ANATOMICAL CHARACTERS DIFFERENTIATING CRAWLING LARVAE OF MALE AND FEMALE LAC INSECTS

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A lac crop depends entirely on the presence of females in the generation. The body outlines of the two sexes in the crawling larval stage shows a difference. This requires morphological or anatomical characters to confirm sex differentiation. The lac insects have two brachial plates as a feature special to them. In the centre of this structure is a cluster of pores secreting wax. These pores are on the two brachia number 14 in the female, and 7 in the male larva. This anatomical finding confirms the observation that the female larva secretes more soft wax filaments than does the male.

Of all species of lac insects that are cultivated the Sind lac insect, *Lakshadia sindica*, Mahd shows the greatest sex-ratio variability. The lac crops differ in quantity and the main contributing factor seems to be the sex-ratio in the generation, favourable to the female when the crop happens to be good. It is therefore necessary to identify the sex of the crawling larvae just settled on a twig, in order to forecast the crop the generation would produce. In actual practice what can be done as a convenient measure would be to place a sample of a twig infected with lac and determine the sex ratio by the difference in outline of the larval bodies. Such a method was first communicated by Mahdihassan[1] and later confirmed by Negi.[2] It is strange that no other author has added further observations on this vital problem. Above all if there be any doubt that the sex of the larva in its first stage has been rightly determined there is no morphological feature to decide the point. It is this crucial problem that forms the basis of the observations reported here.

Fig. 1 represents the male crawling larva, treated with alkali and finally stained with fuchsin, but is seen lying on its back. The anterior portion of the body, below the head, and on each side of the body margin, shows two thick chitinous plates. These are brachia, a structure peculiar to lac insects, and associated with the major spiracles. The insect (Fig. 1) is seen from below so that the brachium to our left actually represents the one which was on the right side of the insect body. The posterior end of the body shows six anal ring hairs forming a sort of brush; further two long Major Apical Hairs; and finally on each side a bidental appendage seen as dark markings. None of these features characterize the sex. But the brachium does. The brachia of Fig. 1 are enlarged in Fig. 2. The peripheral margin shows tactile hairs, represented here as pin holes, numbering five, which have also been partly numbered in Fig. 2. The brachial plate contains in the centre a group of pores from which filaments of soft wax arise. In Fig. 2 the insect's right brachium contains as a central cluster four

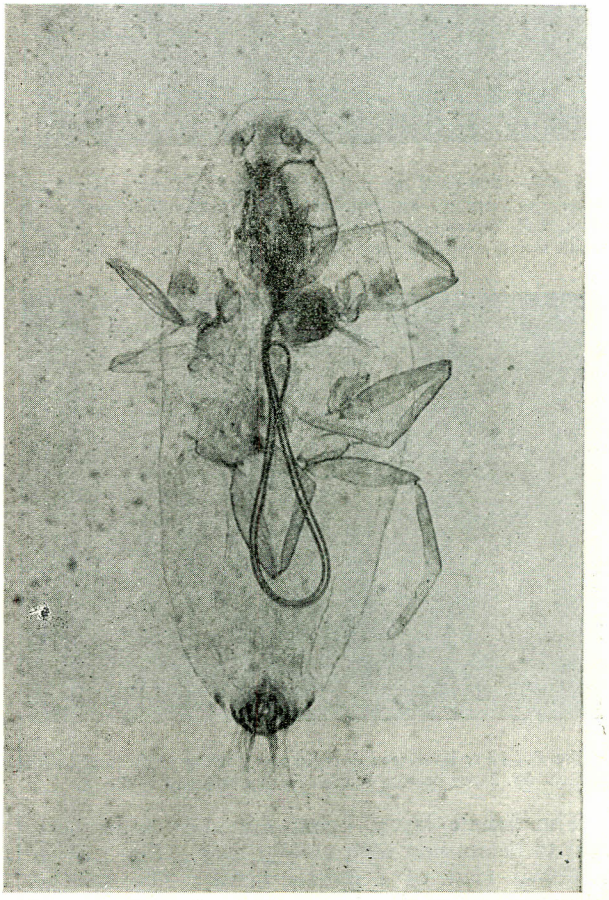

Fig. 1.—*Lakshadia sindica*, male larva, treated with alkali and stained with carbol fushsin, seen ventirally. Its two brachial plates lie on the body segment No. 2; campare Fig. 5, where Brachium is marked B.

pores while the other only three. The total number of central pores is therefore seven in the young male larva.

