Studies on the Peach Saw-fly,

Eriocampoides matsumotonis MATSUMURA.

By

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I. Introduction

It is not known when severe damage by the peach saw-fly was first noticed in Japan. However, it is certain that it has been present in Okayama Prefecture for a long time. It was told to the writer that there was once very severe damage to the peach and pear, but in the last five or six years the peach saw-fly has not done much damage. Of the five years from 1916 to 1920, in the year 1918 the writer observed the most abundant occurrence of this insect in Okayama Prefecture.

However, the insects were not very wide-spread in this year. The occurrence was reported from several other prefectures also in the same year; namely, MURATA[1] reported the injury done by a species of *Caliroa* from Nagano, and NAWA[2] reported from Gifu.

Both these insects were apparently the peach saw-fly that the writer is dealing with in this report.

Though this is an important orchard pest, little has been known about it in Japan, especially with regard to its life-history and habits. The short account which appeared in "Methods of Controlling Injurious Insects for Horticulture"[3] is perhaps the only one.

Therefore, the writer proposes to publish here the results which he obtained up to the end of 1919. The writer published a preliminary paper in the "Journal of Plant Protection" in 1919.[4] Much knowledge has been added to it since that time.

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1) J. MURATA—Byō Chū Gai Zasshi, VI, pp. 367—372, 1919.
2) U. NAWA—Konchū Sekai, XXII, pp. 436—437, 1919.
3) C. FUKAYA—Jitsuyō Engei-Shokubutsu Gaichū Kujohō, 2nd Ed., pp. 382—383, 1915.
4) C. HARUKAWA—Byō Chū Gai Zassi, VI, No. 1, January, 1919.

II. Classification.

The peach saw-fly belongs to the order *Hymenoptera*, family *Tenthredinidae*. The Latin name of the saw-fly has not been determined until recently. MATSUMOTO of Okayama sent the specimen of this insect to MATSUMURA of the Hokkaidō Imperial University, requesting him to identify it. MATSUMURA found that the species is new, and named it *Eriocampoides matsumotonis* MATSUMURA.[1]

Though there is a little doubt about the correct generic name, the present writer followed MATSUMURA and used the genus *Eriocampoides* KONOW in this report.

A species named *Caliroa cerasi* L. is found in Europe as well as in North America.[2] This species resembles very closely the peach saw-fly of Japan, both in the larval and adult stage. There are, however, several differences, among which the following are more easily noted:

1. *Caliroa cerasi* L. is slightly larger than the peach saw-fly.
2. In *Caliroa cerasi* L. the radial cross-vein of the forewing comes (or very nearly) to the base of the free part of the vein R_4; while in the peach saw-fly of Japan R_4 starts at a point situated much more distally.

III. Distribution in Japan.

The distribution of the peach saw-fly has not yet been exactly ascertained. The writer thinks, however, it is certain that it is found at least in a few more prefectures besides Okayama. That it was apparently seen in Gifu and Nagano has been already mentioned. Whether this species is found in foreign countries or not, is not yet known.

IV. Description.[3]

1) *Imago.* Female.—Head shiny black; its length shorter than width; nearly as wide as thorax. Antennae 9-jointed, almost thread-like, thickened very slightly in the middle part; its length slightly shorter than half the length of body; the third segment the longest, nearly twice as long as the fourth; color black, but not as deep black and shiny as in the other parts

1) Private communication to Mr. MATSUMOTO.

2) U. S. Dept. Agr. Div. Ent. Circ. No. 26 (Second Ser.)

3) For the technical description of the species the readers are requested to consult the paper which will be published elsewhere by Professor S. MATSUMURA of the Hokkaido Imperial University.

of body. Compound eye black. Bases of mandibles and lower edges of compound eyes close together, but not touching.

Thorax shiny, black. Forewing dusky almost all over the surface, except a small outer portion which is almost colorless. Hindwing dusky all over, outer margin being slightly paler.

If coloration of the forewing be stated in reference to cells, cell 2d R_1+R_4, cell R_3 and cell M_1 are almost colorless, other part dusky.

Neuration: Forewing.—c. v. (m—cu), i. e., vein which makes outer margin of cell M starts on radius at a point a little nearer to the base of wing than the point at which media starts. Vein M_{3+4} (i. e., 1st recurrent nerve of certain authors) not parallel to c. v. (m—cu).

Cell 2d A + 1st A (i. e. lancet cell) divided into two cells by vein 2d A, and cell 2d A constricted in the middle. Cell R_4 (i. e. 3rd subcostal cell of certain authors and 3rd cubital cell according to COMSTOCK and NEEDHAM) is longer than cell R_5. Cell (R_1+R_2), i. e., so-called radial cell divided into two. Vein R_4 starts at a point much further outward than radial cross-vein. Cross-vein (r—m) is rudimentary.

Hindwing.—Both cell R_4+R_5 and cell 1st M_2 present in most specimens; the latter, however, sometimes lacking.

Legs.—Coxa and trochanter dark brown to black; femur and tibia light brown or pale grayish yellow; tarsi grayish yellow in most specimens.

Abdomen black, shiny.

Length of body 4.8—5.2 mm; expansion 10—10.5 mm. General outline of body oblong.

Male is almost the same in structure and colouration, except the following points: body is somewhat smaller than female, and cell R_4+R_5 and 1st M_2 of the hindwing are absent in most specimens.

2) *Egg.*—Almost semi-circular in outline, slightly flattened, milky white with slight tinge of yellow. Size: length 0.77—0.82 mm; width 0.48—0.54 mm.

3) *Larva.*—Newly hatched larva measures from 1.3 to 1.5 mm in length, very pale yellow and almost transparent. Head is black, thoracic segments strongly swollen, so that general shape of body resembles a club. The larva is not covered with slimy substance when it hatches out, but in a short time the integument secretes a slimy substance and the body is covered with it almost entirely excepting the head and the ventral surface of the body.

The fullgrown larva before the last moulting measures about 10 mm; thoracic segments are swollen, but not so strongly as in the newly hatched larva. The body is covered by the slimy substance, the color of which is dark green in most cases, but it is sometimes pale brown, dark brown or even almost black.

The variation in colour of this slimy substance is probably due to its thickness, age of the larva and to the content of the alimentary canal, the colour of which may in turn be affected by the condition of the food in it.

The larva has a peculiar smell like that of ink.

4) *Pupa.* The pupa is enclosed in the cocoon and belongs to the type called free pupae. It is about 5.5 mm. in length and 2.5 mm. in width.

Its color is at first light yellow, but turn black before the emergence of the adult. The leg remains, however, almost light yellow throughout the pupal stage.

V. Life-History and Habits.

(i) Time of Appearance and Number of Generations.

Field Observation.

The records of the results of observation in the peach orchard and in the pear orchard during 1916 to 1919 are given below. The writer could not continue observation from the beginning of spring till the end of the season either in 1916 or in 1917. In both of these two years the larvae were seen on the 10th of July.

In 1918 it was reported from a certain locity of Okayama Prefecture that many peach slug-worms were found feeding on peach leaves about the 25th of June. The writer found in Kurashiki many larvae on July 5th, some of which were almost fullgrown and some seemed to have just hatched.

