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MISCELLANEOUS NOTES ON INJURIOUS INSECTS.

P. J. PARROTT AND H. E. HODGKISS.



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* Absent on leave. † Connected with Grape Culture Investigations.

MISCELLANEOUS NOTES ON INJURIOUS
INSECTS.

P. J. PARROTT AND H. E. HODGKISS.

SUMMARY.

The fruit insects discussed in this bulletin are generally of minor importance, though certain of them reveal harmful potentialities, and other species are sufficiently numerous in occasional years to cause considerable damage.

In spite of warnings by this Station, the orchard ermine moths *Yponomeuta malinellus* Zell. and *Y. padellus* L. are being introduced in large numbers into this State by importations of foreign-grown nursery stock. During 1915 the number of localities in which the insects were distributed and extent of nursery stock affected exceeded previous records. The infestations were largely confined to apple seedlings. Observations on mining of leaves and other larval activities on apple are in accord with those of foreign writers upon the species attacking this host.

The leaf-weevil (*Anametis granulata* Say) is recorded as being present in destructive numbers during two different years in plantings of young peach trees in Niagara county. The insects ate opening buds and margins of unfolding leaves. Under confinement eggs were deposited in clusters of three to forty in concealed situations, as folded edges of partially-expanded leaves or in recesses caused by a leaf being folded upon itself.

Unusual numbers of the larvæ of the lesser peach borer (*Synanthedon pictipes* G. and R.) were observed in 1907 and 1908 in one orchard of peach and plum trees at Bellona. Some circumstances of the attack, nature of injuries and habits of the species are briefly noted.

Persisting from year to year unnoticed in the woodlot the lime-tree winter moth or linden cankerworm (*Erannis tiliaria* Harr.) appeared in conspicuous numbers in 1912 in fruit plantings as well as in woodlands. The history of the insect indicates that it occasionally causes injuries in orchards. The peculiarities of the species in a measure limit its ability to be injurious. As caterpillars were not observed in injurious numbers in well-sprayed orchards, it is presumed that the prevailing system of treatment with arsenicals affords the needed protection to fruit trees.

The gooseberry fruit-worm (*Zophodia grossulariæ* Packard) occasionally attacks currant plantations in New York, effecting serious losses in fruit yields. The injuries are due to the tunneling of the berries by the larvæ, which draw together fruit clusters and leaves by means of delicate silken threads. Usually several berry clusters are drawn together to form a nest. Spraying with arsenate of lead or paris green as the earliest webs were forming gave a large measure of protection from damages by the larvæ.

In an effort to correlate the different green fruit worms on apple with the moths of the various species, specimens of a common type in one orchard were reared to maturity, which proved to be *Graphiphora alia* Guenée. Descriptions are given of egg and larval instars.

INTRODUCTION.

During the course of their investigations the members of the Department of Entomology often have brought to their attention activities of noxious species of insects other than those that receive primary consideration. This results in the accumulation of notes which, while incomplete and unsuitable for independent publication, possess distinct value and are worthy of permanent record. It becomes desirable from time to time to issue bulletins which contain miscellaneous notes on various injurious insects, and this is the third contribution of the series. The studies reported in this text deal with several species of fruit insects which are discussed in the following order:

1. The orchard ermine moths (*Yponomeuta malinellus* Zell. and *Y. padellus* L.)
2. The peach leaf-weevil (*Anametis granulata* Say)
3. The lesser peach borer (*Synanthedon pictipes* G. and R.)
4. The lime-tree winter moth (*Erannis tiliaria* Harris)
5. The gooseberry fruit-worm (*Zophodia grossulariæ* Packard)
6. A green fruit-worm on apple (*Graphiphora alia* Guenée)

APPLE AND CHERRY ERMINE MOTHS.

(*Yponomeuta malinellus* Zell. and *Y. padellus* L.).

OCCURRENCE.

In Technical Bulletin No. 24 of this Station attention was called to the introduction of the ermine moths (*Yponomeuta malinellus* Zell. and *Y. padellus* L.) into the State of New York through nursery

stock imported from Europe. The conditions of shipments from abroad for the years 1909-12 with respect to these moths were also indicated. Since this announcement a close supervision has been maintained over plantings of foreign-grown nursery stock by the Horticultural Inspectors of the State Department of Agriculture, and the results of the inspection show that each year more or less of these insects are still being brought into this State, and some of them succeed in passing inspection at time of unpacking. Few nests of the caterpillars were obtained in 1913, and the small numbers of the insects which were discovered, coupled with a similar experience during 1912, suggested that the more rigid inspection of nursery stock at the point of its origin was leading to a decided improvement in the conditions of importations with respect to these insects. However, the past two years have witnessed increasing numbers of the caterpillars in plantings of imported seedlings. During 1915 more colonies of the ermine moths were collected than ever before since special precautionary measures were taken against these insects. The distribution of the insects in the State of New York and numbers of nests collected during the past two years are shown in Table I.

TABLE I.—ERMINE MOTHS COLLECTED* IN NEW YORK DURING THE YEARS 1914-15.

DATE OF COLLECTION.	Number of seedlings with nests.	Kind of seedling.	Locality.
June 9, 1914 ¹	10	Apple.....	Geneva
" 12, 1914 ²	5	Apple.....	Orleans
" 15, 1914 ³	10	Apple.....	Dansville
" 15, 1914 ²	10	Apple.....	Geneva
" 17, 1914 ⁴	5	Apple.....	Irondequoit
" 17, 1914 ⁴	3	Apple.....	Penfield
" 17, 1914 ²	16	Apple.....	Orleans
" 19, 1914 ⁵	25	Apple.....	Seneca Castle
" 19, 1914 ²	15	Apple.....	Orleans
" 20, 1914 ¹	20	Apple.....	Geneva
" 20, 1914 ³	73	Apple.....	Dansville
" 20, 1914 ²	†8	Apple.....	Orleans
" 22, 1914 ²	113	Apple.....	Orleans
" 25, 1914 ²	214	Apple.....	Seneca Castle
" 26, 1914 ²	204	Apple.....	Geneva
" 27, 1914 ⁴	56	Apple.....	Rochester
" 27, 1914 ²	66	Apple.....	Geneva
" 1, 1915 ⁴	2	Apple.....	Dansville
" 7, 1915 ³	183	Apple.....	Dansville
" 8, 1915 ³	1	Apple.....	Dansville
" 9, 1915 ³	87	Apple.....	Dansville

* For footnote, see p. 362.

† Cocoons were formed and moths emerged on June 27.

TABLE I (continued).

DATE OF COLLECTION.	Number of seedlings with nests.	Kind of seedling.	Locality.
June 10, 1915 ³	8	Apple.....	Dansville
" 11, 1915 ³	76	Apple.....	Dansville
" 11, 1915 ⁴	4	Apple.....	Brighton
" 12, 1915 ³	9	Apple.....	Dansville
" 14, 1915 ³	229	Apple.....	Dansville
" 14, 1915 ⁴	12	Apple.....	Brighton
" 15, 1915 ⁴	12	Apple.....	Irondequoit
" 15, 1915 ⁶	29	Apple.....	Geneva
" 16, 1915 ⁴	2	Apple.....	Pittsford
" 16, 1915 ³	92	Apple.....	Dansville
" 16, 1915 ⁶	4	Apple.....	Geneva
" 17, 1915 ³	3	Apple.....	Dansville
" 17, 1915 ⁴	25	Apple.....	Penfield
" 17, 1915 ⁶	7	Apple.....	Geneva
" 18, 1915 ⁴	160	Apple.....	Chili
" 18, 1915 ⁶	239	Apple.....	Seneca Castle
" 18, 1915 ³	104	Apple.....	Dansville
" 21, 1915 ³	171	Apple.....	Dansville
" 21, 1915 ⁴	120	Apple.....	Mendon
" 22, 1915 ⁴	2	Apple.....	Perinton
" 22, 1915 ³	45	Apple.....	Dansville
" 24, 1915 ³	44	Apple.....	Dansville
" 24, 1915 ⁶	594	Apple.....	Seneca Castle
" 24, 1915 ⁴	5	Apple.....	Brighton
" 25, 1915 ³	133	Apple.....	Dansville
" 25, 1915 ⁶	134	Apple.....	Orleans
" 26, 1915 ³	26	Apple.....	Dansville
" 28, 1915 ³	55	Apple.....	Grovehurst
" 28, 1915 ⁶	283	Apple.....	Geneva
" 28, 1915 ⁴	5	Apple.....	Brighton
" 29, 1915 ⁴	13	Apple.....	Pittsford
" 29, 1915 ³	1	Apple.....	Dansville
July 1, 1915 ⁴	21	Apple.....	Penfield
" 1, 1915 ⁶	6	Cherry.....	Geneva
" 2, 1915 ⁴	37	Apple.....	Chili
" 2, 1915 ⁶	169	Apple.....	Orleans
" 3, 1915 ⁶	31	Apple.....	Geneva
" 6, 1915 ⁴	87	Apple.....	Mendon
" 7, 1915 ⁷	47	Apple.....	Seneca Castle
" 9, 1915 ⁷	17	Apple.....	Orleans
" 9, 1915 ³	11	Apple.....	Dansville
" 13, 1915 ³	1	Apple.....	Genesee
" 13, 1915 ⁴	13	Apple.....	Chili
" 14, 1915 ⁴	11	Apple.....	Mendon

* Data kindly furnished by Dr. G. G. Atwood, Chief of Bureau of Horticulture, Department of Agriculture, Albany, N. Y. Collections of insects were reported by horticultural inspectors as follows:

¹ J. A. Maney. ² B. R. Blanch. ³ L. D. Rhind. ⁴ J. A. Thomson. ⁵ Thomas Durkin. ⁶ B. R. Blanch and W. B. Freer. ⁷ B. R. Blanch, W. B. Freer and Eugene O'Brien.

