

The Last Two Moults of The Lac Insect

by

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As early as 1899 SHARP ¹⁾ says, "Difference of opinion prevails as to the nature of instars between the young larva and the imago" in the case of the female scale insects, while "in the male coccid we have the highest form of metamorphosis" with four moults. With the lac insects I ²⁾ observed three moults of the female on which NEGI ³⁾ recently remarks "according to MAHDIHASSAN the female larva moults thrice, but so far I have been able to observe only two moults". But NEGI himself illustrates the fully developed larval just about to moult for the second time, Fig. 4, *c*, calling it the early second stage larva, as well as the last larval stage, Fig. 4, *e*, considering it the advanced second stage larva. The fully developed second stage larva Fig. 1, here represents a stage just before the second moult. It is a larva of *Lakshadia nagoliensis*, original brood growing on *Schleichera trijuga* cultivated in Bangalore on *Accia farnesiana*. It was drawn after the lac cell was quickly dissolved out in alcohol, the two rows of small white circles represent transparent muscular joints on the skin; the back is seen a little raised in the middle which as seen partly hides the left row. The same object is better seen from its side but by the time the first drawing was finished the transparent muscular joints became opaque due to alcohol and are not seen in Fig. 2. The dorsal skin shows a slight contraction on account of the action of alcohol but nevertheless shows the transparent hump like spinoid tubercle, *s.t.*, of the old second stage larva. On account of the skin contracting the anal and spinoid tubercles of the forthcoming larva are not seen

¹⁾ The work was done in the Laboratory of Dr. COLEMAN, Director of Agriculture, Bangalore, to whom my thanks are due.

through the old skin which however shows the body outline of the new larva, seen shaded in Fig. 2, in sharp contrast. It may be remarked Fig. 1 here is identically the same stage as NEGI's Fig. 4, *c*.

Very soon after the second moult, the larva of *L. communis*, on *Ficus mysorensis* in Bangalore, July 1925, was treated with cold caustic alkali solution and Figs. 3 and 4 were

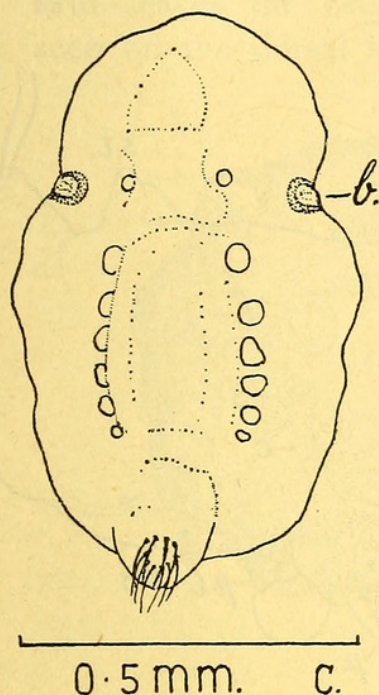


Fig. 1.

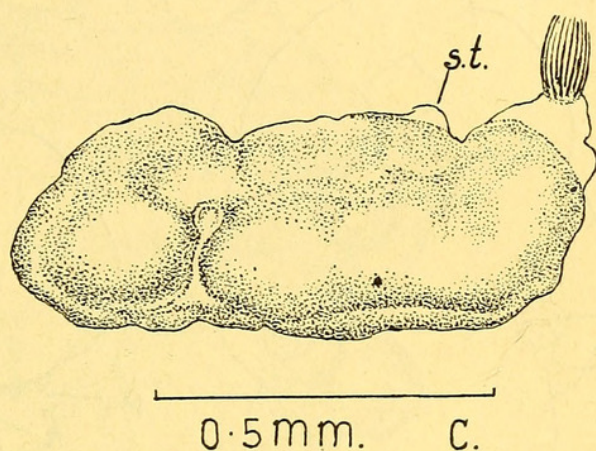


Fig. 2.

drawn to represent two views of the same object. This treatment makes the structures clearer of vision but the natural shape is altered by the body swelling consequently. The spinoid tubercle, *s.t.*, is unmistakable although as yet there is no sign of a pointed needle like spine as in the early adult female. The special structure of the lac insects is the brachial plate, Fig. 4, *b.*, or fused glandular ducts from where filaments of soft wax arise. Adjoining it is the major spiracle, *s.*, and in continuation is a row of canella, *c.*, wax pores, here shown like a channel which really shows a streak of wax secreted from these pores. Dorsally seen, Fig. 3, the brachial plate, *b.*, with the spiracle and canellae would appear to be all one piece, which however is the case only very much later when the insect is nearing its life cycle

and the chitinisation has reached its maximum with the gratest body development. On the ventral surface, Fig. 4 the antennae, *a.*, in rudimentary shape are still seen. About the mouth region are seen two pairs of lobes posterior *o.l.* and anterior *a.l.*, or pad like structures among which lies a beak like mouth with the proboscis, *p.*, while the head, *h.*,

