

# On the Life History of *Trioza Camphoræ* N. Sp. of Camphor Tree and its Injuries.

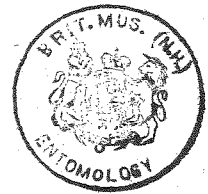
BY

Prof. C. Sasaki.

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With Plates XV and XVI.

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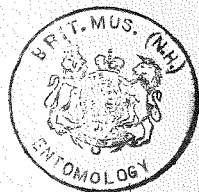
TOKYO,  
OCTOBER, 1910

# On the Life History of *Trioza Camphorae* n. sp. of Camphor Tree and its Injuries.

BY

Prof. C. Sasaki, *Rigakuhakushi*.

With Plates XV and XVI.



In 1907-1908, Mr. KUWAYAMA<sup>1</sup> described a species of Psyllidæ named *Mesohomotoma camphorae* after Prof. M. MATSUMURA, and stated that the same professor collected a large number of it at Bonin and Formosa Islands, in the latter of which it gives a great harm to the camphor trees.

The *Trioza* species, which I will describe in the following lines, is usually found on the camphor trees grown in the main island of Japan, Shikoku, Kiusiu as well as in Formosa, South China etc.

The species *Mesohomotoma camphorae*, which is said to be very injurious to camphor trees, I have unfortunately never been met with on the camphor trees in the above mentioned localities, and I am of opinion that it is never injurious to them.

The species in question, which usually swarms on the camphor trees, belongs unquestionably to the genus *Trioza* described by Messers MASKEL<sup>2</sup> and F. LÖW<sup>3</sup>; but the species is quite new, and I<sup>4</sup> gave it the name of "*camphoræ*" in 1905.

1. Transaction of the Sapporo Nat. Hist. Soc. Vol. II. Parts 1-2, 1907-1908.
2. Transaction of the New Zealand Institute Vol. XXII. 1899.
3. F. LÖW: Zur Systematik der Psylloden. 1878.
4. C. SASAKI: First Report of the injuries Insects of Camphor Trees (Japanese). 1905.

***Trioza Camphorae* n. sp.**

Male: Length 1.65 mm. Body orange yellow (fig. 1). Front margin of the vertex not deeply incised. Eyes large, roundish, prominent, deep crimson red. Frontal horns (Stirnkegel) conical, bluntly ended, their ends lie apart from each other, and provided each with a clustre of short hairs. Antenna (fig. 2) short and filiform, composed of ten segments, light brownish orange with the two basal joints tinged dark brown. The two basal joints are short, broad and stout, the 3rd joint longest of all marked with about 29 ring markings, the 4th about  $\frac{1}{2}$  and the 5th to 7th are each  $\frac{1}{3}$  the length of the 3rd. The 8th shorter than the 7th, but somewhat thickened at the distal end. The 9th and 10th nearly equal in length, are much thicker than the 8th. The terminal or 10th segment bluntly ended and provided with a short and a long bristle. Rostrum very short, 3 segmented, the 3rd segment deep brownish black, and extends beyond the insertion of the first pair of legs. Eyes comparatively large, roundish, deep crimson red, and projected out at each side of the head. Ocelli 3, of which one lies close to each eye, and the remaining one on the middle of frons. Thorax thick and stout, and dorsally swollen. Fore wings (Fig. 3) transparent, narrow and elongated, slightly pointed at the outer margin, primary stalk of the veins more than one third the length of the whole wing; stalk of the subcosta as long as the primary stalk; radius nearly straight, reaches the costal vein at more than one fourth of the length of the wing. Cubitus bifurcating at the junction of the primary stalk of veins and the stalk of subcosta, its upper branch moderately convex at its proximal half, and again bifurcating far beyond the outer margin; the lower branch running straight for a short distance, divided again into two branchlets, the upper long and convex, and the lower short and straight. Clavus arising at the base of the wing close to the primary stalk of veins, descends and soon reaches the posterior margin. Above the clavus runs a fine delicate streak nearly parallel to the former. Hind wing (Fig. 4) transparent, and far smaller than the fore. Costal margin nearly straight, but with a

slight depression at nearly half its length. Apex rounded. A single vein arising at the base, running straight for a short distance, divided into three fine delicate branches. Upper two branches gradually diverging towards the outer margin, one reaches above and the other below the apex. Lower branch running towards the hind margin, divided into two unequal branchlets. Legs rather stout, light orange yellow, their anterior two pairs are somewhat smaller than the 3rd pair, tarsi two, claws two, lying close to the base of an expanded membranous pulvillus. The distal end of the hind tibia with three short blackish spines.

