On the Life-History and Habits of a Peach Leaf-Miner, *Ornix* sp.

By

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I. Introduction.

It has been long known that there is a leaf-miner of the peach-tree, belonging to the genus *Lyonetia*. There is another species of peach leaf-miner which we are going to discuss here. As far as we know, the first paper in Japan on this *Ornix* miner was published by Takachiho in the Report of the Imperial Agricultural Experiment Station, Tokyo, No. 40. He discussed this species under the name "*momo no yotsu-ten hoso-ga*" and described it as belonging to the genus *Lithocolletis*. One of the authors (Chukichi Harukawa) has had the opportunity of seeing the specimens of the peach leaf-miner which Takachiho has studied and considers that Takachiho's "*momo no yotsu-ten hoso-ga*" is probably the same species as that which we are going to discuss. We tried to identify this *Ornix* peach leaf-miner according to the system of A. Spuler and though we were not able to find out the specific name, we are certain that this species belongs to the genus *Ornix*.

We have examined much literature for records regarding the genus *Ornix* but could not find any record of the species which we are here dealing with.

An *Ornix* miner which was investigated by Haseman in America under

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Staiton, H. T. Natural History of Tineina.

" British Butterflies and Moths, 1857–1859.


the name "Unspotted tentiform leaf-miner of the apple" resembles closely our Omix miner in several points, but it does not seem to be the same species.

We have not yet heard that any great damage has ever been done by our Omix miner, yet we are of opinion that there is a possibility that it may cause rather severe injury, if conditions be favourable; for it can lay many eggs and produce as many as five broods a year.

The distribution of this pest in Japan has not yet been thoroughly investigated and at present there are records of it in Tokyo and Okayama Prefectures. In the summer of 1916 we undertook studies of this peach leaf-miner. Preliminary reports of the results obtained were published in the "Byō-chū-gai Zassi." The investigations were again carried on in the season of 1917, and here we propose to report the results of our studies in these two years regarding the life-history and habits of this insect.

II. Life-History and Habits.

1) Number of Broods a Year.

The rearing was carried on out of doors in a breeding cage which was placed in the experiment orchard in such a way that each cage covered a small peach-tree grown in the orchard. The three sides of the cage and the top-side were of cheese-cloth and the remaining side of glass. The cages are of three sizes, the dimensions being $1\frac{1}{2} \times 1\frac{1}{2} \times 2\frac{1}{2}$, $3 \times 3 \times 3$, $5 \times 5 \times 5$ feet.

Several females and males were introduced into a cage and observed. When the adults began to emerge, it was transferred into another cage, to rear the next brood. In this way no two consecutive broods were reared in one and the same cage. This obviously made the observations easier and more accurate.

On April 19, 1917 one female and six males were introduced into a cage. These were the first moths of this season, which emerged from the overwintered pupae of the larvae of the preceding year.

Table I.

<table>
<thead>
<tr>
<th>Generation</th>
<th>First</th>
<th>Second</th>
<th>Third</th>
<th>Fourth</th>
<th>Fifth</th>
</tr>
</thead>
</table>

From the records in table I we see that there are four complete and one partial generation in a year. The length of one generation is longer in the spring and late fall than that in the warmer season. The first generation covers some 50 days, the third only 26 days. The length of the second generation is almost equal to that of the fourth, namely, both are approximately one month. Since the adults emerge in the following spring, the last brood overwintering in the pupal stage, the length of the last generation is the longest. In 1917, some of the larvae of the fifth brood, which had hatched late in the fall, could not attain their full-growth and perished on account of the cold autumn. Though the accurate record concerning the length of the egg, the larval and the pupal stage was not kept, we can estimate it approximately from the results given in the table I as follows:

First generation
- **Egg stage** ......... about two weeks.
- **larval** " .......... about thirty days.
- **pupal** " .......... about ten days.
- **Egg** " .......... about a week.

Second generation
- **larval** " .......... about two weeks.
- **pupal** " .......... about a week.
- **Egg** " .......... from 4 to 5 days.

Third generation
- **larval** " .......... about two weeks.
- **pupal** " .......... about a week.
- **Egg** " .......... from 3 to 4 days.

Fourth generation
- **larval** " .......... about two weeks.
- **pupal** " .......... about a week.
- **Egg** " .......... about a week.

Fifth generation
- **larval** " .......... about 40 days.
- **pupal** " .......... 

It is natural that we often observe individuals of different generations and in different stages of growth living in the field at the same time, since the succeeding generations more or less overlap each other, as we can see from the results given in table I.