Fig. 3 represents the anterior portion of another male larva, but seen dorsally. Its brachia are enlarged in Fig. 4, and show again, three central

pores on its left brachium and four on its right. It is to be pointed out that Fig. 1 is seen ventrally whereas Fig. 4 is viewed dorsally. Therefore what is to our left in Fig. 2 was actually on the right side of the insect, whereas in Fig. 4 what is to our right was also on the right of the insect body. Thus the right brachium contains 4 central pores and the left 3, in both the male larvae, Figs. 1 and 3.

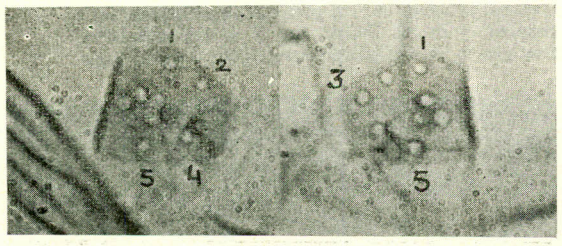

Fig. 2.—Brachia of the male larva, Fig. 1, further enlarged and again seen ventrally. The periphery of each brachium shows 5 white holes, really representing tactile hairs. In the centre a cluster of pores, which secrete soft filamentous wax, are 4 and 3 in number. Mg. 45x6.

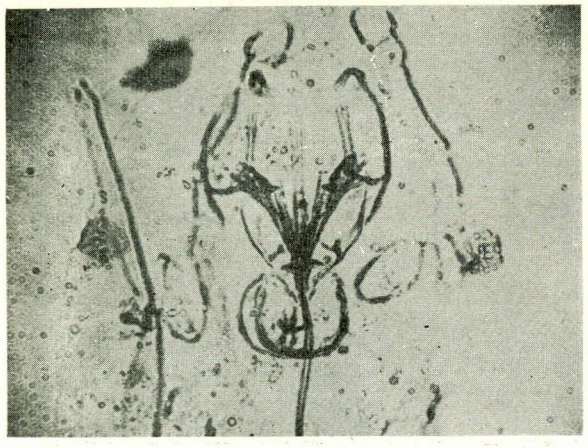

Fig. 3.—Male larva seen dorsally as a portion of the body with segment no. 2 and bearing brachia further enlarged in Fig. 4.

The female larva, being the more important, had to be studied with greater care. Fig. 5 gives a dorsal view of a female larva. The general body outline of the female shows a broader posterior end and the body on the whole has relatively parallel sides. Segments 10 and 11 are not so arched in the female so that the posterior portion of the body does not end in a very acute angle. The Anal ring Hairs, A.H., are six in number. There is a pair of long Major Apical Hairs, M.A.H. Segment no. 11 on each side has a Bidental appendage, B.D., seen in profile. Towards the anterior end, an Antenna is marked, An., the left brachium as B., which shows the major spiracle attached to it like a dark patch.

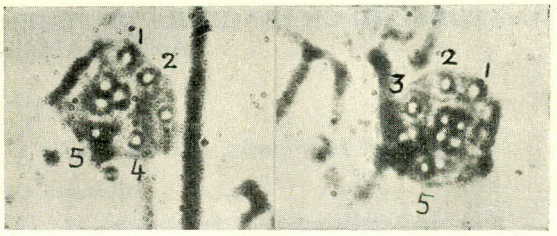

Fig. 4.—Brachia seen dorsally and enlarged. The right brachium has 4 proes as a central cluster, the left only 3. Fig. 2, which is seen ventrally, also reveals the insect's right and left brachia to have exactly the same number of central wax pores. Mg. 45 x 6.

