egg-masses on two large oaks in a pasture owned by H. I. Hibbard and located about one mile north of the North Woodstock store on the road to Southbridge, Mass., and about 50 yards west of the road. The second was located on land owned by Mr. Anderson just southeast of the Woodstock Fair grounds and consisted of 94 egg-masses on six oaks in a pasture. Twenty-seven of these infestations were sprayed during May and June, 51,400 gallons of poison liquid being used.

Union—32 Infestations—35 Egg-clusters.

Union was scouted by State men this year during April, and 32 infestations were found. All but two of these were single egg-clusters, and were scattered over the entire town. This condition is accounted for by the fact that there was a general wind spread to the west in Massachusetts, New Hampshire and Vermont last spring. The southern end of the spread seemed to end in northern Connecticut, as in the southern portion no trace of the gipsy moth was found west of Groton. No spraying was done in Union as it was thought unnecessary.

Stafford—11 Infestations—12 Egg-clusters.

Stafford was only partly scouted this year, as the men had to be withdrawn before the work was completed. In fact, the larvae were hatched, and feeding, before this was done. However the entire northern half of the town was covered. In all, about 54

miles of roadway were scouted. The result of this work was the finding of 11 colonies, all of which were single egg-masses except one. This contained two egg-masses, and was located in an apple orchard owned by Fred Bonden, situated about a quarter of a mile from the Massachusetts line, in the extreme northeastern corner of the town. Two of the colonies were sprayed by State men during June, as larvae were found feeding at these colonies.

Somers—2 Infestations—2 Egg-clusters.

Somers was the last town to be finished during the scouting season, Federal men doing the work. Two colonies of one egg-cluster each were found. At the one found in the orchard owned by C. H. Withington, larvae were found feeding, so a crew of State men were sent there and the colony was sprayed, 100 gallons of poison being used, after which no trace of the pest was found during the remainder of the season.

Putnam—37 Infestations—877 Egg-clusters.

Last year Putnam was scouted by men on snow-shoes, the snow in some places being so deep that they had no difficulty in going across country, as they could easily step over fences and walls. Therefore it can easily be seen that many egg-clusters were hidden from sight, and this condition explained the increase of colonies in Putnam. Most of these colonies are small, and the old (or hatched) egg-clusters were below the snow-line. Only three colonies are large enough to mention, the first being on land owned by George Page and located in some oak and apple trees, and stone walls in a pasture situated about half way between the Foster Hill road and State road from Putnam to Danielson, and contained 102 egg-clusters. The second contained 87 egg-clusters, and was found in woodland owned by Warren Bradway, near the Thompson line about two miles east of the Windham County Children's Home. The third contained 56 egg-clusters and was in woodland owned by Leverett Burrell about one mile northeast of East Putnam four corners. Thirty-five of the 37 colonies were sprayed during June by State men, and after spraying 189 larvae were found and destroyed.

Pomfret—8 Infestations—188 Egg-clusters.

Pomfret was scouted during November and December, only eight colonies of five egg-clusters or more each being found. Of these only two are large enough to mention, the first contained 56 egg-clusters. Fifty-three of them were old ones. All the egg-clusters at this colony were in a stone wall near a scrub apple tree in a pasture owned by H. Anderson, situated on the north side of the

road known as the Pomfret Landing road. It was very fortunate that the scout turned over a stone at the foot of the apple tree, as there was a pupa case on the under side of the stone, which led to the discovery of this colony. There was no trace of the gipsy moth on the trees or brush around there, but on looking over the wall the men found 56 egg-clusters. The second contained 23 egg-clusters and was in an old apple tree on land owned by Louis Daigle, situated in the northeast corner of the town, about one and one-half miles from the Putnam and Woodstock line. Five of the eight colonies were sprayed in the early part of May, and in looking over the colonies after spraying, seven of the 52 larvae found in the town were found and destroyed.

Eastford—6 Infestations—120 Egg-clusters.

Eastford was the first town scouted by the State men this year. The work was completed November 3d, a total of six infestations containing 101 egg-clusters, also 19 singles were discovered. Of these colonies only one is considered dangerous, that being the one on land owned by Mr. William Warren in woodland on the north side of the road leading east from the cemetery on State road from Phoenixville to Eastford, and containing 28 egg-clusters. The infested area this year is all in the northeastern part of the town or within two and one-half miles of Eastford Post Office. Only three single egg-clusters were found north of Crystal Pond. These were near the village of North Ashford, and in the section south of Phoenixville no trace of the gipsy moth was found. Five of the six colonies were sprayed during May.

Ashford—10 Infestations—13 Egg-clusters.

Ashford was scouted by State scouts the last of April and the first of May. Ten colonies were found, seven of these containing one egg-cluster each, and the other three had two egg-clusters each, all of which were new. This fact, as in other towns, is laid to the high northeast winds during the hatching season of 1920. No spraying was done as the men could not find any larvae, and it was not thought necessary.

Killingly—46 Infestations—653 Egg-clusters.

Killingly was scouted during the latter part of March and the first of April by State crews, two crews being used, one in the northern and one in the southern half of the town.

The results of scouting this year show a drop to less than half the number of egg-masses found last season. The whole town is generally infested throughout, and although no large colonies were discovered, three might be mentioned. The first and second are in woodland owned by John Kussino and Mrs. Cora Shekelton,

respectively, and located in the extreme northeastern corner of the town. The first contained 84 egg-clusters and the second 88 egg-clusters. The third colony was on land owned by T. E. Hopkins and contained 52 egg-masses. This colony was in woodland located on the south side of the old Hartford and Providence Turnpike, via East Killingly.

Forty-four of the colonies were sprayed during May and June; 6,505 larvae were destroyed in Killingly this year, very few of which were found after spraying.

Brooklyn—14 Infestations—232 Egg-clusters.

Brooklyn was scouted by State men this year as in previous years, and no large colonies were located, as can be seen by the large decrease in egg-clusters from the season of 1919, a drop of more than 50% in the total number of egg-clusters found. The infestations are all small and are distributed over the entire town. The largest is one of 29 egg-clusters, and is located on land owned by Mr. Oscar Atwood, situated on the top of Tatnic Hill. This colony is spread over about six acres, in which the brush and small trees have been cut and burned during the past two seasons. Twelve of the colonies were sprayed during the latter part of May by a State crew. One thousand, one hundred and eleven larvae were found in the town, 1,094 being located before spraying and 17 afterwards.

Hampton—4 Infestations—11 Egg-clusters.

State men scouted about two-thirds of this town, then as the eggs hatched early and larvae were crawling, the scouting work was stopped, and the men began applying tanglefoot bands. Four colonies were located, all small, the largest one contained six egg-masses and found on land owned by J. W. Cartwright, about one-half mile west of Hampton village. Two of the colonies were sprayed during June by Federal men.

Chaplin—6 Infestations—35 Egg-clusters.

Chaplin was scouted by Federal scouts this year during the early winter, and six colonies were found. Two of these are worthy of mention. One (Number 2) was in woodland owned by C. W. Morey of Hampton, and situated in the northeastern corner of the town, east of the Natchaug River. This colony contained 23 egg-clusters. The other (Number 3) was in woodland owned by H. H. Darling, about two miles north of the Chaplin Post Office, on the east side of the Ashford road; six egg-masses were found here. Two other colonies of two egg-masses each were also found. These four colonies were sprayed by Federal men in early June.

Mansfield—6 Infestations—5 Egg-clusters—1 Pupa.

Mansfield was scouted by Federal scouts. Six colonies were located, all of which were single egg-clusters except one, that being the one found in an orchard at the Connecticut Agricultural College, and consisted of one female pupa case.

During the month of June, State men went to Mansfield and visited these colonies and found larvae feeding at the colony on land owned by I. J. Wilcox at Merrow Station. One of the State sprayer trucks was sent out and sprayed the territory around this section, and no trace of the pest has been found there since.

Sterling—11 Infestations—139 Egg-clusters.

The scouting in Sterling was completed on December 18, by State men. Eleven infestations containing 92 egg-clusters, and 47 single egg-clusters, making a total of 139 egg-clusters, were found and destroyed. No large colony was found in the town, the largest containing only 16 egg-clusters, and was on land owned by Carl Gallup in the southwest corner of the town, near the Plainfield line. Although only 11 colonies were found, these and the singles were scattered over the entire town. At most of the colonies the trees were banded with tree tanglefoot as they were on high, wind-swept ground, and all of the colonies in Sterling were sprayed during the first of May by State crews. In all, 50 larvae were found and destroyed both before and after spraying.

Plainfield—26 Infestations—368 Egg-clusters.

Scouting was started the last of January and completed the first of March. Twenty-six colonies of five egg-clusters or more each, were located. None are large or dangerous. There are only two that contain over 25 egg-clusters, Number 6 and 7. Number 6 had 48 egg-clusters and was in an apple orchard owned by A. Dearnley and situated in the eastern edge of Plainfield village. Number 7 contained 27 egg-clusters in apple and shade trees on land owned by Edward Pike in Plainfield village.

The territory infested in Plainfield this year was mostly a belt across the entire town extending from Moosup west to the Canterbury line, at what is known as the Black Hill district, although there are two other small groups, one in the northwestern corner and another in the village of Plainfield. One hundred and ninety-four trees at the colonies most open to wind-spread were banded with tanglefoot, and during the latter part of May all but one of the 26 colonies were sprayed by State men. Six thousand, two hundred and three larvae were found and destroyed during the season, only 67 of which were found after spraying.

Canterbury—6 Infestations—127 Egg-clusters.

The scouting of Canterbury was completed on November 12 by State men. The colonies this year are practically in two groups, one in the southwest corner or the Woodchuck Hill district, and the other in the northwest section, near the Hampton line. The first group contained the largest colony found in the town, 51 egg-clusters, and was located in an old apple tree on land owned by Fred L. Hyde. This tree has been pruned and the brush cut and burned. Only three single egg-clusters were found in the eastern half of the town, these being near the Brooklyn line. None of the colonies are considered very dangerous. Thirty-three tanglefoot bands were used at the colonies where it was thought necessary, and during the middle of May, five of the colonies were sprayed.

Scotland—2 Infestations—2 Egg-clusters.

Scotland was scouted by Federal scouts, only two colonies of one egg-cluster each being located, one in the northeastern corner of the town, near the Hampton line, and the other about the center of the Scotland-Windham town line. No spraying was done in this town, but a close watch was kept of the colonies during larva season.

Windham—1 Infestation—1 Egg-cluster.

Windham was scouted by Federal men, one single egg-cluster being located in an apple tree on land owned by Mrs. Francis Campbell, situated in Windham Center, on road to South Windham. It was not thought necessary to spray here, but a close watch was kept of the colony during the summer season.

Voluntown—3 Infestations—45 Egg-clusters.

Voluntown was scouted this year by a State crew during February and the early part of March. All three colonies were found in the southern half of the town, the largest one containing only 23 egg-clusters, in woodland owned by L. B. and F. P. Kinne, situated about two miles south of Voluntown village and near the Griswold line. All three of the colonies were sprayed by State men in May, and in looking over the work during July, only one dead larva was found.

Griswold—7 Infestations—7 Egg-clusters.

Griswold was scouted by State men this year, during the last of March and the first of April. Seven colonies of one egg-

cluster each, were discovered. No spraying was done, as it was not thought necessary.

Preston—5 Infestations—11 Egg-clusters.

Federal men scouted most of Preston during the latter part of December and the first of January. Lack of funds compelled the stopping of the work on January 15. The work was taken up and completed by State men in March. A total of five colonies containing 11 egg-clusters was the result. Of these only one, containing six egg-masses, was thought serious enough for mention. This colony was in woodland owned by Albert Benjamin about two miles southeast of Long Society. This colony and another on land owned by Charles Prue, near Amos Lake, were sprayed the latter part of May by Federal men. Since spraying, the colonies have been inspected and no living larvae, but one dead one, found.

Norwich—5 Infestations—17 Egg-clusters.

Norwich was scouted by State men this year, five colonies being discovered. Two of these are worthy of mention. The first contained eight egg-clusters and was located on an oak on land owned by Charles O'Neill, situated about one mile west of what is known as East Great Plain. The second contained five egg-masses, and was on a large oak on land owned by Mrs. William B. Wilcox, situated about a mile and a half north of the Norwich Reservoir. These two and two others were sprayed during the first of June by a Federal crew.

Lisbon, Sprague, Bozrah, Franklin.

These towns were scouted by Federal crews and no trace of the gipsy moth was found.

North Stonington—9 Infestations—26 Egg-clusters.

North Stonington was scouted by Federal men in December and January. Nine infestations containing 26 egg-clusters were discovered, six of them being single egg-cluster infestations. The other three are described as follows: one contained three egg-clusters and was in an orchard owned by Frank Minor, situated about two and one-half miles west of the North Stonington Post Office, on the road to Ledyard. The second contained 10 egg-clusters, and was in an orchard owned by Dorice G. Lewis, situated in the southeast corner of the town, about a quarter of a mile from the Westerly, R. I., town line. The third was on an oak in a pasture owned by George Brown, situated near the west end of

Spalding Pond, and contained seven egg-clusters. The three colonies mentioned were banded, and sprayed in the summer by a Government sprayer.

Ledyard—3 Infestations—20 Egg-clusters.

As in the case of Preston, Ledyard was partly scouted by Federal men and finished by State men. The result was the finding of three colonies with a total of 20 egg-masses. Two of the colonies contained more than one egg-cluster each. The first was found in an orchard owned by A. J. Sheldon, on a high ridge just east of Rose Hill. This colony contained 17 egg-masses. The other colony was found in an orchard owned by F. Green situated on the west side of the road running north from Vinegar Hill, and contained two egg-masses. Both of the above-mentioned colonies were sprayed during May by Federal men.

Stonington—20 Infestations—29 Egg-clusters.

Stonington was scouted by Federal men. Twenty colonies were discovered, 18 of these being of one egg-cluster each, but as several of them were broken, the colonies were visited by State men during the larva season and close watch kept for signs of feeding and larvae. The largest of the other two colonies was found in an orchard owned by C. R. Johnson, situated on the road running over Hinkley Hill, about a mile west from the State line, and contained seven egg-masses. The other contained four egg-masses, and was in an apple tree on land owned by Harry Mitchell at 19 Mass St., Stillmanville. Both of these colonies were sprayed by Federal men, as was also one of the single egg-cluster colonies, where larvae had been located by State men.

Groton—11 Infestations—13 Egg-clusters.

Groton was partly scouted by Federal men in the early winter, about 15 miles of road being done by them. Later State men were sent to finish the town, and discovered 11 infestations, all except one of them being singles. This one consisted of three egg-clusters in white oaks and stone wall, on land owned by Carl Willis, and situated about a mile northwest of Pequot Hill. This colony was sprayed by Federal men the latter part of May.

New London—No Infestations—No Egg-clusters.

New London was scouted by State men during the latter part of March, and no trace of the gipsy moth found.

Waterford—No Infestations—No Egg-clusters.

Owing to the early season this year Waterford was not fully

scouted. About half (the eastern half) was scouted by State men during the last of March and the first of April, and so not having found any trace of the gipsy moth, the men were moved north.

Montville—No Infestations—No Egg-clusters.

As in the case of Waterford, Montville was only partly scouted this year. A line was drawn north and south through the town west of the village of Fair Oaks, and the territory east of that line was scouted by State men.No trace of the gipsy moth was located in this section of the town.

STATISTICS OF INFESTATIONS.

Town	No. of Infestations found	No. of Egg-Clusters destroyed	No. Tangle-foot bands applied	No. Colonies sprayed	Lead-arsenate used, lbs.	No. Larvae killed
Thompson	119	2,605	0	90	2,301	132
Woodstock	33	862	0	27	503¼	1,848
Union	32	35	0	0	0	6
Putnam	37	877	51	35	624¼	189
Killingly	46	653	174	44	981¼	6,505
Pomfret	8	188	61	5	94	52
Eastford	6	120	64	5	89	383
Brooklyn	14	232	177	12	234	1,111
Hampton	4	11	71	3	37¾	27
Ashford	10	13	0	0	0	0
Sterling	11	139	146	11	172	50
Plainfield	26	368	194	25	318½	6,203
Canterbury	6	127	33	5	81¼	577
Scotland	2	2	0	0	0	1
Windham	1	1	0	0	0	0
Chaplin	6	35	35	4	125	11
Mansfield	6	5 & 1 pupa	0	1	31	15
Voluntown	3	45	0	3	56¼	1 dead
Griswold	7	7	0	0	0	0
Preston	5	11	16	2	25	1 dead
Ledyard	3	20	27	2	6¼	357
Norwich	5	17	5	4	25	9
North Stonington	9	26	21	3	87½	24
Stonington	20	29	32	3	25	50
Groton	11	13	68	1	12½	0
New London	0	0	0	0	0	0
Waterford	0	0	0	0	0	0
Montville	0	0	0	0	0	0
Stafford	11	12	0	2	4	20
Somers	2	2	0	1	6¼	25
Lisbon	0	0	0	0	0	0
Sprague	0	0	0	0	0	0
Bozrah	0	0	0	0	0	0
Franklin	0	0	0	0	0	0
27 Towns Infested	443	6,455*	1,175	288	5,840	17,597

*Plus one pupa.

In comparing the statistics in the foregoing table, with corresponding figures for last year, it will be seen that the number of infestations, number sprayed, and number of larvae destroyed, are somewhat greater, though the number of egg-clusters destroyed is less than last year. It will be seen that no infestations were found in the towns of New London, Waterford, Montville, Lisbon, Sprague, Bozrah and Franklin, though Bozrah was infested last year and is still included in the quarantined area shown in figure 1.

The newly infested towns of Somers and Stafford adjoin Massachusetts, and the pest has spread into these towns from Massachusetts.

The following table gives the grand totals of the statistics of the infestations for the past five years:—

TOTALS OF THE INFESTATIONS FOR FIVE-YEAR PERIOD.

Year	Total No. of Infestations	No. of Egg-Clusters Destroyed	No. Tanglefoot Bands Applied	No. of Infestations Sprayed	No. of Larvae Destroyed
1916	210	3,135	13,165	60	31,671
1917	1,257	6,182	17,690	91	37,800
1918	870	18,393	3,298	392	2,852
1919	312	8,144	3,044	212	12,188
1920	350	9,224	2,314	236	7,612
1921	443	6,455	1,175	288	17,597

PARASITES.

A full account of the parasites colonized in Connecticut may be found in the Report of this Station for 1920, page 162. As mentioned therein, it is the policy of those in charge of control work in the State to liberate parasites or natural enemies in sections of the State where there is infestation enough to warrant it. This year, through the courtesy and co-operation of Mr. S. S. Crossman of the Federal laboratory at Melrose, Mass., we were enabled to liberate another egg parasite, *Schedius kuvanae* How., in the northeastern part of the State. The following table gives the names of the towns, and number of parasites liberated in each:

Thompson,	768,000
Putnam,	386,465
Woodstock,	337,960
Killingly,	106,350

These figures show a total of 1,598,775 of these little workers which were liberated in the most thickly infested territory in the State. Although very minute they are very active. It was reported by Mr. McEvoy, who liberated them, that as soon as free, they started to work immediately on egg-masses in the immediate vicinity, 81 being counted on one egg-cluster. From observa-

tions and statistics gathered in the southern part of Massachusetts, an average of 40 per cent. of the eggs gathered in five towns were parasitized, so great things are expected of this parasite.

Financial Statement.

RECEIPTS.

Appropriation for biennial period ending June 30, 1921		$70,000.00
Expended, year ending June 30, 1920	$33,081.11	
Transferred to Insect Pest Account by Board of Control	321.23	33,402.34
Amount available for year		$36,597.66

CLASSIFIED EXPENDITURES FOR THE YEAR ENDING JUNE 30, 1921.

Salaries and Wages:			
John T. Ashworth	$1,800.00		
J. A. McEvoy	1,500.00		
K. E. Buffington	1,316.60		
F. C. Rich	1,206.44		
W. P. Colvin	1,136.40		
C. W. Roth	1,067.90		
J. W. Longo	995.63		
D. La Belle	983.39		
A. J. Gilbert	982.16		
R. G. Newton	980.10		
T. J. Perreault	952.53		
E. Fortin	941.47		
J. W. Thomas	938.60		
D. J. Mondor	898.32		
H. F. Wheeler	879.28		
H. Sweet	697.32		
H. Woodmancy	680.48		
J. H. Higgins	672.56		
H. E. Cook	658.96		
O. Fortin	650.68		
R. A. Spencer	456.56		
J. L. Knight	391.04		
R. Franklin	358.35		
J. Mills	324.60		
Other Labor	4,011.78		
		$25,481.15	
Printing and Illustrations		19.74	
Postage		11.77	
Stationery		2.47	
Telegraph and Telephone		6.55	
Office Supplies		64.05	
Express, Freight and Cartage		92.96	
Machinery, Tools and Supplies		2,461.81	
Insurance		861.37	
Rental and Storage		313.50	
Traveling Expenses, Gasoline, Oil, etc.		1,877.43	
Automobile Repairs, Tires, etc.		3,762.05	
Inspection of Imported Nursery Stock		173.13	
Heat and Light		47.77	
Miscellaneous		12.75	
Total		$35,188.50	
Balance, unexpended			$1,409.16

Quarantine Inspections.

Federal quarantines have been established over the infested territory as is shown by the accompanying map, figure 1, page 132. All nursery stock, forest and quarry products shipped from the quarantined area outside of the area into other states must be inspected and certified by Federal inspectors. This applies only to interstate shipments.

In 1920, the State of Connecticut established quarantines on the same area that is covered by the Federal quarantines, so that nursery stock and forest products going from the infested area into uninfested parts of the State, cannot be shipped unless inspected and certified as with the interstate shipments. The Federal inspectors have made most of the inspections, and there have been 527 shipments of forest products and 23 of nursery stock inspected and certified. The present law gives no authority for quarantining quarry products.

NOTES ON THE EUROPEAN RED MITE.

Paratetranychus pilosus C. & F.

By Philip Garman, Ph.D.

In the spring of 1921 a number of spray materials were tested for control of the European red mite in the egg stage. A general report of the work was given by Dr. Britton in Bulletin of Immediate Information Number 13. More complete records are given herein together with a few observations on the habits of the mite which appear to be important.