The number of infested seedlings reported during the past two years approximates 4223 trees, of which 3370 were collected during 1915. The colonies on the different trees showed great variation in the numbers of the caterpillars as shown in the accompanying figures:

TABLE II.—NUMBERS OF CATERPILLARS IN COLONIES OF ERMINE MOTHS

NUMBER OF COLONIES.	Number of caterpillars.	Average number of caterpillars per colony.
169.....	1,614	9.5
31.....	258	8.3
47.....	367	7.6
17.....	137	8.
594.....	6,340	10.6
134.....	1,908	14.2
6.....	65	10.8
10.....	156	15.6
10.....	39	3.9
5.....	35	7.
16.....	117	7.3
15.....	131	8.7
20.....	68	3.4
73.....	390	5.3
8.....	62	7.7
113.....	406	3.5
214.....	850	3.9
204.....	700	3.4
56.....	200	3.5

As will be observed, the caterpillars ranged approximately from three to sixteen individuals to a colony, all those on a seedling being considered as members of one assemblage, which gives an average of little more than seven of the insects to a colony. In our observations on *malinellus* the smallest number of eggs observed in a cluster on apple seedlings was nine, and the largest number was eighty-three, while the majority of egg masses had between thirty and forty eggs. There is, then, a considerable discrepancy between the average number of eggs in a cluster and the average number of larvæ that has been collected on seedlings, assuming only one egg mass to a plant, which however is not always the case. Various factors are doubtless responsible for the shrinkage, as parasitic and predaceous enemies and handling of nursery stock. In spite of these losses great numbers of the insects have appeared on

nursery trees in New York and, with the demonstrated ability of the creatures to survive the conditions incidental to the importation of nursery stock from abroad and to escape the ordinary nursery inspection, it seems incredible that they have not before this succeeded in establishing themselves along the avenues of trade in this country.

EARLY LARVAL ACTIVITIES.

As previously noted, the status of the foregoing moths as separate species, mining habits of the larvæ, range of host plants, etc., are not completely known. In order not to take any chances with such pests it has not seemed wise to undertake breeding experiments at the Station with them to obtain data bearing on some of these points. However, observations of infested apple seedlings have yielded some information on the habits of the creatures, especially with regard to mining of the leaves by the hibernating larvæ, which are worthy of record. The early habits of the young caterpillars have been discussed by a number of European investigators as Lewis,¹ Delacour,² Bissière,³ Porchinski,⁴ Schreiner,⁵ and have been recently described in considerable detail by Mokshetsky.⁶ According to the latter writer the hibernating caterpillars, which are about 1 mm. long, leave their winter quarters under the protective crust of the eggs when the buds are opening, and hide among the green leaflets. They bore into the parenchyma of the young leaf, beginning at the edge and near the apex. Hidden in the tissues of the leaves the creatures are invisible from the outside, but their presence is easily detected by the discoloration of the invaded areas of the foliage. After two or three days from their entrance into the parenchyma the affected leaves gradually turn a reddish brown on the edges or near the apex, as if nipped by frost. The leaf goes on growing at its base, while the apex continues to grow browner, and the brown spot grows ever larger, occupying a larger area or even the whole of the leaf. The greater the infestation of the orchard, the more of such brown, seemingly frost-bitten leaves are visible on the apple trees before or soon after blossoming. A close investigation

¹ *Trans. Ent. Soc. London* 1 : 21-22, 1836.

² *Essai sur les Insectes*, 1850, p. 296.

³ *Bul. d' Insectologie Agricole*, No. 4, p. 83, 1876.

⁴ *Insects Destructive to the Orchard in Crimea*, 1886.

⁵ *The Apple Moth and Means to Fight It*, 1899.

⁶ *The Apple Moth*, pp. 1-34, 1907.

shows that the browning results from the loss of the parenchyma, which seems to be all eaten out, beginning from the apex of the leaf, and only the epidermis remains, forming a few inflated cavities or mines. The skin is easily torn and within the mine there will be detected the tiny caterpillars grouped on the borders of the cavity, while the area behind the creatures is full of fine black-brown dust of the excrement. If a leaflet proves insufficient for the nourishment of an entire colony, the caterpillars abandon it and mine a neighboring one. In this way the number of brown leaves toward the time of the blossoming of the apple trees grows ever greater. Later on these leaves wither and fall off. The mining stage of the young caterpillars lasts about two weeks, and the time of their exit coincides in a general way with the full blossoming of the apple tree. With the conclusion of the flowering period the caterpillars enter upon another phase of activity which has been designated the skeletonizing stage. They establish themselves on the upper surfaces of the leaves, being concealed in a light, transparent, greyish web, which may be attached to the lower sides of the leaves above them. The caterpillars feed on the leaves, consuming the pulpy tissues, and leaving only a skeleton of veins. The skeletonizing stage lasts about one week, when the caterpillars pass up in whole colonies to the tips of the highest branches, which they first surround with a web, forming a nest; this they continually enlarge by seizing new leaves and enveloping them with silken threads.

Observations of the young caterpillars at Geneva during 1916 showed that they remained sheltered under the protecting crust of the eggs until the second week in May. On May 19, as bearing apples were almost ready to blossom, small brownish areas in the tips and margins of apple leaves as previously described were detected. At the time of full bloom the mining of the foliage was quite rapid and leaves of fairly good size were not infrequently tunneled for one-half of their area, while small leaves were entirely browned. In ten days more, or as petals were dropping, a few colonies abandoned their positions of concealment within the tissues and fed in exposed positions on the foliage. One colony established itself in the center of a leaf cluster, all the leaves being involved in a web, while another established itself on the upper surface of a leaf and then extended its web to the under surface of a superimposed leaf. At this time the caterpillars were in the "skeletonizing" stage, feeding

on the pulpy substance of the leaves, while the veins were little eaten. By June 1 most, if not all, of the colonies observed had passed the mining stage. Some were observed which had passed the "skeletonizing" period and were on June 6 consuming entire leaves except the principal veins. The capacity for damaging foliage greatly increased from this date with the growth of the caterpillars. The webs, which heretofore had been quite inconspicuous, were now plainly visible, reminding one of the tents that are first spun by the common fall webworm. The destructive activities of the insects ceased by the latter portion of June, at which time they had transformed to pupæ.

SUSCEPTIBILITY TO ARSENICALS.

During the period when they are mining the leaves of apple the caterpillars are apparently not easily destroyed by spraying mixtures. However, upon completion of the tunneling and as they are engaged in feeding openly on the foliage the insects appear to succumb quite readily to applications of arsenicals as provided in the common spraying schedule for the treatment of apple orchards following the dropping of the blossoms. Observations on sprayed seedlings showed that the caterpillars fed sparingly on the leaves and then retreated to the webs, refraining from further eating. In such situations they perished in great numbers and usually there was a total destruction of the insects. In one week from the time of treatment all the affected caterpillars had greatly shriveled and hung suspended from the silken threads that composed the nest.

PEACH LEAF WEEVIL.

(*Anametis granulata* Say.).

According to Pierce¹ the synonymy of this species of leaf-weevil is as follows:

Anametis granulata Say.

Barynotus granulatus Say. Descriptions of North American Curculionides, New Harmony, Indiana, p. 12, July, 1831; Entomology of North America, Le Conte Edition, p. 273, 1891.

¹ Pierce, W. D., Proc. U. S. Nat. Museum, Vol. 45, pp. 365-426, 1913.

Anametis grisea Horn. The *Rhynchophora* of America, north of Mexico, by J. L. LeConte assisted by G. H. Horn, *Proc. Am. Phil. Soc.* 15: 43, 1876.