At the same time eggs, though not numerous, were also found. From this day on till about July 23rd larvae which seemed to be the first brood were seen. Eggs which had been laid apparently by the adults of the first generation, and many adults of the first generation were seen on July 26th.

From this day till about August 28th larvae which belonged presumably to the second generation were found and the oviposition of the adult of the second generation began on September 6th, and continued for a long time. Oviposition of the greatest number of eggs per day seemed to have occurred between September 10th and 12th.

The larvae of the third generation appeared during a long period and many larvae could be seen till about October 10th. The writer saw a few larvae even as late as the beginning of November.

This seemed, however, to be an exceptional case.

The writer desires to report the results of the field observation of 1919, also, in spite of tediousness, since the field observation is important in determining the number of generations of this insect.

In 1919 a few eggs of the peach saw-fly were found for the first time on June 9th and on the 18th of the same month many eggs, as well as larvae, were found. These larvae seemed to have hatched only 3 or 4 days before. The interval between this day and June 25th was perhaps the period of the appearance of the majority of the first brood of larvae. A few were, however, seen till about the 20th of July.

On July 23rd the writer found a few eggs which were surely the beginning of the second brood.

Larvae of the second generation began to appear on July 27th. It is worth recording that a few eggs of this generation could be seen till about the middle of August. Probably these eggs were laid by the adults of the first generation, which appeared very late.

The larvae of the second generation were seen till about the 25th of August. At the end of August newly laid eggs were found. This fact shows that the third generation had begun to appear, and from the beginning to the end of September the larvae of the third brood were found.

From the foregoing statements it may be said that the peach slug-worm appears three times in one season. However, as the consequence of marked delay in completing the life-cycle in a part of one brood, the occurrence of generations are not quite regular.

Results of Rearing.

Two rearing methods were used simultaneously:

1. Rearing the larvae separately in a glass vessel such as Petri-dishes or wide-mouthed and low cylinders.

2. Rearing several larvae in one breeding cage at a time.

In the former method growth of the larvae was slightly slower than in the latter, while in the latter accurate observation could not be made. The latter method had, however, some advantage, i. e., the rearing was much easier than in the former and it was sure to obtain the adult insect.

In the following tables the writer gives the records of his rearing experiments.

In table I the record of the emergence of adults in the spring is shown. The cages were kept in the insectary throughout the winter.

Table I.

Emergence of Adult in June, 1919.

Date of emergence / Sex	June, 1919											Remark
	6	7	8	9	10	11	12	13—17	18	19	20	
♂	1	4	2	6	1	1	1	0	0	0	0	
♀	0	1	5	0	0	1	0	0	2	1	0	
♂	1	0	0	0	0	0	0	0	0	0	0	From unfertilized eggs.
♀	0	0	0	0	0	0	0	0	0	0	0	From unfertilized eggs.

Table II.

Results Obtained by the First Method.

Generation	Oviposition	Hatching	Going into soil	Emergence	Remark
A. In 1917					
First gen.	—	—	July 23	—	Rearing begun with collected larvae on July 13th.
	—	—	„ 20	August 3	
	—	—	„ 20	„ 4	
	—	—	„ 25	„ 7	
Second gen.	—	August 11	August 24	Sept. 7	Rearing begun with collected eggs.
	—	„ 11	„ 24	None	
	—	„ 12	„ 27	„	
	—	„ 12	„ 24	„	
	—	„ 12	„ 26	„	
	—	„ 13	„ 27	„	
	—	„ 13	„ 27	„	
B. In 1918.					
First gen.	—	July 6	July 22	None	Rearing begun with collected eggs.
	—	„ 9	„ 25	August 7	
	—	„ 8	(Died)	—	
	—	„ 10	(„)	—	
Second gen.	July 23	July 30	August 13	August 29	
	„ 23	„ 31	„ 11	„ 25	
	„ 23	„ 31	„ 12	„ 28	
	23	„ 31	„ 13	„ 27	
	„ 23	„ 31	„ 12	None	
	„ 23	„ 31	„ 11	„	
	„ 23	„ 31	„ 14	„	
Third gen.	August 31	Sept. 7	Sept. 29	—	Overwintered in cocoon.
	„ 31	„ 7	Oct. 3	—	
	Sept. 2	„ 10	Sept. 27	—	
	„ 2	„ 10	Oct. 3	—	
	„ 2	„ 10	Sept. 29	—	
	„ 4	„ 11	„ 30	—	
	„ 4	„ 11	Oct. 4	—	

(*Table II. Continued.*)

C. In 1919.

Generation	Oviposition	Hatching	Going into soil	Emergence	Remark
First gen.	June 9	June 20	July 7	July 23	
	„ 9	„ 20	„ 5	„ 20	
	„ 8	„ 19	„ 8	„ 22	
	„ 8	„ 19	„ 3	„ 19	
	„ 8	„ 19	„ 4	„ 19	
	„ 10	„ 20	„ 6	„ 21	
	„ 11	„ 21	„ 4	„ 19	
	„ 11	„ 21	„ 6	„ 20	
	„ 8	„ 19	„ 4	„ 18	

Table III.

Results Obtained by the Second Method, 1918.

Generation	Oviposition	Hatching	Going into soil	Emergence	Remark
First gen.	—	—	July 8—18	July 23—Aug. 1	Rearing begun with collected larvae.
	—	—	„ 7—12	„ 23, 24	
	—	—	„ 9—17	„ 22—28	
	—	—	„ 10—17	„ 26—29	
	—	—	„ 9—20	„ 23—Aug. 2	
Second gen.	—	—	Aug. 16—25	Aug. 30—Sept. 4	Rearing begun with collected larvae.
	—	—	„ 18—28	„ 31—Sept. 9	
	—	—	„ 16—19	Sept. 1—	
	—	—	„ 17—26	„ 1—9	
Third gen.	Aug. 31—Sept. 4	Sept. 9—13	Sept. 17—Oct. 6	—	Overwintered.

From the tables I, II and III it is seen that the emergence of adults from the pupae of the preceding year begins at the beginning of June; that the emergence of the adults of later generations occurs to about September 10th; and that the larvae which enter the ground after the middle of September do not transform into adults in that year.

By comparing the results of the field observation and those obtained by rearing in the laboratory the writer concludes that the peach saw-fly occurs three times a year under the climatic conditions as are found in the Okayama Prefecture, and possibly in most of the Prefectures west of Tokyo.

From the foregoing statements the time of appearance of the three broods will be as follows:

The first brood of larvae......from June 20th to July 30th.
,, second ,, ,, ,, ... ,, July 30th to August 30th.
,, third ,, ,, ,, ... ,, September 1st to October 15th.

On account of the rather long interval between the appearance of the first and the last larvae of each generation, a few larvae of the second and the third generation may sometimes be seen for a little longer time than that given above. The larvae of the second generation reared in 1917 had died in the cocoon stage and no adult appeared in that year or in the next spring.

(ii) Ecological Notes.

1) Adult.

Oviposition.