Eggs began hatching in the field April 13, 1921, at which time apple leaves were about one inch long and the delayed dormant sprays had been applied in most orchards. Mites from eggs which hatched April 13 were observed frequently until May 12, 1921. On May 9 adult males and females were seen, but no eggs. On May 12, the mites began to deposit eggs. Here was a period of a month before egg-laying began. The time for the pink bud application fell about April 21 in 1921, and if applied at this time would have had considerable value in killing the mites. If made later in the season, nicotine-lime-sulphur sprays are less effective unless repeated several times, because of the presence of eggs. Sprays applied then are less likely to be thorough because of increased foliage and are more costly since more spray is required. This is confirmed in part by field tests made in 1920.[1]

An unexpected turn of affairs became evident in early summer, 1921, when it was found that orchards in which the mites had been particularly destructive in 1920, had few, whereas in other orchards, having few in 1920, they became abundant: and this in spite of spraying operations or the lack of them. Such a condition may be attributed to adverse weather conditions which included a rather dry fall, mild winter and early spring with continued cool weather until June; or it may be due to the appearance of numbers of predaceous mites in 1920. The latter is a more plausible explanation in view of the fact that red mites were abundant in 1921 in orchards where they were not numerous in 1920. These orchards might easily have had fewer predaceous enemies than the more heavily infested ones, but they could not easily have been subjected to different weather conditions.

The tests tabulated below were conducted in the laboratory, the twigs being kept in moist jars, and were checked with similar tests in which the twigs were hung outside in the branches of a small apple tree. Twigs with eggs were selected, cut into short lengths, examined with a binocular and clear or dead eggs removed with a needle. The twigs were then dipped in or sprayed with the desired solution.

[1] Report Conn. Agr. Expt. Station for 1920, page 189.

In the tables, the names of a number of proprietary compounds appear, and the following explanation in regard to their general composition and source is necessary. Such compounds as lime-sulphur, B. T. S., and Scalecide are too well known to need comment.

"Jarvis Compound."—A miscible oil containing phenol; manufacturer J. T. Robertson; obtained from Apothecaries Hall Co., Waterbury, Conn.

"Kero-spray."—A commercial kerosene emulsion; manufacturer, Kero-Spray Co., 198 9th St., Jersey City, N. J.

"Keresol."—An oil spray containing 70 per cent. kerosene; obtained from Mr. A. A. Claasen, Mascher and Turner Streets, Philadelphia, Pa; effect of spray on trees unknown.

"Sulco V. B."—A spray containing fish-oil and small per cent. phenol; manufactured by Cook & Swan Co., 148 Front St., New York; obtained from Apothecaries Hall Co., Waterbury; effect on apple trees unknown, probably safe.

"Wormol."—A miscible oil recommended for use against peach borers by the General Chemical Company; obtained from General Chemical Company, 25 Broad St., New York, N. Y.; effect upon apple trees unknown.

TABLES SHOWING RESULTS OF TREATING EGGS OF EUROPEAN RED MITE WITH DIFFERENT INSECTICIDES.

TABLE I.

Exp. No.	Treatment	Total Number of Eggs Used	Number Hatched	Per Cent. Hatched	Date Treated	Date Examined
1.	Kerosene emulsion (10 per cent. kerosene)	660	402	60.9	Mar. 16	Apr. 29
2.	Kero-spray 1 part-25 parts water	298	166	56.0	"	"
3.	Sulco V. B. 1 part-25 parts water	502	255	50.7	"	"
4.	Keresol 1 part-18 parts water	442	265	59.9	"	"
5.	Jarvis Compound 1 part-15 parts water	104	6	5.7	"	"
6.	Scalecide 1 part-15 parts water	237	22	9.2	"	"
7.	Lime-sulphur 1 part-9 parts water	652	253	38.8	"	"
8.	Dry lime-sulphur 12 lbs.-50 gals. water	418	125	29.9	"	"
9.	B. T. S. 12 lbs.-50 gals. water	349	162	46.4	"	"
10.	Scalecide 1 part-25 parts water	341	115	33.7	"	"
11.	Check no treatment	265	151	56.9	"	"
12.	Scalecide 1 part-15 parts water	150	8	5.3	Apr. 7	Apr. 29

Exp. No.	Treatment	Total Number of Eggs Used	Number Hatched	Per Cent. Hatched	Date Treated	Date Examined
13.	Scalecide 1 part-15 parts water	669	9	1.3	Apr. 7	Apr. 29
14.	Scalecide 1 part-35 parts water	838	53	6.3	"	"
15.	Scalecide 1 part-25 parts water	744	68	9.1	"	"
16.	Scalecide 1 part-50 parts water	462	47	10.1	"	"
17.	Check no treatment	253	164	65.0	"	"
18.	Check no treatment	100	45	45.0	"	"

TABLE 2.

	Lime-sulphur 1-9					
1.	Nic. Sulphate 1-500	649	189	29.1	Dec. 29	Feb. 23
2.	" " "	2,166	544	25.1	Feb. 8	Mar. 2
	Lime-sulphur					
3.	1 part-9 parts water	403	45	11.1	Apr. 5	Apr. 15
4.	" " "	378	18	4.7	Mar. 12	Mar. 28
5.	" " "	773	268	34.6	Dec. 29	Feb. 23
	Lime-sulphur 1-9					
6.	Nic. Sulphate 1-500	165	80	48.4	Apr. 13	Apr. 28
7.	" " "	221	54	24.4	Apr. 13	Apr. 29
	Lime-sulphur					
8.	1 part-9 parts water	526	351	66.7	Dec. 29	Apr. 28
9.	" " "	652	253	38.8	Mar. 16	Apr. 29
10.	" " "	449	132	29.4	Feb. 17	May 3
11.	" " "	299	83	27.7	Mar. 10	May 2

TABLE 3.

	Dry lime-sulphur					
1.	½oz.-1 pint water	302	114	37.7	Apr. 5	Apr. 15
2.	" " "	274	6	2.1	Mar. 12	Mar. 28
3.	" " "	197	74	37.5	Mar. 4	Mar. 25
4.	" " "	418	125	29.9	Mar. 16	Apr. 29

TABLE 4.

	B. T. S.					
1.	½ oz.-1 pint water	1,047	368	35.2	Feb. 8	Mar. 2
2.	" " "	374	124	33.2	Apr. 5	Apr. 15
3.	" " "	438	35	7.9	Mar. 12	Mar. 28
4.	" " "	234	34	14.5	Mar. 4	Mar. 25

Notes.

Table 1. Eggs in tests 1-11 were taken from the same branch. Those in 12-18 were from another branch. All eggs dipped in the different solutions, not sprayed.

Table 2. Nos. 1-5 were kept indoors after treatment; 6-11 outdoors. Nos. 5 and 6 were sprayed, others dipped.

Table 3. Nos. 1-3 kept indoors, 4 outdoors.

Table 4. Nos. 1-4 kept indoors, 5 and 6 outdoors.

Exp. No.	Treatment	Total Number of Eggs Used	Number Hatched	Per Cent. Hatched	Date Treated	Date Examined
5.	½ oz.-1 pint water B. T. S. ½ oz.-1 pt. water	349	162	46.4	Mar. 16	Apr. 29
6.	N.S. 1 part-500 parts water	282	126	44.6	Apr. 5	Apr. 29

TABLE 5.

1.	Scalecide 1-15[1]	773	27	3.5	Dec. 29	Feb. 23
2.	" 1-15	1,078	0	0.0	Feb. 8	Mar. 2
3.	" 1-15	412	0	0.0	Apr. 5	Apr. 15
4.	" 1-15	67	0	0.0	Mar. 12	Mar. 28
5.	" 1-25	173	0	0.0	Mar. 16	Apr. 4
6.	" 1-50	356	11	3.0	Mar. 16	Apr. 4
7.	" 1-15	119	0	0.0	Mar. 4	Mar. 25
8.	" 1-15	409	135	33.0	Dec. 29	Apr. 28
9.	" 1-15	104	6	5.7	Mar. 9	Apr. 29
10.	" 1-25	341	115	33.7	Mar. 9	Apr. 29
11.	" 1-50	150	8	5.3	Apr. 7	Apr. 29
12.	" 1-15	669	9	1.3	Apr. 7	Apr. 29
13.	" 1-25	744	68	9.1	Apr. 7	Apr. 29
14.	" 1-35	838	53	6.3	Apr. 7	Apr. 29
15.	" 1-50	462	47	10.1	Apr. 7	Apr. 29
16.	" 1-15	326	55	16.8	Feb. 17	May 3

[1] Proportions of Scalecide to water.

TABLE 6. (CHECKS)

Exp. No.	Total Number of Eggs Used	Number Hatched	Per Cent. Hatched	Date Obtained	Date Examined
1.	1,956	345	17.6	Dec. 29	Feb. 23
2.	527	263	49.9	Feb. 9	Mar. 4
3.	60	45	75.0	Feb. 10	Mar. 4
4.	2,421	1,477	61.0	Feb. 8	Feb. 23
5.	334	326	97.6	Apr. 5	Apr. 15
6.	359	324	90.2	Apr. 8	Apr. 28
7.	208	185	88.9	Mar. 4	Mar. 25
8.	402	223	55.4	Mar. 10	Mar. 28
9.	403	333	82.6	Mar. 11	Mar. 28
10.	430	342	79.7	Mar. 12	Mar. 28
11.	255	209	81.9	Mar. 16	Apr. 4
12.	421	181	42.9	Dec. 29	Apr. 28
13.	265	151	56.9	Mar. 16	Apr. 29
14.	253	164	64.8	Apr. 7	Apr. 29
15.	100	45	45.0	Apr. 7	Apr. 29
16.	162	109	67.3	Apr. 13	Apr. 28
17.	120	20	16.6	Apr. 4	Apr. 28
18.	155	85	54.8	Apr. 5	Apr. 29
19.	531	337	63.4	Feb. 17	May 3
20.	188	114	60.6	Mar. 10	May 2

Notes.

Table 5. Tests 1-7 were kept indoors after treatment; 8-16 were kept outdoors. Numbers 10-15 were sprayed, others were dipped in spray solutions.

Table 6. Eggs listed here were not treated with any insecticide. Numbers 1-11 were kept indoors in moist jars; 12-20 outdoors.

COMPARATIVE MORTALITY OF TREATED EGGS OF EUROPEAN RED MITE, KEPT OUTDOORS AND INDOORS AFTER TREATMENT.

TABLE 7.

Treatment	Hatched Per Cent.	Possible Kill Per Cent.	Number of Eggs Used	
Check, no treatment	61.0	0	7,355	Indoors
	54.9	0	2,195	Outdoors
Kero-spray	86.5	0	445	Indoors
	55.7	0	298	Outdoors
Sulco V. B.	49.9	18.6	879	Indoors
	48.0	12.5	958	Outdoors
Keresol	34.2	44.0	385	Indoors
	59.9	0	442	Outdoors
Linseed oil Emulsion	56.0	8.4	841	Indoors
	26.1	52.5	352	Outdoors
B. T. S.	26.7	56.3	2,093	Indoors
	45.6	16.8	631	Outdoors
Lime-sulphur; liquid 1-9	22.1	63.8	3,596	Indoors
	43.1	21.4	2,515	Outdoors
Lime-sulphur; dry	25.0	59.0	773	Indoors
	29.9	45.5	418	Outdoors
Kerosene emulsion	31.6	48.2	227	Indoors
	60.9	0	660	Outdoors
Wormol, 1 part in 15 parts water	5.4	91.1	419	Indoors
	14.7	73.2	292	Outdoors
Scalecide	1.2	98.1	2,978	Indoors
	9.9	81.8	4,043	Outdoors
Jarvis Compound	0	100	792	Indoors
	6	89.1	104	Outdoors

Notes.

Table 7. The percentages in the column headed "possible kill" were obtained by comparing each with the check hatch, obtaining the actual hatch, and subtracting this number from 100, thereby obtaining the per cent. killed. Where the per cent. hatched is higher than the check it is obvious that the insecticide has no killing power.

Summary of Various Treatments.

TABLE 8.

Exp. No.	Treatment	Hatched Per Cent.	Possible Kill[1] Per Cent.	Number of Eggs used
1.	Check, no treatment	55.2	0	9,550
2.	Kero-spray	74.1	0	743
3.	Sulco V. B.	49.2	10.9	1,837
4.	Keresol	47.9	13.3	827
5.	Linseed oil emulsion	46.3	16.2	1,193
6.	B. T. S.	31.1	43.7	2,724
7.	Lime-sulphur (liquid)	30.8	44.3	6,111
8.	Lime-sulphur (dry)	26.3	52.4	1,191
9.	Kerosene emulsion	12.9	76.7	887
10.	Wormol	9.2	83.4	711
11.	Scalecide	7.6	86.2	7,021
12.	Jarvis compound	.6	99.0	896

In order to check more fully the results obtained in the foregoing tests, twigs with eggs were collected from an orchard which had been given a delayed dormant spray of Scalecide. Of 434 eggs examined, 35.9 per cent. had been killed. Another batch of eggs showed 71 per cent. and another 95.7 per cent. mortality.

A few tests were conducted in August partly to check results obtained in 1920. Linseed oil emulsion[2] was tried and found very effective. The results of these tests are given in Table 9.

TABLE 9.

Exp. No.	Treatment	No. Live Mites	No. Dead	Per Cent. Killed	Date Treated	Date Examined	Air Temp. During Test	Temp. of Solution Applied
	Lime-sulphur 1-40							
1.	N. S. 1-500	2	36	95.0	Aug. 15	Aug. 16	60-79° F.	71° F.
2.	" "	18	141	88.7	Aug. 17	Aug. 18	60-79° F.	73° F.
	Borax soap							
3.	4 lbs.-48 gals. water	26	128	83.1	Aug. 17	Aug. 18	60-79° F.	89° F.
	Linseed oil emulsion	2						
4.	1 part-20 parts water	5	81	94.1	Aug. 17	Aug. 18	70-74° F.	84° F.
5.	Check, no treatment	84	2	2.3	Aug. 17	Aug. 18	60-79° F.	

Note:—Table 9. Showing results of four different treatments for controlling the European red mite; not in egg stage.

The results of these tests point to the value of miscible oils as ovicides, but it must be remembered that such oils if used in excessive quantities may become dangerous to apple trees, especially if long continued. Some growers have used them for many years with good success and without apparent injury, while others have not had as good success. In the case of miscible oils, therefore, it is best to examine each barrel or can before using, rejecting those which are not completely emulsified when water is added, and

[1] Calculated as in Table 7.

[2] Made according to directions in Mass. Agr. Expt. Station. Bulletin 179, pages 175-176, 1917.

mixing thoroughly, before dilution, the contents of those that are used.

The greatest amount of injury is done to the trunk and larger limbs (it may be several years in appearing) indicating that these parts should be avoided as much as possible in spraying with miscible oils. Again there is danger to the flower buds in the very late sprays, more than with lime-sulphur or substitutes, since the oil works in more among the buds. All these facts, together with the prevailing high price of oil sprays, make many skeptical of their value, but with care and only occasional use, they should prove valuable as orchard sprays.

In the light of present information, it is advisable to apply miscible oils for control of the European red mite in Connecticut before the buds open (late dormant spray), in March or early April. If lime-sulphur delayed dormant spray is used it should be applied as late as possible since it kills young mites after hatching.

We suggest in general the following procedure: follow the usual spray calendar recommendations unless red mite eggs are numerous. If numerous, apply miscible oil as a late dormant spray, to the outer twigs and smaller branches avoiding the trunks and larger branches as much as possible. By no means omit the pink spray with nicotine since this is important in control of newly hatched mites. Apply this spray as thoroughly as possible.

THE VIOLET GALL MIDGE.

Phytophaga violicola (Coquillett).

By Philip Garman, Ph.D.

During the fall of 1920, attention was called to the injuries of this insect by W. W. Thomson and Co., of West Hartford, Conn. At this time it had become numerous enough in their greenhouses to require continual hand picking and was causing a yearly loss estimated at about $1,000.00. The owners were trying to control it by intermittent fumigation with hydrocyanic acid gas (HCN) and by dusting with lime, both of which measures were ineffective. Hand picking infested leaves was also unsatisfactory. Evidently there was something about the insect which required study and the following notes relate to information obtained by the writer (with the aid of W. W. Thomson and Co.) which bear on its life history and control.

History of the Insect in the United States.

The violet gall midge or gall-fly has been known in the United States since about 1896 when it was discovered near Washington,

D. C. It has been reported from Virginia and New York by Chittenden and from Minnesota by Washburn. The New York localities include Nyack, Tappan, Cornwall-on-the-Hudson[1] and Rheinbeck[3] which are not greatly distant from West Hartford. It is not known definitely how it entered the United States or whence it came but it is thought to be tropical in origin and has perhaps been introduced from abroad.

Regarding life history, Chittenden[1] thinks that the maggots do not enter the soil to pupate. Felt[3] observes that the infestations

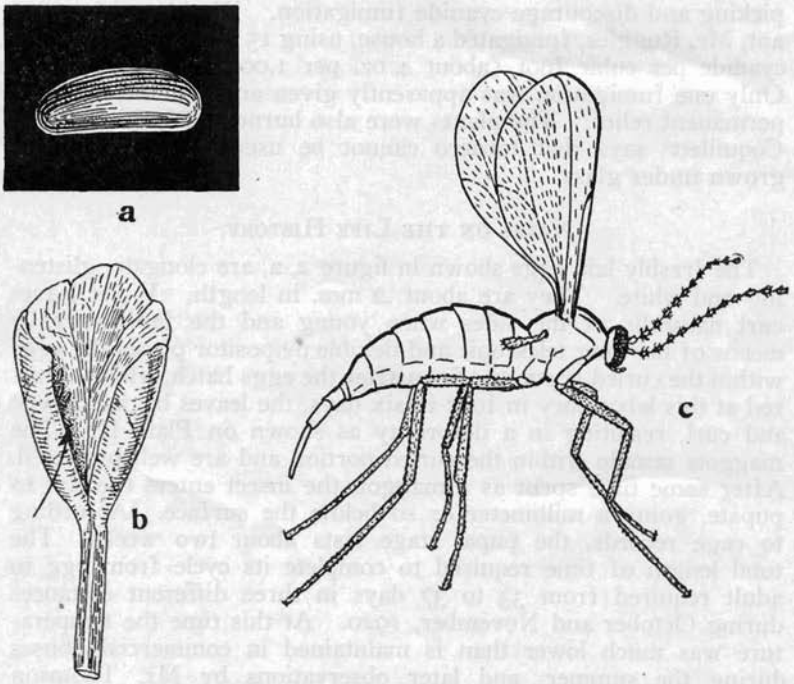

Figure. 2. Violet gall midge. a. egg, enlarged about 100 times; b. young violet leaf with edge rolled back, showing eggs; c. adult female fly, enlarged about 24 times.

in New York houses are local and their relative abundance is largely due to temperature; further that the insects prefer recently opened leaves, apparently laying eggs in such leaves and that there is a marked periodicity in appearance of the larvae. He says that adults rarely leave the plants and few are to be found on the windows; that infested leaves placed on the soil gave forth adults in 10-16 days; and that the maggots enter the soil to pupate.

There is some difference of opinion among authors as to the proper methods of control. Chittenden[1] suggests the use of

hydrocyanic acid gas, but did not test it. He discourages hand picking infested leaves because of injury to the crown of the plant. He suggests the use of air slaked lime thrown into and about the plants, and the free use of buhach or persian insect powder when adults are numerous. Felt's[3] suggestions include care in avoidance of infested plants for setting out, and in keeping the temperature as low as possible in early fall, since the insects are not troublesome at low temperatures. He discourages[4] the use of hydrocyanic acid gas, but thinks it possible that it has value in killing the adult flies. Slingerland and Crosby[6] recommend hand picking and discourage cyanide fumigation. Washburn's[7] assistant, Mr. Ruggles, fumigated a house, using 15 grams of potassium cyanide per cubic foot (about 4 oz. per 1,000) for 35 minutes. Only one fumigation was apparently given and this did not give permanent relief. The plants were also burned with this dosage. Coquillett[2] says that tobacco cannot be used safely on violets grown under glass.

Notes on the Life History.

The freshly laid eggs shown in figure 2, a, are elongate, glistening and white. They are about .2 mm. in length. Violet leaves curl naturally at the sides when young and the female fly by means of her long telescopic and flexible ovipositor places the eggs within the curled portion. Soon after the eggs hatch, which occurred at this laboratory in four to six days, the leaves begin to twist and curl, resulting in a deformity as shown on Plate II. The maggots remain within the curled portion and are well protected. After some time spent as a maggot, the insect enters the soil to pupate, going a millimeter or so below the surface. According to cage records, the pupal stage lasts about two weeks. The total length of time required to complete its cycle from egg to adult required from 33 to 37 days in three different instances during October and November, 1920. At this time the temperature was much lower than is maintained in commercial houses during the summer, and later observations by Mr. Thomson indicate a shorter cycle, possibly three weeks.

Eggs were obtained from adults, in two instances, two days after emergence from the soil (September 27-29, 1920). Emergence of adults takes place during the day or night according to observations made November 2 to 3. A small bottle containing emerging flies was cleared of the latter at 6:00 P. M., November 2. One fly emerged by 8:00 P. M., but no more had emerged by 10:00 P. M. One additional fly had emerged by 8:00 A. M. the next morning, and between 8:00 and 10:00 A. M. a third fly emerged. The flies thus seem to come from the soil at different times during the day or night and are not confined in this regard to any fixed period.

Notes on Control.

Owing to the location of the eggs and maggots within the curled leaves, it seemed inadvisable to use sprays of any sort for their control. It was thought that the maggots or pupae might be killed by applications of insecticide to the soil and to this end insect powder and dry lime were tried without results. Another available method was found in systematic fumigation with hydrocyanic acid gas (HCN) which proved satisfactory from the standpoint of the grower. This treatment kills the adult fly, but must be repeated every other night for some time because of the short preoviposition period of the female. If the fumigation is not repeated within the given time, adults will come from the soil and will mate and lay eggs before another fumigation. The maggots are not all killed by fumigation and many survive the usual dosage. Probably the eggs also survive but this is not certain.

Leaves with live maggots were placed in a small bottle containing soil covered with air slaked lime, September 15. Adults were found in the bottle September 27. This test was duplicated with similar results.