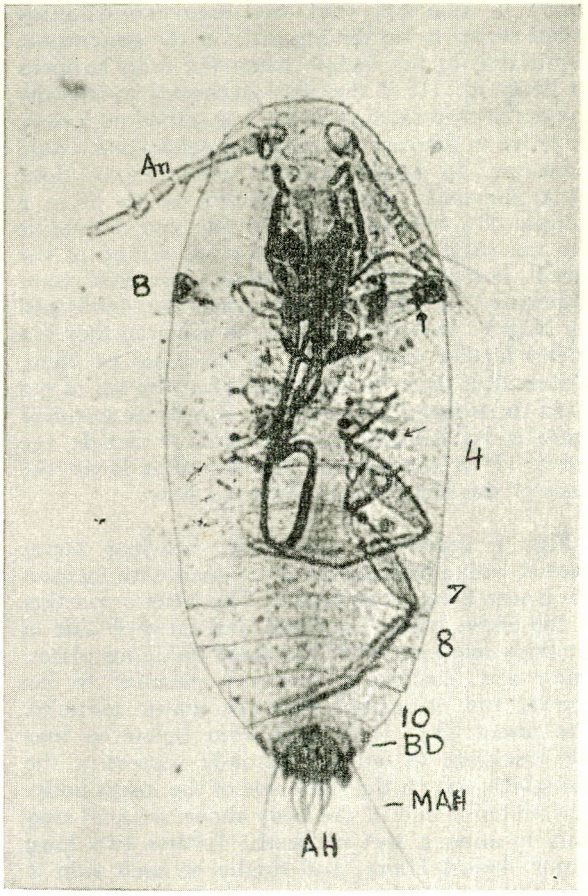

Fig. 5.—*L. sindica*, the female 1st stage larva seen dorsally. The female body terminates with a less acute or "μ" shaped curve; whereas the male larva would correspondingly have a "V" shape. Body segment no. 1 not marked, bears head in the centre, with Antennae, An., segment no. 2 bears brachia, B., with major spiracle, marked with an arrow on the right. Segment no. 4, bears minor spiracle marked with an arrow on our right. Segments 8 to 11, are less arched in the female. Segment no. 11 bears a Bidental appendage, B.D., two Major Apical Hairs M.A.H. and six anal ring hairs A.H., are indicated.

The right brachium also reveals the presence of the associated spiracle which in this case is marked with an arrow. The body segment, bearing the brachia, is no. 2, not marked as such. Body segment no. 4, shows with an arrow, the minor spiracle on the right side. This trumpet shaped structure is seen enlarged in Fig. 6 where the Minor spiracle is marked, Mn., and an associated wax secreting pore, W.

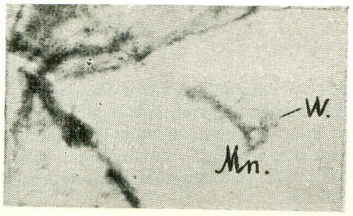

Fig. 6.—Minor spiracle, mn., of segment no. 4, Fig. 5, shown enlarged. An associated wax pore is marked w. Mg. 45 x 6.

Another female larva is shown dorsally in Fig. 7. Its body segment, no. 4, shows both the trumpet shaped, Minor spiracles, quite clearly, the like of which has been shown already in Fig. 6. Whereas the separation between body segments 1 to 8 is more or less like straight horizontal lines, further on, towards the posterior end, the separating lines become arched. Body segments 9 to 11 are relatively more arched whereas 6 to 8 are not. This curvature of segments, already obvious on the body of the female, is far more pronounced in the case of the male. Particularly segments, nos. 10 and 11 are very curved. No. 11 is not marked as such but is the one which bears the Bidental appendage B.D., which, instead, has been indicated. The portion of the body in Fig. 7, representing segment no. 2, is enlarged, as Fig. 8, to show the relative positions of the brachia with the rest of the body. The pair of brachia are further enlarged in Fig. 9. The margin shows five tactile hairs seen here as mere holes, mostly numbered. In the centre is a cluster of holes which represent apertures of glands secreting soft filamentous wax. It is otherwise known that the female secretes more lac and more wax than does the male. The larger number of wax pores offers evidence supporting the greater physiological activity of the female. Comparing brachia of the female, Fig. 9, with those of the male, Figs. 2 and 4, makes the point quite clear.