Male genitalia: Genital plate broad, as long as the genital segment, its free edge even and straight, as broad as the base, its front and hind margins are slightly constricted just beyond the two corners of the free edge. The hind margin is hollowed out lengthwise into a shallow canal. Close to the lower end of the canal lies the end of penis.

All the edges of the plate are thickly covered with fine hairs. The posterior appendages (clasper? elongated triangular, their bluntly pointed end is bent posteriorly and colored black. They are also thickly covered with fine hairs, (fig. 5). The penis (fig. 6) is composed of three segments—the 1st or basal segment is much longer than the remaining two; the 2nd is about one third the length of the first; and the 3rd is shortest, but twice as broad as the 2nd, and nearly spindle shaped. This penis, arising at the basal portion of the genital plate, descends for a short distance, and then forming a large curve ascends by passing between these two triangular appendages, and reaches beyond the base of the genital plate. If the penis is stretched out, it is about three times the height of the genital plate.

Female: Length 1.92 mm. Body larger than the male and lighter in color.

Female genitalia: The upper genital plate is rather longer than the lower, it ends bluntly, and is provided with a few long hairs. The lower, broad at the base, is also bluntly ended, and provided sparsely with hairs. The ovipositor is membranous, but it is supported lengthwise by two long chitinous spines and extends as far as the free end of the upper genital plate (fig. 7).

### Deposition of Eggs.

The winged insects appear abundantly in the month of April; and less so until the month of July. The female insects lay eggs usually on the under but rarely on the upper surface of the young tender leaves of camphor trees (fig. 8). The eggs are laid in groups or not. They hatch out usually within a few days after deposition. The eggs (fig. 9) are nearly spindle shaped, one end bluntly pointed and the other, broad and round. Length 0.32 mm., breadth 0.11 mm. Egg shell rather thin, but elastic, and marked with mesh-like markings. Eggs dull yellowish grey with the broad end tinged orange yellow, but they become nearly transparent except at the broad end, just before hatching. They are tightly attached to the leaves by the broad end, and pretty difficult to detach.

### Larva.

1st stage: Length 0.312 mm. Breadth 0.18 mm. Body elongated oval and flattened. The head, thorax, and abdomen are more or less distinct. The former two divisions are nearly transparent, with light yellow peripheries. Abdomen composed of seven segments, yellow, with a deep yellow triangular marking at its base. Head comparatively large, hemispherical, antenna one segmented with two hairs at its end. Eyes simple, roundish and prominent, dull yellow, and surrounded by a crimson reddish band. Filamentous mouth parts beginning just below the insertion of the first pair of legs, and forming a sort of an oval loop on the ventral surface of the head; but incapable of taking in food. Legs are stout, transparent, and appear to be composed of three segments—coxa, femur, and tibiotarsus. The end of each leg with a large pulvillus and two long hairs. The peripheries of the head and abdomen are provided with long transparent lamellar spines—each projected out from a cup-like base lying close to each other. The basal cup is orange yellow, while the spines are light orange and finely serrated at their blunt free end. The thorax with a single pair of spines—one on each side (fig. 10).

2nd stage: Length 0.444 mm. Breadth 0.288 mm. Body elongated oval, light greenish yellow. Dorsal surface flattened, ventral more or less swollen. The three divisions of the body now become distinct, head hemispherical, and fringed with a series of transparent lamellar spines. Each of the thoracic and abdominal segments with a pair of lamellar spines, the terminal segment of the abdomen with three pairs of the same. Three simple eyes, on each side of the head, light yellow, each surrounded by a broad ring of deep crimson red. In this stage, the filamentous mouth parts become unfolded, and are deeply thrust into the leaf on which the larva rests. The other characters nearly similar to those of the first stage (fig. 11).