**ii) Imago.**

a. **Description.**

Tuft-like scales of vertex white, mixed with grayish scales. Thorax white to light fuscous, mixed with white scales. Forewings grayish white, excepting costal and apical area. In darker specimens, forewings almost entirely fuscous. As a rule, individuals emerging in the colder season are darker in colour. Antennae longer than forewings, filiform, light gray; distal portions of its segments fuscous. Labial palpi slightly ascending in living specimens, drooping in dead dried specimens, white, with transverse
black bands at the base and in front of the tip of last joint. Abdomen
dark fuscous dorsally, white to grayish white ventrally, sometimes with
black segmental markings on two or three of its segments. Tip of abdomen
with rather long grayish yellow tufts of hairs. Forewings: in lighter
coloured specimens, costal and also apical area fuscous, with numerous (from
6 to 8) white short streaks along costal margin, which are directed towards
outer margin. In darker specimens these white streaks are more numerous
and distinct. Towards the basal portion of wing-surface colouration becomes
lighter. All over wing-surface grayish white scales are so arranged as to
make numerous indistinct irregular transverse grayish bands, which start at
the white costal streaks mentioned above. In lighter coloured forms these
transverse grayish bands are hardly visible, the wing surface having sparsely
scattered fuscous scales. Apex, from distal portion of costa to anal angle,
ammed with long, fuscous fringe, thus making the apical area look broader.
At the tip of wing (proper) in this apical area, there is a black round spot;
two marginal lines, the one very indistinct grayish white and the other
more distinct white, along outer margin of this fringe.

Hindwings fuscous, lighter in colour near basal portion; margin with
long fuscous fringe. Underside of both fore- and hindwings fuscous.
Neuration\(^1\): some important points are as follows: in forewings, basal
portion of II indistinct; II\(_{4,5}\) not well developed, thus accessory cell al-
most unrecognizable; in hindwings, basal portion of II not well developed,
III\(_3\) and IV\(_1\) not fused together.

Legs grayish white; tibia almost black, with two white small patches;
coxa with transverse black bands at the middle and tip; femur with black
transverse markings at base, middle and tip respectively; tarsi with small
black transverse markings at base and tip, respectively, of each joint. Two
spurs at tip of middle tibia; two pairs of long spurs on hind tibia, the one
near to base and the other at tip.

Length of body 2.7—3.0 mm. Expansion 7—8 mm.

b. Habits.

The adult is a rather sluggish moth and during daytime, if undisturbed,
it rests for a long time upon a branch, on the underside of a leaf or on the
side of the cage with its head elevated and the tips of the folded wings in
contact with the object upon which it rests.

When disturbed, it flies, but it soon rests again in the peculiar manner
just described above. The moth lays its eggs mostly at dusk and at night.
As to the question how far the moth can fly, we have made no experiments.
However, it may not be probable that this moth can migrate very far to
produce a new brood in another orchard, unless it is carried by a strong
wind; for it is not its habit to fly far away from its resting place.

\(^1\) With regard to the nomination of the wing nervures we follow A. Spuler.
Ornix miner

iii) Egg.

The egg is mostly elliptical in outline, much flattened in shape and almost colourless. The surface has a faint irregular network and is somewhat lustrous. Average size 0.57 × 0.48 mm.

The eggs are laid singly on the underside of leaves, mostly close to the midrib, or sometimes to the smaller nervures. Among 80 eggs which we observed on the leaves of three trees, 63 were found close to the midrib and the rest near to the smaller nervures, that is, nearly 79% were laid close to the midrib.

The number of eggs that one female can lay varies with individuals. For example, one female laid as many as 70 eggs, while another laid 58. We have already stated the incubation period of the egg in a previous chapter.

iv) Larva.

a. Description.

The fullgrown larva is from 5 to 7 mm. in length. Body gray with pale yellowish green tint. Head pale ochraceous brown; cervical shield pale yellowish brown, with four black comma-shaped markings arranged transversely. Thoracic legs yellowish brown; abdominal legs only four pairs, including anal or spurious legs. As we shall soon state, the colour and the structure of the larva changes according to the stages of its growth. Haseman has already observed in America a similar phenomenon in a related species, Ornix geminatella Pack.1)

b. Number of moultings.

