# The first Ecdysis of the Lac insect. (Coccid.)

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(With 12 figures.)

The reader may be interested to know Tschirch's Handbuch der Pharmakognosie, vol. III, pp. 965—81, gives an excellent résumé of our knowledge of stick-lac, the ultimate raw material for the manufacture of best sealing wax, and of the species of insects producing it; while the present study of the first ecdysis of the lac insect is a continuation of observations on the early recognition of its sex [1]).

In some scale insects, e. g. *Monophlebius* species, the exuviae are found loosely adhering to the back. Likewise Comstock [2]), illustrating the wax-coccid, *Cerococcus quercus*, shows that „the form of the sac of the immature female is represented by Fig. 2, b, Pl. XX, and the larval skin occupies in the center of the dorsal shield" Possibly following this interpretation, for Comstock also deals with the lac insect in the same Report, Imms and Chatterjee [3]) assign to the moulted

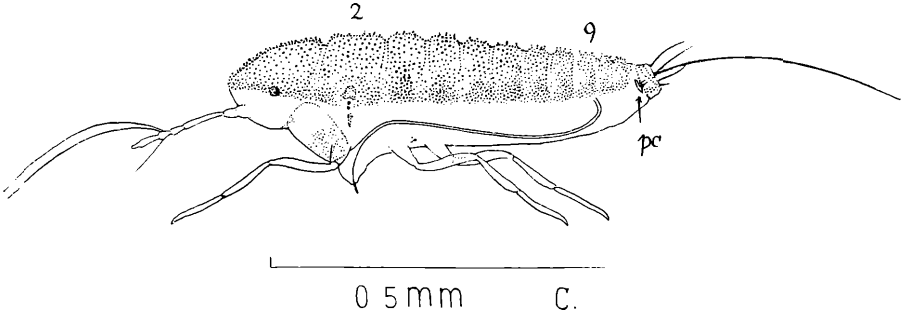



Fig. 1.

Side view of a male crawling larva after treatment with cold caustic soda solution to show the dorsal shield of wax divisible in eleven plates of which 1, 2 and 9 are numbered. It belongs to *Lakshadia mysorensis* Mahdih. on Shorea talura, and swarmed at Bangalore on 11th Sept. 1925. It has slightly lengthened and appreciably swollen on account of the treatment it received.

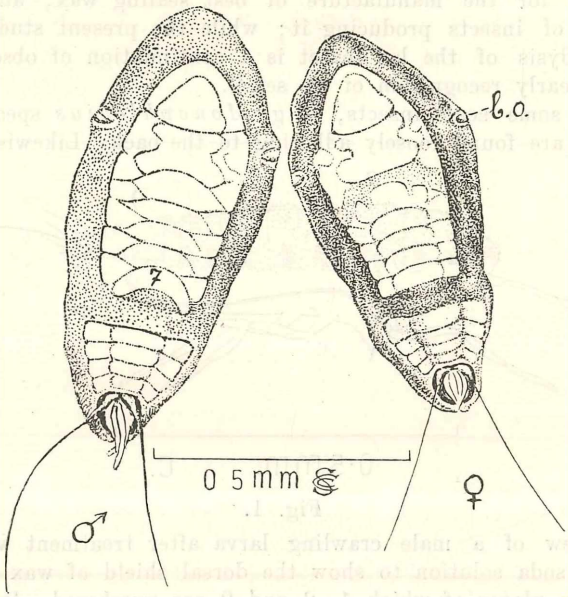
[1]) J. Indian Inst. Sci. Bangalore 1926, Vol. 9 A, Pt. I.

[2]) Rep. U. S. Dep. Agr. 1881—82. Bull. 372, Cornell Univ. Agr. Exp. St. 1916, p. 506.

[3]) Indian Forest Memoir, Calcutta, 1915, Vol. III Pt. I.

skin of the immature female lac insect an identical position, Pl. I, Fig. 4, s, of their Memoir. As will be seen later the exuviae are cast off in the manner of solid excretions while only the secretion products, lac and wax, forming the architecture of larval tests, are ultimately incorporated in the adult cell.

The crawling larva, although red, appears pink on account of the dorsal shield of wax shown in Fig. 1, and again in a




Figs. 2 and 3.