3rd stage: Length 0.60 mm. Breadth 0.42 mm. Body oval, light greenish yellow, with an orange horse-shoe shaped marking on the dorsal surface. The dorsal surface is uniformly even, while the ventral is now more swollen than in the previous stage. The three regions of the body become more or less distinct. Head large, nearly elliptical, thorax as long as the head, but broader than the latter. Abdomen is longer but narrower than the thorax. The abdominal segments are distinct. Body is fringed with closely arranged lamellar angulated appendages. The latter are transparent, but their basal portion is dark orange. The surface of these appendages is marked with longitudinal as well as transverse fine striations. The number of the eyes, as well as the coloration of the broad band surrounding each eye, is exactly similar to that of 2nd stage. The filamentous mouth parts are deeply thrust into the tissues of leaves. Anal ring transversely elongated and lies ventrally close to the end of abdomen. The ring itself is elongated dots (fig. 12).

As the larva grows to be 0.696 mm. in length, and 0.54 mm. in breadth, the ventral surface of its body becomes more swollen than in previous stages, while the dorsal surface remains flattened. The boundary line between the head and thorax disappears so that the two form a single region—cephalo-thorax. The cephalo-thorax is much larger than

the abdomen, which is nearly hemispherical. These two regions are marked dorsally with a large horse-shoe shaped marking of dull orange color. The dorsal mid-line of the body is now marked with a straight streak, which begins at the front of the cephalo-thorax, and extends as far as the middle of the abdomen. The margin of the cephalo-thorax, where the simple eyes are located, shows a slight constriction. Each corner of the posterior margin of the same region is marked with two imperfect wing covers. The marginal cameller fringes are transparent, but their basal portion is still orange yellow. The dorsal surface is usually covered sparsely with white filamentous secretions, beside these there are six clusters of the same filaments—one on each side and in the middle of the same surface, and two close to its posterior margin. Antennae of a conical shape are marked with closely arranged transverse wrinkles, and five thicker transverse ones. Its tip ended with a single short spine. They lie wide apart from each other, close to the anterior margin of the ventral surface of the body. The basal portion of the ventral surface of the abdomen dark orange yellow. Legs stout with a single tarsus provided with a large roundish sucker, and with a single bristle. Anal ring dark orange yellow (fig. 13).

Pupa: Length 1.3 mm. Breadth 1.0 mm. Body nearly roundish, dorsally flattened, dull yellowish brown; ventrally exceedingly swollen, light orange yellow. The three regions of the body are more distinct than in the previous stage. Head large, hemispherical, and lies in a deep indentation formed at the front margin of the large and broad thorax; the wing covers developed more. Abdomen shorter and narrower than the thorax, with its posterior margin rounded. All the margins of the body with closely arranged lamellar transparent appendages similar to those in the previous stage. The dorsal surface, besides the sparse covering of white waxy filaments, bears seven groups of the latter, two groups at the anterior portion of the head; three on the thorax—one on the middle, two on the lateral sides; and two on the abdomen. On the dorso-median line of the body runs a distinct streak, which

begins at the front margin of the head and extends as far as half the length of the abdomen. Three simple eyes on each side of the head are now located on a round purplish red marking, which is one of the compound eyes of the future imago developed beneath the skin of the pupa. Antennae short, stout, and horn shaped, composed of two segments, the 2nd segment pointed, and its distal half marked with closely arranged ring markings. Restrum of three segments, short, bluntly pointed, with its end colored black. Wing covers larger than in the previous stage. Legs are nearly equal in size, tarsus rather long with a well developed oval pulvillus having on each edge of its base a branched claw. The pulvillus seems to form a sort of sucker. Anal ring encloses a long transverse opening, whose peripheries are covered with snowy white secretions (fig. 14).

At the time of the emergence of the imago, the skin usually splits widely open along the dorsomedian streak of the pupa.