From another female larva a portion of the body is shown in Fig. 10, corresponding to that of the male in Fig. 3. The two brachia of Fig. 10 are further enlarged in Fig. 11. Each brachium shows five tactile hairs on the margin as holes, which have been mostly marked. In the centre is a cluster of 7 compound pores of soft wax secreting glands. In the female the two brachia contain 14 holes while in the male larva only half that number; we have to contrast here Fig. 11 with Fig. 4. The right Major spiracle, Mj., of another female larva, is shown enlarged in Fig. 12. The picture further reveals the presence of pores exuding wax; the wax-pores being marked W., Fig. 12. The left Minor spiracle, Mn., of larva, Fig. 10, has been enlarged as a trumpet-shaped structure in Fig. 13.

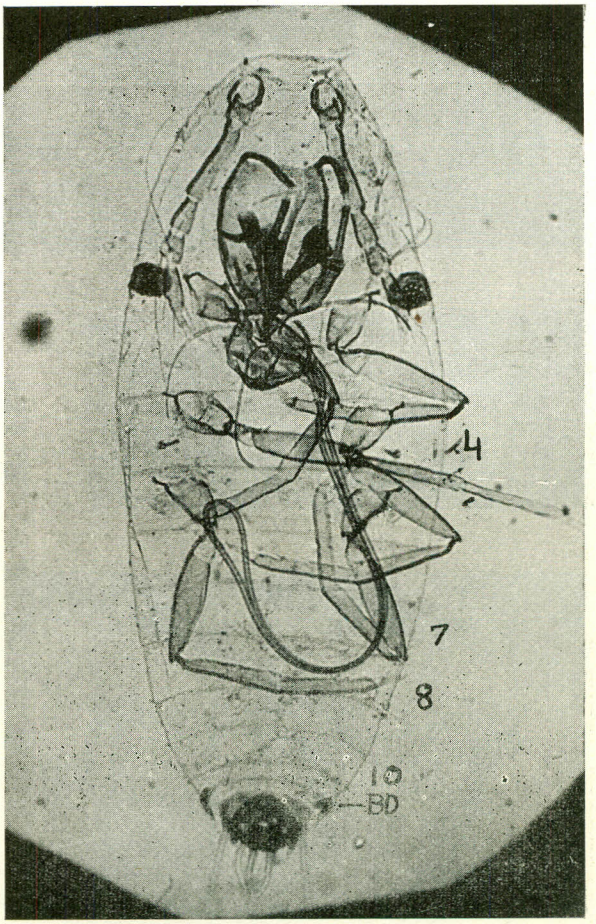

Fig. 7.—*L. sindica*, Female larva seen dorsally, showing brachia on segment 2, minor spiracles on seg. 4, Bidental appendage, B.D. on segment 11. Segments 10 and 11 are less arched in female but would have been pronounced in the male.

Anterior portion of another female larva, incorporating the brachia, shows them clearly in Fig. 14. The right brachium indicates the marginal tactile hairs merely as five holes. The situation of the Major spiracle, Mj., in relation to the brachium is best seen in Fig. 14. Between them are two wax secreting pores marked W. The left brachium, seen enlarged in Fig. 15, depicts its outline quite clearly, with three tactile

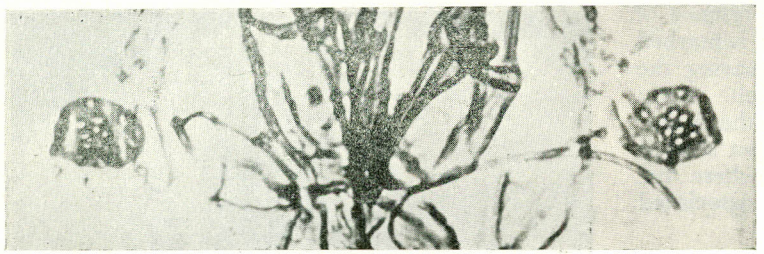

Fig. 8.—Brachia of Fig. 7 further enlarged and retaining their relative distance. Mg. 20 x 6.