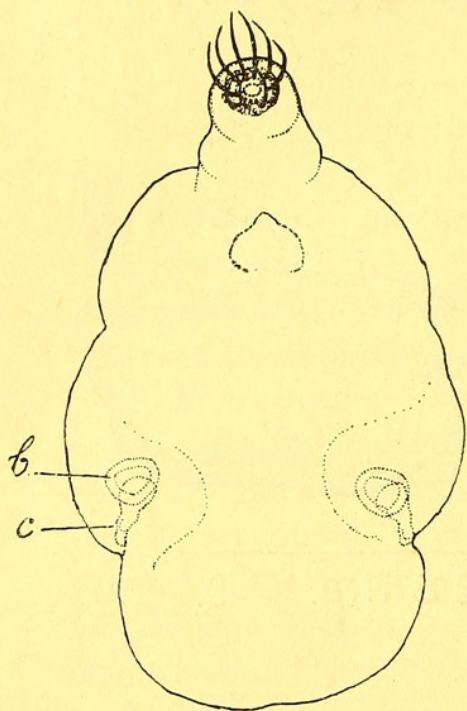


Fig. 3.

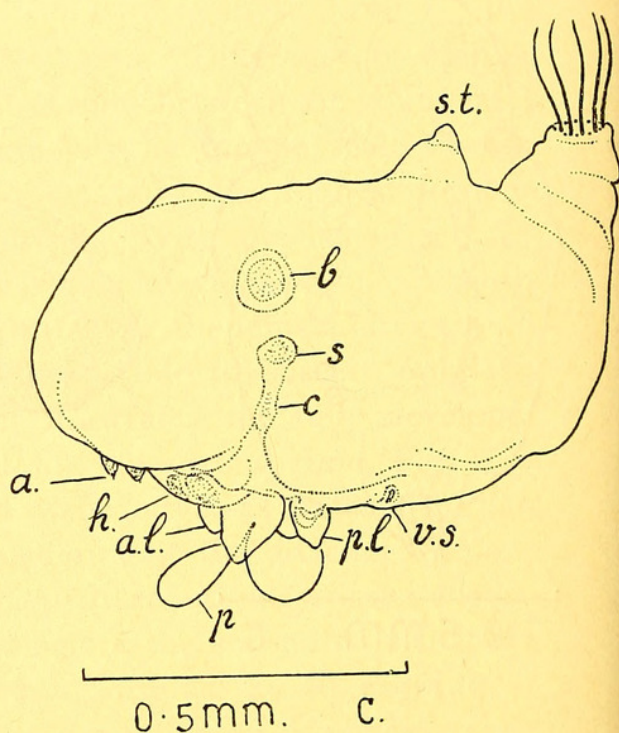


Fig. 4.

is anteriorly situated. The four oral lobes act as pads or buffers facilitating the movements up and down of the needle like mouth parts. The ventral or minor spiracle, *v.s.*, is also seen as much smaller than the upper or major *s.*

A lac cell of *L. communis*, half way between the periods when it moults for the second and third times, is shown very much alive in Fig. 5 with ten anal ring hairs enclosing a drop of honey dew or excreta about to be ejected. Adjoining it are a few wax filaments, *w.f.*, secreted from glandular pores on the anal ring plate. On the left side may be seen three pairs of projections from the margin of the cell while of them the pair nearest the anal end is the clearest i. e.

the cleft between the pair of projections is clearest. These are pencils of hard wax secreted from glands beneath but the wax is enveloped by the general lac exudation. On the dorsal surface a fish like flat body may be easily seen which is identical in shape with the crawling stage larva and has been mistaken by Imms and CHATTERJEE ⁴⁾ for its moulted skin as I ⁵⁾ have already pointed out. In reality the moult skin leaves the cell through its anal opening and what is seen on the dorsal surface as a fish like object is the original

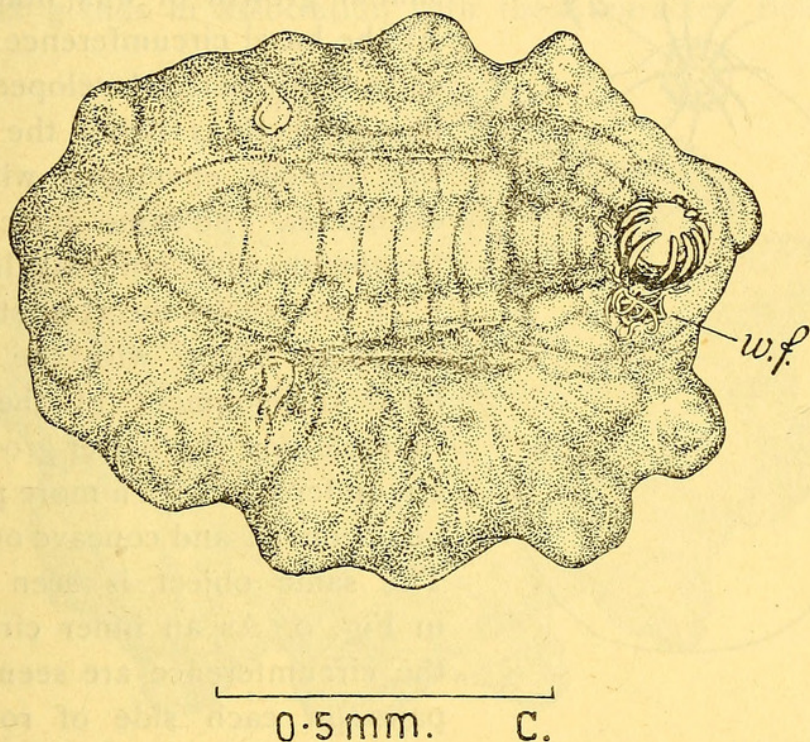


Fig. 5.