*Lakshadia mysorensis* on Shorea talura, Bangalore, 25th Sept. 1923, full grown first stage larvae. Fig. 2 represents that of the winged male, with wax-plate No. 7, tilted slightly vertically. Fig. 3 belongs to the female.

disrupted condition in Figs. 8 and 9, where the eleven wax-plates constituting it are sufficiently indicated. The first stage larva after fixation secretes lac from glands all over the skin, but wax exudes from special glandular pores on the sides in the form of wax threads or wax-pencils, Fig. 7, **w. p.** Pl. I, Fig. 5 of the previous paper [1]) gives their dorsal view and also shows the original wax shield. Lac exudation from the dorsal surface gently raises the wax shield which gets cemented to it, and it is this

which exposed to view and retaining the original form may be mistaken for the first larval skin.

Under the first dorsal wax-plate (Fig. 1) is seen the antenna with its hairs, indicated **a.** and **a. h.** respectively in Figs. 4 and 6. The eye, seen as a dark spot in Fig. 1, soon degenerates with growth and is not apparent in the full grown first stage larva (Fig. 4).

Near the anterior leg the head is giving rise to a long proboscis which proceeds to the posterior region until the ninth wax-plate as seen in Fig. 1, forms a loop characteristic of it in

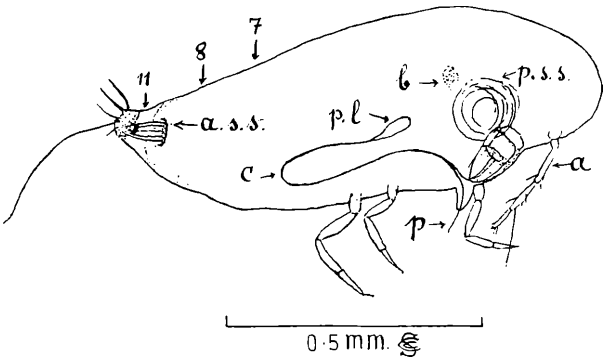



Fig. 4.

*Lakshadia communis* Mahdih. on Ficus mysorensis, Bangalore, 26th Sept. 1923, full grown first stage larva after alkali treatment. Numbers 7, 8 and 11 do not show body segments but instead indicate the present positions of these wax-plates of the dorsal shield. The bidental pseudo-carius, seen where the large anal ring hairs meet, is not marked.

the first stage larva, advisedly not shown here to do justice to the wax shield, returns through the same path, forms a double line as it were and just separates near the head finally leaving the body through a beak-like mouth. The skeleton of the head resembling a sedan chair is marked **h.** and mouth **m.** in Fig. 7; proboscis, **p.**, in Fig. 11; both these larvae however are of second stage. The proboscis loop is indicated **p. l.** in Fig. 4 and in Fig. 10, the first moulted skin which is also seen shaded in Fig. 6. The proboscis of the first stage larva forms a noose-like loop when it returns towards the mouth, and therefore, in Fig. 4, it is single at **p. l.** and folded double at **c.**, where it forms a general curvature or bent of the folded proboscis. The second stage larva,

particularly Fig. 12, shows at **c.** the curvature in the proboscis which is not intimately folded here as in the first stage where it may look like a single thick line, **c.** Fig. 4 and Fig. 6.

In Fig. 1, at the margin of the second wax-plate is seen a circular or disc-like marking, the brachial plate characteristic of the lac insects; Fig. 4 **b.** shows it better, but is well enlarged in Imms and Chatterjee's[3]) Fig. 9, Pl. II. In a vertical line with the brachial plate are two dots representing canal wax pores and lower still a longer structure, the brachial spiracle or the dorsal one. The ventral spiracle is seen like a faint dot and

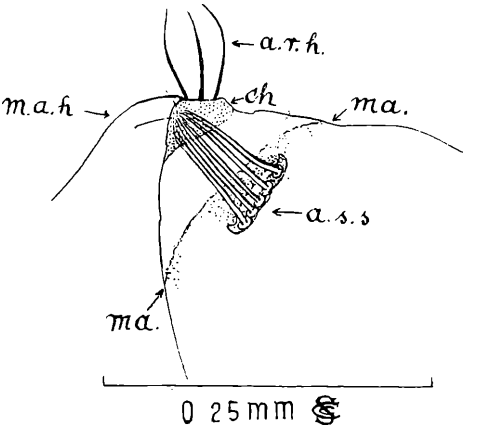



Fig. 5.

*L. communis.* Same as Fig. 4, enlarged posterior portion. The larger anal ring hairs are in a different position to that in Fig. 4. Pseudo-carius is not illustrated here.

a line between the last two legs in Fig. 1. In Figs. 7, 11 and 12, all second stage larvae, brachial plate (**b.**), brachial spiracle (**b. s.**), and ventral spiracle (**v. s.**) are indicated.