Persian insect powder was tried in the same way as lime. Leaves were placed in a small bottle with this insecticide September 29. Adults emerged October 14.

Infested leaves were then dipped in soap (2 lbs. to 50 gallons) and adults were obtained in about two weeks.

Another lot was dipped in "lemon oil" 1 part to 12 parts water, and adults were obtained in two weeks as before.

Fumigation (using sodium cyanide) was tried for killing the flies with the following results:

Dosage	Temperature	Length of Exposure	No. of Flies Used	No. Killed	Notes
⅛ oz.-1,000 cu. ft.	22° C.	2 hrs.	4	0	
" " " "	14° C.	8 hrs.	3	0	
" " " "	17-19° C.	15 hrs.	3	1	
⅙ oz.-1,000 cu. ft.	15-22° C.	2 hrs.	4	0	
⅙ oz.-1,000 cu. ft.	15-22° C.	2 hrs.	4	0	
⅓ oz.-1,000 cu. ft.	16-19° C.	3 hrs.	2	0	Both apparently dead but revived.
⅓ oz.-1,000 cu. ft.	22° C.	2 hrs.	4	3	
1 oz.-1,000 cu. ft.	19-22° C.	2 hrs.	4	4	All apparently dead; one revived.

All tests were made in a small fumigating box and the atmosphere was dry. While limited in extent the tests show that it is not advisable to reduce the dosage of sodium cyanide much under 1 ounce per 1,000 cubic feet. With leaky houses it would probably require 1-2 ounces to kill the fly.

Violets withstand a heavier dosage than some other plants, but care must be taken with this amount, not to leave the house closed over night.

During June, 1921, the gall midge appeared in considerable numbers in the West Hartford houses. The owners began systematic fumigation every other night, using ¾ to 1 ounce of sodium cyanide to 1,000 cubic feet, and keeping this up until July. An inspection June 8 showed that nearly every plant had injured leaves due to the gall fly. Two 180 foot houses, with 12,000 plants each, were treated. From one of these houses a bed was transplanted to a third house and remained without regular fumigation. An inspection of the houses August 10, 1921, showed that two of the houses were entirely free of the pest, while the bed of plants transplanted to the third house had about one infested or injured leaf to every ten plants. Shortly after August 10, systematic fumigation was started in the third house, and inspections were made regularly until September. It was noted that the galls did not become more numerous but were constantly reduced in numbers. On September 24 none could be found.

As a contrast to their condition in 1920, the plants now had good crowns and were much better able to produce flowers than a year ago. A good many plants died during the summer, but this seemed to be localized and was attributed to other causes. The only injury to the plants from the fumigation was a very slight burning of the margins of some of the leaves, which, however, did not retard the growth of the plants and did not compare with the injury caused by continual hand picking.

In drawing conclusions from the above notes, it is well to consider their incomplete nature. The fact should also be emphasized that fumigation with hydrocyanic acid gas (HCN) is dangerous to plant life and should be done with care. Directions for such work are found in Farmers' Bulletin 880 of the U. S. Department of Agriculture, with which every grower should provide himself. However, it is believed that careful systematic fumigation offers an economical and satisfactory relief from the injuries of a troublesome pest.

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AN OUTBREAK OF THE ARBOR VITAE LEAF MINER.

Argyresthia thuiella Packard.

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

Some injured arbor vitae twigs were first sent to the Station from New Haven early in April and referred to the botanical department. As no signs of plant diseases were found and small exit holes were noticed, the material was brought to the entomological department on April 12 by Dr. F. A. McCormick. Some of the leaves had been mined and were partly transparent when held up to the light, and small Lepidopterous larvae were found in the mines. On April 13, the authors visited the locality and collected material which was taken to the laboratory and placed in rearing cages in the insectary. More material was gathered May 2. On May 9, pupae were present in the leaves, and on May 20, small moths emerged. There was little difficulty in identifying the species as *Argyresthia thuiella* Packard, and this identification was later confirmed by Mr. August Busck of the United States National Museum, through the kindness of Dr. L. O. Howard, Chief of the Bureau of Entomology.

Injury.

The narrow leaflets were completely mined so that almost all of the chlorophyll was destroyed in the most extreme cases. Large specimen trees were so badly injured that they appeared brown instead of green, and were noticeable from a distance. Practically all of the leaves on the lateral branches had been mined, wholly ruining them as specimen trees. A block of pyramidal trees six to seven feet tall were badly injured and were brown except for the lower branches and the topmost leaves, which were green. Two rows of trees about three feet tall had hardly a green twig left, and from a short distance away looked entirely dead, but close examination showed that new leaves were starting out from the main trunk. These trees are shown on Plate IV, a. Of course all degrees of injury were noticed from the extreme cases cited to only a trace of infestation. Some degree of infestation was observed in many places, on both hedges and specimen trees, but in no other place visited was the injury so marked as in the locality described in New Haven. If a hedge should become badly infested, its beauty would be destroyed for a season at least. Felt[2] states that usually the operations of this pest are confined to a terminal half inch of the leaves here and there, and sometimes its work is so restricted as to involve only one-half or a portion of the leaflet.

Distribution.

The work of this insect was observed in several sections of New Haven and on June 24 at Norwalk and Riverside. Other towns in Connecticut known to be infested by this insect are Wallingford, Milford, Fairfield, Branford, Hamden and Cheshire.

It has been recorded from Canada,[4] Maine,[7] New York,[2] Pennsylvania,[1] New Jersey,[11] Missouri,[9] and the Middle Atlantic States.[14]

Life History and Habits.

Apparently the insect spends the winter as a larva in the mines of the leaflet. It reaches maturity early in May and pupates. The adults begin to emerge about May 20, and keep it up for some time, as on June 1 and June 4 there were many adults present and even more on June 9. They were resting on the trees or perhaps laying eggs, and on being disturbed fairly flew away in swarms from the trees. On June 9, the first egg was found. On June 21, eggs had hatched and young larvae had begun to mine the leaves. They enter the leaves by crawling under the edge of the base next to the twig and in this axil feed their way into the tissues and tunnel between the upper and lower epidermal layers. On July 1, larvae were about three-sixteenths of an inch long, had just finished mining one leaflet and starting on the adjoining one.

Description.

Egg:—Length about .33 mm., thickness about .17 mm., yellowish green, slightly paler than the leaf, more or less irregular in shape because it is nearly always placed between the tip of one leaflet and the base of the adjoining one and fits the available space. Egg is usually laid from 2-5 leaflets below the tip and can scarcely be seen with the naked eye. Under a miscroscope the surface appears roughly sculptured. The appearance of an egg is shown on Plate V, d.

Larva:—Length about 5 mm., thickness about .5 mm., light green varying to darker green with decided reddish tinge. Head, shiny black, cervical shield, black with median pale line, legs and anal plate black; a black spot on each side of last segment just above anal prolegs. Abdominal prolegs light green like body. A narrow black transverse mark on dorsum of penultimate segment. Head bearing light-colored bristles. Each segment bears dorsally a transverse row of short bristles; these are longer on the first and last two segments.

Pupa:—Length 3-4 mm.; thickness about .7 mm., general color leaf green, head light brown, wing sheath narrow and pointed, extending beyond base of fifth abdominal segment. Head smooth, bluntly rounded.

Adult:—Wing-expanse about 8 mm., forewings light-gray, marked with brown as shown on Plate V, c; rear wings light fuscous without markings. Palpi head and face, white; antennae white ringed with brown. Legs and body yellowish-white.

Parasites.

Dr. Felt[2] records a Chalcidid parasite *Pentacnemus bucculatricis* Howard, reared from the infested leaves in New York State.

This parasite was originally described from Missouri.[9] Two Hymenopterous parasites have been reared from the larvae or pupae of the arbor vitae leaf miner in our breeding cages. One is the Chalcidid *Pentacnemus bucculatricis* Howard, just mentioned, and the other a Vipionid, *Apanteles bedelliae* Viereck.

Control Measures.

Several remedies have been suggested for the control of this insect, but very little work along this line has been recorded. During the outbreak of this pest in Connecticut in the summer of 1921, several remedies were tried. One of the nearby nurseries had quite a serious outbreak and the owners were willing to co-operate with us in the test of control measures. A block of about 1,000 small trees four to six feet tall was used in the experiments. About one week after the experimental sprays were applied, the owners sprayed all their other arbor vitae trees, and by some mistake this block was also sprayed. The application contained nicotine sulphate (1 pint to 50 gallons) and soap.

The following sprays were applied in our tests:—

Lead arsenate, 1 pound to 8 gallons of water. This made a very concentrated poisonous spray and was thought to be of some value in killing the young larvae as soon as they hatched from the eggs.

Lime-sulphur, 1 part to 8 parts water, was sprayed on another plot.

Scalecide, 1 part to 8 parts water, showed a very little burning on the new and tender growth.

Kero-spray, 1 pint to 8 gallons. This is a commercial kerosene emulsion which is on the market under the name of "Kero-spray."

Fish-oil emulsion, 1 part to 20 parts water.

Carbolic emulsion, 1 part to 20 parts water.

These two emulsions were made up as follows:

Soap	4 ounces
Water	1 quart
Fish-oil (or carbolic acid) ...	4 ounces

Dissolve the soap in a quart of hot water, add the fish-oil and churn until a thick emulsion is produced. The carbolic emulsion is made just the same except that crude carbolic acid is substituted in place of the fish-oil.

Nicotine sulphate, 2 teasponnsfùl to 1 gallon of water, was another spray used.

All plots were sprayed twice except the carbolic acid and lead arsenate plots.

The sprays were applied on May 24 and June 4. At this time some of the moths had emerged and were flying around the arbor

vitae trees or resting on the leaves. Two small plots were treated with each of the sprays. In one plot the regular nursery trees were used and in the other smaller trees (less than three feet high) were used that had been transplanted near the larger trees. On the smaller trees all the old infested leaves were cut off.

In the fall careful counts were made of the number of larvae in leaves of the younger trees, with the following result:

Treatment	Living Larvae
Lead arsenate	14
Lime-sulphur	18
Scalecide	18
Kero-spray	12
Fish-oil emulsion	10
Carbolic acid emulsion	8
Nicotine sulphate	13
Check* (nicotine sulphate and soap)	10

The adult moths are very frail and many of them were killed by being struck by the sprays. It is very easy to hit them with spray because when a tree on which they are resting is touched they immediately fly away. Although the results do not show much difference in the number of larvae present for each kind of spray, the total amount of injury is certainly less than it was early in the spring, so possibly all of these sprays are of some value in controlling the arbor vitae leaf miner.

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*The trees left as checks as well as all others in the experiment were sprayed by the nursery owners with nicotine sulphate and soap. Of course all the treatments given above really had their original treatments plus a spraying of nicotine and soap a week later.

INJURY TO YOUNG TOBACCO PLANTS BY THE SEED CORN MAGGOT.

Hylemyia cilicrura Rond.

On May 25, I was called by telephone by Mr. J. B. Stewart of the Windsor Tobacco Growers' Corporation, at Windsor, and informed that a small maggot was injuring his tobacco plants in one section of the field by tunneling in the stem. As this seemed from his description to be a new or unusual trouble, I stated that I would like to visit his field. It happened that Director Jenkins had planned to visit his field the following day and on Mr. Stewart's invitation I accompanied him.

The field was in light sandy soil, and the plants had been set perhaps two weeks. The whole field was covered with cheese cloth as is the practice where shade grown tobacco is raised. The particular section worst infested was a strip of some twenty acres in area not far from one of the big tobacco sheds. This ground was covered with clover, which was plowed under last spring. We pulled and dug up many plants, thousands of which had been injured. The burrow was usually small and inconspicuous, often escaping notice at first and extended from the outside into the pith just below the surface of the ground. Frequently the burrow was considerably enlarged inside the stem, involving perhaps the whole pith and in some cases extending upwards or downwards for a half inch or more. Injured plants are shown on Plate VI, a. The week preceding our visit, Mr. Stewart was able to find a maggot in nearly every injured stem, but though we cut open many plants not a single stem had a larva in it. Mr. Stewart found one larva in the soil close to the plant, and after a long search, I found a Dipterous pupa in the soil. Twenty or thirty of these were found during the course of the day.

The preceding week Mr. Stewart examined and counted 100 plants and found between 80 and 90 infested. He was able from the general appearance to distinguish the injured plants from those not attacked.

It seemed to the writer that many of the infested plants were so slightly injured that they stood a good chance of recovering, but Mr. Stewart states that any injury to the pith is sufficiently serious so that the plant will never develop a good crop of wrapper leaf tobacco, and this opinion seems to be shared generally by the leading growers. Consequently the twenty acres were reset and no injury from this insect was noticed on the later set plants.

Other growers at various times have noticed similar injury to their tobacco plants, but the exact data have not been collected.

From the pupal material gathered on May 26, several adults

emerged on May 31st, and following, and proved to be a small two-winged fly of the Dipterous family Anthomyiidae. Specimens were sent to the Bureau of Entomology at Washington, where the insect was identified as *Hylemyia cilicrura* Rond., also known as *Phorbia* (or *Pegomyia*) *fusciceps* Zett., and commonly called the "seed corn maggot" and "bean maggot." This insect is closely allied to the cabbage maggot *Chortophila* (*Phorbia*) *brassicae* Bouché, the onion maggot, *Phorbia ceparum* Meigen, and the spinach leaf miner, *Pegomyia hyoscyami* Panz. It attacks a great number of different kinds of plants and its literature is extensive, yet I have so far been unable to find tobacco mentioned as subject to its attacks.

Tucker[11] has recorded similar injury by this insect to young tomato, potato, corn, pea, onion and cauliflower plants in Louisiana. The maggots generally feed upon planted seeds like corn, beans, peas, etc., and sometimes in cold wet seasons prevent the seeds from producing plants. Frequently, however, the plant appears above ground but as the terminal bud has been destroyed it fails to grow and produce leaves. The maggots have also been found feeding upon seed potatoes and onions, and attack cabbages and allied plants in much the same manner as the cabbage maggot, with which this maggot is often associated.

In the spring of 1917, the bean crop was seriously injured in New York State by this insect. "In five townships of one county there was a loss of $15,000.00 for seed destroyed, and in another county the loss on 16,000 acres planted was estimated to be between 50 and 75 per cent."[5] Many growers lost their entire crop.

It seems to be the consensus of opinion that clover and alfalfa or even a heavy application of manure, plowed under, make a favorable breeding place for the seed corn maggot. When these conditions are combined with heavy rainfall and low temperature there is apt to be serious injury from the seed corn maggot. The longer the seeds are in the ground before growth starts the greater the danger.

Shallow covering of seeds in cold wet seasons will materially reduce injury from the seed corn maggot.

The adult is a small grayish fly which closely resembles that of the cabbage maggot, and is shown on Plate VI, b. It occurs throughout the Eastern United States and is the species commonly responsible for injury to cabbage and onions in the southern states according to Chittenden.[2] Hawley[5] states that there are two broods annually and a possible third in certain seasons in western New York.

Some of the more important papers appearing in recent years and dealing with the life history and habits of this insect are as follows:-

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TESTS OF MATERIALS FOR THE CONTROL OF WIREWORMS.

BY M. P. ZAPPE.

In the spring of 1921 shortly after the tobacco plants had been set in the fields, the owners noticed that many plants were being attacked by wireworms. Some of the growers had pet remedies which they tried themselves or recommended to their neighbors.

The growers went to considerable expense to control this insect with various preparations. One of the most highly recommended remedies was to dissolve gum camphor in alcohol and dilute with water. This solution was then used to water the plants.

Several complaints were made to the Experiment Station about the damage caused by wireworms and it was suggested that tests be made to determine the value of some of the remedies that were being used by the tobacco growers. Mr. C. A. Huntington of Windsor, agreed to furnish the wireworms and tobacco plants if we would make some tests at the Station. The plants were set on June 1, 1921, in two rows, 30 in one and 31 in the other. There were 12 plants for each treatment, six in each row, except the check plot which only had seven plants, and the naphthalene plot which had only six plants, three in each row. There were five different treatments, besides the check plot.

The treatments used were turpentine emulsion, fish-oil emulsion, carbolic acid emulsion, gum camphor mixture and naphthalene flakes. The mixtures were made up as follows:

Soap	4 ounces
Turpentine	4 ounces
Water	1 quart

The soap was dissolved in the water by heating and when all dissolved, turpentine added and the mixture was churned until a creamy emulsion was produced. The fish-oil and carbolic acid emulsions were made in the same way except that fish-oil or crude carbolic acid was substituted for the turpentine. The gum camphor mixture was made in a different manner. Gum camphor was dissolved in alcohol until saturated. On a large scale, 8 ounces of this saturated solution was poured into a 50 gallon barrel of water. This diluted mixture was then to be used in watering the tobacco plants.

The trouble with this mixture is that the gum camphor is insoluble in water and when the saturated alcoholic camphor solution is added to water all the camphor is thrown out of the solution and settles in the bottom of the barrel as a precipitate. Then when water is drawn out all the camphor comes at once and the remaining portion of the contents is clear water.

All the treatments were applied soon after the plants were set. The turpentine, fish-oil and carbolic acid emulsions were diluted, 1 part of emulsion to 32 parts of water. The plants were watered with these dilute emulsions, using about 8 ounces to each plant. The naphthalene flakes were scattered around the base of each plant and then covered with a little soil. About one-fourth ounce was used for six plants. A little of the soil was removed from around each plant and replaced after the treatment had been applied.

Four hours after the treatment was applied two worms were placed at the base of each plant with the exception of four plants in the check plot. The supply of wireworms was limited so that four plants in the check plot only received one worm each. The worms immediately worked their way down into the soil at base of plants.

The results of the treatments are shown in the following table:-

	Number Plants Killed	Killed by Wireworms	Cut off by Cutworms
Turpentine emulsion	4	2	2
Fish-oil emulsion	4	1	3
Carbolic acid emulsion	1	1	0
Camphor mixture	2	1	1
Naphthalene flakes	0	0	0
Check	0	0	0

All the injured plants showed injury within a week after they were set. After that time there was no further noticeable injury. The trouble with this experiment was the fact that it was not on a large enough scale. If more worms could have been secured and the experiment carried on more extensively, the results perhaps would have meant more. The only thing the experiment shows

is that the remedies tried were of no value. The plants in the check plot having no treatment of any kind were untouched by the worms. The plants treated with naphthalene were also left untouched while the plants in the camphor and the emulsion plots (which were thought to have some value) were killed by wireworms and cutworms.

THE CORN EAR WORM.

Chloridea obsoleta Fabr.

One of the outstanding features of the year so far as insects are concerned, was the wide-spread distribution and comparative abundance of the corn ear worm. Specimens were received many times and from all counties of the State, and many inquiries by letter and telephone were answered, which were not accompanied by specimens. A brief account of this insect appeared in the Report of this Station for 1919, page 188, with illustrations of injury, larva and adult shown on Plate XXVIII. Of course this insect is a common species which has long been known in Connecticut, and it occurs somewhere in the State nearly every year, though perhaps not noticed in the same locality in successive

Figure 3. Corn ear worm in characteristic feeding position, much reduced.

seasons. It is the same insect which is known in the South as the cotton boll worm (not boll weevil), the tomato boll worm because it eats holes into ripening tomatoes, and the tobacco bud worm because it eats into the tips of growing shoots and seed pods of the tobacco plant. Scientifically this insect was formerly called *Heliothis armigera* Hübner, but more recently *H. obsoleta* Fabr., and now specialists agree in placing it in the genus *Chloridea,* making its name *Chloridea obsoleta* Fabr.

Injury to Corn and Other Food Plants.*

In the southern states where there are several generations each year and where the corn ear worm is very abundant, the larvae eat holes in the corn leaves as shown by Garman,[7] but in Connecticut the damage is confined to the ears late in the season, usually September and October. The larvae feed upon the soft immature kernels at the tips of the ears, though an occasional one works its way down under the husk between the rows nearly to the base of the ear. In most seasons sweet corn which was planted late or which matures late is the only crop damaged. But when abundant, as in the present season, it attacks field and ensilage corn and is often found feeding on the kernels which are mature and hard. The most of the injury is at the tip of the ear and the tip kernels are often all destroyed or injured so that they must be discarded for seed or for human food. In the canning factories, it is necessary also to cut out with a gouge the injured kernels on the side of the ear. The loss from this insect cannot be accurately measured by the kernels actually eaten or mutilated; the injury from moulds or other fungi which gain an entrance through the depredations of the corn ear worm, must also be taken into account. Garman[7] regards this as being quite as important as the loss from the kernels actually eaten or mutilated, and mouldy corn is considered unsafe to feed animals.

In some gardens this season, nearly every ear contained at the tip one or more larvae. Sometimes there would be four or five per ear. Some of the late maturing corn at the Station Farm, Mount Carmel, and in Mr. Zappe's garden not far away had from one to four larvae in each ear and Mr. Walden found six in one ear at the Station Farm. A grocer informed the writer that all sweet corn was "grubby" this year. On October 8, 1919, the writer saw sweet corn on sale in the market in Washington, D. C., nearly every ear of which contained one or more large caterpillars. That this injury was more severe in 1921 than usual in Connecticut may be evidenced by the statements of several farmers, one of whom had farmed for fifty years or longer, that they had never seen these worms before. Yet frequently infested corn is sent to the Station from some point in the State.

Sanderson[17] estimates that the corn ear worm destroys annually from two to three per cent. of the corn crop of the United States, thus causing a loss of between $30,000,000.00 and $50,000,000.00.

In the southern states this insect seriously injures cotton by eating into the base or side of the bolls, thus destroying or staining the fibers so that the cotton from these bolls must be discarded. With tomatoes the larvae eat holes into the fruits near the stem

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* To learn the extent of injury in Connecticut in 1921, 5,100 ears were examined from five plantations, and the percentages of injury were as follows: 11.8, 6.1, 6.4, 1.33, 17.2. In the middle west the injury ran as high as 50, 75 and even 100 per cent.

or on the side of green and ripe tomatoes of all sizes. Whenever a tomato is mutilated by being eaten in such a manner, rot usually sets in, thus destroying it. With tobacco the larvae eat holes into the tips of the new growth and also into the seed pods, yet this insect is not considered an important pest of tobacco.