By counting the number of cast head capsules of a larva in its mine, we can tell to what stage that larva belongs, while it is in the original mine. Near the middle of the fourth larval stage the larva leaves its original mine and builds a new completely closed cell with the leaf, in which it conceals itself and continues feeding. Since it is impossible to tell, to what stage the larvae which are found in this closed cell, always belong, the counting of the number of head exuviae in the original mine and in the new cell is not sufficient to tell the number of moultings. It is necessary to measure the widths of the head exuviae and of the heads of the larva in mines and to compare these measurements. In tables, II and III, we give the results of the measuring.2)

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2) The figures in two tables are the readings of the ocular micrometer; the corresponding widths in millimetres can be obtained by multiplying the figures in the tables by 0.032.
Table II.
Widths of the head exuviae in a mine and that of the head of the larva in that mine.

<table>
<thead>
<tr>
<th>1st Exuvia</th>
<th>2nd Exuvia</th>
<th>3rd Exuvia</th>
<th>4th Exuvia</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>5.8</td>
<td></td>
<td></td>
<td>7.5</td>
<td>This larva belongs to 2nd stage.</td>
</tr>
<tr>
<td>5.7</td>
<td>8.0</td>
<td></td>
<td>11.2</td>
<td>&quot;</td>
</tr>
<tr>
<td>6.0</td>
<td>8.0</td>
<td>10.3</td>
<td>13.8</td>
<td>This larva belongs to 4th stage.</td>
</tr>
<tr>
<td>5.9</td>
<td>8.0</td>
<td>10.8</td>
<td>15.2</td>
<td>&quot;</td>
</tr>
<tr>
<td>6.0</td>
<td>8.5</td>
<td>10.3</td>
<td>13.5</td>
<td>&quot;</td>
</tr>
<tr>
<td>5.5</td>
<td>7.8</td>
<td>9.8</td>
<td>13.5</td>
<td>&quot;</td>
</tr>
<tr>
<td>—</td>
<td>8.0</td>
<td>10.7</td>
<td></td>
<td>&quot;</td>
</tr>
</tbody>
</table>

* The four larvae from the bottom are those which left their original mine and confined themselves in their new cells; therefore the 1st, 2nd and 3rd exuviae are not found in these new cells.

Table III.
Widths of the heads of the larvae.

<table>
<thead>
<tr>
<th>1st stage</th>
<th>2nd stage</th>
<th>3rd stage</th>
<th>4th stage</th>
<th>5th stage</th>
</tr>
</thead>
<tbody>
<tr>
<td>5.5</td>
<td>7.5</td>
<td>10.5</td>
<td>14.0</td>
<td>19.0</td>
</tr>
<tr>
<td>5.8</td>
<td>7.5</td>
<td>11.2</td>
<td>13.0</td>
<td>21.0</td>
</tr>
<tr>
<td>5.6</td>
<td>8.0</td>
<td>10.6</td>
<td>14.1</td>
<td>19.7</td>
</tr>
<tr>
<td>5.7</td>
<td>7.4</td>
<td>9.9</td>
<td>14.2</td>
<td>20.3</td>
</tr>
<tr>
<td>6.0</td>
<td>8.0</td>
<td>10.8</td>
<td>14.2</td>
<td>20.5</td>
</tr>
<tr>
<td>5.8</td>
<td>8.0</td>
<td>10.0</td>
<td>15.0</td>
<td>20.7</td>
</tr>
<tr>
<td>5.9</td>
<td>8.0</td>
<td>10.3</td>
<td>15.2</td>
<td>20.8</td>
</tr>
<tr>
<td>5.5</td>
<td>7.8</td>
<td>10.0</td>
<td>13.5</td>
<td>20.0</td>
</tr>
<tr>
<td>5.5</td>
<td>7.8</td>
<td>10.6</td>
<td>13.0</td>
<td>19.0</td>
</tr>
</tbody>
</table>
From the results in two tables given above, it will be seen that this *Ornix* larva moult six times; that is, it has five larval stages.

c. Growth of the larva and its feeding habits.

The newly hatched larva is whitish in colour and slightly flattened dorso-ventrally. It is entirely without both the thoracic and abdominal legs; the positions where the legs are later to be formed, are indicated by slight elevations of the integument. On hatching the small larva directly mines into the leaf-tissue, breaking through the part of the egg-shell, which is cemented to the leaf. It remains just under the epidermis of the underside of the leaf and feeds on the chlorophyll cells and makes a blotch mine from the very beginning. Therefore, the mine is an “underside mine” and at first one can not detect the mine from the upper surface of the leaf. In this stage of feeding the larva is seen through the transparent cuticle of the underside of the leaf.

The second instar larvae are almost the same in colour and structure as the first.

