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THE EARLY STAGES OF SOME INDIAN MOSQUITOES:  
*MEGARHINUS.*

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THE larvæ of *Megarhinus* are very uniform in structure throughout the genus, and, up to the present, no attempt appears to have been made to draw up a synoptic table for the identification of those found in any particular region. In the published descriptions of the early stages little or no reference appears to have been made to differences in pilotaxy, it being generally assumed that such did not exist. A study of the 4th stage larvæ and of the pupæ of the six Indian species has revealed differences which are constant in the material available and keys are given below for the identification of these stages. It seems probable that the characters used in these keys will be of value in the differentiation of larvæ and pupæ of species occurring in other countries.

The important structural characters of both the larvæ and pupæ are illustrated on the accompanying plates.

The larvæ are of some importance in India as, by their predaceous habits, they serve to keep down the numbers of blood-sucking forms such as *Aedes* (*Stegomyia*), *Aedes* (*Finlaya*), *Armigeres*, and others, with the larvæ of which they are most frequently found in association in tree-holes and bamboo stumps.

Larvæ of the 4th instar may be distinguished from those of other genera by the following characters: very large larvæ, usually of a deep red or reddish-brown colour, those of the larger species measuring up to 16 mm. in length. Head sub-quadrangular, hairs on dorsal surface all placed very far

forward, frontoclypeus divided by a suture into an anterior part and a much larger posterior part, the anterior carries four hairs on each side, three fine and simple and one very minute and spine-like (the outermost), the posterior part also carries four hairs on each side, three fine and simple and one very small and branched (the innermost). Antenna short, shaft smooth, hair tuft represented by two fine hairs situated some little distance below the tip, between these and the tip there is a small branched sub-apical hair. Mouth parts adapted for predaceous purposes, hairs of mouth brushes modified into strong lamellæ with hooked tips. Thorax with some heavily chitinized plates carrying thick spinulose bristles. The arrangement of the thoracic hairs is shown in diagrammatic form on Plate LX. Pro-thorax with two large plates on each side, a dorso-lateral and ventro-lateral, the former carries hairs 6, 7, and 8, the first and last being bristles, the latter carries hair 13, always small and branched, and the four pleural hairs (9 to 12) on a raised tubercle, one of these being a bristle. On the meso-thorax there are in some species three plates, in others four, on each side; in the former the dorso-lateral plate bears hairs 3 to 7, 6 being a bristle; in the latter the plate is divided, hairs 3 and 4 being on a separate small plate; hair 8 is lateral, bristle-like, and arises from a tubercular plate; the ventro-lateral plate carries the pleural hairs 9 to 12 and hair 13, as on the pro-thorax. On the meta-thorax there appear to be thirteen hairs as against fourteen on the pro- and meso-thorax; by comparing the hairs on the three parts of the thorax it would seem that the missing hair is No. 7; hairs 6, 8, and 14 are bristles arising from separate plates, the last being ventral; the pleural hairs and hair 13 are on a ventro-lateral plate as on the other two segments. In addition to the large plates mentioned there are some much smaller plates from which the finer hairs arise. On abdominal segments 1 to 7 there are three plates on each side a dorso-lateral, lateral, and ventro-lateral, which carry either spinulose bristles or long plumose hairs, or both; these are very similar in all the species except the dorso-lateral plate on the 7th segment, on which there may be two bristles and three hairs, or one bristle and four hairs. Eighth segment with a large lateral plate on each side in place of a comb, with two strong bristles and some small hairs, the length of the longer bristle compared with the length of the siphon tube is of diagnostic value in some cases. Siphon tube short and wide, a single pair of strong branched hair tufts arising near the base, pecten absent. Anal segment enclosed in a strongly chitinized ring with numerous spines along the posterior margin, both long and short irregularly alternating, lateral hair bristle-like, spinulose, both pairs of sub-dorsal hairs divided into a number of long branches, anal papillæ quite short, anal fan well developed, the hairs split into fine branches. The relative length of the siphon tube\* and of the chitinized part of the anal segment† is of importance in certain species.