dorsal wax shield divisible in eleven plates all to be counted in Fig. 5, as permanent recollections of the first larval stage. The same cell was later treated with alkali solution and is afterwards seen in Fig. 6. Ten anal ring hairs are self evident with the shaded anal ring area surrounding the actual anal opening seen as a central white circle. At the very outside is a third row of roughly outlined dark circle. This represents the fringe of the anal tubercle *a.f.*, and consists of spines which are better developed on the front side than on the posterior half of the circle. Fig. 6 also shows the shading of this circle thicker on the anterior side than on

the other half. The spinoid hump is shown in the middle while the dotted short curved lines near the sides show folds of the skin as seen on the swollen skin. Figs 5 and 6 were drawn from the same specimen collected on *F. mysorensis* on 11 June 1925.

From the same colony was also drawn Fig. 7 which is relatively nearer to the stage when the larva moults for the third time. The anal ring hairs contain a smaller honey

drop and at their base shows a similar growth of wax filaments. At the basal circumference of the cell are now better developed teeth like projections being the inner wax pencils enveloped with lac exudation. The same object after treatment with cold alkali gave Fig. 8 and shows the same structures as in Fig. 6 with the additional development of the anal tubercle and the better growth in circumference with a more prominent convex and concave outline. The same object is seen again in Fig. 9. As an inner circle to the circumference are seen three pairs on each side of rows of short lines, being the ducts of wax glands, *w.d.*, which secrete wax in the form of pencils responsible for the teeth like pro-

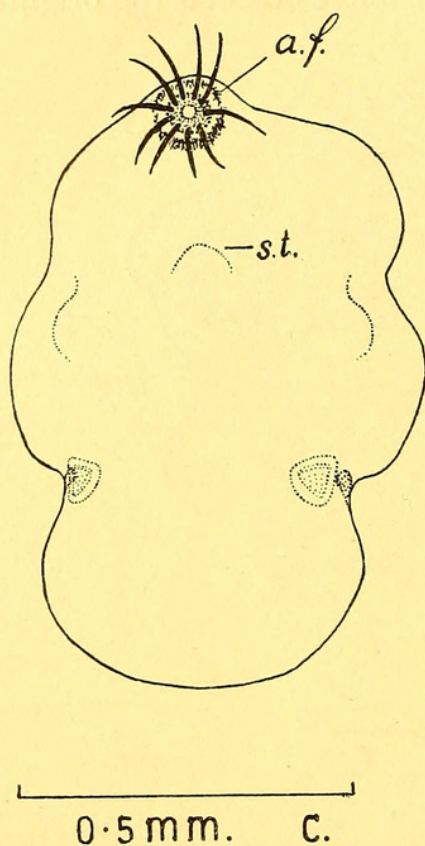
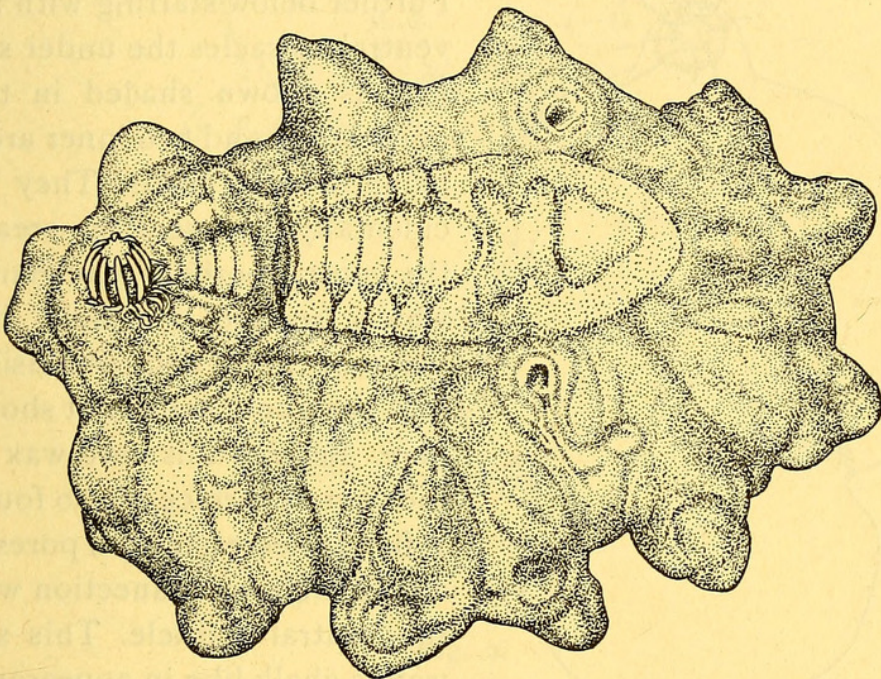