The peach saw-fly begins to lay its eggs as soon as it emerges. Therefore, some of the eggs, at least, which are in the ovarian tubes must be mature when the abult emerges. Hence, it can not be said that the *pre-oviposition* period exists in the case of this insect. Moreover, as this abult insect has generally a very short longevity, the number of eggs which are already fully mature by the time the adult emerges will probably constitute the most part of the eggs which an adult can lay. In other words the number of eggs which develop and mature after the emergence of an adult and are laid, would be very small.

The egg is laid singly just under the upper epidermis of the leaf. The process of oviposition is briefly as follows: First, the adult crawls about on the leaf surface as if it is looking over it to know whether the leaf is suitable for oviposition; then, it goes on the under surface, thrusts its ovipositor through the cuticule and tissue, separates the upper epidermis from the tissue by swinging its saw to and fro, and inserts one egg in the space thus made. So, we can find out the cut on the cuticle by carefully examining the under surface of the leaf just under the part where the egg is seen on the upper surface.

The portion of the epidermis which is separated from the tissue is almost semi-circular in outline, and its longer axis is 1.09 to 1.28 mm. and the shorter axis 0.77 to 0.96 mm.

The part of the leaf cuticle of the peach-tree, which is covering an egg, swells up a little and looks just like a transparent blister on the leaf; while on the leaf of the cherry, the japanese flowering cherry and the pear, this portion is light brown in colour and is not so transparent as in the case of the peach.

Food of Adult.

The writer has not yet observed the adult of the peach slug-worm taking food in the orchard. In the laboratory it takes water apparently with much eagerness. In the hot and dry midsummer the adult dies in a short time, if we do not keep moist sand in the cage.

The cane-sugar solution and the diluted honey seem to be favorite food of this insect.

Oviposition Period.

Table IV.

Oviposition Period.

In 1917

Generation	Emergence of adult	Oviposition (Date)	Oviposition period	Death of adult	Remark
	June 7	June 7, 8, 9, 10	4 days	June 11	
	„ 8	„ 8, 9, 11	3 „	„ 15	
	„ 8	„ 8, 9	2 „	„ 12	
Third gen.	„ 8	„ 8, 9, 10, 11	4 „	„ 11	Adults emerged from the pupae of larvae which overwintered, i. e., the third generation of the preceding year. Average ovip. period 3.6 days.
	„ 8	„ 9, 10, 11	3 „	„ 15	
	„ 8	„ 8, 9, 10, 11, 12	5 „	„ 14	
	„ 11	„ 11, 12, 14, 15	4 „	„ 17	
	July 26	July 26, 27, 28, 29	4 days	July 30	
	„ 26	„ 26	1 „	„ 28	
	„ 27	„ 27, 28	2 „	„ 29	
First gen.	„ 27	„ 27, 28, 29	3 „	„ 30	Average ovip. period 2.6 days.
	„ 27	„ 27, 28, 29	3 „	„ 30	
	„ 27	„ 27, 28, 29	3 „	„ 31	
	„ 28	„ 28, 29	2 „	„ 30	
	Aug. 31	Aug. 31, Sept. 1	2 days	Sept. 4	
	Sept. 1	Sept. 1, 2	2 „	„ 5	
	„ 1	„ 1, 2	2 „	„ 6	
	„ 3	„ 3, 4	2 „	„ 7	
	„ 3	„ 3, 4, 5	3 „	„ 6	
Second gen.	„ 3	„ 3, 4	2 „	„ 6	Average ovip. period 1.9 days.
	„ 3	„ 3	1 „	„ 6	
	„ 5	„ 5, 6	2 „	„ 9	
	„ 7	„ 7	1 „	„ 11	
	„ 6	„ 6, 7	2 „	„ 11	
	„ 6	„ 6, 7	2 „	No record	

As shown in table IV, the adult begins oviposition on the day of emergence. And the period in which oviposition occurs covers from 1 to 5 days. The average oviposition period is 2.6 days in the first generation; 1.9 days in the second generation, and 3.6 days in the third generation.†

It will be seen that the oviposition period is the longest at the beginning of summer and that, as the season becomes warmer, the oviposition period is shorter. Some of the adults die immediately after oviposition and others live only 3 days at the most.

Number of eggs laid.

Table V.

Number of eggs laid by one female.

In 1919.

Generation	Number of females	Number laid	Average number	Remark
Third gen.	1	40 eggs	40 eggs	Adults emerged from the pupae of the third generation of the preceding year. Oviposition in June 1919.
	1	16 „	16 „	
	1	29 „	29 „	
	1	6 „	6 „	
	1	31 „	31 „	
	1	44 „	44 „	
	1	29 „	29 „	
First gen.	1	17 „	17 „	July, 1919.
	1	31 „	31 „	
	1	28 „	28 „	
	1	28 „	28 „	
	1	3 „	3 „	
	1	23 „	23 „	
	3	63 „	21 „	
	1	23 „	23 „	
Second gen.	1	21 „	21 „	September, 1918.
	2	47 „	23.5 „	
	1	18 „	18 „	
	2	38 „	19 „	
	1	6 „	6 „	
	1	34 „	34 „	
	1	33 „	33 „	
	1	12 „	12 „	
	1	19 „	19 „	
	1	22 „	22 „	
	2	4 „	2 „	
	2	47 „	23.5 „	
	1	12 „	12 „	
	1	33 „	33 „	
	1	25 „	25 „	
	1	11 „	11 „	

† The writer assumes that a generation begins with the egg and ends with the adult. In the case of the peach saw-fly the adults which appear from the pupae of overwintering larvae in the spring, are considered the third generation of the preceding year according to the writer's assumption.

The records shown in table V were obtained from the experiments conducted in the laboratory. During the course of the experiments the writer often met with a few females which did not lay any egg. The cause of this failure in getting egg is unknown. However, most females laid eggs apparently without any hesitation when they were introduced into a cage containing a peach twig with leaves. The number of eggs that one female laid varied from 2 to 44. Whether this smallest number, i. e., 2 eggs, was all that the female concerned could oviposit, is very doubtful.

The number of females in the experiment was 37, and the eggs laid were 683 in all. That makes about 19 eggs per female.

Parthenogenesis and its Relation to Sex.

Parthenogenesis is not a rare occurrence in insects. It has been known to occur among several classes of insects from long ago, especially in the saw-fly it has often been observed.

To cite some of the more recent observations, MacDougal[1] in England reported that he reared 106 adults of the pine saw-fly (*Lophyrus pini*) from the unfertilized eggs, and that all of them were males.

Caliroa cerasi is the pear saw-fly found in North America, which is very closely allied to the peach saw-fly in Japan, as I have already mentioned. Webster says in his report, "Parthenogenesis probably occurs with this species, but this has not been satisfactorily proved. We have collected and examined large numbers of saw-flies, but have never found a male."[2]

Table VI.

Oviposition of Virgins.