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\* Measured along the anterior margin in side view not including the valves.

† Measured along the dorsal border in side view.

Key to the 4th stage larvæ of the Indian species of *Megarhinus*.

## (Plate LXI.)

1. Meso-thoracic dorso-lateral plate undivided, carrying 1 bristle and 4 hairs (hairs 3-7) (Fig. 1) .. .. . 2.  
     Meso-thoracic dorso-lateral plate divided, the larger part carrying 1 bristle and 2 hairs (hairs 5-7) and the smaller 2 hairs (3 and 4) (Fig. 2) .. .. . 4.
2. Dorso-lateral plate of abdominal segment 7, carrying 2 bristles and 3 hairs (Fig. 7) .. .. . *splendens*.  
     Dorso-lateral plate of abdominal segment 7, carrying 1 bristle and 4 hairs (Fig. 6) .. .. . 3.
3. Bristle representing hair 6 on pro-thoracic dorso-lateral plate only about half the length of that representing hair 8, both usually single (6 occasionally bifid) (Fig. 4), meso-thoracic dorso-lateral plate with a projection carrying hairs 3 and 4, hair 7 on this plate with 3 to 5 branches (Fig. 5), chitinizations of head and body light brown or yellow .. .. . *kempi*.  
     Bristles representing hairs 6 and 8 on pro-thoracic dorso-lateral plate about the same length, 6 single, 8 bifid (Fig. 3), meso-thoracic dorso-lateral plate without a marked projection, hair 7 on this plate nearly always simple (Fig. 1), chitinizations of head and body deep brown .. .. . *edwardsi*.
4. Siphon distinctly shorter and smaller than chitinized part of anal segment, longer bristle on lateral plate of 8th segment more than half the length of the siphon (not including valves) (Figs. 14, 15, 16), chitinizations of head and body deep brown. *albipes*.  
     Siphon as long as, or longer, than chitinized part of anal segment, longer bristle on lateral plate of 8th segment less than half the length of siphon (Figs. 8 to 13), chitinizations of head and body light brown or yellow .. .. . 5.
5. Larva comparatively small, siphon about the length of chitinized part of anal segment, or slightly longer (Figs. 9 and 10), hair 7 on meso-thoracic dorso-lateral plate usually simple .. .. . *minusimus*.  
     Larva comparatively large, siphon a good deal longer than chitinized part of anal segment (Figs. 12 and 13), hair 7 on meso-thoracic dorso-lateral plate with 3 or 4 branches .. .. . *gravelyi*.

## PUPÆ.

Size generally very large, length from a point between the respiratory horns measured round the curve of the body to the tips of the paddles about 13 mm. in a medium sized species (*M. albipes*). Coloration light brown to black according to age. Respiratory horn about  $2\frac{1}{2}$  to 3 times as long as the greatest width in side view, expanded towards the tip, the opening oval and oblique; in antero-posterior view the basal part is rather swollen with a slight constriction at the base of the opening. Dendritic tufts on abdominal segment 1 well developed. The five sub-median and sub-lateral hairs on tergites 2 to 7 form a group towards the lateral margin, the innermost is always small and simple; the character and development of the other four, and of the larger lateral hair, are of diagnostic importance; the dorsal and lateral hairs on

tergite 8 are both small and usually simple. Paddles large and of characteristic shape in each species, mid rib strong, no terminal hair or spine, posterior margin fringed with delicate hairs, a dark irregular mark across the bases of paddles in all except one species.

Key to the pupæ of Indian species of *Megarhinus*.

(Plate LXII.)