Fig. 6.

jections seen outside in Fig. 7. The antenna, *a.*, of the present stage is short while that of the first stage larva, *a*¹., is long and may be sometimes left behind as seen here. I have elsewhere ⁵) explained how the dorsal surface of the larval body about to moult first splits dorsally and the rupture extends ventrally and the skin to be casted off escapes through a rolling action between the ventral surface of the new larval body and the old cell just a little too tight for the newcomer. Besides the antennae the legs, *l.*, equally

liable to be torn off may also remain behind and are actually seen here. It may be further remarked these relics constituting torn off skin are appendages not always easily rejected on account of their delicate joints to the main skin and not easily rolled by the ventral rhythmic pressure and further that they are all seen ventrally while only the wax shield of the first stage larva is seen dorsally. The brachial plate, *b.*, is roughly shown while the ventral spiracle, *v.s.*, is seen with small dots partly in a long row, being the duct openings of wax glands in association with these spiracles. Below the



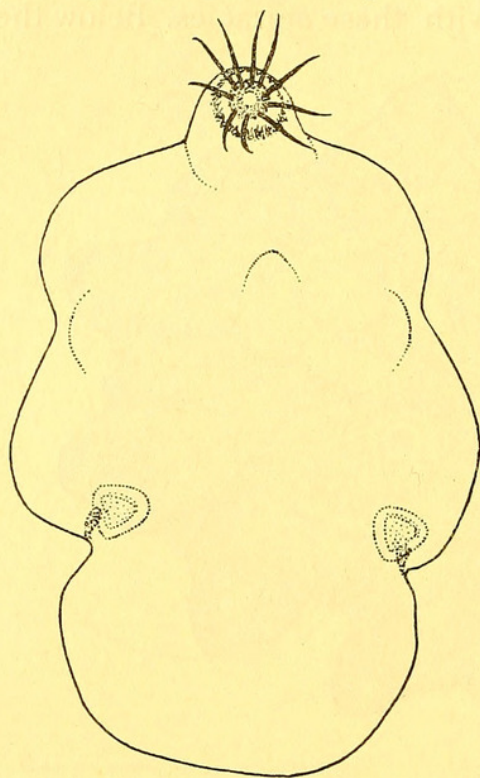
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0.5 mm. c.

Fig. 7.

antennae, *a.*, is the large head with the proboscis, the oral lobes on the posterior side are seen forming together a half circle. In line with the head towards the posterior end are seen two parallel dotted rows which represent muscle points, *m.j.*, on the skin. The muscles are those which hold the anal tubercle in a verticle position. Adjoining them is the outline of the anal tubercle shown as an outside dotted line with a middle circle of ten points being the joints of the anal

ring hairs on the anal ring which is not otherwise represented here and lastly an innermost small circle, the actual opening of the anus.

Before the last moult the third stage larva when tilted to expose the under surface is like Fig. 10, which was drawn after the cell was treated with alcohol and the exudation of lac was carefully removed. The four oral lobes, surround the mouth which is not seen here. Adjoining the posterior pair of lobes are two dark spots, the



0.5 mm. C.

Fig. 8.

minor or ventral spiracles, *v.s.* Further below starting with the ventral spiracles the under surface is shown shaded in two outer strips and two inner areas being muscle joints. They incidentally represent the area of the ventral pores of wax glands which secrete a shield like plate of hard wax indivisible into segments and is not shown here. Besides this hard wax on the ventral surface is also found soft wax secreted from pores of wax glands in connection with the ventral spiracle. This soft wax is chalk like in appearance of the same nature as the wax filaments from the brachial plates. The brachial plate is born on the adult full grown female as a tower like tubercle; in

some larval stages the corresponding region resembles a raised shoulder as in Fig. 10 where the brachial region is shown by *b*. The portion of the third stage larval skin corresponding to the spinoid tubercle of the adult is seen as an envelope, *s.t.*, enclosing a sharp pointed structure shaded below. The anal tubercle is seen with five anal ring hairs on one side. The side surface between the ventral and the dorsal regions is seen divided in three parts separated by dotted lines in Fig. 10.

The same specimen is seen sideways in Fig. 11. The brachial region, *b.*, like a raised mount is self evident. The old spinoid tubercle with the new one bearing a spine about to pierce its way out is also clear while beneath the anal ring hairs the convex line shows the limit of the anal tubercle of the forthcoming young adult stage. The ventral surface shows two lobes, one larger of the anterior, one smaller of