Generation	Number of females	Number of eggs laid	Number of eggs per female	Remark
Third	1	44	44	Oviposition June 8—12, 1919.
"	1	29	29	" " 11—15, 1919.
First	3	63	21	" July 27—29, 1919.
"	1	23	23	" " " "
Second	1	6	6	" Sept. 3, 1918.
"	1	12	12	" " " "
"	1	19	19	" " 3—5, 1918.
"	2	47	23.5	" " 4, 5, "
"	1	12	12	" " 5, 6, "
"	1	25	25	" " 6, 7, "
"	1	11	11	" " 7, "

Average number of eggs per female............20.7

1) MacDougal, R. S.—Parthenogesis in *Lophyrus pini.* Journ. Econ. Biol., II, pp. 49—55, 1907.

2) Webster, R. L.—The Pear-slug, *Caliroa cerasi* Linn. Iowa Agric. Exp. Sta. Bull. No. 130, 1912.

Finally, EWING has shown that this species (*Caliroa cerasi*) is parthenogenetic and that unfertilized eggs produce female insects only.[1)]

We have shown definitely that the peach saw-fly in Japan is another example of Tenthredinoidea in which parthenogenesis occurs.

In table VI the records of oviposition of the virgin female are shown.

It is worth studying whether or not the unfertilized egg can develope normally, even though the virgin female lays eggs just as much as the fertilized female.

The writer made some observations regarding this point. The results are shown in table VII.

Table VII.

Development of Unfertilized Eggs.

A. Third generation, 1918.

Rearing No.	Oviposition	Hatching	Fullgrown	Remark
No. 1	Sept. 4	Sept. 11	Sept. 30	Overwintered in cocoon.
„ 2	„ 4	„ 11	Oct. 4	„
„ 3	„ 4	„ 12	„ 6	„
„ 4	„ 2	„ 11	—	Larva died before fullgrown.
„ 5	„ 3	„ 11	—	„
„ 6	„ 3	„ 12	—	„
„ 7	„ 3	„ 13	—	„
„ 8	„ 3	„ 13	—	„

B. First generation, 1919.

Rearing No.	Oviposition	Hatching	Fullgrown	Emergence of adult	Sex	Remark
No. 1	June 9	June 20	July 6	None	—	Died in cocoon stage.
„ 2	„ 9	„ 20	„ 7	July 22	♂	
„ 3	„ 8	„ 19	„ 5	None	—	Died in cocoon stage.
„ 4	„ 9	„ 20	„ 6	None	—	„
„ 5	„ 9	„ 20	„ 5	July 20	♂	
„ 6	„ 8	„ 19	„ 8	„ 22	♂	
„ 7	„ 8	„ 19	„ 3	„ 19	♂	
„ 8	„ 8	„ 19	„ 7	None	—	Died in cocoon.
„ 9	„ 8	„ 19	„ 7	None	—	„
„ 10	„ 8	„ 19	„ 4	July 19	♂	
„ 11	„ 8	„ 19	„ 3	None	—	Died in cocoon.
„ 12	„ 8	„ 19	„ 5	None	—	„
„ 13	„ 8	„ 19	„ 6	None	—	„
„ 29	„ 12	„ 23	„ 12	July 25	♂	
„ 30	„ 12	„ 23	„ 10	„ 23	♂	
„ 31	„ 12	„ 23	„ 10	„ 23	♂	
„ 32	„ 12	„ 23	„ 14	„ 28	♂	
„ 33	„ 12	„ 24	„ 10	„ 24	♂	

1) EWING, H. E.—Parthenogenesis in the pear slug saw-fly. Ann. Entom. Soc. America, (Columbus), X, pp. 330—335, 1917.

According to table VII unfertilized eggs developed to larvae and about half of them were full-grown and went into the soil. But, nearly 45% of the full-grown larvae which had entered in the cocoon stage died in the cocoon. Out of 3 larvae of the third generation in 1918 one male saw-fly emerged on June 1st of the next year.

As shown in table VII, all the adults which originated from the unfertilized eggs were males.

As I have mentioned above, in the experiments of EWING unfertilized eggs produced female insects only. Curiously enough in our experiments all unfertilized eggs gave rise to male insects only, though the peach saw-fly in Japan and the pear slug saw-fly in America are apparently quite closely related to each other. MACDOUGALL's observation is in accord with ours in that he obtained male insects only from the unfertilized eggs.

According to GOLDSCHMIDT's[1] explanation regarding the relation of parthenogenesis to sex, this apparent discrepancy between the results obtained by different investigators seems to be explained.

He states that in Hymenoptera the adults produced by parthenogenesis in some cases may be females only, sometimes a mixture of males and females, or males exclusively in the third case. The sex is determined by the mode of origin of mature eggs which are produced parthenogenetically.

In the writer's experiment many larvae died before reaching the adult stage, so that it can not be assured that there had not been any female insects at all among those which died.

Another point of interest in connection with parthenogenesis was pointed out by both WEBSTER and EWING. WEBSTER[2] reports "Both Mr. NESS and Mr. MCCALL confined virgin female saw-flies in insectary cages and obtained eggs from them. Some of these eggs hatched, but the larvae were weak and in no case did they live more than a few days. None reached the second stage."

EWING[3] states "I am unable to account for the failure of these second brood larvae to produce active adults unless it be on account of a lack of vigor due to the absence of fertilization for this brood; etc."

The writer also found it rather difficult to rear the larvae hatched from the unfertilized eggs, and to get adults from such larvae. The results shown in table VII seem to indicate this fact.

At any rate, the fact that even unfertilized eggs are able to develop deserves emphasis from the view-point of the applied entomologist.

Longevity of Adult.

The writer fed peach saw-flies with sugar solution in the breeding cage,

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1) GOLDSCHMIDT, R.—On a case of facultative parthenogenesis in Gypsy-moth; etc. Biol. Bull. 32, pp. 35—43, 1917.

2) WEBSTER, R. L.—Loc. cit.

3) EWING, H. E.—Loc. cit.

to see how long they live. The bottom of the cage was filled with sand, and the sand was kept moist by spraying water now and then. The results of this experiment are shown in table VIII.

Table VIII.

Longenity of Adult.

Adult which lived for	Number and sex of adult		Remark
	♂	♀	
Second generation, August—September, 1918.			
1 day	1	1	Observations from August 29 to September 14, 1918.
2 days	10	5	
3 "	5	11	
4 "	1	6	
5 "	0	4	
Average longevity	2.9 days	3.3 days	
Third generation, June, 1919.			
2 days	2	0	Observations at the beginning of June, 1919. Adults which emerged from the pupae of the third generation of the preceding year, (1918).
3 "	2	1	
4 "	3	2	
5 "	5	0	
6 "	1	2	
7 "	2	2	
8 "	1	0	
Average longevity	4.7 days	5.3 days	
First generation, July, 1919.			
1 day	1	0	Observations in the latter half of July, 1919.
2 days	2	3	
3 "	2	4	
4 "	0	4	
Average longevity	2.2 days	3.3 days	

According to table VIII the average longevity of the male which appears in the spring is 4.7 days and that of the female is 5.3 days. In the first and second generations, the averages for the males are 2.2 and 2.9 days respectively, and for the female 3.3 days. Generally the average longevity for the female is slightly longer than that for the male. In June the peach sawfly lives markedly longer than in the latter part of July or in August. The longer longevity in June is probably due to the lower temperature and higher humidity of the air in this month.

2) Egg.