1. Paddle elongate,  $1\frac{1}{2}$  times to twice as long as greatest width (Figs. 24, and 27 to 29), all the 5 inner hairs\* near the posterior margin of tergite 7 fine and short, hardly projecting beyond the posterior border of that segment (Fig. 17) .. 2.  
 Paddle wide and rounded, less than  $1\frac{1}{2}$  times as long as greatest width (Figs. 25 and 26), one of the 5 inner hairs near the posterior margin of tergite 7 very long and stout, reaching beyond the posterior margin of tergite 8 (Figs. 18 and 23) .. 5.
2. Apical margin of paddle not emarginate nor produced into a point (Fig. 28) .. .. . *gravelyi*.  
 Apical margin of paddle emarginate or produced into a blunt point (Figs. 24, 27 and 29) .. .. . 3.
3. One of the 5 inner hairs near the posterior margin of tergite 5 long and stout, the 4 others slender and comparatively short (Fig. 19) .. .. . 4.  
 Two of the 5 inner hairs near the posterior margin of tergite 5 long and stout, the 3 others quite small (Fig. 20) .. *albipes*.
4. One of the 5 inner hairs near the posterior margin of tergite 4 long, the 4 others quite small (Fig. 21), paddle  $1\frac{1}{2}$  times as long as greatest width, the apical margin emarginate and rounded, an irregular dark line across the base (Fig. 27) .. *minimus*.  
 Two of the 5 inner hairs near the posterior margin of tergite 4 long and stout, the 3 others quite small (Fig. 22), paddle twice as long as greatest width, the apex produced into a blunt point, no irregular dark line across the base (Fig. 24) .. *kempi*.
5. The larger lateral hair on segment 7 long and stout, usually much longer than tergite 8, and often as long as greatest width of paddle (Fig. 18) .. .. . *splendens*.  
 The larger lateral hair on segment 7 comparatively short and fine, not as long as tergite 8 (Fig. 23) .. .. . *edwardsi*.

NOTES.

**Megarhinus albipes** Edw. Larva, 4th stage (Plate LXI, figs. 2, 14, 15 and 16). Approximate length of fully grown larva 12 to 13 mm., colour deep reddish-brown, pale beneath; siphon from 0.73 to 1.0 mm. long, † more usually about 0.85; siphonal tuft with 4 to 7 branches, more usually 5 or 6. The meso-thoracic dorso-lateral plate is completely divided in 14 specimens available for examination, except in two, in which the two parts of the plate on one

\* The expression 'inner hairs' is used to include the five sub-median and sub-lateral hairs as distinct from the lateral.

† In these notes the length of the siphon given is the measurement along the anterior margin in side view from the base to the apex of the tube, not including the valves.

side of the thorax are connected by a very narrow strip of chitin, on the opposite side of the larva, in each case, the plate is divided into two. Skins of 10 isolated larvæ and four complete larvæ have been examined.

*Pupa* (Plate LXII, figs. 17, 20 and 29): of the five sub-median and sub-lateral hairs two are moderately long on tergite 2, and three on tergite 3, two are long and black on tergites 4 and 5, and one on tergite 6; the larger lateral hair on segments 2 to 4 is fine and short, that on 5 and 6 longer, that on 7 quite small. The posterior border of the paddle is occasionally only slightly emarginate and the pupa then resembles that of *M. gravelyi* closely, the hairs on tergites 1 to 7 having very much the same arrangement and development.

**M. gravelyi** Edw. *Larva*, 4th stage (Plate LXI, figs. 11, 12 and 13): this is fairly easily separated from the larvæ of *M. albipes* and *M. minimus* (with which it agrees in having the meso-thoracic dorso-lateral plate divided into two) by having the siphon distinctly longer than the chitinized part of the anal segment. Length of siphon 1.5 to 2.0 mm., siphonal tuft of four branches in the skins of two isolated larvæ examined.

*Pupa* (Plate LXII, fig. 28): differs from all the other species in the shape of the paddle which is not emarginate on the posterior border (in this respect resembling the pupa of *M. magnificus* from Malaya). In the character and development of the hairs on the abdominal tergites it agrees closely with the pupa of *M. albipes*.