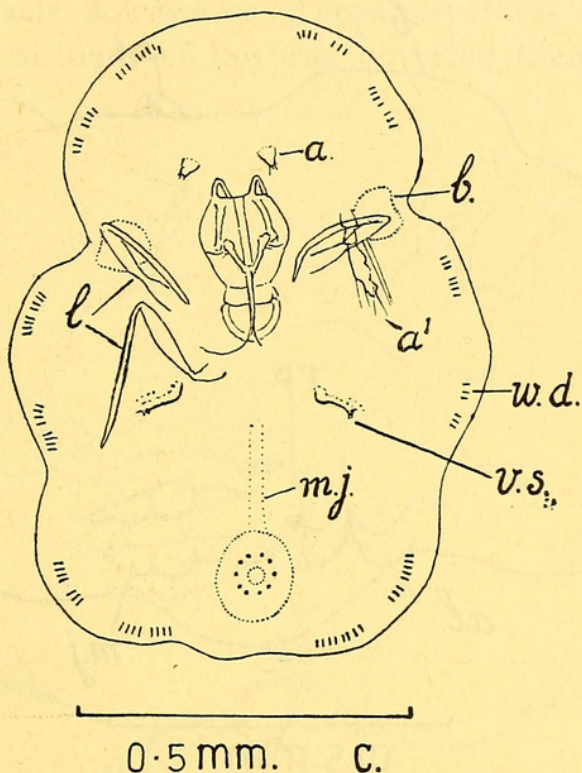


Fig. 9.

the posterior pair as seen sideways, the mouth not seen, is represented by the four long thread like separated parts forming the proboscis.

Figs. 10 and 11 being the same specimen represent, *L. nagoliensis* experimentally grown on *A. farnesiana*.

A female cell of *L. communis* on *F. mysorensis* about to moult for the third time was treated with a mixture of xylol and alcohol as the former has a more contrasting or shrivelling action and darkens the red bodies of lac insects bringing into prominence the outlines of the skins of the last stage larva and the forthcoming adult. Figs 12 and 13 were made after such treatment from a cell collected on 15 Aug. 25.

The brachial plate, *b.*, the brachial or major spiracle, *s.*, antenna, *a.*, the posterior lobes, *p.l.*, the mouth, *m.*, and the spinoid tubercle, *s.t.*, of the old larva are all shown and the two skins, the old larval body outside and the forthcoming adult within are also self evident.

It may be here remarked Fig. 13 is identical with NEGI's

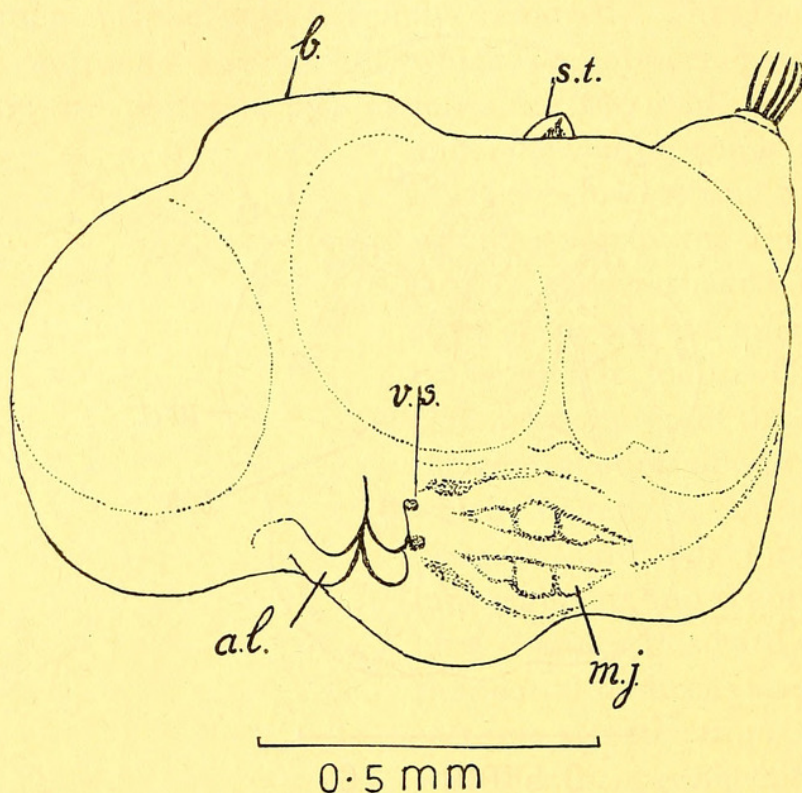


Fig. 10.

advanced second stage larva Fig. 4, *e.*, but he does not represent the spinoid tubercle clear enough to show the characteristic structure of this stage.

Immediately after the last moult the earliest adult stage is shown in Fig. 14, being *L. nagoliensis* experimentally grown on *A. farnesiana* in Bangalore. The cell was treated with alcohol and quickly drawn while the two rows of muscle joints looking like seven pits on each side were still transparent on the dorsal surface. But for this apparent difference it corresponds with NEGI's Fig. 4, *f.*, which must have been drawn after the object being left long in alcohol to deprive observation of the musculature attachments shown here.

For the first time a needle like spine is now seen and is different from the wedge shaped tubercle of the larval stage; Fig. 14 thus shows quite a different spine to that of Figs. 12 and 13. The brachial region is seen like a cavity at the circumference a raised adjoining portion bearing the actual brachial plate with soft wax covering it and adjoining it a long strak of wax along the canella tract starting from the brachial spiracle downwards. These structures are of course not seen on account of the wax covering them.