Anametis subfusca Fall. The Coleoptera of New Mexico by H. C. Fall and T. D. A. Cockerell, *Trans. Am. Ent. Soc.* 33: 212, 1907. Description by Fall on page 261.

The confusion in the identity of the insect as exhibited in the foregoing synonymy has been responsible for the discussion of its work under the name of *grisea*. In 1882 Riley¹ briefly referred to the destructive capacity of the beetle, designated as *A. grisea*, which was reported to him as being injurious to apples and pears in Wisconsin. In 1892 Riley² and Howard noted damage to young peach trees in Michigan by *grisea*. It is stated that the beetles hide near the surface of the ground during the day time and eat the bark and also the buds in places during the night. In his report of 1893 Fletcher³ recorded *grisea* as being destructive at Grafton, Ontario, to apple trees by eating the bark off of young twigs. Mention is also made of the occurrence of the beetle at Okanagan Mission, British Columbia. During the following year he⁴ again called attention to the injurious work of the beetle, especially on peaches near Queenstown, Ontario. It is stated that the insects appeared on warm sunny days and attacked the leaf buds and bark of young trees when first set out or when a young tree is budded and cut off near the ground, then by eating the bud they destroy the tree. Mechanical protectors are suggested as means of avoiding injuries to the trees. In 1899 Lugger⁵ listed *grisea* as injurious to apple on account of its eating holes in the leaves and feeding on tender bark. He stated that the species hides in folds of a leaf during the day and, while not often seen, it will probably be found to be much more common than is suspected.

With the exception of the preceding accounts dealing with the occurrence of the species on fruit trees there is very little definite data as to its natural food plants, habits or life history. Hamilton⁶

¹ Riley, C. V., *Amer. Nat.* 16: 916, 1882.

² Riley, C. V., and Howard, L. O., *Insect Life*, 4: 401, 1892.

³ Fletcher, James, *Canad. Exp. Farms Reports* for 1893, p. 177.

⁴ Fletcher, James, 25th Ann. Rept. of Ent. Soc. of Ontario, pp. 80-81, 1894, and *Experimental Farms Reports* for 1894, pp. 198-199.

⁵ Lugger, Otto, *Minn. Agr. Exp. Sta. Bul.* 66, pp. 267-268, 1899.

⁶ Hamilton, John, *Trans. Am. Ent. Soc.* 32: 375, 1895.

recorded that the beetle was not rare on *Ambrosia trifida* during July in southwestern Pennsylvania. Dury¹ has stated that small collections of the insect were obtained by beating vegetation, while Blatchley² secured specimens from the foliage of buckeye (*Æsculus* sp.) and other trees and shrubs as early as May and as late as the middle of July.

Wickham³ writes that he has no direct evidence of the natural food plant of the species and says that the specimens in his collections were largely captured during the month of May in brush land of a mixed type, where there is a great variety of short growth, often including wild plum, wild cherry and crab apple.

DISTRIBUTION.

The leaf weevil has a wide range of distribution. Blatchley⁴ gives as the northern limits of its occurrence Newfoundland, Quebec, Ontario and Wisconsin, and says that it exists as far west and south as Wyoming and Texas. Fall⁵ states that it is more common in the Mississippi Valley than in the State of New York. The species has been noted from Canada (Thompson⁶ from Toronto, May 24, 1910, Wickham⁷ from Toronto and Albany on apple, and Pierce⁸ from Ontario) and the following states: Michigan (Pierce, Dury⁹); Wisconsin (Pierce, and by Snyder⁶ from Beaver Dam, April 29); Ohio (Dury); Illinois (Fall, Wolcott from oak at Willow Springs on August 19, 1905, and Blue Island on Aug. 24, 1905, Liljeblad⁶ at Fort Sheridan on June 19 and Rock Island on July 2); Pennsylvania (Hamilton¹⁰); Ohio (Dury); Indiana (Pierce, Dury, and by Blatchley from Warren, Marion and Posen counties); South Dakota (Pierce); Nebraska (Pierce); Iowa (Pierce, Fall, Wickham from Iowa City and Independence during May, Wolcott and Liljeblad from McGregor during July, 1904); Wyoming (Pierce); Texas (Pierce); New Mexico (Pierce, Dury, Fall and Cockerell); Kansas (Dury); Missouri (Dury, Liljeblad from St. Louis on August 1);

¹ Dury, Chas. Letter dated May 20, 1916.

² Blatchley, W. S. Letter dated May 24, 1916.

³ Wickham, H. F. Letter dated June 2, 1916.

⁴ Blatchley, W. S. Letter dated May 24, 1916.

⁵ Fall, H. C. Letter dated May 24, 1916.

⁶ Wolcott, A. B. Letter dated May 29, 1916.

⁷ Wickham, H. F. Letters dated November 8, 1915, and June 2, 1916.

⁸ Pierce, W. D. Proc. U. S. Nat. Mus. 45: 382, 1913.

⁹ Dury, Charles. Letter dated May 20, 1916.

¹⁰ Hamilton, John. Trans. Am. Ent. Soc. 22: 344, 1895.

Colorado (Dury); New Jersey (Smith,¹ Davis²); and New York (Blatchley from Portage, Davis from Staten Island).

SOME HABITS OF THE LEAF WEEVIL.

On several occasions our attention has been called to the injurious work of this species in young peach plantings. The first intimation to us of the occurrence of the beetle in injurious numbers in fruit plantings in this State was given by Mr. C. H. McClew, Newfane, who on May 10, 1902, wrote as follows: "I am sending to you a box containing some snout beetles and specimens of injured peach leaves. They are abundant and we can supply you with goodly numbers of them. The insects were first discovered feeding on yearling trees. They attack the plants at night, and during the day partially bury themselves in the ground. The beetle has been reported by others on apple trees and seems more numerous on sandy, loamy soils." No further complaints were made of the insect until the summer of 1912, when Mr. McClew wrote "that the beetle was numerous on young peach trees, which had just been transplanted, and was doing considerable damage by feeding on the opening buds and tender leaves, thus checking the new growth." It is of interest to note also that on account of the attacks by the insects, it was necessary for him to cover the trees with netting until the new growth was sufficient to withstand the insects.

Injuries by the beetle have been first detected by fruit growers during the latter part of May or during early June. As with many otiorhynchid beetles the damage caused by this insect is two-fold: first, it eats into the opening buds, destroying or severely injuring the leaf clusters, and then there is the more common type of injury which is caused by the creatures nibbling along the margins of the leaves (Plate II). Observations of the beetles in breeding cages in the laboratory showed that they would chew on the green ends of the opening buds, but rarely did so when tender leaves were available. Injuries to foliage varied with the numbers of the insects. When they were few the damage consisted of little more than the consumption of small semi-circular areas along the margin of the leaf. If foliage was limited in amount, the insects would eat as much as one-third of the area of the leaf or the entire leaf, the main rib only

¹ Smith, J. B. The Insects of New Jersey, p. 378, 1909.

² Davis, Wm. T. Letter dated May 22, 1916.

remaining. Feeding by the beetles was observed as late in the summer as August 3 when the last specimen in confinement died. They feed, apparently, at night. If foliage was not heavy they were detected in the day time concealed under small lumps of earth or partly buried in the soil (Plate I), but if the foliage was abundant they were often observed in the folds of the leaves. The insects avoided the strong sunlight and they showed a tendency to be more active, or at least to occupy more exposed positions, on cloudy days. In the laboratory eggs were deposited from July 2 to July 17. The eggs were laid on the foliage in concealed situations, as the folded edges of partially-expanded leaves or in pockets caused by a leaf being folded upon itself (Plate I). They occurred in clusters of three to forty eggs to a unit. Masses of twenty to thirty eggs each were very common. The eggs were deposited in irregular clusters embedded in a gelatinous substance, and they were bluntly rounded, and measured about 940 to 987 microns long by 376 microns in width (Figs. 1, 2, 5, Plate I). In one week from time of laying, the eggs turned brown in color. A cluster of eggs deposited on July 2 hatched on July 15. Larvæ were observed hatching as late as July 19. After hatching the larvæ fell to the ground and were observed soon afterwards in tiny cells just beneath the surface. Owing to the death of larvæ in breeding cages it has not been possible to follow the later stages in the development of the creatures.

METHODS OF CONTROL

As previously stated, this insect has so far caused important injuries only to nursery trees soon after the time of transplanting in the orchard, and growers who have sustained damage by the insect have protected their young trees by covering them with mosquito netting. Since the beetles feed on the foliage it would appear that they can be controlled by a timely application of arsenate of lead. If efficacious, such treatment would be more economical than the use of netting. In the case of peaches, arsenate of lead sometimes causes injuries to the foliage, so great care should be exercised in the use of this arsenical. For experimental treatments it is suggested that the grower apply two pounds of the poison to fifty gallons of water, to which are added two pounds of lump lime previously reduced to a paste. For a small planting considerable protection could doubtless be obtained by collecting the beetles or jarring them into a sheet, when they should be destroyed.