**M. minimus** Theo. *Larva*, 4th stage (Plate LXI, figs. 8, 9 and 10): the comparatively small size and the characters given in the key serve to distinguish this larva from those of the other five species. Siphon 0.7 mm. long, siphonal tuft, in one specimen, of three branches on each side, in another specimen the tuft is represented by a single strong hair on one side, and by a two-branched hair on the other. Skins of two isolated larvæ examined.

*Pupa* (Plate LXII, figs. 21 and 27): size and shape of paddle fairly distinctive. Of the sub-median and sub-lateral hairs one is long on tergites 2 to 6, and a second of moderate length on tergites 2 and 3, larger lateral hair on segments 5 and 6 very long.

**M. kempfi** Edw. *Larva*, 4th stage (Plate LXI, figs. 4 and 5): length of siphon 1.0 to 1.2 mm., siphonal tuft of 4 to 6 branches, more usually 5. Bristle representing hair 8 on pro-thoracic dorso-lateral plate single (in the skins of five isolated larvæ examined), in some other species this bristle is invariably bifid.

*Pupa* (Plate LXII, figs. 19, 22 and 24): paddle of very distinctive shape and without an irregular black line across the base (in these characters closely resembling the pupa of *M. leicesteri* Theo. from Malaya). Of the five sub-median and sub-lateral hairs three are rather long and black on tergites 2 and 3, the innermost of these three on 2 branched, two are long and black on tergite 4, and one on tergites 5 and 6.

**M. splendens** Wied. *Larva*, 4th stage (Plate LXI, fig. 7): this is comparatively easy to identify by the characters given in the key. When fully

grown it is from 15 to 16 mm. long, and of a crimson colour or deep reddish-brown. Length of siphon 1.1 to 1.5 mm., more usually about 1.2, siphonal tuft with from 4 to 8 branches, more usually 5. The ventro-lateral plate on the 1st abdominal segment is sometimes divided into two. The more heavily chitinized parts of the head and body are of a deep rich-brown. Skins of 15 isolated larvæ, and two complete larvæ have been examined.

*Pupa* (Plate LXII, figs. 18 and 26): of the five sub-median and sub-lateral hairs one is long and black on tergites 2, 6, and 7, and two on tergites 3, 4, and 5; the larger lateral hair on segments 2 to 7 is long.

**M. edwardsi** Barraud. *Larva*, 4th stage (Plate LXI, figs. 1, 3 and 6): resembles that of *M. splendens* in general appearance and size but is distinct on the characters given in the key. Siphon from 1.0 to 1.2 mm. long, siphonal tuft usually of 5 branches. Hair 7 on meso-thoracic dorso-lateral plate usually simple, occasionally split into two towards the tip, but not branched as in *M. kempfi*. Chitinizations of head and body deep-brown. Skins of four isolated larvæ have been examined.

*Pupa* (Plate LXII, figs. 23 and 25): very similar to that of *M. splendens* differing only in the length of the larger lateral hair on the 7th segment (*compare* Plate LXII, figs. 18 and 23).

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In a previous paper (*Ind. Jour. Med. Res.*, XVII, 1929, pp. 271-280) the adults have been described and the distribution and breeding places given. With regard to *M. quasiferax* Leic., which was included as an Indian species in Edwards' Synopsis (*Ind. Jour. Med. Res.*, X, 1922, p. 459), this record was based on a specimen from Sikkim which, on re-examination, proved to be *M. splendens*.

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#### EXPLANATION OF PLATE LX.

Diagram showing the character and approximate position of the hairs on the right side of the thorax of *Megarhinus* larva (*M. splendens* Wied.) from the mid dorsal line on the left, to the mid ventral line on the right. The numbers from 1 to 14 indicate the individual hairs on each segment of the thorax, 9 to 12 being the pleural hairs in each case. On the meta-thorax hair 7 is apparently absent.