#### Postembryonal Development of *Trioza camphorae* in Relation to the Formation of Galls.

The winged insects appear abundantly in the month of April, and less so in the following two months in the central provinces of our main island; but more or less earlier in the islands of Shikoku and Kiushiu as well in Formosa. At the time of their appearance, they fly about around the infested camphor trees for some days, in such numbers as to make the air cloudy. They then copulate, and the females resting on the younger tender leaves as mentioned before, lay eggs generally in groups on their under surface. The newly hatched larvæ crawl about on the same surface, and undergo soon the first moult. The larvae of the 2nd stage thrust their filamentous mouth parts deep into the tissues of leaves, and begin to suck up nourishment. At the same time, the upper surface of the leaf, below which the larva rests, is slightly elevated into a round or oval shape, thus forming an imperfect gall. The latter bears a lively greenish yellow color, and its center is decorated with a rosy or reddish dot, while its under surface is on the

contrary marked with a shallow depression, in which rests a single larva (fig. 15).

When the larva attains the 2nd stage, the galls grow 2.5-2.8 mm. in diameter, and are more swollen than in the previous stage. The galls are now colored a lively crimson red on the outside, and dull reddish purple on the inside. The surrounding regions of the gall assume a light greenish yellow coloration, which becomes conspicuous in contrast to the color of the leaves (fig. 16). In the month of June most of the larvae are in the 3rd stage, and the galls have grown larger (about 2-3 mm. in diameter). The shape of the galls remain unchanged, but their crimson red coloration becomes deeper and darker than before, the swollen ventral surface of the larvae occupies the cavity of the gall, and its opening is closed up by the flattened dorsal surface of the larvae (fig. 17).

The larvae begin to pupate from about the end of June, and continue to do so in July. At this time, the galls become greyish purple, and finally black; but their opening is still closed up by the dorsal surface provided with a certain number of clusters of white waxy filaments, so that the under surface of the leaf appears mottled with scattered white patches (fig. 18). In this condition, the pupa passes the winter, and the adult insects appear in April of the following year, and lay eggs as stated before.

#### The Injuries of *Trioza camphorae* to Camphor trees.

Although younger as well as older camphor trees are liable to be infested by this insect, both larva and pupa, the injuries are more serious for younger (one to ten years old) than for older trees. When the young leaves are largely infested, there may be formed large numbers of oval or roundish galls on the surface, and the growth of the leaves is retarded. Later all the infested leaves will shrink up and finally fall off. If only a few larvae become lodged on the under surface of the leaves, the latter grow to the normal size, but they may be marked either with blackish spots or patches according to the number of galls

produced by the larvae. Most of the infested leaves will sooner or later fall off and thus the growth of the trees is affected more or less. If the infestation of the younger trees is too intense, the shrunk or deformed leaves will fall off, and bring about the death of the trees.

This insect is liable to do harm to camphor trees under all sorts of cultivation, viz. to the pure or mixed camphor forests, those planted along road sides or to those grown independently far apart from each other. The winged insects usually fly about in the neighbourhood of the localities, where they emerge, but their wings are not strong enough to enable them to fly to a distance. They are mostly carried about by winds in all directions, and when they reach camphor trees, there they lay eggs and propagate their kind. The injuries of this insect mostly do not extend higher up the tree than 9-10 feet above the ground. The trunks or branches above these limits are comparatively free from it on account of its weak power of flight.

#### Preventive Measures.

1. All fallen leaves, either infested or not, must be strictly gathered and burnt, or better used up for the preparation of camphor.
2. If any trees should be too much infested, cut them down without reference to their age, and use them for the preparation of camphor.
3. Whale oil, herring, shark, and sardine oil soaps of 1-2% were applied to the infested leaves, and the latter examined after 24 hours. It was found that the solutions of the whale and herring oil soaps were much more efficient than the remaining ones.

October, 1909.