Several posterior characters, external and internal, are specific to the first stage larva. In Figs. 2 and 3 are seen externally two long major apical hairs, delicate and fragile, and a small brush of six anal ring hairs; in Fig. 5, **m. a. h.** represents the former and **a. r. h.** the latter of one side and also in Figs. 6 and 7. Near the base of the chitinous anal ring (Fig. 5, **ch.**) which is an enlarged portion of Fig. 4, is seen in the latter, without being lettered, a dark small bidental appendage, the pseudo-carius, not shown again in Fig. 5 to do justice to the anal ring hairs, but

indicated **p. c.** in Fig. 1. The pseudo-carius is also shown without indication in Figs. 3 and 4 of the former paper [1]). This appendage functions in shaping the cell opening as lac exudes from the adjoining region.

On careful study a few anal setae may be seen in the figures which, being unimportant, have not been lettered.

The larva of the male lac insect shows a relatively faster rate of growth and, at least in a few species, is just appreciably larger by the time it is ready for its first moult, Figs. 2 and 3.

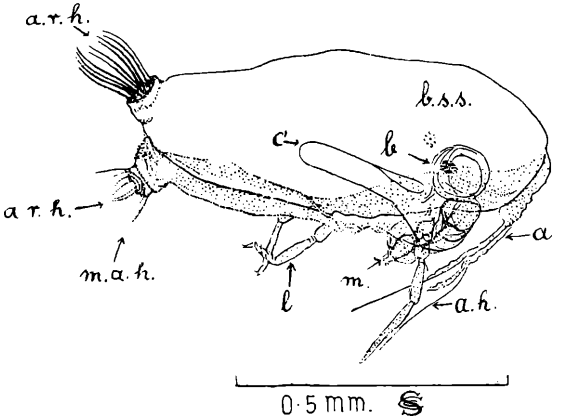



Fig. 6.

*L. mysorensis*, Sept. 26th, 1923, male larva in the act of ecdysis. The first larval skin is shaded. The dorsal slit passes over its brachial plate, **b.**, and cannot be mistaken for **b. s. s.**, brachial plate of the second stage.

Its longitudinal development finds an external expression, easy of observation, as already illustrated. It is particularly noticeable in the frequent displacement of the seventh plate of the dorsal shield numbered 7, Fig. 2, where it is seen vertically inclined and gives a dorsal view of Fig. 1, Pl. I, of the former paper [1]).

By the time the larva is ready for moulting (Fig. 4) the proboscis of the second stage, **p. s. s.**, like a coiled watch spring, and the anal ring of the second stage, **a. s. s.**, with its formidable ten hairs, five on one side, can be seen through the skin. The body of the second stage larva, with its posterior margin shown dotted in Fig. 4, and lettered **ma.** in Fig. 5, causes a general distension of the old skin incapable of further expansion. Besides

its body has been observed to show a regular rhythmic movement on the ventral side from the anterior to the posterior end. The new anal ring hairs thereby exert a to and fro movement like byonet exercise at the posterior extremity. On observation a subtle difference in the positions of the anal rings of the second stage (**a. s. s.**) of the same specimen will be observed in Figs. 4 and 5; in the latter they touch the very extremity.

As the new hairs are to occupy the aperture of the cell they naturally point towards it, i. e. dorsally, between **ch.** and **ma.** (Fig. 5) or just below this portion on the side, piercing the

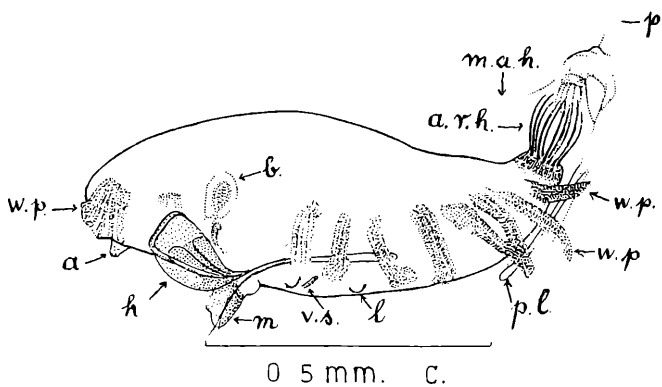



Fig. 7.