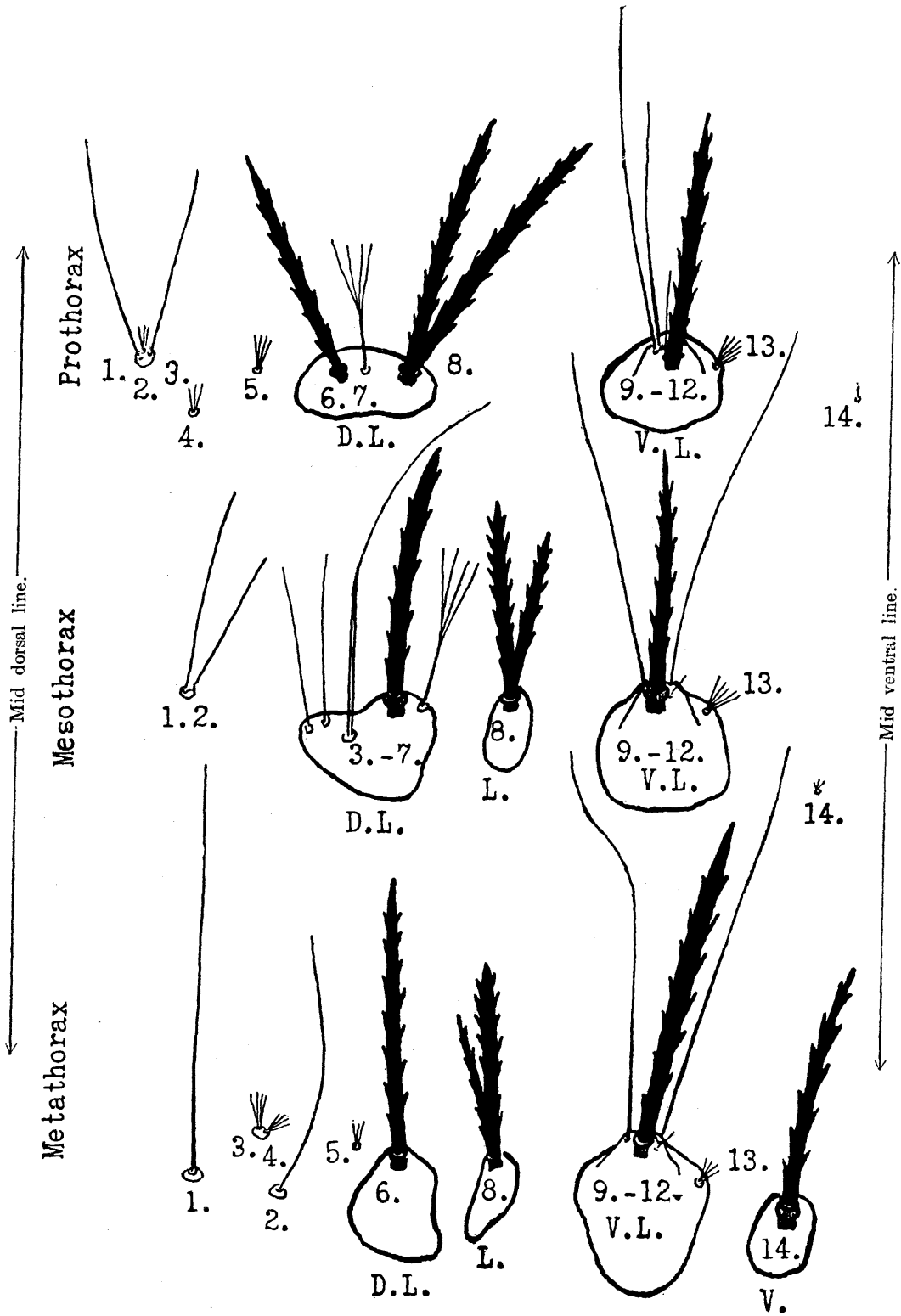
Lettering:—D. L. Dorso-lateral plates.

L. Lateral plates.

V. L. Ventro-lateral plates.

V. Ventral plate.

PLATE LX.