In addition to corn, cotton, tomato and tobacco, the larvae may feed upon many other vegetable and field crops some of which are:—peas, beans, pumpkin, squash, cucumber, egg-plant, pepper, okra, potato, asparagus, peanut, collard, sorghum, sugar-cane, vetch, cow peas, alfalfa, clover and millet. It also can live upon the wild plants such as bindweed, cocklebur, hemp, horse nettle, wild sunflower, ground cherry and Jamestown weed, and it occasionally attacks such cultivated plants as geranium, gladiolus, mignonette, rose and morning glory. Sometimes the caterpillars attack ripening plums and peaches.

Distribution.

The corn ear worm is found all over the United States, in southern Canada, Mexico and southward to Argentina, the West Indies, throughout Europe, Africa, southern Asia, the East Indies, Australia and New Zealand. In Connecticut it has been received at the Station at various times from nearly all parts of the State as follows:—Bethany 1908; Kensington 1909; New London 1910; Wilton 1913; Westport, New Haven, Northford, Rockville, Colchester, 1919; New Canaan, Milford, Middlebury, Vernon, 1920. In 1921 it has been received from Brookfield Center, Stratford and Shelton, Fairfield County; New Haven, Hamden, Middlebury and Wallingford, New Haven County; Cromwell and East Haddam, Middlesex County; Ledyard, New London County; Roxbury, Woodbury and Lakeville, Litchfield County; Bristol, Unionville, Collinsville, Simsbury, West Hartford, Southington, New Britain, Melrose, South Manchester and Glastonbury, Hartford County; Columbia, Tolland County; Putnam, Pomfret, Killingly, Windham County. Correspondence and telephone communications indicate that it also occurred in Norwich, Fairfield, Wilton, West Cornwall, Thompsonville, Suffield, Hartford, Danbury, Newtown, Redding, Ridgefield and New Canaan. No doubt it has occurred this year in every town in the State. It has also occurred the past season throughout the northern states and in southern Canada.

Life History and Habits.

The adult females lay their eggs on the silk of the corn and the young larvae at first feed upon the silk and later find their way to the kernels. According to Crosby and Leonard[6] the eggs are deposited singly, and though the corn silk seems to be the preferred place, may be laid upon the leaves and tassels and upon the leaves and stems of cotton, tomato, tobacco and other plants if

corn silk is not available. Early emerging moths must necessarily oviposit elsewhere before corn silk is available. Each female is said to lay from 500 upwards to 2,500 eggs. The time required for hatching varies from a week in spring to two weeks in late fall, while in the summer only two or three days are necessary, depending upon the temperature. Likewise the length of the larval stage varies according to temperature and food, ranging from eleven days in hot weather to perhaps a month in spring and late fall. Usually the caterpillars pass through six moulting stages but sometimes pupate after the fifth stage.

When mature the caterpillar goes into the ground from two to seven inches deep, then makes a tunnel lined with silk almost to the surface for the emergence of the adult moth. It then descends to the lower and larger portion of the burrow and pupates. The pupal stage varies from two weeks in summer to three in cooler weather and those transforming late in the fall live through the winter as pupae in the soil. The number of annual generations varies with the latitude and altitude or to make it plainer, with the temperature. Thus in most of the cotton-growing states. there are probably four generations, but in southern Texas and Florida there may be as many as seven. In New Jersey, there are three broods in the southern half of the State, but only two in the northern half. Though its life history has not been thoroughly worked out for Connecticut, it has been called single brooded here, though in certain seasons a partial second brood may be expected.

This insect is never noticed on corn in Connecticut except late in the season or after September 1. If there is only one brood annually and the pupae live through the winter, why shouldn't the adults emerge in May or June? Also if there are two broods, why shouldn't the larvae feed upon the usual host plants in June and July? Some entomologists believe that our invasion late in the fall may be due chiefly to a flight of moths from the southern states. Apparently no one has observed such a flight, but possibly the moths would escape notice as they are not attracted to lights like the cotton moth *Aletia argillacea* Hubn. It is hoped that further observations on the life history of this insect in Connecticut may be recorded next season.

Description.

Egg:—About .5 mm. in diameter, nearly globular, flattened at base and tip; white or yellowish, marked with ridges radiating from the center of the tip.

Larva:—From 1.5-2 inches in length when full-grown, varying from light green to dark brown, but striped longitudinally as follows:—a dark median stripe divided by a narrow white line, a broad stripe above the spiracles, and a pale stripe in the region of the spiracles, margined above with black. The skin has a distinctly granular appearance. Head and legs vary from light to dark tan, under surface varies from nearly white to gray or tan, usually with a pinkish tinge. Each segment bears small tubercles and weak short hairs.

Pupa:—From .75-1 inch in length, smooth, brown, with a pair of caudal setae or spines.

Adult:—From 1.5-1.75 inches wing-spread, ground work buff in color, forewings marked with darker and more brownish suffusions and rather indistinct bands: rear wings paler with veins and submarginal band or cloud of brown. Head, antennae and thorax, light brown: abdomen and legs slightly paler. Under surface paler than upper with discal dots and subdistal transverse bands of forewings showing. Male closely resembles female, though smaller.

Larval, pupal and adult stages are shown on Plate VIII.

Natural Enemies.

Dr. Garman[7] records a bacterial disease of the larvae and seven insect enemies of the corn ear worm in Kentucky. One, *Trichogramma minutum* Riley (*pretiosa*), is a Hymenopterous parasite of the eggs, and the others are all predatory upon the eggs or larvae. Two species of lady beetles, the spotted lady beetle, *Ceratomegilla fuscilabris* Mulsant, and the convergent lady beetle *Hippodamia convergens* Guer.-Men., feed upon the eggs; a Telephorid larva was observed devouring the caterpillars; two true bugs, *Coriscus ferus* Linn., and *Triphleps insidiosus* Say, feed upon the eggs; the larva of the lace wing fly or aphis lion *Chrysopa oculata* Say, was also recorded as a common enemy of the corn ear worm.

Quaintance and Brues[16] give several other enemies of *Chloridea obsoleta* occurring in the South, among which are the following: a Hymenopterous egg-parasite *Telenomus heliothidis* Ashm., two Hymenopterous parasites of the larva, *Microplitis nigripennis* Ashm., and *Perilampus hyalinus* Say; eight species of Tachinid flies, *viz. Frontina armigera* Coq., *F. frenchii* Will., *F. aletiae* Riley, *Winthemia quadripustulata* Fabr., *Exorista ceratomiae* Coq., *Euphorocera claripennis* Macq., *Gonia capitata* DeG., and *Archytas piliventris* Van der Wulp, which are parasitic in the caterpillars or pupae. These authors also mention several species of ants, ground beetles, bugs, toads and birds which are common around cotton fields and which occasionally feed upon some stage of *C. obsoleta*. Some kind of wilt has been noticed in connection with the larvae in Connecticut. A number have been found dead in the ears and others have died in the breeding cages; such larvae usually become soft, turn dark colored and die.

Control Measures.

As a rule control measures have not been practiced in Connecticut, because of the uncertainty of damage. In ordinary seasons the injury has been so slight that control measures are unwarranted. In 1921, however, the damage has been quite severe and if we knew that it would be repeated next year, control measures would certainly be warranted. As it is by no means certain that

this insect will be destructive in Connecticut corn fields next season, the writer hesitates to recommend any form of treatment, though the owners can practice some of the methods if they think best.

Fall plowing will uncover many of the pupae in the soil so that they will be eaten by poultry, wild birds or other animals. As they are not far beneath the surface, most of the pupae will be uncovered or disturbed by this practice. Thorough harrowing will crush some of them and uncover many more.

In New Jersey,[11] sweet corn has been satisfactorily protected by dusting the silk, soon after it appears, with powdered lead arsenate and sulphur, equal parts. As the eggs are laid upon the silk and the young larvae feed upon it, there is an excellent prospect of poisoning them before they can find their way through the husks to the kernels. Perhaps this treatment would not be practicable in large areas of field or ensilage corn, but would be well worth carrying out in the home garden or where corn is grown for seed.

LITERATURE.

The literature regarding this insect is exceedingly voluminous. As much of it applies particularly to cotton, it need not be mentioned here. The following are only a few of the more helpful and readily accessible references:

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THE ASPARAGUS BEETLES.

Nearly all asparagus plantations in Connecticut are each year to some extent infested with the common asparagus beetle *Crioceris asparagi*. Just nineteen years ago a brief account of this insect was printed in the Report of this Station (1902, page 172) but more recent control methods have now supplanted those advised at that time. That same year the twelve-spotted asparagus beetle made its appearance within the State and a note to that effect may be found in the Report of this Station for 1902, page 174. Now the adults of both species may be found together on asparagus plants, both injuring them in much the same manner, though the common or blue asparagus beetle is usually much more abundant than the red or twelve-spotted species. These beetles have been mentioned and control measures advised, in each of the several editions of the Station Spray Calendar.

Both species have been common pests of asparagus in Europe since our earliest records. Both are now widely distributed and well established in the United States, and must be reckoned with, wherever asparagus is grown.

During 1921, asparagus beetles were unusually abundant and caused considerable injury to plantations, one report of serious injury to a large plantation near New Haven being brought to the office with specimens on May 24.

Common Asparagus Beetle.

Crioceris asparagi Linn.

History and Distribution.

Though long known in Europe, this species was not present in this country until about 1856,[3] when it appeared at Astoria, Long Island, near New York City, having apparently been introduced from Europe, though in what manner is unknown. It soon reached the large asparagus plantations of Long Island, and by 1862, it was said to have destroyed more than one-third of the crop in certain localities, occasioning a loss of $50,000.00.[3] It now covers an area reaching from Canada on the north to Cape Hatteras on the south, and westward to the Mississippi River. Separate colonies have also appeared further westward, one in Colorado and three in California.[3] Probably it will soon extend its distribution over the entire northern portion of the United States and perhaps Canada. It remains to be seen whether it continues to spread southward.

The natural means of spread is by the flight of the adults, but undoubtedly hibernating beetles or pupae have been shipped in asparagus roots or in other materials, and perhaps carried long distances.

Life History and Habits.

There are said to be at least two complete annual generations in the northern states, and possibly three or four, further south. In Connecticut the adult beetles appear in May soon after the cutting season begins, and feed and presently lay their eggs upon the tender shoots as shown on Plate IX, c. or upon the more slender growth that comes from young seedlings in or around the bed as shown on Plate IX, a. These eggs are dark brown, elongated-oval, thickness about one-third the length, which is nearly one-sixteenth of an inch. Each egg is fastened endwise to the leaf or stem, and projects from it nearly at a right angle, as shown on Plate IX, a. It is not uncommon to see one egg fastened end to end on top of another as shown in the illustration.

The eggs hatch in a few days and the grubs, "slugs" or larvae which are lead-gray with black shiny heads and legs, begin to feed upon the new foliage. The larvae are soft and wrinkled, gray in

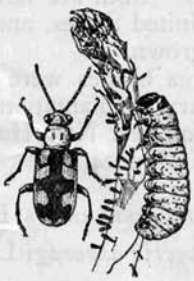

Figure 4. Common or blue asparagus beetle and larva, about twice natural size; the eggs are shown on the new shoot.

color, and present a disgusting appearance as shown on Plate IX, d. As a rule they feed only upon the slender leaves which they are able to clasp, and are not found upon the thick and tender sprouts. Injury to the sprouts is usually the work of the adult beetles.

When fully grown, the larva enters the ground and forms a rounded cell in which it transforms to the pupa and from which the adult beetle emerges in about a week. On Long Island the complete life cycle requires about 30 days but this period may be considerably lessened in a warmer climate and much lengthened in a colder one.

The beetles when abundant often eat holes into the sprouts, but seem particularly fond of the delicate foliage after that has developed, and also eat the bark or rind of the mature plants. Perhaps the most serious injury occurs on new beds or plantations where the plants must grow for a year or two and become strong before cutting begins. In such places both larvae and adults will soon

strip the plants of their leaves and perhaps devour the epidermis of the stems. This greatly weakens the plants so that they do not form strong shoots for later cutting. All new beds, and seedling plants, should be protected from injury and the foliage preserved.

Description of Adult.

The adult of the common asparagus beetle is a striking and beautiful insect about one-fourth of an inch in length and showing a combination of dark blue, yellow and orange red colors. The under side of body, head, antennae, legs and a portion of the wing covers are a dark metallic blue, nearly black. Thorax and outer margins of wing covers are orange red. The inner margins of wing covers and usually three cross bars are dark blue: these cross bars alternate with lemon yellow bars or patches, usually three on each wing cover, one narrow longitudinal one at the base and two about equi-distant from the first and the orange red apical area. There is great variation, however, in the arrangement and size of the yellow and blue areas, grading from forms almost wholly dark blue to those which appear yellow with narrow blue markings. A form common in Connecticut is shown on Plate IX, b.

Twelve-Spotted Asparagus Beetle.

Crioceris duodecimpunctata Linn.

This species is a native of Europe, where it is widely distributed, and though common is not particularly destructive. It was first noticed in this country near Baltimore in 1881,[4] but has spread rapidly until it now covers the entire northeastern United States and extends into Canada. This species was first discovered in Connecticut at New Haven in 1902.[1]

In some localities the twelve-spotted asparagus beetle is reported as being more abundant than the common species, but in Connecticut, so far as my observations go, it is found nearly everywhere with the common species but it is never so abundant and is much less injurious.

Life History and Habits.

The eggs of the twelve-spotted asparagus beetle are laid singly, and in preference upon the old and fruiting plants. Instead of being fastened endwise to the stem or leaf as are the eggs of *C. asparagi,* they are attached sidewise. The larvae feed chiefly upon the pulp of the berries,[5] and therefore are not of great importance as destroyers of foliage. It is where the plant is grown for seed that this species is particularly destructive. The adult beetles feed upon the tender shoots in early summer, and later upon the leaves and eat out irregular areas in the bark of the stems.

The life history is very similar to that of the common species and probably there are the same number of annual generations. The adults pass the winter under rubbish in much the same manner.

Description of Adult.

This beetle, called the red asparagus beetle, is about the same length as *C. asparagi* but is somewhat broader and thicker. The color is uniform reddish-brown above, with six black spots on each wing cover. Antennae, eyes, legs and under surface, blackish. It has been noted that the beetles match the berries very closely in color. The appearance of this species is shown on Plate IX, e.

Natural Enemies of Asparagus Beetles.

If poultry have the run of the asparagus bed they will take care of the beetles early in the season, but later after the plants have reached their growth, some of the beetles will be out of the reach of poultry. However, where poultry have access to the asparagus plantation it will seldom if ever be necessary to spray for the control of the beetles. In the writer's own garden one summer, a neighbor's flock of ducklings entered one day and in a few minutes cleaned the plants of all beetles and larvae.

There are many kinds of predaceous insects that devour the larvae and adults. Lady beetles are prominent among these, and the spotted lady beetle *Ceratomegilla fuscilabris* Muls., and the convergent lady beetle *Hippodamia convergens* Guer., have been recorded as feeding upon the larvae. The spined soldier bug *Podisus maculiventris* Say, and the bordered soldier bug *Stiretrus anchorago* Fabr., both impale the larvae and occasionally the adults on their beaks and suck out the juice. The common wasp, *Polistes pallipes* LeP., and a small dragon fly *Ischnura posita* Hagen, are known to prey upon the larvae of asparagus beetles. A small Hymenopterous or four-winged fly *Tetrastichus asparagi* Crawford, lays its eggs in those of the common asparagus beetle; the eggs hatch and the parasites live in the bodies of the larvae of the host, which die after entering the ground to transform.

In addition to the natural agencies mentioned above, temperature changes occasionally aid the grower in checking the pest. Asparagus beetles are very susceptible to sudden and violent changes in temperature, and in 1896, the intense heat of the first half of August killed many of the larvae in the vicinity of Washington, D. C. In Concord, Mass., hibernating beetles have been killed in immense numbers where a severe cold spell followed a warm one.

Thus it will be seen that under certain favorable conditions these natural agencies are of material assistance in checking the numbers of asparagus beetles.

Artificial Control Methods.

On all newly set beds and where young plants are grown from seed it will usually be necessary to employ some artificial means of keeping the plants free of beetles. If chickens or ducks have the run of the asparagus bed on low plants no other form of control will be needed.

Hand picking may be practiced in very small garden areas, and air-slaked lime dusted upon the plants when wet with dew will kill the larvae. Pyrethrum or insect powder is also of some value in killing the larvae when dusted upon the plants.

The larvae are rather delicate and when knocked or brushed off the plants in hot weather, often die when they reach the hot soil. Frequent syringing with a forceful spray from the garden hose will knock them from the plants and many are unable to return.

In the large cutting fields, it is probably best to make clean cuttings, in which case the beetles are forced to lay their eggs upon the new shoots which are in turn cut in a day or two so that the eggs are destroyed. Another method is to allow certain slender and worthless shoots to grow as trap plants to be cut and burned after they are well infested or to be sprayed with poison before the larvae begin to feed.

I have known several successful growers to practice clean cutting as long as the season lasts, and this in some years would be all that is necessary. In case defoliation threatens the plants, after the cutting season is over a thorough spraying or dusting with lead arsenate will destroy the beetles and save the plants from defoliation. In spraying asparagus it should be borne in mind that the leaves are very narrow and do not readily catch and hold the poison. Hence it is necessary to use a fine spray and to direct it against each plant or row from both sides with plenty of force back of the nozzle in order to coat the leaves as completely as possible. For this purpose it is well to use a strong mixture containing at least six pounds of paste or three pounds of powdered lead arsenate to 50 gallons of water. If the poison is applied as a dust it should be blown upon the plants in early morning when they are wet with dew or just after a shower before they have become dry.

Literature.

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THE TULIP-TREE SCALE.

Toumeyella liriodendri Gmelin.

This insect occurs throughout the State on tulip trees and each year specimens are received at the Station, and it is also found each year in late summer in the nurseries by the inspectors, when making the annual inspection required by law. This scale was mentioned in Bulletin 151, page 9, with illustrations from a photograph, and both the note and the illustration were reprinted in the Report of this Station for 1905—page 239, and Plate IV, f. As both the report and the bulletin have long been out of print, a new and more complete account of the insect is given here.

This scale occurs chiefly on the lower branches of wild and cultivated tulip trees. Sometimes these branches are killed, but I have never seen cases where the entire tree died from the attacks of the scale, though Professor A. J. Cook states that in 1870, the insect was so abundant on the grounds of the Agricultural College at Lansing, Michigan, that some of the trees were killed outright and others much injured. In Connecticut many tulip trees have lost their lower branches from its attack. Magnolias are also occasionally infested.

This scale is one of our largest species of soft scales; the females are hemispherical in shape, sometimes reaching a diameter of eight millimeters or about one-third of an inch. These are

Figure 5. Tulip-tree scale, much reduced.

brown in color and are usually crowded together on the twigs as shown on Plate X, a. The smaller light-colored objects are the shells from which the males have emerged. Some twigs will show a preponderance of females, others of males, though in many cases the sexes are about evenly divided.

There is usually a copious exudation of honey dew which drips upon the foliage underneath, or upon the ground, making it look as if a coating of varnish had been applied. In the honey dew a black fungus or sooty mold grows, giving the surface a blackened

appearance. A fungus grows in the dead bodies of the females, which often adhere for a long time to the twigs, and its white threads of mycelium are rather conspicuous against the brown scales.

The tulip-tree scale was reported as causing severe injury at Hartford in 1895, by Dr. W. C. Sturgis of this Station. Since that time it has been received from many localities in the State. Records of the samples have been kept for twenty years, and it is interesting to note that no specimens of tulip-tree scale were sent to the Station in the years 1908, 1918 and 1919. More specimens were sent in 1902 and 1913 than any other years.

This insect has been received from, or observed in the following localities: Hartford, 1895; Berlin, 1898; South Windsor, 1901; Brookfield Center, Danbury, Bridgeport, New Haven, Southington, Hartford, 1902; New Haven, Hamden, Middletown, 1903; Suffield, Wilton, 1904; Columbia, 1905; Green's Farms, Branford, 1906; New Haven, 1907; Greenwich, Stamford, Waterbury, 1909; Danbury, New Britain, Norwich, 1910; Brookfield Center, Bridgeport, New Haven, Hamden, 1911; New Haven (on magnolia), Columbia, Waterford, Greenwich, Fairfield, 1912; Newtown, Rowayton, Bristol, Plainville, Woodbridge, West Haven, Middletown, Killingworth, Chester, Norwich, 1913; Ridgefield, Deep River, Lyme, New London, East Hartford, 1914; Danbury, Plantsville, Norwich, 1915; Woodbury, Naugatuck, Wilton, Bridgeport, New Haven, 1916; New Canaan, Springdale, New Haven, Middletown, Hartford, Talcottville, Rockville, Pomfret Center, 1917; Stamford, Norwalk, Stratford, Branford, 1919; Fairfield, Stratford, New Haven, Branford, Haddam, 1920; New Haven, Hamden, Guilford (on magnolia), Meriden, Branford, Stratford, Bridgeport, Norwalk, Stamford, 1921.

This scale was described as *Coccus liriodendri* by Gmelin[7] in Europe in 1789, but Cook[3] supposing the American form to be distinct, described it in 1878 as *Lecanium tulipiferae,* and it is under the latter name that the insect is mentioned in the earlier American literature. In fact, the European and American forms were considered as distinct species until 1909, when Sanders[11] after a careful study decided that they were identical, and belonged in the genus *Toumeyella.* Gmelin's name *liriodendri* having priority must be retained. Several writers, notably King and Mrs. Fernald, have placed this insect in the genus *Eulecanium,* where, according to Sanders,[11] it does not belong.

Only one parasite, *Coccophagus flavoscutellum* Ashm., recorded by Dr. L. O. Howard, is known to attack this scale. Houser[8] mentions the fact that a small lady beetle *Hyperaspis signata binotata* Say, was observed at Mineral, Ohio, July 12, 1916, associated with this scale. It is probable that other lady beetles may prey upon the newly-hatched scales.

Life History.

Though the yellow oval eggs were described by Professor Cook, young are found here underneath the female shells, so evidently the species is viviparous in Connecticut, as well as further south as observed by Dr. C. V. Riley.[10] The young appear here early in September according to our observations extending over a period of more than twenty years, and crawl about for a time but soon locate on the bark of the twigs and begin to suck the sap. At first the young are yellow but they soon change to brown. They are nearly black by the time winter approaches, and hibernate when about one-fourth grown.