LESSER PEACH BORER.*

(Synanthedon pictipes G. and R.)

On May 8, 1907, our attention was directed to destructive numbers of this species at Bellona, N. Y., in an orchard of 1200 trees, consisting of Wickson plums and various sorts of peaches. The trees were six years old and evidently had received very little care. The orchard had not been cultivated for several years and in certain areas there were many weeds besides grass. Pruning had been attempted just before our visit, and the dead trees cut down, which, with the prunings, had been left in the planting. Most of the trees that were seriously infested the year before had succumbed. Nearly seventy-five per ct. of the plums were dead, while the remainder contained many dead branches (Plate IV). The trees seemed to be most injured about or just below the crotch formed by the union of the main branches, and in nearly every case the trees also showed injury about the collar. Some of them were practically dead at this point while the entire top was still alive. The wood beneath the bark showed conspicuous evidences of the work of the borer. Besides the work of the borer the plum trees had the appearance of having been injured also by cold weather or perhaps by unfavorable conditions of environment, though an examination of a number of the dead trees showed that the bark had been entirely girdled by the channels of many insects. What foliage there was looked, on the whole, fairly healthy.

On June 15 the orchards in the vicinity of Bellona were again inspected and the plums were so nearly dead that only a few borers were found; but the peaches, though they had suffered to a much less degree, were generally infested. Somewhat similar conditions existed in another planting of peaches, consisting of trees about four years of age, which had been given cultivation the previous year. In many of the trees every branch showed the presence of one or more borers, and in some cases the trunks were affected. The trees which were infested about the trunk or crotch had evidently suffered injuries to the bark by some other cause previous to the attacks by the borers. In collecting, most of the larvæ were secured from branches ranging from one to two and one-half inches in diameter. The borers apparently did not attack smooth portions of the

* By W. J. Schoene.

bark, for all the areas of infestation were located either in a crotch or where a branch had been pruned or broken.

It appears that the Wickson plum is either very susceptible to injury by this insect or that the region about Geneva is unfavorable to the best development of this variety of fruit tree. During the summer of 1907-8 several examinations were made of this and other varieties of plums growing on the Station grounds. It was usual to find a number of larvæ of both *pictipes* and *exitiosa* in the Wickson plum trees, while the insects were relatively scarce in other varieties.

DESCRIPTION OF INJURY.

The larvæ were observed feeding in the soft tissues of the bark in all parts of the trunk and branches, and even twigs one-third of an inch in diameter were infested. The appearances of the wounds varied somewhat according to their location in different parts of the tree. In the smaller twigs the larval channel was concealed by the thin outer cortex, its presence being indicated only by the larval frass and exudation of gum. In the larger branches the bark was often thickened and much discolored. The outer cortex of these enlarged areas was frequently split, which, together with the frass and gum, presented a very rough appearance (Plate IV). In the crotch and the main stem several larvæ were frequently found closely associated. Here the surface of the bark was dotted with exit holes made by the pupæ and with an occasional empty pupal case protruding half its length from the bark. In other places the bark was cracked, with the edges turned outward, disclosing underneath, the split surface of the wood covered with finely chewed pieces of bark produced by the caterpillars tunneling their path beneath the cortex. The point of injury frequently covered a number of square inches, the cambium being so thoroughly tunneled that large areas of the bark were dislodged. The lower opening to the wounded area was usually hidden by a large patch of gum, hard on the outside, and protruding near the gum was a mass of excremental particles and larval sawdust, brick red in color, held together to some extent by strands of silk. With the removal of the gum a large hole was found in the cambium, which was apparently the exterior entrance of numerous channels. The pupal cells were detected in the drier parts of these cavities. They were constructed of fine sawdust cemented together with silk and gum and slightly

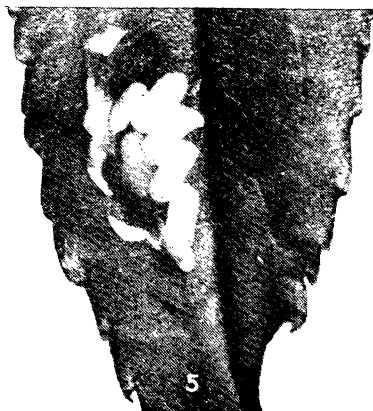
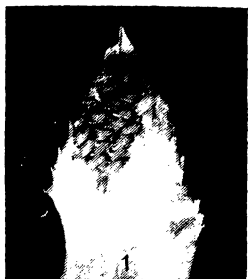


PLATE I.—PEACH LEAF-WEEVIL.

1 and 5, Egg clusters (enlarged); 2, eggs in fold of peach leaf and leaf unfolded showing egg cluster; 3 and 4, adult.



PLATE II.—PEACH LEAF-VEEVIL: INJURED PEACH FOLIAGE.

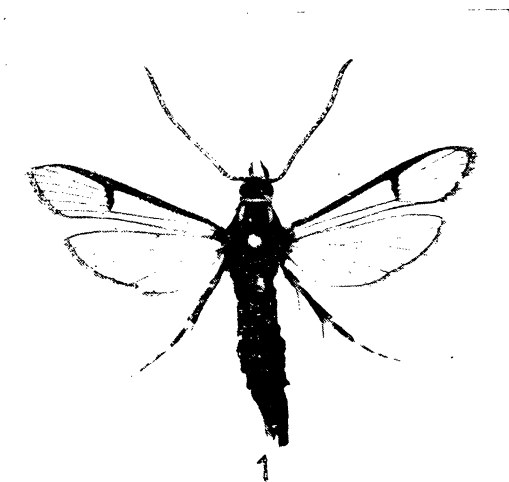
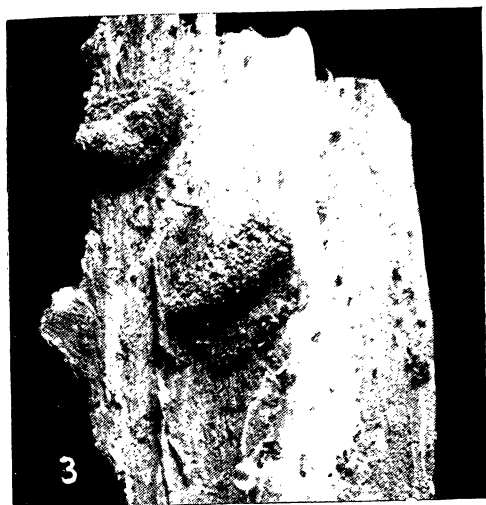


PLATE III.—LESSER PEACH BORER.
1, Adult; 2 and 3, larva and cocoon; 4, pupa.

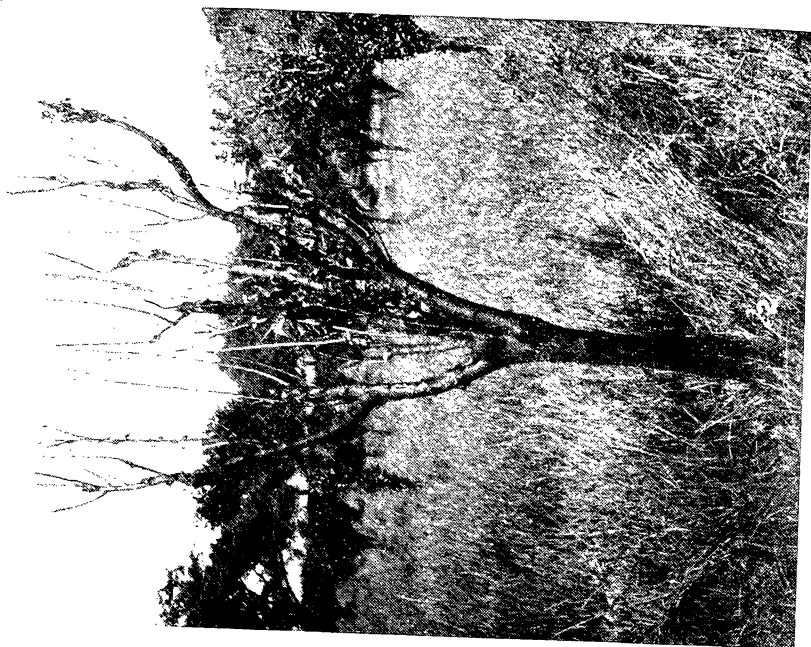


PLATE IV.—INJURIES FROM WORK OF LESSER PEACH BORER.