EXPLANATION OF PLATE LXI.

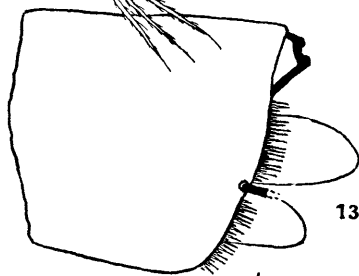
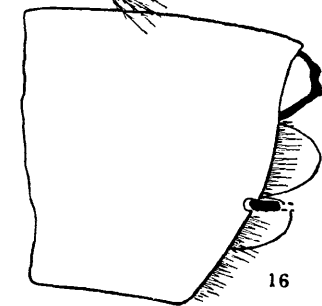
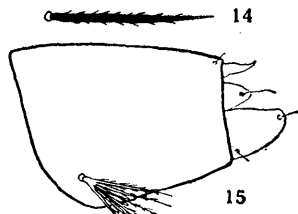
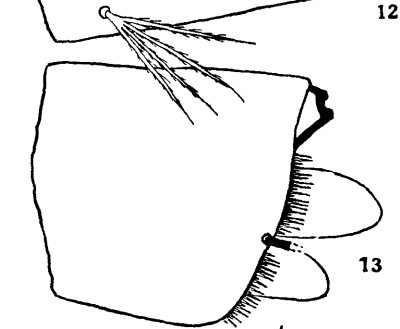
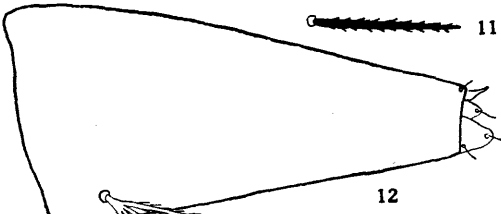
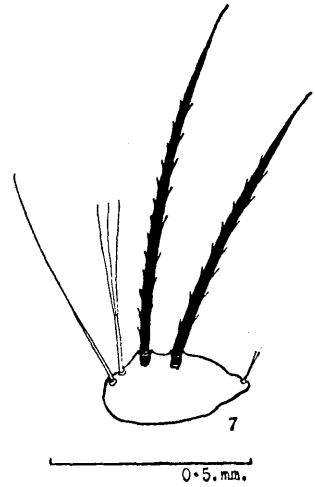
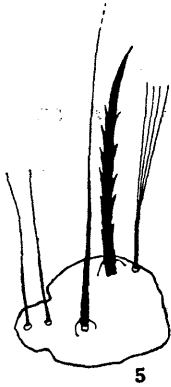
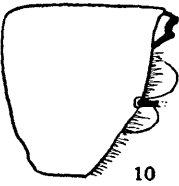
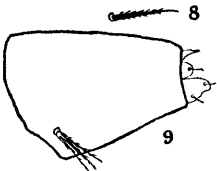
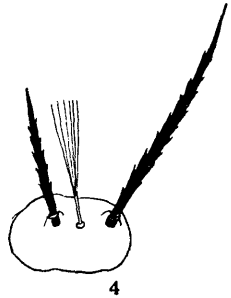
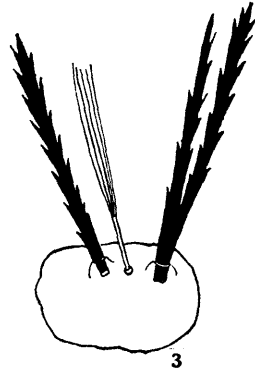
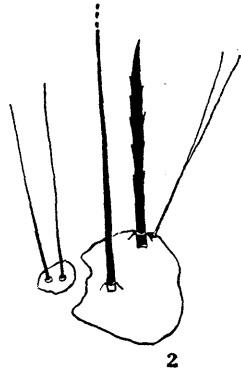
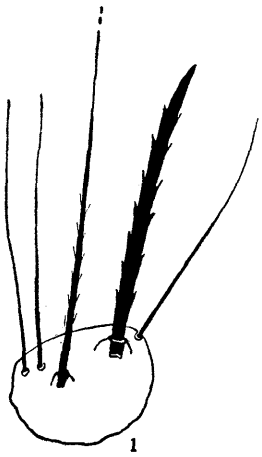
Camera lucida drawings illustrating points of structure in the 4th stage larvæ of Indian species of *Megarhinus*.