Incubation period.

Table IX.

Incubation Period.

Second generation, 1918.

Incubation period	Number of eggs	Remark
6 days	2	Observations from July 23rd to August 8th, 1918.
7 „	7	
8 „	10	
9 „	2	
10 „	3	

Average incubation period.........................7.8 days

Third generation, 1918.

Incubation period	Number of eggs	Remark
7 days	8	Observations from August 31st to September 16th, 1918.
8 „	62	
9 „	55	
10 „	31	
11 „	1	

Average incubation period.........................8.7 days

First generation, 1919.

Incubation period	Number of eggs		Remark
	Fertilized (?)*	Unfertilized	
9 days	3	0	Observations from June 7th to July 1st, 1919.
10 „	29	4	
11 „	27	27	
12 „	17	16	
13 „	7	0	
Average incub. period	11.0 days	11.3 days	

Second generation, 1919.

Incubation period	Fertilized eggs (?)	Unfertilized eggs	
7 days	1	2	Observations from July 26th to August 6th, 1919.
8 „	5	23	
9 „	24	7	
10 „	5	0	
11 „	1	0	
Average incub. period	9 days	8.2 days	

* Eggs which are classed as "fertilized (?)" in table IX were laid by females which had been confined in a cage together with males at least one day before the females were used for the experiment. However, it was somewhat doubtful whether they really mated or not.

The records shown in table IX can be summarized as follows:

Kinds of eggs	Average egg periods
The second eggs in 1918	7.8 days
„ third „ „ 1918	8.7 „
„ first „ „ 1919	11.0—11.3 „
„ second „ „ 1919	8.2— 9.0 „

Although the average egg period was from 7.8 to 11.3 days according to the generation to which the eggs belonged, the incubation period varied between rather wide limits. For example, in 1918 the longest egg period for the second generation was 10 days, the shortest 6 days; for the third generation the egg period was from 7 to 11 days; while in 1919 for the first generation the longest egg period was 13 days and the shortest 9 days. The chief causes of this variation are the time at which eggs are laid and individuality.

3) Larva.

Hatching, Feeding and Growth.

When the embryo in the egg fully develops, it cuts open the egg-shell and the leaf epidermis covering over it in the form of a broken circle and comes out on the upper surface of the leaf.

The newly hatched tiny larva eats the epidermis and tissue here and there making small cavities which are shallow and do not reach the lower epidermis of the leaf. When the larva grows a little more, its mode of feeding changes a little; i. e., it eats the leaf cuticle and tissue deep enough to reach the lower epidermis which is, however, left uninjured in the shape of irregular whitish blotches. In most cases the larva feeds on the upper surface, but sometimes it attacks the leaf from the lower surface also. In the peach-tree injured leaves appear to have whitish irregular flecks on the leaves, while in the pear these flecks are brownish.

After the larva leaves the egg, the position of the egg can easily be detected as a white speck in the case of the pear-tree; while on the peach leaf, this speck is not so distinct.

The newly hatched larva has no slimy covering on the body surface; but, it secretes in a short time a brownish or dark green slimy substance over all the body except the head and the ventral surface of the body. When the larva is fullgrown, it makes its last moulting and immediately afterwards it enters the soil.

After this last moult the body of the larva is yellow in colour and has no slimy covering at all. The slimy covering is cast off at each moulting with the exuvia and after moulting it is secreted again.

Moulting.

The peach slug-worm moults 5 or 6 times in its larval stage. It is not yet known what conditions determine the number of moulting. But, it seems to be fairly certain that among individuals of one brood there is no marked difference in the number between the individuals which moult 5 times and those which moult 6 times.

As shown in table X, out of 30 slugworms of the first generation in 1919, 18 moulted 6 times and the rest moulted 5 times.

The sex of the larva does not seem to have any relation to the number of moulting. For, among several larvae which were males some moulted 5 times and the rest 6 times. (See table X).

Table X.

Breeding Record.

A. In 1918

First generation

Rearing No.	Hatching	First moult	Second moult	Third moult	Fourth moult	Fifth moult	Sixth moult	Full-grown	Emergence	Remark
No. 3	July 9	July 12	July 14	July 17	July 19	July 21	July 25	July 25	Aug. 7	♀
„ 5	„ 6	„ 9	„ 11	„ 12	„ 17	„ 19	„ 22	„ 22	Died in cocoon.	

Second generation

Rearing No.	Hatching	First moult	Second moult	Third moult	Fourth moult	Fifth moult	Sixth moult	Full-grown	Emergence	Remark
No. 1	July 30	Aug. 2	Aug. 3	Aug. 7	Aug. 9	Aug. 13	None	Aug. 13	Aug. 29	♂
„ 2	Aug. 6	„ 10	„ 12	„ 15	„ 18	„ 22	„	„ 22	Died in cocoon.	
„ 3	July 31	„ 2	„ 4	„ 5	„ 8	„ 11	„	„ 11	Aug. 25	♂
„ 4	„ 31	„ 2	„ 4	„ 6	„ 8	„ 12	„	„ 12	Died in cocoon.	
„ 5	„ 31	„ 2	„ 4	„ 6	„ 9	„ 12	„	„ 12	Aug. 28	♂
„ 6	„ 31	„ 2	„ 6	„ 8	„ 11	„ 13	„	„ 13	„ 27	♂

Third generation

Rearing No.		No. 1	No. 2	No. 3	No. 4	No. 7	No. 13	No. 20	No. 10	No. 14
Date of hatching / Full-grown on		Sept. 7	Sept, 9	Sept. 10	Sept. 10	Sept. 11	Sept. 12	Sept. 13	Sept. 11	Sept. 12
Sept. 27	Number of larvae				1					
„ 28					1					
„ 29		1	1		2					
„ 30			1	2	4				1	
Oct. 1			2							
„ 2			2	2						
„ 3		1		1	1					
„ 4								1	1	
„ 5								3		
„ 6							1			
„ 7						1				1
Remark									From unfertilized eggs.	

(*Table* X. *Continued.*)