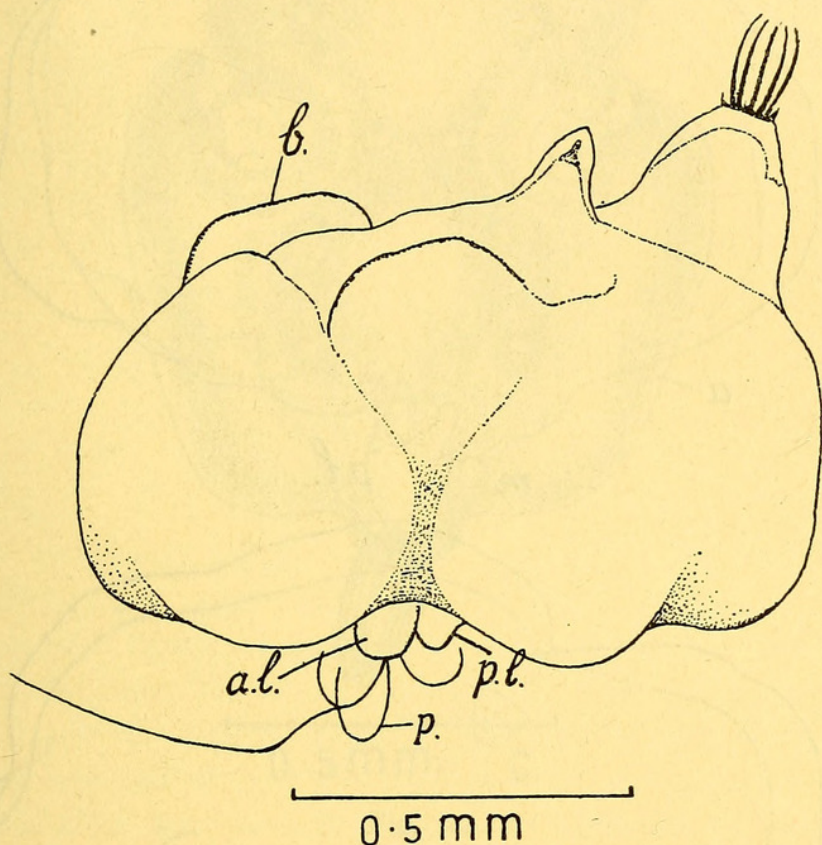
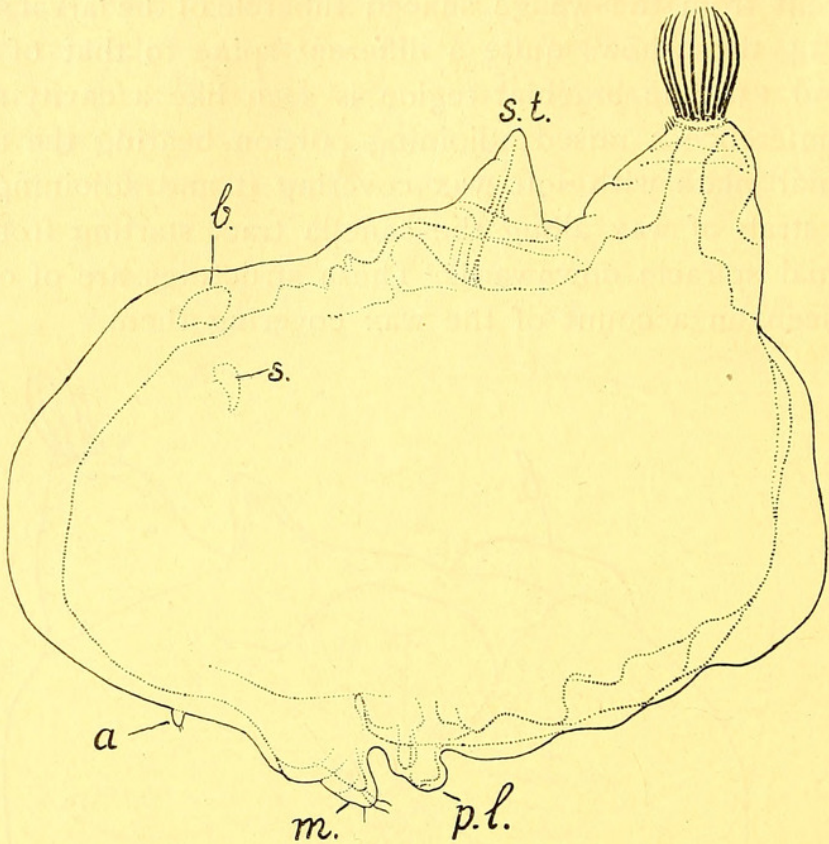


Fig. 11.