- Fig. 1. *Megarhinus edwardsi* Barr. Meso-thoracic dorso-lateral plate; the hairs shown are, from left to right, 3 to 7; the apical part of 5 is omitted.
- „ 2. *M. albipes* Edw. Ditto. Showing the division of the plate into two parts, hairs 3 and 4 being on a separate small plate.
- „ 3. *M. edwardsi* Barr. Pro-thoracic dorso-lateral plate; the hairs shown are, from left to right, 6 to 8.
- „ 4. *M. kempi* Edw. Ditto. Compare this with Fig. 3.
- „ 5. *M. kempi* Edw. Meso-thoracic dorso-lateral plate carrying hairs 3 to 7, hairs 3 and 4 being on a projection. Compare this with Figs. 1 and 2.
- „ 6. *M. edwardsi* Barr. Dorso-lateral plate of 7th abdominal segment carrying one bristle and four hairs.
- „ 7. *M. splendens* Wied. Ditto. Carrying two bristles and three hairs.
- „ 8. *M. minimus* Theo. Longer bristle from lateral plate of 8th segment. Compare the length of this with the length of the siphon.
- „ 9. *M. minimus* Theo. Siphon tube.
- „ 10. *M. minimus* Theo. Chitinized part of anal segment, anal fan omitted, bases of sub-dorsal and lateral hairs indicated.
- „ 11. *M. gravelyi* Edw. Longer bristle from lateral plate of 8th segment. Compare the length of this with the length of the siphon.
- „ 12. *M. gravelyi* Edw. Siphon tube.
- „ 13. *M. gravelyi* Edw. Chitinized part of anal segment, anal fan omitted, bases of sub-dorsal and lateral hairs indicated.
- „ 14. *M. albipes* Edw. Longer bristle from lateral plate of 8th segment. Compare the length of this with the length of the siphon.
- „ 15. *M. albipes* Edw. Siphon tube.
- „ 16. *M. albipes* Edw. Chitinized part of anal segment, anal fan omitted, bases of sub-dorsal and lateral hairs indicated.

Figs. 1 to 7 drawn to the scale shown under Fig. 7.

„ 8 to 16 drawn to the scale shown under Fig. 13.

PLATE LXI.



1.0. mm.

EXPLANATION OF PLATE LXII.

Camera lucida drawings illustrating points of structure in the pupæ of Indian species of *Megarhinus*.

Fig. 17. *M. albipes* Edw. Posterior border of 7th tergite showing five sub-median and sub-lateral, or inner, hairs, and two lateral.

„ 18. *M. splendens* Wied. Ditto.

„ 19. *M. kempfi* Edw. Posterior border of 5th tergite, showing hairs.

„ 20. *M. albipes* Edw. Ditto.

„ 21. *M. minimus* Theo. Posterior border of 4th tergite, showing hairs.

„ 22. *M. kempfi* Edw. Ditto.

„ 23. *M. edwardsi* Barr. Posterior border of 7th tergite, showing hairs.

In Figs. 18 to 23 only about one-fifth of the length of the longer hairs is shown in each case.

Fig. 24. *M. kempfi* Edw. Paddle.

„ 25. *M. edwardsi* Barr. Ditto.

„ 26. *M. splendens* Weid. Ditto.

„ 27. *M. minimus* Theo. Ditto.