*L. communis* on Ficus mysorensis, Bangalore, 13th July 1925, early second stage larva of wingless male after alkali treatment seen sideways in the act of removing the moulted skin. The numerous wax-pencils, **w. p.**, form the skeleton support of the lac cell, its home, and have been secreted by the first stage larva. The last of them, somewhat like a wax-plate, is slightly different to the rest and belongs to the anal cell aperture. — In Fig. 5 Pl. I of the former paper **w. pl.** have been misprinted.

delicate skin with the least difficulty. Once a puncture is caused in the old skin, already distended by the body of the second stage larva, a slit is produced along the line of greatest pressure, i. e. a dorsal longitudinal partition occurs leading to the removal of the skin towards the ventral side. Fig. 6 shows a second stage larva in such an act of undressing with the slit above the brachial plate (**b.**) i. e. sufficiently dorsal.

The moulted skin now gets pressed between the old test and the body of the new occupant which finds its cell somewhat

tight; at the same time the bodily rhythmic movement forces the expulsion of the skin. Both these forces act upon the skin as though it was being pulled through a rolling machine. It is evident the portion which is largest and hardest will bear the greatest pressure and move fastest so that the skeleton of the head glides along so fast that it comes to lie next to the anal ring by the time it leaves the cell. The dotted skin in Fig. 6 shows the anal ring (with anal ring hairs, **a. r. h.**) and head (with its mouth, **m.**) far apart as they naturally are. In the moulted skin after leaving the cell (Fig. 10) mouth (**m.**) is close to the anal ring hairs (**a. r. h.**) because the head beneath the

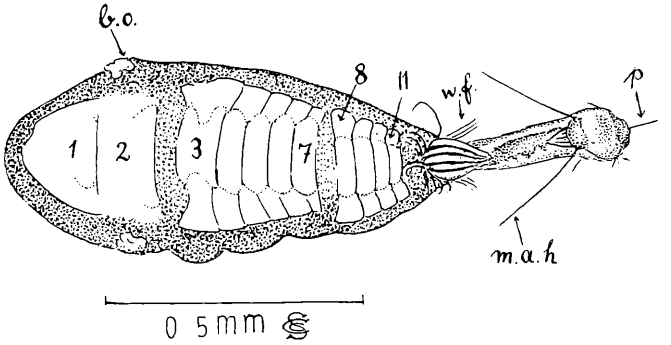



Fig. 8.

*L. mysorensis*, 26th Sept. 1923, winged male larva seen from above in the act of removing the first moulted skin. The wax-plates of the original dorsal shield are numbered, showing the usual separation that occurs with growth. Wax-filaments from pores in the anal ring surround the brush of ten anal ring hairs which are sufficiently thick not to be mistaken for the former. Wax-filaments from the brachial opening are not shown here advisedly.

skin is actually touching the anal ring. All the skin shown in Fig. 6 between **a. r. h.** and **m.** gets completely shrivelled while the delicate legs (**l.**) often get broken during the passage; in Fig. 10, **l.**, the last pair of legs are faintly seen.

As the head moves along, the proboscis is also pulled out and sometimes may be almost completely removed from the bark as shown **p.**, Fig. 10. However the proboscis often breaks in this act and is left in the plant while only fragments of it are seen in the moulted skin, **p.** Figs. 8 and 10.

A glance at Fig. 6 shows the old proboscis vertically placed on one side of the new body. During its outward passage, however,

it gets ventrally situated and its length and curvature (**c.**) prevent an easy removal. To avoid a long description of details it is easy to imagine the skin at **m.** being pulled through a slit-like hole comparable with the aperture of the lac cell partially blocked by the anal ring. The proboscis will first leave with the mouth **m.**, then the portion near **c.** and finally the proboscis loop **p. l.** (Figs. 6, 7 and 10). This means the curvature **c.** will disappear as the proboscis passes out, but the remnant of it is

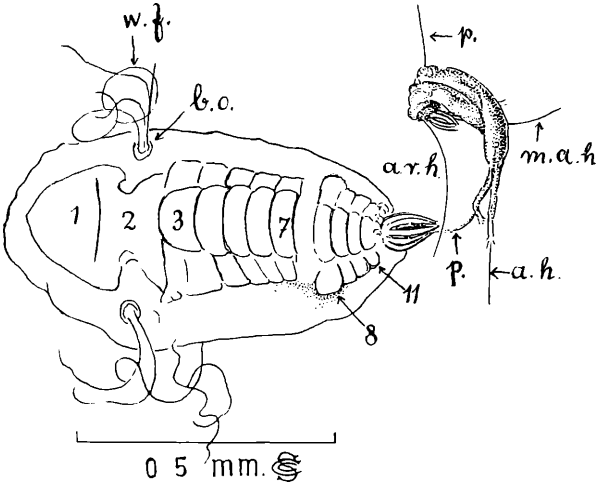



Fig. 9.