Elsewhere I⁵) have illustrated the first moult skin which is easily recognised by the appendages characterising the first stage, namely the long antennae and the major apical hairs and six anal ring hairs. The second and third moulted skins differ between them in the size of their brachial plates and of their anal ring hairs. Figs. 15 and 16 particularly bear evidence to this fact. Again Figs. 11 and 14 show the relatively smaller sized anal ring hairs of the earlier stage. It may be particularly remarked Figs. 15 and 16 represent

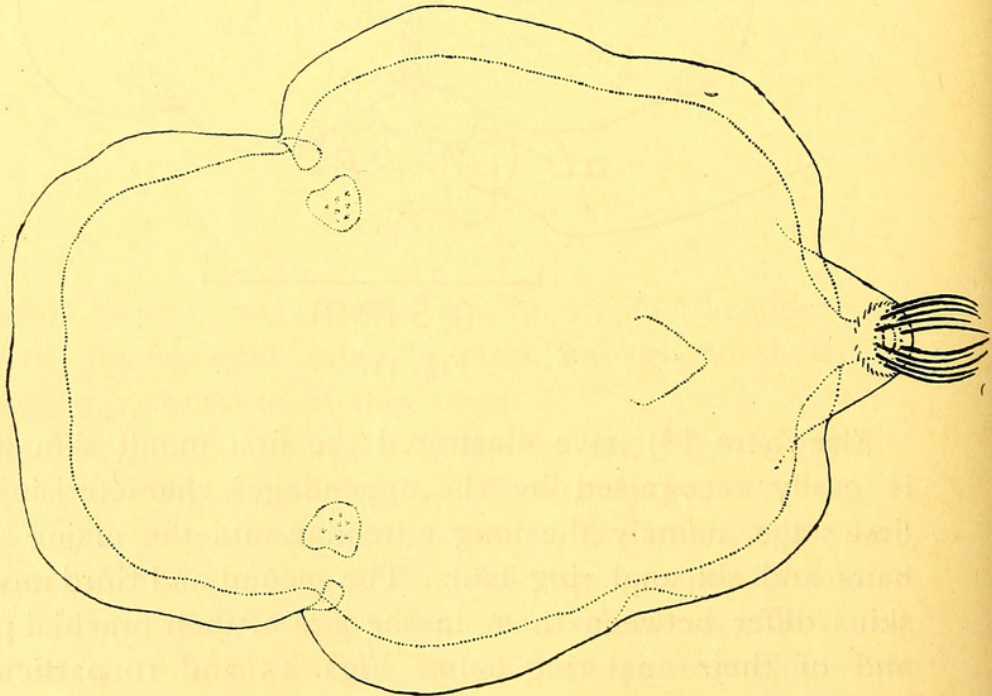
Fig. 12.



1mm.

C.

Fig. 13.



objects as actually seen smeared with soft wax. The brachial plate *b.*, naturally represents only roughly the size; mouth *m.*, is also indicated by its position and likewise the thorny or saw like anal fringe, *a.f.*, just outside the anal ring

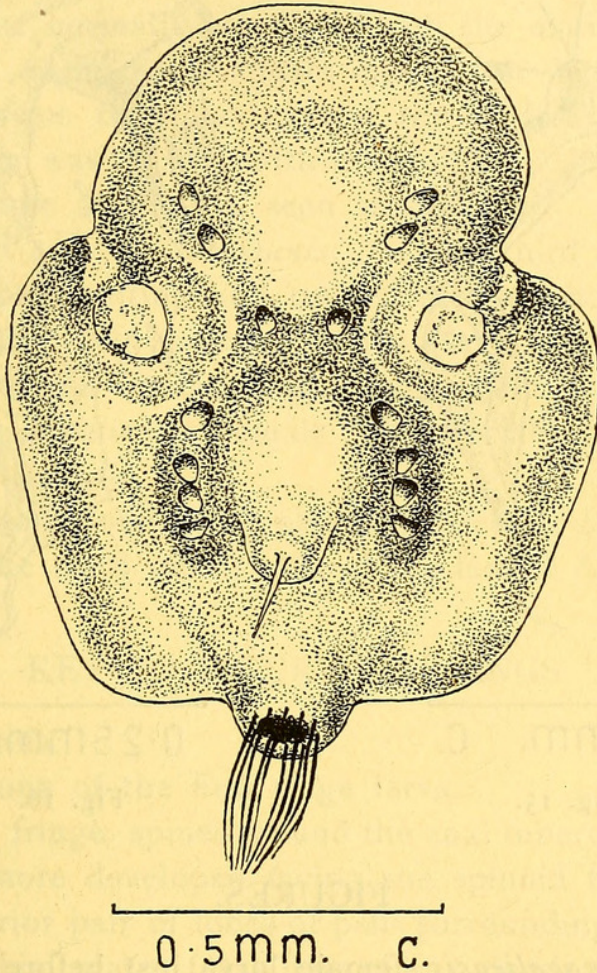


Fig. 14.

where the anal fringe forms a thicker semi circle facing the spinoid tubercle.

Summary.

Among coccids the male has long been studied and its four moults established. The metamorphosis of the female has not been well known and in the case of the lac insects even doubts expressed if there should be more than two moults. The last two moult skins are illustrated and the different intermediate stages described and figured. It is

established the female coccid has three moults or only one less than the male.