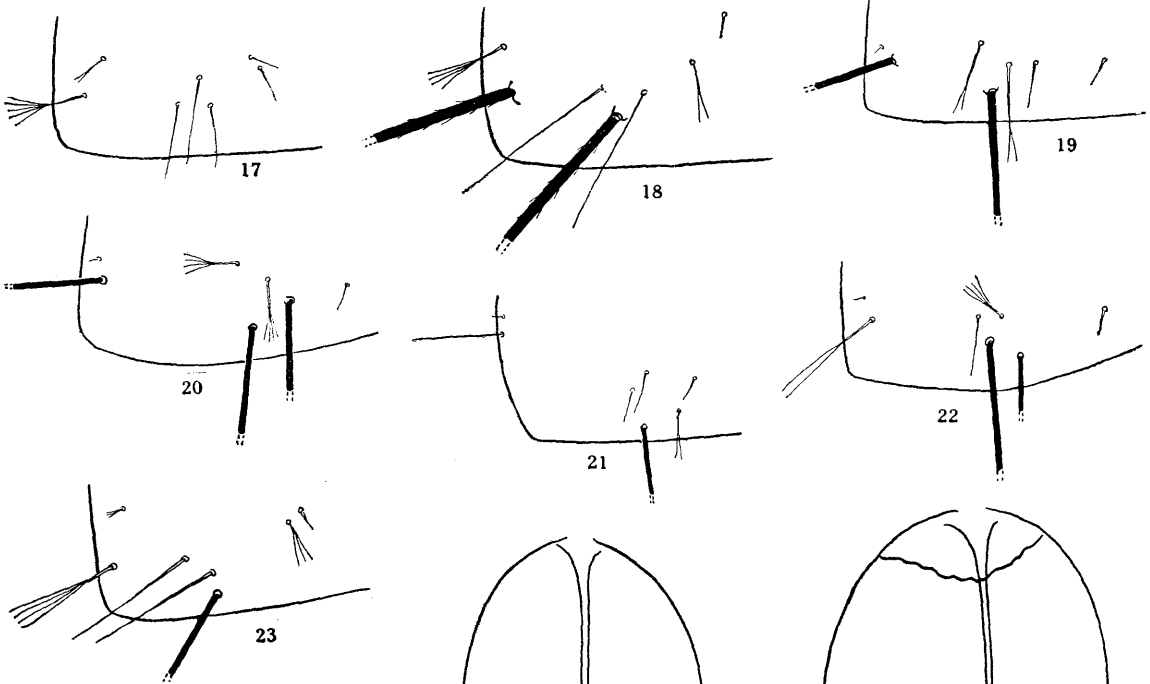
„ 28. *M. gravelyi* Edw. Ditto.

„ 29. *M. albipes* Edw. Ditto.

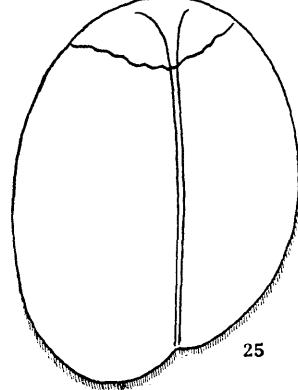
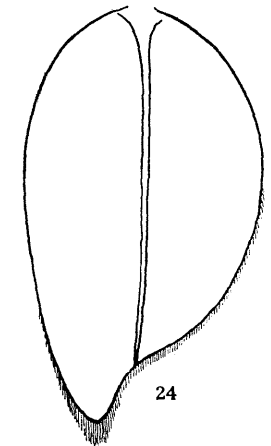
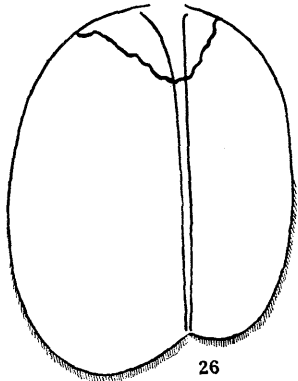
Figs. 17 to 23 drawn to the scale shown under Fig. 23.

„ 24 to 29 drawn to the scale shown under Fig. 29.

PLATE LXII.



0.5. mm.



1.0. mm.