Remedies.

Spraying the trees as soon as the leaves drop in autumn, with concentrated liquid lime-sulphur, one part in nine parts water, is believed to be the best form of treatment. Probably this mixture would also be effective during the winter and early spring, but possibly it would be more so in the fall before the insects reach the condition in which they pass the winter. At any rate, this lime-sulphur spray applied in the fall has been used successfully by some of the tree-protecting firms.

It is possible that kerosene emulsion, nicotine soap solution, or some other contact insecticide, may also prove effective. Houser[8] obtained good results in Ohio with Scalecide, one part in 15 parts water, applied in March, but miscible oils are not recommended for Connecticut, because there is some evidence to show that the tulip tree, like the sugar maple, is rather susceptible to oil injury.

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THE COTTONY MAPLE SCALE.

Pulvinaria vitis Linn.

Perhaps the most conspicuous of all the scale-insects, particularly during the egg-forming season of early summer, is the cottony maple scale. During the dormant season it is found upon the bark and closely resembles any other large brown soft scale, but after the trees begin to grow the formation of eggs causes the posterior end of the insect to become raised and the egg-sac begins to protrude. This shows as a white cotton-like mass of wax, and increases in size until when fully developed is as long as the insect itself, as is shown on Plate XI, b.

This scale was formerly described as *innumerabilis* by Rathvon and in most of the American literature it occurs under that name. In 1909, Sanders[18] after a careful study proved it to be identical with the European *P. vitis* Linn., and this name having priority must stand. It occurs in the United States and Canada and also in Europe.

In most cases this insect is found sparingly here and there on various host trees and shrubs, but there has been an infestation of silver maples south of the railroad at Sound Beach near Stamford which has persisted for eight or ten years and which has caused considerable injury to the trees and has necessitated control measures. The Connecticut records for the cottony maple scale are as follows:—Norwich, 1905 and 1909; Branford, 1906; New Haven, 1910 and 1917; Milford, 1913; Bridgeport, 1910, 1912 and 1913; South Norwalk, 1912; Sound Beach, 1921; Danbury, 1914; Cheshire, 1913; Wethersfield, 1916; Hartford, 1910. In most of these cases the scales were on silver maple, but the hosts also include red maple, sugar maple, euonymus, black locust, honey locust, and gooseberry. Other reported hosts are: Norway maple, box elder, hercules club, osage orange, red mulberry, apple, pear, plum, peach, hawthorn, currant, gooseberry, lilac, poplar, willow, linden, alder, oak, hackberry, sycamore, grape, rose, sumac, elm, beech, Virginia creeper and poison ivy.

Each female deposits about 3,000 eggs, which are oval, light-colored with a reddish-yellow tinge. The eggs hatch late in June or early in July, and the young at first go to the leaves and establish themselves mostly on the under side along the mid-rib and veins. The males are frail two-winged creatures which mature in August or September, fertilize the females and perish. The females migrate to the twigs just before the leaves drop, and pass the winter on the bark in a partially grown condition.

In some parts of the country the injury caused by this insect is so severe as to kill many trees. Dr. S. A. Forbes[3] ventures the

opinion that in Illinois destructive outbreaks of this insect may be expected to last about eight or ten years, with corresponding periods of scarcity in sections where it becomes established. The disappearance of the insect he considered due to parasites and predaceous insects.

Six Hymenopterous or four-winged flies are known to be parasitic on this scale. All are very small species, and known only by their scientific names as follows: *Coccophagus lecanii* Fitch, *C. flavoscutellum* Ashmead, *Atropates collinsi* Howard, *Aphycus pulvinariae* Howard, *Comys fusca* Howard and *Eunotus lividus* Ashmead. A Dipterous parasite, *Leucopis nigricornis* Egger, has been reared from the cottony maple scale, and the larva of a moth, *Laetilia coccidivora* Comstock, feeds upon it. Three lady beetles, *Rhizobius ventralis* Erichson, *Hyperaspis signata binotata* Say, and the twice-stabbed lady beetle *Chilocorus bivulnerus* Mulsant, have been recorded as preying upon it, the second being abundant at Wooster, Ohio, in July 1916,[6] both larvae and adults devouring the eggs. Both adults and larvae of the third feed upon this insect.

A *Chrysopa* larva and two species of assassin bugs have been observed feeding upon the scales, and the nymphs of *Corizus hyalinus* Fabr. were found working among the egg-masses at Denver.[8] Miss Murtfeldt observed harvest mites feeding upon the eggs in Missouri. One bird, the common English sparrow, has been observed feeding upon the cottony egg-masses.

In regard to remedies for the cottony maple scale, on account of the difficulty of making a thorough application where trees are in foliage, it is best to spray the dormant trees when the twigs and branches can be thoroughly covered. Mr. F. A. Bartlett informs the writer that in his experience the lime-sulphur mixtures have not proven effective against this insect, due perhaps to poor penetrating powers. On the other hand the miscible oils like "Scalecide" diluted at the rate of one part in 15 parts of water, are satisfactory in destroying the partially grown females. Houser[6] also recommends this treatment in the spring just before the buds open. Forbes[5] found that a strong kerosene emulsion containing from 10-12 per cent. of kerosene applied in the summer would kill a majority of the scales, but that one treatment in winter with a 20 per cent. emulsion destroyed more scales than two summer treatments with a 10 per cent. emulsion.

In the use of miscible oils or strong kerosene emulsions, it should be borne in mind that maples may be injured if too much of the oily mixture is allowed to run down the trunks and settle in the ground at the base. The sugar maple especially is very susceptible to oil injuries, but the silver maple is apparently in much less danger of being injured.

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THE PINE LEAF SCALE.

Chionaspis pinifoliae Fitch.

During recent years in Connecticut, it has been rather common to find young pine trees of several species infested with a scale which resembles the scurfy scale of apple and pear, except that it occurs only on the leaves instead of on the bark. Apparently this insect does not gain a foothold on the larger trees, and is not able to persist upon the infested trees after they reach a certain size. The most common habit of this insect is to infest the leaves of small trees which are overshadowed by larger ones. The writer once saw small white pine seedlings four or five years old under a grove of large native pines, which had been killed evidently by this scale. Nearly every year this insect is found in nurseries, when the annual inspection is being made.

This insect occurs throughout the State, and is found in all of the northern United States. It is usually more prevalent around towns and cities than in the open country.

According to our observations and records, the pine leaf scale has occurred in Connecticut as follows:—South Manchester, 1902; Hartford, 1903, 1905; Thompson, 1906; Rainbow, 1907; Hartford, New Haven, 1908; South Manchester, New Haven, 1909; Hartford, 1910; Riverside, 1911; Greenwich, New Canaan, 1912; New Haven, Cos Cob, 1913; Avon, South Manchester, Cos Cob, Bridgeport, 1914; Bridgeport, 1915; New Haven, Norwalk, Hartford, Bristol, 1916; Stamford, New Haven, Hartford, 1917; Wallingford, Cromwell, Bristol, Hartford, Manchester, 1918; Greenwich, New Haven, Hartford, Manchester, 1919; New Haven, Meriden, New Canaan, Cromwell, Westbrook, Hartford, West Hartford, Bristol, Manchester, 1920; New Canaan, Bridge-

port, Meriden, Cromwell, Bristol, Hartford, Simsbury, Rockville, Sharon, Thompsonville, 1921.

In a majority of cases this scale has been found upon Mugho pines in nurseries and ornamental plantings, but it has occurred also on red, Scotch, Austrian, jack, stone and white pines and on *Pinus densiflora* and hemlock. On four occasions, in 1908, in 1909, in 1913 and in 1920, this scale has been sent to the Station on the leaves of hemlock, and on October 23, 1907, the writer examined a tree on the estate of the late J. M. Greist, Westville, where several branches had lost their leaves from the attacks of this insect.[3] Several species of spruce have been recorded as hosts, but the writer has never found this scale on spruce in Connecticut.

There are supposed to be two generations each year in Connecticut, though its life cycle has not been followed closely through the season. The parent female deposits under her shell oval purple eggs and in this stage the insect passes the winter. These eggs were present in specimens received at the Station on September 17, 1921. They begin to hatch during May, but the hatching period is quite a long one so that the two broods are not distinct but overlap somewhat. The scales of both sexes are similar, pear-shaped and white with a yellow pellicle at the narrow end, the males being somewhat smaller. The appearance of this scale is shown on Plate XI, a.

The following two parasites have been reared from the pine leaf scale: *Aphelinus mytilaspidis* LeBaron, and *Perissopterus pulchellus* Howard. The Nitidulid beetle *Cybocephalus nigritulus* Lec., the twice-stabbed lady beetle, *Chilocorus bivulnerus* Mulsant, the painted lady beetle *Harmonia picta* Randall, *Scymnus* sp., and a species of golden eye or lace wing *Chrysopa* sp., have been recorded as being predatory upon the pine leaf scale.

Control measures for the pine leaf scale have not been thoroughly tested for Connecticut. The worst infested branches can be removed and burned and this is usually advisable with any species of scale insect. Probably the best treatment will be to spray during the summer months with kerosene emulsion or with a nicotine soap emulsion. An application soon after the eggs hatch (about June 10) will readily kill the young, but as the young of this species do not all hatch at the same time, it will probably be necessary to repeat the treatment in order to get most of the first brood. Additional treatments should be made after the young of the second brood appear, but until the life history of this species has been worked out for Connecticut, no definite dates can be given for the hatching of the second brood. Houser[9] reports his experience in Ohio in spraying with a weak kerosene emulsion when the young of the first brood were hatching, followed by an application of whale-oil soap in late summer when the young of the second brood appeared. The combined treatment was effective in reducing the infestation.

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THE TERRAPIN SCALE.

Lecanium nigrofasciatum Pergande.

This insect occurs in Connecticut chiefly upon the smaller twigs of the silver maple and the red maple, but occasionally we find it on sugar maple and Norway maple. The writer has received specimens on peach from Philadelphia, Pa., where it is reported as being quite a pest of the peach orchard. It is also recorded as attacking plum, cherry, apple, quince, *Crataegus*, sycamore, Carolina poplar, olive, blueberry, spice bush and *Bumelia*. It occurs throughout the eastern United States westward nearly to the Rocky Mountains, and has been reported from Ontario, Canada.

This insect is commonly known as the terrapin scale, but is sometimes called the black-banded scale, and is one of the smaller of the soft scales, varying from one-sixteenth to one-eighth of an inch in length. It is longer than broad, and of a color varying from reddish-brown to black. Usually it is reddish-brown mottled or banded with black, but occasionally we find one that is uniformly red or black. The scales are usually crowded on the twigs giving the general appearance shown on Plate X, b.

This scale is quite convex with a smooth brown area in the center with ridges radiating from it and becoming more and more pronounced as they reach the margin. The eggs are deposited under the bodies of the females during June and the females soon die. The males appear in August and are very delicate winged creatures, seldom noticed unless reared in the breeding cage. The young establish themselves on the smooth bark of the smaller twigs and branches, usually on the under side, but sometimes entirely encircling them. According to Houser[5] they sometimes migrate

later to a more favorable situation. There is only one generation each year and the winter is passed by the females only, in a partially mature state.

The injury caused by this insect is due to sucking the sap from the twigs throughout the active season and from the leaves for a portion of the summer. Thus a badly infested tree is severely injured. As in the case with a number of scale insects, honey dew is exuded and drips from the twigs, and a black fungus or sooty mold grows therein, giving the foliage a blackened appearance.

In Connecticut, this insect has been identified on silver maple, except where otherwise indicated, from the following localities: Forestville, 1905; Deep River, 1906; Hartford (2) once on sugar maple, South Glastonbury, 1907; New Haven, 1908; Norwich, on red maple, 1909; Thompsonville, 1911; Hartford, Bristol, 1914; New Haven, 1915 and 1916; New Haven, Seymour, Middletown, Danbury, 1920; Milford, Bridgeport, (on red maple), New Haven, Durham, Hartford, Watertown, 1921.

According to Houser[5] a number of minute four-winged flies or Hymenopterous parasites have been reared from the terrapin scale. These are: *Coccophagus lecanii* Fitch, *C. cinguliventris* Gir., *C. longifasciatus* How., *Aphychus stomachosus* Gir., *A. cognatus* How., *Angyrus nubilipennis* Gir., and *Encyrtus* sp. The twice-stabbed lady beetle *Chilocorus bivulnerus* Mulsant, feeds upon the young, and a fungus, probably *Cordyceps clavulata,* is reported as attacking the mature scales.

Control measures against the terrapin scale must be practiced for the most part while the trees are dormant. Summer sprayings to kill the young have been suggested, but as the eggs continue to hatch over a long period, several treatments would be necessary. On account of the foliage, it is difficult to make a thorough application. The most satisfactory time is perhaps in early spring just before the buds open. Badly injured branches should be cut off and burned, and the remaining portions of the tree sprayed. For this purpose, Sanders[9] recommends kerosene emulsion containing from 20-25 per cent. of kerosene. Houser[5] states that the miscible oils applied at the rate of one part in 15 parts of water are entirely satisfactory.

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THE EUONYMUS SCALE.

Chionaspis euonymi Comstock.

This scale injures the species and horticultural varieties of euonymus, all of which are grown for ornament, though it is reported as infesting orange, *Althea,* and bitter sweet *Celastrus scandens,* in some localities. In Connecticut it is perhaps most commonly noticed on the climbing evergreen *Euonymus radicans,* which it often kills in large patches on walls, rendering it unsightly. It is found in the Atlantic States from Massachusetts to Georgia, and has been recorded from Ohio, Mississippi, Texas and California. It was first described by Comstock[3] from Norfolk, Va., in 1880. Outside of the United States it has been reported from Cuba, France, Italy and Japan.

From the records of the State Entomologist's office, the euonymus scale may be reported from Connecticut as follows: Hartford, 1905; Middlebury, 1906; Greenwich, 1910; New Haven, 1912; Stratford, 1913; Bridgeport, 1915; Norwalk, New Haven, Bantam, 1916; Greenwich, Stratford, 1919; New Haven, Wilton, 1920; New Canaan, Saugatuck, Stratford, New Haven, 1921.

Thickly infested plants often look as though covered with snow on account of the pure-white males which are small with parallel margins, and extremely abundant on certain plants or parts of plants. The females are much less abundant, larger and broader, about one-sixteenth of an inch in length, pear-shaped, and dull gray or brown in color. Both sexes are shown on Plate X, c.

Apparently the insect passes the winter as a mature female in New Haven and Washington, D. C., notwithstanding the statements made in some publications that it winters in the egg stage. One minute four-winged Hymenopterous parasite, *Aphelinus fuscipennis* Howard, has been reared from the euonymus scale.

The life history of the euonymus scale has not been worked out in Connecticut, but according to Houser[7] there are at least two broods each season. In 1920 a large plant of *Euonymus radicans* in New Haven was sprayed with kerosene emulsion, containing two gallons of kerosene, one-half pound of soap and one gallon of water, diluted at the rate of one part emulsion to three parts water, thus containing about 16 per cent. of kerosene. On May 15 this was applied to a portion of the vine. Two days later, the

vine was examined and no injury to the foliage was apparent. At this time no young had appeared. On July 1, many young were present on the unsprayed portion, but no young appeared on the branches which were sprayed May 15. On July 8, the entire vine was sprayed with the same kind of mixture used on May 15. At this time the growth was nearly complete and the blossoms had dropped ten days before. The effect of this treatment was not followed up, but the vine had already been considerably injured and the owner had it cut back to the ground the following spring.

Sanders[10] recommends for summer application a kerosene emulsion containing not more than 15 per cent. of kerosene, or a solution of whale-oil soap, a pound in a gallon of water. During the winter or dormant season, a stronger emulsion may be used, up to 20 per cent. on the evergreen species and up to 25 per cent. on the deciduous species of *Euonymus*. He warns against allowing the oily emulsion to collect at the base of the plants on account of danger of injury.

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RAPID SPREAD OF THE APPLE AND THORN SKELETONIZER.

Hemerophila pariana Clerck.

In the Report of this Station for 1920, page 190, may be found a brief account of this insect and its discovery in the State. At the time this article was written, the insect was known to occur in Connecticut only at Greenwich and Stamford. The season of 1921 had not progressed very far before we learned that this insect was much more widely distributed in Connecticut. In addition to the towns mentioned above, the insect was sent to this office from the following towns in 1921: New Canaan, Danbury, West Haven,

Wallingford, Portland and West Cornwall. Entomologists from this department have collected or observed the insect in New Haven, Milford, Hamden, Cheshire, Durham, Hartford, Bantam, Litchfield, Mansfield and Groton. It is therefore known to be present in all of the eight counties of the State except Windham County, but as Mansfield borders on Windham County, it may be considered as being distributed all over the State. Though the work of this insect has been chiefly upon apple, sweet cherry trees in New Canaan were partially defoliated in 1921. On June 24, Mr. Zappe and the writer visited Stamford, Greenwich and Port Chester, N. Y. At that time the moths had just emerged and when disturbed fairly swarmed about some of the infested apple trees in Port Chester. They were also resting upon flowers in the field, nearly every daisy blossom having one or more moths upon it. Smaller numbers of the moths were seen in Greenwich.

The larvae feed upon the upper surface of the leaves, partially and sometimes entirely skeletonizing them. The larva spins a

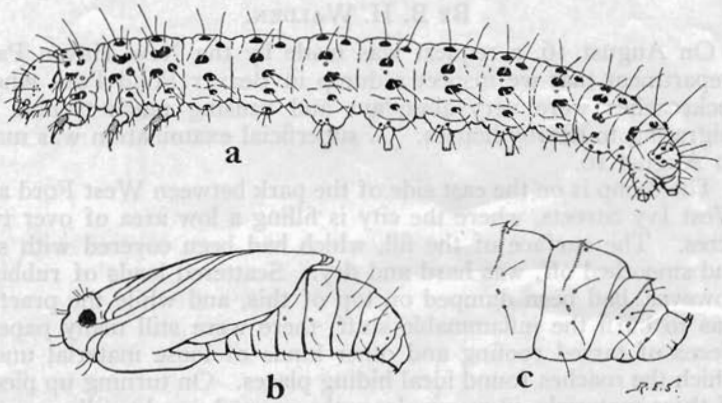

Figure 6. Apple and thorn skeletonizer. a. larva; b. female pupa; c. caudal extremity of male pupa, all greatly enlarged. Drawing lent by U. S. Bureau of Entomology.

light web over the center of the leaf, curling it upward and drawing the margins together especially toward the tip. The leaves are not webbed together like those in the nest of the fall web-worm. In badly infested districts, unsprayed orchards may be completely defoliated. In fact some of the trees in Port Chester observed by the writer on June 24 were quite brown from the attacks of the larvae, and no doubt the injury from later broods would be even more severe because the insects are usually more abundant. Adults were also present and fairly common around New Haven the last days of October, and several were observed on the laboratory windows. Mr. Zappe found the adults to be fairly common

at New Canaan, while inspecting nurseries, and larvae of all sizes were observed. A Tachinid fly *Exorista pyste* Walk. was reared from the pupae.

The structures of the larvae and pupa are shown in the drawing, figure 6. and the appearance of the adult, larva and pupa, is shown on Plate IV, b and c. Further studies will be necessary to ascertain the exact life history of this insect in Connecticut.

Spraying with lead arsenate is the remedy, though it may be necessary to make applications late in the season to prevent injury from the late brood, as the poison applied in May or June is sometimes washed off or new leaves may grow so that the larvae are able to feed upon them without being killed by the poison.

ABUNDANCE OF THE GERMAN ROACH IN A CITY DUMP.

Blattella germanica Linn.

By B. H. Walden.

On August 16, a request was made by the New Haven Park Department that we inspect a dump in Beaver Pond Park where cockroaches were very abundant and causing much trouble by migrating to nearby houses. A superficial examination was made on August 16.

The dump is on the east side of the park between West Ford and West Ivy Streets, where the city is filling a low area of over two acres. The surface of the fill, which had been covered with soil and smoothed off, was hard and dry. Scattered loads of rubbish, however, had been dumped on top of this, and while the practice was to burn the inflammable stuff, there were still many papers. pieces of tarred roofing and other kinds of loose material under which the roaches found ideal hiding places. On turning up pieces of these materials, in many places the ground was literally covered with all stages of the German roach or croton bug, *Blattella germanica* Linn. A few days later a more careful examination was made. It was found that the roaches were well scattered over the dump although they were more numerous near the north edge where there was a bank covered with bushes and small trees. Here the roaches were found in numbers under loose bark and in cavities in the trees. Several specimens of the large American roach *Periplaneta americana* Linn., were also found in similar places in the trees. Associated with the German roaches on the dump were a number of the European house-crickets, *Gryllus domesticus* Linn., which is the second record of the occurrence of this species in the State.

The roaches were active at night and swarmed on the nearby houses and street trees. Roaches were found fully a block away from the dump.

A resident of a house at the end of one of the streets adjoining the park told of killing a great number of the roaches on the side of the house with a proprietary roach powder and called attention to a small shade tree in front of the house on which he killed over one hundred in one evening.

Tests to kill the roaches were made by turning over the material under which they clustered and spraying them with kerosene oil. All of the roaches hit with the oil died in a few minutes.

A proprietary spray was tried in the same manner and while it may have killed the roaches more quickly than kerosene, it did not appear to be any more effective and the cost was about twenty times as much.

Sodium fluoride was given a trial by placing a band about three inches wide around a colony of roaches and driving them through it. Twenty of these roaches were placed in a jar and on the following morning all but one were dead.

The Park Department had spread a quantity of calcium chloride around the edge of the area and a number of the roaches were driven for a distance of two to three feet over this material. The next day all the specimens collected were alive. The Park Department greatly reduced the number of roaches by spraying with kerosene and burning as much of the rubbish as possible.

THE MEALY FLATAS.

Ormenis pruinosa Say, and *O. septentrionalis* Spin.

By B. H. Walden.

During the past season the mealy flatas *Ormenis pruinosa* Say and *Ormenis septentrionalis* Spin. have been unusually abundant. These insects belong to the family Fulgoridae of the sub-order Homoptera, and have the popular name of "lantern flies." While they are not considered of special economic importance, when abundant more or less injury must be caused by their sucking the juice from the stems of the large variety of plants which they attack.