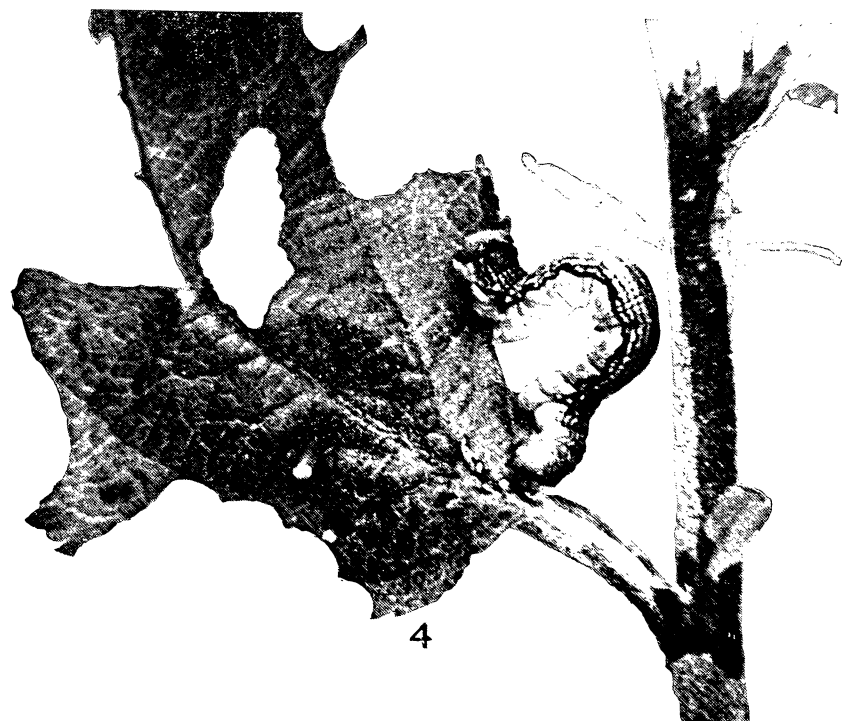
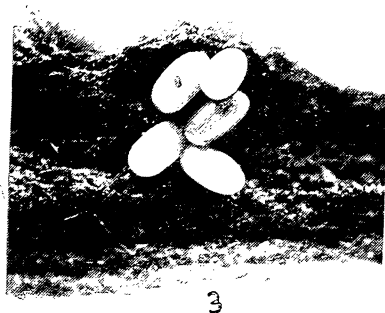
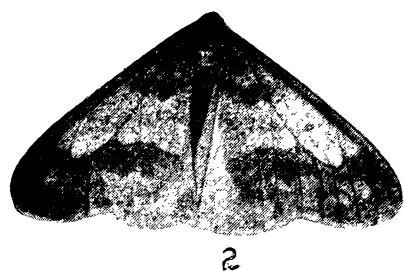


PLATE V.—LIME-TREE WINTER-MOTH.
 1, Female adult; 2, male adult; 3, eggs; 4, caterpillar; 5, pupæ.



PLATE VI.—LINDEN FOLIAGE INJURED BY CATERPILLAR OF WINTER-MOTH.

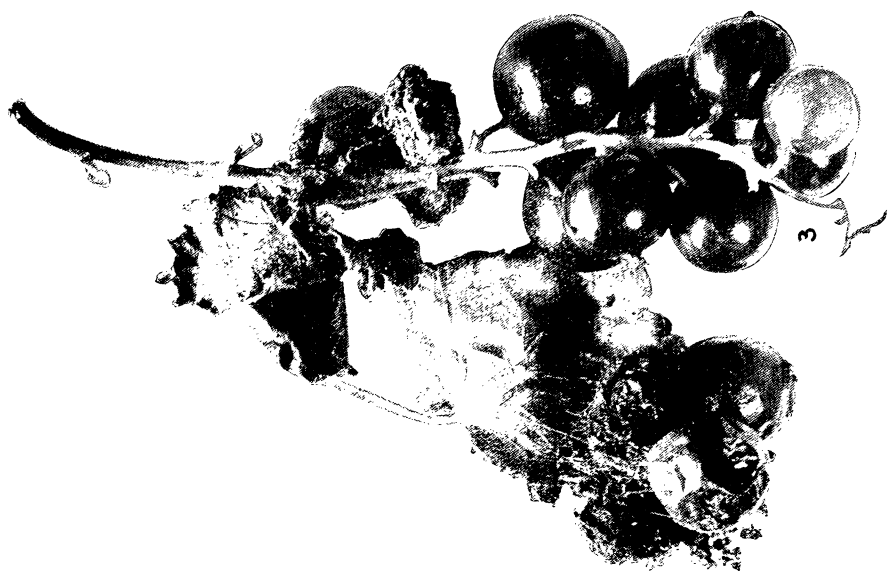


PLATE VII.—INJURIES TO CURRANTS BY GOOSEBERRY FRUIT-WORM.



PLATE VIII.—GREEN FRUIT-WORM ON APPLE.

imbedded in the surface of the sap wood. At other parts of the wound there occurred a fluid, gummy exudation in which were observed caterpillars in various stages of development. The channels of the larvæ were very irregular in shape and ran in varying directions. The dimensions varied with the size of the insect, but the channel was broad enough to permit the larva to reverse itself. A great many channels examined had a longitudinal direction, frequently being four to five inches in length, with two or three side branches an inch or so apart.

ECONOMIC IMPORTANCE AND DISTRIBUTION.

The insect was first described in 1868 by Grote and Robinson¹ who also noted its occurrence in Pennsylvania. In 1879 it was found in injurious numbers upon a plum tree by Bailey,² who gave an excellent description of the insect and the character of its work. Two years later Kellicott³ reported the insect attacking an old plum tree and wild cherries at Buffalo, N.Y., and the same observer stated in 1891 that it fed upon both black and red wild cherries at Columbus, Ohio. Webster⁴ recorded peach and the black-knot fungus on cherry and plum as a host of the species, and Beutenmüller⁵ added chestnut and juneberry to the list of host plants. The lesser peach borer has been reported as occurring in parts of Canada adjacent to New York, also in Minnesota, Pennsylvania and New Jersey; and Girault⁶ in an excellent account of the insect states that it occurs in a number of southern states and adds: "In some of the Georgia and Maryland peach orchards groups of old, scarred trees have been found with their trunks literally honey-combed by the channels of these larvæ." The same author reports that it seems to be on the increase, though according to all reports the insect has been observed in only a few numbers except on old or neglected trees.

LIFE HISTORY, HABITS AND DESCRIPTIONS OF LIFE STAGES.

At the time our observations on the insect began, May 8, 1907, only the larvæ were present on the trees. These varied in length,

¹ Grote, A. R. and Robinson, C. T. *Trans. Amer. Ent. Soc.*, 21:82-183, 1868.

² Bailey, J. S. *No. Amer. Ent.*, 1:17-21, 1879.

³ Kellicott, D. S. *Can. Ent.* 13:7, 1881, and *Ohio Hort. Soc. Journ.*, 5:16-19, 1891.

⁴ Webster, F. M. *Ent. News.* 4:267, 1893.

⁵ Beutenmüller, W. *Bul. Amer. Mus. Nat. Hist.* 9:220, 1897.

⁶ Girault, A. A. U. S. D. A. Bureau of Ent. Bul. 68, Pt. IV, 1907.

being mostly about one-third of an inch. On May 25 two pupæ were found and the larvæ showed greater differences in size, though most of them were from one-half to three-fourths of an inch in length. Thirty days later, or on June 25, the trees were again examined and it was found that a good proportion of the adults had emerged, though one pupa and thirty-five large larvæ were secured. By July 24 practically all of the adults had emerged and only one large larva and one pupa were found. The orchard was again inspected on November 4, when only hibernating larvæ were present. These ranged in size from one-fourth to an inch in length, though some of the largest individuals proved to be of the species *exitiosa*. A final observation was made of the orchard on June 20, 1908, at which time about thirty per ct. of the adults had emerged, thirty per ct. were in the pupa stage and the larvæ were nearly all full size.

These observations indicate that in this part of New York State the adults emerge in June and July, that the insect hibernates as a half-grown larva and that there is but one brood a year. This is in full agreement with Bailey's observation made in the region of Buffalo, N. Y., although Girault reports a partial second brood in Georgia.

Egg.—According to Girault the eggs are small, compressed, elliptical-oval, reddish-brown objects similar in general to the eggs of the common peach borer. They are deposited singly in clusters on all parts of the tree, especially on the trunk, being placed in crevices and openings of the bark and under loosened bark. The female deposits from two hundred to three hundred eggs. These hatch in about ten days.

Larva.—The larva is a typical borer, being white or of a cream color with head yellowish brown and thoracic shield pale yellow (Fig. 2, Plate III). Our specimens averaged three-fourths of an inch in length. It is similar in general appearance to the ordinary peach-borer larva, which is about one inch in length. The larva lives in channels or cavities under the bark. If an individual is placed in a glass receptacle with a flat piece of bark it will in a few hours construct a retreat for itself of sawdust and particles of loose bark held together by silk. Half-grown larvæ have been reared to maturity in this manner. In the field larvæ have been observed to live for a time after the tree had died.