B. In 1919
First generation

Rearing No.	Hatching	First moult	Second moult	Third moult	Fourth moult	Fifth moult	Sixth moult	Going into soil	Emergence	Remark
No. 14	June 20	June 23	June 26	June 29	July 1	July 3	July 6	July 6	July 21	♂
„ 16	„ 21	„ 23	„ 26	„ 29	„ 1	„ 4	„ 7	„ 7	—	Died in cocoon.
„ 17	„ 21	„ 23	„ 25	„ 28	June 30	„ 4	—	„ 4	„ 19	♂ No 6th moult.
„ 18	„ 21	„ 24	„ 27	„ 29	July 2	„ 4	„ 6	„ 6	„ 20	♂
„ 19	„ 21	„ 23	„ 27	„ 29	„ 2	„ 5	„ 8	„ 8	„ 21	♂
„ 20	„ 19	„ 22	„ 24	„ 28	June 30	„ 4	—	„ 4	„ 18	♂
„ 21	„ 21	„ 24	„ 27	„ 29	July 2	„ 5	„ 9	„ 9	—	
„ 22	„ 20	„ 23	„ 26	„ 29	„ 1	„ 3	„ 7	„ 7	—	
„ 25	„ 21	„ 24	„ 26	„ 29	„ 1	„ 6	—	„ 6	—	
„ 26	„ 22	„ 26	„ 28	July 1	„ 3	„ 6	—	„ 6	„ 21	♂
„ 27	„ 22	„ 25	„ 28	„ 1	„ 3	„ 6	—	„ 6	„ 22	♂
„ 28	„ 23	„ 26	„ 29	„ 1	„ 3	„ 6	„ 11	„ 11	—	
„ 1*	„ 20	„ 23	„ 25	June 28	„ 1	„ 3	„ 6	„ 6	—	
„ 2*	„ 20	„ 23	„ 26	„ 29	„ 1	„ 4	„ 7	„ 7	„ 22	♂
„ 3*	„ 19	„ 22	„ 24	„ 28	„ 1	„ 5	—	„ 5	—	
„ 4*	„ 20	„ 23	„ 25	„ 27	June 30	„ 2	„ 6	Died before going into soil.		
„ 5*	„ 20	„ 22	„ 25	„ 29	July 1	„ 6	„ 8	July 8	July 22	♂
„ 6*	„ 19	„ 22	„ 24	„ 27	June 29	„ 2	—	„ 3	„ 19	♂
„ 7*	„ 20	„ 23	„ 25	„ 28	„ 30	„ 2	„ 5	„ 5	„ 20	♂
„ 8*	„ 19	„ 22	„ 24	„ 27	„ 30	„ 3	„ 7	„ 7	„ —	
„ 9*	„ 19	„ 22	„ 24	„ 26	„ 29	„ 2	—	„ 3	„ —	
„ 10*	„ 19	„ 22	„ 24	„ 27	„ 29	„ 1	„ 4	„ 4	„ 19	♂
„ 11*	„ 19	„ 22	„ 24	„ 26	„ 29	„ 3	—	„ 3	„ —	
„ 12*	„ 19	„ 22	„ 24	„ 26	„ 29	„ 1	„ 5	„ 5	„ —	
„ 13*	„ 19	„ 22	„ 24	„ 26	July 1	„ 6	—	„ 6	„ —	
„ 29*	„ 23	„ 28	„ 30	July 2	„ 6	„ 8	„ 12	„ 12	„ 25	♂
„ 30*	„ 23	„ 27	„ 30	„ 2	„ 4	„ 7	„ 10	„ 10	„ 23	♂
„ 31*	„ 23	„ 28	July 2	„ 4	„ 6	„ 8	„ 10	„ 10	„ 23	♂
„ 32*	„ 23	July 1	„ 6	„ 9	No records..................			„ 14	„ 28	♂
„ 33*	„ 24	June 29	„ 2	„ 4	July 6	July 10	—	„ 10	„ 24	♂

Larval period.

For the sake of convenience the writer assumes the interval from the day of hatching to the day when the larva enters into the soil (including both days) to be the larval period.

The larval period observed in the laboratory can be calculated from the results shown in table X.

The records shown in table X are the results of observations on individuals which were reared separately. The individuals marked with an asterisk in the table represent the larvae hatched from the unfertilized eggs. Records in which the dates of emergence are not given refer to the individuals which died in the cocoon stage; and those without the dates of the sixth moulting refer to the larvae moulted only five times.

According to the records shown in table X the larval period is as follows:

Generation	Length of Larval Period, (in days)		
	Maximum	Minimum	Average
The first generation	19	14	16.7
„ second „	16	12	13.8
„ third „	26	17	22.5

During the growing period of the second brood larvae the weather is the warmest. It is probably due to this high temperature that in the second brood the average larval period is the shortest of the three averages. That the larval period of the third generation is the longest is perhaps due in the similar way to the lower temperature in the later part of September and in October.

As it has been already stated, some larvae moult 6 times, while others moult 5 times.

Consequently some have 5 larval stadia, and others 6 stadia. Calculating the length of each larval stadium according to table X, the following results are obtained:

Table XI.

Average length of larval stadium (in days).

First stadium	Second stadium	Third stadium	Fourth stadium	Fifth stadium	Sixth stadium	Remark
3	2	2	3.5	2	3.5	First generation, 1918
2.8	2.8	2.8	2.3	3.1	3.4	First generation, 1919
2.5	2.1	2.3	2.7	3.3	—	Second generation, 1918

Each larval stadium covers from 2 to 3.5 days in average and the length of the sixth stadium is the longest. The interval from the hatching to the end of the sixth larval stadium is the growing period of the larva.

4) Pupation and Overwintering.

When fullgrown the larva makes its last moulting and goes into the soil to make its cocoon.

The cocoon is made of soil and its inner side is lined with a brown substance.

The cocoon is an ellipse in shape and its long axis measures about 6 mm. and the short axis 3 mm. The nature of the lining substance is not known. However, some properties of this substance can be given. It does not dissolve in water and does not allow water to pass through it freely. Moreover, it does not dissolve in dilute acid or alkali.

According to the observation in the field as well as to the experiments in the insectary, the depth which the larva reaches in order to make its cocoon seems to be very small.

Cocoons are found at a depth of from 0.6 to 1.0 inch from the surface. Most of them are found at about 0.6 inch from the surface.

The writer tried to let the larvae overwinter in several ways. Sometimes larvae were allowed to make their cocoons in the soil in the breeding cage, and sometimes the writer dug a small cavity in the ground, put into it a porous pot (which was not glazed) with its brim a little higher than the surface of the ground, filled the pot with soil and let the larvae make their cocoons in this soil.

In both cases the percentage of larvae that overwintered was low. Perhaps, the larvae are not resistant to moisture, dryness and cold which are slightly unfavorable for them.

The larvae of the third brood all enter the soil and overwinter in cocoons and it is probable that some individuals of the second generation, which are much delayed in growth may also overwinter.

Pupal period.

It is not easy in this insect to determine the length of true pupal period, as the larva retains its form for sometime after the formation of the cocoon.

The writer assumed for the sake of convenience the pupal period to be the period from the next day after the entrance into the soil to the day before the emergence of the adult (including both of these days). According to this assumption the maximum length of the pupal stage for the first generation is 15 days, the minimum 12 days and the average 13.3 days. For the second generation the maximum length is 15 days, the minimum 13 days and the average 14 days.*

These figures were obtained from the results of individual rearings.

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* There is reason to believe that this average pupal period of the second generation is slightly longer than it ought to be. Thig error is perhaps due to the fact that the writer had unfortunately a rather small amount of data of the individual rearing of the second brood larvae.

True pupal period.

The figures given above are not the length of the true pupal stage as might be expected from the assumption given. These questions remain unanswered. How many days after the entering into the soil does the larva pupate? And, how long does it take to complete the true pupal stage?

To answer these questions the following experiment was conducted. Though the results were not satisfactory, they will be stated below.

Three earthen pots were filled with soil and fullgrown larvae were introduced into them in the following manner:

Pot No.	Date on which larvae were introduced	Number of larvae
I	July 10th	3
II	„ 11th	12
III	„ 12th	32

On July 14th pot I and III were examined. In both of them the cocoons were found; but, the insects in the cocoons were still in the larval stage. On July 19th pot II was examined. The contents of several cocoons were inspected and found to be still in the larval form, but it seemed they were just in the stage before pupation.