The adult of *Ormenis pruinosa* Say is about one-third of an inch in length, with broad wings folded vertically against the sides of the body. With the wings spread these insects have somewhat the appearance of small moths, though the flight is usually short and feeble. The color is dark gray or brownish, covered with a light, powdery substance giving the insect a pale bluish gray appearance.

The eggs are laid in late summer or early fall in long slits just under the bark of twigs, and are placed end to end, forming ridges in the bark an inch or more in length. According to Riley, these eggs hatch about the middle of May. The nymphs and pupae are

greenish white in color and are covered with a whitish, waxy secretion which often remains on the host plant for several weeks after the insects disappear. The adults emerge early in July. There is only one brood during the season. *O. pruinosa* attacks a number of shrubs and plants, having been recorded on about thirty different plants. Specimens sent to this office were attacking grape, currant and gooseberry.

The adult of *Ormenis septentrionalis* Spin. is slightly larger than *O. pruinosa*. The color is a pale bluish green. The habits are probably similar to those of *O. pruinosa* although our records would indicate that *O. septentrionalis* occurs somewhat later in the season. Both species have been found together on the same plant. Adults of *O. pruinosa* in our collection have been taken from July 5 to September 12. The records for *O. septentrionalis* are from August 6 to October 3.

Where these insects are abundant and causing injury to cultivated plants, the treatment would be to spray throughly with a contact insecticide such as kerosene emulsion or 40% nicotine sulphate.

The mealy flatas were much more abundant this season on some grape vines that were not pruned in the spring than they were in an adjoining yard where the vines were pruned to one or two buds of the previous season's growth. This would indicate that these insects can be controlled by pruning to destroy the eggs. The eggs of *O. pruinosa* and the adults of both species are shown on Plate XII.

MOSQUITO CONTROL WORK.

Season of 1921.

By S. T. Sealy.

All of the salt marsh areas in the towns of Branford, East Haven, Fairfield, Guilford, Groton, Madison, New Haven, Orange and Stamford that have previously been drained for mosquito control have been carefully inspected, patrolled and maintained during the season of 1921.

Many of the ditches that were cut a few years ago had to be almost entirely recut, as drainage had been completely stopped, due to growing vegetation. Several hundred feet of new ditches have been installed to drain low places caused by the meadow sinking.

About 250 acres of marsh land in the Shippan Point section, town of Stamford, that were drained for mosquito elimination by private subscription, were approved and accepted by the Deputy in Charge of Mosquito Work. The maintenance and control work has been done under State supervision this season.

No new work has been done under the State law this year.

Some prominent citizens of Clinton and Westbrook are trying to interest their townspeople in the project of draining the salt marshes in these towns. A preliminary survey and estimated cost of drainage has been prepared for them. A stream that drains off a large amount of the storm water from Westbrook Center has caused considerable trouble. The sand shifted by the winds and tide has repeatedly closed up the outlet, making it necessary to dig it out. The labor costs, which have been rather expensive, have been paid by property owners along the shore. The water held back by a closed outlet flooded a large area, making a serious breeding place for mosquitoes. A survey was made of the brook, and plans and estimates were submitted to Mr. Wilson, a property owner on the shore front. The proposed plan calls for a 24-inch wood pipe-drain, from a point north of the beach in the deep part of stream to go in a straight line through the beach to the low water mark. Both ends of pipe line are to be anchored with concrete bulkheads. The outer end is to be fitted with a suitable tide gate and inner one with a grill to keep rubbish from entering drain. Plan also calls for a clean-out chamber to be placed in the pipe line, so as to make it possible to clean out any sand that might work its way in.

Details of the maintenance work in each town are given below :—

Branford.

The tide-gates at Indian Neck, which have seriously hindered mosquito control in that section in the past, have been replaced by new ones. It is now possible to keep the salt water from flooding the area east of the State road. This area when flooded breeds untold numbers of mosquitoes.

The gates are hung on the new road bridge and are of standard construction. They will undoubtedly last a number of years without repairs.

Mr. L. E. Rice has furnished labor and supervised the cleaning of all drainage ditches on the marshes.

The stone dike in the eastern or Stony Creek section of the town is in need of repairs. It is planned to do some repair work on this dike next season in co-operation with the dike association.

East Haven.

The marshes that are drained have been inspected and ditches cleaned. Building operations and land development along the shore west of Cosey Beach have created several extensive mosquito breeding areas by stopping the natural drainage.

Fairfield.

Maintenance work has been under the immediate direction of Mr. Nicholas Matinck. All the salt marsh ditches have been inspected and cleaned. All low swampy places were oiled with fuel oil when necessary.

Several fresh water breeding areas have been permanently eliminated, and all fresh water streams of any importance have been cleaned or oiled. The labor costs of fresh water operations were paid directly by the town.

Guilford.

Maintenance work on the Guilford marshes has been done by Mr. Frank Blatchley. The drainage ditches are in excellent condition.

On July 18, 1921, a complaint was received at this office saying that mosquitoes were very numerous in Guilford Center. The writer made an inspection of the marshes and a night collection was taken to determine what species of mosquitoes were causing the annoyance.

Following is report of inspection and collection: Inspection made on the marshes July 20, 1921. All ditches draining and in proper condition, scattered surface breeding.

Result of night collection of ten minutes duration taken at Guilford Green:

Mosquitoes taken	15	specimens
Salt marsh species	6	"
Fresh water species	9	"

The heavy infestation of mosquitoes at this time was due to heavy rainfall and exceedingly high tides, causing water to stand in places that under normal conditions would be dry.

Groton.

Salt marsh was regularly inspected and ditches cleaned as often as necessary.

Madison.

Mr. Russell Bartlett has been employed on the marsh land which is not included in the Hammonassett State Park Reservation.

Mr. Joseph P. Synnott has directed the work on the marshes controlled by the State Park Commission and several new ditches have been installed for better drainage.

New Haven.

The marsh along West River from Congress Avenue to Derby Avenue was found to be in very poor shape: several large breed-

ing areas had been formed from lack of proper drainage. This area was inspected and ditches installed wherever necessary to insure good drainage. All other marsh areas in New Haven were inspected, patrolled and the ditches kept cleaned throughout the season.

ORANGE. (West Haven)*

Several hundred feet of new ditches were installed in the marsh area between Beach Street and Blohm Street, West Haven. The pipe drain at Peck Avenue was cleaned out several times during the season.

It will be necessary to repair or build a new tide-gate at Beach Street next season, as it is now impossible to keep the tide water from flooding the meadow and forming mosquito breeding areas.

STAMFORD.

The marsh lands in the Shippan Point section of Stamford have been inspected, patrolled and the ditches cleaned several times during the season. It has been necessary to use a considerable amount of fuel oil on the low swampy places and some of the long drainage ditches.

COST OF MAINTENANCE, SEASON 1921.

Madison	$. 207.00
Guilford	421.50
Branford	1,179.00
Fairfield	1,624.85
New Haven	796.85
Orange	152.00
West Haven	130.10
Groton	72.00
Stamford	258.15
East Haven	90.00
Total	$4,931.45

The total cost for the season is $4,931.45, of which one-fourth, or $1,232.86, is borne by the State. The other three-fourths, or $3,698.59, is collected by the State Comptroller from the towns.

*The town of Orange was divided by the Legislature, and after July 1, 1921 all of the shore portion where this work was done has been called West Haven.

MISCELLANEOUS INSECT NOTES.

Dog Biscuit Infested with Drug Store Beetle:—On June 20, samples of dog biscuit were brought to the Station which had been attacked by the drug-store beetle, *Sitodrepa panicea* Linn. One cake was riddled with holes. This insect is known to attack a large number of stored vegetable foods, and certain plant products used as drugs. Frequent heating or fumigating with carbon disulphide are the remedies.

A Leaf Roller of Hickory:—A number of leaf rollers were collected from a large hickory tree near Forest and Chapel Streets, New Haven, on June 9, by Messrs. Britton and Zappe. The larvae were about an inch in length, yellowish-green, and rolled the leaves in a conspicuous manner. On June 21, three adults emerged. These had a wing-expanse of about an inch, were dark brown, with darker oblique bands on the forewings. Specimens were sent to the Bureau of Entomology, Washington, D. C., and identified by Mr. Carl Heinrich as *Eulia juglandana* Fernald, a species not hitherto recorded from Connecticut.

The Stalk-Borer:—Considerable injury was done to corn and other vegetable crops in 1921, by the stalk-borer, *Papaipema nitela* Guen., which was received from New Britain, Middletown, and Hamden in corn and from Hockanum, Windsor and Cromwell in tobacco. Though we may expect to find the larva of this insect in all kinds of herbaceous stems, these are the first specimens that the writer has seen injuring tobacco plants. A full account of this insect, with illustrations, may be found in the Report of this Station for 1919, page 180.

An Enemy of Japanese Iris:—During June, Mr. F. A. Bartlett of Stamford informed the writer that the blossoms of his Japanese iris plants had been injured and some of them ruined by small black weevils which ate the petals. He was asked to send specimens, and on returning home hunted for some but could not find a single specimen. Later in the season he discovered what he took to be the same species, breeding in the seed pods, and he sent specimens. It proved to be *Mononychus vulpeculus* Fabr., a weevil known to breed in the seed pods of the native flag *Iris versicolor*.

A Curious Caterpillar on Bayberry:—On June 5, Miss G. M. Finley brought to the laboratory some peculiar larvae which were found feeding upon the leaves of bayberry in Hamden. They were about the same color as the leaves, and in outline were notched or serrated. They pupated on June 18, making a loose cocoon of bits of leaf webbed together. Later the adults emerged,

and proved to be beautiful little Geometrid *Aplodes mimosaria* Guenee. Wing-expanse about one inch, color pale green, both front and rear wings being crossed by two narrow whitish lines; fringe pale yellow, costal margin of forewings white, antennae, legs and abdomen white.

Paria canellus Injuring Japanese Walnut:—On April 26, specimens were received from Dr. W. C. Deming of Wilton, with a statement that the beetles were feeding upon the tender terminal leaves of Japanese walnut, thus checking the growth and injuring the trees. The beetles received represented three varieties of the strawberry root worm or borer, *Paria canellus* Fabr., as follows: *aterrimus* Oliv., *gilvipes* Dej., and *quadrinotatus* Say. These beetles are usually abundant and feed upon a large number of plants. Spraying the buds and new leaves frequently with arsenate of lead will prevent extensive injury.

A Bayberry Beetle:—On June 24, Messrs. Zappe and Britton observed that many bayberry bushes along the railroad between Saugatuck and South Norwalk had been defoliated by small shiny green beetles. Many were collected and proved to be *Colaspis favosa* Say, a species accredited to Dakota and Florida, and not previously recorded from Connecticut. These beetles vary in color, some being bluish, some greenish, but all have a bronzy metallic luster. The wing-covers are deeply and regularly punctate. There is also considerable variation in size, the average being about three-sixteenths of an inch in length. As the bayberry is not cultivated except perhaps in parks and on large private estates, this beetle cannot be said to be causing injury. Spraying with lead arsenate will prevent defoliation.

Larvae Feeding Upon Witch Hazel:—On June 2, some curious coiled larvae were found on witch hazel in North Branford by Messrs. Walden and Zappe. They were greenish-white with noticeable granular wax secretion and about one and one-half inches long. They were not carefully examined at the time but on account of their coiled resting position, were supposed to be saw fly larvae and put in a rearing cage. They were nearly full grown and pupated in due season. On October 4, two Noctuid moths emerged which we identified as *Conistra indirecta* Walker, commonly labeled in collections as *Scopelosoma moffatiana* Grote. The forewings are bright rust red with three narrow darker transverse bars. Wing-expanse, about one and one-fourth inches. Larvae are shown on Plate XIII, a.

A New Pest of Willows:—On June 24, Messrs. Britton and Zappe visited several localities in Fairfield County, and in company with Mr. F. A. Bartlett of Stamford, examined several willow trees in Greenwich and Port Chester, N. Y., which had been

partially defoliated by the larvae and adults of a small bluish-green leaf beetle, *Plagiodera versicolora* Laich. This insect is about three-sixteenths of an inch long and is an European species which has recently appeared in the vicinity of New York City; from this point it has now spread into Connecticut and New Jersey. It feeds upon willow and poplar, and injured leaves are shown on Plate XIII, b. Spraying with arsenical poisons is an effective means of control.

An Engraver Beetle Injuring Pine:—On August 30, there was brought to the laboratory, a section of the wood and bark of the trunk of a large white pine tree which had recently died, at Putnam. There were many holes in the bark, and some of these contained Scolytid beetles which were identified as *Ips calligraphus* Germ. This is the largest Scolytid occurring in the north-eastern states and is usually found in dying trees and logs. According to Swaine[1] it enters trees green enough to form pitch tubes, and may at times be considered a primary enemy. Apparently the owner considered that the beetles were responsible for the death of the tree, but no examination was made from this office, and possibly the tree was first injured by some other cause.

Larkspur Plants Injured by Mites:—For a number of years, the writer has observed in his own garden and elsewhere an occasional plant with the newer leaves curled and swollen unnaturally, and that such plants failed to blossom. At first this was thought to be of bacterial origin, but on referring specimens to the botanical department, the report came back that no bacteria or fungi were found. Specimens of such plants were received from Ansonia on May 31, and from New Haven on June 1 and June 3, and are shown on Plate XIV, a. On examining the tissues a few mites were noticed and these were afterward examined by Dr. Garman who identified them as belonging to the genus *Tarsonemus* and probably being *T. pallidus* Banks, the same species known to attack and cause similar injury to chrysanthemum, snap-dragon and cyclamen.[2] If this proves to be true, possibly the plants may be saved by several thorough sprayings with nicotine solution and soap(1 teaspoonful in 1 gallon of water).

The Barberry Web-Worm:—On September 9, twigs of Japanese barberry containing webs and nearly full-grown larvae, were received from Mr. Walter Shaw, New Haven, with a request for information regarding the identity and habits of the insect. The adult is a moth belonging to the family Pyralidae, and bearing

[1] Swaine, J. M., Canadian Bark-Beetles, Part II, 112, 1918.
[2] Report of Connecticut Agricultural Experiment Station for 1914, page 176.

the name of *Omphalocera dentosa* Grote. A full account of this insect with illustrations appeared in an earlier report of this Station.[1] The larvae are black, checkered with white and are less than an inch long when fully grown. They live in tube-like cases formed of leaves and excrement webbed together. The adult moth has a wing-expanse of between one and one and one-fourth inches, and is of a dusty brown color, with a darker area near the center of the costal margins of the forewings. This insect was quite abundant in 1911 and 1912, and defoliated some barberry hedges around New Haven. Apparently it shows a preference for the common barberry *Berberis vulgaris,* but also occasionally attacks the Japanese barberry *B. Thunbergii.* Spraying with lead arsenate will prevent injury by this insect.

The Bumble Flower Beetle Injuring Corn:—On August 29, an ear of sweet corn was received from Mr. C. D. Clark, County Agricultural Agent, Danbury, Conn., from the field of H. M. Knapp, containing a specimen of the bumble flower beetle *Euphoria inda* Linn., which was eating the immature kernels as shown on Plate XV, a. This beetle usually feeds upon fermenting sap, decaying fruits, etc., and is sometimes found in connection with injury caused by other insects. We might expect to find it following the work of the corn ear worm, but in this case it appeared to be the primary cause of injury; it has also been recorded[2] as injuring unripe corn in this manner. On September 12, another specimen was received from the field of G. N. Peterson of Unionville, through B. G. Southwick, County Agricultural Agent, Hartford, on the same ears where corn ear worm was feeding. The beetle is yellowish-brown, sprinkled with small black dots. It is about half an inch in length, and appears in late summer and early fall. There is only one generation each year and the insect breeds in rotting turf, manure, and other decaying vegetable matter. Hand picking is the best remedy for the control of this insect on sweet corn.

The Box-Wood Leaf Miner in Connecticut:—On December 15, 1921, when the manuscript of this report was nearly finished, specimens of the box-wood leaf miner or midge *Monarthropalpus buxi* Labou., were received from South Norwalk. This is an European pest discovered in this country in 1910, but not previously recognized as occurring in Connecticut. The adults emerge the latter part of May and first of June, and lay their eggs. The winter is passed by the larvae which are nearly grown. The most

[1] The Pyralid (*Omphalocera dentosa* Grote), A Pest of Barberry Hedges, Report Connecticut Agricultural Experiment Station for 1911, page 292.
[2] Manual of Vegetable-Garden Insects, by C. R. Crosby and M. D. Leonard, page 231, 1918.

promising control measures should be applied at the time that the adults begin to emerge. Hamilton[1] found that spraying both upper and under surfaces of the leaves with common molasses, one part in three parts water, caused nearly all the adult flies to become entangled in the sticky spray before they could lay eggs. Also spraying once with Black Leaf 40 and once with Black Leaf resinate, each diluted one part to 500 parts water, killed about 80 per cent. of the flies, but this should be repeated every four or five days during the period while the adults are emerging.

The Resplendent Shield-Bearer:—During the season it has been rather common to find apple leaves with several holes through them, caused by the mines of the resplendent shield-bearer, *Coptodisca splendoriferella* Clem. The writer noticed this form of injury on his own grounds, and the winter cases of the insect were received from Danielson, March 15. In preceding years this insect was received from Newtown, February 13, 1913, and from Greenwich on cherry November 17, 1920. It was first recorded from Connecticut by Dr. W. C. Sturgis[2] in 1893, as injuring quince trees in Cheshire. This insect occurs throughout the northern United States from Maine to Minnesota and has been reported from Canada.

The adult is a beautiful gray moth with golden head and ends of forewings marked with gold, silver and dark brown streaks. The eggs are laid on the leaves in May and the young larvae make a blotch-shaped mine in the leaf nearly one-fourth of an inch in diameter. When nearly full grown each larva lines its mine with silk and cuts out the case in the shape of a shield, and goes to the bark. These little cases are fastened to the bark of trunk and twigs and inside the larvae pass the winter. The mines and the winter cases are shown on Plate XIV, b. Very little has been published about this insect and one of the best accounts is by Comstock.[3] A good recent account, though brief, is given by Slingerland and Crosby.[4] There are two broods each season. Where orchard trees are thoroughly sprayed with lead arsenate including nicotine sulphate, probably there will be little or no injury from this curious little insect.

Flea Beetles and Tobacco Wild Fire:—During the tobacco wild fire epidemic in the tobacco seed beds in the spring of 1921, quit a number of flea beetles, *Epitrix cucumeris* Harris, were present. It has long been known that insects often carry diseases

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[1] C. C. Hamilton, Journal of Economic Entomology, Vol. 14, page 359, 1921.
[2] Report Connecticut Agricultural Experiment Station for 1893, page 80.
[3] Report U. S. Department of Agriculture for 1879, page 210.
[4] Manual of Fruit Insects, page 75, 1914.

from plant to plant. With this in mind, several attempts were made to transmit the wild fire disease from diseased to healthy plants by means of flea beetles.

Dr. Florence A. McCormick of the botanical department and the writer carried on a few simple co-operative experiments to see if this could be done. Beetles were captured from infected seed beds and then confined in cages containing healthy plants. Others were captured on tomato plants and were confined in petrie dishes containing leaves on which there were large diseased areas. They were then transferred to cages containing healthy plants. In every case the beetles had first eaten diseased plants and later healthy ones. Seventeen attempts were made to transmit the tobacco wild fire disease in this way, but in no case were we successful in producing the disease on healthy plants. These experiments are altogether too meager to be conclusive and should be continued. M. P. Zappe.

Apple Seed Chalcid in Connecticut:—The presence of the apple seed chalcid *Syntomaspis druparum* Boh., in Connecticut, was discovered August 19, 1921, by Dr. Philip Garman, at Cornwall, where some wild apples were badly infested, nearly every fruit showing the external punctures. Dr. Garman afterwards found a few cultivated apples in Mr. Frank N. Platt's orchard at Milford which had been attacked by this insect. The punctures resemble those of the false red-bug, but on cutting open the apple a hard streak will be found connecting each puncture with a seed. This insect is an European species first discovered in this country by Prof. C. R. Crosby at Ithaca, New York, in 1906. It is known to occur throughout the northeastern United States at least as far west as Michigan, and as far south as Virginia. Most of the commercial varieties are not subject to attack but the lady apple and crab apples are often injured. Though there is only one generation each season, and the winter is passed by the larvae in the seeds, it has been found that only a part transform and emerge as adults the following spring. In fact more than half (55 per cent.)[1] lived over two winters in the seeds before transforming. About the only artificial means of control consist in destroying all drop fruit and culls, especially of the wild seedling apples and crab apples. If made into cider the pomace should be destroyed in order to kill the larvae in the seeds, which would probably not be crushed in the press.

Termites Injuring Telephone Wires:—During a damp spell of weather in July 1921, the Southern New England Telephone Company reported insects eating the insulation from their tele-

[1] *Syntomaspis druparum* Boh., The Apple Seed Chalcid, by R. A. Cushman, Journal of Agricultural Research, Vol. VII, page 487, 1916.

phone wires. The writer and one of the Telephone Company's engineers visited the scene of the trouble, which was in the basement of the office building of the New York, New Haven and Hartford Railroad Company. The wires from their switchboard went down to the basement and then up to the various offices in the building. All of the wires were insulated first with rubber and then a fabric covering over the rubber. It was necessary to have all the wires pass from a corridor into another room in the basement before going upstairs. The wires were all massed together, wrapped with tape and conducted through a hole in the top of the door frame. At this point the termites had chewed off the insulation and in some cases exposed the copper wire. Wherever the wire was completely bare, moisture would collect and electrolysis set in, and caused trouble with the telephone service. See Plate XVI, a. The door frame was taken apart and the colony of termites found. The building is built entirely of steel and masonry, and all the termites were in this single wooden door frame. Nobody knew where they came from unless they were in two large boxes of sawdust that were stored nearby. It was recommended that the entire door frame be taken apart and sprayed either with kerosene or hot water and soap.

Late in the fall inquiries were made at the office of the Telephone Company, and the reply stated that no further trouble had been reported. Specimens were not taken for identification, but probably this insect was *Reticulitermes flavipes* Kollar, a species common in this locality. M. P. Zappe.