Cocoon.—The cocoon (Fig. 3, Plate III) is formed of particles of

sawdust and excrement firmly woven together by silk. It is usually slightly reddish or similar in color to bark upon which it is formed. As has been observed by Bailey and others, it has a habit common with many borers of excavating a slight depression in the wood, over which the pupa cell is built. The cocoon is generally hidden on the under side of the bark in or near the larval chamber, though a few have been found in exposed situations on the outside of the bark of small twigs.

Pupa.— The pupa is light in color when first formed, later changing to reddish brown or black. It is about one-half inch in length (Fig. 4, Plate III). When ready to emerge the pupa works itself out of the cocoon to a hole in the bark which has previously been made by the caterpillar, and there, projecting for half its length, it changes to an adult.

Adult.— The adults resemble the male of the common peach borer. They are clear-winged moths, bluish-black in color, with the eyes encircled with yellowish-white scales (Fig. 1, Plate III). There is a pale yellow band on each of the second and fourth segments. The moths resemble certain wasps both in appearance and manner of flight.

TREATMENT.

The only certain means of successfully combating this pest is that of digging out the grubs as recommended for the common peach borer. The "worming" should be done during the fall, winter or spring months. If in the operation of removing the borers large wounds are made in the bark, they should be coated with an antiseptic, which will protect the cut surfaces during the healing process and act as a deterrent to the insects. A strong mixture of lime-sulphur or bordeaux to which arsenate of lead has been added may be used for this purpose. As the insect is thought to thrive best in old or weakened trees or those somewhat neglected, such as have passed their period of usefulness should be removed and the remainder of the orchard carefully pruned. All dead and injured wood should be immediately burned. In case of bad infestation by this insect severe pruning should be practiced. This will remove many of the larvæ and increase the vigor of the trees. Thorough cultivation should be practised and care also exercised to keep the bark smooth and clean and the trees in a good state of health.

THE LIME-TREE WINTER MOTH.*

(Erannis tiliaria Harr.)

This insect takes rank with the white-marked tussock-moth, the common orchard canker worms, the orchard and forest tent caterpillars and certain other leaf-eating insects that persist from year to year unnoticed in the woodlot. The caterpillars of this species occasionally become numerous and cause serious defoliation both in the woods and adjacent orchards.

RECENT OCCURRENCE IN ONTARIO AND CAYUGA COUNTIES.

The presence of large numbers of the caterpillars during the spring of 1912 attracted the attention of many farmers and fruit growers in certain counties in western New York. They occurred in abundance about Hopewell Center, Ontario County, and eastward to Seneca Castle and Geneva. The apple and cherry trees along the roadside were principally affected, though the larvæ were found in commercial orchards of both fruits. One farmer near Hopewell Center reported that the insects were so numerous in his woods that he could hear the caterpillars chewing the foliage. In Cayuga County near Venice Center there are many apple orchards that are either poorly cared for or neglected. Such plantings suffered more or less defoliation due to this and other leaf feeders. The combined work of the canker worms and the orchard and forest tent caterpillars resulted in the defoliation of one orchard and serious injury to several others in the neighborhood of Kings Ferry. The roadside lindens and elms in this vicinity showed the peculiar ragged appearance to the feeding of the caterpillars of this species (Plate VI). The lindens of a woodlot near the worst-injured orchard were partly defoliated. Of the forest trees the elms and lindens were most susceptible and only a few larvæ were found on the maples, hickories, ashes and oaks. Apparently the insects do not naturally feed upon fruit, but in the laboratory under the stress of hunger they ate the epidermis and some of the pulp of cherries and apples.

LITERATURE OF THE SPECIES.

The species is said to be a native insect and is stated by Holland¹ to range from the Atlantic coast to the Rocky Mountains. The

* By W. J. Schoene.

¹ Holland, W. J. The Moth Book, p. 347, 1903.

first authentic record we have is that of Harris¹ in 1841, and as compared with other canker worms he evidently thought this species was not of much importance, as indicated by the following statement. "Apple, elm and lime trees are sometimes injured a good deal by another kind of span worm." Saunders² writes "It is often very destructive to basswood, elm, hickory and apple trees." The insect is also mentioned by Packard³ as being often found on apple and elm. It is of interest to note that no recent outbreaks have occurred and that there is no record of important injuries in this State preceding this appearance of the insect.

BIOLOGY.

The larva is a characteristic canker worm and has in common with other insects of this group the peculiar habit of feigning death by holding the body rigid or suspending itself by the rear feet. The caterpillars feed by chewing elongated areas in the leaves as shown in Plate VI. When the larvæ are numerous the foliage looks as if it had been riddled by shot.

During 1912 the larvæ were first observed on June 8 in an apple orchard near Geneva. The size of the caterpillars indicated that they were nearly mature. On June 19 the creatures were still numerous, though some had entered the soil. Another inspection was made on June 24 when the larvæ had practically all pupated.

The pupæ were found at various depths extending to three inches. Many were found under leaves and rubbish at the surface or in the first one-half inch of soil. A few were found at a depth of three inches. According to Harris the insect remains in the pupa stage until late in October or November and occasionally until spring.

The adults during 1912 continued to emerge in the field from October 21 to November 4, and females were still ovipositing November 10.*

¹ Harris. *Ins. Inj. to Veg.* Flint Ed. p. 472, 1862.

² Saunders, William. *Can. Ent.* 14:222, 1882.

³ Packard, A. S. *Insects injurious to forest and shade trees*, 5th Rept. of U. S. Ent. Com., p. 475. 1890.

* As stated above the adults were observed to emerge out-of-doors October 21 to November 4, and eggs were still being oviposited on November 10. In our unheated insectary a number emerged during the first ten days of December. These facts, when compared with the minimum temperature records appended, are interesting; for they

Habits.—During the day the males have been found resting on leaves and occasionally on the bark. They become active about 4 P. M. Five specimens were taken about electric lights at 9:30 P. M. on October 27, at which time the temperature was 41° F. The females were taken from the undersides of the branches, hanging suspended by their slender legs. They were very sluggish during the day until after mating, when they were observed to slowly creep over the bark, protruding the extensile ovipositor. The females in a cool room continued to oviposit for a week. They scattered their eggs over the bark, some on exposed situations and others in cracks and under the rough bark. From the abdomen of one female there were taken five hundred and eighty-three eggs.

DESCRIPTION OF LIFE STAGES.

Egg. (Fig. 3, Plate V.)—Color dirty cream, slightly cylindrical and bluntly rounded at the ends. The sides and one end are marked with compressed hexagonal reticulations. These are more noticeable on the cap. Length .893 mm., width, .517 mm.

Larva. (Fig. 4, Plate V.)—A bright-yellow looper with a rust-colored head and ten crinkled black lines along the back. The variation in the width of these lines is such that some individuals are light on the dorsum and others very dark. The dorsal lines are so faint in some caterpillars that they are barely discernible, which gives the effect of two sub-dorsal stripes. In other specimens the black lines are so broad that altogether they appear as a black ribbon. The length of the mature larvæ is from 1.25 to 1.5 inches.

Pupa. (Fig. 5, Plate V.)—The males measured 60–65 hundredths

suggest that the adults do not emerge until after the appearance of freezing weather and that they are able to survive and oviposit in spite of temperatures below 33° F.

MINIMUM TEMPERATURE RECORDS DURING SEPTEMBER, OCTOBER AND NOVEMBER, 1912.

DATE.	Degrees F.	Date.	Degrees F.
Sept. 30.....	34	Oct. 29.....	35
Oct. 2.....	36	Nov. 2.....	30
Oct. 8.....	37	Nov. 3.....	28
Oct. 16.....	31	Nov. 4.....	27
Oct. 27.....	33	Nov. 8.....	34

inch long and 15–18 hundredths inch wide, while the females averaged 47–60 hundredths inch long and 17–20 hundredths inch in diameter.

Adult male. (Fig. 2, Plate V.) — “The males¹ have large and delicate wings, and their antennæ have a narrow feathery edging on each side,” “The forewings of the male are rusty buff or nankin-yellow, sprinkled with very fine brownish dots and banded with two transverse wavy, brown lines, the band nearest the shoulders being often indistinct; in the space between the bands and near to the thick edge of the wing there is generally a brown dot. The hind wings are much paler than the others and have a small brownish dot in the middle. The color of the body is the same as that of the fore wings; and the legs are ringed with buff and brown. The wings expand one inch and three-quarters.”