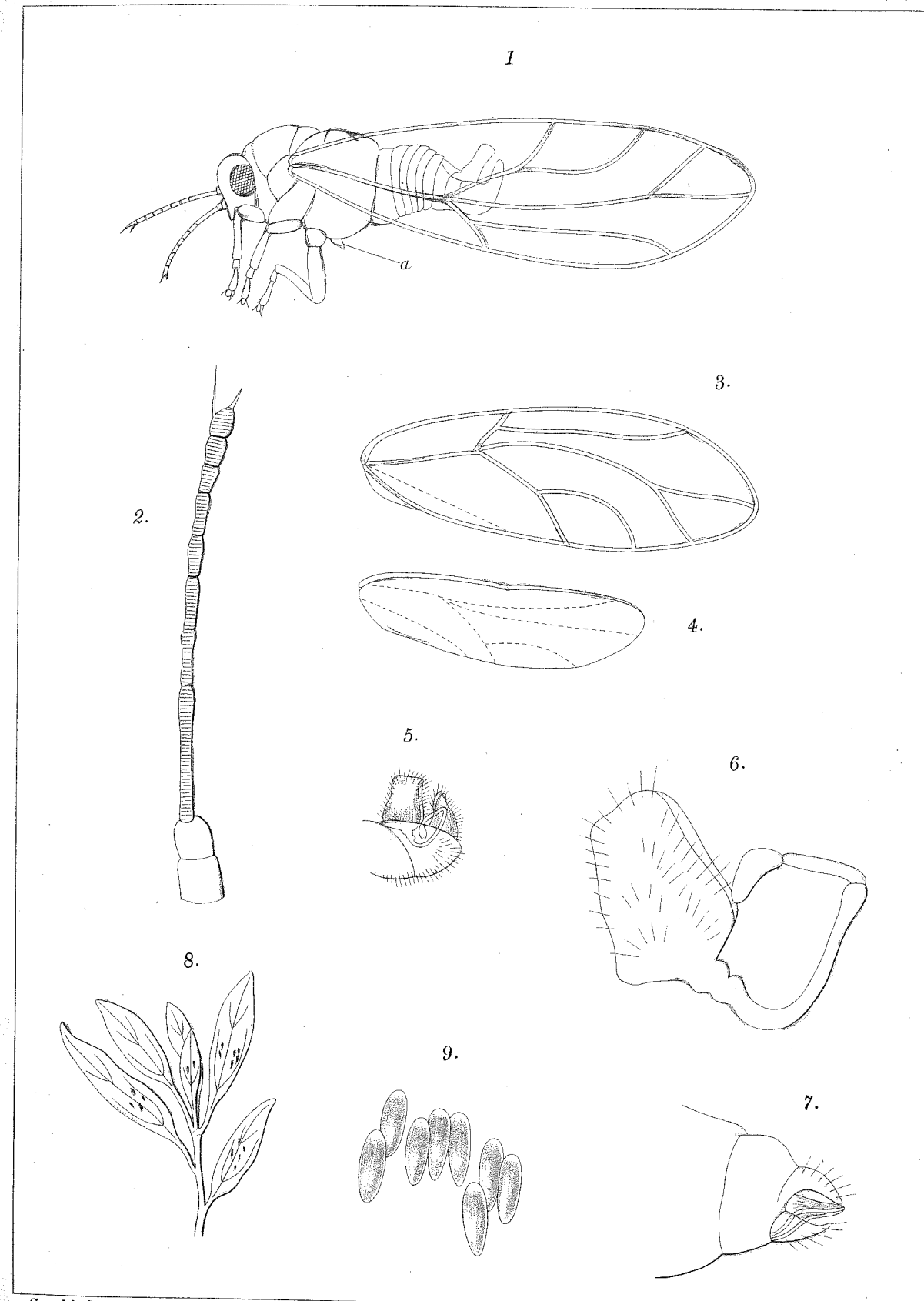
## Explanation of Figures

## Plate XV.

- |         |  |                        |
|---------|--|------------------------|
| Fig. 1. | <i>Triosa camphorae</i> ... ..                                       | Male. Zeiss, A. oc. 1. |
| Fig. 2. | Antenna of ditto ... ..  | Zeiss, D. oc. 2.       |
| Fig. 3. | Fore wing of ditto ... ..  | Zeiss, A. oc. 1.       |
| Fig. 4. | Hind wing of ditto ... ..  | Zeiss, A. oc. 1.       |
| Fig. 5. | Male genitalia ... ..  | Zeiss, B. oc. 1.       |
| Fig. 6. | Penis ... ..   | Zeiss, D. oc. 1.       |
| Fig. 7. | Female genitalia ... ..  | Zeiss, D. oc. 1.       |
| Fig. 8. | Eggs on the under surface of the young leaves of camphor tree ... .. | Nat. size.             |
| Fig. 9. | Eggs ... ..  | Zeiss, A. oc. 1.       |