Rhododendron Lace Bug:—During the summer of 1921, one of the Connecticut nurseries had a serious outbreak of the rhododendron lace bug *Leptobyrsa rhododendri* Horv. The nursery firm thought that the insects were brought in on rhododendrons which they had bought from a North Carolina nursery. This insect is not new to Connecticut, having been taken in Rockville, South Manchester, Middlebury, Greenwich, New Haven and Hamden.

The nursery was visited on July 6, 1921. At this time the insect was in the adult stage. Eggs were also present but no nymphs. Other visits were made during the summer but no nymphs were found at any time. Apparently there is but one brood in Connecticut, although two broods have been recorded from New Jersey. Injured leaves are shown on Plate XV, b. The insects cause injury to the leaves by sucking out the juices from the under side. The injured leaves show whitish spots or lines scattered all over the surface. Often the leaves have a tendency to curl and in extreme cases turn brown and drop off. The under side of the leaves are disfigured by brownish spots along the midrib under which the eggs may be found, also by the excrement of the insects.

Several sprays were tried as control measures. As this is a sucking insect and feeds on the under side of the leaves, a contact spray must be used and must be applied to the under side of the leaves to hit and kill the bugs. One pound of common laundry soap to eight gallons of water sprayed on the under side of the leaves killed all lace bugs that were hit.

Nicotine sulphate (2 teaspoonsful to 1 gallon of water) and one-half ounce of soap was a very effective remedy and killed all that were reached by the spray.

Kerosene emulsion made as follows:

Kerosene	2 gallons
Water	1 gallon
Soap	½ pound

Dissolve soap in hot water, add kerosene and churn until a creamy emulsion appears. Dilute nine times. This was also effective in controlling this insect but more trouble to prepare than some of the other sprays.

Scalecide, 1 part in 25 parts of water, was also tried, but most of the insects ten minutes after spraying were still alive and crawling around on the leaves. Some were killed, but the majority escaped.

This is not an especially hard insect to kill, but perhaps it may be necessary to spray twice in order to kill them all. A few might escape the first treatment which would be killed by the second.

M. P. Zappe.

Parandra Borer Injuring Maple Tree:—On August 10, 1921, the writer examined a sugar maple street tree in front of the premises of Mr. T. S. Allis, 54 Atwater Avenue, Derby. This tree had been injured in preceding years by the maple borer, but in the spring had leafed out well and later the leaves dried up and dropped, only a few green ones remaining. In the trunk which was nearly all dead there were many (perhaps 40-50) exit holes. These holes were nearly circular, but slightly flattened, and in some of them were found living or dead specimens of *Parandra brunnea* Fabr. One beetle was crawling upon the bark of the trunk. The illustrations on Plate XVI, b, show the holes in the trunk and the appearance of the adult beetle. The borer belongs to the Order Coleoptera and family Cerambycidae, and is known to attack and kill various fruit and shade trees, particularly if they have been injured previously. It usually lays its eggs in the dead or decaying wood where a tree has been mutilated or otherwise injured. Chestnut telephone poles are occasionally damaged by this borer, which has also been recorded from ash, black walnut, hickory, beech, chestnut, chinquapin, oak, elm, willow, tulip tree, locust, ailanthus, maple, bass-wood, apple, pear, plum, wild and

cultivated cherry, and pine. According to F. E. Brooks,[1] old apple, pear and cherry trees are especially liable to attack, particularly if they have hollow bases, cavities or decaying areas in the trunk, or if storms have broken their larger branches. Hart[2] calls this insect the heart-wood borer because it tunnels in the heart wood, but its attacks are not confined to the heart wood but may involve the sap wood, either dead or living. Most of the injury is usually in the main trunk or in case of telephone poles according to Snyder,[3] near the ground line or from one to two feet above it.

On July 26, 1905, this beetle was received from South Manchester, where it was found boring in the trunk of an oak tree.

The Parandra borer is a flattened brown beetle nearly three-fourths of an inch in length and emerges during July and August. The female lays eggs in small punctures in the wood around wounds and decayed places, in groups of ten or twelve. The egg is creamy-white, oblong-ovate, and about 1.5 mm. long by .5 mm. thick. It hatches in two or three weeks, and the larva is yellowish-white with a black head. The galleries are very crooked and long but the larva never gets very far away from its hatching point, and when mature, pupates in a cell at the terminus of its burrow. No sawdust is thrown out from the burrows of this beetle, and it is thought that three years are required for this insect to pass from the egg to the adult stage.

As the attacks of this borer always or nearly always follow some other injury or mutilation, the trees should be kept in the best possible condition; remedial measures should be directed against other borers, and if a tree is injured or mutilated, the wounds should be given attention and all cavities cleaned out and filled. All unprotected wood surfaces should be dressed with paint. If all of these matters are given thorough and prompt attention there will be little chance for the entrance of the Parandra borer.

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[1] The Parandra Borer as an Orchard Enemy, Bulletin 262, U. S. Department of Agriculture, 1915.

[2] The Heart-Wood Borer, 26th Report of the State Entomologist of Illinois, page 68, 1911.

[3] The Chestnut Telephone-Pole Borer, Bulletin 94, Bureau of Entomology, U. S. Department of Agriculture, page 3, 1910.

INDEX.

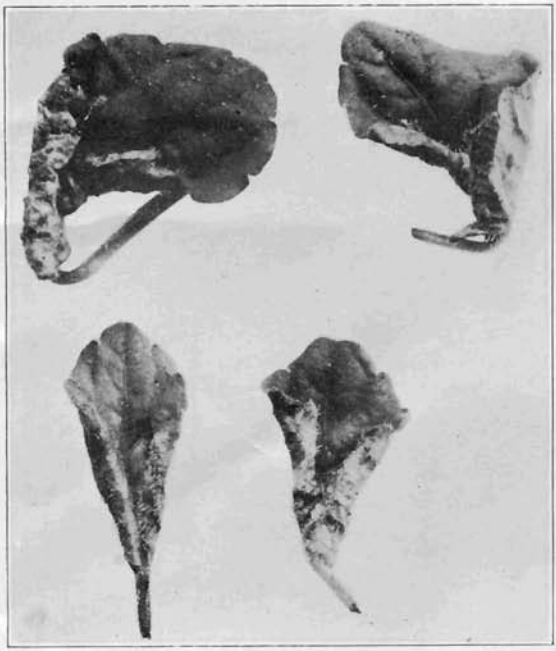
ILLUSTRATIONS.

The illustrations in this report (Bulletin 234) are from the following sources:—text figures are all from drawings as follows:—Figure 1, map drawn by A. E. Moss; Figure 2 drawn by Philip Garman; Figures 3, 4 and 5, from Spray Calendar drawn by Mrs. E. L. Beutenmüller; Figure 6, drawn by R. E. Snodgrass, lent by the U. S. Bureau of Entomology. The Plates are all from photographs; Plates I, III, a, IV, a, by W. E. Britton; Plate II, by Philip Garman; Plates IX, a, c, and d, X, a, by H. A. Doty; Plate XIV, b (except inserts), from the report for 1893 by W. C. Sturgis; all others by B. H. Walden.

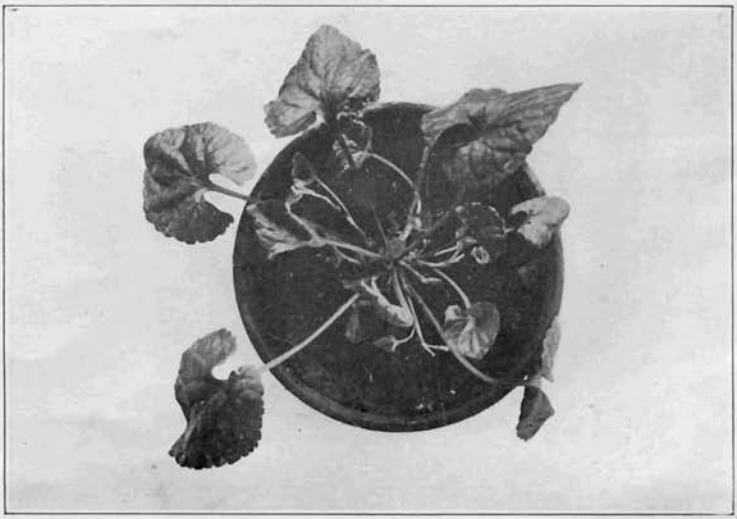
a. Spraying nearby foliage with auto power sprayer, Mechanicsville.

b. Spraying a tall tree with auto power sprayer, Mechanicsville.

PLATE II.

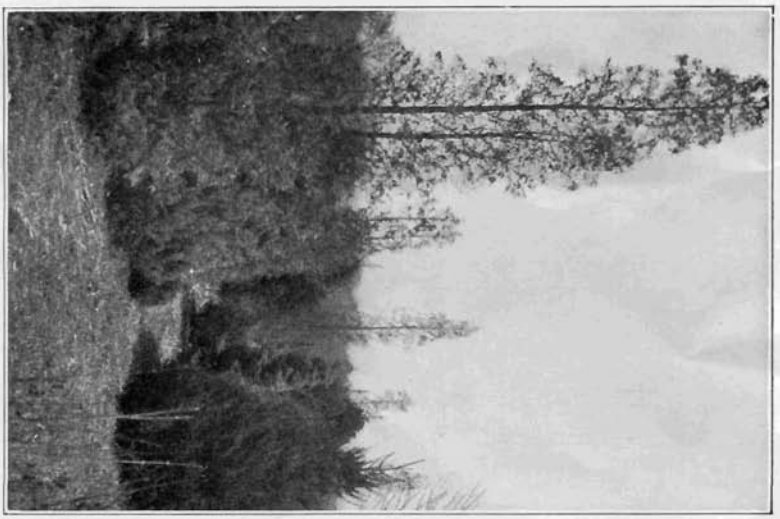


a. Infested and distorted leaves or "galls." About natural size.

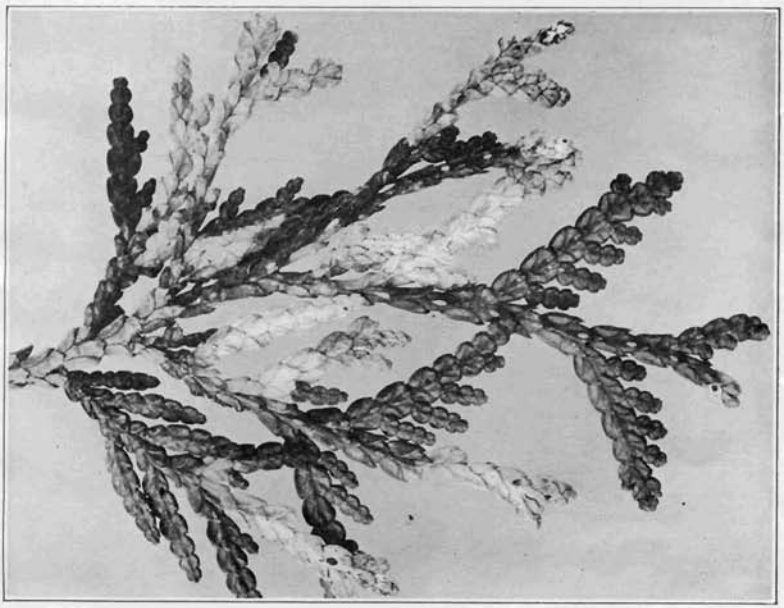


b. Infested plant showing distorted leaves.

VIOLET GALL MIDGE.



a. Large trees in nursery which were seriously injured and turned brown.

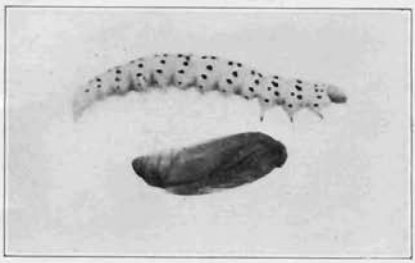


b. Twig of arbor vitae showing mined leaflets. Twice enlarged.

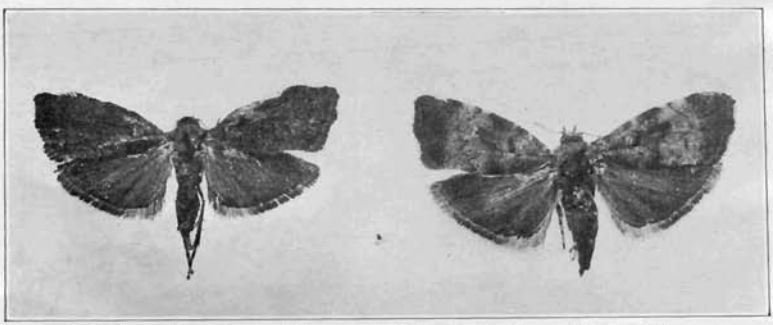
ARBOR VITAE LEAF MINER.

PLATE IV.

a. Block of pyramidal arbor vitae where experiments were conducted.



b. Larva and pupa of apple and thorn skeletonizer. Four times enlarged.

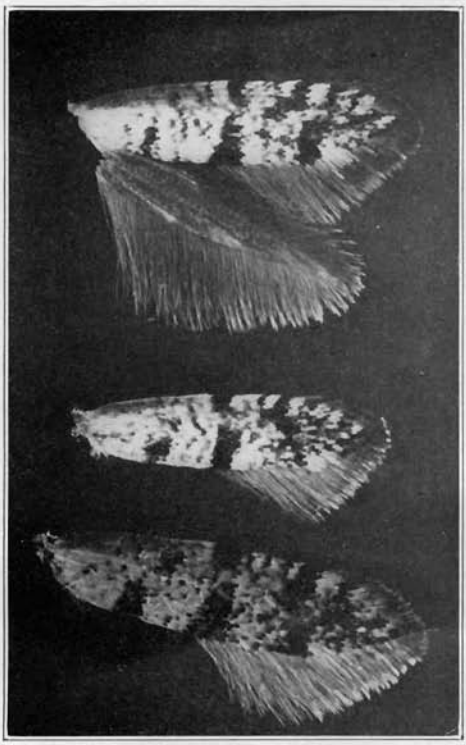


c. Adults of apple and thorn skeletonizer. Four times enlarged.

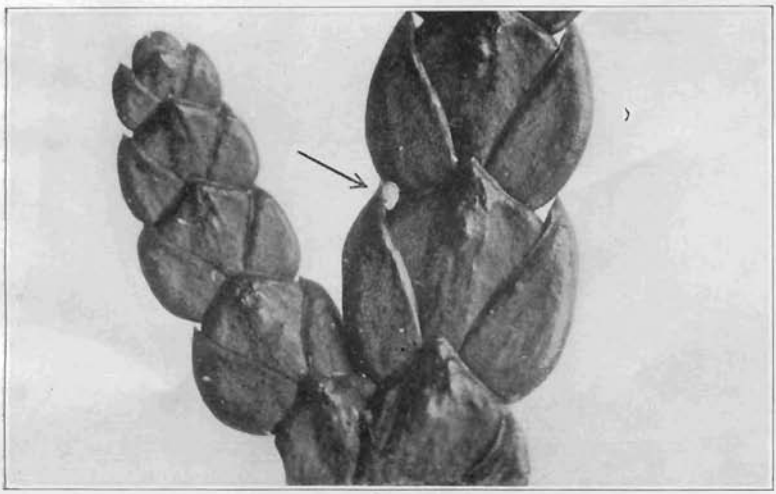
ARBOR VITAE LEAF MINER AND APPLE AND THORN SKELETONIZER.

a. Larva. Six times enlarged.

b. Pupae. Six times enlarged.



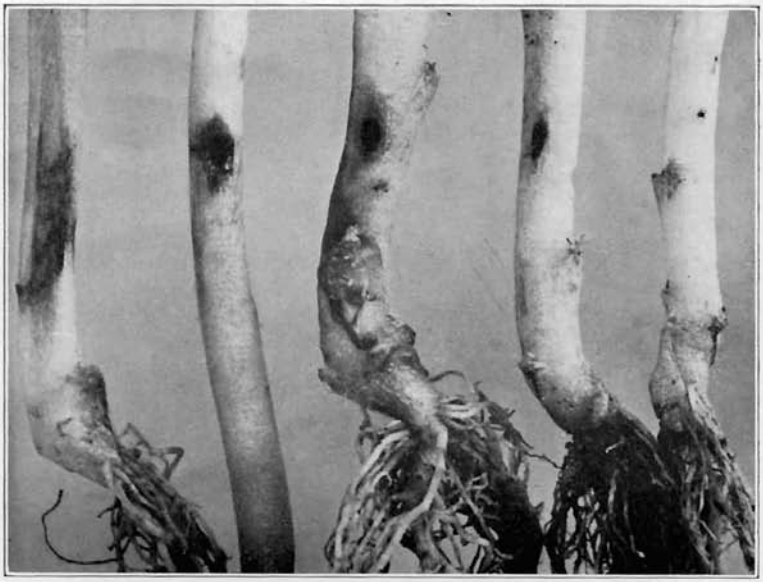
c. Wings of adults. Twelve times enlarged.



d. Egg on leaflet. Twelve times enlarged.

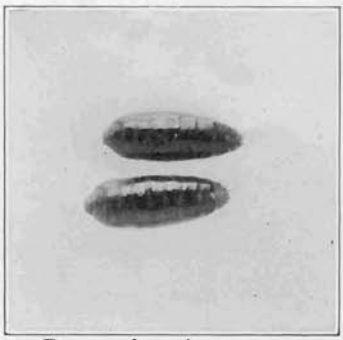
ARBOR VITAE LEAF MINER.

PLATE VI.

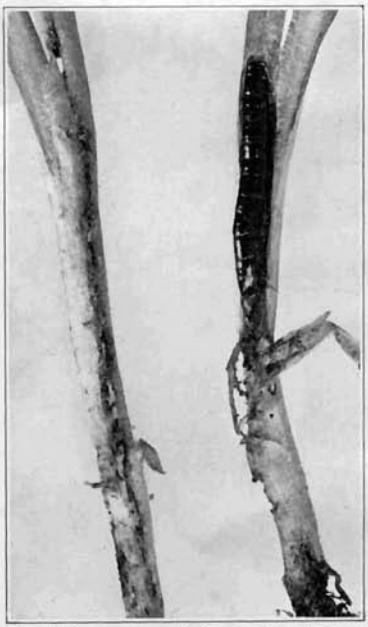


a. Stems of newly-set tobacco plants, showing injury by seed corn maggot. Twice enlarged.

b. Adult of seed corn maggot. Four times enlarged.

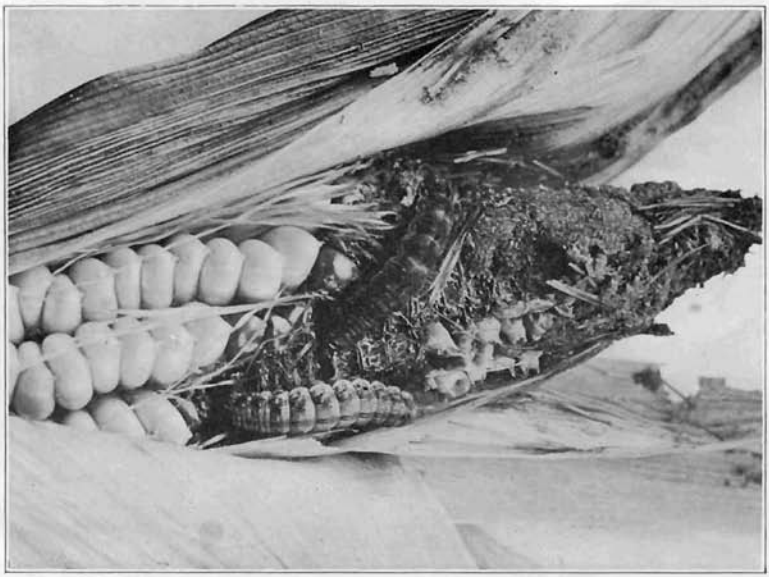


c. Pupae of seed corn maggot. Four times enlarged.

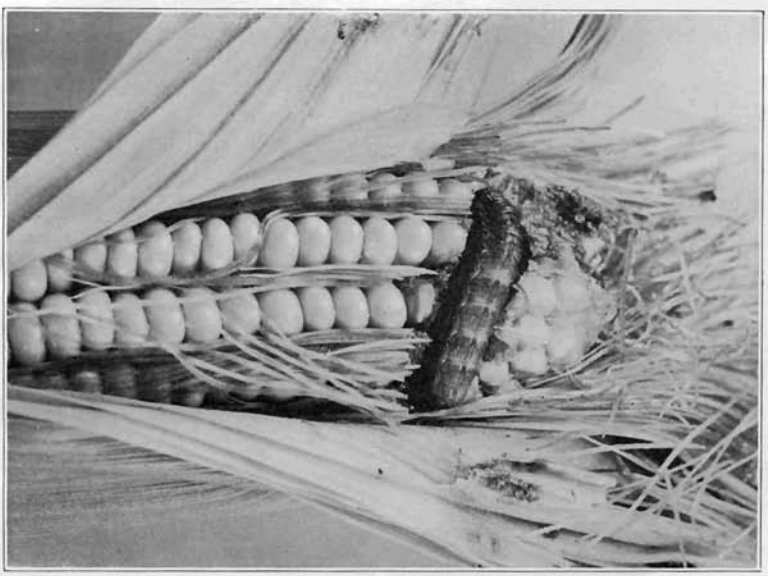


d. Wire worm injury on tobacco plants. Twice enlarged.

TOBACCO PLANTS INJURED BY SEED CORN MAGGOT AND WIREWORMS.