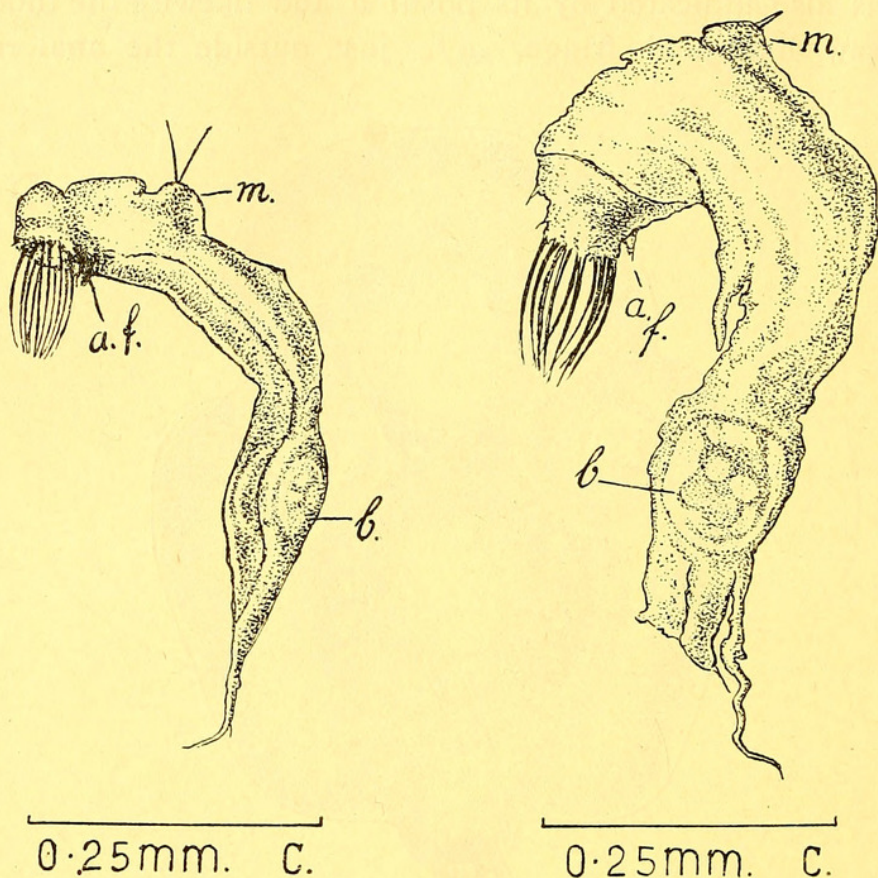


Fig. 15.

Fig. 16.

FIGURES.

Fig. 1. *L. nagoliensis*, female larva just before the second moult and after removal of the lac cell with alcohol. Rows of small circles on the back represent musculature attachments on the skin.

Fig. 2. Same as Fig. 1 seen sideways, shaded portion partly represents the third larval skin.

Figs. 3 and 4. *L. communis*, female larva after the second moult and treated with alkali, shown in two positions.

Fig. 5. *L. communis*, female cell half way between the third and fourth larval stages. The anal ring hairs contain a drop of honey-excretion.

Fig. 6. Same as Fig. 5 after treatment with alkali to show the skin in outline.

- Fig. 7. *L. communis*, female cell more advanced than Fig. 5 with a smaller excretion drop within the anal ring hairs.
- Fig. 8. Same as Fig. 7, seen after treatment with alkali.
- Fig. 9. Same as Fig. 8 seen ventrally to show the remains of the first larval skin, legs and antenna which are otherwise normally casted off with the main moult skin.
- Fig. 10. *L. nagoliensis*, female larva just before the last moult seen tilted to expose the under surface. The specimen was treated with alcohol.
- Fig. 11. Same as Fig. 10 seen sideways.
- Figs. 12 and 13. *L. communis*, female third stage larva ready for moulting and treated with alcohol and xylol. The outer skin belongs to the larva the inner shown dotted to the forthcoming young adult.
- Fig. 14. *L. nagoliensis*, female just after the last moult or as young adult.
- Fig. 15. The second moult skin of the female *L. nagoliensis*.
- Fig. 16. The third moult skin of the female *L. nagoliensis*.

KEY TO FIGURE MARKINGS.

- a.* = antenna.
- a*¹. = antenna of the first stage larva.
- a.f.* = anal fringe, spines around the anal tubercular extremity more developed facing the spinoid tubercle.
- a.l.* = anterior pair of lobes or pads surrounding the mouth.
- b.* = brachial plate; fused ducts of wax glands secreting soft filamentous wax. This structure characterises only the lac insects.
- c.* = canella; a row of wax secreting pores in vertical line with the major or dorsal spiracle.
- l.* = legs of the first stage larva torn off and left ventrally in the cell.
- m.* = mouth usually beak like.
- m.j.* = muscle joints or musculature attachments on the skin.
- p.* = proboscis.
- p.l.* = posterior pair of lobes or pads around the mouth.
- s.* = spiracle near the brachial plate, the major or dorsal or the anterior spiracle.

- s.t.* = spinoid tubercle also more or less specialised to the lac insects where the larvae have hump like undeveloped forms.
- v s.* = ventral spiracle or the minor or the posterior spiracle.
- w.d.* = wax glandular ducts giving rise to a hard wax in the form of pencil from the margin or the sides.
- w.f.* = Wax filaments like cotton threads.

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