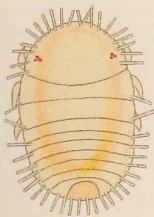
## Plate XVI.

- |          |   |                  |
|----------|---|------------------|
| Fig. 10. | Larva of 1st stage ... ..                                     | Zeiss, D. oc. 1. |
| Fig. 11. | " " 2nd " ... ..  | Zeiss, B. oc. 1. |
| Fig. 12. | " " 3rd " ... ..  | Zeiss, B. oc. 1. |
| Fig. 13. | Mature larva of 3rd stage ... ..                              | Zeiss, B. oc. 1. |
| Fig. 14. | Pupa ... ..   | Zeiss, B. oc. 1. |
| Fig. 15. | Imperfect galls formed by newly hatched larvae ...            | Nat. size.       |
| Fig. 16. | Galls formed by the larva of 2nd stage ... ..                 | Nat. size.       |
| Fig. 17. | " " " " " 3rd stage ... ..                                    | Nat. size.       |
| Fig. 18. | Under surface of camphor leaf occupied with many pupae ... .. | Nat. size.       |

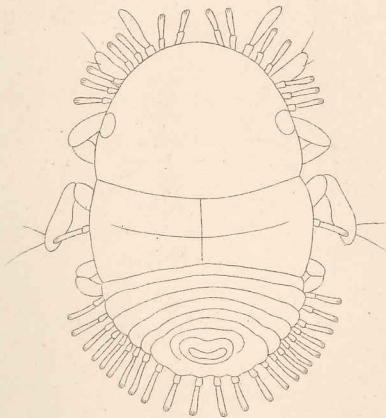




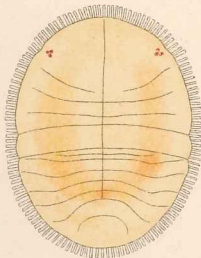
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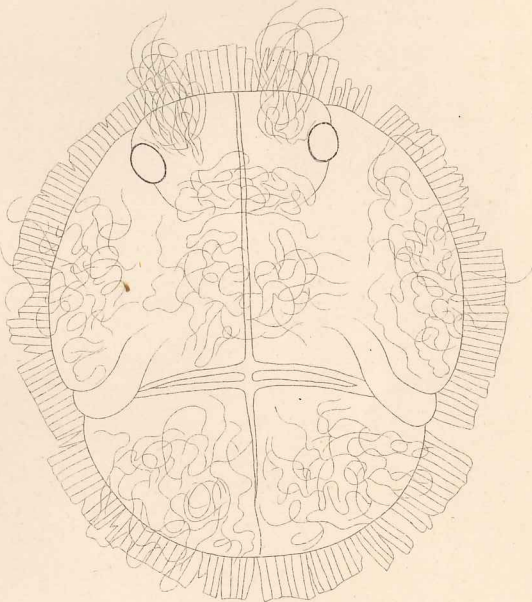
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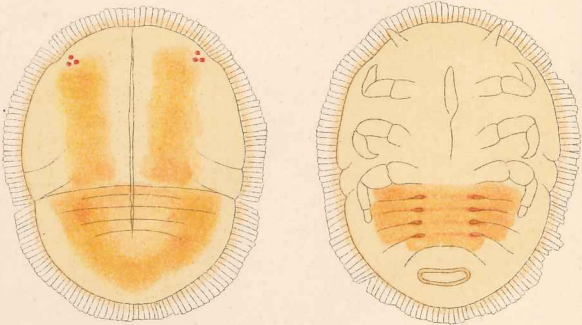
18.



14.



13.



16.



17.



15.