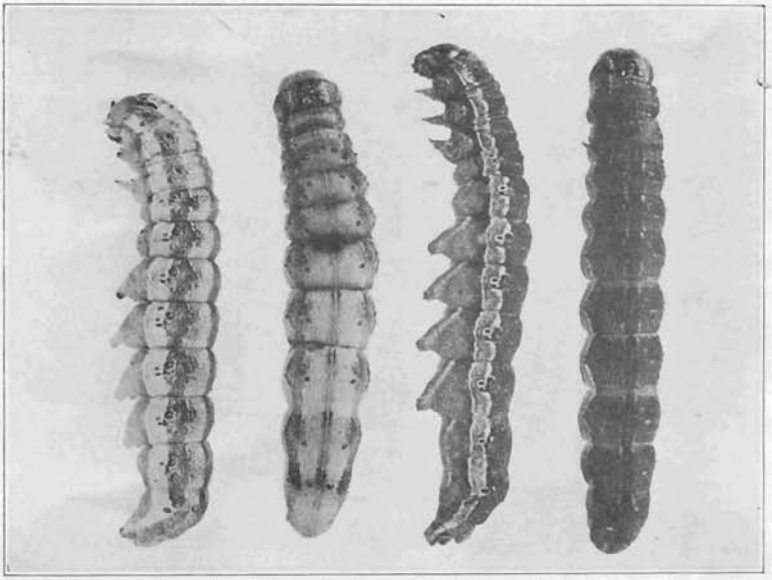
a. Light and dark larvae, feeding at tip of ear. Natural size.



b. Medium colored larva. Natural size.

CORN EAR WORM.

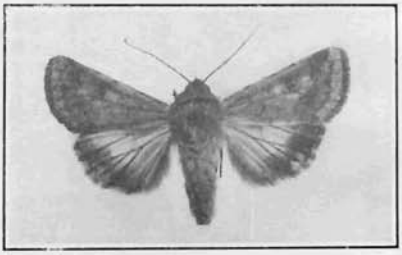
PLATE VIII.



a. Larvae, dorsal and lateral views showing variations in color and markings. Twice enlarged.

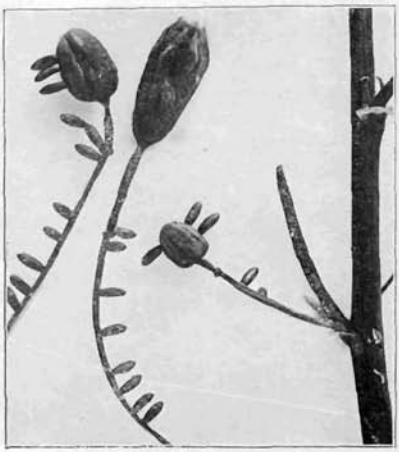
b. Tip of ear of corn showing where a half-grown larva has eaten through the husk. Natural size.

c. Pupa.
Natural size.



d. Adult moth. Natural size.

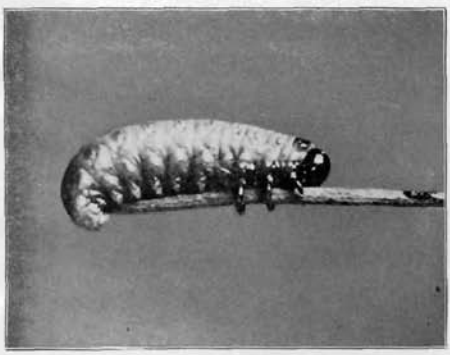
CORN EAR WORM.



a. Eggs of common asparagus beetle as laid upon mature stems. Much enlarged.

b. Common or blue asparagus beetle. Enlarged about five times.

c. Eggs of common asparagus beetle as laid upon tender shoot. Natural size.

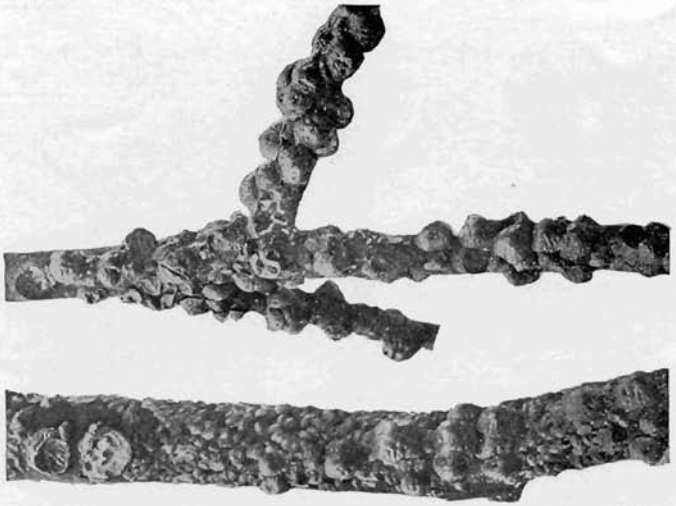


d. Larva of common asparagus beetle. Much enlarged.

e. Red or 12-spotted asparagus beetle. Enlarged four times.

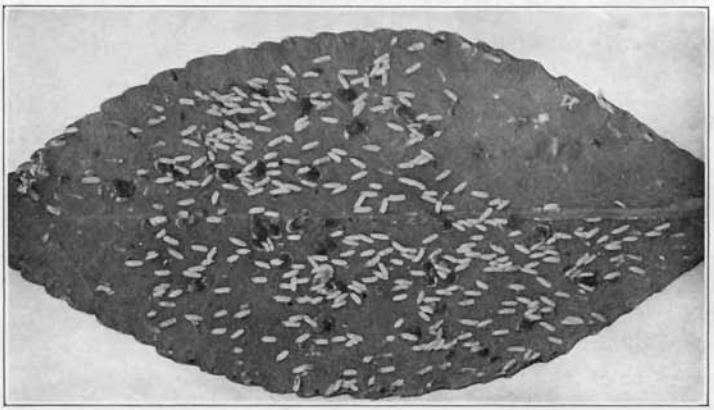
ASPARAGUS BEETLES.

PLATE X.



a. Tulip-tree scale. The large brown hemispherical shells are the females, and the smaller gray shells on lower twig are those of the males. About natural size.

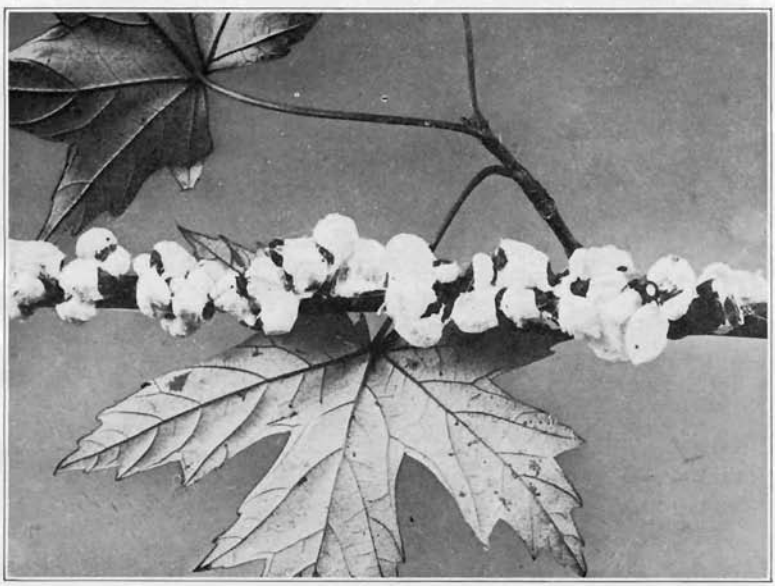
b. Terrapin scale. Natural size.



c. Euonymus scale. The narrow white shells are those of the males: the larger pear-shaped gray ones are females. Twice natural size.

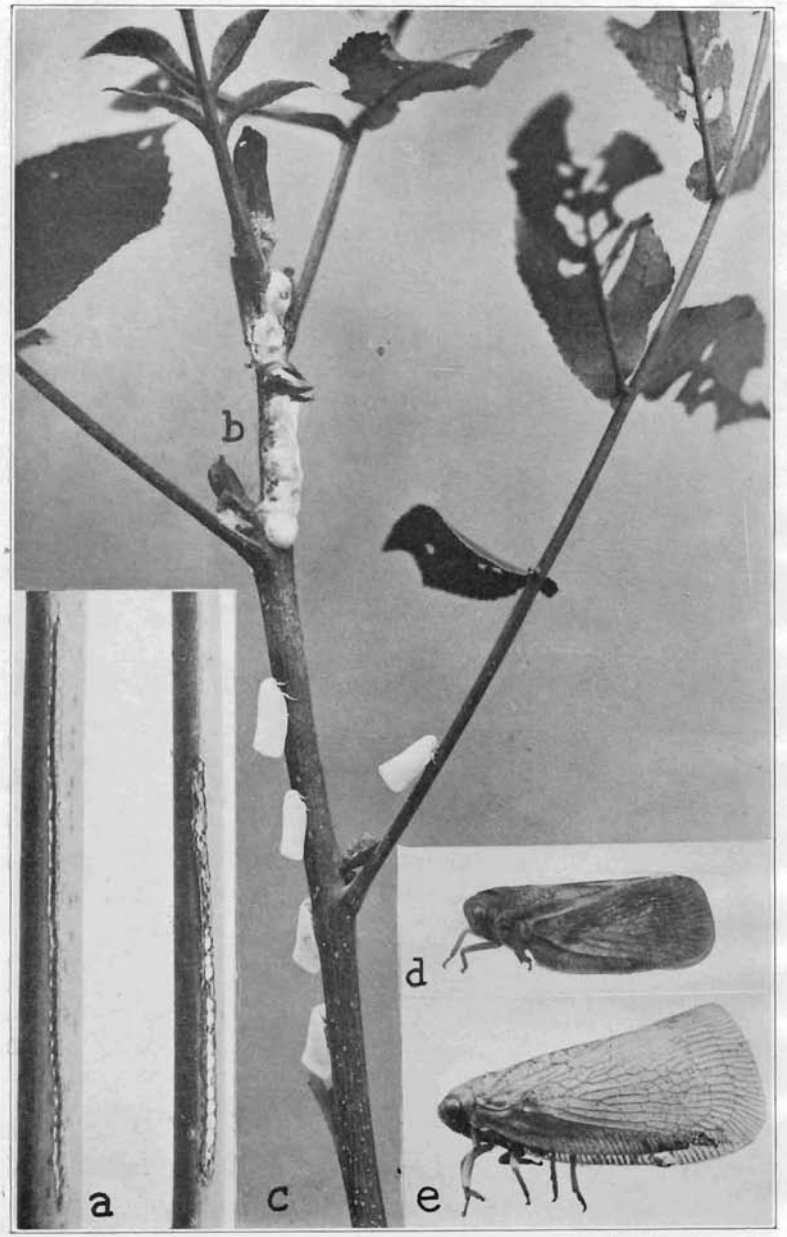
SCALE INSECTS.

a. Pine leaf scale. Twice enlarged.

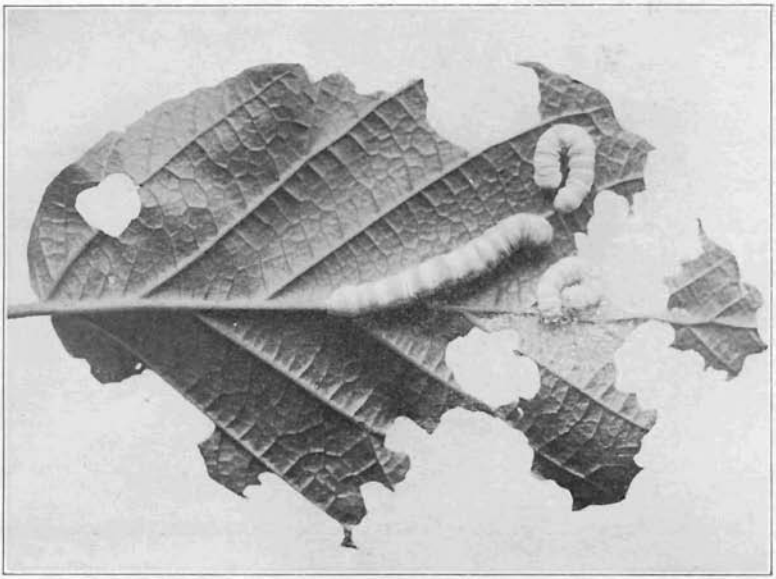


b. Cottony maple scale. Natural size.

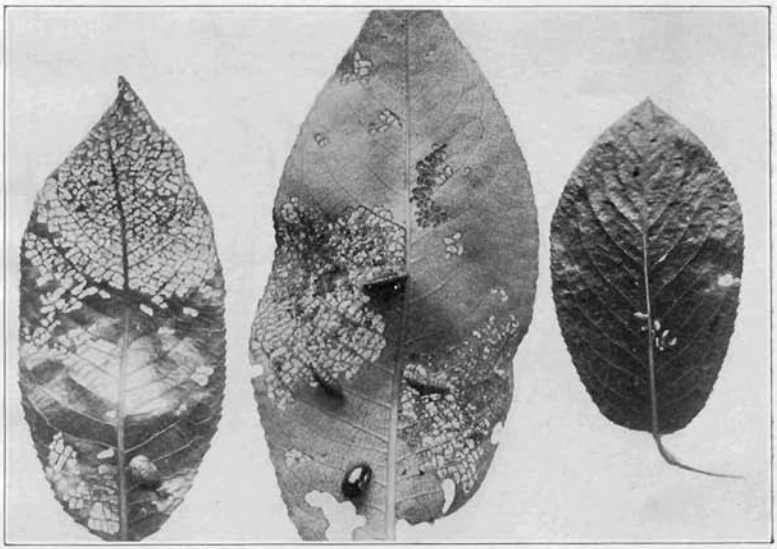
SCALE INSECTS.



a. Egg-punctures of *Ormenis pruinosa,* twice enlarged; b. Froth masses of *Ormenis septentrionalis,* natural size; c. Adults of *O. septentrionalis,* natural size; d. Adult of *O. pruinosa,* four times enlarged; e. Adult of *O. septentrionalis,* four times enlarged.



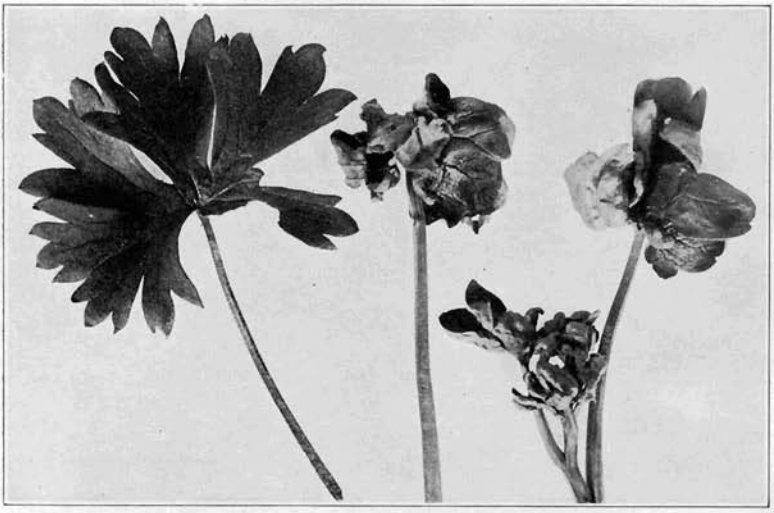
a. Larvae of the moth, *Conistra indirecta* Walker, feeding upon hazel. Natural size.



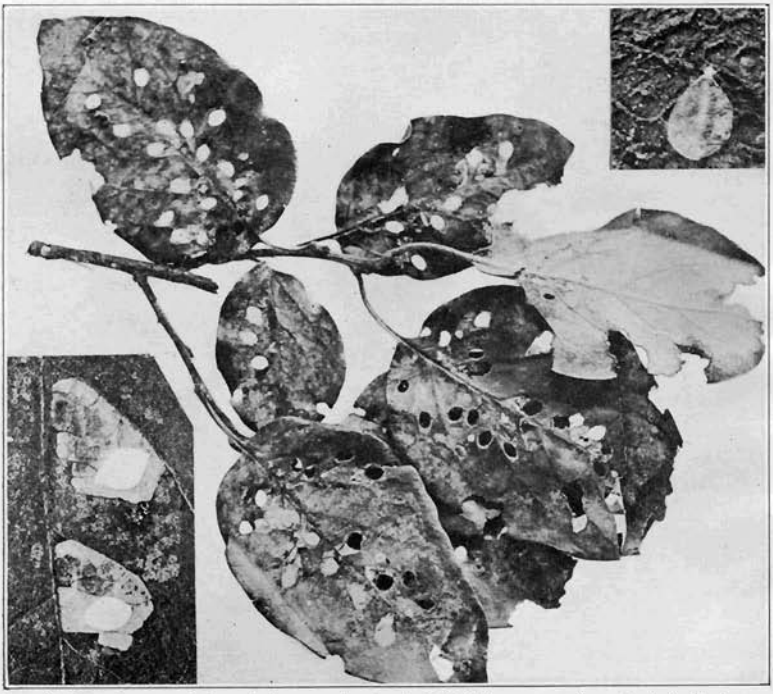
b. Larvae, pupa and adult of *Plagiodera versicolora* Laich., and injury to willow leaves. Slightly enlarged.

INSECTS ATTACKING HAZEL AND WILLOW.

PLATE XIV.

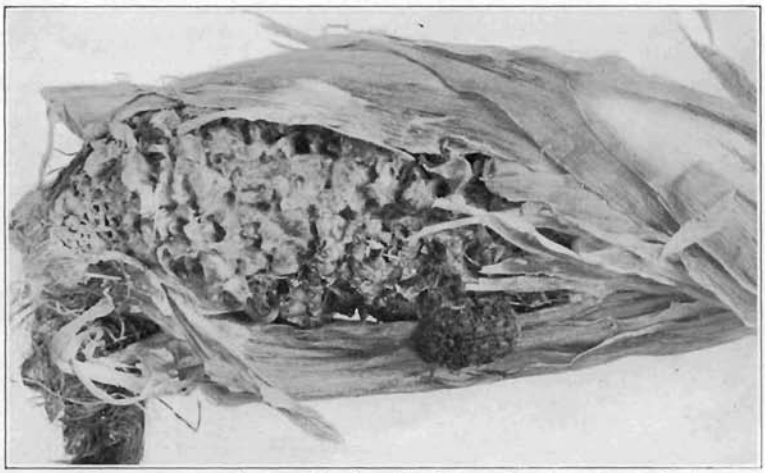


a. Larkspur leaves curled by mites, healthy leaf at left. Somewhat reduced.

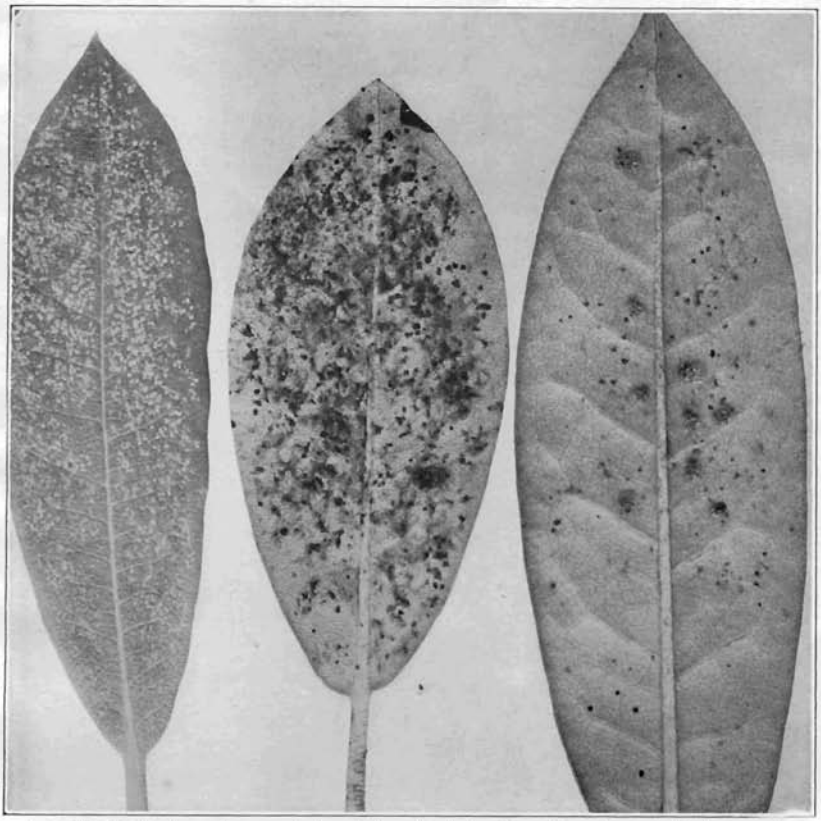


b. Quince leaves injured by resplendent shield bearer: insert at left shows mines; insert at right shows winter case of larva. Both greatly enlarged.

LARKSPUR INJURED BY MITES; RESPLENDENT SHIELD BEARER.



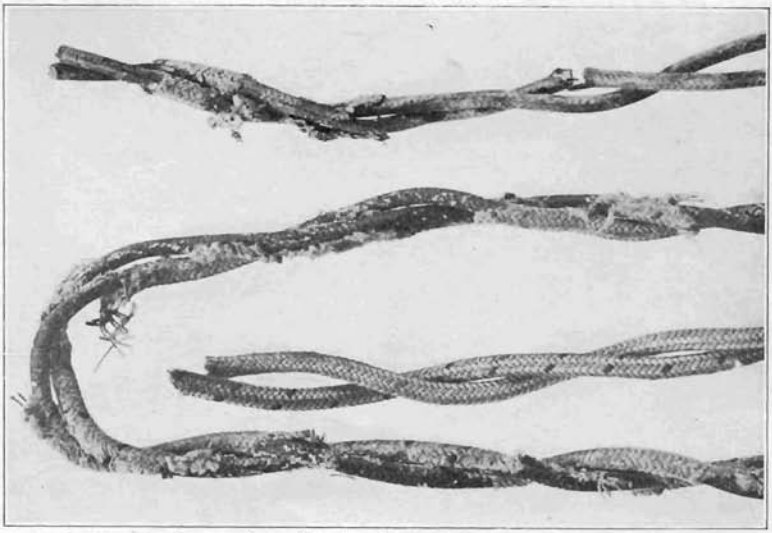
a. Injury to ear of corn by bumble flower beetle. Natural size.



b. Rhododendron leaves injured by rhododendron lace bug, which may be seen on lower surface at right. Leaf at left shows appearance on upper surface.

BUMBLE FLOWER BEETLE AND RHODODENDRON LACE BUG.

PLATE XVI.



a. Inside telephone wires showing how the covering and insulation was eaten off by white ants. Natural size.

b. Maple tree with exit holes of the Parandra borer: beetle, natural size.

TELEPHONE WIRES INJURED BY WHITE ANTS; PARANDRA BORER.