Adult female. (Fig. 1, Plate V.) — Our specimens show considerable variation in the color and markings. They range from very dark, having but a few white or brown scales to individuals that are light brown or ash gray, having only a few splashes of black. Most of the specimens present a mottled appearance with a more or less well defined double row of black spots on the dorsum; and in all of our specimens there are two well-defined spots on the dorsum of the first abdominal segment. In some specimens these two spots are equally well defined on all but the posterior segment, in others they are much reduced or lost in the general sprinkling of black. There is a distinctive area of heavy blotches along the stigmatal line. The ground color is silver gray, or with some specimens a light brown. The typical markings are head and front of eyes black, back of head white; dorsum of thorax brownish-white bearing four pairs of black spots. Those on the metathorax not well defined, the rear pair on the mesothorax are well separated and the others contiguous. The antennæ and legs are slender and of the same general color as the body.

TREATMENT.

The peculiarities of this insect in a measure limit its ability to become injurious. The females do not fly, hence there is no danger of a sudden migration to the orchard from the woodlot such as is possible with other species. In addition the habit of emerging during the winter must certainly in a measure limit the production

¹Harris. Ins. Inj. to Vegetables. (Flint Edition, 1862) p. 473.

of eggs, for the insects that come forth in October are subject in November, in this latitude, to severe and sudden changes, often accompanied by ice storms. Notwithstanding these facts the insects have been known to cause injuries in fruit plantings.

The occasional outbreaks of such insects as this serve to emphasize the necessity of a regular system of orchard treatment that will nip in the bud, so to speak, the multiplication of this and other species of similar habits. Since the caterpillars of this species have not been found in well-sprayed orchards it is taken for granted that the treatments ordinarily made for the common insects afford the necessary protection.

GOOSEBERRY FRUIT-WORM ON CURRANTS.

(*Zophodia grossulariæ* Packard)

Currant and gooseberry fruits sometimes become withered and drawn together in a delicate silken web, which occasionally produces a considerable reduction of the quantities of marketable berries. These injuries are largely caused by the gooseberry fruit-worm *Zophodia grossulariæ* Packard. During 1904, at White Plains, this insect was abundant in the plantation of Mr. Peter Witzel and associated with it were small numbers of the larvæ of the leaf roller, *Archips parallela* Robinson.¹ The feeding of these associated species practically destroyed the yield of currants each year during the period of 1902-1905. Our attention was called to this outbreak late in the spring of 1904 and after many of the berry clusters were injured. Suggestions were made to the owner with the idea of securing relief from the pest until an investigation could be undertaken. The studies were begun in 1905 but later were discontinued. Some information on methods of control was obtained which, while fragmentary, is mentioned as a guide to further studies on the protection of *Ribes* from attacks of these pests.

SUMMARY OF LITERATURE.

Although the gooseberry fruit-worm is common and of considerable importance in plantings of *Ribes* in some regions, there are few published accounts which contain really satisfactory information concerning this species. Most of the citations appear to be largely

¹ Determination through the courtesy of Prof. C. H. Fernald.

compiled from the reports of Riley ¹ and Saunders ² who have published the most complete notes on the insect up to the present time. Other writers have been satisfied to quote from these authorities and no later investigations appear to have been made.

APPEARANCE OF INJURIES.

The work of this species on currants has received little attention in literature and much of what has been written is inaccessible to most workers. In 1855, Fitch ³ reported having seen wild gooseberries with every berry withered. Riley in 1869 noted its attacks on native gooseberries and green-gage plums. During 1876 Saunders observed the work of this species and in 1883 ⁴ again published a very concise account of its attacks on Ribes. In such instances the gooseberries ripened prematurely or else became dull whitish in color and soon withered. The currants were drawn together and the berries fastened to each other with silken threads. Lochhead ⁵ noted the premature dropping of well-formed unripened fruits which at that time showed no external evidence of the cause of injuries. A few days later the heart of the berries softened and the presence of larvæ became evident through the softening of the tissue at the center of the berries and the subsequent collapse and decay of the fruits. An external evidence of injured gooseberries was a dark spot on the skin which gradually increased in size until the pulp became red but not ripe. Thick-skinned berries appeared not to be affected. According to Slingerland and Crosby ⁶ several fruits may be connected by a delicate silken thread.

In our study this insect was especially destructive to red currants during the period of 1903-1906. The earliest indication of infestation was in May when the berries were drawn together by a delicate silken thread. The young larvæ within the web afterward began to eat into the fruits which soon became shriveled and decayed (Plate VII). In some instances the berry injury consisted only of a wound in the skin, but in any case the fruits dried and shriveled. Usually several berry clusters and adjacent leaves were drawn

¹ Rpt. State Ent. Mo. 1:140, 1869.

² Rpt. Ent. Soc. Ont. (Canada) 7:39-40, (1876), 1877.

³ Rpt. State Ent. N. Y. 3:437, 1855.

⁴ Insects injurious to fruits, pp. 357-359, 1883.

⁵ Rpt. Ent. Soc. Ont. (Canada) 34:35-36 (1903), 1904

⁶ Manual of Fruit Insects pp. 353-355, 1914.

together to form a nest in which occasional larvæ transformed. Often leaves only were drawn together, and the caterpillars did not feed on the berries. On the other hand single currants only were eaten, or two or three fruits in a cluster affected. In many instances the currants ripened prematurely with no other evidence of the larvæ at work.

DISTRIBUTION AND FOOD PLANTS.

Dyar¹ lists the range of this species in North America as north eastern United States and Canada. In other sections it has been reported as occurring in Missouri, Minnesota, Montana, Illinois, Oregon and Washington where it also feeds chiefly on *Ribes*. The native and cultivated gooseberries, red and white currants, and green-gage plum, according to an obscure reference by Riley, are the recorded hosts of this species.

LIFE HISTORY AND HABITS.

The adult female deposits her eggs on the young gooseberries a short time after the fruit is set. The young larvæ soon appear and bore into the berry. On April 21 at White Plains, N. Y., no trace of an infestation could be found. During the second week in May occasional berries were being drawn together by a delicate silken thread which that year was the earliest evidence of the insect in this planting. About the last week in May the caterpillars left the berries first attacked and webbed together other fruits of the cluster. As the creatures became larger in size several berry clusters were usually drawn together and formed a nest in which the caterpillars remained concealed. When disturbed the larvæ quickly left the berries or the nest and lowered themselves to the ground with the aid of a slender thread. By June 7 the caterpillars were mature, and on June 28 few of the creatures were to be found. On the latter date many delicate, finely-woven cocoons were found among the injured currant clusters or fallen leaves and other debris on the ground beneath the bushes. Specimens of these cocoons and others obtained from larvæ bred in the laboratory were placed in cages where they remained until the following spring when the moths emerged. The adults appeared during the last week in April.

¹ U. S. Nat'l Mus. Bul. 52, p. 429, 1902.

DESCRIPTION.

The following stages of the insect were noted:

First instar.— Body whitish; head, thoracic shield, and appendages ferruginous. Pro-legs similar to body with a brownish ring at their extremities. Spiracles ringed with brown. Anal segment tinged ferruginous and hairy. Length $5\frac{1}{2}$ mm., width, 1 mm.

Second instar.— Body white, finely pitted with dark points. Thoracic shield, dark ferruginous; Head and mouth parts somewhat lighter, showing reddish translucent. Thorax and abdomen concolorous with hairs regularly placed in rows. Anal segment same color as other abdominal segments. Appendages somewhat tinged with brown. Less dark color in this stage than in preceding instar. Length 8 mm., width $1\frac{1}{2}$ mm.

Third instar.— Body yellowish; head light amber. Mouth parts reddish brown. The thoracic shield similar to head in color. Thorax and abdomen finely punctured, giving blackish cast. Hairs regularly placed in rows. Length $10\frac{1}{2}$ mm., width 2 mm.

Fourth instar.— Body pale green with faint tinge of yellow; head much swollen; yellowish translucent in color; thorax and abdomen as before. Length 13 mm., width 3 mm.

Fifth instar.— Deeper green than preceding instar. Anal segment with a suggestion of yellow. Head yellowish translucent. Abdomen deeper green, translucent, distinctly tinged with red; becoming deeper as stage lengthens. Length 15 mm., width 4 mm.

Pupa.— When fully formed the pupa has first a greenish tinge which gradually changes to a mahogany brown color. The spiracles are papilliform and rather prominent. A whorl of hooks surrounds the anal tip.

Cocoon.— Light, fluffy, silken structure of a close weave; often attached to several leaves or may hang from a bunch of currants.