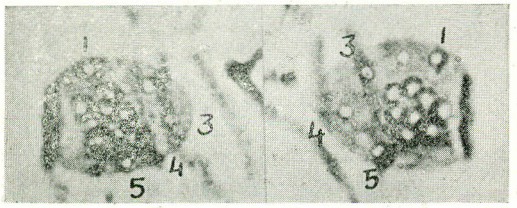

Fig. 9.—Brachia of Fig. 7 enlarged to show the details. There are 5 tactile hairs on the margin represented as pin holes mostly numbered. The centre has a cluster of pores, numbering 7 in each brachium. An extra hole in Fig. 9, as compared with Fig. 8, is due to the presence of a wax pore from beneath appearing at a different focus. Mg. 45 x 6.

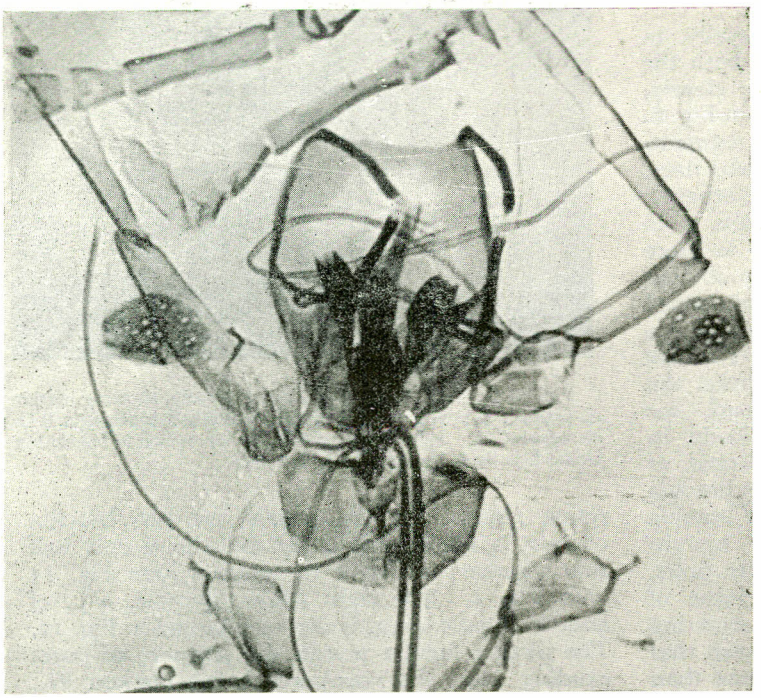

Fig. 10.—The anterior portion of a female larva showing brachia and the minor spiracles with their relative distance. Mg. 10 x 6.

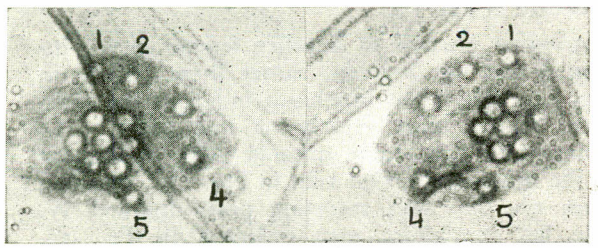

Fig. 11.—The brachia of Fig. 10 enlarged to show 5 peripheral tactile hairs mostly numbered and central cluster of 7 wax pores in each brachium. Mg. 45 x 6.

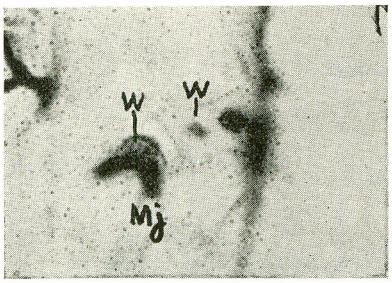

Fig. 12.—The major spiracle, Mj., with associated wax secreting pores. w. Mg. 45 x 6.