On July 24th pot III was examined. Among several cocoons only one contained a yellow pupa. In the rest the pupae were black and obviously they were in the more advanced stage, some being just about to emerge as the adult insects.

On July 26th adult insects began to emerge from pot III. (all the other cocoons had been already used for examination.)

From the results of this experiment it may be said that in July the larva makes its cocoon only a few days after it enters into the soil, pupates after about 8 or 9 days and in 4 or 5 days after pupation it transforms into the adult insect.

5) Days required for completing one life-cycle.

By calculating from the results which have been already stated, the following figures are obtained concerning the duration of one life-cycle:

Generation	Duration of one life-cycle (in days)		
	Maximum	Minimum	Average
First generation in 1919	47	35	41
Second generation in 1918	41	28	35.6

According to the rearing experiment in 1918 the number of days required for the third brood larvae to reach their full development was as follows:

Maximum	Minimum	Average
37 days	24 days	31.2 days

From these results it is seen that even in the same generation the number of days required for the completion of one life-cycle varies fairly widely. In consequence of this variation larvae in different stages of growth are seen in the field at one time and a few larvae of the third generation may be found until very late in the autumn.

6) Food plants.

There are five kinds of plants which have been known as being attacked by the peach saw-fly larva.

These are the peach, pear, Japanese sand pear, cherry and the Japanese flowering cherry. According to the writer's observation in the field, the injury by this insect is almost restricted to the peach and pear (including the Japanese sand pear). On the cherry and Japanese flowering cherry the larvae of this insect are very rarely seen.

The writer conducted the following experiments to determine whether the peach saw-fly oviposits on the leaves of every species enumerated above:

1. On July 23rd a female emerged from the pupa of a larva which had been reared on the pear leaf. The female was supplied with peach leaves. On that day it laid over 20 eggs.

2. Adult emerged on July 23rd from the pupa of a larva that fed on the peach, sometimes suppling with the pear leaf. By the next morning laid over 20 eggs.

3. Adult emerged on July 24th. (The food of the larva unknown.) It was supplied with the plum leaf. Within two days five eggs were laid.

4. Adult emerged on July 25th. (The breeding media supplied to the larva unknown.) It was supplied with the cherry leaf. Within two days 4 eggs were laid.

From the foregoing results of experiments it is apparent that the adult of the peach slug-worm that was fed with the pear leaf in its larval stage oviposits freely on the peach leaf, and that just the reverse can occur. Moreover, it is proved that the adult lays its eggs on the cherry and the plum also. It seems, however, that these latter two species are not so suitable for food as the peach and pear.

Choice of food plants.

The larvae of the peach saw-fly do not like to have the food plant changed after they have once taken a certain species of plant as their food.

This does not, however, imply that the rearing with another food plant is absolutely impossible.

In the field larvae are found generally on the leaf of peach and pear. The plum leaf may sometimes be seen infested by this insect.

As to which, the peach or the pear, the peach saw-fly prefers in oviposition, the writer can not yet make a definite statement. In this respect the writer conducted the following experiment. He covered with a large mosquito-net several peach and pear-trees which had been planted side by side in the laboratory garden and introduced ten saw-flies (among which 6 were female and the rest male) into this net. After 5 or 6 days, the eggs which had been laid were counted. It was found that out of 146 eggs 129 were laid on the peach and the rest were on the pear.

In September, 1918 the writer reared many a newly hatched larvae one by one in Petridishes. Three species of plants, i. e., the peach, pear and the plum were tried as their food.

The plum or the pear leaf does not seem to be suitable for food to young larvae; for, some young larvae seemed not to have taken food enough and died while they were still very young. However, if they could pass their earlier stage successfully, they would feed on the pear leaf quite well and would grow just as well as if they were fed with the peach leaf. In short, the peach saw-fly seems to like the peach and pear leaf the best, the plum the next and the cherry and Japanese flowering cherry perhaps the least.

VI. Natural Enemies.

There are two kinds of parasites, one species of egg parasites and apparently the three species of larval parasites.

They are not yet identified, but it is certain that the three larval parasites belong to a genus of *Ichnenmonidae* and the egg parasite to *Chalcididae*. The writer obtained only one specimen of the egg parasite last year, but unfortunately lost it.

Though the generic and specific names of the larval parasites are not yet known, they seem apparently to belong to different species. But, two of them resemble each other very closely and there is some doubt as to whether they are the same species and the differences in coloration are due to the difference in sex of the specimens or they belong to different species. Since the writer has only a few specimens of the larval parasites, and moreover their life-histories have not yet been traced, he can not, at present, answer this question.

VII. Dispersal.

There are perhaps two means of the spreading of the peach slug-worm, i. e., 1. by means of the adult insect, and 2. by means of the cocoon.

It does not seem to be the habit of this insect to fly far away from the orchard where it emerged to other orchards. That this is the case is proved by the fact that the infested area is usually restricted only to a small plot in an orchard instead of the infestation occurring evenly all over the orchard. However, it is possible that the adult may be carried a great distance by a strong wind.

The spreading by the cocoon into a new orchard is effected by means of the soil clinging to the roots of nursery stocks.

During his time of studying on this insect the writer has not yet met with the orchard to which importation of this insect seemed to have occurred by the second method, but he has seen several peach or pear orchards which had been infested apparently by the first method.

VIII. Suggestion for the method of control.

According to the writer's experiments and observations, it may be said that the resistance to spray-fluids or to other insecticides of the peach slug-worm is rather small.

It can be easily controlled by common contact insecticides such as oil-emulsions, soap solutions, etc. The oil-emulsion prepared with the oil extract of insect-powder is very effective.

The writer has seen good results obtained with it; and he has been informed that others have had similar success.

It is stated that in the United States freshly slaked lime, arsenate of lead, soap water, etc. are used to control the cherry and pear slug (*Caliroa cerasi* L.).

The writer conducted some experiments, though on a small scale, with soap solution and arsenate of lead in the insectary.

According to the results of the experiments a soap solution at a concentration of 4 ounces per gallon (=15 "momme" per "shō") kills all the slug-worms and when it is used at half its original strength, it killed about 70%.

In the case of the arsenate of lead a few worms survived when a concentration of 2 pounds per 5 gallons of water (which is the concentration usually recommended in the United States) was used. When arsenate of lead was used at a concentration just mentioned, the appearance of the effect was slightly slower than in the case of the soap solution.

Since the depth in the soil which the peach slug-worms reach is small, and the resistance of the worm to adverse climatic conditions is rather small, clean cultivation of the orchard and mid-winter tillage will be effective in controlling this insect.