Adult.— “Expands 22–25 mm. Labial palpi, head, antennæ and thorax fuscous gray; fore wings very light gray overlaid with fuscous and blackish; basal field rather darker in the middle; basal line near base whitish, rounded outwardly, followed by a broad, even, rounded, blackish band; middle field with blackish running somewhat in longitudinal striæ, with two parallel, somewhat coalescing white stripes just anterior to middle; discal spot fuscous, diffuse, dentated; outer line, white dentate rather oblique, distinct, margined within with blackish, more marked costally, and lined outwardly

with blackish, which extends over the outer field; marginal points black. Hind wings light fuscous, pellucid.¹"

CONTROL MEASURES.

Suggestions for the control of this pest usually made since the work of Riley and Saunders have largely consisted of preventive measures such as hand picking of infested fruits or clusters or of allowing poultry to have the run of the garden.

In 1904 the plantation under observation was divided into four plats which were either sprayed with a weak caustic soda solution, or arsenate of lead, or dusted with hellebore. This work was done by the owner after webs were formed and when the berries were largely destroyed. No appreciable differences were noted between the sprayed and unsprayed bushes at the time pupation commenced.

In the spring of 1905 the planting was divided into four plats which were sprayed respectively with lime-sulphur wash, arsenate of lead and paris green in bordeaux mixture, with one plat as check.

The lime-sulphur spray was applied before the buds opened and was used largely for the San José scale. It did not act as a deterrent to the berry moth. The poison sprays were applied just as the first webs appeared on the currants. No great differences in effectiveness were noted between the two poison sprays. These treatments were very beneficial, and in both instances little damage resulted from the work of the insects on the sprayed plats.

In 1906 the garden was again sprayed with either arsenate of lead or paris green in the usual proportions just as the earliest webs were being formed. On June 1 scarcely any injured berries or clusters were observed, although the unsprayed bushes were quite badly infested.

A GREEN FRUIT-WORM ON APPLE.*

(*Graphiphora alia* Guenée.)

The common species of green fruit-worms, which cause trouble in apple and pear orchards by chewing holes in young fruit, have generally been considered as belonging to the genus *Xylina*. In an effort to correlate the different types of green fruit-worms found on the apple with the moths of the various species, the writer reared

¹ N. A. Lepidoptera, Hulst, Geo. D. Trans. Am. Ent. Soc. 17:173, 1890.

* By B. B. Fulton.

to maturity a number of specimens of a type most numerous in a neglected orchard near Geneva, N. Y. (Plate VIII). These pupated about the end of June, 1913, in earth contained in flower crocks and were buried in the ground for the remainder of the year. On March 27, 1914, five moths appeared, a sixth emerged on March 28, and a seventh on April 2. All proved to be of the species *Graphiphora alia* Guenée. Another specimen which had been reared from a green caterpillar collected on basswood, emerged April 2 and proved to be identical to those reared from caterpillars on apple.

In 1914 another lot of larvæ was collected from the foregoing apple orchard. They were all carefully examined and were divided into two distinct types, one of which was probably a species of *Xylina* although none matured, while the other and the more numerous type proved to be larvæ of *Graphiphora alia* (Fig. 2). The latter pupated during the last week of June and were kept buried in a flower crock over winter. A pair of these moths emerged on April 7, 1915, about 9 A. M. These were put in a breeding cage and eggs were deposited on April 10 or 11, which hatched during the forenoon of April 16.

The young larvæ were placed on opening apple buds in lantern globes. They tunneled into the buds and fed on the young leaves. They grew rapidly in the laboratory and reached full size by May 15. In the later stages many of the larvæ became very dark (Fig. 2), much darker than the larvæ from which the adults were reared, but retained the same structure and markings exhibited by the light specimens.

DESCRIPTION OF LIFE STAGES.

Egg.—The egg (Fig. 1) is of the type common to the group. It is hemispherical, about .65 mm. to .70 mm. in diameter, and of a pale purplish gray color. Its surface is ornamented with between thirty and forty ribs which radiate from the center. The ribs are somewhat wavy in outline and are made up of a series of elevations.

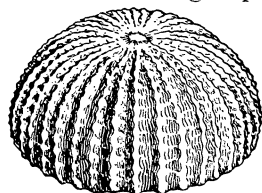


FIG. 1.—EGG OF *Graphiphora alia* (ENLARGED).

Larva: First instar.—Pale, uniform, greenish gray. Head and dorsal plate on first segment black and

shining. Last segment dark. Each segment with several black bristles with black spots at the bases. Length 1.75 to 2.5 mm. Head .37 mm. wide.

Second instar.—Body grayish green, more green on posterior part. With five longitudinal pale lines, consisting of a median dorsal and paired lateral lines, and a narrow pair of lines intermediate in position and indistinct on first three segments. Head dark brown; plate on first segment light brown. Length 3.6 to 6 mm. Head .57 mm. wide.

Third instar.—Body darker green. White lines more distinct. Head light brown; plate on first segment pale. Length 7 to 9 mm. Head .87 mm. wide.

Fourth instar.—Body light to dark green. Head pale, mottled with brown spots. Two pairs of bristle-bearing black spots nearest

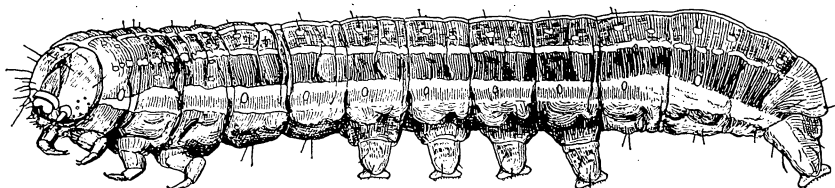


FIG. 2.—LARVA OF *Graphiphora alia* (ENLARGED).

median line on each segment are bordered on the outer side by a larger white crescent-shaped spot. Length 10 to 16 mm. Head 1.37 mm. wide.

Fifth instar.—Body light green or in some specimens dark grayish green; color darkest just above lateral white lines. Upper parts and portion of sides below lateral line speckled with minute white spots. Outer faces of prolegs with a black patch. Length 18 to 22 mm. Head 2.2 mm. wide.

Sixth instar. (Fig. 2.)—Color light yellowish green or occasionally dark grayish green, darkest toward the sides; the first and last segments paler. With five longitudinal white or cream-colored lines. The median line is narrow on the first three segments and ends on the penultimate segment. The broad lateral lines include the stigmata and are clouded with gray on the lower half; the posterior end slants downward and runs to the tip of the posterior leg. The intermediate lines are irregular in outline and much broken near the anterior and posterior ends. The whole upper

part of the body is speckled with minute whitish spots. The black bristle-bearing spots are small and inconspicuous; the two pairs nearest the median line on each segment are bounded on the outer side by prominent white spots. Head pale, mottled with light brown. Thoracic legs dark at tip only; prolegs with a dark patch on the outer face. Ventral area pale. Length 30 to 35 mm. Head 3 mm. wide.

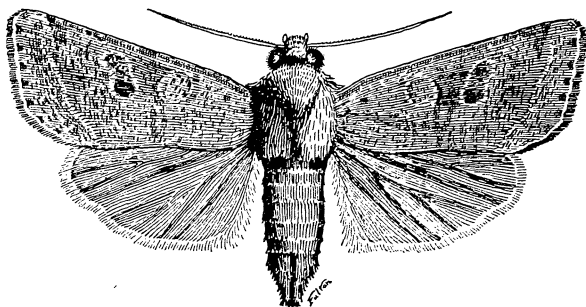


FIG. 3.—ADULT OF *Graphiphora alia* (ENLARGED).

Adult. (Fig. 3.)—"Varies in ground color from pale luteous gray to dark grayish brown.¹ Median lines obsolete or very faint; t. p. line usually punctiform. S. t. line irregular, pale, preceded by a darker shade. A row of black terminal dots. Ordinary spots large, pale ringed, reniform usually darker, at least inferiorly. Secondaries pale fuscous, powdery. Beneath powdery, with more or less complete common line and distinct discal spot. Head and thorax concolorous. The harpes (Fig. 4) of the male are suddenly

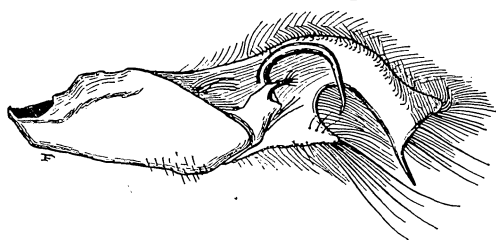


FIG. 4.—GENITAL STRUCTURES OF *Graphiphora alia*.

narrowed and curved toward tip, which at its inferior angle is produced into a long, straight, acute process. The clasper is long, slender, regularly curved and acutely terminated. At the base there is an additional small, slender corneous process. Expands 1.40 to 1.60 inches (35 to 40 mm.).

Habitat.—Northern, Middle and Eastern States; Missouri."

¹ Smith, J. B. Revision of some Taeniocampid Genera, Proc. U. S. Nat. Museum. Vol. 12, p. 487, 1889.