*L. mysorensis*, 26th Sept. 1923, female from the same colony as Fig. 8. Wax-plates are numbered and show less spacing particularly between 2 and 3. Wax-filaments, **w. f.**, from the brachial openings are shown here. From pores in the anal ring, similar wax-filaments arise, very faintly seen here since growth, during the early second stage, is relatively poor in the female.

seen in the arched bent of the moulted skin in Fig. 9 and also in Fig. 7 where the old anal ring hairs are seen stooping as it were over the new ones. There is the possibility of the old proboscis leaving the cell aperture with its curvature **c.**, Fig. 6, still maintaining the original shape, but such an instance was not observed. Figs. 6 to 10 represent consecutive stages in the passage of the moulted skin; in Fig. 9, the proboscis loop, the last to leave is its only portion within the cell after which it is completely removed, Fig. 10.

The portion of the moulted skin between the mouth and the posterior extremity gets rolled up on account of the speed with which the head overtakes the anal ring; but the head in its outward passage unduly pulls and stretches the remaining or anterior portion of the skin. In Fig. 10, **m.** and **a. r. h.** close ot each other represent the shrivelled posterior portion, the first to leave the cell aperture, but includes all the skin between **m.** and **a. r. h.** (Fig. 6), while the anterior stretched portion, which leaves later (Fig. 10, **m.** and **a.**), is well comparable with that between **m.** and **a.** in Fig. 6.

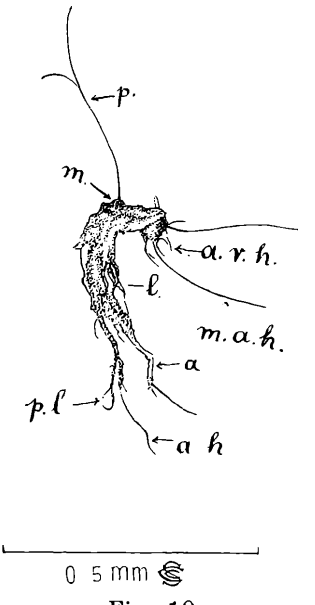



Fig. 10.
The first moulted skin of a female *L. mysorensis*. The young larva had settled on 23nd Aug. 1923 on S. talura and moulted on 15th Sept. 1923.

The moulted skin is generally removed within a day but may take much longer. In Fig. 8, the glandular wax pores of the anal ring are seen producing wax filaments, **w. f.**, while the old skin has not yet evacuated the cell. The best and also the immediate sign of moulting, of course, is the presence of a thick brush of ten anal ring hairs instead of the former six and the two long major apical hairs as can be seen on comparison between Figs. 2 and 3 of the first stage and Figs. 8 and 9 of the second stage. The anal ring hairs of both the stages are conspicuous in the several figures in the text and therefore have not been always lettered. It will be noticed the anal brush of the male cell (Fig. 8) is more conspicuous than the female of the same age (Fig. 9), which is only visual and is due to the posterior portion of the former being so shaped that the brush of anal hairs point lies more horizontally or longitudinally while of the female more vertically, as already mentioned (**l.**). The more interesting point is to notice the comparatively better development of wax filaments at the anal extremity of the male cell (Fig. 8, **w. f.**), while the similar filaments in Fig. 9, the female cell, are so faint that they could not be lettered. The wax filaments from the brachial opening (**b. o.**), shown in Fig. 9, have been brushed off in Fig. 8, to show the general shape of the male cell as longer but much less raised than the female cell.

As compared with the adult female, the adult male has long antennae and well developed legs. The second stage male larva (Fig. 11) is possessed with a better developed antenna (**a.**) and has rudiments of legs (**l.**) the latter absent in the female (Fig. 12).