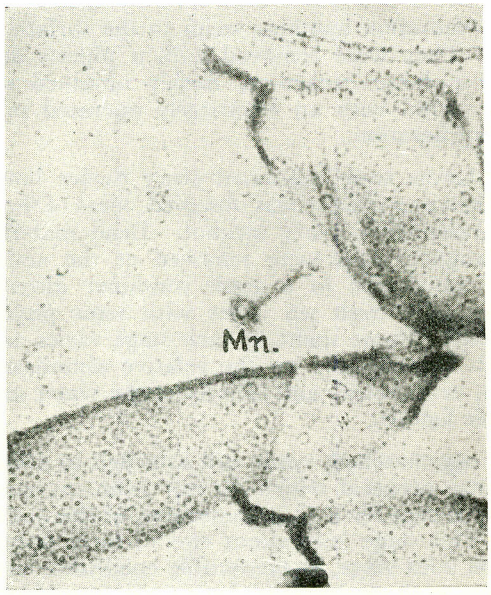

Fig. 13.—Minor spiracle, Mn., trumpet shaped, further enlarged, larged, belonging to body segment No. 4, Fig. 10. Mg. 10 x6.

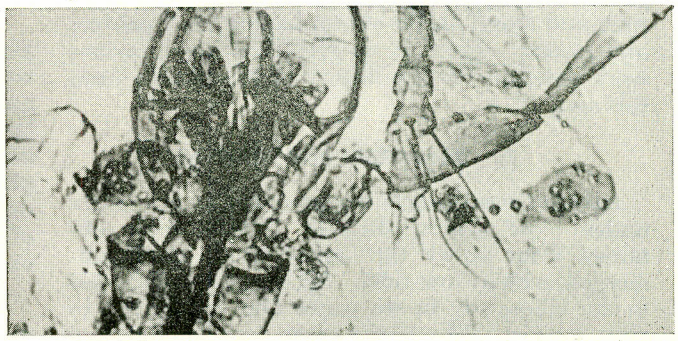

Fig. 14.—Female larva represented by its second body segment bearing the brachia, and major spiracles, with two wax pores in between. Mg. 20 x 6.

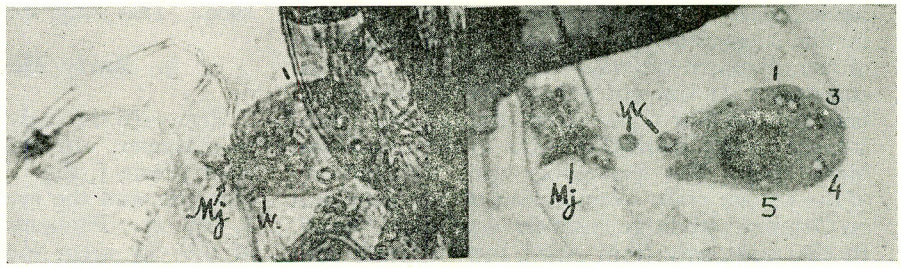

Fig. 15.—Brachia and major spiracles of Fig. 14 further enlarged. The relative distance between the right brachium and its Major spiracle, Mj., is quite clear. In between are two wax secreting pores, w. The left brachium shows the peripheral hairs as such, though out of focus. The major spiracle, Mj., and its associated wax pores, w., are not in position, which is ideally the case with the corresponding half to our right. The central cluster of pores in each brachium comprise 7. Mg. 45 x 6.

hairs, 2 to 4, somewhat indistinct. The left Major spiracle, Mj., is not in its natural position in Fig. 15, while the corresponding one to our right is in proper order. But the cluster of central pores is clearly seen as being seven. Through the semi-transparent left brachial plate is revealed a wax-pore, marked, W., Fig. 15, comparable with those marked likewise on the right side in Fig. 15. The point quite clearly revealed in Fig. 15 is the number of central wax-pores as 14 on the two brachia.

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References

1. S. Mahdihassan, J. Ind. Inst. Sci., 9A. Pt. 1 pp. 1-14 (1926).
2. P.S. Negi, Btn. Ent. Res.; 10, 328-9 (1929) Figs. 1 and 2.