IX. Summary.

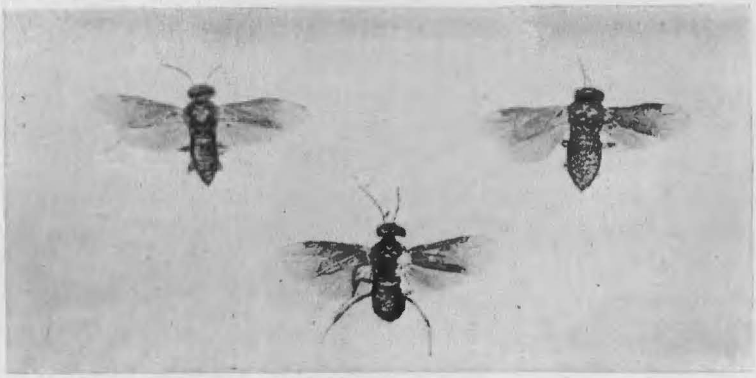
1. The peach saw-fly in Japan is a new species, and MATSUMURA named this species *Eriocampoides matsumotonis* MATSUMURA.
2. The peach saw-fly produces three broods a year and the larvae of the third generation over-winter in the cocoon.
3. The adult begins oviposition on the day of emergence; and it oviposits without any mating.
4. Eggs laid by the virgin female, i. e., unfertilized eggs produced male saw-flies only in the writer's experiments.
5. Average number of eggs laid by a female is about 20.
6. The longevity of the adult is from 2 to 5 days on the average.
7. The egg period varies from 7 to 11 days on the average according to the season.
8. The larval period is different also according to the season and varies from 14 to 22 or 23 days on the average. The longest larval period was found in the third generation.
9. The peach slug-worm feeds generally on the tissue of the leaf without the epidermis of the underside.
10. The larva moults 5 or 6 times; when fullgrown it goes into the soil to make its cocoon.
11. The true pupal period is about 4 or 5 days; the duration from its entering into the soil to the emergence of the adult is about two weeks.
12. Plants attacked by the peach slug-worm are the peach, pear, Japanese sand pear, plum, cherry and the Japanese flowering cherry, among which the peach and pear are most often attacked. The preference is probably in the order just stated.

Acknowledgment.

The writer wishes to tender his sincerest thanks to Professor A. D. MACGILLIVRAY who kindly allowed the writer to examine his specimens of saw-flies and pointed out to the writer the differences between the peach saw-fly in Japan and the pear slug saw-fly in America. The writer is also much obliged to Professor E. O. ESSIG who kindly showed the specimens of the pear slug saw-fly and to Professor S. MATSUMURA who kindly allowed the writer to publish the description of the peach saw-fly before the publication of his technical description of it.

Thanks are also due to Mr. N. YAGI and Mr. C. TANABE who carried out many of the experiments and observations.

PLATE I.



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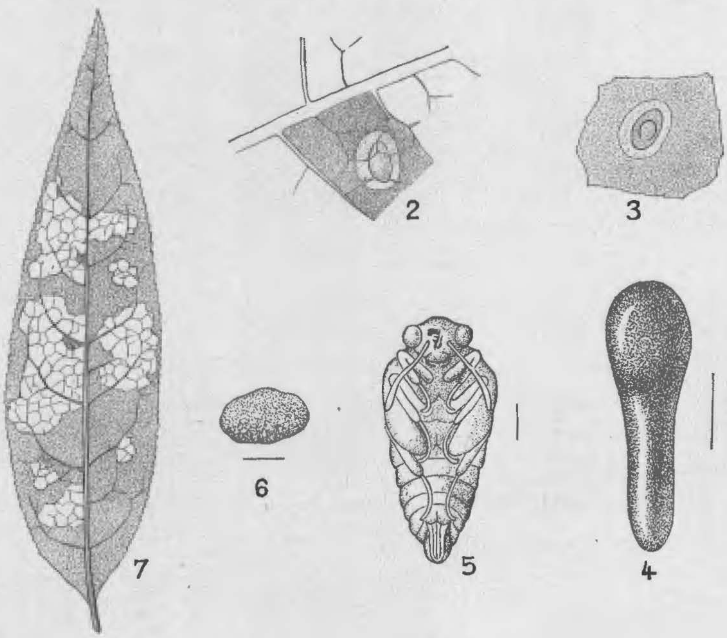
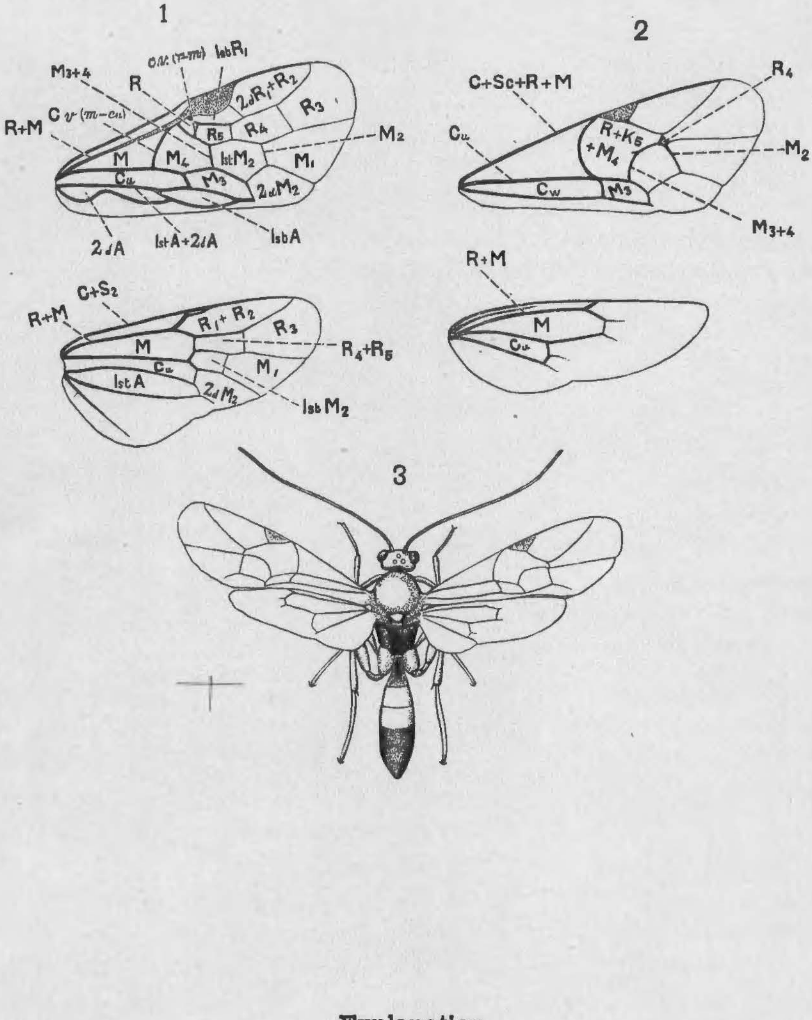


Explanation.

Figure 1. Peach saw-flies. (Upper two females; lower one male.)
Figure 2. Egg.
Figure 3. Egg-shell after hatching of the larva.
Figure 4. Larva.
Figure 5. Pupa.
Figure 6. Cocoon.
Figure 7. Injured peach leaf.

PLATE II.



Explanation.

Figure 1. Neuration of the wings of the peach saw-fly.
Figure 2. Neuration of the wings of a species of larval parasites.
Figure 3. A species of larval parasites.