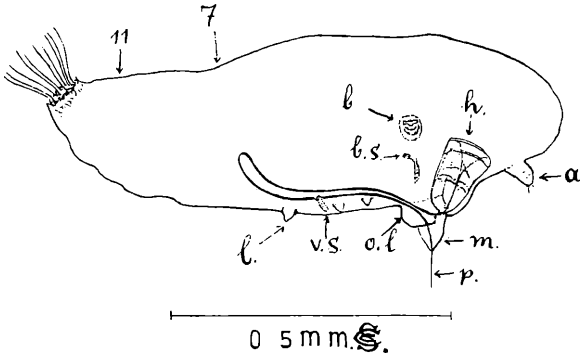



Fig. 11.

*L. communis* on F. mysorensis, Bangalore, larva of winged male. The first moulted skin was removed on 28th Nov. 1923, when it was treated with alkali solution. There are seen three rudimentary legs, **l.**, of one side. The dorsal surface bears the numbers 7 and 11 which show the present positions of the wax-plates of the shield.

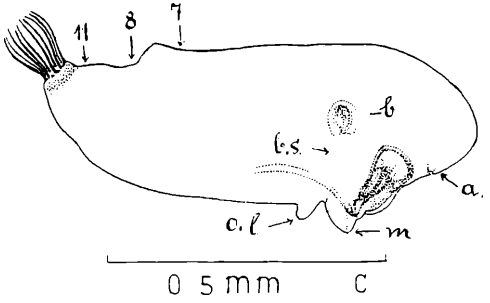



Fig. 12.

*L. communis* on Guazuma tomentosa, Bangalore, female larva. The first moult skin was removed on 13th July 1925, when it was treated with caustic solution. The proboscis is larger than in Fig. 11 and is distinctly double at curvature, **c.** The beginning of the future dorsal spine in the adult is seen like a hump in the skin beneath wax-plates 7 and 8.

The oval lobe (**o. l.**) absent in the first stage is now present in both sexes (Figs. 11 and 12). The brachial plates differ between them, but will be illustrated on a future occasion. The female (Fig. 12) has a better developed proboscis than the male (Fig. 11), a point which needs further study.

The adult female has a spinoid process on the dorsal surface. The earliest vestige of this spine is seen before ecdysis and is shown in the former paper [1]), Fig. 4, in the uneven skin under wax-plates 7 and 8. After ecdysis this portion of the skin indicated by numbers 7 and 8, Fig. 12, here, shows a humplike upheaval, and contrasts with the dorsal skin of the male (Fig. 11) at 7.

The female grows vertically, the male longitudinally; the last wax-plate of the dorsal shield, numbered 11, is naturally nearer the anal ring in the female (Fig. 12) than in the male (Fig. 11) as is seen externally in Figs. 8 and 9 respectively.

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## Summary.

The following anatomical characters distinguish the first and second stage larvae:

| Characters. | Ist Stage. | IInd Stage. |
|---|---|---|
| | Internal Characters. | |
| Antennae and legs: | Well developed, Fig. 4. | Rudimentary, better in the male Fig. 11, than in female Fig. 12; legs absent in female. |
| Eyes: | Present only in the crawling larva, Fig. 1. | Absent. |
| Brachial plates and the two spiracles: | Small in the first stage, Figs. 1 and 4. | Larger and different in the sexes. |
| Proboscis: | A noose-like loop characteristic of the Ist stage, Fig. 4. | Probably better developed in the female Fig. 12, than in the male Fig. 11. |
| Pseudo-carii: | Present, **p. c.**, Fig. 1. | Absent. |

| Characters. | Ist Stage. | IInd Stage. |
|---|---|---|
| | Characters External to the cell. | |
| Major apical hairs: | Present, Figs. 2 and 5. | Absent. |
| Anal ring hairs: | Six in number, Figs. 2 and 5. | Ten in both sexes and similar, Figs. 6 and 12 and 8 and 9. |

## Key to Plate Markings.

a. = Antenna.
a. r. h. = Anal ring hairs.
a. s. s. = Anal ring of the second stage larva.
b. = Brachial plate or Brachium.
b. o. = Brachial opening in the lac cell.
b. s. = Brachial spiracle or dorsal spiracle.
c. = Curvature of the proboscis where it is folded or double.
ch. = Chitinised portion of the skin at the base of the anal ring.
l. = Leg.
m. = Mouth.
ma. = Margin, posterior, of the second stage larval body.
m. a. h. = Major apical hair.
p. = Proboscis.
p. c. = Pseudo-carius.
p. l. = Proboscis loop, a noose-like loop where the proboscis returns again towards the mouth.
p. s. s. = Proboscis of the second stage larva.
v. s. = Ventral spiracle.
w. p. = Wax pencils forming skeleton framework of the lac cell.