After the second moult, the larva, that is, the 3rd instar larva, acquires 3 pairs of well developed thoracic legs, 3 pairs of abdominal legs and one pair of spurious legs. The thoracic legs are jointed and each has one claw at its tip. The abdominal legs have no joint and are armed with from 16 to 25 claws arranged in a ring at the tip. The number of these claws varies not only in the different segments on which the legs are found, but also in two legs which are on the same abdominal segment. The colour of the head, which is light ochraceous in the second stage, becomes almost black and on the cervical shield there appear four comma-shaped black markings. At the end of the third larval stage, the larva changes its manner of mining. Namely, it lines the inner surface of the epidermis of the underside of the leaf with its silk, and folds in the epidermis in the middle line lengthwise of the mine.

Accordingly the blotch mine becomes now almost elliptical in outline and the corresponding upperside of the mine becomes slightly projected upwards, thus making a cavity between the under epidermis and the roof of the mine. In this stage of the mine we can no more see the larva through the under epidermis and we can point out the existence of a mine from the upper surface of the leaf. In this state the larva moult six times. The colour of the head now changes to pale ochreous and the body is whitish, with greenish alimentary canal. The four comma-shaped markings on the cervical shield deepen in colour. The number of abdominal legs remains unchanged. Until about the middle of the fourth larval stage the larva continues its feeding in the above described mine. Therefore, the larva moult six times in the original mine.\(^1\)

\(^1\) Though the shape of the mine changes at the end of the 3rd larval stage, the resultant mine is essentially a continuation of the original mine.
Consequently we can find out three head exuviae in the mine, if we carefully cut open the mine and examine it.

At about the middle of the fourth larval stage, the larva leaves its mine and commences the third mode of feeding. Namely, it crawls towards the margin of the leaf, folds over the edge of the leaf downwards, fastens it to the leaf surface with its silk and makes a completely closed cell, in which it lies and feeds on the epidermis and leaf tissues, leaving the outer epidermis untouched.

Soon after the larva confines itself in this closed shelter, it undergoes the fourth moulting and this is the last one. After this moulting the larva is grey in colour, tinged with pale yellowish green, as has been already stated. The structure of the body in the fifth larval stage is almost the same as in the last one, the number of abdominal legs remaining equal to that in the fourth instar larva. The increase of the width of the head capsule after succeeding moults is shown in table III.

v) Pupation.

When fullgrown, the larva either spins an yellowish cocoon at one end of the mine, or else it leaves the mine, folds over the edge of the leaf and fastens the edge to the leaf surface and builds its cocoon in the recess thus made.

The pupa is spindle-shaped, about 6 mm. in length and light yellow in colour. It has long antennae and a pointed process on the head.

vi) Overwinterring.

This insect overwinters in the pupal state. Cocoons of the last brood are made on the leaves, which later fall off on the ground; the larva often spins its cocoon in a curled back strip of the bark of the tree.

vii) Food plants.

The most favorite food plant of this miner is, no doubt, the peach tree; and several other species of the family Rosaceae are also attacked. They are the cherry (prunus spp.), Japanese flowering cherry (prunus spp.), plum (prunus sp), apple (Mali sp.) and apricot (prunus sp).

Among them the peach, plum and cherry are attacked more often.

1) According to the opinion of Haseman, this is only a preparation for cocoon making. loc. cit.
III. **Suggestions for the method of control.**

The most important point in the controlling of this pest is to clean up the orchard so as to deprive it of an overwintering place. The fallen leaves and rabbish of all sorts should be gathered and burned during the winter.

Furthermore, waste ropes, withered leaves, remains of paper bags and such things should be cleared off from the tree. As we have already stated, the curled back strips of the bark of the tree often harbour the overwintering pupae. Therefore, to strip off the rough outer bark of the trunk is also a good control method. This method is practised every year in the orchard of our institute. To spray pyrethrum decoction oil emulsion against the adults has been said to be in some cases effective. But since the adults appear irregularly in localities where several broods are produced in a year, this method will probably be of little effect. A good means of controlling the larvae has not yet been discovered.

We wish to express here our hearty thanks to Baron N. Taka-chiho of the Imperial Agricultural Experiment Station, Tokyo, for his kindness in allowing us to examine his valuable specimens of the peach leaf-miner.
PLATE V.

1. Moth expanded.  x6.
2. Larva.
3. Pupa.
5. Ditto. Lower surface.
7. Forewing of the darker form of adult.
8. Neuration of the forewing.

Explanation of Plate V.